

Nutrient Management and Air Emissions Tools for Livestock and Poultry Operations: CLEAN^{EA}ST™ Project Review

*Methane Expo 2013
Global Methane Initiative
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RTI International*



RTI Offices

International Locations, Global Reach

Headquartered on a 180-acre campus in central North Carolina, RTI maintains satellite and project offices around the world.

Research Triangle Park, NC	1958
Washington, DC	1983
Rockville, MD	1988
Atlanta, GA	1996
Chicago, IL	1999
Waltham, MA	2002
San Francisco, CA	2005
Ann Arbor, MI	2007



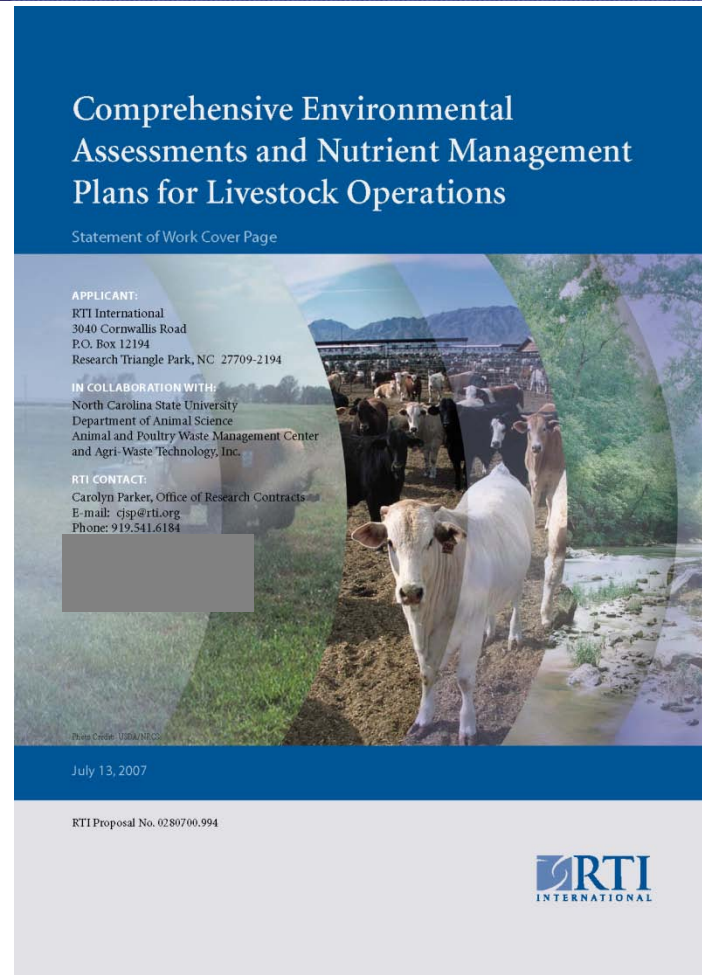
**project offices in over 40 countries*

Presentation Outline

- History and Overview
- Tools
- Greenhouse Gas Relevance
- Conclusions

History and Overview

- 2007 – Congressionally funded, EPA Cooperative Agreement awarded to RTI and its sub-agreement partner, North Carolina State University to serve 27 states east of the Mississippi River.
- RTI developed the **Comprehensive Livestock Environmental Assessment and Nutrient Management Plan Project (CLEANEAST™)**.
- This project closed in 2012.



Livestock and Poultry Operations

- Potential environmental impacts from livestock and poultry operations:
 - Surface and ground water quality
 - Gaseous and Particulate Matter (PM) emissions from manure
 - Objectionable odors
- Manure management can help address all three
- Scale or size of operation may intensify environmental impacts

Manure Management



- Production Housing
 - Storage/Treatment
 - Land Application
- Present Air and Water Quality Challenges



Photos courtesy of USDA NRCS

CLEANEAST™ Project Goals

Provide confidential, no-cost technical assistance to livestock and poultry operations in the eastern U.S. by —

- Reaching out to farm operators to volunteer for services.
- Developing tools to produce Environmental Assessments (EAs) and Nutrient Management Plans (NMPs).
- Training and managing a team of Technical Assistance Professionals (TAPs) to produce EAs and NMPs

Outreach

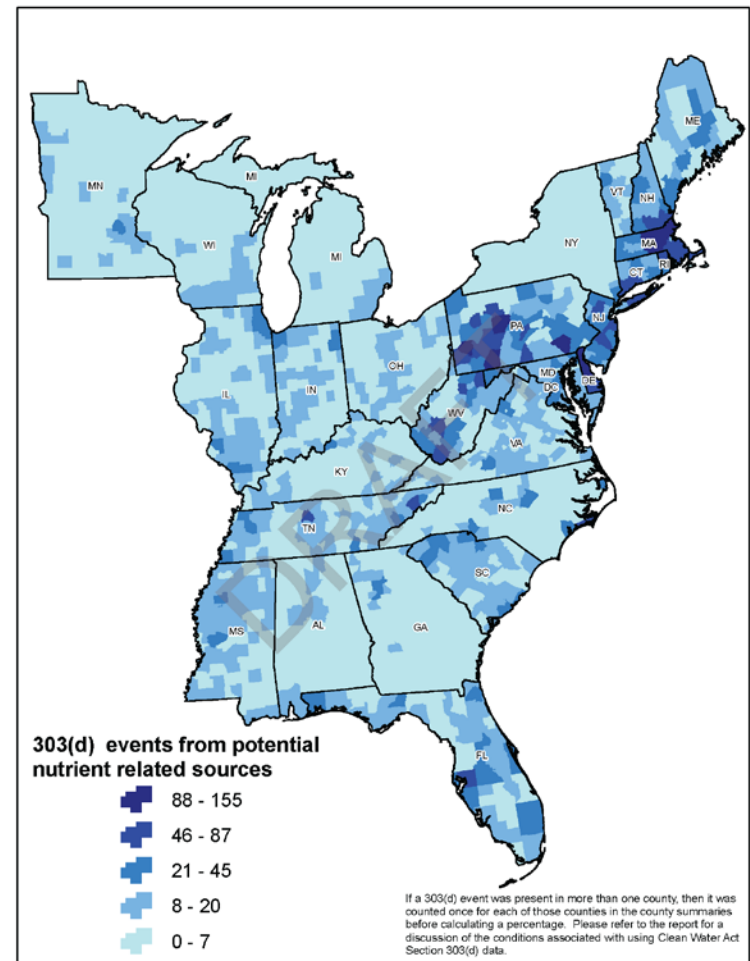
Outreach Strategy:

