Recommendations to Estimate Poultry Nutrient Production in the Phase 6 Watershed Model

Report of the Agricultural Modeling Subcommittee to the Watershed Technical Workgroup

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Matt Johnston
University of Maryland Department of Environmental Science and Technology
Chesapeake Bay Program Non-Point Source Data Analyst

Photo courtesy of USDA-ARS

Data Sources

- **ASABE, 2003**. ASABE D384.1: Manure Production and Characteristics. February, 2003. American Society of Agricultural Engineers. St. Joseph, MI.
- **ASABE, 2005**. ASABE D384.2: Manure Production and Characteristics. March, 2005. American Society of Agricultural Engineers. St. Joseph, MI.
- **Malone, G.W. 2007**. Delmarva Poultry Litter Production Estimates. University of Delaware, Georgetown, DE. (http://extension.udel.edu/ag/files/2012/12/LitterQEst_MultiYear-as-of-2010.xls)
- **NASS, 2014**. Poultry Production and Value. United States Department of Agriculture's National Agricultural Statistics Service. Updated, April, 2014. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1130
- **NASS, Multiple Years**. Census of Agriculture. United States Department of Agriculture's National Agricultural Statistics Service. http://www.agcensus.usda.gov/.
- **NRCS, 2003.** Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans. United States Department of Agriculture's Natural Resources Conservation Service. June, 2003.
- **Gollehon, N., 2014.**Personal Communications re: Unpublished. 2014 Update to: Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients (published December, 2000). USDA NRCS Economic Research Service. August, 2014.

PLS- Results

- The PLS developed an alternative method to estimate poultry populations
- The PLS developed a method to allow states to annually update their litter generation and N&P concentrations
- However, these results cannot be utilized in the current Bay Model 5.3.2, rather are recommendations for the Bay Model Phase 6

PLS- Conclusions

- The PLS focused on updating and quantifying values to develop creditable estimates for concentrations, manure generation and population for each poultry type at the **state and regional scale**.
- Data suggests a **state/county difference** in the concentration of manure, manure generation, and each poultry type population
- Where data gaps exist in these parameters in any state or poultry type data the PLS recommends **default data be used**
- Concentrations: Utilize **annual average N & P concentrations for each state** based on samples from certified state and private labs
- Manure generation: Utilize **annual average litter mass data from each state** and relate it to the size of the bird produced (days of litter produced)
- Population: utilize the USDA-NASS annual production numbers for broilers and turkeys. However, there is insufficient NASS data for layers, breeders and pullets

