ABSTRACT

Title of Document: DOES THE POLICY-MAKING PROCESS AFFECT FARMER COMPLIANCE? A THREE-STATE CASE STUDY OF NUTRIENT MANAGEMENT REGULATIONS

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A series of fishkills in 1997 in the Chesapeake Bay were linked to *Pfiesteria piscicida*, a rare toxic microorganism, and to nutrient pollution from agricultural sources. Manure from poultry production on the Delmarva Peninsula was regarded as the primary source of the excess nutrients. These fishkills served as a focusing event for policy-makers in Maryland, Virginia, and Delaware to update their scientific guidance on phosphorus management, promulgate agricultural regulations, and depart from decades of relying on voluntary technical and financial assistance to improve farm-related water quality problems.

This dissertation conducts a comparative case study of these three states to determine if 1) the policy-making process in each state affects compliance by farmers and 2) if the laws improved farmer nutrient management behavior. Data sources include information gathered from interviews with 60 corn farmers on the Peninsula that use broiler chicken manure as fertilizer; interviews with over 60 policy

stakeholders; and reviews of primary and secondary documents. Analytical methods include: political analysis of the main stages of the policy development process; policy analysis of the effectiveness of plan-based regulations; statistical tests to determine significant differences between states regarding farmer responses to Likert Opinion Statements and questions about their nutrient management practices; logit regression analysis to determine factors influential to low manure application rates; and a review of compliance data collected by the state regulatory agencies.

Answers to both research questions are, overall, “yes,” though this answer depends on which dataset of compliance and which metric of improved nutrient management behavior is reviewed; there are “no” answers as well. Results of this dissertation highlight the serious difficulty of regulating dispersed nonpoint source agricultural nutrient pollution through nutrient management plans. Several findings arise, including: plan-based agricultural regulations are in reality voluntary; plans prepared by private and public sector planners result in non-uniform standards; gaining “buy-in” from rather than “alienating” the regulated community likely results in better overall outcomes; regulations that account for on-the-ground realities of farming and state regulatory capacity likely achieve better overall outcomes; and focusing events that turn out to be weak can undermine the justification for new regulatory policies.

DOES THE POLICY-MAKING PROCESS AFFECT FARMER COMPLIANCE? A THREE-STATE CASE STUDY OF NUTRIENT MANAGEMENT REGULATIONS

By

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Dissertation submitted to the Faculty of the Graduate School of the
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Dedication

This dissertation is dedicated to the many members of the agricultural and environmental communities; may it help improve the effectiveness of future agricultural-environmental policies.

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Finally, thank you to my family and friends who kept me going and assured me there was light at the end of the tunnel: my mother, Nancy Perez; my father, Dr. Tony Perez; my brother, Jonathan Perez; my best friends, Cheri Love and Julia Postolov Kantor; and the Chair of the PhD Shriekers: Sally Wengrover. Finally to my step-daughter, Anna Claire Loper and to my husband, Joe William Loper the V, thank you for your love and support through this journey.

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SUMMARY

1. Introduction

Agriculture is one of the largest sources of nutrient pollution causing impairment of the Chesapeake Bay and other waters of the nation. Due to the widely dispersed nature of nonpoint source agricultural nutrient pollution, and the political, cultural, and economic challenges of regulating farmers, governments have largely relied on a voluntary technical and financial assistance approach to reduce farm pollution.

However, three states – Maryland, Delaware, and Virginia – decided to regulate farmers via nutrient management plans after a series of fishkills occurred in 1997 in the waters off the eastern shore of the Chesapeake Bay. The states had very different problem diagnosis, policy development, and implementation stages. This dissertation employs a comparative and case study approach to examine whether the regulatory policy-making process affects farmer compliance and if the laws have improved nutrient management behavior. This summary provides brief highlights of the dissertation.

2. Problem Definition

The 1997 fishkill events in the eastern shores of the Chesapeake Bay that drain the Delmarva Peninsula were linked with the rare and little-understood toxic microorganism called *Pfiesteria piscicida*. Fishkills and *Pfiesteria* are associated with excess nitrogen and phosphorus pollution from commercial fertilizers, animal manures, wastewater treatment facilities, and urban and suburban runoff. Because the dominant land-use on the Delmarva Peninsula is row crop farming and poultry production and the long-time concern about excess poultry manure, agricultural sources were identified at the time as the leading cause of the fishkills.

Among the policy issues discussed in this dissertation is the view that a voluntary approach to reducing farm pollution, which involves providing farmers with educational materials and events, one-on-one technical assistance, and cost-share to help pay for management and structural practices, was inadequate to achieve the level of farmer participation necessary to yield major pollution reductions.

3. Research Questions and Methods

This dissertation asked two research questions:

1) Did the regulatory policy development process of nutrient management regulations in Maryland, Virginia, and Delaware in response to the 1997 *Pfiesteria* events affect the rate of farmer compliance?
2) Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva Peninsula?

I obtained both quantitative and qualitative data from interviews with over 60 farmers and 60 stakeholders. To reduce variability between farmers and between states, I only included farmers on the Delmarva Peninsula who grew corn and used poultry manure as a fertilizer source. I interviewed 30 farmers from Maryland, 20 farmers from Delaware, and 10 farmers from Virginia. Policy stakeholders were chosen because they were involved in policy-development or policy-implementation (see Appendix A for a list of stakeholders). In addition, I administered a 26-item Likert Opinion Statement survey, analyzed eight years of compliance data from each state's regulatory agency, and reviewed primary and secondary documents.

4. How the State Policy-Making Processes were Different

Before answering the research questions, the dissertation establishes that several important aspects of the policy-making process in each state were indeed different, while other elements of the regulatory process were similar.

Table 1. Summary of Key Policy-Making Process Elements in each State

	Maryland	**Delaware**	**Virginia**
Political Style	Contentious	Collaborative	Negotiated
Chesapeake Bay Environmental Culture	Very Strong	Limited	Limited
Problem Diagnosis	Saddled with diagnosing *Pfiesteria*	Skipped diagnosis	Took a "go slow" approach
Policy Deliberations	Dominated by environmental stakeholders and internal pressures	Dominated by agricultural stakeholders and external pressures	Agricultural stakeholders had an edge; motivated by internal pressures
Requirements	“All” farmers need plans + 4 practices (Eligible farmers started at 16,000; in 2008: 5,902)	“All” farmers need plans + 2 practices (Eligible farmers started at 6,775; in 2008: 1,158)	Poultry growers[1] need plans + 8 practices (Eligible growers started at 1,309; in 2008: 894)
Educational Requirements	A 2-hour nutrient application voucher training every 3 years	6 hours of continuing educational events every 3 years	None
Requirement for Poultry Integrators	Required to use *phytase* in chicken feed and pay 50% of manure transport program	Support growers to comply with the law through technical and financial assistance	
Phosphorus-Poultry Manure Policy	Phosphorus Site Index required on fields with “Excessive” P values	3-year phosphorus crop removal policy	Several options depending on location
Implementation Schedule	1st deadline 3.5 years after law enacted caused major implementation problems	1st deadline 3.5 years after law enacted but only 20% had to comply each year over 5 years; was easily implemented	1st deadline nearly 3 years after law enacted; was easily implemented

[1] Virginia poultry growers with more than 20,000 chickens or 10,000 turkeys were required to obtain a Virginia Pollution Abatement permit.

Enforcement Approach	All three states used a "compliance assistance" approach "to bring farmers into compliance" and rarely levied penalties		
Inspection Rate	7 to 16% n=500 to 1,100 (Started in 2005)	1 to 6% n=8 to 21 (Started in 2003)	69 to 93% n= 713 to 962[2] (Started in 2001)
Cost-Share Available	For nutrient management plans and for manure transport		For NM plans but very limited support for manure transport
For more details, see Chapter 4 for a discussion about each state's political and environmental culture; see Chapter 5 for a chronological presentation of the policy responses in each state to the *Pfiesteria* focusing events and 14 Likert Opinion Statements revealing farmer opinions about their state's policy process; and see Chapter 6 for data and analysis regarding state agency inspection efforts and estimates of compliance and enforcement approaches. And for an analysis on each state's capacity to regulate farmers and design effective policies to reduce agricultural nutrient pollution, see Chapter 9.			

According to responses to the Likert Opinion Statements, the majority of farmers in Maryland and Virginia felt that "farmers did not have an equal seat at their state's policy-making table," the "state focused more on farmers obtaining the required plans rather than on educating farmers," and their "state law is not justified." In contrast, the majority of Delaware farmers felt they did have an "equal seat," education was an important focus of their state law, and the law is justified.

5. Answering the Research Questions

One key finding of this dissertation was how difficult it is to determine compliance with agricultural nutrient management plan regulations. Because the required nutrient management plans are prepared by both private-sector and public-sector planners, the regulatory standards in each plan may be different and thus adherence to a plan may actually represent different levels of nutrient management. Comparing state regulatory

[2] Virginia's inspection rate includes non-poultry growers (about 150 dairy, swine, and beef operations) that are also regulated by the Virginia Pollution Abatement (VPA) permit for confined animal operations. The inspection rates and number provided in Table 1 are from 2007 and 2008.

agency compliance data is difficult because state deadlines and regulatory requirements are different, and states conduct different levels of inspections and provide different sets of compliance data. In addition, there are many forms of compliance such as "administrative" compliance (possession or submission of the required plan and/or annual reports) and "adherence" compliance (following the nutrient application recommendations in the plan or other required best management practices), which can paint a conflicting picture of the overall level compliance in each state. I also found it difficult to quantify compliance given the "social desirability problem" of asking farmers questions about their adherence to their state law.

I amassed multiple sets of metrics for compliance and conclude that, overall, "yes," the policy-making process in each state did affect farmer compliance rates, and "yes," the laws have improved farmer nutrient management behavior. However, there are "no" answers to these research questions as well, depending on the dataset.

Answers to Research Question 1

(1) My analysis of state regulatory agency datasets is summarized in tabular format in Table 2 below. Data included in this table reflect that there is a difference in the administrative and adherence compliance rates, as well as a difference in the inspection rates conducted by the states.

Table 2. Summary of Key Compliance Rates from Each State's Regulatory Agency			
State Regulatory Agency Datasets	**Maryland 1998 Water Quality Improvement Act**	**Delaware 1999 Nutrient Management Law**	**Virginia 1999 Poultry Waste Law**
# Regulated Farmers in 2008	n=5,902	n=1,158	n=894 poultry growers
First Administrative Compliance Rate	By 2001 deadline, 30% filed NM Plans and 60% filed Justification for Delay forms	By 2003 deadline, 40% of the eligible acres[3] were covered by NM Plans when only 20% were required to be	By 2001 deadline, likely[4] nearly 100% of eligible growers filed NM Plans
2008 Administrative Compliance	98% had NM Plans and 99% submitted Annual Implementation Reports	70% of eligible acres had NM Plans while only 38% of the expected 1,158 Annual Reports were submitted	Likely[5] near 100% had NM Plans
2008 Inspection Rates	8% n=450 of 5,902	2% n=25 of 1,158	93% n=962 of 1,040 permitted operations
2008 Adherence Compliance Rates	65% n=158 of 450	84% n=21 of 25[6]	88% n=843 of 962
For more details, see Chapter 6 for data and analysis of state agency inspection effort, estimates of compliance and enforcement approaches.			

(2) Responses to three key Likert Opinion Statements showed statistically significant differences between states in that the majority of Maryland and Virginia farmers reported a) they would not be "satisfied with their crop harvest if they strictly followed plan," b) their "plan's nutrient recommendation rates are too conservative," and c) their "regulations are too strict." In contrast, the majority of Delaware farmers reported that

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[3] Delaware has never published the number or percentage of the 1,158 eligible farmers that are in compliance with possessing a nutrient management plan. Instead, Delaware publishes the number of acres in compliance. Given there are an estimated 480,000 eligible acres in Delaware, I calculated the percentage of acres in compliance.
[4] I use the term "likely" here because the compliance rate was provided by policy stakeholders, as staff at the Virginia regulatory agencies were unable to provide the compliance rates for the first deadline.
[5] I use the term "likely" here because Virginia does not report compliance data by animal type.
[6] This 2008 on-farm audit compliance rate was determined from data provided upon request from the Delaware Nutrient Management Commission.

they would be satisfied if they followed their plan; their recommendations were not too conservative and the regulations were not too strict.

Delaware farmers' positive opinions about their state's policy-making processes may influence their positive opinions about their plans and their regulations, but complicating factors include that Delaware also requires the fewest additional best management practices, conducts the lowest rate of inspections, and most Delaware farmers receive cost-share funding to hire private-sector planners. Smith (1999) and Lawley et al. (2007) found that private-sector planners are more likely to recommend higher nutrient application rates than public-sector planners. The two main reasons offered by farmers and planners to explain this difference was that private-sector planners have an economic interest in their clients' crop yields and some have business relationships with fertilizer dealers (see Chapters 3, 7, and 8).

(3) During my pre-interview trials I found that directly asking farmers if they were following their plans suffers from the social desirability problem, leading me to eliminate this question. However, during the 1.5-hour interviews, 36 of the 55 regulated farmers (65%) across all three states did offer comments on their own indicating their level of compliance. Comments that either explicitly stated or implicitly implied farmers were not following their plans outnumbered comments indicating adherence nearly 2 to 1. Of the farmers in each state that provided comments, most Delaware farmers indicated adherence with their plan recommendations and most Maryland and Virginia farmers gave comments indicating non-adherence, though the non-response rate was high in Delaware (see Chapter 7 for more details).

(4) Farmers were more alike than they were different in complying with three practices required by all three states and seven practices required by at least one state, suggesting that the different policy-making processes in each state did not have a statistically significantly different impact on farmer compliance or adoption of these practices. In addition, half the practices required or encouraged by states showed good compliance or adoption rates while half the practices showed poor compliance or adoption rates. Despite Virginia's attempt to inspect nearly all the Virginia poultry growers, Virginia farmers were doing just as poorly as farmers in Maryland and Delaware at complying with practices required by the Virginia Poultry Waste Law.

Table 3. Summary of Compliance or Adoption Rates of Nutrient Best Management Practices in Each State

Required by	Requirements or Guidance	Maryland n=30	Delaware n=20	Virginia n=5	Statistical Significance between States
All 3 states	Possess a current NM Plan	77%	95%	100%	No
	Take soil tests at least every 3 years	73%	95%	100%	Yes
	Take residual N credits for legumes or manure	~20%	~20%	~20%	No
VA	Take manure tests at least every 3 years	60%	95%	80%	Yes
MD	Take manure tests at least every 2 years	43%	65%	60%	No
VA	Use the PSNT or stalk test	70%	50%	40%	No
VA	Split apply fertilizer	80%	85%	90%	No
VA	Calibrate spreaders every year	20%	20%	20%	No
VA	Keep manure-free setbacks from ditches or streams	37%	20%	40%	No
MD & VA	Do not apply manure in winter months	27%	35%	0%	No

Compliance or adoption rates that were 60% or higher were considered “good” while rates below 60% were considered “poor” and were underlined and highlighted in red. Statistical significance between states measured at the 90% confidence level.

These metrics suggest that most farmers do have current nutrient management plans and make good use of two important practices: using soil and manure tests and split-applying commercial fertilizer. Most Maryland farmers are using the pre-sidedress diagnostic tests (the PSNT or the stalk test) before they are split-applying commercial fertilizer to determine if the corn needs additional nitrogen, while only half to a minority of Delaware and Virginia farmers are doing so.

There is room for improvement in many practices as most farmers across all three states are: not taking residual nitrogen credits and thus are over-applying nitrogen; likely getting poultry manure in surface waters because they are driving manure spreaders too closely to ditches or streams; disposing of manure by applying it during winter months when no crops can absorb the nutrients and nutrients are subject to significant environmental losses; and not calibrating manure spreaders at least annually and thus, given the variable moisture and nutrient content of manure generated by different growers, farmers may not be applying the manure rate they think they are applying.

Research Question 2:

Overall, the six datasets regarding improvements in nutrient management behavior do indicate that farmers in all three states are more alike than they are different. Farmers do appear to be managing nutrients better than they have in the past, though there is still room for improvement. Findings include:

(1) Delaware is the only state that has attempted to estimate the effects of the law on key nutrient problems. The University of Delaware (2008) has found that the state's nitrogen and phosphorus surpluses have been reduced by at least half due to the law, attributing the success to reduced fertilizer purchases, the use of *phytase* in chicken feed, the state manure transport programs, and alternative manure uses. In addition, the Delaware Nutrient Management Commission has estimated that the state's excess manure problem has been minimized from over 100,000 excess tons to just less than 10,000 excess tons due to the law (see Chapter 6).

(2) In response to the direct question, "Did you change your commercial fertilizer or manure use because of the law?" only 34 of the 55 regulated farmers (62%) provided quantifiable answers due to the social desirability problem and the catch-22 nature of this question. I believe that many farmers did not want to admit to changing their behavior because they felt the law was not justified, but comments offered at different times during the interviews indicated they had improved various nutrient management practices.

Most of the farmers able to respond to this question said "yes," indicating that at least 40% of the Maryland farmers, 45% of the Delaware farmers, and 80% of the Virginia farmers have improved their nutrient management behaviors. Even four of the five unregulated Virginia farmers I interviewed (non-poultry growers) said they changed their fertilizer and manure practices because of the law, indicating even regulations with limited reach can improve farmer nutrient management practices (see Chapter 8).

(3) Many farmers offered comments indicating they have improved various aspects of nutrient management. Among the most important improvements, many farmers said they have a) a "greater awareness of nutrient management," b) reduced their purchase of commercial phosphorus fertilizer, c) lowered nitrogen concentrations in their purchased fertilizer mixes, d) lowered poultry manure rates to grow corn (from 5 or 3 tons/acre down to 3, 2, or less than 2 tons/acre), and e) increased the frequency of taking manure nutrient tests. Several farmers also said that poultry growers who don't also raise crops are no longer disposing of manure (see Chapters 7 and 8).

(4) Overall, poultry manure application rates on corn show a majority of farmers (60 to 97%) in all three states report using 3 tons/acre or less, which are modern and reasonable rates. About a third of the farmers across all three states indicated the law might have influenced them to reduce their manure rates to 3 tons/acre or less. In addition, there was a statistically significant difference in manure rates among states, and 75% of Delaware farmers report using 2 tons/acre or less while only 47% of Maryland and 40% of Virginia farmers use that low of rate (see Chapter 8).

(5) The logit regression model revealed that the state a farmer is from is not an important factor in predicting the likelihood that he will use a low manure rate (2 tons/acre or less) to grow corn. The model did show that farmers were more likely to use 2 tons/acre or less if they a) think "farmers had an equal seat at the policy table," b) accept the scientifically true statement that "(pre-*phytase*) manure use to meet corn nitrogen needs exceeds corn phosphorus needs," and c) use private planners to prepare

their plans. The last factor is an unexpected finding since studies by Smith (1999) and Lawley et al.(2007) find that private planners are more likely to recommend higher nutrient rates than public planners (see Chapter 8).

(6) Overall, there was poor acceptance of basic nutrient science concepts across all three states, as: a) only half of all farmers understand that (pre-*phytase*) manure use to meet nitrogen needs of corn exceeds the corn phosphorus needs by up to a factor of four, b) few agree with the modern science that soluble phosphorous can runoff with surface water even if soil erosion is controlled, and c) about half of all farmers identify with the "Maintenance approach" of nutrient application philosophies, which results in over-application of nutrients (see Chapter 8).

(7) There was limited to poor acceptance of basic agricultural-environmental problems across all three states, and: a) just over half of all farmers agreed that, "in the past, many poultry growers applied manure for disposal purposes on nearby fields," b) just over half of all farmers agreed that "some counties on the Delmarva have more manure than can be applied at agronomic rates," and c) most farmers disagreed with the commonly accepted fact that "agriculture is the largest source of nitrogen and phosphorus loads to the Chesapeake Bay" (see Chapters 5 and 8).

6. Main Themes

I offer five main themes about regulating farmers from these three states (see Chapter 10).

Plan-based agricultural regulations are in reality voluntary

Plans are an intrusive regulatory option that largely instructs farmers how to farm and require behavioral changes. In contrast, most point-source regulations require technology adoption to reduce water quality impacts. Behavioral change requires farmers to believe that adhering to the nutrient recommendation rates in their plans is in their economic interest. Many farmers from all three states reported not following their university-standard plans because they disagreed with the approach of setting a yield goal for each field based on the average of the best three out of five years of yield results. In addition, many other farmers said they did not want to use manure to meet corn phosphorus needs because they did not want to incur the additional commercial nitrogen purchase costs and did not believe that phosphorus is an environmental problem. Thus, adherence to the nutrient recommendation rates in the mandated plans remains voluntary since, in practice, farmers can apply nutrients at higher rates, inspectors cannot monitor nutrient application on every farm field, and by its very nature, nonpoint source nutrient pollution is very difficult to detect and is often not easily attributed to specific farm operators.

Plans prepared by private and public planners result in non-uniform standards

As Smith (1999) and Lawley et al. (2007) point out, private-sector planners tend to recommend higher nutrient application rates than public-sector planners. Many farmers and private-sector planners I interviewed suggested that some farmers will trust private planners more because they view private planners as business partners who care about the same goal: raising crop yields. And though some farmers trust their public-sector planners, many do not believe that the university-standard nutrient recommendations that seek to “optimize crop yield while minimizing nutrient losses to the environment” will be good for their farming business. Thus, regulations that involve the private sector to help implement the law are likely to result in different regulatory standards.

Furthermore, across the three states, several farmers and crop consultants revealed efforts to evade the state laws by a) keeping double books (one nutrient management plan the farmer uses and second plan the farmer shows to inspectors), b) recommending higher nitrogen-based manure application rates than the lower phosphorus-based rates inspectors tell the farmer he should be using, c) writing higher than average crop yield results as their yield goals in order to justify higher nutrient application rates, and d) not taking the required residual nitrogen credits for manure or legumes and thus encouraging over-application of nitrogen. Several other farmers using public-sector planners revealed receiving their "true" nutrient recommendation rates from fertilizer dealers because they perceived their rates from university employees as too conservative and disagreed with the state's average yield goal approach (see Chapters 7 and 8).