- Assess economic incentives for volunteering
- Use GIS analysis to identify greatest need for assistance
- Develop outreach tools

The screenshot shows the homepage of the RTI International website for the project. At the top, there is a navigation bar with a 'Login' link and a date 'Wednesday, January 16, 2008'. Below this is a banner image featuring a pig, a cow, and a chicken. The main heading reads 'Comprehensive Environmental Assessments and Nutrient Management Plans for Livestock Operations'. Logos for RTI International and NC State University are displayed. A sidebar on the left contains a menu with items: Home, States Covered, Frequently Asked Questions, Environmental Assessment Tools, Nutrient Management Plan Tools, Press Releases, Contact, About RTI International, and About North Carolina State University. The main content area includes a search bar, a 'Home' section with a welcome message, and an 'Information for:' section listing target audiences: Farmers and Ranchers, Technical Assistance Professionals, and Other Interested Parties. A footer note mentions the site's future expansion.

Outreach - GIS Analysis – ID Impaired Watershed

- Using GIS, the percentage of 303(d)-listed waters impaired by a potential livestock and poultry nutrient-related source was calculated for counties served by the project.
- RTI categorized the counties using 3 tiers based on % of 303(d) listed waters in each county.
 - High-priority: 77.4–100%
 - Medium-priority: 35.4 –77.3% and
 - Low-priority: 0–35.3%



Outreach – GIS Analysis – Farm and Animal Density

Figure 24: Dairy Farm Density & Percent of Potential Nutrient-related 303(d) Events

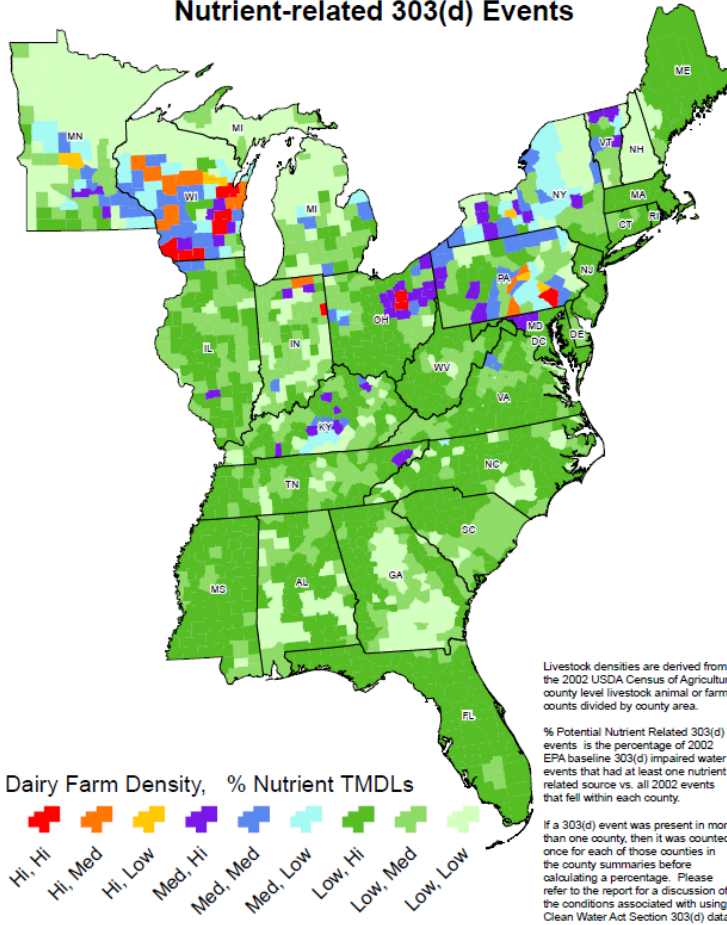
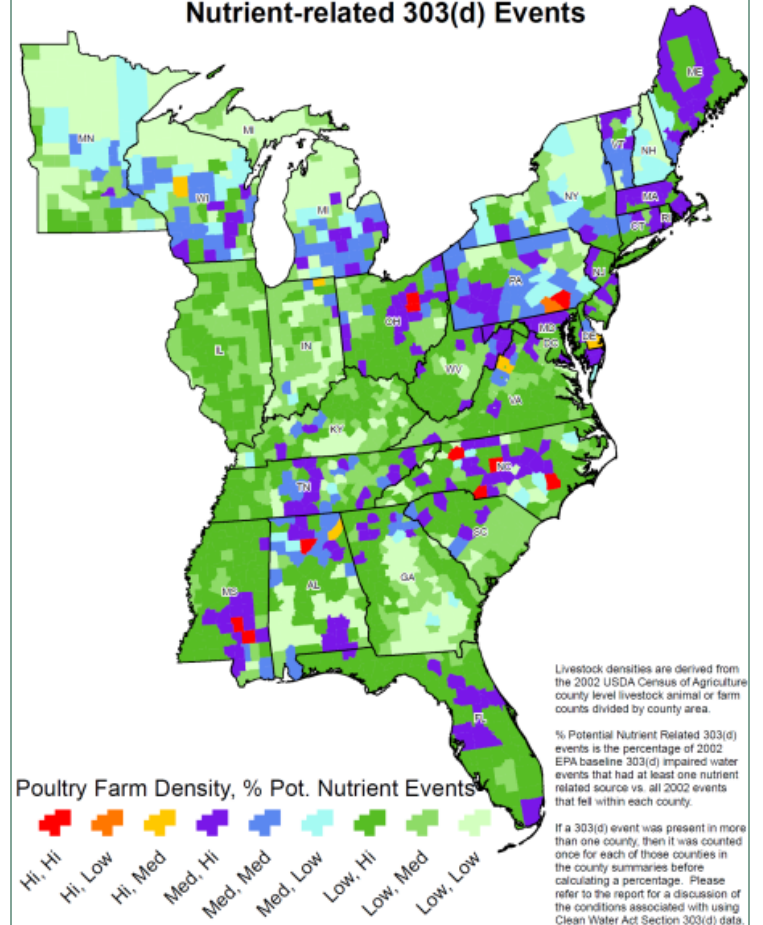


