Ag Data Source Review

July 16, 2020

Why Are We Talking About This?

CAST-19 (i.e. most recent update of the watershed model)

- Release approved, with reservations from some partners…
    - Reservations included concerns regarding the agricultural data used to inform the model
    - AND how that data is utilized
    - See CBPO response to CAST-19 feedback under "Model Documentation"
        - Comments from the Jurisdictions and the Chesapeake Bay Program Responses

- **Ag Census** - Determine alternative or supplemental source of data. The data we use are crop land acres, harvested acres, and crop yields (bushels per acre, for example).
    - The Agriculture Workgroup has already begun discussions on the purpose and use of the Ag Census data
- **Soybeans** - The nutrient management expert panel did not consider that the Nutrient Management BMP could be applied to full season soybeans' nitrogen load. That should be reevaluated since there is a minimal amount of nitrogen applied to the full season soybean crop.
- **Double Cropping** - There are unexpected effects from the current methodology. The method for determining double cropped acres and the crops that are matched with each other in a year should be reevaluated. In addition, there is an existing glitch that could be corrected by using a more robust way of determining the total vegetable acres.

From Water Quality GIT presentation to Management Board 7/9/20

- **Ag Census** - Determine alternative or supplemental source of data. The data we use are crop land acres, harvested acres, and crop yields (bushels per acre, for example).
  - The Agriculture Workgroup has already begun discussions on the purpose and use of the Ag Census data

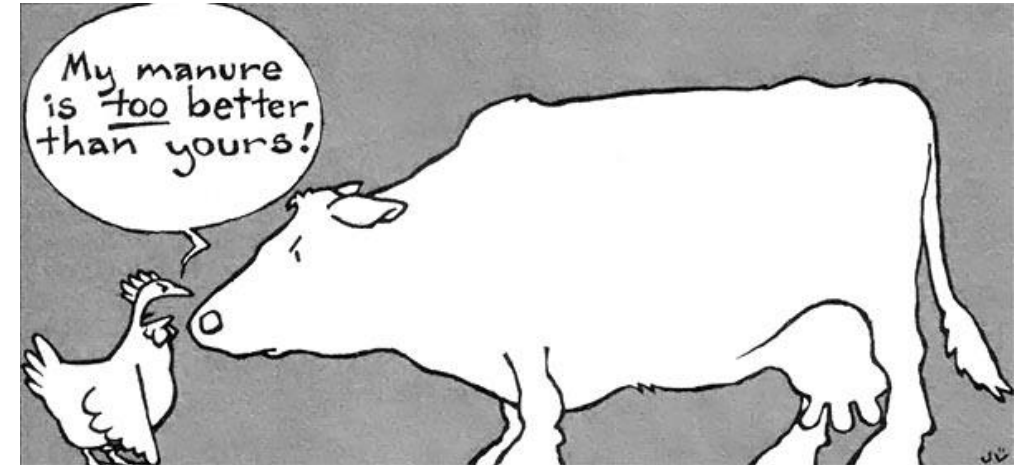# Why Do We Use the Ag Census?

1980s: Early CBP Partnership Decision
- Predictable and reliable (in terms of access)
- Public
- Breadth of coverage

2013: Building a Better Bay Model...
- Interest in alternative sources of data

How Do We Use the 5-Year Ag Census Data?

- Animal Inventory & Sales
  - Estimate populations by county
  - Define feed space acres
  - Estimate the "manure bucket" for the CBW
    - Manure nutrients applied to crops, directly deposited to pasture and riparian areas, and left in the feed space.

- Crop acres by county
  - Used in conjunction with high-resolution mapped land cover data to improve land use assumptions

  - Used in conjunction with yield data & crop application goals to allocate annual fertilizer & manure applications across the watershed

My manure is too better than yours!

https://www.motherearthnews.com/homesteading-and-livestock/manure-fertilizer-zmaz83mazraw

What About Annual Data?