In the end, because some farmers with private-sector planners acknowledged they apply less nutrients per acre than recommended while some farmers with public-sector planners said they apply more nutrients per acre than recommended, future research should attempt to discern how different actual nutrient application rates are between these two groups and how much excess nutrients are being lost to the environment.

Gaining "buy-in" rather than "alienating" the regulated community likely results in better overall outcomes

Gaining the support of the regulated industry was very important to policy stakeholders in Delaware who found "it was the only way" they could regulate farmers and believed "they had to get farmers to regulate themselves." At the time of the 1997 fishkills, Delaware was also experiencing significant external pressure from the Environmental Protection Agency (EPA) to start their long overdue Confined Animal Feeding Operation (CAFO) Program. Thus, policy stakeholders in Delaware fostered an "us" (agricultural and environmental stakeholders) versus "them" (EPA) dynamic.

Stakeholders described "The Delaware Way" as being inclusive of farmers with many informal, face-to-face meetings that involved not only listening to the agricultural community's insights on how best to regulate farmers but established a farmer-dominated, quasi-government regulatory agency to develop and implement the regulations. This collaborative approach yielded many positive outcomes such as enacting legislation and regulations very quickly, gaining early compliance with the law, high participation rates in the manure transport and plan-writing cost-share programs, and an interest in evaluating their law's impact on the excess manure and nutrient surplus problems in the state.

However, there are limits to self-regulation and some concerns about regulatory capture since Delaware's law requires the fewest practices, most of the plans are written by private-sector planners who may be recommending higher application rates than public-sector planners, and the farmer-dominated regulatory Commission does not know if all its eligible farmers have obtained the required plans and has not made any effort to take action against the 50% of farmers that are not filing the required Annual Reports.

In contrast, the regulated industry in Maryland felt alienated during the policy-making process by the environmentally-oriented Executive and Legislative branches of government; felt wrongfully attacked by the media and environmentally-oriented stakeholders for causing the *Pfiesteria*-related fishkills; and felt the state abandoned them, as the state did not claim sufficient share of the blame for the phosphorus-manure problem on the Peninsula though the state had not updated its nitrogen-based manure application guidance.

Alienating the regulated community resulted in many negative outcomes in Maryland, including a highly contentious problem diagnosis stage that was unsuccessful at getting farmers to agree with scientists about the seriousness of the agricultural nutrient pollution on the Peninsula, highly contentious legislative and regulatory phases, large non-compliance problems by the first deadlines and continued non-compliance six years after the first deadline, and further poor compliance rates gleaned from on-farm inspections. In addition, many Maryland farmers I interviewed who have public-sector prepared plans indicated that they are not following their plans.

In Virginia, the poultry industry largely felt they did have an equal seat at the policy-making table and the state's negotiated regulatory approach was fair. In contrast, the environmental stakeholders felt alienated during the policy-making process because despite their ability to require many nutrient management practices, they were unable to gain regulatory oversight over roughly three-quarters of the poultry manure generated in the state that is transported off the generating farm for use by non-poultry growers.

Regulations that account for on-the-ground realities of farming and state regulatory capacity likely achieve better overall outcomes

Three factors arose as being critically important to some states being able to achieve good administrative, behavioral, and possibly environmental outcomes, which reflect an understanding of both government regulatory capacity and knowledge of farmers. First, the pace for implementing an agricultural regulatory program is important. Maryland's

3.5-year roll-out phase was impossibly rapid given the state did not know who among a database 16,000 individuals would meet the eligibility criteria. At the same time, Maryland had to finish establishing its phosphorus policy, develop the plan-writing software, hire and train public-sector planners and certify private-sector planers, and prepare plans for all eligible farmers by the same deadline.

In contrast, Delaware listened to the regulatory community about the advantages of a five-year, phased implementation schedule that would not only distribute workload and income for planners but also enable farmers to comply in an orderly fashion. Virginia found it easy to set a deadline for all poultry growers within 3 years of the law because there was a small eligible regulatory population (only about 1,300 growers), many growers had already obtained a voluntary nutrient management plan, and most growers needed only a Waste Management and Transfer Plan because they do not raise crops.

Second, cost-share for both obtaining private-sector nutrient management plans and for transporting excess manure appears to be a critically important feature of regulations addressing excess manure problems. Delaware stakeholders say they were able to get farmers to comply earlier than necessary because of the cost-share incentives to hire a private-sector crop consultant. In addition, Delaware attributes their ability to reduce the excess manure and nutrient surplus problem to the manure transport program.

Third, given the problem of excess poultry manure in some counties on the Delmarva Peninsula, it was important to specify requirements for the poultry integrator companies. Maryland required the companies to include the enzyme *phytase* in their chicken feed to reduce the phosphorus content of the manure and required the companies to pay 50% of the cost-share for the manure transport program. Both of these policies are generating significant improvements in environmental outcomes across the Peninsula, though Delaware and Virginia do not require these policies of the integrator companies. In addition, state inspectors in Maryland maintain good working relationships with the integrators, whom they call upon to bring some non-compliant poultry growers into compliance.

Surprisingly, the six hours of continuing education every three years required by Delaware's law does not appear to be making Delaware farmers any more willing to accept basic and modern nutrient science concepts or the link between agriculture and environmental problems than farmers in Maryland and Virginia, who have little to no educational requirements.

Focusing events that turn out to be weak can undermine the justification for the new regulatory policies

The 1997 *Pfiesteria*-related fishkills served as an important focusing event that galvanized media and public attention and gave policy-makers the political will to finally regulate agriculture. However, the sensationalism surrounding "*Pfiesteria* hysteria" distracted scientists, farmers, environmentalists, and policy-makers from discussing the ongoing excess manure and nutrient imbalance problems on the Delmarva Peninsula, the low adoption rate of nutrient management practices, and the many inadequacies of the voluntary cost-share programs to address the agricultural-environmental problems. Given the scientific conclusion that there was only a weak link between *Pfiesteria* and nutrient pollution from agriculture, many farmers felt that a regulatory approach was not justified.

7. Policy Recommendations

I offer several policy recommendations based on findings in this dissertation. States should better understand: a) the many reasons preventing farmers from following university-standard plans, b) why farmers don't accept basic and modern nutrient science concepts, and c) why farmers don't see eye to eye with the scientific and environmental community about the link between agriculture and water quality problems.

Given that the majority of farmers across all three states said they were "interested in receiving more educational materials about nutrient management-related topics" and they "believe that protecting the environment is part of what it means to be a farmer," there is an opportunity to address and potentially correct the perspectives that result in unintentional nutrient losses from agricultural production.

Although none of the three states attempted to employ conventional regulatory powers by signaling a credible threat of deterrence and levying significant penalties for non-compliance, given that many years have passed since the regulations were enacted, states should evaluate if they should continue with their "compliance assistance" approach. States should consider taking stronger enforcement actions against private planners, fertilizer dealers, and farmers who are colluding to evade the law.

As the EPA and states grapple with the upcoming 2011 Chesapeake Bay Total Maximum Daily Load (TMDL) policy, involved states should: a) focus on gaining buy-in from farmers through a collaborative rather than coercive policy-making process, since the solutions to agriculturally-related environmental problems largely involve behavioral change instead of technology solutions, b) be cautious that gaining buy-in from farmers can result in regulatory capture, c) make it easier for their inspectors to detect non-compliance by requiring easily monitored and verified practices, d) establish realistic implementation schedules, e) require changes that will have a major environmental impact, as was the case with requiring *phytase*, f) develop regulations directly tied to specific nutrient application reduction goals or to specific water quality goals, and g) target financial support to solutions with major environmental impacts, which was the case with cost-sharing transport of excess manure. Finally, states should work collaboratively with the poultry integrator companies to avoid conducting “Total Clean Outs” from chicken houses in winter (see Chapters 10 and 11).

CHAPTER 1 – INTRODUCTION

1.1. Introduction

Cleaning up waters of the United States has proved to be a difficult and frustrating task. Nutrient pollution, a term describing the nitrogen and phosphorus elements, is one of the leading causes of water quality impairment in the U.S. and across the world. Since enactment of the Clean Water Act (CWA) in 1972, there have been some successes in reducing nutrient pollution from point sources such as industrial facilities and municipal sewage treatment plants. However, further progress has been limited as the largest source of nonpoint source nutrient pollution, the agricultural sector, is unregulated by the Clean Water Act save for a few of the largest confined animal feeding operations (CAFOs).

This policy void at the federal level leaves dealing with the majority of agricultural nutrient pollution to the states. Thus, a study of state policies to address agricultural nutrient pollution is an important policy exercise. This dissertation will focus on the issue of agricultural pollution in three states – Maryland, Delaware, and Virginia – that drain into one of the most economically, culturally, and recreationally important water bodies in the U.S., the Chesapeake Bay.

Specifically, this dissertation focuses on the agricultural nutrient management regulations developed by these three states in response to the same focusing event: a series of fishkills in 1997 on the eastern shores of the Chesapeake Bay. This focusing event was so powerful it galvanized these three states to enact a regulatory approach to address agricultural nutrient pollution, when prior to the fishkills the states had relied primarily on a voluntary approach that entailed educational programs and technical and financial assistance.

The manner in which these three states developed their agricultural regulations varied considerably and has resulted to some degree in different outcomes. These conditions offer a case study opportunity to study the effects that agricultural regulatory policy processes may have on farmer compliance and nutrient management behaviors and to offer suggestions of what political and policy options likely work best. Studying these Bay states will provide insight into the broader political, policy, and scientific challenges to effectively reducing agricultural sources of nutrient pollution. The approach taken by this dissertation is to restrict the study to farmers of only one production type – those growing corn using poultry manure as a fertilizer source – and to one location – the Delmarva Peninsula – since all three states are represented on the Peninsula (which receives its name from this shared geography of Delaware, Maryland, and Virginia).

This introductory chapter provides an overview of the nutrient pollution problems affecting the Bay, highlights the agricultural sources of pollution, and lists the many policies enacted over the last three decades to solve those problems. Then, I provide a brief overview of the 1997 *Pfiesteria*-related fishkill events in rivers on the Delmarva Peninsula and the Eastern Shore of the Chesapeake Bay, and I provide a brief summary of the unprecedented policy responses to the *Pfiesteria* fishkill events by the three states. I will introduce the two overarching research questions and five thematic hypotheses of the dissertation. Finally, I will discuss the approach I took with this dissertation case study and introduce the rest of the dissertation chapters.

1.2. Agricultural Nutrient Pollution and Historical Approaches to Reducing It

The problem

Nutrient pollution in the Chesapeake Bay

Draining over 64,000 square miles, the Chesapeake Bay is the world's largest estuary. The Chesapeake suffers from many pollution problems, including:

- Nutrient pollution from point sources like sewage treatment plants, septic tanks, power plants, and vehicle emissions and from nonpoint sources like agriculture, forests, and urban areas;
- Sediment pollution from land development, urban stormwater runoff, and agricultural soil erosion; and
- Toxic pollution from industrial sources, acid mine drainage, and herbicides/pesticides/insecticides from farms and lawns.

In the 1970s and '80s, many fisheries saw population collapses of commercially important species like shad, rockfish, and oysters. Scientists also noted dramatic declines in underwater grasses, which filter the water and provide critical habitat (Ernst, 2003). Although toxic pollutants were thought originally to be the cause of many of the Bay's problems, only in the early 1980's did scientists realize that the main cause of the Bay's problem was nutrient pollution (Greer, 2005).

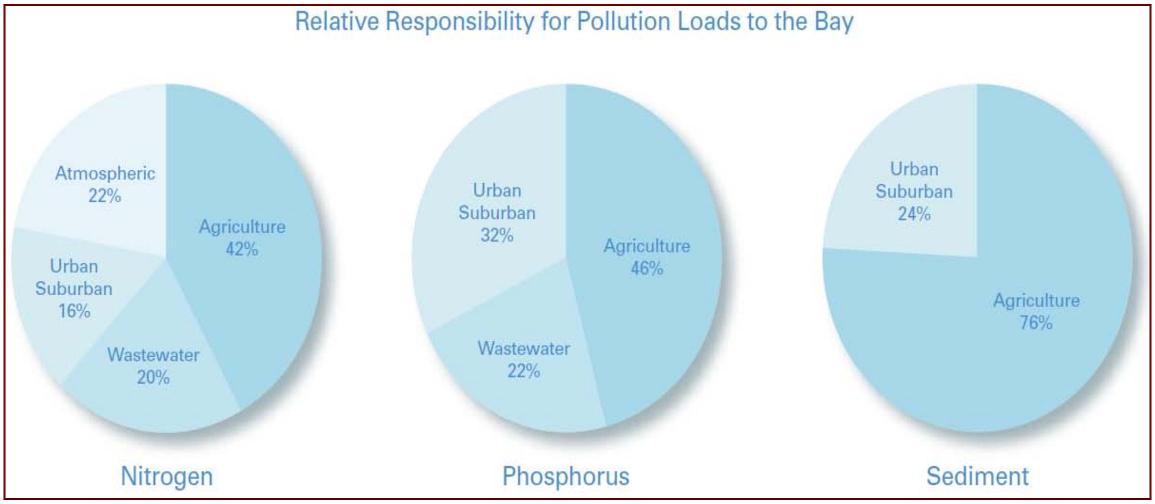
Though the nutrients nitrogen and phosphorus are essential ingredients to sustaining human, plant, and animal life, excess concentrations of these nutrients cause problems in rivers, estuaries, and bays all over the world. In water bodies such as streams and rivers, ponds and lakes, and estuaries and oceans, excessive nutrient concentrations stimulate a process called eutrophication by essentially "fertilizing" rapid algae growth. These algae blooms cause water clarity problems by blocking the sunlight from reaching underwater grasses. When these algae blooms die, they cause the eutrophication problem wherein their decomposition rapidly robs the water of oxygen, asphyxiating many fish species and bottom-dwelling creatures such as crabs and oysters. In addition, some algae blooms also stimulate the development of toxic microorganisms that can kill aquatic animals. More commonly known as “dead zones” for the widespread species death and “red tides” due to the color of the algae, eutrophication is responsible for closures of fish and shellfish industries worldwide, and 425 such dead zones have been identified globally (Selman et al., 2009). In addition to eutrophication, nitrogen pollution in groundwater drinking wells can be deadly to infants and livestock, causing what’s known as “blue baby syndrome” where babies can become asphyxiated and cows can experience spontaneous abortions (USEPA, 2007).

In the Chesapeake Bay, eutrophication occurs each year in hotspots all over the bay. Over the years, these dead zones have persisted, gained in size, and worsened in levels of dissolved oxygen (USEPA CBP, 2010). The U.S. Geological Survey estimates that 15% of groundwater wells on the Delmarva Peninsula are impaired with nitrate concentrations that exceed the federal safe drinking water standard (USGS, 2004). On the Bay’s Eastern Shore, the Maryland Department of Environment reports that more than 70% of the Delmarva Peninsula’s monitored rivers and streams are unable to maintain healthy fish and other aquatic life (CBF, 2004).

Agricultural sources of nutrient pollution in the Chesapeake Bay

Though agricultural land makes up just 29% of all land in the 64,000 square mile Chesapeake Bay watershed (forests comprise 60%), agriculture comprises 70% of the actively managed land area (Simpson, 2002). Over the last two decades, Bay scientists using sophisticated modeling programs and water quality monitoring data have estimated that approximately 40%, 46%, and 76% of the nitrogen, phosphorus, and sediment pollution, respectively, entering the Bay stems from agricultural sources (see figure below) (USEPA CBP, 2009).

Figure 1.1. Sources of Nitrogen, Phosphorus, and Sediment to the Chesapeake Bay



Source: EPA Chesapeake Bay Program. (March 2009) Bay Barometer; a Health and Restoration Assessment of the Chesapeake Bay and Watershed in 2008.

Livestock and poultry manure play a significant role in the agricultural nutrient pollution problem. Of the nitrogen loadings from agriculture that reach the Chesapeake Bay, it is estimated that nearly half stems from manure (43%), while over half comes from commercial fertilizer sources (57%). Of the phosphorus loadings from agriculture that reach the Bay, 51% are estimated to come from manure while 49% are from commercial fertilizer (USEPA CBP, 2009).

In the Chesapeake Bay watershed, there are three dominant manure nitrogen and phosphorus production areas: Lancaster County, Pennsylvania, in the Susquehanna River basin; Shenandoah Valley, Virginia; and the Delmarva Peninsula. Though Lancaster covers only 1.5% of the watershed's area, it generates 12% of the total nitrogen from the watershed's manure sources, primarily beef and dairy cattle operations (CBF, 2004). Shenandoah Valley, Virginia, is the largest turkey producer in the country, the largest dairy and chicken producer in Virginia, and generates more excess manure than any other area in country (CBF, 2004). The Delmarva Peninsula's 11 broiler-producing counties across Delaware, the Eastern Shore of Maryland, and Accomack County, Virginia, together rank fifth in the nation in broiler production (Chase et al., 2003). It is estimated that five of these 11 counties generate more poultry manure than the nutrient absorptive capacities of cropland in those counties (Lichtenberg et al., 2002), and portions of seven of these counties drain into the four rivers affected by the *Pfiesteria*-related fishkills.

Policy solutions to nutrient pollution

There are numerous regulatory and voluntary policies at the federal, regional, and state levels addressing the issue of nutrient pollution in the Chesapeake Bay and the Bay states' tributaries. Among the first federal voluntary programs with an impact on agricultural nutrient pollution through soil erosion prevention was the establishment of the Soil Conservation Service (now the Natural Resources Conservation Service), which was established by the U.S. Department of Agriculture after the "Dust Bowl" events in the 1930s. Also at the federal level, the Clean Air Act of 1970 and its Amendments in 1977 and 1990 and the Clean Water Act of 1972, and its 1977, 1981, and 1987 Amendments focused directly on nutrient pollution. The Clean Air Act established nitrogen oxides from power plants, industrial facilities, and vehicles, as one of the six air pollutants that are regulated by each state through a State Implementation Plan to ensure their air quality attainment zones do not fall below set standards (Portney, 2000).

The Clean Water Act established an NPDES[7] permit program for wastewater treatment plants and industrial facilities and an additional TMDL[8] monitoring and permit

[7] NPDES stands for the National Pollutant Discharge Elimination System.
[8] TMDL stands for Total Maximum Daily Load.

program for segments of polluted water bodies. In addition to requiring these facilities to install the “best available technologies” to reduce their nitrogen and phosphorus effluent concentrations, the Clean Water Act also established a funding program to help states build municipal wastewater treatment plants, which were not prevalent in the 1970s (Freeman III, 2000). With authority from the Clean Water Act, the Environmental Protection Agency (EPA) concluded it had the authority to regulate the largest animal production operations as point sources, and in the mid-1990s began developing a Confined Animal Feeding Operation (CAFO) permit program.

One of the most prominent regional voluntary partnerships in the world was established in 1983 when the three states bordering the Bay, Maryland, Pennsylvania, and Virginia, along with the District of Columbia, and the EPA, signed the Chesapeake Bay Agreement to coordinate their efforts to clean up the Bay. In 1983, the EPA concluded that agricultural runoff was the primary factor causing in the Chesapeake Bay’s declining health. And just two years later, the Chesapeake Bay Commission[9] concluded, that voluntary agricultural assistance programs would be insufficient to restore the Bay (CBC, 1985).

Four years later, in 1987, the Agreement was renewed, setting a specific and ambitious goal of reducing the controllable nutrients entering the Bay by 40%. In 2000, though significant reductions had been made, the goal was missed and a third version of the Bay Agreement set even more ambitious reduction targets (Ernst, 2003). As of 2006,

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[9] The Chesapeake Bay Commission provides advice to the legislative assemblies of the three states and acts as a liaison to the U.S. Congress. It has 21 members with each of the three signatory states having five legislators, including each state’s governor, and includes each state’s secretary of natural resources, and a citizen representative.

the other three watershed states, Delaware, New York, and West Virginia, have become "cooperators" with the voluntary agreement.

At the state level, in response to the 1983 Bay Agreement and the 1987 40% nutrient reduction goal, many Bay states formalized and enhanced their voluntary agricultural environmental programs. Operating through the state and county soil conservation districts (SCD) and the university cooperative extension service (CES), each Bay state further developed its voluntary educational outreach programs and financial cost-share programs. These programs aimed to persuade farmers, through technical and financial assistance, to adopt the most cost-effective farming and manure management practices.

State legislatures also enacted a variety of statues with an eye toward fulfilling the goals of the voluntary Chesapeake Bay Agreement. Each signatory state passed statues banning phosphate in laundry detergent.[10] In addition, these three signatory states (Maryland, Virginia, and Pennsylvania) passed vehicle emissions control legislation[11] (CBC, 2003). Over several legislative sessions, state assemblies in Pennsylvania and Maryland repeatedly attempted to pass mandatory agricultural management plans. Though Pennsylvania became the first of the Bay states to regulate its agricultural sector in 1993, its regulatory program was delayed until 1997 and was restricted to only a few large animal operations. In Maryland, a bill requiring all farmers to implement best management practices by 2000 was introduced but failed in the 1992, 1993, and 1994 legislative sessions (Ernst, 2003).

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[10] Phosphate bans occurred in Maryland in 1985, in Virginia in 1987, and in Pennsylvania in 1989.
[11] Vehicle emissions control legislation was passed in Pennsylvania in 1992, and in Virginia and Maryland in 1993.

1.3. Highlights of the dissertation case study

The 1997 *Pfiesteria* focusing events

The timeline of Pfiesteria-related fishkill events

Between August and September 1997, four fishkills were discovered on the Eastern side of the Chesapeake Bay in tributaries draining the Delmarva Peninsula into the Bay. Then Maryland Governor Glendening (D) closed each of these affected river segments to all fishing and recreational activities while scientists worked to determine what was causing these fishkills and why the little-studied microorganism *Pfiesteria piscicida* was also detected. These events were dubbed "*Pfiesteria* hysteria" in the media and gained national attention when the Maryland Department of Health reported that some fisherman and scientists working in the affected waters experienced nausea, headaches, and short-term memory loss.

On September 15, 1997, Governor Glendening appointed a Blue Ribbon Citizens *Pfiesteria Piscicida* Action Commission to study the problem. On September 19, Governor Glendening convened a Governor's Summit with the leaders of five of the Chesapeake Bay watershed states, the District of Columbia, the EPA, and the Bay Commission to discuss these unprecedented events. The Governor also met with President Bill Clinton and the Maryland Congressional delegation to keep them apprised of the latest news.