Figure 28: Poultry Farm Density & Percent of Potential Nutrient-related 303(d) Events



CLEAN EAST™ Tools

For completing farm services, RTI developed:

- Farm Operation Information Profile (Farm Profile)
 - Farmer completes before the on-farm visit
- Environmental Assessment (EA) Tool
 - TAP completes on-farm
- Nutrient Management Plan (NMP) Protocol and NMP Supplement Tool
 - 2 types: update existing NMP; develop new NMP

<http://cfpub.epa.gov/npdes/afo/info.cfm>

For Analysis of Farm data:

- Nutrient Environmental Release Potential Indicator (NERPI)
 - Nitrogen (N) and Phosphorus (P)
- Ammonia Air Emissions Mitigation Indicator (AAEMI)

The image shows three overlapping document covers for CLEAN EAST MANAGEMENT PLANS tools. The top cover is titled 'Farm Operation Introductory Profile'. The middle cover is titled 'Farm Operation On-Site Environmental Assessment Tool' and includes a 'FARM IDENTIFICATION CODE' field. The bottom cover is titled 'FARM OPERATION PROFILE SUPPLEMENT (NMP Supplement)' and includes fields for 'Farm Identification Code', 'Technical Assistance Professional' (Name, Address, Phone, E-mail), and 'Farm Operator Signature' and 'Date'.

Environmental Assessments (EA Tool)

Environmental Management Topics Evaluated

- Animal holding areas, building/lot layout, and management:
 - Ventilation
 - Animal contact with water bodies
- Construction, operation, maintenance of handling and storage facilities for manure, litter, and wastewater
- Nutrient management, including:
 - Existing NMP
 - Land application practices
- Conservation practices
- Land management and tillage practices
- Mortality management
- Water quality and quantity management
- Chemical storage and handling
- Facility emergency management plans
- Records and sampling

Example EA Tool Questions

Farm Operation On-Site Environmental Assessment Tool

E. Manure/Wastewater Storage and Treatment Ponds, Lagoons, and Other Structures

E.1 Liquid Wastewater Storage Structures. Complete Section E.1 for each liquid wastewater storage and treatment structure (enter Y, N or N/A). Use the same name/ID provided by farm owner in the "Farm Operation Introductory Profile." (Copy table as needed.)

Please check the box if this section is not applicable

Structure ID	ID	ID	ID
Storage capacity (<i>circle one: gal. or ft.³</i>)			
Age of structure (<i>years</i>)			
Liquid depth (<i>ft.</i>)?			
Type of structure			
Is the structure covered?			
If yes, what is the cover material?			
If covered, are gases vented?			
If gases are vented, describe how in Comments: Section below			
Complete the following for storage ponds and lagoons			
Depth of sludge (<i>ft.</i>)?			
Is the liquid storage full or close to full entering the winter months?			
Is the lagoon/pond located in a 25-yr. floodplain?			
Is there secondary containment to contain any discharge?			
Is lagoon/pond lined?			
If yes, with what material? (<i>specify clay or synthetic</i>)			
Last date dredged (<i>month/day/year</i>)			
What is the total design storage period (<i>days</i>)?			
Does the lagoon/pond have a stage marker?			
Is there adequate freeboard?			
Are there indications of the lagoon/pond over topping?			
Is the wastewater inlet submerged?			
Is the wastewater inlet protected?			
Is access to the lagoon/pond adequate?			
Does storage pond/lagoon operate into freeboard?			
Do embankments have/show signs of the following:			
Burrowing animals			
Large weeds/trees			
Erosion or gullies			
Poorly established sod/vegetation			
Heavily cracked sidewalls			
Seepage, damp, or soft areas on or near the embankments			
Do the wastewater outlet pipes pass through the lagoon/pond wall or berm?			
Is there pooling on the lowest side of the lagoon/pond, indicating leaks?			
Are wastewater flushing channels well maintained (<i>dairy farms only</i>)?			
Is there indication of an overflow from the flushing channels (<i>dairy farms only</i>)?			
Is surface water less than 200 ft. from the storage lagoon/pond?			
Are there concerns with odor or air emissions from lagoon/pond?			

Comments: _____

Example EA Tool Questions

Farm Operation On-Site Environmental Assessment Tool

J. Odor and Air Emissions

Please check the box if this section is Not Applicable

What measures does this farm use to reduce odor and air emissions of dusts and gases, such as ammonia (NH₃) and hydrogen sulfide (H₂S)?

Odor and Air Pollution Control Techniques Used (Check all that apply.)		For Control of		
		Dust	Odor	NH ₃ /H ₂ S
<input type="checkbox"/>	Manipulate diet to reduce odors/air emissions		•	•
<input type="checkbox"/>	Treat manure with odor-reducing additive		•	•
<input type="checkbox"/>	Mix animal feed in enclosed area	•		
<input type="checkbox"/>	Mix animal feed during low-wind periods	•		
<input type="checkbox"/>	Remove manure frequently from feedlots and/or short-term storage		•	•
<input type="checkbox"/>	Maintain minimum manure depths		•	•
<input type="checkbox"/>	Treat confinement building exhaust air with ozone		•	•
<input type="checkbox"/>	Treat confinement building exhaust air with biofilter		•	•
<input type="checkbox"/>	Use complete anaerobic digestion		•	•
<input type="checkbox"/>	Use high-rate aeration in manure/wastewater storage lagoons/ponds		•	•
<input type="checkbox"/>	Cover manure/wastewater storage lagoons/ponds		•	•
<input type="checkbox"/>	Compost manure		•	•
<input type="checkbox"/>	When planning new structures, maximize distance to nearby residences		•	
<input type="checkbox"/>	Locate buildings/manure/wastewater storage to account for prevailing winds		•	
<input type="checkbox"/>	Exhaust buildings away from nearby residences		•	
<input type="checkbox"/>	Maintain adequate/regular building ventilation		•	•
<input type="checkbox"/>	Incorporate manure into soil within 24 hours		•	•
<input type="checkbox"/>	Inject manure into soil		•	•
<input type="checkbox"/>	Apply manure during periods of low winds	•	•	•
<input type="checkbox"/>	Avoid applying manure when neighbors are outside		•	
<input type="checkbox"/>	Avoid applying manure on hot and/or windy days		•	•
<input type="checkbox"/>	Apply water to unpaved roads and/or traffic areas	•		
<input type="checkbox"/>	Apply chemical dust suppressant to unpaved roads and/or traffic areas	•		
<input type="checkbox"/>	Clean application and other farming equipment before leaving fields	•	•	
<input type="checkbox"/>	Minimize and/or promptly remove tracked mud on paved roads	•		
<input type="checkbox"/>	Avoid and/or minimize burning of vegetative waste or residue	•		
<input type="checkbox"/>	Use treelines and/or other vegetative windbreaks	•	•	
<input type="checkbox"/>	Use structural windbreaks	•	•	
<input type="checkbox"/>	Other (specify)			
<input type="checkbox"/>	Other (specify)			