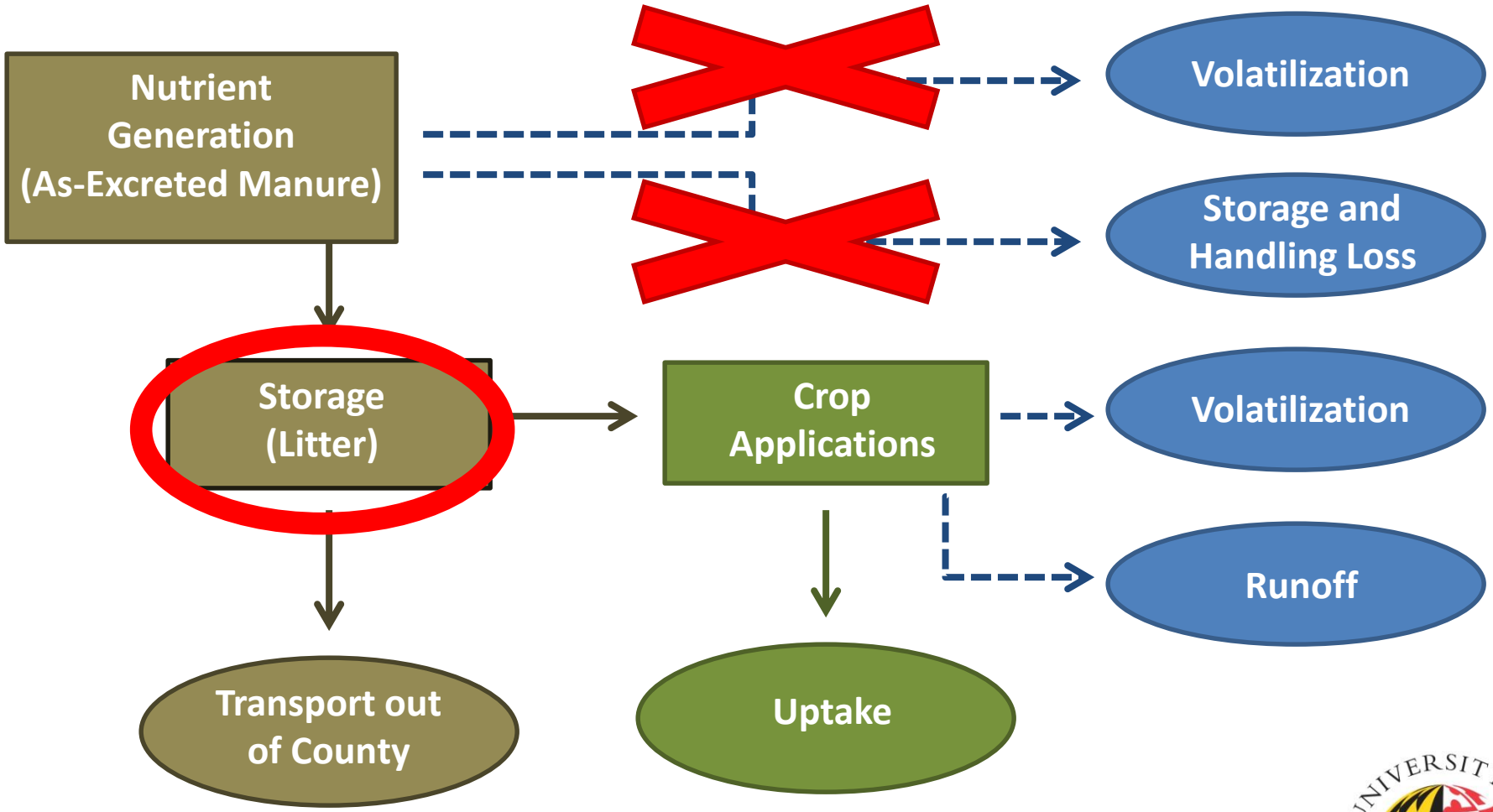
PLS- Recommendations

- The PLS will continue to pursue alternative methods to better quantify the data utilized in the Bay Model
- The PLS will continue to work with the poultry industry to quantify how the changes in feed formulas, genetics, phytase amendments, and litter management impact the litter volume and nutrient concentration

PLS- Recommendations

- Suggestions:
  - Need county scale bird populations including:
    - Layers, breeders, and pullets
    - Turkey hens and toms
  - Need average live bird weight at county scales
  - Need mass of litter or manure produced for all poultry types
  - Need concentration values of N & P for all poultry types

Estimating Poultry Nutrients



Difference between As-Excreted Manure and Poultry Litter

- "…Recoverability can be interpreted as the amount of as-excreted manure or nutrients left in litter to be made available to crops after all storage and handling losses and volatilization has occurred. As-excreted manure values cannot be compared to litter values without first applying estimates of recoverability…"

Importance of Recoverability Factors

Table B–3 Manure recoverability factors and nutrient recovery parameters used to estimate manure nutrients available for application for fattened cattle, milk cows, veal, confined heifers, swine, chickens, and turkeys—Continued