National Agricultural Statistics Service (NASS) Annual Surveys

- Incorporated every two years (milestone)
  - When the watershed model "opens" for changes

- Yield data for the following major crops:
  - Alfalfa Hay; Barley; Buckwheat; Corn for Grain; Corn for Silage; Oats for Grain; Rye for Grain; Sorghum for Grain; Sorghum for Silage; Soybeans for Beans; and Wheat for Grain

- Broiler & Turkey Sales Data (state-level)

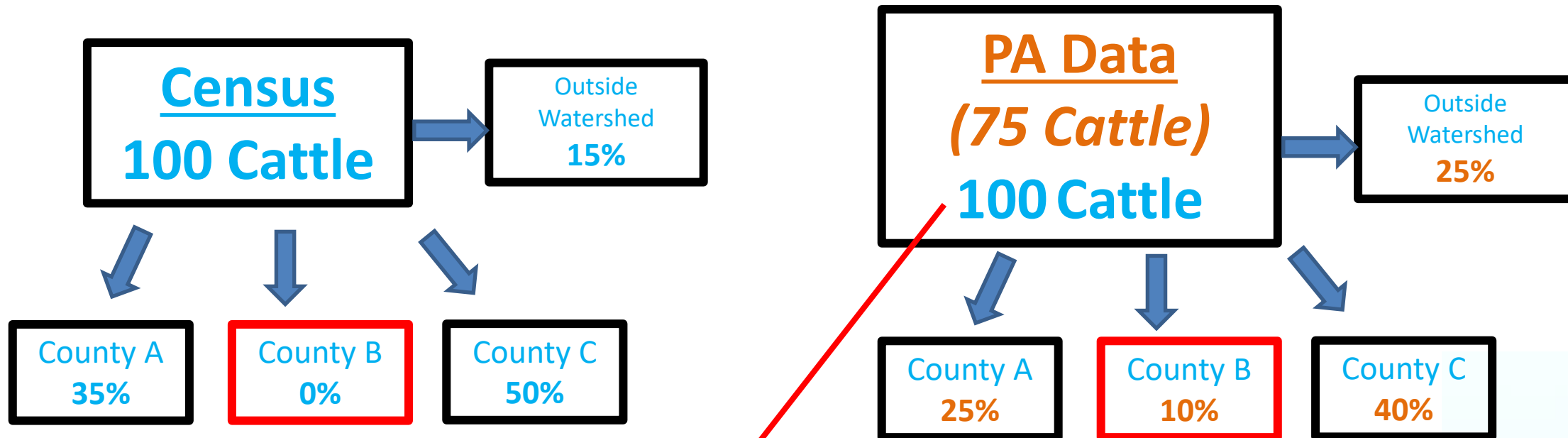**1.Define Crop Application Goal**

A Crop Application Goal/Yield Unit

B Yields/Acre

C Acres

Crop Application Goal

2. Define Manure Available to Crops

Manure Generated

Feed Additive BMPs

Direct Deposition on Pasture

Direct Deposition to Riparian Pasture Areas

Deposited within Barnyard

Ammonia Reduction BMPs

Stored Manure

Storage and Handling Loss

Barnyard BMPs

Available for Transport

Manure Transport

Available for Application

Mineralization

Volatilization

3. Spread Manure to Crops

4. Define Inorganic Fertilizer Available to Crops

AAPFCO Fertilizer Sales Data

Ag Census or NASS Annual Surveys (Animal populations dictate manure load estimates)

A AMS
B NASS Annual Survey
C Ag Census

5. Spread Fertilizer to Crops

Allocation of Ag Nutrients in the Watershed Model

AMS= Agricultural Modeling Subcommittee

https://www.dreamstime.com/stock-images-square-peg-round-hole-image12777364

Source for *distribution* of statewide populations can change.

Example: Pennsylvania provides fraction of cattle in every county for the year 2019, and these fractions are used to distribute TOTAL statewide cattle populations from the Census of Agriculture.