Comments: _____

Nutrient Management Plans

- Were required to be consistent with requirements in
 - Concentrated Animal Feeding Operation (CAFO) National Pollutant Discharge Elimination System (NPDES) regulations, and
 - Applicable State regulations.
- Used Manure Management Planner (MMP)¹ software or, where required, State software.
- RTI NMP Supplement Tool

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Nutrient Management Planning

- “nutrient management planning is demonstrating that an animal feeding operation has sufficient crop acreage, seasonal land availability, manure storage capacity, and application equipment to manage the manure produced in an environmentally responsible manner.”

Source: Getting Started with Manure Management Planner

Author: Phil Hess

Revised: 06-Oct-2010

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www.agry.purdue.edu/software

- “Manure Management Planner (MMP) is a Windows-based computer program developed at Purdue University that's used to create manure management plans for crop and animal feeding operations. The user enters information about the operation's fields, crops, storage, animals, and application equipment. MMP helps the user allocate manure (where, when and how much) on a monthly basis for the length of the plan (1-10 years). This allocation process helps determine if the current operation has sufficient crop acreage, seasonal land availability, manure storage capacity, and application equipment to manage the manure produced in an environmentally responsible manner. MMP is also useful for identifying changes that may be needed for a non-sustainable operation to become sustainable, and determine what changes may be needed to keep an operation sustainable if the operation expands. MMP currently supports 37 states by automatically generating fertilizer recommendations and estimating manure N availability based on each state's Extension and/or NRCS guidelines.” (Purdue University <http://www.purdue.edu/agsoftware/mmp/MmpBlurb.htm>)

Nutrient Management Plan Supplemental Tool



FARM OPERATION PROFILE SUPPLEMENT (NMP Supplement)

Farm Identification Code: _____

Technical Assistance Professional
 Name _____
 Address _____
 Phone _____
 E-mail _____

 Farm Operator Signature

 Date

D. Manure Analyses Information

1. Obtain a copy of the latest manure analysis for each manure storage structure (manure pack, lagoon, daily scrape & haul, etc.).
2. How much manure do you typically apply each year (if some manure is handled dry and some wet, estimate an amount for each)? _____
3. If manure is imported to the farm, what is the manure type and how much is applied (obtain copy of the latest manure analysis)? _____

Comments: _____

E. Manure Application Equipment Information

1. For each type of manure application equipment, indicate the minimum application rate at which the equipment can operate and the design capacity of the equipment.

Equipment Type	Minimum Application Rate (ton/ac or gal/ac)	Equipment Capacity (tons, gal or gpm)

Comments: _____

F. Mortality Information

1. If mortality is composted, is it land applied? Yes No
 If Yes, indicate application rate (ton/ac), timing (time of year/season), and where compost is applied?