Livestock type and region	Size class (AU)	Representative farm (RF)	Probability (%)	Before CNMPs			After CNMPs		
				Proportion of manure that is recoverable	Proportion of N retained in recoverable manure	Proportion of P retained in recoverable manure	Proportion of manure that is recoverable	Proportion of N retained in recoverable manure	Proportion of P retained in recoverable manure
		RF #2: flush system with lagoon	48	0.80	0.35	0.90	0.95	0.25	0.90
West	35-400	RF #1: shallow pit, ground level	49	0.75	0.80	0.90	0.95	0.80	0.90
		RF #3: scraper system	51	0.75	0.60	0.95	0.95	0.60	0.95
	> 400	RF #1: high rise, pit at ground level	18	0.75	0.60	0.95	0.95	0.60	0.95
		RF #3: manure belt	14	0.75	0.60	0.95	0.95	0.60	0.95
		RF #3: scraper system	68	0.75	0.55	0.95	0.95	0.55	0.95
South Central	35-400	RF #1: shallow pit, ground level	45	0.75	0.80	0.90	0.95	0.80	0.90
		RF #3: scraper system	55	0.75	0.55	0.95	0.95	0.55	0.95
	> 400	RF #2: flush system with lagoon	100	0.80	0.25	0.90	0.95	0.25	0.90
North Central & Northeast	35-400	RF #1: high rise, pit at ground level	55	0.85	0.70	0.95	0.95	0.70	0.95
		RF #1: shallow pit, ground level	25	0.85	0.85	0.90	0.95	0.85	0.90
		RF #3: manure belt	20	0.85	0.70	0.95	0.95	0.70	0.95
	>400	RF #1: high rise, pit at ground level	81	0.85	0.70	0.95	0.95	0.70	0.95
		RF #3: manure belt	19	0.85	0.70	0.95	0.95	0.70	0.95
Pullets									
North central & Northeast	All	RF #1: layer-type confinement houses	100	0.85	0.70	0.90	0.95	0.70	0.90
Southeast	All	RF #1: layer-type confinement houses	100	0.80	0.60	0.90	0.95	0.60	0.90
West	All	RF #1: layer-type confinement houses	100	0.80	0.55	0.90	0.95	0.55	0.90
South Central	All	RF #1: layer-type confinement houses	100	0.80	0.55	0.90	0.95	0.55	0.90
Turkeys									
All Regions	<35	RF #2: turkey ranch	100	0.45	0.60	0.75	0.50	0.60	0.75
East	>35	RF #1: confinement houses	90	0.80	0.60	0.95	0.98	0.60	0.95
		RF #2: turkey ranch	10	0.45	0.60	0.75	0.50	0.60	0.75
South Central	>35	RF #1: confinement houses	100	0.80	0.55	0.95	0.98	0.55	0.95
North central	>35	RF #1: confinement	90	0.80	0.65	0.95	0.98	0.65	0.95

- Recoverability factors determine how much as-excreted manure is available to runoff from the barnyard.
- Recoverability can be improved by implementing BMPs.
- Recoverability factors should be fully reviewed by AMS, AWMS Panel and Ag Workgroup

Equation 1. Poultry Phosphorus Production Based on Litter

(Used for Broilers)

Lbs of P/Year = (Lbs of Litter/Bird Produced)
X (Lbs of Dry Matter/Lb of Litter)
X (Lbs of P/Lb of Dry Matter)
X (Birds Produced/Year)

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Equation 2. Poultry Phosphorus Production Based on As-Excreted Manure

(Used for Pullets)

Lbs of P/Year = (Lbs of As-Excreted Manure/Bird Produced)
X (Lbs of Manure Recovered/Lbs of As-Excreted Manure)
X (Lbs of Dry Matter/Lb of Manure Recovered)
X (Lbs of P/Lb of Dry Matter)
X (Lbs of Recoverable P/Lb of P)
X (Birds Produced/Year)

Equation 3. Poultry Phosphorus Production Based on As-Excreted Manure with Litter Concentrations

(Used for Turkeys and Layers)

Lbs of P/Year = (Lbs of As-Excreted Manure/Bird Produced)
X (Lbs of Manure Recovered/Lbs of As-Excreted Manure)
X (Lbs of Dry Matter/Lb of Manure Recovered)
X (Lbs of P/Lb of Dry Matter)
X (Birds Produced/Year)