The findings of the Blue Ribbon Commission

The Commission included Republican and Democrat members of Maryland's General Assembly, environmental and farm organization representatives, various retired lawmakers, and scientists. The Commission studied the problem for two months, receiving expert testimony from a variety of scientists, university professors, and medical professionals.

Among the most important findings the Maryland Department of Natural Resources and Department of Environment reported was that agriculture provided the highest sources of both nitrogen (74%) and phosphorus (72%) loadings to the Pocomoke River where two of the four fishkills occurred. The Pocomoke River drains portions of Delaware's Sussex County, Maryland's Wicomico and Worcester Counties, and Virginia's Accomack County. In contrast, urban and residential runoff accounted for only 9% of the nitrogen and 7% of the phosphorus, and point sources contributed only 2% of the nitrogen and 9% of the phosphorus in the Pocomoke watershed.

Various representatives of the University of Maryland's College of Agriculture revealed a series of shortcomings in the voluntary Nutrient Management Program established in 1983. The voluntary Program was successful in getting farmers to regard poultry manure as a valuable substitute for expensive commercial fertilizer instead of as a waste product needing disposal. However, the Program provided manure application recommendations on a nitrogen-basis knowing that that rate would apply up to four times as much phosphorus as the crop needed. At the time, phosphorus was not considered to be an environmental problem if farmers maintained good soil conservation practices, which the state encouraged via conservation tillage (Fretz, 1997).

As new science evolved to suggest that phosphorus was not only found in a particulate form that adhered to soil particles but occurred also in a dissolved form that could runoff with water, the Program did not update farmers on this new science or try to tailor their recommendations to account for this new information. In addition, the new science also found that the high concentrations of phosphorus in the state's soils could exceed soil saturation, leach out of solution, and become a surface water pollutant. In fact, the University of Maryland's soil test laboratory reported that 70% of soil samples tested as "high" or "very high" for phosphorus and the Lower Eastern Shore tests were the highest in the state.

In addition, the Maryland Department of Agriculture reported to the Commission that just over half (56%) of farmers surveyed in the watershed reported having a Nutrient Management Plan while over three-quarters (78%) said they had a Soil Conservation and Water Quality Plan. Although the survey concluded that "there were no extraordinary circumstances of conditions occurring in the Pocomoke watershed," it did disclose that "less than half the crop acreage in the watershed currently receives all the poultry manure generated," indicating that there may have been excess manure application occurring in concentrated areas (Maryland Department of Agriculture, 1997).

Finally, two weeks before the Commission was due to publish its findings, the panel of scientists[12] studying the complex and novel microorganism *Pfiesteria* issued its report. Though the panel concluded that the scientific evidence linking *Pfiesteria piscicida* to nutrient pollution, algal blooms, and fishkills, was sparse, it did determine that nutrient reductions may reduce the risks of future outbreaks of toxic *Pfiesteria*. Additionally, the panel concluded that nutrient reductions would be "generally good for aquatic life, human health, and water quality."

The Commission's final report stated:

> "The Commission recommends that the State enroll all farmers in nutrient management plans by the year 2000. These nutrient management plans

[12] Known as "The Cambridge Consensus" for meeting in Cambridge, Maryland.

> should be fully and demonstrably implemented by 2002, contingent upon the State supplying the appropriate level of education, outreach, technical support and financial resources necessary to meet these goals."
> (Blue Ribbon Commission, 1997)

Policy development processes

The pace and process of developing the three states' agricultural nutrient management laws were very different. Maryland's policy development process was very rapid. Less than two months after the Blue Ribbon Commission released its report in November 1997, Governor Glendening and State Senator Brian Frosh (D), Chair of the Environment Committee, submitted the Water Quality Improvement Act (WQIA) to the General Assembly in Annapolis. Dubbed the "most comprehensive agricultural law in the country," the WQIA required mandatory nutrient management plans from all farm operations in the state. Two Republican members of the Assembly then submitted alternative bills to keep the plans voluntary, and the contentious debate over regulating farmers consumed the four-month 1998 Maryland legislative session. The WQIA passed only on the last day of the session in April, 1998, just nine months after the August 1997 Pfiesteria-related fishkills.

In Richmond, Virginia, according to the Richmond Times Dispatch, Governor George Allen (R) took "a go-slow approach." Instead, Virginia Delegate Tayloe Murphy (D), Chair of the Environment Committee, proposed the Poultry Waste Law (PWL) in January, 1998, that would require waste management by all poultry growers in the state. Citing the state's longtime declining seafood industry due to the poor health of the Bay, Delegate Murphy reasoned that the poultry industry was the only remaining animal production sector not already under the state's pollution abatement permit program. No consensus was reached on the bill by the end of the 1998 legislative session and the bill was carried over to the 1999 session. During the summer months, representatives from the key poultry, farm, and environmental organizations produced a compromise bill that required all poultry operations in the state to obtain a Virginia Pollution Abatement permit, which included obtaining and following a nutrient management plan. The PWL was accepted into law in April 1999, or 21 months after the August 1997 Pfiesteria-related fishkill events.

Delaware took a “wait and see” approach (Goodwin, 1999) and state legislators observed the contentious debate in Maryland and the negotiated compromise in Virginia unfolding. Several individual farmers approached Governor Tom Carper (R) to suggest that the agricultural industry develop its own response to the tide of agricultural nutrient management regulations. Carper appointed 10 farmers to an Agricultural Industry Advisory Committee on Nutrient Management to develop recommendations for state actions. With this input, Representative Wally Caulk (R), Chair of the Agricultural Committee, drafted the Nutrient Management Law (NML) to require all farm operations in the state to obtain and follow a nutrient management plan. Caulk received comments on the NML from members of the various agricultural trade associations. In April 1999, the law was submitted to the legislature and passed with only limited debate.

Laws and regulations

The scope of the agricultural nutrient management laws in Maryland and Delaware are very similar. Both laws applied to all 12,800 farmers in Maryland and to the 2,500 farmers in Delaware (NASS, 2007) that met the acreage, agricultural income, or animal unit thresholds specified in each state law. In addition, these two laws mandated nutrient management plans from lawn and landscaping companies. In contrast, instead of applying to all 47,000 farmers in Virginia or landscaping companies, the Poultry Waste Law only applied to the 1,200 poultry growers in the state that may or may not also have been crop farmers that met the animal unit threshold for eligibility.

A major hurdle to initiating the regulatory program in each state was determining the size of the regulated community, as only one individual for each farm or poultry operation was required to be responsible for obtaining and following the nutrient management plan. Thus, over the years, Maryland’s regulated community dropped from a potential high of 12,800 individuals who identified themselves as farmers to about 6,000 people; Delaware’s regulated community dropped from 2,500 to 1,158; and Virginia’s 1,200 growers dropped to 900 regulated poultry growers. The basic requirements of each state’s law involves the preparation and filing of a nutrient management plan by a state certified planner and following that plan in the management of animal waste and nutrient application to cropland. Virginia poultry growers that did not grow crops had to develop a Manure Management Plan and a Waste Transfer Plan instead of a Nutrient Management Plan, while the poultry growers that did also grow crops had to obtain and follow a Nutrient Management Plan.

The timelines for implementing the laws are very different across the states. Maryland’s 1998 WQIA called for a two-stage implementation process with deadlines in 2001 and 2004, depending on commercial fertilizer use or manure use. By 2001, all farmers in Maryland using commercial fertilizers were to file plans managing both nitrogen and phosphorus and to update those plans in 2004. Farmers using animal manures had to file nitrogen-based plans by 2001 and then file phosphorus-based plans in an updated 2004 plan. In contrast, the 1999 Delaware NML set a five-year implementation schedule between 2003 and 2007 wherein 20% of the state's farmers would be randomly chosen to obtain and follow a phosphorus-based plan for both commercial and manure fertilizers. In Virginia, the 1999 PWL required all poultry growers to file nitrogen-based nutrient management plans by 2001 and to update those plans in 2005 to manage manure on a phosphorus basis.

The regulation writing stages were also very different across states. Maryland's law established an Interagency Nutrient Management Advisory Committee with representatives from the Departments of Agriculture and Environment and members of various agricultural and environmental groups to write the regulatory standards. The Department of Agriculture would run the regulatory program with many of the plans being written by newly hired county extension service nutrient management advisors. Delaware created a new quasi-government agency, the Delaware Nutrient Management Commission, with seven of the 15 members being full-time farmers and with non-voting members from the Departments of Agriculture and Natural Resources. This Commission wrote the regulations, implemented the program, and ensured enforcement. Virginia's regulations and regulatory program were given to the Department of Conservation and Resources (DCR), which manages the voluntary nutrient management program, but the Department of Environmental Quality was to manage the pollution abatement permit aspect of the plan in line with their pollution abatement permit program for beef, dairy, and swine operations and their industrial permit program.

Implementation, compliance, and enforcement

The rates of implementing the regulatory program, the estimates for farmer compliance, and the enforcement efforts of each state's program have been very different. Given the 3.5-year turn-around between the 1998 law and the first regulatory deadline in 2000, state officials in Maryland were under tremendous time constraints to develop and roll out the state's regulatory program and to identify the portion of the regulated community that would be responsible for obtaining and following the nutrient management plan. In addition to developing the software to write the plans and the phosphorus site index to tailor the recommendations based on field-specific hydrology and topography, the Maryland Department of Agriculture (MDA) and the University of Maryland (UMD) had to train and hire certified nutrient management planners to meet the needs of a potential 12,800 farmers. Because most of Virginia's poultry growers are not also farmers, their plan requirements are much simpler and Virginia had an easier time rolling out their program for their 1,200 growers. In Delaware, because the state had four years to prepare for just the first 20% of farmers to comply, and because Delaware provided cost-share incentives for farmers to hire certified private consultants to write the required plans, Delaware's implementation phase was much smoother than Maryland's.

In terms of compliance, the first 2001 Maryland deadline resulted in only 30% of the required farmers filing their nutrient management plans while 60% filed "Justification of Delay" Forms that Maryland had to offer because farmers were unable to get plans prepared for them by the overwhelmed Extension Service (Ernst, 2003). And in 2004, when all farmers were to have renewed their first plan, only 60% of the required plans were filed (MDA, 2004). In 2005, according to the MDA, only 71% of farmers covering 70% of the agricultural land have complied with the law (MDA, 2005). All regulated poultry growers in Virginia complied with filing their permits and nutrient plans by the 2001 deadline (Perkinson, personal communication, February 7, 2005), though just under 100% renewed their plan in 2004 as scheduled due to the confusion over phosphorus-based management. In Delaware, farmers are ahead of their state's five-year compliance schedule, as 60% have already filed plans but only 40% were required to do so in 2004 (DNMC, 2004).

Regarding on-farm inspections and enforcement, only in 2005 – four years after plans were first required – did Maryland begin conducting site visits with farmers and only in 2008 did MDA begin publishing the results of those inspections. In contrast, Delaware began conducting a handful of farm visits in 2003, the first deadline year of the law, rarely publishes results of those reviews. Virginia's law required annual inspection visits of every regulated poultry farm, and over the years the state has accomplished between 70 and 100% of that goal (JLARC, 2005).

1.4. Purpose, Research Questions, and Themes

Over the years there has been greater and more widespread advocacy for a shift toward regulatory approaches to farm nutrient pollution. Agricultural economists in the U.S. and Canada have advocated for switching from voluntary programmatic approaches to regulatory agro-environmental policies (Napier, 1994; Stonehouse, 1997; and Tweeten and Zulauf, 1997). In 2008, on the twenty-fifth anniversary of the Chesapeake Bay Agreement, a coalition of scientists, economists, and policymakers concluded that the voluntary partnership approach to cleaning up the Bay had failed and that a regulatory approach was needed that included additional agricultural regulations.

Hence, this dissertation investigates whether the regulatory approaches employed by the three case states "work" to reduce agricultural nonpoint sources of nutrient pollution. In addition, this dissertation will study whether the political process of developing agricultural regulations has an effect on how farmers react to being regulated. This dissertation looks into basic questions such as were the states different in their policy-making approaches, and if so, why and how were they different? Were the regulatory requirements established by each state different? Did these differences in regulatory style and ensuing requirements affect farmer compliance rates and ultimately, did they improve farmer nutrient management behavior?

In addition, because all three states chose to regulate nonpoint source agricultural nutrient pollution via a nutrient management plan, this dissertation hopes to shed light on how effective a plan may be as a regulatory mechanism. Central to each state's choice to regulate agriculture is the question of *how* to regulate individual farmers and non-point source pollution, or the nitrogen and phosphorus pollution from the use of commercial fertilizer and animal manure on cropland.

Agricultural nonpoint source pollution fundamentally differs from the conventionally regulated point source pollution that discharges from industrial or municipal facilities as liquid effluent or as air emissions at the outlets of pipes or smokestacks. By definition, nonpoint source pollution is not readily collectable and cannot be funneled into discrete discharge pipes but rather trickles over cropland into surface water, leaches downward through the soil column into groundwater, moves laterally through the soil column through subsurface flows and discharges into surface waters, and volatilizes into the air during and after the application of commercial and manure fertilizers.

Although a water body cannot distinguish between nutrient pollution from point sources or from nonpoint sources, Stonehouse (1997) reminds us of certain differences in "the insidious nature of most nonpoint-source pollution." Unlike point source facilities that discharge directly into surface water via a discharge pipe, most farm fields are not located adjacent to a body of water. Hence, Stonehouse says that nonpoint source pollution:

> "…stealthily enters water systems and the upper atmosphere … leaving many farmers unaware of the contributions they are actually making to environmental degradation. In fact, most of the environmental damage occurs miles away from the farms responsible for creating the pollution in the first place. Farmers who contribute to this pollution can, if they choose, ignore these damages. They are often motivated to do just that because most measures aimed at remediating the damage cut into their profits."

Furthermore, the approach to point source nutrient pollution could be viewed as relatively the straightforward and simple application of "Best Available Technology" (BAT) at the outlet to filter the effluent or transform the emissions before they escape the facilities pipes or smokestacks. At wastewater treatment facilities whose purpose is to treat sewage and stormwater before discharging it into surface waters, technological upgrades involve reducing the concentration of nitrogen and phosphorus to environmentally benign concentrations.

In contrast, a plan-based regulatory mechanism for farmers whose purpose is to produce "food, fiber, and fuel" is a step-by-step prescription on how raise crops – prescribing the amount, type, timing, and method of application of nutrients, including necessary interim diagnostic tests, and alternative approaches to setting yield goals.

Essentially, a plan-based approach prescribes a production function of how to farm, which may be in contrast to the farmer's outlook on farming.

Thus, to address such a challenging source and form of pollution as nonpoint source agricultural nutrient pollution, it is important to assess how well the plan-based regulatory approach chosen by all three states in this dissertation is working. Equally important to understand is how the regulatory policy development process may or may not have affected the regulated community's willingness to be regulated given farmers have to be willing to follow the required plan for a plan-based regulation to work.

The research questions this dissertation proposes to answer are:

1) Did the regulatory policy development process of nutrient management regulations in Maryland, Virginia, and Delaware in response to the 1997 *Pfiesteria* events affect the rate of farmer compliance? and
2) Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva Peninsula?

Hopefully, answers to these research questions will help identify "what works" and what should be avoided when states attempt to regulate agricultural nonpoint sources of pollution. Furthermore, since the conventional voluntary educational, technical, and financial assistance approach to improving rates of farmer best management practices is inadequate to solve the problem, it is important to learn whether regulatory approaches fare any better.

Many additional questions are embedded in these overarching research questions that serve as hypotheses worth exploring. These hypotheses can be grouped into five main themes that are first phrased as questions in this introductory chapter, discussed throughout the dissertation, and then answered and summed up in the conclusion chapter:

1) Is a plan-based regulatory approach to agricultural nutrient pollution an enforceable regulatory tool?
2) Can plan-based regulations that allow plans prepared by both the public and private sectors result in uniform nutrient management standards?
3) Does it matter if the target of agricultural regulations, i.e., farmers, feel included or excluded from the policy-making process?
4) Do regulations that account for on-the-ground realities of farming and state regulatory capacities have better administrative, behavioral, and environmental outcomes than those that don't?
5) Can focusing events that turn out to be weak undermine the justification for and compliance with new regulatory policies?

1.5. Organization of the Dissertation Chapters

The dissertation is organized into 11 chapters. Chapter 1 introduces the dissertation research questions and main themes, reviews the science of agricultural nutrient pollution and the historical policy approaches to reducing it, and highlights the key political and policy events during the main stages of the policy-making process in the three case study states in this dissertation.

Chapter 2 provides a review of the literature relevant to this political and policy analysis of environmental regulations and discusses the methods employed in this three-state case study dissertation that uses a combination of qualitative and quantitative data.

Chapter 3 provides background information on the Delmarva Peninsula, specifically the types of agricultural production found on the Peninsula and the hydrological characteristics of the land mass, describes the basics of corn production using poultry manure as a fertilizer source, introduces the farmers in this case study, and shares observations about farm culture and farmer views of the environment.

Chapter 4 provides background information on the political culture in the three states and specifically the role that the Chesapeake Bay and agriculture plays in the culture of the states, and reviews the pre-Pfiesteria policies and programs addressing agricultural nutrient pollution.

Chapter 5 presents findings about how each state responded to the *Pfiesteria* fishkills between 1997 and 2006 and goes into detail about how each state diagnosed the policy problem, deliberated the policy options, developed the regulatory targets and requirements, and implemented its law. Fourteen Likert Opinion Statements are presented revealing farmer reactions to a) their states' problem diagnosis, b) the role that integrators and poultry growers should play in dealing with manure, c) their states' policy-making process, and d) the implementation phase of the regulatory program.

Next, three chapters provide answers to the dissertation's research questions.

Chapter 6 provides state estimates of administrative and adherence compliance from the years of available data either published by the states, as is the case in Maryland and Delaware, or obtained by request from Virginia. When available, inspection and violation rates are presented as well as the sizes of penalties for non-compliance. Data regarding the financial assistance programs helping states to carry out the regulations such as the nutrient management planning cost-share program and the manure transport programs is also presented when available.

Chapter 7 provides my estimates of compliance based on reported compliance rates with three practices required by all three states and compliance rates with seven practices required by at least one state, six Likert Statement opinions about the regulations and likelihood of compliance, and a count of comments explicitly stating or implicitly indicating adherence with nutrient management plans.

Chapter 8 provides my estimates of whether nutrient management practices have improved because of the laws, discusses the challenges of asking farmers about changes due to the laws, provides estimates of poultry manure rates on corn, soybeans, and wheat, a logit model on the factors that influence low poultry manure application rates, and the level of acceptance of basic and new nutrient science on which the required nutrient management plans are based.

Chapter 9 provides an analysis of the capacity of government to regulate agricultural nonpoint source pollution. I will analyze and discuss the capacity of governments to define the farm pollution problem, the capacity to deliberate effective regulatory solutions and serve as a policy broker between the environmental and agricultural policy stakeholders, the capacity to design effective regulatory solutions, and the capacity to wield conventional regulatory power over the agricultural sector.

In Chapter 10, I will conclude the dissertation with a summary and discussion of answers to the research questions, a summary and discussion of the answers to the hypotheses posed as questions that are the main themes of the dissertation, and a presentation of some policy recommendations.

Finally, in Chapter 11, I provide an epilogue to the dissertation to describe recent policy events and policy proposals from 2007 to 2009 that are related to agricultural nutrient pollution. I will discuss how my dissertation's themes and findings bear on these recent events and suggest areas for future research.

CHAPTER 2 – LITERATURE REVIEW AND METHODS

2.1 Introduction

Chapter 2 provides a review of the literature relevant to this political and policy analysis of state regulations to reduce agricultural nutrient pollution and discusses the methods employed in this dissertation. A dissertation investigating the possible effects of state political processes on regulatory compliance wherein farmers are the regulated entities and nutrient pollution is the environmental problem draws from a wide-range of academic fields. There is the field of political analysis that provides the framework to study government response to a problem through several stages of the policy development process and identifies key factors that help achieve effective implementation of public policy. There are general theories about compliance from both the private sector firm's perspective and the government's view that are important to consider. And because of the agricultural focus in this case study, there are important findings from the agricultural literature about the factors driving voluntary adoption of best management practices by farmers.

To achieve a historical comparative analysis about whether farmer perceptions of the policy process and regulatory requirements in three states affect their willingness to comply, this dissertation employs a case study approach. For several reasons that will be discussed in the chapter, a randomized and representative mailed survey was not an option for this dissertation. The core method of obtaining data for a case study was interviewing farmers and policy stakeholders as well as reviews of state regulatory program information that was either publically available or had to be requested. Qualitative data from farmers and policy stakeholders in the form of informal comments were analyzed and narratives were developed. Quantitative data generated from the interviews and from a 26-item Likert Statement questionnaire was analyzed with chi-square statistical analysis to determine if there was a statistically significant difference between states. With data gleaned from the interview process, this dissertation developed a logit regression model using Stata statistical software to identify statistically significant factors related to a farmer's use of a "low poultry manure rate".

2.2. Key policy issues identified by the existing literature

In order to understand the complex and multi-faceted components of this comparative case study, this section briefly highlights the literature I consider relevant to help explore explanations for why the three case study states responded the way they did to the same focusing event and correspondingly why farmers responded to the state's regulatory requirements the way they did.

I have scanned the literature a) on regulatory policy-making, b) on the role of focusing events in agenda-setting, c) for explanations of variation in state policy divergence, d) for criteria for effective policy implementation, e) on regulatory compliance from the perspectives of the regulators and the regulated, f) for factors involved in manure management compliance with federal animal permit programs, g) for factors driving voluntary adoption of agricultural best management practice, and h) for characteristics of farmer environmental culture and the changing societal paradigm of agriculture.

Regulatory environmental policies

Lowi (1964) explains that environmental policy is an example of protective regulatory policy intended to reduce the negative effects of private activity on behalf of the public interest. Protective regulatory policy is often contentious; decisions are often reached by negotiation and compromise between the regulated agency and the business interests; and the visibility of the process is usually moderate. In Wilson's (1995) cost-benefit policy typology, environmental policies are categorized as having costs that are concentrated among very few people while the benefits are distributed among many. As such, environmental policies often require a policy entrepreneur to represent the public interest in seeking regulation of polluting private industries. Bardach and Kagan (1982) discuss the ever-present concern of industry capture when regulators at federal agencies become too "industry-oriented, reluctant to jeopardize their post-government careers by being too tough and/or gradually co-opted by informal contact with regulated firms."

