Methodology for Estimating U.S. Livestock Populations for Use in National Emissions Inventory Development

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Introductions

- Joe Mangino, U.S. EPA
- John Steller, U.S. EPA
- Kara Edquist, Eastern Research Group, Inc.

Overview

- Air emissions from livestock populations and corresponding manure management are an important component of agricultural sector emissions inventories in the U.S.

- Inventories reporting this information include:
  - *Inventory of U.S. Greenhouse Gas Emissions and Sinks*
  - *National Emissions Inventory (NEI)*

- A key input variable to both the emission inventories is livestock populations

- However, there are different spatial needs of livestock populations which require refinement of data

U.S. Greenhouse Gas Inventory

- U.S. EPA annually compiles a national U.S. Greenhouse Gas Inventory (GHGI) Report since 1993

- Official U.S. Government data on total national emissions and removals

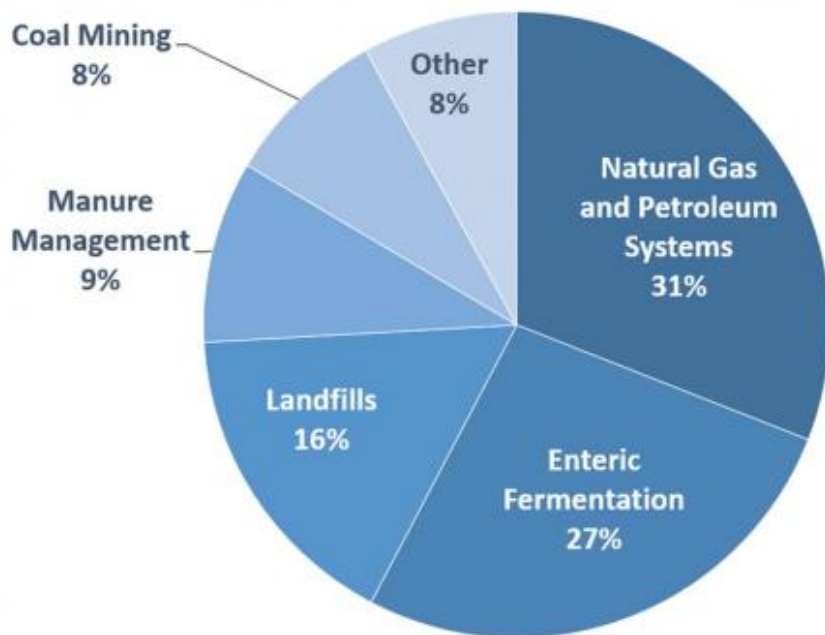- Fulfills U.S. treaty obligation under the United Nations Framework Convention on Climate Change (UNFCCC)