Census 100 Cattle		

→ Outside Watershed 15%

County A 35%	County B 0%	County C 50%

PA Data (75 Cattle) 100 Cattle		

→ Outside Watershed 25%

County A 25%	County B 10%	County C 40%

Source of *TOTAL* statewide populations will not change for Phase 6 Watershed Model.

Manure Generation – Nutrient Content

Data Currently Used in the Phase 6.0 Model

Manure Generated

Animal Type	Manure Source	Lbs Dry Manure/Animal/Yr	Lbs TN/Lb Dry Manure	LbsTP/Lb Dry Manure
Beef	Use Beef - Cow (confinement) from ASAE 2005 for manure values	5,475.00	0.028788	0.006467
Dairy	Use Lactating Cow, Dry Cow and Heifer from ASAE 2005 for manure values	4,404.33	0.042221	0.006764
Other Cattle	Estimated based upon weighted average combination of Beef and Dairy from Census of Agriculture	1,605.07	0.035504	0.006616
Horses	Use average of Horse- Sedentary and Horse - Intense Exercise from ASAE 2005 for manure values	3,102.50	0.031672	0.005941
Hogs for Breeding	Swine Characterization Report;	220.62	.294653	Varies
Hogs for Slaughter	Swine Characterization Report;	97.09	0.106841	Varies
Sheep and Lambs	Use ASAE 2003 for manure values	240.9	0.038182	0.007909
Goats	Use ASAE 2003 for manure values	680.91	0.034615	0.008462
Pullets	PLS Report; See Appendix A	12.95	Varies	Varies
Layers	PLS Report; See Appendix A	17.89	Varies	Varies
Broilers	PLS Report; See Appendix A	Varies	Varies	Varies
Turkeys	Turkey Characterization Report;	7.62	Varies	Varies

3-year trends (up or down) can be applied to existing values in this table.

(requires 3 consecutive years of data)

Data must be collected in a similar fashion as was done for:
- Poultry Litter Subcommittee report
- Swine Characterization Study
- Turkey Characterization Study

Alternatives to the Ag Census?

Crop Acreage Data

Alternative methods to account for fitting Ag Census data to CBP needs?
- Adjusting methods for estimating crop acres (e.g. double crops, vegetables, etc.)

Alternative/supplemental data sets
- Other data sets at the state or federal level?

> **Crop Application Goal**

Animal Population Data

Additional NASS Annual Survey Data may be available to inform population trends between census years (incorporated every two years)
- Dairy, Beef Cattle, Layers, Swine...

Direct from industry data can inform animal population **_trends_** between census years.
- Requires careful cooperation
- Legal, privacy assurances

> **Manure Generated**

Other Data Issues (new data incorporation every 2 years)

Soil P data
- Gary Shenk Sept 2018 presentation to AgWG on data set incorporated into the CBWM
- **Additional soil P data is welcome and encouraged**

Manure Nutrient Concentration Data
- Changes in management may result in changes in nutrient concentrations
- **Additional manure concentration data is welcome and encouraged**

Fertilizer Data
- More accurate allocation of fertilizer within the CBW?

> **4. Define Inorganic Fertilizer Available to Crops**

CRITICAL CONCEPT:

To maintain integrity of CBWM there are two options for new data sets:

- Provide data all the way back through 1985.
  OR
- Use the **_trend_** in new data sets for the years available.

CBWM= **Chesapeake Bay Watershed** Model

N Application on Soybeans

- **Soybeans** - The nutrient management expert panel did not consider that the Nutrient Management BMP could be applied to full season soybeans' nitrogen load. That should be reevaluated since there is a minimal amount of nitrogen applied to the full season soybean crop.

Concern:

Nutrient management on full-season soybeans?
YES: "core NM"
      NO: "supplemental NM" for N rate, placement & timing
            Why? NM on soybeans is controlling for P…

Given the same acreage…
A shift from double-crop to full-season soybeans will result in an increase in attributed N load.