Focusing events

Focusing events can help us understand how three states were able to achieve a regulatory policy approach to agricultural nutrient pollution after many previous attempts in the 1992, 1993, and 1994 Maryland legislative sessions had failed. Ernst concludes, "Had it not been for the 1997 *Pfiesteria* outbreak that shocked the state into action, mandatory farm management plans may not have been considered again." Some focusing events have transient effects and thus, they may not result in dramatic policy changes. Kingdon (1995) reminds us that focusing events can be powerful in "opening policy windows" if: 1) they serve as reinforcements for something already taking place, 2) they are combined with a solid quantification of the problem and 3) they provide assurances that the crisis event was not an isolated fluke.

Focusing events can result in what Breyer (1982) describes as a “panic-stricken character” of regulatory politics and policy. Panic does not lend itself well to a constructive policy development process.

Enforced v. negotiated compliance styles

Shover, Clelland, and Wiler (1986) suggested there were at least two regulatory approaches – Enforced and Negotiated – which reflect how much deference the regulated industry is able to achieve. The authors suggest that a state’s style of regulatory process affects all policy stages: statute formation, bureaucratic process, rule making, regulations, and rule application. In accordance with their theory, states that embodied the *Enforced* Compliance approach are those that experience a rigid and comprehensive statute formation; a tightly coupled bureaucratic process; adversarial, formal, and attorney controlled rule-making process; regulations that are legalistic and detailed design standards; and rule-based, stringent, coercive, and punitive rule application.

In contrast, states that represented the *Negotiated* Compliance regulatory style are those that experience a flexible, indeterminate, and vague statute formation process; a loosely coupled bureaucratic process; negotiated, informative, and administrative-technical control rule making; regulations that are discretionary and broad performance standards; and a results-based accommodative, educational, and conciliatory rule application.

State variation in policy adoption

When states are faced with focusing events or basic indications of policy problems, what makes them choose one policy approach over another? Through interviews with policy stakeholders, Montpetit and Coleman (1999) explain agro-environmental policy variation between two Canadian provinces by comparing the 1) policy community membership, 2) policy network structures, 3) policy feedbacks, and 4) modes of negotiation. Because Quebec's environmental and agricultural ministry are equal members of the policy community, they negotiate the costs and benefits of environmental protection through distributive bargaining which usually results in side-payments to the agricultural sector in exchange for more comprehensive and intrusive policies. In addition, since Quebec's heterogeneous, agricultural sector has long-been represented in political discussions by a single, dues paying trade association that has close ties to the agricultural ministry, conflict amongst the different agricultural sectors has been minimized.

Implementation

The scholarship on the implementation phase of public policy generally is divided into a "top-down" or "bottom-up" perspective. Sabatier (1986) identifies six "top-down" factors "sufficient and generally necessary" for effective implementation of a law. These factors include enacting a policy with 1) clear legal objectives, 2) satisfactory causal theory, and 3) an implementation process that is structured adequately to enhance compliance by the bureaucracy and the targets of the policy. Three additional factors pertaining to the political and socioeconomic factors during the implementation phase include: 1) implementing officials are committed and capable of achieving the policy objectives, 2) support of interest groups and political officials, and 3) socio-economic conditions that do not undermine either the causal theory or political support.

The "bottom-up" approach focuses on the network of actors at the local level, including the various representatives of the program and the clients or in the case of regulatory policy, the regulated targets. A relatively new development in “street-level bureaucracy” theories is known as “adaptive management.” Farber (1999) suggests that many policies, environmental regulations, in particular, are implemented though creative negotiations between the agency and regulatory target. Though some might suggest collusion, others suggest that informal collaboration with regulated targets can help achieve the spirit of the law, through non-specified and unintended ways, though sometimes the letter of the law may not be fulfilled.

Compliance and enforcement

Although the lines between the implementation and compliance stages of the regulatory public policy process appear blurry, the quantity of scholarship in each stage suggests sufficient distinction. Theories on compliance draw from the theories of economics, sociology, politics, and crime and punishment. These theories can be divided into those that focus on the state and those that focus on the firm. Before I review those theories, I will highlight some “rules of thumb” about rates of compliance.

In terms of typical corporate compliance rates, Grumbly (1982) notes that “most federal compliance strategies operate under the assumption that most businesses will comply with most of the regulations most of the time.” More specifically, Wasserman (1992) highlights’ Bowles’ suggestion that “there will always be 5% of individuals who will violate no matter what, 20% who will comply no matter what, and 75% who will comply only if the violators are punished and/or the requirements are perceived as nonarbitrary.” Note that a regulated entity’s perception of the requirements of a law as arbitrary may be grounds for their decision not to comply. The Random House Dictionary (1983) defines arbitrary as “decided by a judge or arbiter rather than by a law or statute,” "using or abusing unlimited power," "despotic," "tyrannical", "unreasonable," "unsupported."

Compliance from the state's perspective

Four sets of scholars offer theories regarding compliance from the state's perspective. Charlton (1985) provides four elements of deterrence critical to a state agency trying to prevent noncompliance: 1) credible likelihood of detection of the violation, 2) swift and sure enforcement response, 3) appropriately severe sanction, and 4) each of these actions is perceived as real. In addition to these deterrence factors, Kagan (1983) says that the regulators' outlook on the regulated target as an "amoral calculator" (industry is perceived to be consciously devising ways to get around the regulation) versus a "corporate citizen" (industry is willing to work with the regulator to achieve common goals) affects their enforcement of regulations.

Church and Nakamura (1993) found that more accommodating strategies were more successful in getting Superfund sites cleaned up than more prosecutorial strategies. The authors explain that accommodation strategies: a) tended to emphasize common goals between the government and the potentially responsible parties for the polluted site, b) assumed a certain amount of responsible corporate citizenship and good will on the part of the industrial parties, and c) deemphasized legal adversarialness.

Brehm and Hamilton (1996) remind us that most models of environmental enforcement are derived from economic theories of crime and punishment in which all parties know the legal standards. Thus, most principal agency models of compliance in political science assume that the agent is fully aware of the principal's request. In their study of firms not reporting emissions to the Toxic Release Inventory (TRI) Program, the authors found that the majority of the estimated one-third of firms not complying with the regulations were small, ignorant firms that were unaware that they should self-report rather than firms that were trying to evade the regulations.

Compliance from the firm's perspective

Three sets of scholars offer different ways to understand the firm's views of compliance. Brehm and Hamilton (1996) review basic economic theory that assumes the would-be violator is an amoral, rational calculator that trades off the marginal cost of compliance with the marginal benefit of compliance when choosing to comply. "Marginal benefit of compliance often relates to the expected values of fines avoided, which is a function of the probability of inspection, likelihood a violation is found, and magnitude of the assessed penalty."

Scholz and Pinney (1995) highlight the "calculus of consent" in taxpayer compliance theory, which assumes that taxpayers include not only a calculus of the costs and consequences of tax evasion but also sense of citizen duty. Taxpayers with an elevated sense of citizen duty are more likely to comply because they overestimate the risks of an audit and the expected penalties for noncompliance.

The behavioral school of compliance theory, according to Wasserman (1982) argues that for corporate compliance, individuals within a firm are motivated less by conscious decisions based on profit or loss than by motives of personal advancement, fear of corporate sanction, or social influence through an individual relationship with the regulator, peers, and social and moral norms.

Factors affecting farmer environmental practices in regulatory settings

In contrast to the extensive literature on why farmers participate in voluntary environmental programs and what drives them to adopt best management practices (BMPs), there is limited literature on farmer compliance with environmental regulations. This section will review some of this literature. In addition, since poultry manure was identified as the primary source of agricultural nutrient pollution related to the 1997 *Pfiesteria* events, I will also highlight the challenges involved with manure management and the particular constraints facing contract farming.

Innes (2000) contends that "neither (the) environmental outcomes nor (livestock) operators' manure-spreading practices can be monitored and regulated." Because of this situation, "policies need to provide firms with indirect incentives for environmentally friendly choices." Innes reminds readers of this dissertation that government does not have the capacity to be present at the time of manure-application on every farm to ensure that it is done properly and given the "insidious" nature of nonpoint source nutrient pollution, government cannot easily monitor the environmental effects of manure application practices. Thus, through a spatial model of regional livestock production, Innes finds that "the standard Pigouvian approach to environmental regulation, that is taxing marginal pollution damages, cannot be implemented."

Innes does assert that:

> "When the government cannot directly regulate producers' manure-spreading practices, producers will always choose to apply more manure to surrounding croplands than just substitut(ing) for chemical fertilizer; as a result, the application of manure increases environmentally harmful nutrient runoff from croplands."

Innes offers two economically efficient regulatory policies for such situations that meet the criteria of "regulating observable producer choices that affect both their manure spreading practices and the environmental effects of these practices." For example, Innes shows that requiring a liquid manure livestock facility (dairy or swine) to adopt an irrigation system for delivering liquid manure to croplands far away from the livestock facility lowers the operator's incentives to apply excess manure close to the facility. Innes also demonstrates that taxes on commercial fertilizer can provide operators with the incentive to transport manure away from the facility to lower the nutrient runoff in the nearby locations and use substitute the manure on distant crop fields for the more expensive chemical fertilizer.

It should be noted that this second economically efficient regulatory option is not appropriate in this case study for nitrogen fertilizer but may be appropriate for phosphorus fertilizer given the excessive soil phosphorus concentrations and excess poultry manure problem on the Delmarva Peninsula. Because the three state nutrient management laws in this case study require with excessive soil P content to only use poultry manure to meet the phosphorus needs of the crop, farmers are forced to purchase additional commercial nitrogen fertilizer to meet their crop's nitrogen needs. Thus a tax on nitrogen commercial fertilizer would not have the desired effect while a tax on commercial phosphorus fertilizer may be appropriate as that may increase demand for poultry manure in non-poultry producing regions of the three state which would facilitate transport of excess manure away from the poultry areas.

In a review of the CAFO regulatory permit program for the dairy industry, Purvis and Outlaw (1995) found three factors that can delay or even eliminate adoption of new technological solutions: 1) policy uncertainty, 2) lack of monitoring and enforcement, and 3) contentious, public debate. The authors find that the lack of stable and coherent

CAFO rules within a state for managing dairy manure and nutrients can create a "fear of the unknown" which can dampen technology adoption and innovation. When administering the CAFO permit, regulators often seek "the path of least resistance" which results in a bias for old technologies that were the "best available" in the 1970s but may not be the "best available" today. Though manure application rates and irrigation rates for dairy wastewater are included in most permit guidelines, Purvis and Outlaw acknowledge that monitoring and enforcement is sparse to nonexistent giving farmers little incentive to try new technologies to meet the required application rates in the permit. Finally, the authors observed that when permitting decisions are made in a public forum, contentious and divisive debates often ensue which often leads to dampening the producers' experimentation with new technologies.

Purvis and Outlaw provide additional insight into the challenges of manure management citing three distinctive characteristics making investment in manure management technologies difficult. In contrast to productivity-enhancing technologies like new chemicals or new seed varieties that can be adopted on a short-time, trial and error basis, manure management technologies are large, capital structures whose investment is irreversible. Second, this large, one-time investment hurdle, coupled with environmental rules with short deadlines, can perversely encourage a livestock operator to increase in economies of size to overcome short-run cash flow problems. More animals mean more manure and added stress on a manure system that was probably sized for fewer animals.

Finally, unlike productivity-enhancing technologies, the cost to manure producers of the capital structure is not easily passed on to consumers. Since there is no marketable output of animal agriculture products or increase in quality, passing on the costs of manure management to consumers is problematic. In contrast, productivity-enhancing technologies like increased purchases of agrichemicals can result in increased yields and output which can lower costs. Furthermore, the authors explain that the corresponding environmental consequences of using greater amounts of agrichemicals to increase production largely affect water users downstream from the farm rather than the farm itself (unless these chemicals contaminate the farms groundwater drinking wells).

Finally, Purvis and Outlaw point out there are three specific constraints on manure management in vertically-integrated, contract livestock operations, such as poultry production. First, unlike independent, non-contract livestock operations such as dairy farms, a poultry grower is a contractor to the processing company and thus, their decision-making powers are not independent. Second, in contrast to dairy operations which usually grow their own feed crops on their own land to feed their own livestock, poultry growers receive the feed that the processing company's feed mill delivers to their chicken houses. Thus, if a poultry grower is not also a crop farmer with acreage, manure as a valuable substitute to commercial fertilizer may instead be an economic burden. Finally, the very business nature of vertical integration involves "clustering" each segment of the processing operation into a specific location. This usually results in lowering the amount of land available for manure spreading and the reliance on feed importation from crop farming areas without nearby livestock operations. Soil scientists recognize that this clustered characteristic of vertically integrated livestock operations creates a "nutrient imbalance" on the Delmarva Peninsula (Lichtenberg et al, 2002).

Indeed, over 30% of the grains fed to chickens on the Delmarva Peninsula are imported from outside the Peninsula.

Factors affecting farmers to voluntarily adopt environmental practices

Most of the agricultural literature has focused on the factors that affect farmer decisions to adopt environmentally protective best management practices, participate in voluntary programs, and specifically adopt voluntary nutrient management practices.

Factors determining adoption of voluntary best management practices

Feather and Cooper's (1995) review of USDA's voluntary conservation practice programs identified the impacts on farm profitability to be the most important factor influencing farmer decisions to participate in the voluntary programs and adopt best management practices that reduce water pollution. This suggests that efforts to improve water quality must provide a win-win situation for both the environment and the farmer's bottom line. Other factors that were found to be important include the farmer's ability to derive on-farm water quality benefits as well as those benefits "downstream" from the farmer (i.e. benefits to society) and the farmer's knowledge of or familiarity with the best management practices. Feather and Cooper conclude that programs aimed at controlling agricultural non-point sources may achieve success if they a) target the promotion of inexpensive changes in existing agricultural practices that are already familiar to the farmers and b) if the practices result in visible and immediate environmental benefits. These are very difficult conditions to achieve considering a) many agricultural-environmental practices impose moderate to significant costs such as switching to phosphorus-based nutrient management plans, manure transfer, and manure storage structures and b) the nutrient pollution is characteristically invisible.

Gale et al. (1993) evaluated the effectiveness of the Rural Clean Water Program at controlling nonpoint source (NPS) pollution from agriculture and found that “high awareness about water quality issues and the impacts of agriculture on water quality do not necessarily translate into ownership of water quality problems by farm operators.” Nevertheless, Gale et al. concluded that ownership of water quality problems by farmers is essential to successful NPS control programs and the way to achieve that is through educational programs that deepen the understanding of farm operators of NPS pollution and water quality impacts. Gale et al. conclude that well-targeted and effective educational efforts can alter farm behavior.

Ribaudo and Johansson (RAE, V29, N4) posited that there are two ways in which a voluntary program could succeed: if farmers consider society’s demand for water quality when making production decisions and if conservation practices increase net returns. The authors suggest three ways to achieve these two conditions: 1) disseminating educational programs about impaired water quality, 2) providing financial incentives to adopt conservation efforts, and 3) imposing local ordinances requiring or restricting specific farm practices to respond to public complaints. The third policy option assumes that societal requirements for or against certain farming practices might lead farmers to adopt conservation practices at a higher rate than they would if they only considered private benefits. Many conservation practices offer private or “onsite” benefits such as nutrient management planning and soil nutrient testing are likely to provide on-farm net economic benefits while other practices such as streamside buffers and livestock exclusion from streams primarily provide “offsite” benefits to society.

Factors determining voluntary adoption of nutrient management plans

Lawley et al. (2007) used survey data from the fall 1998 of 487 Maryland farmers when nutrient management plans were still voluntary to build a regression model of factors influencing voluntary adoption of nutrient management plans. The authors found three factors had statistically significant positive impacts on decisions to adopt a nutrient management plan: farm size, the share of corn, soybeans, and small grains in total crop acreage, and the number of cattle.

The larger the farm, the authors hypothesized, the likelier to be targeted by private crop consultants for plan development because of economies of scale. Farmers with a corn-soybean-small grain crop rotation may be prompted to adopt a plan because Extension personnel were likely targeting these fertilizer intensive farm operations due to their potential for improved fertilizer efficiency and reduced environmental loss of nutrients. The greater the number of head of cattle increased the probability a farmer would obtain a nutrient management plan because Extension personnel regard animal farms as more prone to environmental risk when using the manure as fertilizer to reduce the commercial fertilizer purchase and to dispose of the waste.

Factors determining fertilizer application rate

Lawley et al. (2007) also found that two variables had a significant impact on whether nutrient management plans would recommend increases, decreases, or no change in fertilizer application rates: the percentage of household income from farming and type of planner. The authors found that farmers more dependent on farming as a source of income are more likely to receive recommendations that they decrease commercial fertilizer application rates. SriRamaratnam et al. (1987) and Babcock (1992) suggest that households dependent on farming may be more sensitive to the risk of yield loss from under-application of fertilizer and hence more likely to be over applying fertilizer prior to having a nutrient management plan.

Lawley et al. (2007) found systematic differences in recommendation rates for fertilizer application amongst the type of person preparing the nutrient management plan. Fertilizer dealers and independent crop consultants recommended increases in commercial fertilizer application rates more frequently than all other plan preparers. Extension and other certified personnel (typically farmers preparing plans for other farmers) recommended no change in application rates most of the time, otherwise recommending decreases. Farmers preparing plans for their own operations almost always recommended decreases. These findings indicate some evidence for the concern that fertilizer dealers and private consultants are unlikely to recommend more environmentally protective lower rates. Plus, if farmers consistently decrease their application recommendations, this suggests there is hidden information linking more protective lower rates to more profitable crop production that private planners and extension personnel are not aware of.

Evaluation of economic impact of use of nutrient management plans

Ribaudo and Johansson (RAE, V29) provided a review of studies that showed nutrient management planning can increase or decrease net returns in some farms depending on the type of farm (crop or livestock) and other farm characteristics. Of the three Virginia studies they reviewed, two found that nutrient management would reduce net returns for farms. Bonham, Bosch, and Pease (2004) found that implementing phosphorus-based nutrient management plans would reduce net returns for poultry farms in Virginia. Feinerman, Bosch, and Pease (2004) found that nutrient management reduced net returns for poultry and dairy farms in Virginia. In contrast, Van Dyke et al. (1999) found that implementation of nitrogen-based nutrient management plans increased net returns for four Virginia livestock farms. These studies suggest that phosphorus management of animal manure can increase costs to the point of lowered profitability while some cases of nitrogen-based management can increase returns.

Farmer environmentalism and new societal paradigms for agriculture

As much of my preliminary conversation with farmers suggests, farmers, regardless of which state they operate in, share a common cultural identity that involves their important role as providers of basic needs to society and as stewards of the land. However, this identity is evolving as more farm families earn most of their income off the farm and agricultural systems shift away from family farming to industrial operations that optimize economies of scale and vertical integration. This section highlights the role a cultural schema of morality plays in farmer identity and the evolving belief paradigm of family farms.

Paolisso and Maloney (2000a), from their observations of public hearings in 2000 on nutrient management issues in Maryland, observed that the public and political context within which the 1998 Water Quality Improvement Act and the resulting regulations were formulated, violated the sense of morality among farmers. For many people in family farming, the land is a symbol of family welfare, status, and a source of family pride and “farming is seen as a morally right way to live” (Rosenblatt, 1990). During the 1998 policy discussions, rumors persisted that Maryland was going to ban manure spreading and place a moratorium on new chicken house construction. In response, rumors spread that poultry processing companies were threatening to leave the Delmarva Peninsula. Farmers took these rumors very seriously as they suggested the threat of farm loss which, according to Rosenblatt (1990) is a threat to “one’s very moral center and self worth.” Paolisso and Maloney concluded with “a call for agricultural and environmental policies to use the emotive power of farmers’ sense of what is morally right to develop more participatory approaches to managing agricultural environmental issues.” I will investigate whether Delaware’s participatory approach to their policy-making process relied on this sense of farmer morality.

Tweeten and Zulauf (1997) discuss the transition in how the public views agriculture from the old paradigm belief system based on “farm fundamentalism” to the new belief system represented by industrialized agriculture operations. Farm fundamentalism is a cornerstone of the old paradigm belief system that views “the family farm as an essential part of our national heritage that must be preserved.” Agriculture was understood to be synonymous with family farmers “pursuing a way of life.” The public traditionally viewed agriculture as family farms to be cherished, partly because they possess valued moral and cultural traits. The new paradigm belief system is already developing as the public image of agriculture changes to recognize farms as high-technology, factory-type operations. The transition to this new paradigm also is creating a belief that agriculture is no longer any different from other industries justifying similar treatment.

The ramifications of this transition are already evident in the new role that farmers play in the political arena. No longer do farmers have the power of the plebiscite. Tweeten and Zulauf (1997) point out that farmers now participate in the political process through trade associations just like business interests in other industrial sectors; with campaign contributions and direct links to members of Congress and the executive branch to influence appropriate legislation.

2.3. Analytical framework and methods for the dissertation

This dissertation proposes to answer the following research questions: 1) Did the regulatory policy development process of nutrient management regulations in Maryland, Virginia, and Delaware in response to the 1997 *Pfiesteria* events affect the rate of farmer compliance?, and 2) Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva Peninsula?

Data gathering methods

To answer these overarching research questions, I conducted a comparative historical case study of farmer opinions towards their state's policy development processes and their level of nutrient management efforts across the three states. In addition to interviewing farmers, I interviewed policy stakeholders, reviewed primary and secondary documents and analyzed the policies enacted by each of the three state laws in response to the Pfiesteria focusing events.