EPA United States Environmental Protection Agency
EPA 430-R-19-001

Inventory of
U.S. Greenhouse Gas Emissions and Sinks

1990-2017
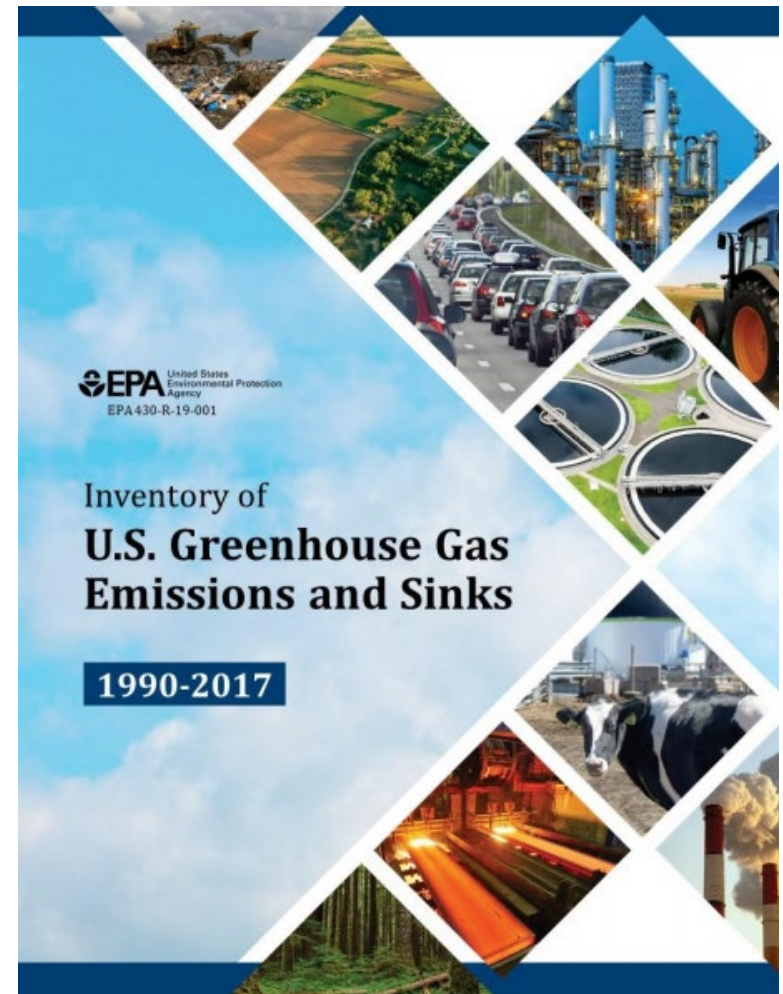
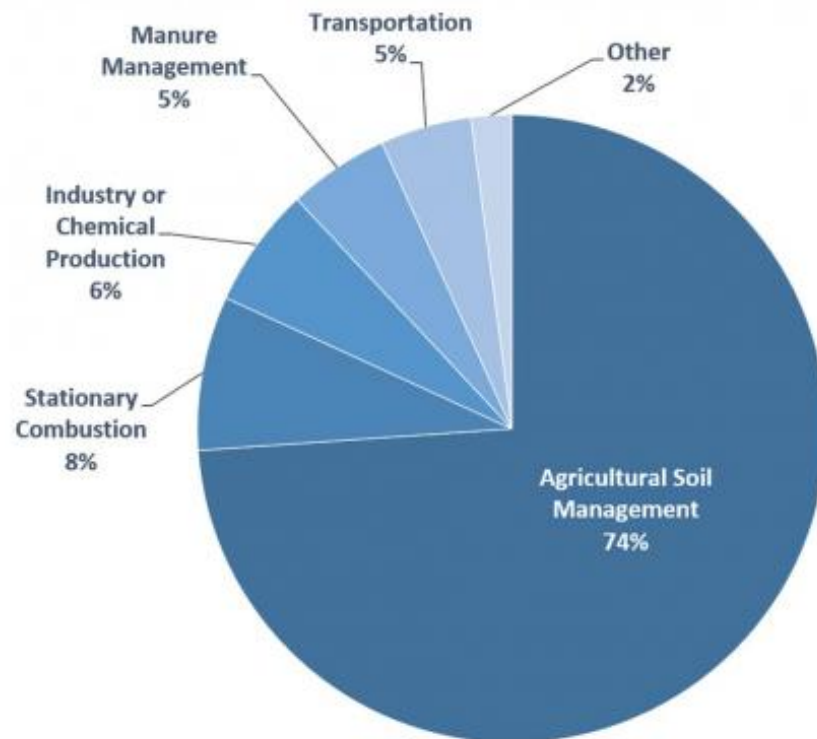# Guidelines for Compiling U.S. Greenhouse Gas Inventory

- Intergovernmental Panel on Climate Change (IPCC) Guidelines provides technical guidance for the compilation and reporting of GHG inventories
- The use of the *2006 IPCC Guidelines* is implemented by the UNFCCC Inventory Reporting Guidelines