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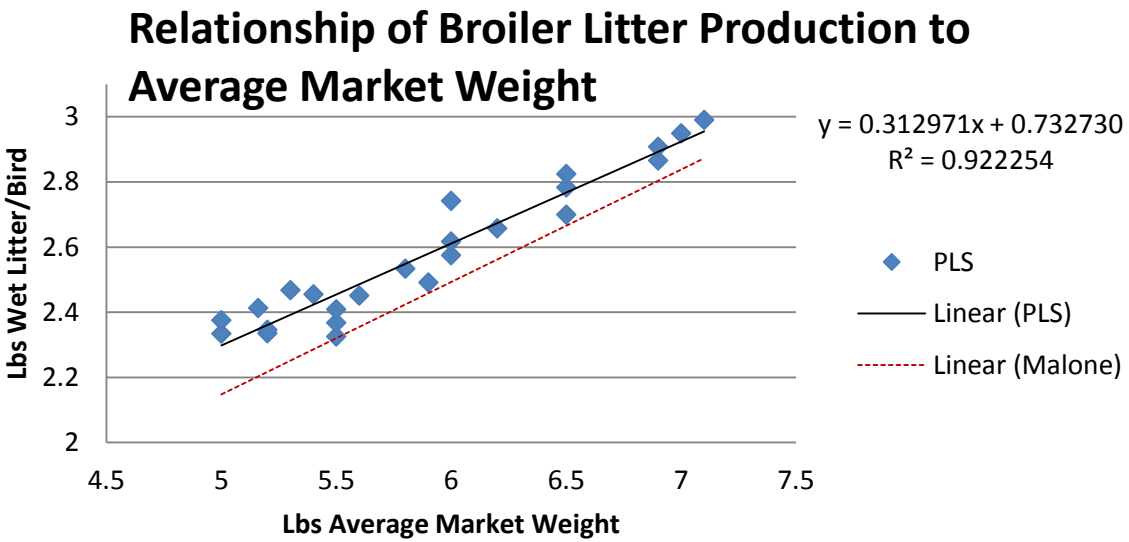
Litter (or Manure) Produced



- Broiler litter production can be estimated based upon average market weight.

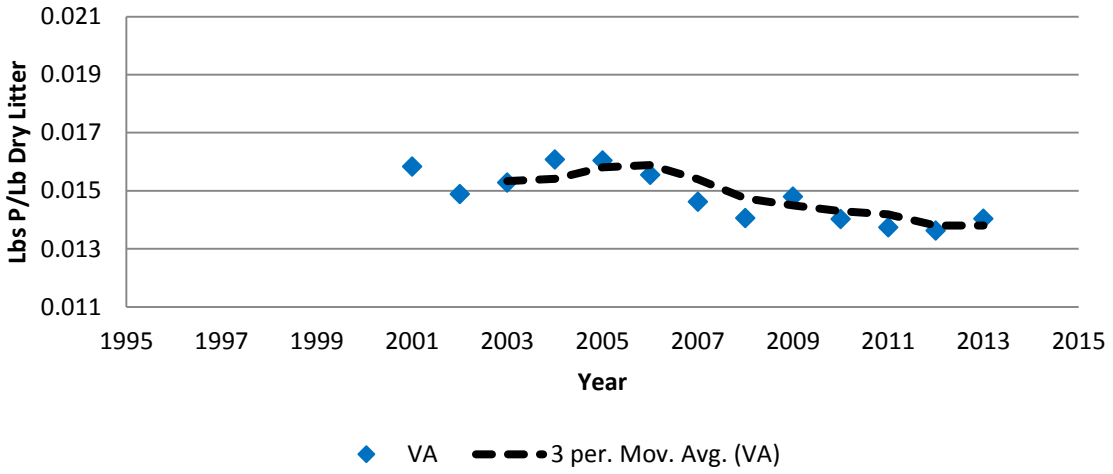
• Turkey, Pullet and Layer as-excreted manure production was taken from ASABE sources.