CRITICAL CONCEPT:
N load attributed to soybean acres includes estimated leaching/runoff of residual N based on scientific literature review.

Ag Loading Rate Review Steering Committee
Agricultural Loading Rates

Model Assumption

Full Season (under Core NM):
Assume 40 bu/ac @ 100 ac

40 bu/ac x 0.12 lbs N/bu x 1.0 x 100 ac =

480 lbs N applied

Double-Crop
Assume 25 bu/ac @ 100 ac

25 bu/ac x 0 lbs N/bu x 1.0 x 100 ac

0 lbs N applied
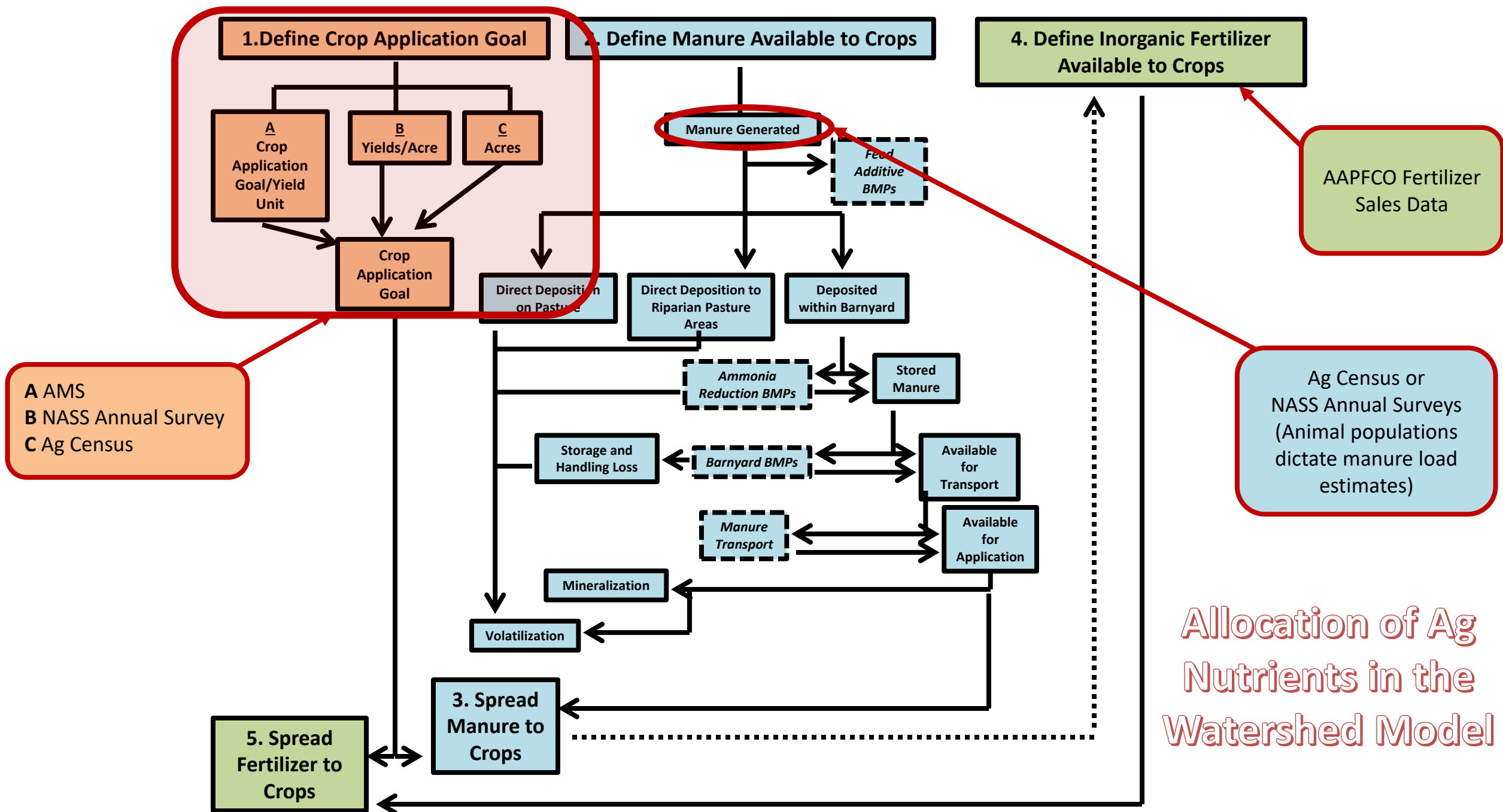
Soybean Crop Application Goal