For the stakeholder interviews, I formally interviewed 44 individuals and informally interviewed 24 additional persons. Each of these "stakeholders" were chosen because they represent the policy and programmatic stakeholders from the state and county nutrient management programs as well as the representatives of the states departments of agriculture and environment, farm trade associations, environmental groups, elected officials, private nutrient management consultants, and university scientists and economists in each state. These individuals were involved in the development of the laws and regulations or are currently involved in implementing the regulatory programs and enforcement. Some individuals were informally interviewed solely to obtain contact information for farmers to interview. (see **Appendix A** for a list of stakeholders interviewed)

Stakeholder interviews were both in-person and over the phone with many interviews tape recorded with consent and with me taking notes by typing on a lap top computer. All stakeholders were informed that should I wish to include their comments in my dissertation or other publications that they had the option to have all, some, or none of their comments kept confidential. Only a few interviewees requested that some of their comments be kept anonymous while three individuals requested that all of their comments be kept anonymous. All persons formally interviewed were given or emailed an "Information Sheet" with a description of the project (see Appendix **B**).

From these stakeholders, I obtained first-hand, open-ended oral accounts, descriptions, and opinions of the policy development process in each state; views of their role and the role of other stakeholders in the policy process; explanations for differing farmer compliance rates in each state; and expert opinion on whether farmers have improved their nutrient management behavior. Informal interviews took the form of conversations lasting a few minutes while formal interviews were scheduled for 30 minutes to one hour though many formal interviews lasted more than one and a half hours. (see **Appendix C** for the interview template for stakeholder groups)

For the review of primary and secondary documents, I looked at: the three state laws; legislative hearing transcripts and reports; meeting materials and notes from various public meetings; news articles and editorials from agricultural industry, environmental interest group, and mainstream news publications; press releases by various stakeholder organizations; memos and correspondence by the various stakeholder groups; scientific, economic, and policy studies by various researchers; state and county nutrient management program reports and websites, and peer-reviewed journal articles.

Given the inability to conduct a “natural experiment” which would have involved a random survey of farmer nutrient management attitudes and practices before and after the law (Creswell, 2002), I attempted to develop conditions as close to a natural experiment as possible. Thus, to isolate the effect of the state policy processes on farmers, I chose to restrict the farmer respondents from all three states to just one geographic area: the Delmarva Peninsula which offers similar soils and hydrologic conditions across all three states. In addition, to minimize the different experiences of the law, I chose to restrict the farmer respondents from all three states to just one agricultural production sector: corn production using poultry manure.

I set a goal of interviewing 60 farmers; 30 from the three Lower Eastern Shore counties of Maryland (Somerset, Wicomico, and Worcester); 20 from the two agricultural counties of Delaware (Kent and Sussex); and 10 from the only poultry producing county on the Eastern Shore of Virginia (Accomack). Given the acreage of corn production in each of the six case study counties, I tried to meet a similar proportion of farmers in the three counties in Maryland and the two counties in Delaware. (see **Appendix D** for a map of states and counties on the Delmarva Peninsula)

I identified farmers by meeting them randomly at state Farm Bureau annual meetings, agricultural trade shows, state agricultural events and meetings, public auctions, and nutrient management meetings sponsored by representatives from the state and county nutrient management programs, and the private sector. I also identified farmers through the "snowball sampling" method (Frank, 1979; Erickson, 1978;Kelley et al, 2003) by asking farmers, state and county agricultural program representatives, equipment dealers and grain mill representatives for contact information of farmers that grew corn and used poultry manure.

Many farmer interviews occurred in the farmers' homes around their kitchen table or living rooms. Many interviews occurred in their barns or workshops, their pick-up truck or my car. A few interviews occurred in the meeting rooms of county libraries and at food establishments. All farmer interviews were conducted in-person for one hour to two and a half hours while the average and most common interview length was 1.5 hours. All farmers were assured their identities would be kept confidential and their responses anonymous. With farmer consent, most interviews were tape-recorded and I took notes by typing on a lap top computer. (see **Appendix E** for the information sheet provided to each farmers)

I asked farmers a variety of questions, including questions about their: individual and farm demographic characteristics, poultry manure management and use practices, manure and commercial fertilizer application rates on corn crops, best management practices, and their awareness of various nutrient management issues. During the interview, I had farmers fill-out, on their own, a Likert questionnaire asking them to indicate their level of agreement with 26 statements. The Likert questionnaire was meant to solicit their opinions on: the problem diagnosis of the Pfiesteria events; the role of integrators, Growers, and Farmers in solving nutrient problems; the state policy development process and the implementation of the regulatory programs; the regulatory requirements and their likelihood of compliance; and their awareness and understanding of nutrient science. (see **Appendix F** for the interview template for the farmer interviews, and **Appendix G** for the Likert-type questionnaire)

Analytical approaches

While analyzing the qualitative data generated during the farmer and stakeholder interviews, I will be paying attention to the "narratives (which) express underlying, taken-for-granted assumptions that people hold about themselves and their situations – a manifestation of implicit and interrelated ideas that help people make sense of the world" (Ospina & Dodge, 2005). Narrative expressions by farmers, regarding their underlying assumptions about themselves, their farming community, the environment, their state government, the demands of society, etc. may play a major role in influencing their level of compliance behavior. I will heed the general guidelines of narrative analysis given its increased popularity in studying comparative public administration issues (Jreisat, 2005).

The quantitative data gathered during the farmer interviews will be compiled and analyzed by a three statistical methods. Continuous variables, like age and acreage, will be analyzed using simple descriptive statistics, such as mean, median, and the standard deviation of responses to determine if there are statistically significant differences between states.

The quantitative variables that are categorical (e.g. responses to the Likert Opinion Statements; responses to questions about nutrient management practices that are either yes-no or are in more than two categories like “every year,” “every two years,” every three years,” etc) will be tested for statistical significance using Fischer Exact Test methods for contingency tables.

The Fischer Exact Test is the preferred method for contingency table or Chi Square analysis when the values of the cells in the table are below 5 which is often the case in my dissertation since I have a small number of farmers in each state and some variables have many categories which leaves the opportunity for few, even zero responses within a category cell. Thus, the Fischer Exact Test helps solve the contingency table problem of sparsely populated cells. (Kirkman, 1996)

Contingency table analysis asks "do treatments cause different effects?" For this three-state comparative case study, in each of my variables, the treatment is “which state a farmer is from.” Thus, my null hypothesis is: Treatments do not affect the outcome; outcomes are independent of treatments. Or: States do not affect farmer outcomes; farmer outcomes are independent of which state they operate in. If the p value is sufficiently small, then we reject the null hypothesis and conclude that states do affect farmer outcomes. Thus, the Fischer Exact Test asks if any of the three state treatments affect the farmer outcome, in general and does not go into detail testing for statistically significant differences between two states at a time.

Given the small sample size in each treatment state, it was decided that the null hypothesis could be rejected (i.e. the state treatment does affect farmer outcomes) at the 90 percent confidence level (i.e. p=<0.1). The standard * symbol will be used to signal to readers what level of statistical significant each p-value is at (i.e. *** symbolizes significant at the 99% level (p=<0.01); ** symbolizes significant at the 95% level (p=<0.05); * symbolizes significant at the 90% level (p=<0.1))

To determine if there are certain factors that can predict a farmer's choice of a "low" or "high" poultry manure application rate on corn, a logit regression model was built and analyzed using "Stata" statistical software. Methods describing the logit regression model are discussed in Chapter 8.

Review of the advantages and disadvantages of case study methods

According to Yin (2004), a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Researchers use case studies to deliberately cover contextual conditions believing that they might be highly pertinent to the phenomenon of study. George and Bennett (2005) explain the strengths of using case study methods for testing hypotheses and in theory development include: a) the potential for achieving high conceptual validity, b) strong procedures for fostering new hypotheses, c) a useful means to closely examine the hypothesized role of a causal mechanism in the context of individual cases, and d) the capacity for addressing causal complexity.

Hence, the laws regulating farmers largely for the first time in all three states epitomizes three separate case studies of the factors likely to influence the compliance with regulations and ultimately improved environmental outcomes. A three-state comparative analysis of agricultural regulatory approaches provides the opportunity to test hypothesis about what may work and doesn't work when trying to regulate farmers and to develop theories about why certain things (e.g. tone, style, regulated community size, plan-based regulatory mechanisms, phosphorus-management policy, educational requirements, etc) may or may not work.

However, case studies are not without their weaknesses. George and Bennett (2005) report that case studies have to trade-off between parsimony and richness and between achieving high internal validity and good historical explanations of particular cases versus making generalizations that apply to broad populations. The inherent limitations of case studies include: a) a relative inability to render judgments on the frequency or representatives of particular cases, b) a weak capability for estimating the average "causal effect" of variables for a sample, c) indeterminacy, and d) lack of independence of cases.

Another issue of concern is the use of qualitative data generated by interviews. According to Miles and Huberman (1994), interviewing allows the researcher to discover meanings people place on events, process, and structures, as well as, meaning behind action or inaction and discourse, that cannot be gathered in a quantitative fashion. The weaknesses of using qualitative data gathered through interviewing include: a) subjectivity of the researcher, b) reliance on interpretation to manipulate the date, c) potential bias in the results, and d) reliance on reported ideas and behavior not necessarily actual ideas and actions.

There are several methods of testing and confirming finds to reduce bias, such as: a) rigorous observation and recording of actions, b) avoiding interpreting words or actions with multiple meanings, and c) attempting to objectively record meetings. Furthermore, findings can be legitimized through: a) looking for evidence to disprove the findings, b) exploring other explanations, c) triangulation, and d) using, not discarding extreme cases or outlying data.

Challenges and benefits to my dissertation methods

Despite the obvious benefit of producing a dataset with results that could be generalized to the state populations of farmers, I did not pursue a random and representative statistical survey of farmer opinions for a variety of reasons. Given the sensitive nature of questions regarding compliance with regulations, I asked farmers in my pre-interview trials if I should attempt a mailed survey and if they think farmers would respond to an anonymous questionnaire. Almost all farmers said that a survey response rate would be exceedingly low if the survey asked the same questions I was asking in person and they conjectured that the survey responses I did receive would not be honest.

In addition, I approached a representative from the federal National Agricultural Statistics Service and one from the Maryland Agricultural Statistics Service about collaborating with them to develop a mailed questionnaire survey project. Both said they would not do so because of the ill-regard farmers had for the state nutrient management laws in general, and the ill-will that the Maryland Water Quality Improvement Act had instilled in Maryland farmers, in particular. These representatives said they rely on smooth working relationships with farmers to continue collecting up-to-date and reliable data for their agencies and that the type of project I was proposing would jeopardize those relationships.

Regarding the snowball sampling methods of identifying farmers for my interviews, there was some initial concern that the snowball method may result in my being introduced to only the “best” farmers. It turned out that most recommendations had nothing to do with the recommender’s perception of the farmers’ level of nutrient management but persons would recommend farmers to me based on relationships (either friendship or being a longtime customer), proximity, or their perception that a farmer would be receptive to talking about the state nutrient management laws. Thus, friendship may generate bias as farmers who are "good environmental actors" may be likely to associate with similar-minded farmers as would farmers who are "bad environmental actors."

Thus, there is a concern that the snow ball method may have generated bias by creating several small circles of farmers that "think alike." With this potential in mind, I attempted to meet as many farmers who would become the first set of recommenders, through as random a process as possible to reduce the potential bias of "like-mindedness." And because I asked for farmer recommendations from a variety of people (farmers, scientists, representatives from farm trade associations and equipment dealers, state and county nutrient management program representatives, etc), I was able to make several small "snow balls." Thus, I think I was able to meet a variety of farmers with a variety of opinions and management levels. Because I did rely on some equipment dealers for recommendations, and because state representatives would usually recommend "real farmers" (that is those whose primary occupation is farming), there does appear to be a bias towards larger farms in my sample of interviews.

Another concern about the interview method of generating quantitative and qualitative data is that it relies on self-reporting of information. In general, self-reported information tends to suffer from a "social desirability problem." That is, there is a tendency for respondents to provide answers that they perceive are socially acceptable and responses they think the researcher wants to hear. Thus, a socially desirable bias tends to occur because there is under-reporting of "bad" behavior and over-reporting of “good” behavior. In addition, this dissertation’s focus on issues of compliance with state laws, specifically, or merely the discussion of manure and nutrient management practices that are frowned upon may generate additional worries about potential legal ramifications for revealing violations or unsavory behavior.

Indeed there are several research questions in this dissertation that resulted in high non-response rates that are likely attributable to the social desirability problem. In consultation with my committee members and a review of literature on the subject of non-response rates in interview-based research, I established a 30% non-response rate.

Johnson (2010) suggested that personal interview surveys should expect a 60 to 80% response rate thus my 70% response rate is within this range. Sitzia and Wood (1998) found that the mean response rate for face-to-face interviews was 76.9% for 106 studies evaluating health patient satisfaction. Again my 70% response rate is close enough to this estimate of average response rates.

Responses from states that exceed the 30% non-response rate will then be analyzed for why non-response rates were high and whether there were observable differences between farmers who gave responses and those who didn’t. Some variables were thrown out from this dissertation due to high non-response rates while a few variables were kept in and analyzed because they were deemed important. I acknowledge that only weak conclusions can be drawn from these variables with high non-response rates.

Among the many advantages to a study with both quantitative and qualitative data is that when certain quantitative data variables showed one or more states with high non-response rates is that the corresponding qualitative data often made up for the lack of numbers with rich narratives and many times, greater clarity. Furthermore, qualitative comments often provided explanations for why there was a high non-response rate.

In addition, because some questions asked about events or practices that occurred in the past, these questions did suffer from "recall" problems making logging a quantifiable response difficult, leading to a high non-response rate. Again, corresponding qualitative responses provided reasonable clarity of what happened in the past without a discrete number response.

My interview experience

My experience interviewing farmers was, overall, very positive. The majority of farmers gave indications that they had a positive experience during the interview saying things like, "Well, glad to talk to you," "It was nice talking to you," "I enjoyed talking to you," and "I hope that helps you and your dissertation." Many farmers indicated that they enjoyed being "heard," "to tell their own side of the story," and were glad for the opportunity to get things "off their chest." Several farmers who had at first balked at my request for 1.5 hours of their time to conduct the interview were still going strong after two hours when I said I had to wrap things up and travel to the next interview. Several farmers even followed me out to me car as they continued to want to chat with me.

Many farmers offered on their own and agreed to at my request, to take me around their farm and other farms to show me their planting, harvesting, spraying, and manure application equipment, manure sheds, and were eager to point out the differences in crops, cover crops, tillage systems, and ditch management systems. I rode along in several manure spreader trucks and one tractor pulling a planter applying herbicides to a field to get it ready for corn planting.

As will be described in detail in Chapters 7 and 8, there were specific topics that several farmers appeared to be reluctant to talk about: belief in the new phosphorus science, compliance with the regulations, adherence with the required nutrient management plans, whether they improved their nutrient management practices. In other words, several farmers did not want to discuss the very questions I sought to find answers to for this dissertation.

CHAPTER 3 – BACKGROUND: FARMING ON THE DELMARVA PENINSULA AND FARMERS IN THIS CASE STUDY

Chapter 3 provides background information about farming on the Delmarva Peninsula and an introduction to the farmers in this case study. The first section will introduce corn and poultry production on the Delmarva Peninsula and discuss the hydrologic conditions on this land-limited location. For readers unfamiliar with corn production and use of poultry manure as a fertilizer source, a "farming 101" discussion will be provided to explain the basic mechanics of how to grow corn and use poultry manure. Another section will highlight how the chemical instability of nitrogen (from either commercial or manure sources of fertilizer) and the specific characteristics of poultry manure, makes farming, in general, and on the Delmarva Peninsula an inherently environmentally "leaky" enterprise. Since significant changes were required by each of the state nutrient management laws regarding phosphorus management, another section will explain the new phosphorus science and each state's different phosphorus policies. And finally, to illustrate what was known about the level of farmer adoption of best management practices (BMPs) before the state nutrient management laws, the results of three studies about poultry growers on the Delmarva Peninsula and famers in Maryland is provided.

A second section in Chapter 3 will introduce the farmers in this dissertation. The basic demographic characteristics of the farmers in this dissertation will be discussed, identifying which characteristics are statistically significant between the farmers in each state. Because there is a statistically significant difference between farmers in this dissertation regarding the type of planner they chose, I included a discussion section on what two studies in Maryland have found prior to the state nutrient management law regarding differences in recommendations by private planners versus public planners. By way of further background information, I will go on to introduce to the basic fertilization techniques employed by farmers in this case study, their reported status of soil phosphorus conditions in their crop fields, and their participation rates in state and federal BMP programs.

A third section in Chapter 3 will provide some insights I gleaned from my interviews into "farming culture," regarding how farm communities operate and how farmers view themselves vis a vis the environment. In addition, two more sections will discuss the evolution in society's view of farmers that scholars began to notice occurring in the late 1990s and my understanding of how environmental policy can conflict with farming philosophies. Chapter 3 will end with a short summary.

3.1. Farming and environmental conditions on the Delmarva Peninsula

The land-limited Delmarva Peninsula

The Delmarva Peninsula is about 183 miles long and 71 miles wide (see map below). It is comprised of nine of Maryland's 23 counties, two of Virginia's 95 counties, and all three counties making up the state of Delaware. The three bodies of water surrounding the Peninsula are the Chesapeake Bay on the west, the Atlantic Ocean on the east, and the Delaware River and Delaware Bay to the northeast. The Delmarva is connected by land to the north to Pennsylvania but is also connected to the "mainland" by the Chesapeake Bay Bridge near Annapolis, Maryland and by the Chesapeake Bay Bridge-Tunnel at the southern tip of the Peninsula in North Hampton County, Virginia connecting to Norfolk, VA.

Figure 3.1. Map of the Delmarva Peninsula

Source: http://www.worldatlas.com/webimage/countrys/namerica/usstates/lgcolor/delmarva.htm

The Peninsula is part of what's known as the Atlantic Coastal Plain, an area that is characterized by uplands, low flatlands, and tidal marshes, with very little elevation in the southern half of Delmarva. There are many dozens of soil types on the Peninsula but the dominant soil classes are known as "sandy loams" and "loamy sands" though there are also heavier, clay soils. Most farmers mentioned they had "Mattapeake" and "Matapex" soil types which are the highly valued soils for crop production capable of producing high yields, as well as, "Othello" soils which are soils that have a higher clay content and typically offer low yields.

The water table on the southern half of the Peninsula (includes Kent and Sussex County in Delaware and Maryland and Virginia counties in this dissertation) is very shallow; in some locations it is only inches from the surface. Thus, the low-lying nature of land of the Peninsula means there are naturally a lot of puddles and soggy ground. In order to grow crops and prevent the plants from getting waterlogged or even drowned, farmers since the time of the original colonies have dug ditches throughout their crop fields to divert standing water away from the crop. As a rule of thumb, just about every field on the southern half of the Peninsula has ditches running through or alongside the field boundaries and the concentration of ditching intensifies the further south you go on the Peninsula.

Ditches lead water down slope to larger ditches which connect the water to what are called "tax ditches" that then connect to streams, rivers, and eventually the Chesapeake, the Atlantic Ocean, or the Delaware Bay. Some ditches are dug annually and are small enough that farmers plant right through them in the spring. Other ditches are permanent and farmers plant right up to the edge of the ditch bank which is often grassed and maintained by mowing, or they keep a riparian buffer strip of grass, shrubs or trees to trap eroding soil, nutrients, and farm chemicals before they reach the tax ditch or other surface water.

The birthplace of modern poultry industry

The Delmarva Peninsula is a historic location in the agricultural sector because it is credited as the location of the "birth of the modern poultry industry." Before today's large-scale vertically integrated poultry production system dominated by household names like Perdue and Tyson's, chicken meat was "produced" when backyard flocks of egg laying hens were no longer productive. Cecile Steele, of Ocean View, Delaware, is credited with the accidental start of the industry. The story goes that in 1923, Steele accidentally received 500 chicks instead of the 50 she ordered for her flock of laying hens. She evidently housed them in a piano box while she built a shed. Eighteen months later, Steele sold the surviving chickens to the New York City restaurant market. Three years later, the Steeles had 10,000 birds and the rest, as they say is history.

Today, poultry production is a major player in the agricultural sector in all three states. Cash farm income from the poultry production generated an astonishing 73% of Delaware's farming economy. Though not as large a role, cash farm income from poultry production is 40% in Maryland and 15% in Virginia. As of 2009, there are 1,757 contract poultry growers raising broiler (meat) chickens in 5,004 houses with a capacity of holding 128 million birds per flock. (DPI, 2009) There are approximately 5.5 flocks raised in each house, each year.

As of 2008, four poultry companies operated on the Peninsula and three maintain their company headquarters on Delmarva: Allen's Family Foods, Inc is headquartered in Seaford, Delaware and ranks 17^{th} in the nation for millions of pounds (lbs) of ready-to-cook product; Mountaire Farms, Inc is headquartered in Millsboro, DE and ranked 6^{th} in the nation; Perdue Farms, Inc. is headquartered in Salisbury, MD and ranked third, and Tyson's Food Inc. is headquartered in Springdale, AR and ranked second. (DPI, 2009) For 2008, Maryland ranked 8^{th} in the country with 298.6 million broilers, Delaware ranked 9^{th} with 242.9 million, and Virginia ranked 12^{th} with 250.3 million broilers statewide. Taken together, all poultry production on the Delmarva Peninsula ranks fifth in the country.

Sussex County Delaware remains the number one broiler production county in the nation, producing 224 million broilers in 2002 alone. The three Lower Eastern Shore counties in Maryland (where farmers in this dissertation operate) ranked quite high: Somerset (25th), Worcester (26th), and Wicomico (36th) while two additional Maryland counties also grow chickens: Caroline (40th) and Dorcester (63rd). Accomack County, Virginia ranked 72nd while Kent County, Delaware ranked 83rd. (DPI, 2009)

According to the Mid-Atlantic Farm Credit agency which is an agricultural bank, “every poultry job results in 7.2 allied industries.” Examples of these industries includes the companies that a) make and maintain the heating, cooling, and lighting control systems in the chicken houses; b) build the chicken houses, and c) perform the litter clean out. A University of Maryland study concluded that jobs directly and indirectly dependent upon the broiler chicken industry represent over 1 out of every 12 jobs in the region. (DPI, 2009)

Given the concentration of chickens and the land limitations of a Peninsula, the dominant agricultural land use is corn and soybean production - the two main feed ingredients of a broiler chicken’s diet. Thus, the grain industry on the Delmarva, according to MAFC is supported by a “poultry premium.” That is, the poultry industry pays an additional 30 cents per bushel (bu) of corn, 10 cents/bu of soybeans and a transportation subsidy of 22 cents/bu to corn and soybean cooperatives on the Peninsula to ensure that the poultry industry gets the grain instead of the international commodities market. (Bounds, personal communication, February 23, 2006) Furthermore, given the land-locked nature of the Peninsula, according to the Delmarva Poultry Industry, Inc (DPI), the corn and soybeans produced on Delmarva can only meet about 68% of the corn and 63% of the soybeans fed to broilers (DPI, 2009). Thus, the poultry industry must import the remaining 25.8 million bushels of corn and 9.9 million bushels of soybeans from the Midwest every year to feed the 571.2 million broilers grown on the Peninsula in 2008.