2. Obtain latest analysis of compost.

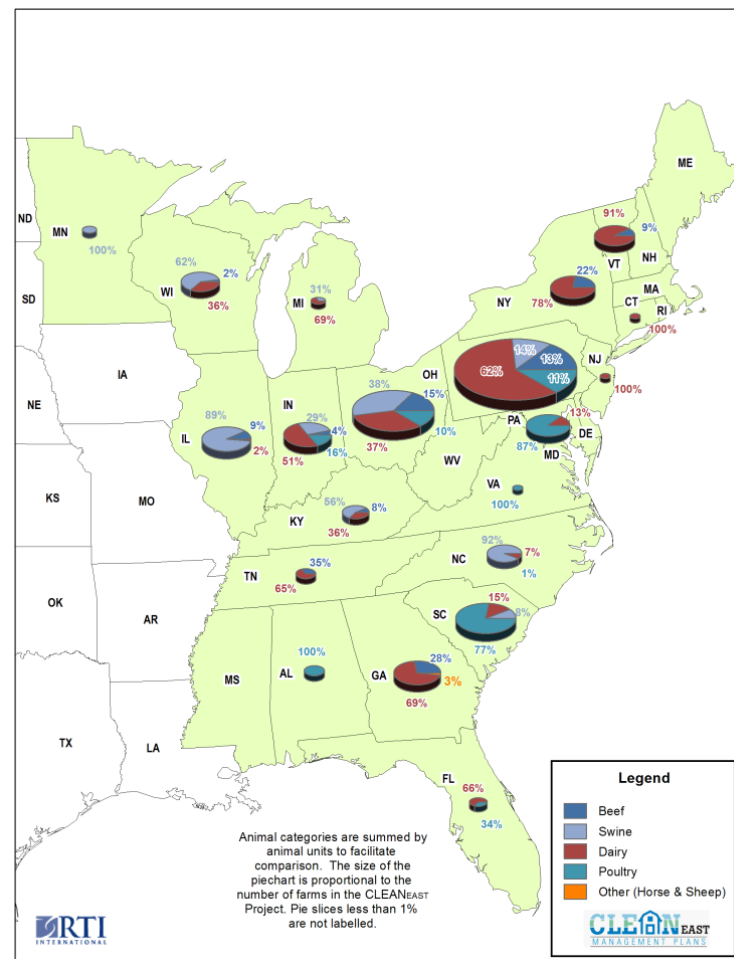
Comments: _____



Results – Farm Participants

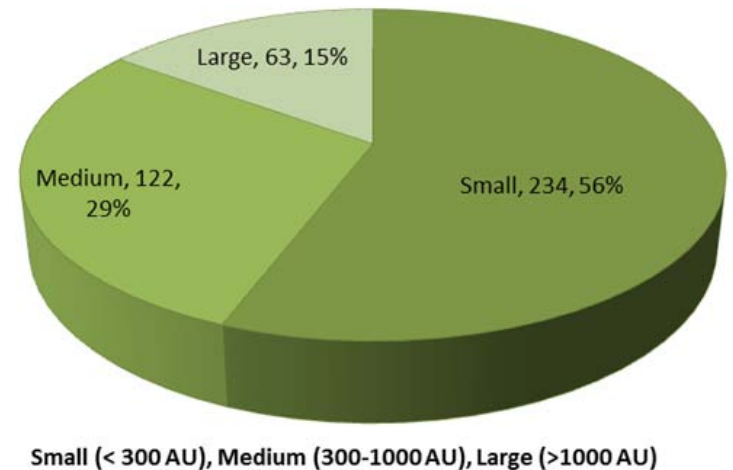
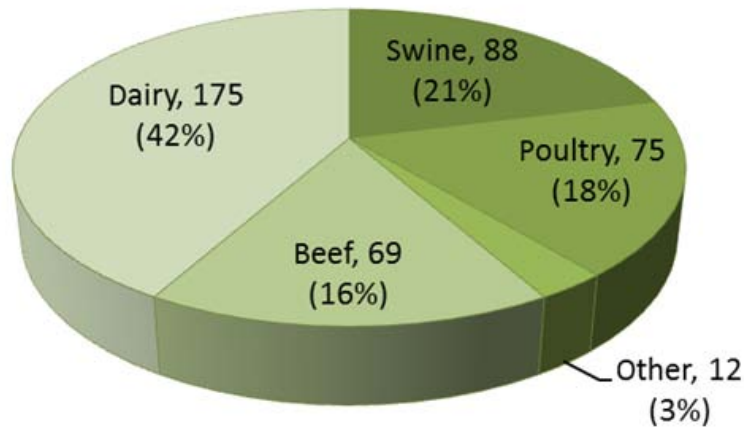
Requested Service(s)	Reports Completed
Environmental Assessments (EAs)	297
Nutrient Management Plans (NMPs)	393
Total	690

Served 429 farm operations.



Results - Farm Participants - Animal Type and Farm Size

Participants by Predominant Animal Type



Predominant Animal Category	Number of Farm Participants						
	Predominant Animal Species Only at Farm Site	Multiple-Animal Species Farms with Other Species in Addition to Predominant Species at Farm Site					Total
		Beef	Dairy	Swine	Poultry	Other ^a	
Beef	53		6	5	0	5	69
Dairy	144	6		5	6	14	175
Swine	66	13	4		3	2	88
Poultry	53	13	4	2		3	75
Other	12	0	0	0	0		12
							419

¹ Other category includes horses and sheep.

Results - Farm Participant Profile - Farm Size

Farm Data Category	Large	Medium	Small	Total
Size range of AUs	> 1,000	≥300 to 1,000	<300	NA
No. of farms	63 (15%)	122 (29%)	234 (56%)	419
Predominant Animal Type	Dairy, Swine, Poultry	Dairy, Swine, Poultry	Dairy, Beef	NA
Animal units (AU) and acres statistics				
Total number of AUs (percentage)	118,555 (55%)	67,431 (31%)	29,774 (14%)	215,760
Total acres for manure land application	66,895	69,614	62,162	198,671
Acres available per AU, acre/AU	0.56	1.03	2.09	NA

TAP Recommendations and Implementation

1,637 recommendations were made to 419 farm operations in the project.

(The 10 most frequently cited categories of recommendations are presented below.)

Confirmed ~ 55 % of recommendations were implemented, within 1 year.

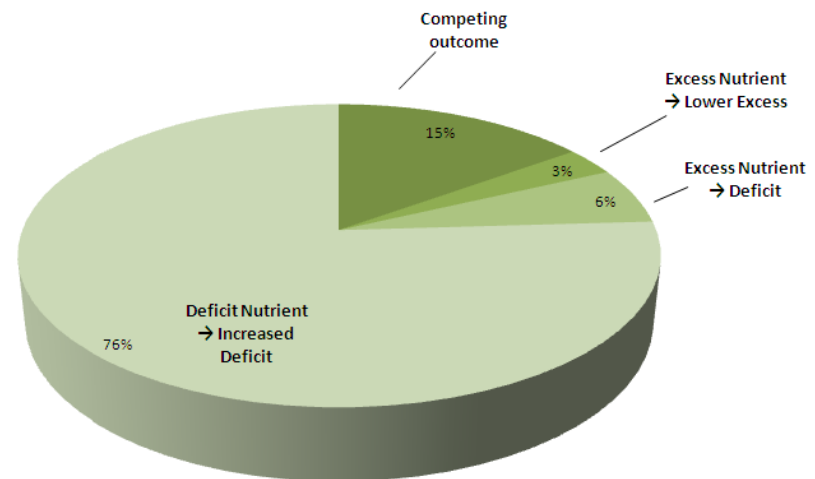
NRCS BMP Code ^b	Recommendation Category	Frequency of TAP Recommendation to Farm Participant
313	Waste Storage Facility	289
	▪ Waste Storage Facility (Increase Capacity Or Add New Facility)	136
	▪ Waste Storage Facility (O&M)	123
	▪ Waste Storage Facility (Install Permanent Marker)	20
	▪ Milk Parlor Wastewater Treatment	9
	▪ Waste Storage Facility (Liner)	1
590	Nutrient Management Modifications	225
	▪ Nutrient Management (Combination of Applying Setbacks, Method, Rates, Timing, Sampling And Setbacks)	95
	▪ Nutrient Management (Sampling)	85
	▪ Nutrient Management (Application Timing)	30
	▪ Nutrient Management (Application Rates)	10
	▪ Nutrient Management (Application Method)	5
748	Recordkeeping	128
558	Roof Runoff Structure	115
561	Heavy Use Area Protection	83
472	Access Control/ Livestock Exclusion Area	60
316	Animal Mortality Facility	59
317	Composting Facility	59
N/A	Calibrate Application Equipment	57
359	Waste Treatment Lagoon	48