Full Season Soybeans

- 0.12 lbs N/bu (~5.7 lbs N/ac)

- CBW Average: (~3.58 lb/N ac)

- UME, Penn State, VT recommend zero N application

Double Cropped Soybeans

- Zero N applications

- UME, Penn State, VT recommend zero N application

Assumption: "Nitrogen application is not recommended for soybean production, however, **use of commercially available fertilizer formulations may result in application of up to 50 lb N / acre when fertilizer formulation and application rate is determined by crop P2O5, K2O, S, or other nutrient needs**. Organic waste nitrogen application to full-season soybean is not recommended because it is an agronomically inefficient use of applied nutrients. Organic wastes should only be applied to small grain - double-crop soybean rotations at rates and timings to supply the recommended nitrogen rate to the small grain crop." – UME SFM-1

Allocation of Ag Nutrients in the Watershed Model

1. Define Crop Application Goal
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- B Yields/Acre
- C Acres
- Crop Application Goal

A AMS
B NASS Annual Survey
C Ag Census

2. Define Manure Available to Crops
- Manure Generated
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- Direct Deposition on Pasture
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- Deposited within Barnyard
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AMS= Agricultural Modeling Subcommittee

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Crop Application Goal on Major Crops

lbs of N/Year = State-Supplied lbs of N/Application Goal Yield Unit/Year X Yield/Year X 1.1*

Crop	DoubleCrop	Nutrient	Yield Unit	DE_1	MD_1	NY_1	PA_1	VA_1	WV_1
Alfalfa Hay Harvested Area	N	TN	dry tons	1	1	1	1	1	1
Alfalfa Hay Harvested Area	N	TP	dry tons	5	5	5	6	5	5
Corn for Grain Harvested Area	N	TN	bushels	0.92	0.92	0.92	0.92	0.92	0.92
Corn for Grain Harvested Area	N	TP	bushels	0.12	0.12	0.12	0.12	0.12	0.12
Corn for Grain Harvested Area	Y	TN	bushels	0.92	0.92	0.92	0.92	0.92	0.92
Corn for Grain Harvested Area	Y	TP	bushels	0.12	0.12	0.12	0.12	0.12	0.12
Wheat for Grain Harvested Area	N	TP	bushels	0.31	0.31	0.31	0.31	0.31	0.31
Wheat for Grain Harvested Area	N	TN	bushels	1.25	1.25	1	1	1.25	1.25
Wheat for Grain Harvested Area	Y	TP	bushels	0.465	0.465	0.465	0.465	0.465	0.465
Wheat for Grain Harvested Area	Y	TN	bushels	1.25	1.25	1	1	1.25	1.25
Pastureland and rangeland other than cropland and woodland pastured Area	N	TN	acres	15	15	15	15	15	15
Pastureland and rangeland other than cropland and woodland pastured Area	N	TP	acres	4	4	4	4	4	4
Soybeans for beans Harvested Area	**N**	**TN**	**bushels**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
Soybeans for beans Harvested Area	**N**	**TP**	**bushels**	**0.33**	**0.33**	**0.33**	**0.33**	**0.33**	**0.33**
Soybeans for beans Harvested Area	**Y**	**TN**	**bushels**	**0**	**0**	**0**	**0**	**0**	**0**
Soybeans for beans Harvested Area	**Y**	**TP**	**bushels**	**0**	**0**	**0**	**0**	**0**	**0**

Data provided by states after consultation with nutrient management program staff.