Agriculturally-related environmental issues on the Delmarva Peninsula

The poultry industry's importation of corn and soybeans to feed chickens, coupled with the limited land available to use the poultry manure as an alternative source of fertilizer has led to what's called a "nutrient imbalance" on the Delmarva Peninsula. Common to livestock and poultry production areas, an area experiencing nutrient imbalance is one in which more nitrogen and phosphorus nutrients are imported or generated than is either a) recommended for crop production or b) removed through crop harvest in the same area.

As will be described in detail in Chapter 5 and 6, the Pfiesteria-related fishkills and ensuing nutrient management laws helped jump start research to quantify the magnitude and trends in the nutrient imbalance in the Peninsular states.

The environmental concerns on the Delmarva Peninsula that have been associated with agriculture include: nitrate contamination in drinking water wells, impaired surface waters requiring Clean Water Act clean-up plans known as "TMDLs", and poor counts for biological stream surveys. The U.S. Geological Survey reported in 2004 that 15% of sampled drinking wells on the Delmarva Peninsula had levels of nitrate concentrations that exceeded the safe drinking water levels of 10 mg/l nitrogen. (USGS, 2004) According to USGS, "High nitrate concentrations in the surficial aquifer are more likely in upland areas (fig. 1), where soils typically are well-drained and sandy and the predominant land use is agriculture, than in other parts of the Peninsula. High nitrate concentrations also are found in deep parts of the surficial aquifer."

Figure 3.2. USGS map of hydrogeomorphic regions on the Delmarva Peninsula

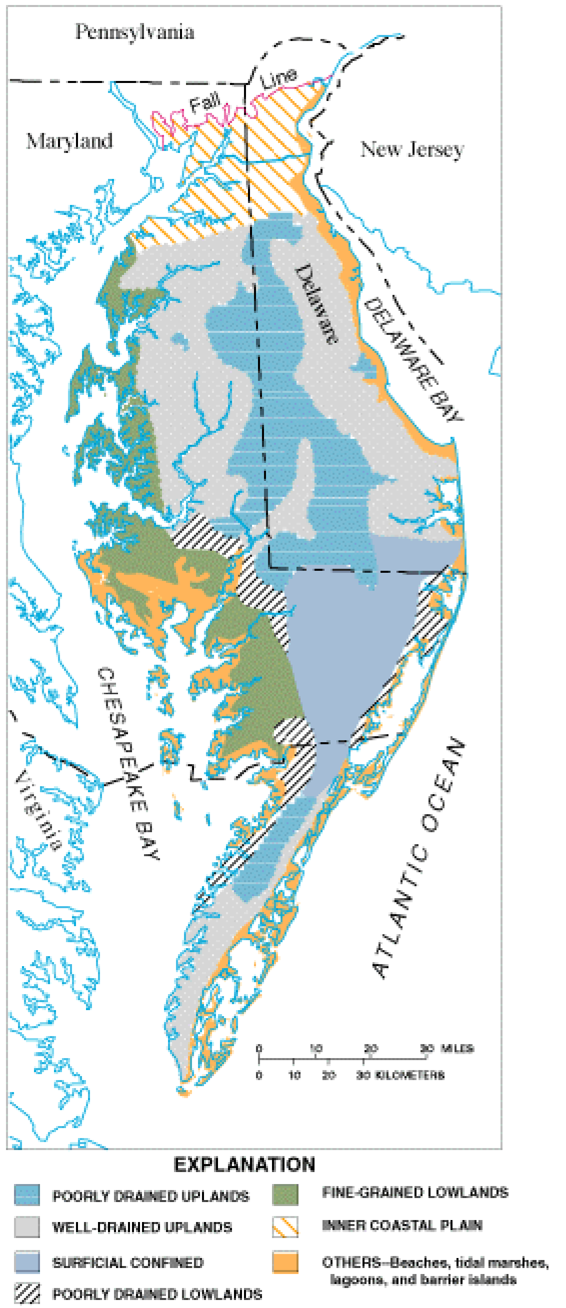


Figure 1. Hydrogeomorphic regions in the surficial aquifer in the Delmarva Peninsula.

According to the Maryland Department of the Environment (MDE) more than 70% of the Eastern Shore's monitored stream and river segments are impaired that they are unable to support healthy populations of fish or the bottom-dwelling creatures that are a key link in the aquatic food chain. (CBF, 2004)

One serious policy challenge to addressing the nutrient imbalance and hydrologic conditions on the Peninsula is the reality of the hydrologic time scale. The USGS study pointed out that "Nitrate presently in the ground-water system will continue to discharge to streams for at least the next few decades." Nitrate leaching through the soil-water column into groundwater then moves laterally to streams and travel time is slow; on the order of decades. In terms of phosphorus, soils with high phosphorus concentrations can take 10 to 20 years before it is depleted from the storage in the soils.

One paired watershed study on the Delmarva Peninsula revealed the challenge of solving agricultural nutrient pollution. The Green Run Watershed Study in the Upper Pocomoke River in Maryland and Delaware demonstrated that after all farmers in the treatment watershed spent four years planting winter cover crops, following nutrient management guidelines and only commercial fertilizers to grow crops and exporting all poultry manure out of the watershed, only a 25% decrease in nitrate concentrations in the treatment watershed streams could be detected in comparison to the control watershed streams. There was no change in the phosphorus concentration in streams due to the strong legacy of phosphorus in the soils despite no manure application for four years. (CBF, 2004)

Farming 101 - How to grow corn and use poultry manure

What follows is a description of how to grow corn, using a combination of poultry manure and commercial fertilizer while minimizing environmental losses on the Delmarva Peninsula. The description presents a snapshot “how things were done” before the state nutrient management laws. A second section will follow describing the new phosphorus science and the ensuing phosphorus management options provided by each state. Another section will describe the natural characteristics of manure nutrients and nitrogen, specifically, that pose significant challenges to the environment and to farmers trying to manage manure and fertilizers to protect the environment.

Since most corn production is actually grown in a two-year, three-crop rotation, Farmer 23 from Worcester County, Maryland explained what is involved in being a corn-wheat/soybean rotation farmer:

> "Between April 20th and May 20th that's when corn planting gets done. From May 20th to July 15th you plant soybeans on your remaining acres. From July 15th through August, that's clean-up time with your sprayer. You apply pesticides and fertilizers (as sidedress) to corn when it's over a foot tall. Plus there's mechanic work, when you have slow time to fix equipment that's broke down.
>
> If you're doing a corn-wheat-soybean rotation, then in July you'll:
> 1. Clean the corn
> 2. Harvest wheat from July 10th to July 15th from your previous year's October planting
> 3. And you'll plant your double-crop soybeans then July 10th to July 15th too.
>
> Then from Sept 1st to Oct 20th, you'll harvest the corn and plant wheat if you're on a corn-wheat rotation. And from Oct 20th to Thanksgiving, you're harvesting soybeans. You aim to get outta the fields by Thanksgiving as your rule of thumb coz weather becomes a major problem after Thanksgiving. Ground's too cold, there's rain, snow, and freeze that interferes with planting the wheat."

When I asked what kind of hours he puts in, Farmer 23 said, "From April to Thanksgiving, except for the slow mechanic time, I work from 7 am to 9 pm every day."

Start by outlining production goals and taking diagnostic tests

Prior to the three state laws requiring farmers to obtain and follow certified nutrient management plans, farmers made decisions about what and how to plant by: a) seeking advice from Maryland's and Virginia's voluntary nutrient management program, b) working with a county Extension Service agent to develop a voluntary plan, c) engaging a private crop consultant to develop a crop fertilization plan, d) getting advice from the fertilizer dealer they bought their commercial fertilizer mixes from, and e) making decisions on their own using available information from trade magazines, trade associations, and the results of scientific experiments by Cooperative Extension scientists.

The first decision for a farmer to make in the nutrient management decision-making process is what to grow. Most commodity crop farmers (e.g. corn, soybeans, and wheat are commodity crops because they are traded as commodities on the international markets) on the Peninsula follows a corn-wheat-double crop soybean crop rotation as described above. However, many farmers will watch the commodity prices and may choose to plant corn back to back instead of switching those acres to soybeans if the price of corn is more favorable than the price of soybeans. Such a rotation is called continuous corn and is not a recommended practice because it can reduce the soil fertility and result in large environmental losses of nutrients due to the large amount of poultry manure used to grow corn and the inherently leaky nature of manure. These issues will be discussed below.

Establishing yield goals

Once the rotation and distribution of acres assigned to each rotation is determined, yield goals are set. Each state has established very similar guidelines for calculating reasonable yield goals which mainly involves picking the best three out of five yields in each field to obtain an average and setting that as the yield goal for each field. Prior to the state nutrient management laws that required this yield goal setting procedure, some farmers set one yield goal for their whole farm while others using private consultants would establish three different yield goals for three sets of farm fields. The state-certified approach to establishing crop yields takes into account the dominant soil type in each crop field and based on county- and state-level data that is updated annually, reflects the crop yields each type of soil is capable of producing.

Establishing nitrogen fertilizer recommendations

The next step in the process is establishing nitrogen fertilizer recommendations. Unlike phosphorus and potassium, the other two primary nutrients required to raise crops, nitrogen recommendations are not based on soil test analysis because there is no pre-plant soil test for nitrogen. According to a 1995 "Nutrient Manager" Newsletter from the University of Maryland:

> "Instead of soil tests, nitrogen fertilizer recommendations are based on:
> 1. Yield potential of the crop and soil; and
> 2. Nitrogen credits for previous legume crops or organic nutrient sources like manure."

Thus, if a farmer were deciding what quantity of nitrogen to apply to corn and was getting advice or a voluntary nutrient management plan from an Extension agent in Maryland, the agent would likely begin by recommending that one pound of plant available nitrogen would be needed to raise one bushel of corn as the "expected yield gross recommendation." Then, the agent would reduce that recommendation by the amount of nitrogen credits needed to reflect the residual nitrogen left over in the crop fields from previous crops of legumes or previous applications of manure that will become "available" to the corn crop as it grows.

In addition, Soil Test Laboratories commonly provided nitrogen recommendations despite their not analyzing the soil samples for nitrogen. A farmer would submit the type of crop he intended to grow in each soil sampled field and the bushel goal. However, because not all private labs ask a farmer for information regarding the previous crops of legumes or manure application and thus do not take residual nitrogen credits into account when providing their nitrogen fertilizer applications. In contrast, Soil Test Labs associated with land-grant universities do take nitrogen credits.

Following state guidelines for residual nitrogen from legumes, a farmers' nitrogen recommendation could be reduced by 15 to 40 lbs of N per acre to account for the previous year's soybean crop and as much as 75 to 150 lbs of N per acre to account for the "hairy vetch" a common winter annual crop grown in Virginia (MCE, 2006). The range depends on the planting date of these crops, the kill date, and the type of tillage.

As for manure nitrogen credits, a common credit is 30 to 50 lbs per acre. The manure credit takes into account manure mineralization rates and ammonium conservation factors. For broiler manure, only 50% of the nitrogen in 1 ton is considered "Plant Available Nitrogen" (PAN) during the first crop year following application while another 15% is available the next year and 8% is available two years after application. The ammonium (NH4) conservation factors indicate that all the ammonium will be available to the crop if the manure is injected into the soil or 80% is available if the manure is incorporated on the same day it is applied. If two days go by, then 64% is available. If six days go by, then 100% of the ammonium is lost to the atmosphere and no longer available to the plant.

Thus, if farmers are not incorporating their manure or not applying the manure as close as planting time as possible, the farmer is losing available nitrogen in the form of ammonium and his nitrogen recommendation will have to compensate for that loss and the credit will not be reduced.

Typical corn yields on the Delmarva Peninsula range between 100 and 200 bushels per acre with an average of about 130 bushels per acre. If a farmer sets a yield goal of 130 bushels per acre, instead of needing to apply 130 pounds of nitrogen to achieve the 1:1 N to bu ratio, accounting for the 15 lbs of plant available nitrogen residual in the soil from previous crops of soybeans can reduce the application from 130 to 115 lbs. Then, the 30 lb-manure residual nitrogen credit can further reduce the nitrogen application recommendation from 115 to 85 lbs of nitrogen.

Taking manure nutrient analyses

Manure nutrient analyses provide farmers and their advisors with critical information about the availability of nutrients in the manure sources they generate, receive or buy from their neighbors. Given that manure nutrient content can vary tremendously depending on the integrator companies' feed regime, the production management in the chicken houses and the manure storage and handling management by the farmer, Extension agents would recommend farmers to take manure samples from every source of manure and take the samples as close to the time as the manure is going to be applied in the spring on corn.

Thus, before the state nutrient management laws, farmers who had access to poultry manure were, in the words of one Wicomico county farmer, "lucky bastards" because they were able to "farm cheaper" than their counterparts in the Upper Eastern Shore counties on the Delmarva Peninsula where fewer poultry houses are located or the Western Shore where no poultry production occurs. Before the law, with guidance from Maryland and Delaware Cooperative Extension scientists, farmers were encouraged to use manure as a valuable resource rather than a waste product. They encouraged farmers to use manure to supply most if not all the nitrogen needs of the corn crop. Thus, manure recommendation rates to meet the nitrogen needs of corn were commonly 3 tons to 4 tons per acre given that plant available nitrogen in average broiler manure 15 years ago (prior to the laws) was about 30 pounds per acre.

Establishing phosphorus recommendations

To establish recommendations for phosphorus and potassium, the two remaining primary nutrients and the minor nutrients like calcium, magnesium, zinc, sulfur, etc, farmers and their advisors, rely on soil and manure nutrient analyses.
Farmers commonly collected soil samples by themselves or had Cooperative Extension agents, private consultants, or fertilizer dealers collect them for them and had them analyzed for their nutrient content. Before the state nutrient management laws, two soil test laboratories were commonly used by farmers on the Delmarva Peninsula – the University of Maryland Lab and the University of Delaware Lab but many other private laboratories out of the state continue to be commonly used by farmers for the soil analysis. Soil tests provide two main pieces of information: the amount of plant available phosphate (P205) and potash (K20), also called potassium, plus the micronutrients in each soil sample and a fertilization recommendation for each field the soil sample was taken from.

Three different approaches to establishing nutrient recommendations

According the a 1994 Nutrient Manager newsletter by the University of Maryland Cooperative Extension Service, there are three major philosophies or approaches to making nutrient recommendations: (1) the Maintenance Approach, (2) the Cation Saturation Ratio Approach, and (3) the Sufficiency Approach.

The maintenance approach was encouraged during the years after the “Dust Bowl” in the 1930s “in response to widespread exploitation of soil resources in many regions of the country” and involves “replenishing nutrients removed by crops and applying nutrients regardless of soil test. The maintenance approach is associated with the “feed the soil” philosophy. The Newsletter says:

> “The major shortcoming of this approach is that it ignores the nutrient reserve capacities of many soils. If this approach is used on soils already containing adequate levels of nutrients, it can decrease profitability.”

The Cation saturation ratio approach is built upon the belief that the ideal soil should contain the following exchangeable cations: 65% calcium, 10% magnesium, 5% potassium, and 20% hydrogen and aluminum. The newsletter states:

> “(r)esearch in a number of states has shown no consistent relationship between crop yields and cation ratios. Furthermore, this approach can lead to unrealistic nutrient recommendations – that increase production costs with no concurrent increase in yields.”

As for the Sufficiency Approach, there is:

> “(b)elieved to be a critical soil-test level for every nutrient above which there is no yield increase when additional nutrients are applied. If soil test levels are above the critical values, no nutrients are applied. Research in several states has shown that the sufficiency approach does not rapidly deplete soil nutrients…Soil test labs associated with most land-grant universities adhere to the sufficiency approach because it is agronomically and economically defendable.”

Thus, depending on nutrient recommendation philosophy, farmers may have been getting advice that resulted in excess nutrient application, lower profitability, and pollution to the environment.

Prepare the fields

Once the crop rotations, crop yield goals, nitrogen and phosphorus application rates, and the combinations of commercial fertilizer and manure sources of nutrients have been determined, the farmer proceeds to prepare the fields for planting.

Apply the manure

After preparing the fields and before planting the corn crop with starter commercial fertilizer, the poultry manure must be applied. However, before applying the manure at the desired application rate, farmers are encouraged to calibrate their manure spinner spreaders. Since the poultry manure moisture content can vary depending on: the integrator's feed composition, the house production management, whether the manure was able to compost before being applied, whether it was stored outside for any period of time, and whether the manure is "crust out" or "Total Clean Out" litter. Each of these factors will affect the way the manure moves through spinner spreader.

Crust out is the term for the mixture of litter (sawdust, wood chips, or wood shavings), manure, urea, chicken feathers, skin, and nails, and spilled feed and water that forms a thin crust on the dirt floor of a chicken house during every 5.5 flocks raised in a typical poultry house. A farmer operating a small modified Bobcat will skim up this "crust" and drive it to: a) the poultry grower's manure shed if he has one, b) a waiting spinner spreader to take it directly to the fields, or c) form a conical or a "windrow" stockpile. Manure sheds cost-shared by the state of Maryland are designed to store approximately half a year's worth of crust out. Windrows are long, tall piles of poultry manure that if shaped properly can form a crust that prevents significant nutrient loss through volatilization, runoff or leaching. After the crust out process, fresh litter is often brought into the chicken house and spread on the dirt floor.

Total Clean Out (TCO) refers to the poultry manure-litter mixture that is generated when the entire chicken house is cleared out. Depending on integrator, this can occur annually or any number of years, though three to five years is common nowadays. Over time, the build-up of manure, urea and ammonium in the litter becomes unhealthy for the birds and the manure, down to the dirt floor, must be completely removed. A Total Clean Out generates several orders of magnitude of manure than a crust out and thus cannot be stored entirely in a manure shed. Thus, timing a TCO to when cropland is available and it is agronomically and environmentally safe to apply the manure is important. The moisture content and nutrient content of crust out manure varies significantly from that of TCO, hence another good reason for taking manure nutrient analysis.

A 2001 “Delaware Nutrient Management Notes” newsletter from the Delaware Nutrient Management Commission in collaboration with the University of Delaware described the three main methods used to calibrate manure spinner spreaders. In addition, the newsletter reminded farmers that box or beater-type spreaders designed for wet, high-density manures generated from dairy operations cannot be calibrated below 3 to 4 tons of per acre and thus not reliable enough for poultry manure application rates. The newsletter said, “Only through field calibration can the correct spreader settings be determined to achieve the required application rate.”

To adjust the application rate until the desired application rate is achieved, farmers can either use the (1) tarp method, (2) the swath width and distance method, or (3) the loads per field method and adjust the: a) height of the spreaders’ “endgate” (the rear door), b) driving speed (for spreaders with PTO-driven conveyers), or c) speed of the conveyer (for spreaders with a hydraulic conveyer drive) (DNMC, Spring 2001). Most farmers ask their county Extension agent to work with them to calibrate their manure spreader because in the words of one Maryland county Extension agent, “it’s a time-consuming, tiring, and dirty job.”

After the calibration, farmers are advised to keep a healthy set-back in their spinner spreaders from surface waters and ditches given that the swath of the majority of manure streaming out is about 20 feet on either side of the spreader, though chunks of manure can easily be flung 60 to 90 feet. Most farmers on the Delmarva Peninsula, given my personal observation driving across the Peninsula, plant corn right up to the edge of permanent agricultural ditches and even streams rather than keeping a vegetative setback or what’s called a riparian buffer (riparian means stream). To ensure that manure does not enter the ditch, stream, or pond, the spinner spreader should be driven at least 20 feet away from the surface.

As mentioned earlier, the closer a farmer can apply organic sources of fertilizer (i.e. manure) to the time corn is planted, the better. And, if manure can be lightly incorporated without ruining the no-till tillage system, that can reduce ammonium volatilization losses. The decision to incorporate the manure under no till conditions remains a scientific conundrum, however. No formal guidance has been issued from the Cooperative Extension Service about manure incorporation though many scientists recommend it informally on cropland that is flat and there is little concern about soil erosion.

Farmer 23 from Worcester County provides some insight into the time it takes to apply poultry manure to crop fields:

> "I'll spread manure sometime between March and April. By April 1st, I like to have it done. I can do all 200 acres in 2 ½ weeks. I can spread about 20 acres per day. That's about 7 loads a day or about 1 load an hour."

This Worcester County farmer was describing the 200 acres of fields dedicated to growing corn on his 550-acre operation. The remaining fields were under the double crop wheat/soybean rotation. Thus for a small farming operation, it takes a one-man operation just under three-quarters of a month to apply the manure needed for his corn crop. This estimate of time does not include the time needed to return to each field every day to incorporate the manure since Farmer 23 does not do it. Further complicating the task is the role of weather. Springtime is known for its showers which prevent farmers from spreading because driving their heavy spinner spreaders across soggy ground will have deleterious compaction consequences for the soil and they could get stuck. In addition, applying manure during or right before a rain can increase the likelihood of nutrient runoff.

Plant the corn

After the manure has been applied which can take some farmers, depending on acres of corn cropland and how many spinner spreaders and drivers they have, over a month, the corn is ready to be planted. Farmers may choose to apply a mix of "starter" commercial fertilizer along with the corn seed containing nitrogen, phosphorus, potassium, and micronutrients. Typical commercial nitrogen fertilizers are 30% or 20% concentrated nitrogen. Most farmers inject the starter fertilizer right next to the seed and simultaneously while planting. Farmers that have not upgraded their equipment will use granulated commercial fertilizer and broadcast it after the corn has been planted.