U.S. GHG Inventory: Total 2017 Emissions

2017 U.S. Methane Emissions, By Source

Coal Mining 8%
Other 8%
Manure Management 9%
Natural Gas and Petroleum Systems 31%
Landfills 16%
Enteric Fermentation 27%

2017 U.S. Nitrous Oxide Emissions, By Source

Manure Management 5%
Transportation 5%
Other 2%
Industry or Chemical Production 6%
Stationary Combustion 8%
Agricultural Soil Management 74%

Input Data Source: Population

State-Level Data Updated Annually from USDA NASS data

State-Level Data Updated Every 5 Years from USDA Census of Ag

Input Data: Population

Cattle

Beef cows, bulls, heifers, and steer not on feed (NOF)

Feedlot heifer and steer

Dairy cows

Dairy heifers

Dairy and beef calves

Swine

Breeding

Market

- Less than 50 lbs
- 50-119 lbs
- 120-179 lbs
- Greater than 180 lbs)

Sheep

Market

Breeding

Poultry

Hens

Pullets

Chickens

Broilers

Turkeys

Manure Management: Population Issues

- There are some issues to note when using USDA population data, including:
  - Some data may be not available due to disclosure concerns.
  - Some states are reported in groups to avoid disclosure.
  - There are some thresholds under which data are not reported.

Manure Management: Population Issues Example

Table 19. **Poultry - Inventory and Number Sold: 2017 and 2012** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Kansas	Kentucky	Lou
INVENTORY			
Any poultry ....farms, 2017	4,236	8,965	
2012	4,088	7,121	
Layers (see text) ....farms, 2017	3,967	8,032	
2012	3,781	6,252	
number, 2017	(D)	5,909,873	
2012	(D)	4,308,549	

RESPONDENT CONFIDENTIALITY

In keeping with the provisions of Title 7 of the United States Code, no data are published that would disclose information about the operations of an individual farm or ranch. All tabulated data are subjected to an extensive disclosure review prior to publication. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived, was suppressed and coded with a 'D'. However, the number of farms reporting an item is not considered confidential information and is provided even though other information is withheld.

Manure Management: Population Issues Example

All Sheep and Lamb Inventory – States and United States: January 1, 2014-2018

State	All sheep and lambs				
	2014	2015	2016	2017	2018
	(1,000 head)	(1,000 head)	(1,000 head)	(1,000 head)	(1,000 head)
Arizona	150.0	150.0	140.0	130.0	125.0
California	590.0	600.0	575.0	600.0	570.0
Colorado	365.0	420.0	435.0	420.0	445.0
Idaho	250.0	260.0	255.0	250.0	235.0
Illinois	56.0	57.0	60.0	55.0	55.0
Indiana	50.0	50.0	51.0	56.0	57.0
Iowa	155.0	175.0	175.0	175.0	165.0
Kansas	75.0	66.0	65.0	68.0	67.0
Kentucky	49.0	48.0	53.0	53.0	58.0
Michigan	81.0	76.0	82.0	85.0	80.0
Minnesota	135.0	130.0	125.0	130.0	130.0
Missouri	83.0	85.0	90.0	95.0	100.0
Montana	220.0	215.0	230.0	230.0	225.0
Nebraska	76.0	81.0	80.0	83.0	80.0
Nevada	80.0	69.0	60.0	63.0	61.0
New England [1]	44.0	43.0	44.0	47.0	49.0
New Mexico	81.0	90.0	90.0	97.0	96.0
New York	75.0	80.0	80.0	80.0	85.0
North Carolina	27.0	30.0	32.0	30.0	27.0
North Dakota	66.0	64.0	73.0	66.0	70.0
Ohio	117.0	121.0	120.0	117.0	119.0
Oklahoma	59.0	53.0	46.0	48.0	54.0
Oregon	195.0	195.0	180.0	170.0	165.0
Pennsylvania	94.0	86.0	94.0	93.0	96.0
South Dakota	260.0	245.0	255.0	240.0	250.0
Tennessee	39.0	44.0	48.0	46.0	46.0
Texas	730.0	720.0	725.0	710.0	750.0
Utah	280.0	290.0	285.0	275.0	275.0
Virginia	83.0	75.0	75.0	80.0	75.0
Washington	55.0	52.0	50.0	48.0	45.0
West Virginia	32.0	33.0	36.0	34.0	35.0
Wisconsin	83.0	77.0	76.0	76.0	75.0
Wyoming	355.0	345.0	355.0	360.0	345.0
Other States [2]	145.0	145.0	155.0	160.0	155.0
United States	5,235.0	5,270.0	5,295.0	5,270.0	5,265.0