• These as-excreted values must be combined with estimates of manure lost in the barnyard prior to storage using recoverability factors from USDA.

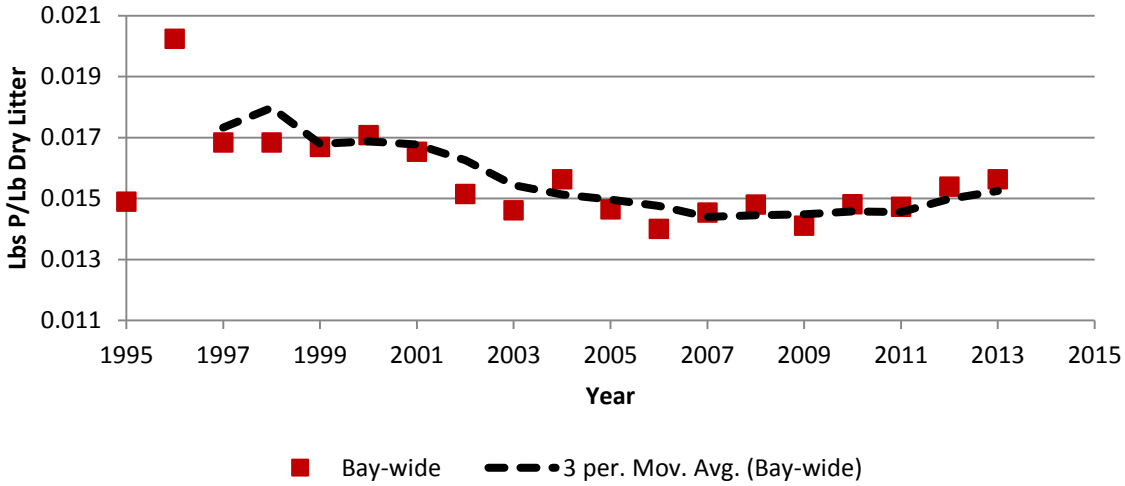
• Recoverability factors will be subject to change for all livestock based upon recommendations from the AMS and the AWMS expert panel.

Nutrient Concentrations

VA Lbs P/Lb Dry Litter for Broilers



Bay-Wide Lbs P/Lb Dry Litter for Broilers (to be used by NY, PA)



- Sample years: Use 3-year moving average

- 1985 through first sample year: Use first moving average point

- Last sample year forward: Use last moving average point

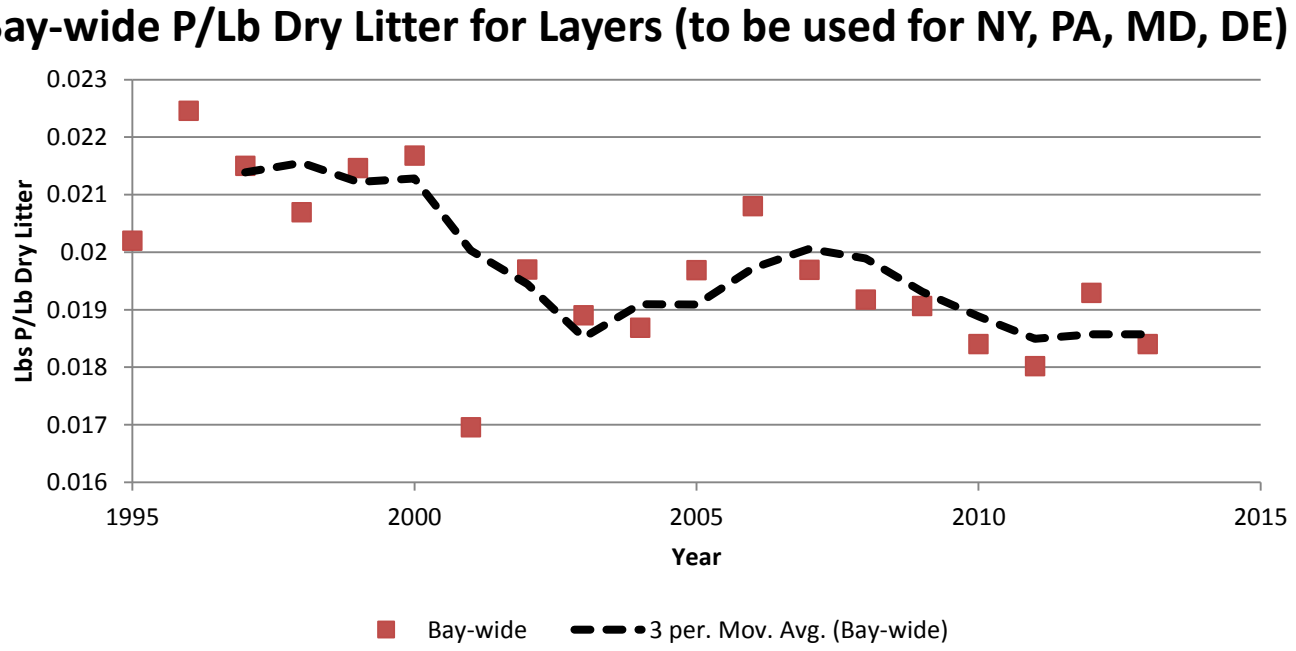
- States should submit sample data each year