Farmers have been encouraged in all three states to split apply their sources of nitrogen fertilizer due to the growth cycle of the corn plant. In a 1995 Nutrient Manager newsletter, Maryland Cooperative Extension Service explained:

> "In the spring, a corn seedling uses the nutrients stored in the seed to grow. For approximately a month after planting, corn has a shallow root system and grows at a relatively slow rate. During this early period, seedlings do not take up much nitrogen from the soil. When the corn is approximately a month old, it begins to grow rapidly. It is at this time that the crop requires an adequate supply of nitrogen and has the root system needed to absorb it. Synchronizing the presence of nitrogen and the period of rapid crop uptake can maximize nitrogen's use and minimize its potential for loss.
>
> Split applying nitrogen fertilizer, applying a small quantity (<+ 50 pounds per acre) as a starter and the rest as a side-dress at the appropriate crop stage, synchronizes the time that the nitrogen is supplied with the time that the crop's nitrogen is needed." (MCE, 1995 Nutrient Manager)

Take the PSNT test to consider applying sidedress

Thus, farmers have been encouraged in all three states to apply a minimal amount of nitrogen before the crop is planted or grown in the form of manure or commercial fertilizer and then to apply the rest of the crops nitrogen needs later in the corn's growing phase. When corn is about a month old and about 6 to 18 inches tall, it is approaching its "peak nutrient uptake period." At the same time in late May, the temperature of the soil rises and soil microbial activity increases which mineralizes the organic nitrogen from the manure transforming it into absorbable inorganic nitrogen and contributing to peak inorganic nitrogen levels.

The Nutrient Manager newsletter explains:

> "This period, immediately before rapid nitrate uptake and coinciding with peak soil nitrate levels, is the window of opportunity to perform a PSNT (a pre-sidedress nitrogen test). A PSNT taken at this time will accurately measure the quantity of nitrate present at a specific field at a specific time

> and will allow a grower to determine if sidedressing is actually necessary. Then is the PSNT shows that the soil nitrate level is inadequate for corn production, the test can be used to determine the appropriate side-dress nitrogen rate.
>
> The goal of good nitrogen management is to synchronize the period of rapid crop uptake with the availability of an appropriate amount of inorganic nitrogen and to end the season with litter residual nitrogen, thereby minimizing what is lost to the environment." (UMDCES, 1995 Nutrient Manager)

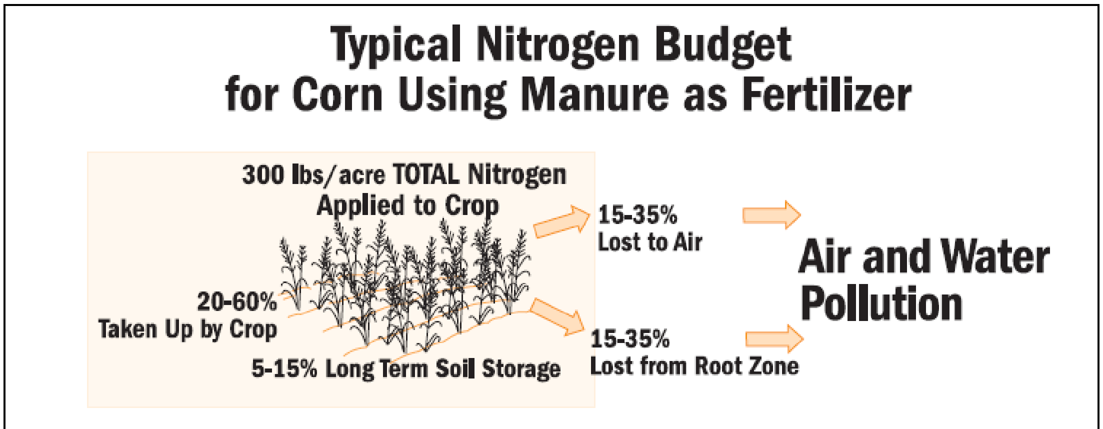
Why farming is an inherently leaky business

Given the description of residual nitrogen from previous applications of manure and legumes provides some insight into the technically challenging aspects of farming to achieve the dual goals of raising profitable crops and protecting the environment. The nutrient nitrogen, regardless of source is inherently a challenging nutrient to manage. A 1996 Nutrient Manager newsletter called "Focus on Nutrients and the Hydrologic Cycle" explained that "crops are not efficient at removing fertilizer and manure nitrogen from the soil during a growing season." Even under "the best of circumstances" – using commercial nitrogen sources at economically optimal rates – the average recovery of nitrogen fertilizer by corn was only 35 percent." Thus, the unused or residual 65% of the remaining nitrogen is "vulnerable to leaching before the next cropping year, particularly during the fall and winter if precipitation occurs when no actively growing crop is on the field."

Using analysis by the US Department of Agriculture's Agricultural Research Service (ARS) and the University of Maryland, the Chesapeake Bay Foundation succinctly described in a 2004 report, the inherent difficulties to use manure fertilizer as a source of nitrogen and provided the figure below:

> "Recent research at the University of Maryland and the USDA has shown that if manure is not properly incorporated into the soil, 15 to 35% of its nitrogen can volatilize, escaping into the air. Most of the remaining nitrogen is in a form that plants can't use until soil bacteria decompose it, and that process takes time.
>
> About 50% of the manure nitrogen is unavailable to the plant during the first growing season and remains in the soil after the crop is harvested, making it susceptible to leaching and runoff. An additional 20% of the total nitrogen may be broken down by bacteria and available for the next year's crop. Of the amount that is unused by the crop, 5 to 15% stays in the soil for numerous years.
>
> The exact fate of manure's nitrogen will vary from year to year depending on the weather conditions, plant growth, and a farmers' management practices. However, in general, over a typical two-year crop cycle roughly 50% of the manure nitrogen applied to the land may be vented into the air or washed into ditches and streams and eventually may enter local waterways and the Bay."

Figure 3.3. USDA:Typical Nitrogen Budget for Corn Using Manure as Fertilizer



Source: USDA Agricultural Research Service, 2004

Phosphorus policy after the state nutrient management laws

The new phosphorus science

A concern about phosphorus as an environmental pollutant arose in the 1990s as emerging research showed that phosphorus did not exist solely as particulate phosphorus but also could exist in the form of soluble phosphorus. Previously, Cooperative Extension scientists and Soil Conservation District personnel encouraged farmers to manage soil erosion to prevent reduced soil fertility and reduce sediment pollution to streams and lakes. By managing soil erosion, these experts told farmers they would also be managing the particulate phosphorus adhering to the soil particles. However, new research was emerging demonstrating the soluble phosphorus could runoff in water runoff even if soil was not being eroded and could move laterally through the soil column in what's called "sub-surface lateral flows" that discharge into surface water streams.

Thus, the state nutrient management laws provided the turning point for scientists and educators to discuss the new science with farmers to call their attention to the problem of soluble phosphorus and the problem of using manure as the dominant source of nitrogen to grow corn.

Prior to the state nutrient management laws, typical broiler manure had about equal amounts of nitrogen and phosphorus. However, since corn nitrogen uptake is about 1 lb per bushel while corn phosphorus uptake is only 0.4 lbs per bushel, applying poultry manure on a nitrogen basis resulted in about four times too much phosphorus. Thus, over the years, phosphorus was building up in the soils on the Delmarva Peninsula receiving poultry manure. Recent research indicates that some soils can reach a saturation point, typically around 30 percent, when the phosphorus will begin to move laterally through sub-surface flows and discharge into surface waters.

Management options for fields with “excessive” phosphorus

After the state nutrient management laws, the focus on soluble phosphorus posed significant changes to farmers generating manure and using manure to grow corn. Each state adopted different phosphorus management policies. For farmers using commercial fertilizer only, each state required that phosphorus application shall not exceed the crop nutrient needs over the crop rotation based on a soil test. Thus, phosphorus-based management for commercial fertilizer users was relatively easy to adopt because of the ability to purchase commercial fertilizer mixes with little to zero inorganic phosphorus. For organic manure users, phosphorus management is more complicated as a policy had to be established to determine when and how manure phosphorus management would occur. Maryland’s law prescribes the use of the Maryland Phosphorus Site Index to determine how much manure may still be applied to soils that were high in phosphorus. Delaware’s law adopted a three-year phosphorus crop removal policy as the default application rate while its Phosphorus Site Index was being developed. Virginia’s law prescribed the development of a phosphorus policy but set as an early default “phosphorus application rates shall not exceed the greater of crop nutrient needs or crop nutrient removal.” By 2005, Virginia provided farmers with three management options: soil test recommendations for commercial fertilizer users and for manure users: a threshold approach and Phosphorus Site Index.

In brief, Phosphorus Site Indices attempt to determine how much environmental risk can be expected from crop fields with high agronomic phosphorus soil test results. The PSI places a field’s likelihood for phosphorus loss into one of four categories. Three of the four categories indicate that some risk of loss is possible and prescribes a level of nutrient management corresponding to that level of risk.

Maryland’s first PSI was developed to satisfy Maryland’s law, took into account:

a) Six factors associated with phosphorus loss potential due to site characteristics (soil erosion, soil runoff class, subsurface drainage, leaching potential, watershed code, and distance to water) and
b) Five factors associated with P loss potential due to management practices, soil test and source characteristics (soil test phosphorus, planned P fertilizer application rate, P fertilizer application method and timing, planned organic P application rate, and organic P application method and timing).

The PSI developed in Delaware is identical to that of Maryland while the PSI developed in Virginia is slightly different. As of 2010, Delaware and Maryland are in the process of updating their PSI. (MCE, 2001) The table below reflects Maryland and Delaware’s existing PSI.

Note that the medium, high, and very high PSI categories all require manure users to manage on a phosphorus basis to varying degrees of intensity. The “high” PSI category restricts phosphorus application from manure to the crop removal rate which resembles Delaware’s three-year crop removal default policy. In addition, however, the PSI in Delaware and Maryland require “all best management practices for reducing P losses by erosion, runoff or leaching to be implemented.” In the “very high” PSI category, phosphorus loss is very likely and thus no application is allowed resulting in a “ban” of manure on these fields and “active remediation techniques” to reduce phosphorus loss potential from these fields.

Table 3.1. Maryland's and Delaware's Phosphorus Site Index		
P Loss Rating	**PSI Category**	**Management Rules**
0 -50	LOW potential for P movement from this site given current management practices and site characteristics	N-based nutrient recommendations are acceptable for this site. Soil P levels and P loss potential may increase in the future due to continued N-based recommendations.
51 - 75	MEDIUM potential for P movement from this site given current management practices and site characteristics.	N-based nutrient recommendations 1 year in 3. P based recommendations 2 years in 3. P applications limited to amount expected to be removed from field by crop harvest or soil test-based P application recommendations, whichever is greater.
76 - 100	HIGH potential for P movement from this site given current management practices and site characteristics.	P-based nutrient recommendations for this site. P applications limited to amount expected to be removed from field by crop harvest or soil test-based P application recommendations. All BMPs for reducing P losses by erosion, runoff, or leaching should be implemented.
> 100	VERY HIGH potential for P movement from this site given current management practices and site characteristics.	No P should be applied to this site. Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.

Due to the significant amount of time required to conduct the PSI on fields with high soil test phosphorus, most farmers and their advisors in Delaware select the state's three-year crop phosphorus removal rate policy over the PSI option. In brief, a three-year "crop removal" policy for phosphorus involves only adding the amount of manure and commercial phosphorus that will be removed by the three-year's worth of rotating crop in the harvested portion of the crop (e.g. the grain, silage, or hay). This is not to be confused with "crop nutrient uptake" which is the total amount of nutrients taken up in the entire crop including the grain, the roots, and stover (i.e. the stalk and leaves) – all which except the harvested grain can remain in the field.

Thus, the under high soil phosphorus conditions, farmers who want to continue using manure sources of fertilizer are allowed only to apply an amount that will be removed by the three-years worth of crops at harvest, representing a steady-state equilibrium where the same amount of phosphorus that is added is then removed at the end of the crop rotation. Delaware's policy does not then "draw down" the reserves of phosphorus in the soil but it does not increase the already high concentrations of phosphorus in the soil.

The University of Delaware College of Agriculture and Natural Resources published in 2002 its sixth Nutrient Management newsletter giving several examples of what the three-year crop removal phosphorus policy would mean for six different crop rotation conditions. Under the most typical crop rotation – the corn-wheat/soybean-corn three year crop rotation, the scientists Sims and Campagnini illustrate that a 150 bushel/acre corn crop will remove 60 lbs of P205/ac in year 1, the 70 bu/ac wheat crop and 35 bu/ac soybean crop will remove 70 lbs P205/ac in year 2; while the 150 bu/ac corn crop will remove 60 lbs P2)5 in year 3. Thus, the 3-year crop phosphorus removal rate is 190 lbs P2O5/ac.

Next, the scientists showed a four-step calculation process to grow this rotation using 3 tons/acre of broiler manure given the state average P2O5 content of 70 lbs/ton. The scientists demonstrated that this 3 ton/ac rate applied in the first year to the corn crop in combination with 25 lbs P2O5/ac starter commercial fertilizer, no phosphorus applied to wheat or soybeans in year 2 and then only another 25 lbs P2O5/ac starter fertilizer applied to the corn in year 3 would result in an excess of 70 lbs of P2O5/acre. However, if the farmer lowered his manure rate from 3 to 2 tons/acre, then the system would be in balance for phosphorus. That is, only 190 lbs P2O5/ac would be applied via manure and starter fertilizer over the three-year four crop rotation and all 190 lbs P2O5/ac would be removed by the harvested corn, wheat, and soybean grains over the course of three years.

What was not included in this discussion of the three-year crop phosphorus removal policy, however, was the extra amount of commercial nitrogen fertilizer the farmer would have to purchase to make up for the 30 to 50 or so lbs of plant available nitrogen he was relying on to grow the corn with manure. The example also points out that no manure is applied to the soybean and wheat crops to meet either their nitrogen or phosphorus needs which some farmers continue to do. Hence, phosphorus-based management of manure necessitates purchase of additional commercial nitrogen fertilizer to grow the crops which raises the input costs of crop production.

Virginia's phosphorus site index appears less rigorous than that of Maryland and Delaware. Like in Delaware, most farmers opt out of having a PSI conducted on their fields and select Virginia's "Phosphorus Environmental Thresholds" policy instead. In brief, the policy establishes various maximum phosphorus application rates in three regions of the state and three categories of phosphorus soil test categories. In the Eastern Shore Threshold:

- Fields with soil test results under 55 (Mehlich 1) parts per million (ppm), "phosphorus applications should be managed to reduce adverse water quality impacts";
- Fields with soil test results between 55 to 135 P ppm, "phosphorus applications shall not exceed crop removal"; and
- Fields with soil test results greater than 135 ppm, "no phosphorus shall be applied during the life of the plan."

Hence, Virginia's environmental threshold policy appears to be a combination of Delaware's three-year crop removal policy and Maryland's PSI policy which calls for no application of P. (VDCR, 2005)

Adoption rates of nutrient management practices in Maryland and Virginia and the Delmarva Peninsula before the state laws

Given all of these many challenges to optimizing nutrient application and minimizing environmental losses, it is important to appreciate what level of adoption of best management practices or participation in farm conservation programs was occurring on the Delmarva Peninsula before the state nutrient management laws.

I am aware of only four such surveys of crop farmers and animal producers conducted prior to the three states' nutrient management laws. Two surveys were focused on Maryland: Smith (1999) and Lichtenberg (1996). One survey focused on poultry growers in all three states on the Delmarva Peninsula: Michel et al. (1996). And one survey was conducted in 1992 in Virginia by Pease.

Overall, these the Smith, Lichtenberg, and Michel et al. studies paint a picture of relatively limited to poor adoption of best management practices regarding the basic soil, manure, and nutrient management issues before the state nutrient management laws. In addition, the Pease study reveals that livestock and poultry producers tended to apply manure at higher rates than applied by crop farmers and those rates could be considered "disposal" rates rather than agronomic (rates needed by the crop to grow). Finally, the Smith study reveals that private consultants tend to recommend greater nutrient application rates than public sector planners.

Lichtenberg (1996) summarized the results of two statewide surveys of Maryland farmers regarding soil conservation and manure management practices. In 1995, half of the state's farmers with crops had adopted the best management practice of conservation tillage and thus were taking advantage of the savings in diesel fuel and the advantages of reduced soil erosion and improved soil fertility from the organic matter left in the harvest crops roots, stalks and leaves. About 40% of the farmers in the statewide surveys planted cover crops and thus were taking advantage of the nitrogen fixing benefits of legumes and the added organic matter and soil tilth benefits. Another 40% incorporated both chemical and manure fertilizers into the soil to reduce runoff or volatilization.

These BMP adoption rates are notable for two reasons. On the one hand, it appears that many Maryland farmers are taking advantage of the indirect economic benefits provided by these BMPs and are providing environmental benefits to society and their neighbors downstream. On the other hand, these BMP adoption rates do not appear high – none of them are greater than 50 percent. Thus, it is remarkable that they were not higher given the significant amount of funding, administrative infrastructure, and political attention that Maryland has given to its 1989 Voluntary Nutrient Management Program and the availability of additional federal USDA funds and technical assistance. Thus, the success of the voluntary technical and financial assistance approaches to nutrient management practices pre-Pfiesteria appear limited.

In contrast to the moderately successful BMP adoption rates reported above, Lichtenberg found that only 25 to 35% of Maryland farmers with livestock and poultry operations reported having animal waste storage facilities. This finding is alarming as it suggests that because manure storage facilities allow farmers to appropriately use the manure as a resource, at a majority of the animal operations in the state without storage, inappropriate amounts of manure may have been applied to cropland or inappropriate timing of applications may have been occurring. Though many farmers have informal agreements or formal contracts with their neighbors to haul the manure away for use on their neighbors' crop fields, without a manure storage facility, there still is a high risk that manure will be applied to cropland at the wrong time and the wrong rates given the pressure "to get rid of it."

In 1992, Pease conducted a survey of nutrient, pesticide, and cropping practices in two regions in Virginia, the intensive cropping region in the Northern Neck of Virginia and in Rockingham County in the Shenandoah Valley. Pease told me that his study:

> "provided a wealth of information about farmers' attitudes about water quality and nutrient applications to their land. It showed a remarkable, though not surprising lack of sense of risk to the environment of the practices they were conducting on farmland. The good news is that things have changed dramatically in last 18 years since the study.
>
> We found that crop farmers applied manure at agronomic rates (for nitrogen) and very few of them were piling it on because they were driven by the economics. But the livestock farmers (dairy and poultry) who had to dispose of manure paid very little attention to recommend application rates.
>
> We estimated that average P applications were 64 lbs greater per acre than recommend levels. The ones with the most over application were the combined poultry-dairy farms because the farm was sized for the dairy herd but over time, they would add chicken production and that would generate too much for the farm." (Pease, personal communication, March 16, 2010)

In 1999, Smith published an evaluation of Maryland's Nutrient Management Program conducted in 1997. Smith's study involved a) farmers with voluntary nutrient management plans prepared either by the Cooperative Extension Service or by private consultants and b) farmers that did not have a plan. Thus, three groups of farmers were located to represent those with public plans, private plans, and no plans. Like Lichtenberg's review, Smith also found that BMP adoption rates were low. Smith found that overall, all the farmers that said they implemented BMPs related to nutrient management other than those found in their plans, just 38% planted vegetative buffers, 23% planted unfertilized cover crops, and 20% used the pre-side dress nitrate test (PSNT) with corn.

Smith also found several differences between plan and no-plan farmers but she did not indicate whether differences were statistically significant or not.

In terms of taking nitrogen credits, Smith reported statistics for the whole sample. Of the 79% of farmers that grew legume crops like soybeans, only 55% said they take credits for the residual nitrogen when planning the next year of crops. Of the 73% of farmers using manure on crops, only 42% said they took the residual nitrogen credit for manure.

In terms of manure best practices, Smith revealed that overall, there appeared to be some differences between plan and no-plan farmers and only in a few instances were adoption rates of important practices widespread. About half (54 percent) of the plan-farmers calibrated their manure application equipment while only 35% of the no-plan farmers reported doing so. About half (54 percent) of both groups of farmers reported applying manure during the most environmentally risky months in winter (November through February). A large portion (70 percent) of plan farmers said they conduct manure nutrient analysis but only 34% of no-plan farmers said so. Just 65% of the plan farmers and 54% of the no-plan farmers use a manure storage facility.

Although all of these Maryland surveys included poultry growers in their samples, a Master's student at the University of Delaware and her professors specifically surveyed the nutrient management attitudes and practices of 2,000 poultry growers (over 75% of the population of growers) in the Delmarva region in 1996. From the 562 plus poultry growers that responded to the survey, Michel et al. (1996) found that only 46% had a litter storage facility. This low adoption rate of manure storage facilities found in poultry growers across all three states on the Peninsula again confirms the concerns about inappropriate storage and management of the manure, as well, as potentially inappropriate timing for manure application, even if all the growers had informal or formal agreements with their neighbors to take the manure.

Regarding BMP adoption rates related to crop production, Michel et al's study is difficult to interpret. In all, 210 of the 562 growers (37 percent) reported that they raised crops on their own land or on rented land. And even though 192 of the 562 growers (34 percent) said they had a nutrient management plan, only 78 of the 218 growers (36 percent) responding to the question about how they determine their manure application rate said they used a nutrient management plan. Thus, it can be inferred that only about a third of the crop farmers in the poultry grower survey were using a nutrient management plan to guide their manure application decisions.

Regarding how the remaining respondents to the question were determining manure application rate, another 37% (80 / 218) said they use soil tests, 19% (41 / 218) said they use yield records, while 9% (19 / 218) said they used conservation plans. As discussed earlier in this chapter, soil tests may be an acceptable method of determining manure application rates if the soil test lab calculates residual nitrogen credits for legumes and manure and adheres to the Sufficiency Concept of making nutrient management recommendations. The two remaining methods for determining how much manure to apply to crops, yield records and conservation plans, are an inadequate methods and likely untrue responses since conservation plans focus on soil erosion prevention and do not provide information about nutrient or manure management.

Regarding frequency of manure spreader calibration, only 142 growers responded to this question despite there being at least 210 crop farmers suggesting there may be a social desirability bias problem with this high non-response rate (32 percent). Surprisingly, respondents to the question report very frequent and ideal manure calibration practices: 104 of the 142 (73 percent) said they calibrate annually or more often (two times a year or at each application).