[1] New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.
[2] Includes data for States not published in this table.

Manure Management: Population Issues Example

Broiler Production and Value – States and United States Total: 2018

[Annual estimates cover the period December 1 previous year through November 30. Broiler production including other domestic meat-type strains. Excludes States producing less than 500,000 broilers]

State	Number produced	Pounds produced	Value of production
	(1,000 head)	(1,000 pounds)	(1,000 dollars)
Alabama	1,123,700	6,180,400	3,454,844
Arkansas	1,092,000	7,316,400	4,089,868
Delaware	263,600	1,924,300	1,075,684
Florida	65,400	385,900	215,718
Georgia	1,361,400	8,168,400	4,566,136
Kentucky	303,300	1,971,500	1,102,069
Maryland	289,400	1,736,400	970,648
Minnesota	59,100	360,500	201,520
Mississippi	747,800	4,711,100	2,633,505
Missouri	293,100	1,465,500	819,215
North Carolina	873,600	6,901,400	3,857,883
Ohio	107,900	561,100	313,655
Oklahoma	196,800	1,318,600	737,097
Pennsylvania	200,100	1,140,600	637,595
South Carolina	237,800	1,807,300	1,010,281
Tennessee	177,300	939,700	525,292
Texas	653,500	4,247,800	2,374,520
Virginia	278,900	1,673,400	935,431
West Virginia	83,300	316,500	176,924
Wisconsin	55,800	228,800	127,899
Other States [1]	573,300	3,435,500	1,920,446
United States	9,037,100	56,791,100	31,746,230

[1] California, Illinois, Indiana, Iowa, Louisiana, Michigan, Nebraska, New York, Oregon, and Washington combined to avoid disclosing individual operations.

Manure Management: Population Issues Resolution

- "D" values are estimated based on number of missing values and difference between reported and total values.

  - If there are 4 states that have D values, the population for each D state is calculated:

    $$\frac{\text{Total U.S. Population} - \text{Sum of Population of Non "D" States}}{4}$$

- Grouped states are estimated based on number of states and difference between reported and total values.

- Currently, states under thresholds are not included in the GHGI estimates.
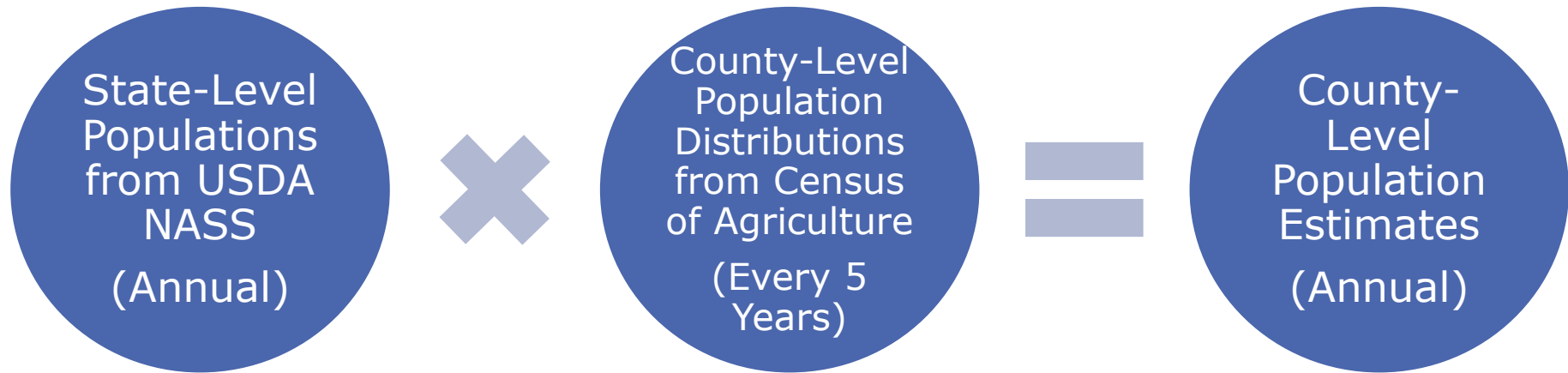
Manure Management: County-level Populations