Chesapeake Bay Program Phase 6 Beta 3 Watershed Model Webinar
July 11, 2016

*AMS elected to multiply yearly yield by 1.1 assuming farmers are optimistic, and average yields are often under-estimated.

CRITICAL CONTEXT:
"Crop Application Goal" assumes Core NM is in place

Full Season Beans receive
0.12 lb N/bu
&
0.33 lb P/bu

Double Crop Beans
0 lb N/bu
&
0 lb P/bu

NM on full season beans is controlling/managing for phosphorus!

Application Goal Multipliers

Land Use	Non NM N Multiplier	NM N Multiplier	Non NM P Multiplier	NM P Multiplier
Full Season Soybeans	**1.2**	**1.0**	1.5	1.0
Grain with Manure	1.3	1.0	3	1.0
Grain without Manure	1.2	1.0	1.5	1.0
Legume Hay	1.2	1.0	1	1.0
Silage with Manure	1.4	1.0	3	1.0
Silage without Manure	1.2	1.0	1.5	1.0
Small Grains and Grains	1.2	1.0	1.5	1.0
Small Grains and Soybeans	1.2	1.0	1.5	1.0
Specialty Crop High	1.3	1.0	2	1.0
Specialty Crop Low	1.2	1.0	2	1.0
Other Agronomic Crops	1.1	1.0	1.5	1.0
Other Hay	1	1.0	1	1.0
Pasture	1	1.0	1	1.0

Data provided by Phase 6.0 Nutrient Management Expert Panel

Full Season Soybeans:
40 bu/ac @ 100 ac

Core NM:
40 bu/ac x 0.12 lbs N/bu x 1.0 x 100 ac =
480 lbs N applied
40 bu/ac x 0.33 lbs P/bu x 1.0 x 100 ac =
1,320 lbs P applied

Non NM:
40 bu/ac x 0.12 lbs N/ac x 1.2 x 100 ac =
570 lbs N applied
40 bu/ac x 0.33 lbs P/bu x 1.5 x 100 ac =
1,980 lbs P applied

CRITICAL CONCEPT:
Multipliers are applied to Crop Application Goal

NM Supplemental Percent Reductions
(Only after Core NM is applied)

Land Use	Nutrient Management BMP			Nutrient Management BMP		
	N Rate Supplemental	N Placement Supplemental	N Timing Supplemental	P Rate Supplemental	P Placement Supplemental	P Timing Supplemental
Full Season Soybeans	0%	0%	0%	5%	10%	1%
Grain w/ Manure	15%	5%	10%	10%	20%	20%
Grain w/o Manure	5%	3%	5%	5%	10%	1%
Legume Hay	0%	0%	0%	1%	10%	1%
Silage w/ Manure	15%	5%	10%	10%	20%	20%
Silage w/o Manure	5%	3%	5%	5%	10%	1%
Small Grains and Grains	5%	3%	10%	5%	10%	1%
Small Grains and Soybeans	5%	3%	10%	5%	10%	1%
Specialty Crop High	15%	5%	5%	5%	10%	1%
Specialty Crop Low	5%	3%	5%	5%	10%	1%
Other Agronomic Crops	5%	3%	5%	5%	10%	1%
Other Hay	0%	3%	5%	0%	10%	1%
Pasture	0%	0%	0%	0%	0%	0%

Data provided by Phase 6.0 Nutrient Management Expert Panel

CRITICAL CONCEPT:
Supplemental NM is applied to Edge of Stream Delivery

Next Steps

- Enjoy the next presentation on the double cropping method…

  - **Double Cropping** - There are unexpected effects from the current methodology. The method for determining double cropped acres and the crops that are matched with each other in a year should be reevaluated. In addition, there is an existing glitch that could be corrected by using a more robust way of determining the total vegetable acres.

