

Phosphorus Concentration in Agricultural Runoff

Lauren Hutchison
Environmental Studies and Sustainability,
The University of the South
Mentors: Dr. Deborah McGrath and Dr. Keri Watson

There are several factors that need to be monitored to fully understand agricultural contributions to environmental degradation as well as the effectiveness of implementing sustainable practices. This study did so by sampling cow ponds from different locations in northern Virginia with different cattle exclusion methods to evaluate the phosphorus levels in each aquatic system.

Problem Statement and Objectives: Agriculture has been attributed to the problem of the declining health of the Chesapeake Bay, but it is still unclear as to the degree that current agricultural practices in the region contribute. The goal of this study is to examine various agricultural ponds, all of which are within or of close proximity to cow pastures. The study will examine both the levels of phosphorus found in these aquatic systems to determine if they currently align with the EPA recommendations while also considering the effectiveness of cattle exclusion practices taken by farmers.



METHODS

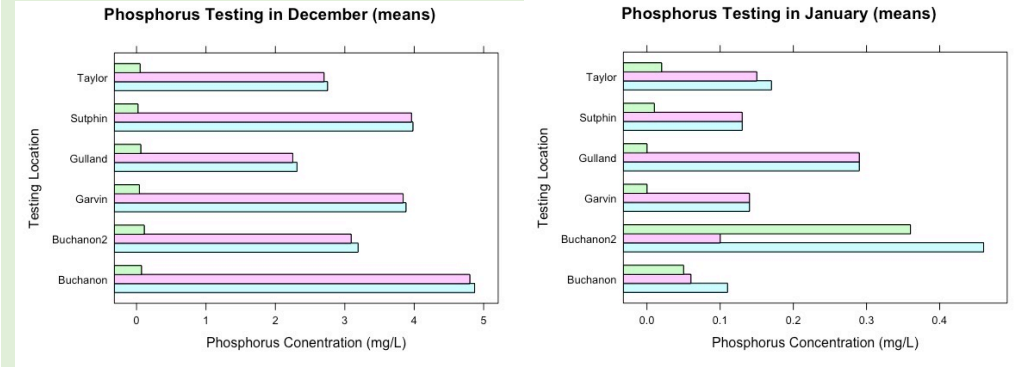
- Cow ponds were identified, and permission was given to take samples from in the Northern Virginia area
- Cow pond samples were taken at two different times, once in December 2021 and once in January 2022
- Three samples were taken at each pond during each round of sampling
- The conditions of the site were taken, including stream exclusion practices that were currently in place
- They were brought back to Sewanee to then be testing using a reactive phosphate method in Dr. Deborah McGrath's lab
- The data from both rounds of testing were then used to conduct an ANOVA statistical test to determine if there were any statistically significant values
- The total P from each testing site was compared to the EPA recommendations regarding healthy levels of P in aquatic systems

DATA

location	total P (dec)	organic P (dec)	inorganic P (dec)	total P (jan)	organic P (jan)	inorganic P (jan)	number of cows	acreage
Garvin	6.62	6.57	0.05	0.0408	0.0383	0.003	30	12.1
Garvin	3.7	3.65	0.06	0.2436	0.237	0.007	30	12.1
Garvin	1.31	1.29	0.02	0.1482	0.1473	0.001	30	12.1
Sutphin	5.45	5.44	0.01	0.0587	0.057	0.002	0	19.31
Sutphin	5.45	5.41	0.04	0.172	0.1712	0.001	0	19.31
Sutphin	1.04	1.02	0.03	0.172	0.1578	0.014	0	19.31
Buchanon	4.52	4.46	0.07	0.0706	0.0213	0.049	1200	38
Buchanon	5.08	5.04	0.04	0.3212	0.2878	0.033	1200	38
Buchanon	5.01	4.9	0.1	-0.0667	-0.1218	0.055	1200	38
Buchanon2	2.95	2.83	0.12	0.4525	0.1051	0.347	1200	38
Buchanon2	2.66	2.54	0.12	0.3809	0.0034	0.377	1200	38
Buchanon2	3.97	3.88	0.09	0.536	0.1819	0.354	1200	38
Taylor	1.66	1.61	0.05	0.1303	0.1119	0.018	5	33.82
Taylor	3.65	3.6	0.05	0.178	0.1463	0.032	5	33.82
Taylor	2.93	2.88	0.06	0.2138	0.1929	0.021	5	33.82
Gulland	4.58	4.53	0.05	0.4525	0.4558	-0.003	110	55.8
Gulland	1.19	1.1	0.09	0.1362	0.1337	0.003	110	55.8
Gulland	1.17	1.12	0.04	0.2675	0.2725	-0.005	110	55.8

LOCATION	CATTLE EXCLUSION PRACTICES	DESCRIPTION
Garvin	Yes	Electric fence surrounding pond
Sutphin	Yes	Pasture fenced off from pond
Buchanon	Yes	Pasture fenced off from pond
Buchanon2	Yes	Pasture fenced off from pond
Taylor	No	Direct access to pond from inside pasture
Gulland	Yes	Fenced off pond including vegetated buffer area

EPA recommendation for phosphorus levels in water: .025 mg/L



Total P = Blue, Organic P = Pink, Inorganic P = Green

Significant P Values from ANOVA Test:

December:

Garvin: Buchanon2
Sutphin: Buchanon2

January:

Buchanan: Buchanon2
Garvin: Buchanon
Gulland: Buchanon
Sutphin: Buchanon
Gulland: Buchanon2
Taylor: Gulland
Garvin: Buchanon2
Sutphin: Buchanon2
Taylor: Buchanon2

** values that repeat are in bold**

Through comparing these sites, there were conclusions shown through a statistical analysis to summarize both the current health of agricultural ponds compared to government recommended criteria and the effectiveness of varying forms of clean water practices. There was also statistical significance shown through some of the locations, which provided partial credibility to the efficiency of clean water practices. These studies are important to both the overall issue of clean water in agricultural industry regions as well as the specific situation of Virginia agricultural practices. Currently under a voluntary stream exclusion program, there is potential for mandates to be put in place without a shown improvement in water quality by 2025. Taking progression measurements into consideration it is clear that there is still a way to go to meet federal satisfaction. This study opens up the door for future research regarding the progress of clean water restoration efforts as well as the monitoring of agricultural impacts on overall regional water quality.