- If no sample data is collected, state receives Bay-wide average

More about Concentrations…

- Data not collected for pullets, so ASABE must be used.

- AMS recommends applying yearly change in layer concentrations for P to the ASABE estimates for pullets.



Populations

Broiler Production and Value – States, United States, and 19 State Total: 2013

[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	1,048,600	5,872,200	3,558,553
Arkansas	996,400	5,978,400	3,622,910
Delaware	215,600	1,530,800	927,665
Florida	64,400	392,800	238,037
Georgia	1,334,600	7,607,200	4,609,963
Kentucky	309,000	1,668,600	1,011,172
Maryland	305,200	1,617,600	980,266
Minnesota	48,100	283,800	171,983
Mississippi	734,000	4,477,400	2,713,304
Missouri	277,400	1,331,500	806,889
North Carolina	785,500	5,891,300	3,570,128
Ohio	70,100	406,600	246,400
Oklahoma	206,200	1,360,900	824,705
Pennsylvania	168,800	945,300	572,852
South Carolina	226,500	1,585,500	960,813
Tennessee	172,800	898,600	544,552
Texas	610,100	3,599,600	2,181,358
Virginia	249,600	1,347,800	816,767
West Virginia	96,800	387,200	234,643
Wisconsin	53,100	223,000	135,138
Other States [1]	552,000	3,220,600	1,951,683
United States	8,524,800	50,626,700	30,679,781
19 State Total [2]	8,222,700	49,008,600	29,699,212

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

[2] States in the 19 State Total include Alabama, Arkansas, California, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Missouri, Mississippi, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

- NASS provides yearly production values for turkeys and broilers. Production can be assumed to represent total population.

USDA Bird Production Estimates

Birds Produced/Year = (Year-End Inventoried Birds X 1/Cycles of Birds per Year) + [(Annual Birds Sold/Cycles of Birds per Year) X ((Cycles of Birds per Year-1)/Cycles of Birds per Year)]

- USDA estimates 1 cycle of layers produced per operator per year; this means that inventory from Ag Census can be used to estimate population.
- USDA estimates that 2.25 cycles of pullets are produced per operator per year.