- Future updates & discussion based on today's comments
  - Address NM on soybeans issue
    - *The Agriculture Workgroup will be asked to consider establishing a group to evaluate nutrient management BMPs for N on full season soybeans.*
      - *Thoughts?*
  - Invite problem solvers to propose ways to improve ag data sets

Recommendations for Chesapeake Bay Program Partnership Phase 6.0 Models

From Building a Better Bay Model: A Workshop for Agriculture Partners, May 22-23, 2013

Prioritized by the Agriculture Workgroup's Agricultural Modeling Subcommittee on September 12, 2013

Intended Activities

Priority	Task Category	Task	Line Reference in Detailed Recommendations Sheet
High Priority Tasks	Soils	Characterize how legacy nutrients (especially legacy P) impact nutrient losses from agricultural lands.	59,60,61,62
	Soils	Incorporate soil and nutrient content data into the next version of the Watershed Model. Soils test data is available in annual reports from Maryland and Deleware and in nutrient management plans.	55,56,58
	Manure	Collect and analyze data from industry sources on animal populations, manure and nutrients produced, and mortality rates to update Scenario Builder assumptions. Some sources include: Milk Processor Surveys; Dairy, Calves and Heifers Association; National Pork Board Environmental Committee; Pig Production Environmental Footprint Calculator; Iowa State University; Virginia Tech; Poultry Growers Association	33,34,35,36,38,39,42,44,51
Medium to High Priority Tasks	Manure	Investigate additional sources of data for manure nutrient content and application including: state extension publications; Gilmore and Gilmore, 1992; ASABE Standards; state laboratory results	32,37,39,41,43,46
	Manure	Track annual application of manure through state or other data rather than estimating manure production.	49
	Land Uses	Investigate loading rates for a number of land uses including AFO/CAFOs, trampled riparian pasture, nutrient management lands, etc.	18,19,26,30,31
	Yields	Consider replacing estimated yields with yearly yield values obtained from nutrient managemen plans or FSA individual farm records.	64,66
	Application	Analyze chemical fertilizer sales data from International Plant Nutrition Institute to estimate amount of fertilizer being applied.	15,17
	Land Uses	Investigate the use of more detailed land use information by using the Cropland Data Layer, USDA-FSA Common Land Units, and local land use data.	20,23,24,27,28,29
	Manure	Collect better litter, manure and biosolids transport data from the states and the industry to better understand how nutrients move around the watershed.	45,50,51
	Application	Analyze farmer surveys completed in Delaware and Maryland which describe biosolids, manure and fertilizer applied to crops.	3,4,15
	Yields	Consider modifying or eliminating the use of theoretical maximum nutrient uptake in Scenario Builder, and using solely local yield data to estimate crop need.	63,65
	Manure	Consider using annual NASS production data where possible to estimate animal populations	47,48
	Soils	Explore soil data for slope and permeability used in USDA-NRCS CEAP modeling.	57
	Land Uses	Compare land uses in the USDA-CEAP project to Watershed Model land uses.	22
	Land Uses	Consider creating a new set of land uses based off of USDA's CDSI land use list.	25
	Application	Investigate extension recommendations for the timing and rates of nutrient applications to crops.	1
	Soils	Investigate mineralization rates in soils and differences in rates between wet and dry years. This info is available from PSWMRU.	54
	Application	Investigate the use of nutrient management planning software such as Maryland's NUMAN or similar software being used at Purdue.	5
	Application	Determine crops that need manure and those that do not. Participants stated that some pasture forage types do not receive manure beyond direct deposition.	2