Environmental Release Estimation Tools – NERPI

- The NERPI is a measure of the change in nitrogen (N) and phosphorus (P) potentially available for release into the environment (post-CLEANEAST™ release minus Baseline release)
- The potential release values were derived from CLEANEAST™ NMPs.
- The gross nutrient balance is calculated for each participating farm operation using the NRCS 2010 Animal Waste Management software

Results:

- NERPI was applied to 133 (34%) of 393 farms receiving NMPs.
- 85% of the 133 participants were predicted to have decreases in N and/or P runoff beyond baseline, assuming 100% of the NMP was fully implemented.



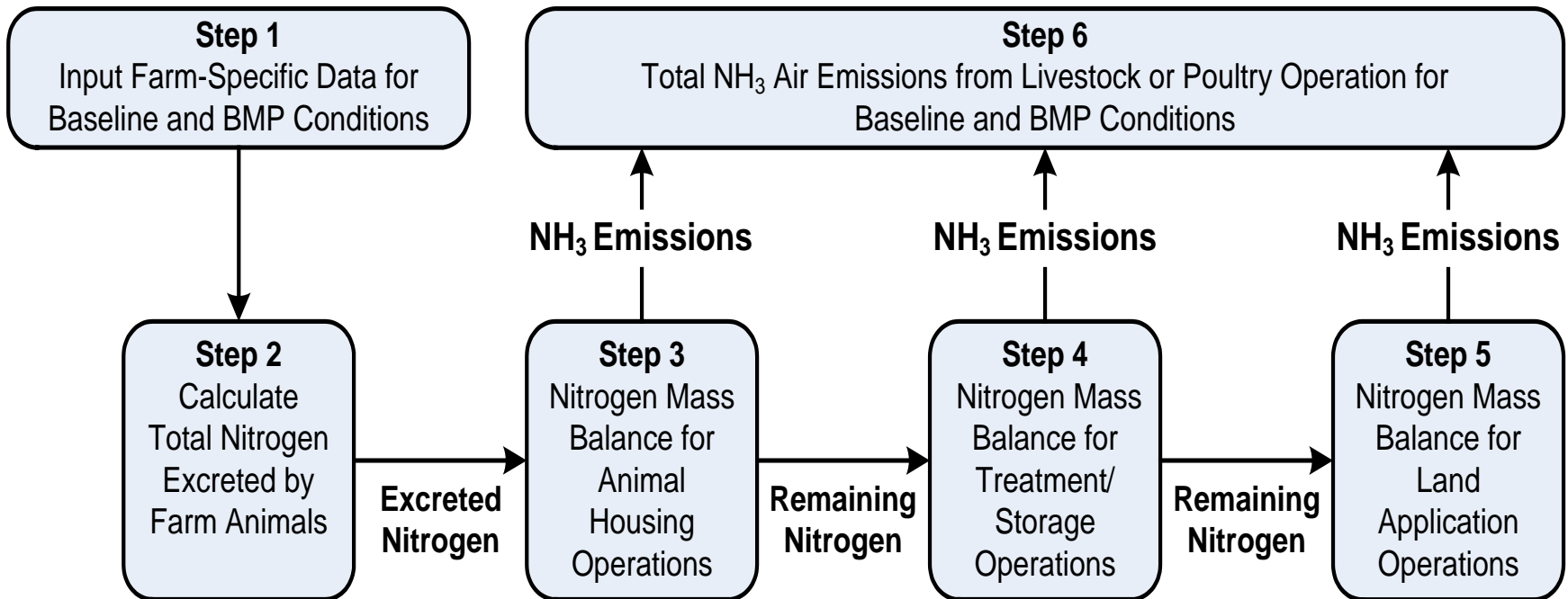
Environmental Release Estimation Tools – AAEMI

- ***Ammonia (NH₃) Air Emissions Mitigation Indicator (AAEMI)***
 - Change in total **potential** NH₃ air emissions after manure management recommended by TAP
 - Calculated using a custom Excel spreadsheet program based on protocol used by EPA for its *National Emission Inventory of Ammonia Emissions from Animal Agricultural Operations*

Gaseous Emissions from Animal Feeding Operations

- NH_3 ; H_2S ; CH_4 ; N_2O ; CO_2 ; Odor; VOCs
- Ammonia selected as air pollutant to track:
 - Potential for off-site movement
 - Wet or dry deposition impacts on nutrient sensitive waters
 - Precursor to $\text{PM}_{2.5}$
 - Multiple emission points and pathways
 - Established BMPs to reduce emissions

Flow Diagram for AAEMI Tool



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Normal Page Layout Full Screen Workbook Views

Ruler Gridlines Message Bar Formula Bar Headings Show/Hide

Zoom 100% Zoom to Selection

New Window Arrange All Freeze Panes Split Hide Unhide Window

Save Workspace Switch Windows

Macros

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2 - DAIRY FARM OPERATIONS

WORKSHEET USER INSTRUCTIONS

1. Use farm-specific information to fill in values for all input parameter orange-colored cells as applicable to farm's dairy animal operations.
2. Choose to use either default values shown for input parameter green-colored cells or replace with your own farm-specific values.
3. All cells with red values are calculated by the spreadsheet

Table 2A - Dairy Animal Inventory

Dairy Animal Population	Current Operations				After Implementation of TAP Recommended BMP			
	Number of Animals	Average Animal Weight ^a (lb)	Nitrogen Excretion Rate ^a (lb N/1000 lb animal)	Total Nitrogen Excreted	Number of Animals	Average Animal Weight ^a	Nitrogen Excretion Rate ^a (lb N/1000 lb)	Total Nitrogen Excreted
Lactating Dairy Cows	200	1,500	0.45	135.0	200	1,500	0.45	135.0
Dry Dairy Cows	50	1,332	0.36	24.0	50	1,332	0.36	24.0
Dairy Heifers		1,049	0.31	0.0		1,049	0.31	0.0
Other (List type)				0.0				0.0
Total Animal Population	250			159.0	250			159.0

^a Default values from U.S. Environmental Protection Agency, *National Emission Inventory-Ammonia Emissions from Animal Agricultural Operations*, Revised Draft Report, Table 3-6. April 22, 2005.