Results and Updates

Appendix B. Nutrients Produced Per Bird

Broilers

DE	Average Lbs Market Weight/Bird	Wet Lbs Litter/Bird	Dry Lbs/Lb Wet Litter	Dry Lbs Litter/Bird	Lbs P/Dry Lb of Litter	Lbs P/Bird	Lbs N/Dry Lb Litter	Lbs N/Bird
1985	4.799999	2.267338	0.713500	1.617745	0.018336	0.029663	0.046215	0.074765
1986	4.799998	2.267337	0.713500	1.617745	0.018336	0.029663	0.046215	0.074765
1987	4.997618	2.330518	0.713500	1.662825	0.018336	0.030489	0.046215	0.076848
1988	5.000000	2.331280	0.713500	1.663368	0.018336	0.030499	0.046215	0.076873
1989	5.000000	2.331280	0.713500	1.663368	0.018336	0.030499	0.046215	0.076873
1990	5.000000	2.331280	0.713500	1.663368	0.018336	0.030499	0.046215	0.076873
1991	5.100000	2.363251	0.713500	1.686180	0.018336	0.030918	0.046215	0.077927
1992	5.100000	2.363251	0.713500	1.686180	0.018336	0.030918	0.046215	0.077927
1993	5.100000	2.363251	0.713500	1.686180	0.018336	0.030918	0.046215	0.077927
1994	5.300039	2.427205	0.713500	1.731811	0.018336	0.031754	0.046215	0.080036
1995	5.299886	2.427157	0.713500	1.731776	0.018336	0.031754	0.046215	0.080035
1996	5.500000	2.491135	0.713500	1.777425	0.018336	0.032591	0.046215	0.082144
1997	5.500195	2.491197	0.713500	1.777469	0.018336	0.032592	0.046215	0.082146
1998	5.500000	2.491135	0.713500	1.777425	0.018336	0.032591	0.046215	0.082144
1999	5.599921	2.523081	0.713500	1.800218	0.018336	0.033009	0.046215	0.083198
2000	5.899879	2.618980	0.713500	1.868642	0.018336	0.034263	0.046215	0.086360
2001	5.800155	2.587098	0.713500	1.845894	0.018354	0.033879	0.044284	0.081744
2002	6.000000	2.650990	0.713500	1.891481	0.017213	0.032559	0.042818	0.080990
2003	6.000000	2.650990	0.713500	1.891481	0.015728	0.029749	0.043513	0.082305
2004	6.199834	2.714879	0.713500	1.937066	0.014412	0.027918	0.041786	0.080942
2005	6.500000	2.810845	0.713500	2.005538	0.013724	0.027524	0.041782	0.083795
2006	6.600000	2.842816	0.713500	2.028349	0.013538	0.027461	0.040294	0.081730
2007	6.500000	2.810845	0.713500	2.005538	0.013689	0.027454	0.040669	0.081564
2008	6.500206	2.810911	0.713500	2.005585	0.014122	0.028324	0.040363	0.080952
2009	6.905832	2.940593	0.713500	2.098113	0.014346	0.030100	0.039897	0.083709
2010	6.939795	2.951452	0.713500	2.105861	0.014744	0.031048	0.040236	0.084731
2011	7.000000	2.970700	0.713500	2.119594	0.014830	0.031435	0.040236	0.085284
2012	7.100000	3.002671	0.713500	2.142406	0.015704	0.033643	0.041000	0.087839
2013	7.100186	3.002730	0.713500	2.142448	0.015826	0.033907	0.042545	0.091150

- Appendix B has results by bird type, state and year.
- Results will be used in initial, October, 2015 Phase 6 calibration.
- Results will replace automatic phytase BMP in Phase 6. BMP will still be available for planning.
- New data can be collected to update tables prior to September, 2015.
- New data can be collected prior to final Phase 6 calibration in Fall, 2016.

Submitting New Data

- "… The AMS recommends that raw sample data for each parameter be submitted to the Bay Program using standardized templates… Ultimately, the Partnership will need to determine both the method and frequency of collecting and updating these values…"

- These standardized templates should be provided by Ag Workgroup.

Next Steps

- Ag Workgroup approved report in March.
- Water Quality GIT reviewing report for April 13 face-to-face meeting.
  - Report available at: http://www.chesapeakebay.net/S=0/calendar/event/22315/.
  - Please provide any comments to Water Quality GIT representative ahead of April 13 meeting.

Questions?

Photo courtesy of Chesapeake Bay Program