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https://www.chesapeakebay.net/who/group/agricultural_modeling_subcommittee --> https://www.chesapeakebay.net/channel_files/20763/agwg_ams_workshop_recommendations_and_tasks_092413.pdf
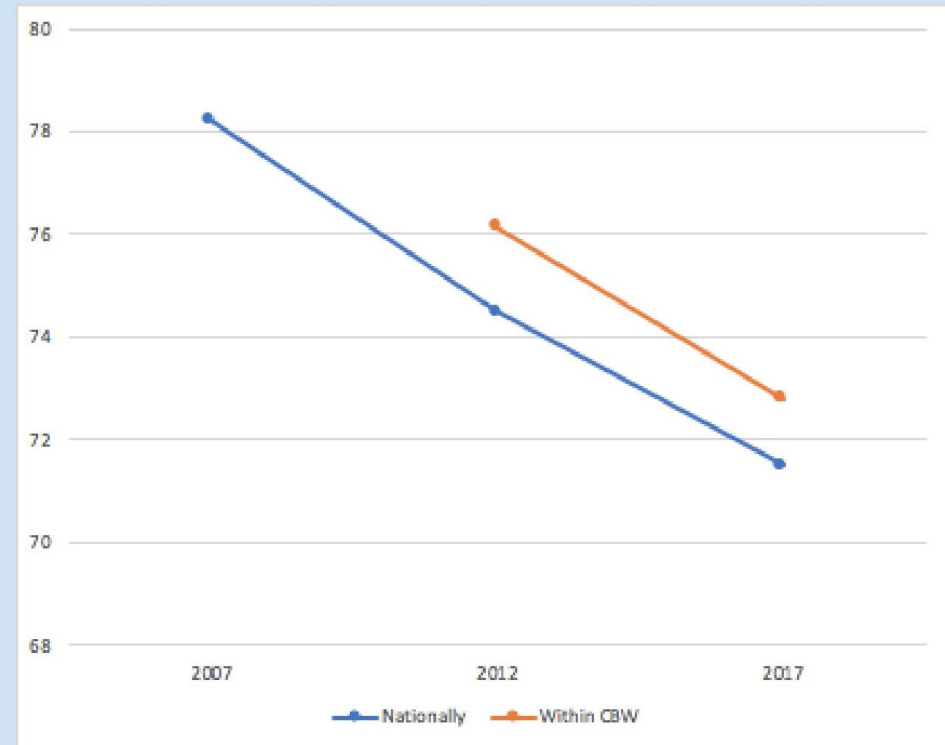
What/Who/When of the Ag Census?

AG Census Framework

- "Farm" Definition: "any place that produced and sold, or normally would have sold, **$1,000 or more** of agricultural products during the census year"

- Surveys can be completed online or mailed in

- AG Census data collected every five years

- NASS is bound by law to use the data for statistical purposes only.

- All data is kept confidential and are presented in aggregate form so that no individual operation or producer can be identified

https://www.chesapeakebay.net/channel_files/31803/ag_census_response_rate_presentation_2.pdf

Who Responds is the Ag Census?

Response Rates

- Sent to 3 million people in 2017

- Nearly 25% of responses were completed online

- National Response Rates:
  - 2017: 71.5%
  - 2012: 74.5%
  - 2007: 78.2%

- CBW Response Rates:
  - 2017: 72.8%
  - 2012: 76.15%

https://www.chesapeakebay.net/channel_files/31803/ag_census_response_rate_presentation_2.pdf

Manure Generation – Animal Populations

Animal Type	Population Source
Swine	Census of Agriculture (Inventory and Sales)
Layers and Pullets	Census of Agriculture (Inventory and Sales)
Broilers and Turkeys	NASS Annual Survey (Sales) Census of Agriculture (Inventory)
All Other Livestock	Census of Agriculture (Inventory)

Manure Generated

__Distribution of TOTAL__ statewide populations down to counties, regardless of population source, is based upon Census of Agriculture distribution to counties

CRITICAL CONCEPT

- Source of __TOTAL__ statewide populations will not change for Phase 6 Model.

- Source for __distribution__ of statewide populations can change.
  - Example: Pennsylvania provides fraction of cattle in every county for the year 2019, and these fractions are used to distribute TOTAL statewide cattle populations from the Census of Agriculture.