Table 2B - Farm Operating Conditions

Parameter	Current Operations	Operations After Implementation of TAP
Animal Housing		
Days per year animals housed indoors	265	265

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Clipboard Font Alignment Number Styles Cells Editing

A75 Table 2F- Manure Treatment and Storage Ammonia Emissions

Table 2F- Manure Treatment and Storage Ammonia Emissions									
76	Dairy Manure Treatment/Storage Unit		Percentage of Total Manure Produced Managed in Unit		Annual Nitrogen Content of Manure Entering Unit (lb/yr)		Annual NH ₃ Emissions (lb/yr)		
			Current Management Practices	Management Practices After Implementation of TAP	Current Management Practices	Management Practices After Implementation of TAP	Current Management Practices	Management Practices After Implementation of TAP	
78	Manure Liquids								
79	Treatment Unit	Solids separator /settling basin							
80		Milking Parlor flush water		100%	100%	7,391	7,391	0	0
81		Barn flush water		100%	100%	28,675	28,675	0	0
82	Dry lot runoff		0%	100%	0	0	0	0	
83	Storage Unit	Uncovered lagoon							
84		Milking Parlor flush water		100%	100%	739	739	386	386
85		Barn flush water		100%	100%	3,676	3,676	1,920	1,920
86		Dry lot runoff		0%	100%	0	0	0	0
87		Lagoon with permeable cover							
88		Milking Parlor flush water		0%	0%	0	0	0	0
89		Barn flush water		0%	0%	0	0	0	0
90	Dry lot runoff		0%	0%	0	0	0	0	
91	Storage Unit	Storage tank or lagoon with							
92		Milking Parlor flush water		0%	0%	0	0	0	0
93		Barn flush water		0%	0%	0	0	0	0
94		Dry lot runoff		0%	0%	0	0	0	0
95	Total Manure Liquids Storage				4,415	4,415	2,305	2,305	
96	Manure Solids								
97	Storage Unit	Uncovered stockpile							
98		Separator solids		100%	100%	4,328	4,328	1,051	1,051
99		Scrape barn solids		0%	0%	0	0	0	0
100		Barn with deep pit solids		0%	0%	0	0	0	0

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A118			Total						
118		Total	100.0%	100.0%	2,110	2,110	448	77	
119	Manure Solids Land Application								
120	Broadcast		100.0%	0.0%	3,277	0	895	0	
121	Broadcast with immediate incorporation		0.0%	100.0%	0	3,277	0	119	
122		Total	100.0%	100.0%	3,277	3,277	895	119	
123	Total Manure Land Application NH₃ Emissions				5,387	5,387	1,344	196	

Table 2H - Ammonia Emissions

Dairy Farm Operations	Annual Total Farm NH ₃ Emissions (lb/yr)		Annual NH ₃ Emissions per Animal (lb/yr/animal)		Annual Per Animal NH ₃ Emissions Reduction (lb/yr/animal)	Annual Per Animal Percentage NH ₃ Emissions Reduction
	Current Operations	Operations After Implementation of TAP Recommended BMP	Current Operations	Operations After Implementation of TAP Recommended BMP		
129 Animal housing (including milking parlor)	11,168	11,168	44.7	44.7	0.0	0.0%
130 Manure treatment/storage units	3,357	3,357	13.4	13.4	0.0	0.0%
131 Manure liquids land application	448	77	1.8	0.3	1.5	82.9%
132 Manure solids land application	895	119	3.6	0.5	3.1	86.7%
133 Farm Total	15,869	14,721	63.5	58.9	4.6	7.2%

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General

Conditional Formatting as Table Cell Styles

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	A	B	C	D	E
1	7 - AMMONIA EMISSIONS FACTORS				
2	DAIRY FARM OPERATIONS (Worksheet 2)				
3		Dairy Farm Site	Manure Management Component	NH₃ Emissions Factor	Reference
4		Animal Housing	Milking center	0%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations, D.2 Dairy Emission Factor Development</i> , Page D-7. April 22, 2005. < ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/nonpoint/nh3inv >
5			Flush barn	22%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
6			Scrape barn	11%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
7			Barn with deep pit	28%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
8			Pasture/range	8%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
9			Dry lot	15%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
10		Manure Treatment & Storage	Solids separator	0%	Assumption based on insufficient information to assign another value otherwise.
11			Lagoon - uncovered	43%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005.
12			Lagoon - permeable cover	37%	Assume cover is an permeable type and it reduces ammonia emissions by 15% Litter Treatment, Biofilter, and Cover, Mid-Atlantic Water Program, Table 3. < http://archive.chesapeakebay.net/pubs/bmp/Ammonia_Emissions_Reduction [43% x (1 - 0.15) = 36.6% = ~37%]
13			Storage tank or lagoon with impermeable cover	7%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005. 7% emission factor is for storage tank. impermeable cover.
14			Manure solids stockpile - uncovered	20%	U.S. Environmental Protection Agency. <i>National Emission Inventory - Ammonia Operations</i> , Table 3-7. April 22, 2005. 8% emission factor is for storage tank. impermeable cover.
					Assume cover is an permeable type and it reduces ammonia emissions by 15%

Inputs

- Table 2A - Dairy Animal Inventory
- Table 2B - Farm Operating Conditions
- Table 2C - Manure Management
- Table 2D - Manure Land Application

Calculated Outputs

- Table 2E - Animal Housing Ammonia Emissions
- Table 2F- Manure Treatment and Storage Ammonia Emissions
- Table 2G - Manure Land Application Ammonia Emissions
- Table 2H - Ammonia Emissions Calculation Summary