- Reasons county-level populations are needed:
  - Develop annual methane conversion factors for liquid systems using weighted-average county-level temperature data and county-level population.
  - Manure management sector develops county-level nitrogen data for Agricultural Soil Management to maintain consistency across Inventory source categories.

Manure Management: County Population Development

State-Level Populations from USDA NASS

(Annual)

×

County-Level Population Distributions from Census of Agriculture

(Every 5 Years)

=

County-Level Population Estimates

(Annual)

NEI Overview

- NEI is compiled from emissions data provided by state/local and tribal (SLT) programs and/or estimated by EPA for some sources

- Complete inventory for required pollutants <u>every 3 years for nonpoint sources,</u> such as livestock waste management

  - Ammonia is an important pollutant for this category since it can be considered a $PM_{2.5}$ precursor under certain air quality modeling scenarios

- The NEI is one of the key inputs for:

  - Modeling of national rules
  - Non-attainment designations
  - Trends reports and analyses

Purpose for using **GHGI** livestock populations in **NEI**

Overall goal is to use consistent livestock population dataset

- Facilitate best practices in spatial allocation of data
- Facilitate a variety of inventory end uses
- Efficiencies in development

Livestock population dataset is:

- Developed annually
- Based on USDA statistical datasets
- Peer-reviewed
- Comprehensive in livestock coverage

□ *NOT* used to replace SLT-reported livestock emissions or population data—but available where no SLT submission

□ First used with current NEI development cycle - 2017 base year

Need for NEI Adjustment to Livestock Populations

- County-level refinement critical to support NEI end-uses such as modeling local air quality
- National totals hold up well, but allocations to some states and counties not always consistent with past trends and livestock operation levels
- Issues identified:
  - Non-disclosed county data were equally distributed
  - Low producing states below NASS reporting thresholds have 'zero' values
- Looked at past NEI and USDA Census data to help identify where refinements and adjustments likely needed

NEI Adjustments

- Adjustments limited to spatial allocations for certain livestock types, including:
  - Poultry (broilers, layers, and turkeys)
  - Swine
  - Sheep
- Used USDA 2012 Census data to develop county and state ratios to apply to 2017 livestock populations where needed
- Beef and dairy populations used directly from GHGI dataset
- Maintained national consistency with GHGI livestock population dataset for all livestock type with one exception:
  - Poultry broilers, where 20 low-producing states had 'zero' values due to reporting threshold in NASS. Populations from previous NEI were used to fill these gaps which increased national total by .03%

Next Steps

- ## National GHGI:
  - Inventory sees this as an opportunity to consider a new population allocation approach
  - Among other improvements, EPA will consider revising the methodology for population distribution to states/counties with disclosure concerns (best reflects current status of industry)

- ## NEI:
  - Establish a robust and repeatable basis for livestock populations estimates for NEI inventory development in future years
  - Develop best practice procedures for a consistent livestock population dataset at different spatial scales to meet different inventory program needs

Thank you