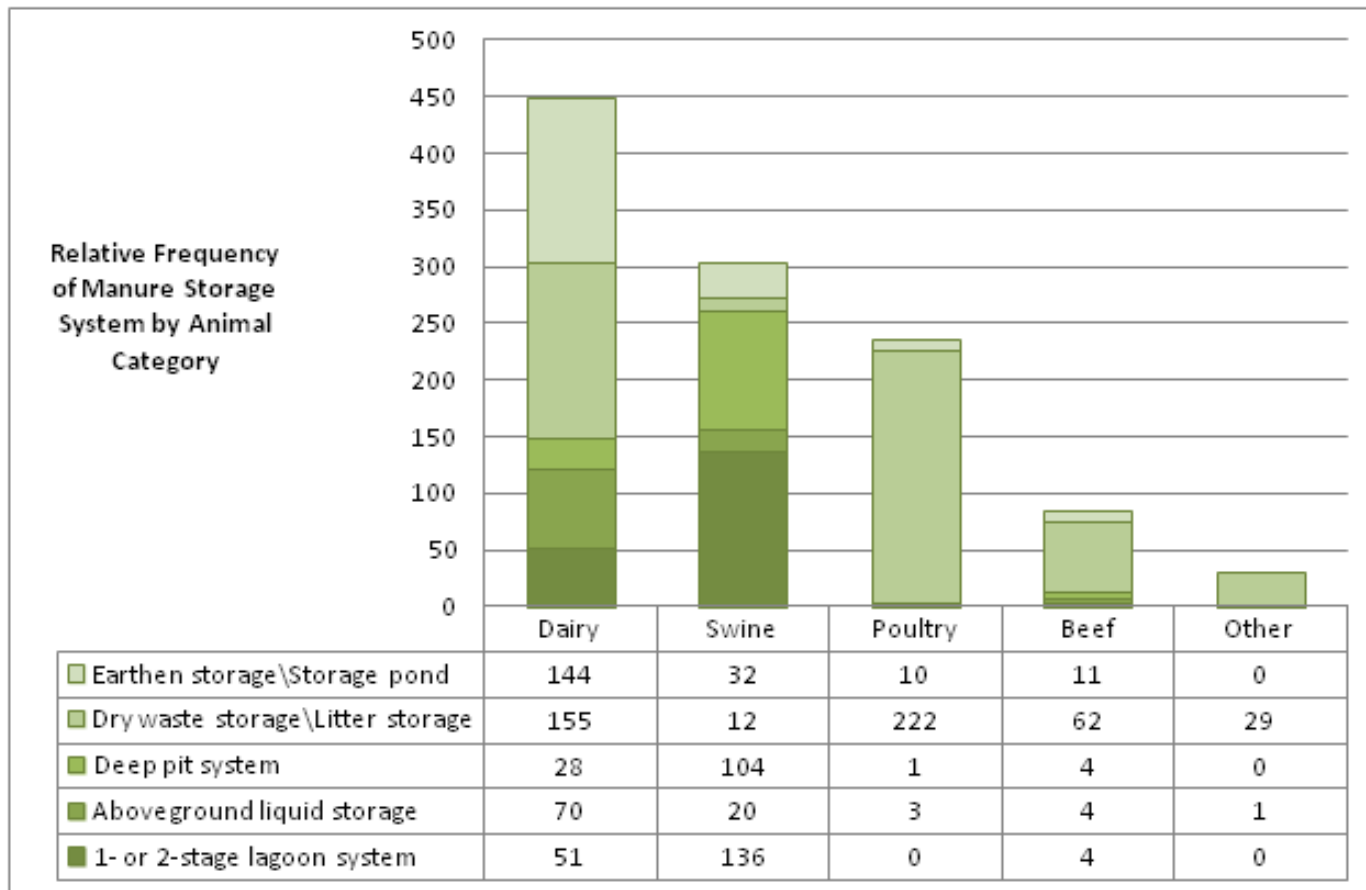
AAEMI Tool's Capability to Measure Potential Impacts of BMPs on Ammonia Emissions

Farm Emission Point	Tool Measures Effect of Farm BMP on NH ₃ Emissions	Tool Does Not Measure Effect of Farm BMP on NH ₃ Emissions
Animal Housing	Animal housing type	Animal diet manipulation Manure collection work practices Housing ventilation biofilters Housing ventilation NH ₃ scrubbers Landscaping around buildings
Manure Treatment/Storage	Solids separation Impermeable covers Permeable covers	Treatment unit operation adjustments Manure acidification Additives Landscaping
Land Application	Application method Soil incorporation Crop acreage change	Manure amendments

Ammonia (NH₃) Air Emissions Mitigation Indicator (AAEMI)

- Developed AAEMI Tool to understand impacts on air emissions.
- Realized that air quality recommendations were not being made by TAPs (no NH₃ specific BMPS recommended), due to:
 - Few existing regulations require use of BMPs to decrease NH₃ air emissions
 - High cost issues related to air quality BMPs
- Air emissions gap likely needs to be addressed.

Farm Participant Baseline Conditions – Manure Storage Practices



GHG Relevance - CLEAN EAST™

- Manure Management practices may have co-benefit of mitigating GHG emissions (CH₄, CO₂, N₂O), in addition to treating and controlling nutrients.
- IPCC Tier 2 methodology for livestock can be applied to estimate and compare CH₄ and N₂O emissions of different manure management practices (e.g., manure storage in lagoons, liquid/slurry, and dry storage).
- Recent GHG analysis for the 190 Dairy operations that participated in CLEAN EAST™ demonstrated preferred manure storage practices from a GHG perspective (will be reported at the *Greenhouse Gas and Animal Agriculture* conference in June 2013).

CLEANEAST™ Project Tools Summary

✓ Developed 3 tools to conduct technical services for the project.

- ✓ Farm Profile
- ✓ EA Tool
- ✓ NMP Supplement Tool

✓ Developed 2 performance tracking tools to measure water quality and air impacts.

- ✓ Nutrient Environmental Release Potential Indicator (NERPI)
- ✓ Ammonia Air Emissions Mitigation Indicator (AAEMI)



Photos courtesy of USDA NRCS

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PROJECT VIDEO AND DISCUSSION