Regarding frequency of manure testing, only 93 growers in Michel et al's survey responded to this question, thus, 66% of the 210 crop farmers did not respond to this question indicating another social desirability bias. Surprisingly, 68 of the 93 respondents (73 percent) report very frequent and ideal manure nutrient testing: every year or more frequently.

Finally, in response to the question of which months was poultry manure applied to their own land, surprisingly 272 growers responded to this question – 62 more growers than the 210 that said they raised crops, indicating that at least 62 additional growers do land apply their manure to cropland they own but rent out to other farmers who raise the crops. The most popular months for land application were March and April as 192 and 180 of the 272 growers responding to this question, or 71% and 66 percent, respectively. As described by DP, these are the months when most farmers apply poultry manure for their April 15th corn crop. Between 30 and 43% (82 to 117 growers) responding to this question said they applied manure to land during the most environmentally risky times of the year: November through February. To be fair, it was only after the state nutrient management laws that Virginia and Maryland came out with timing restrictions. Furthermore, Virginia's manure timing policy allows application for small grains (e.g.

wheat) in November and the last two weeks of February so if these growers were doing such a practice, then their behavior may not be regarded as inappropriate.

Michel et al. asked several policy-related questions reflecting pre-Pfiesteria and pre-nutrient management law perspectives. Though 66% of the respondents thought that water pollution was a serious threat to the Delmarva region, 36% thought there were too many regulations aimed at preventing water pollution. A large majority (78 percent) thought that the government should share the cost of agricultural pollution prevention practices and a smaller majority (60 percent) thought that society's desire for environmental improvement would ultimately reduce their income.

3.2 An introduction to farmers in this case study

Demographic characteristics

Recall that all farmers in each state in this dissertation were selected to represent the dominant agricultural land use on the Delmarva Peninsula: corn production and the dominant animal manure use to grow crops: poultry manure. Thus, all farmers in each state in this dissertation grow corn using poultry manure but not all of them were poultry growers.

Due to the non-random, non-representative nature of the "snow-ball" method to finding farmers in each of the three states to interview, it is not surprising that the majority of demographic variables are not statistically significantly different. Overall, the farmers sampled in this dissertation are more alike than they are different across the states in terms of demographic characteristics. This similarity helps to minimize significant differences between the states to the differences that may arise regarding their opinion of their policy development process, their level of administrative and adherence compliance, whether nutrient management practices changed in response to the law, or their acceptance of nutrient management science, that will be described in Chapters 5, 6, 7, and 8.

However, two demographic variables were statistically significantly different: proportion of acres owned and the type of planner chosen to develop their NM plan. Due to the snow-ball effect, this dissertation was unable to randomly assign the “treatment” of type of planner to “treatment” and “control” groups of farmers in each state. Doing so would have enabled the researcher to remove this variable as a possible factor influencing a farmers’ opinion about the policy process and level of compliance and thus allowing, only the effect of the state a farmer comes from to influence the outcomes. As will be discussed in this and future chapters, the type of planner preparing the required plan appears to be significantly related to how well farmers regard the plan and ultimately how well they may be following their plans.

Age

The average age of farmers in this dissertation is 49.8 years old which is younger than the average age of farmers reporting in the 2007 US Department of Agriculture Census of Agriculture as “principal operators” in each state (see tables below). The USDA Census is conducted every five years. The youngest farmer in this dissertation is 25 years old while the oldest was 82. There was no statistically significant difference in age of farmers in each state in this dissertation.

Table 3.2.a. Average Age of Farmers in Dissertation			
Simple statistics	**Mean (Std. Dev.)**	**Min.**	**Max.**
MD, N=30	50.1 (11.5)	30	72
DE, N=20	49.9 (13)	25	82
VA, N= 10	48.5 (10.3)	25	61
All, n=60	49.8 (11.6)	25	82

Table 3.2.b. Age in 2007 Census of Agriculture	
"Average age of principal operator"	
Maryland	57.3
Delaware	55.4
Virginia	58.2

AGE	Table 3.2.c. Age in Categories (p=0.964)				
Categorical statistics	**39 and under**	**40 to 49**	**50 to 59**	**60 to 69**	**70 and older**
MD, N=30	23%	20%	40%	13%	3%
DE, N=20	20%	35%	25%	15%	5%
VA, N= 10	0%	30%	40%	10%	0%

Educational attainment

Table 3.3.a Average Year of Educational Attainment			
Simple statistics	**Mean (Std. Dev.)**	**Min.**	**Max.**
MD, N=30	13.1 (1.8)	11	18
DE, N=20	12.7 (1.66)	10	16
VA, N= 10	12.8 (1.3)	10	14
All, n=60	12.9 (1.7)	10	14

The average number of years of education is 12.9 across the states (see tables below). Over 90% of the farmers in this dissertation finished high school. Between 37 and 60% of farmers in all states went on to obtain some college or finished a two-year technical degree. One farmer has a graduate teaching degree. The USDA Agricultural Census does not report educational attainment figures.

There was no statistically significant difference in education attained by farmers in each state in this dissertation.

EDC	**Table 3.3.b. Education in Categories (p=0.192)**				
Categorical statistics	**Didn't finish H.S. (<12 yrs)**	**Finished H.S. (12 yrs)**	**Some college or technical degree (>12 <16 yrs)**	**Finished college (16 yrs)**	**Graduate work (18 yrs)**
MD, N=30	3%	60%	17%	17%	3%
DE, N=20	10%	55%	30%	5%	0%
VA, N= 10	10%	30%	60%	0%	0%

Acres operated

The average size of cropland operated by farmers in this dissertation was 1,484 acres with a minimum of 81 acres in Maryland to a maximum of 5,000 acres in Delaware (see tables below). Average and median sizes of farms reported in the 2007 Census of Agriculture are much smaller than average and median sizes of farms in this dissertation because the Census reports statistics for all agricultural landowners, including those that do not farm themselves and those that are considered “hobby” farmers. This dissertation sought to focus on farmers whose primary occupation is farming. There was no statistically significant difference in acreage operated by farmers in each state in this dissertation.

Table 3.4.a. Total Acres Operated				
Simple statistics	Mean (Std. Dev.)	Median	Min.	Max.
MD, N=30	1,187 (1,051)	704	81	3,600
DE, N=20	1,739 (1,354)	1,150	370	5,000
VA, N= 10	1,866 (1,070)	1,750	500	3,500
All, n=60	1,484 (1,193)	1,104	81	5,000

Table 3.4.b. Farm Size 2007 Census of Agriculture		
	Average farm size (acres)	Median farm size (acres)
Maryland	150	52
Delaware	200	31
Virginia	171	70

ATC	Table 3.4.c. Acres in Operated in Categories (p=0.112)				
Categorical statistics	0 to 499 ac	500 to 999 ac	1000 to 1999 ac	2000 to2999	> 3,000 ac
MD, N=30	37%	23%	10%	23%	7%
DE, N=20	15%	20%	35%	15%	15%
VA, N= 10	0%	20%	40%	20%	20%

Owned versus rented cropland acres

There is a significant difference in the “proportion of acres operated that are owned” demographic characteristic (see tables below). Delaware farmers in this dissertation owned the greatest portion of acres they operated (50 percent) while Virginia farmers owned the smallest portion (17 percent). Maryland farmers, on average owned 36% of the acres they operated.

There is no corresponding statistic reported by Census of Agriculture. Although an imperfect comparison, I tried to use the Census data to find the percent of farmers in each state that are “full time farmers.” Thus, I divided the number of “principal operators who say farming is their primary occupation” in the Census by the number of farms in each state to find that 59% of Delaware farmers say their primary occupation is farming while 49% of Maryland and 43% of Virginia farmers also say so. Thus, there may be some correlation between the percent of farmers whose primary occupation is farming in each state with the percentage of operated acreage that is owned. If so, my dissertation finds are in line with the Census statistics.

Table 3.5.a. Proportion of Acres Owned by Farmers				
Simple statistics	**Mean (Std. Dev.)**	**Median**	**Min.**	**Max.**
MD, N=30	.36 (.29)	0.31	0.00	1.0
DE, N=20	.50 (.34)	0.49	0.03	1.0
VA, N= 10	.17 (.17)	0.12	0.00	0.5
All, n=60	.37 (.31)	0.32	0.00	1.0

(PAOC)**	**Table 3.5.b. Percent of Acres Owned in Categories (p = 0.075**)**				
Categorical statistics	**100%**	**0%**	**1 to 33%**	**34 to 65%**	**66 to 99%**
MD, N=29	3%	3%	52%	28%	14%
DE, N=20	5%	0%	35%	25%	35%
VA, N= 10	0%	30%	50%	20%	0%

Corn-wheat-soybean rotation

Half to 70% of all farmers in this dissertation are following a corn-wheat-soybean rotation in their crop production (see table below). This is considered as a beneficial rotation for soil fertility purposes and nutrient management benefits. Due to the poor prices wheat has been getting on the international commodity markets in the years prior to 2006 when the farmers were interviewed, between 25 and 43% of farmers did not plant wheat in their rotation.

CWS	**Table 3.6. Farmers following a Corn-Wheat-Soybean rotation** (p = 0.728)				
Categorical statistics	**Yes**	**Corn-soybeans**	**Corn only**	**Soybeans only**	**No response**
MD, N=30	50%	43%	3%	3%	0%
DE, N=20	70%	25%	5%	0%	0%
VA, N= 10	70%	30%	0%	0%	0%

Proportion of household income reliant on farming

Despite all the farmers in this dissertation identifying themselves as “full-time farmers,” or as part of “production agriculture” versus “hobby” or “part-time” farmers, many said they had to take a second or third job themselves or their wives worked to provide the family with health insurance and additional income. The average proportion of household income from farming was 78% with a median of 93 percent. Typical second or third jobs for farmers in this dissertation were driving school buses, driving trucks for vegetable companies, spreading clam shells on farm lanes, and other jobs.

Table 3.7.a. Average Proportion of Household Income from Farming of Farmers				
Simple statistics	**Mean (Std. Dev.)**	**Median**	**Min.**	**Max.**
MD, N=30	.77 (.28)	0.95	0.1	1
DE, N=20	.83 (.23)	0.97	0.35	1
VA, N= 10	.73 (.23)	0.70	0.5	1
All, n=60	.78 (.26)	0.93	0.1	1

PHIC	Table 3.7.b. Proportion of Household Income from Farming in Categories (p=0.552)				
Categorical statistics	**100%**	**75 to 99%**	**51 to 75%**	**50%**	**49% and less**
MD, N=30	43%	20%	3%	23%	10%
DE, N=20	45%	25%	10%	10%	10%
VA, N= 10	30%	20%	0%	50%	0%

Poultry growers

About half to 85% of all crop farmers in this dissertation also are poultry growers. Differences were not statistically significant. Each poultry grower, on average, raises about 117,535 chickens per flock which is just shy of the 125,000 bird threshold established by the Environmental Protection Agency (EPA)'s for being considered a "Large" Confined Animal Feeding Operation (CAFO). Median size flocks in Delaware and Virginia exceed the EPA threshold.

Table 3.8.a. Number and percent of farmers that are poultry growers		
Simple statistics	**Frequency**	**Percent**
MD, N=30	20	67
DE, N=20	17	85
VA, N= 10	5	50
All, n=60	42	70

PG	Table 3.8.b. Farmers that are Poultry Growers in Categories	p = 0.119
Categorical statistics	**Yes**	**No**
MD, N=30	67%	33%
DE, N=20	85%	15%
VA, N= 10	50%	50%

Table 3.9.a. Number of chickens produced per flock				
Simple statistics	Mean (Std. Dev.)	Median	Min.	Max.
MD, N=20	95,090 (80,191)	70,000	12,000	340,000
DE, N=17	138,200 (88,396)	135,000	34,000	350,000
VA, N=5	145,320 (70,781)	162,000	33,000	225,000
All, n=42	117,535 (83,506)	89,000	12,000	350,000

PCPF	Table 3.9.b. Poultry Capacity Per Flock in Categories (p=0.338)				
Categorical statistics	Not a Poultry Grower	49,000 and under	50,000 to 99,000	100,000 to 199,00	200,000 & greater
MD, N=30	33%	23%	20%	17%	7%
DE, N=20	16%	11%	26%	26%	21%
VA, N= 10	50%	10%	0%	30%	10%

Choice of nutrient management planner

There is a statistically significant difference (p=0.010***) between the states to the 99% confidence level regarding the types of individuals that farmers chose on to develop their plan (see table below). The majority of regulated farmers in Virginia (60 percent) and Delaware (85 percent) in this study relied on the private sector for plan writing while only 40% of Maryland farmers did so. Private sector planners include crop consultants and fertilizer company representatives that are certified by the respective states to prepare the required plans. Public sector planners include Cooperative Service Extension specialists, Soil Conservation District specialists, and Virginia Department of Conservation and Recreation specialists.

Table 3.10. Who prepares your state-required nutrient management plan? (CPF, 0.010*)**

# of Farmers	Public Planner	Private Planner	No response
MD=30	56%	40%	3%
DE=20	10%	85%	5%
VA=5	40%	60%	0%

Table 3.11. State estimates of the percent of farmers using private-sector planners, statewide	
Maryland	19%
Delaware	84%
Virginia	17%
MD Source: Maryland Department of Agriculture. 2007 Nutrient Management Program Annual Report.	
DE Source: Delaware Nutrient Management Commission. Average estimated from the data in the 2003 to 2008 Annual Reports.	
VA Source: Virginia Department of Conservation and Recreation. 2008 data provided upon request from Emily Aleshire, Nutrient Management Coordinator -- Animal Waste.	

This significant difference is interesting as it does reflect the trend statewide in Delaware for most farmers to choose private consultants; is the opposite the trend statewide in Virginia where most of the regulated poultry growers choose specialists at the Department of Conservation and Recreation and other public planners to write their NM plans, and only a minority of farmers statewide in Maryland choose private planners (see tables above).

As will be discussed in Chapters 6, 7, 8, and 9, the choice of planner is potentially a significant factor related to a farmer's opinions about their plan and thus, the likelihood of adhering to the plan. Furthermore, states put forth varying degrees of effort to determine if plans prepared by private sector consultants are no different in quality from those prepared by public sector consultants. Many stories by farmers in this dissertation suggest that some private sector planners are not adhering to the nutrient recommendation guidelines established by the land-grant universities when they prepare their plans. Two studies by Smith (1999) and by Lawley et al. (2007) indicate that there is a difference in nutrient recommendations between plans prepared by private planners and those prepared by public planners. Smith also found a difference in the degree of implementation by farmers of the nutrient recommendations depending on who made them.

Smith's 1999 statewide study of Maryland farmers with public plans, private plans, and no plans found serious differences between farmer nutrient management behaviors depending on who was preparing their plan. Farmers with nutrient recommendations from Extension agents complied with the plans on less acreage (62% of planned acres) than farmers with management plans prepared by private consultants (82% of planned acres). Furthermore, Smith found that:

> "Private consultants recommended the application of more nutrients (over and above nitrogen credits) than did (public planners), and farmers with private plans stayed within their recommendations on a greater portion of their planned acreage than did the (public plan) group."

In addition, public plan farmers "applied more nitrogen, phosphate, and potash than was recommended for wheat/soybeans and for nitrogen on soybeans." Private consultant recommendations were greater than those of the public planners by 25 to 50 lbs per acre for nitrogen (corn and wheat/soybeans) and 17 to 43 lbs per acre for potash (wheat/soybeans and soybeans). Surprisingly, for phosphate, public planners recommended 25 to 59 lbs per acre more than private consultants (corn, soybeans, and wheat/soybeans). Most alarming was that was that

> "animal producers who used manure on their crops did not receive recommendations from consultants for use of manure on crops under plan. This disparity between recommendations and manure use was greatest for private-plan farmers where more than twice as many animal producers used manure (88 percent) as received recommendations to do so for their crops (35 percent)."

Lawley et al. (2007) found systematic differences in recommendation rates for fertilizer application amongst the type of person preparing the nutrient management plan. Reviewing data from Maryland's then voluntary nutrient management program database from 1997, fertilizer dealers and independent crop consultants recommended increases in commercial fertilizer application rates more frequently than all other plan preparers. Extension and other certified personnel (typically farmers preparing plans for other farmers) recommended no change in application rates most of the time, otherwise recommending decreases. Farmers preparing plans for their own operations almost always recommended decreases.

These findings indicate some evidence for the concern that fertilizer dealers and private consultants are likely recommending nutrients at rates that are greater than considered defensible by land-grant universities. Plus, Lawley et al. point out, if farmers preparing their own plans consistently decrease their application recommendations, this suggests there is “hidden information” on the part of the farmer and evidence suggesting that lower rates can still result in profitable crop production.

Use of basic nutrient management practices

Rule of thumb for how much nitrogen it takes to grow corn

As described earlier in this chapter, the rule of thumb in the Mid-Atlantic region for corn production for the amount of nitrogen typically needed to grow is 1 lb of nitrogen to 1 bushel of corn. The non-response rate for Delaware exceeds the 30% threshold while for Maryland and Virginia is at or just under the 30% threshold, reflecting some difficulty in pinning farmers down on their specific nutrient application practices. There is no statistical difference in responses between states.

ROTNFC	**Table 3.12. What is your Rule of Thumb for Nitrogen on corn? (lbs N/bu corn)**			
p=0.437	**1 lb N/bu**	**<1 lb N/bu**	**>1 lb N/bu**	**No response**
MD, N=30	**53%**	10%	10%	27%
DE, N=20	**30%**	20%	5%	45%
VA, N= 10	**50%**	0%	20%	30%

MD Rules or Guidance	Guidance: " Field Corn for Grain: Apply 1.0 lb N/ bushel of expected grain yield up to 250 bu/A. No additional nitrogen is recommended for yield goals above 150 bu/A." Source: Maryland Department of Agriculture. Table 1. Plant Nutrient Recommendations Based on Soil Tests and Yield Goals for Corn Grain and Sorghum Grain Production.
DE Rules or Guidance	Guidance: "University of Delaware nitrogen (N) recommendations for grain corn production are based on an N rate of 1 lb N per bushel of expected yield (I.e. a realistic yield goal of 150 bu/ac should receive a maximum of 150 lbs N/ac." Source: University of Delaware. Soil Testing Program's Subsection 3A: Nutrient Recommendations Agronomic Crops. Last Revised 4/03.
VA Rules or Guidance	Guidance: "To determine nitrogen needs for corn yields above those listed in Table 1-2, Estimated Yields in Bushels or Tons per Acre of Various Non-Irrigated Crops for Identified Soil Productivity Groups, use 1 lb of nitrogen per bushel for grain yields,..." Source: Virginia Department of Conservation and Recreation. Nutrient Management Standards and Criteria. Revised October 2005.

The largest group of farmers in all three states (30 to 53 percent) reported they do believe in and use the 1 to 1 ratio when applying nitrogen for corn production. Only 10 to 20% of Maryland and Delaware farmers respectively say they believe that they can apply less than the 1 to 1 ratio and still be satisfied with their crop. Another 5 to 20% of farmers in all three states say they believe it takes more than the 1 to 1 ratio to grow their corn crop and offered alternative rates of between 1.1 to 1.4 lbs of nitrogen to raise one bushel of corn. Without a thorough review of these farmers’ plans and records by a nutrient management specialist, it is impossible to interpret that these rates are inappropriate although they exceed the regional norm.

Use of starter fertilizer on corn

A large majority of farmers in all three states (70 to 80 percent) reported using starter fertilizer on their 2005 corn crop while only 10 to 25% say they don’t need it (see table below). As described earlier, starter fertilizer refers to using a commercial fertilizer mix that is applied in the same pass as the planter is planting the corn. There is no formal guidance from the land-grant universities regarding starter fertilizer and most say they leave it up to the farmers who may or may not have a preference for using starter fertilizer. All but two farmers use a liquid form of starter fertilizer and are no longer using granular fertilizer that needs to be broadcast into the air and is prone to environmental losses and waste.

DYUSFC	**Table 3.13. Use of Starter Fertilizer on Corn**		
p=0.803	**Yes**	**No**	**No response**
MD, N=30	77%	20%	3%
DE, N=20	70%	25%	5%
VA, N= 10	80%	10%	10%
MD Rules or Guidance	Guidance: Split-applying nitrogen fertilizer, applying for a small quantity (less than or equal to 50 pounds per acre) as a starter and the rest as a side-dress at the appropriate crop stage, synchronizes the time that the nitrogen is supplied with the time that the crop's nitrogen is needed. Source: University of Maryland Cooperative Extension Service. "Focus on Nitrogen." Nutrient Manager Newsletter. Summer 1995.		
DE Rules or Guidance	No rules or guidance found.		
VA Rules or Guidance	Rules: "If no pre-plant nitrogen will be broadcast and planting conditions exist where the cold soil temperatures may be limiting mineralization of nitrogen, starter nitrogen may aid in plant establishment and early season growth." Rules: Virginia Department of Conservation and Recreation. Nutrient Management Standards and Criteria. Revised October 2005.		

Use of commercial phosphorus fertilizer to grow corn

A majority of farmers in all three states (57 to 75 percent) do not use commercial phosphorus fertilizer to grow corn while between 15 to 40% do (see table below). Without access to their nutrient management plan or records, it is impossible to determine whether those who are using commercial phosphorus fertilizer should be using it. It is a positive finding that 57 to 75% of the farmers in this dissertation say they did not use commercial phosphorus to grow corn given the fact that all of them are either poultry growers or long-time manure users (except one) and as will be described later, the majority of their fields are high in phosphorus already. None of the states have any regulatory requirements for use of commercial phosphorus and only Virginia and

Maryland provide voluntary guidance to their farmers about how much starter phosphorus is advised.

DYUCP	Table 3.14. Use of Commercial Phosphorus Fertilizer to Grow Corn		
p=0.277	**Yes**	**No**	**No response**
MD, N=30	40%	57%	3%
DE, N=20	15%	75%	10%
VA, N= 10	40%	60%	0%
MD Rules or Guidance	Guidance: "For corn yield goals above 140 bu/A, adjust P205 as follows: 1. If phosphorus soil test index is less than 51, increase P2O5 0.6 lb/A for each bushel of expected yield above 140 bushels. If phosphorus soil text index is between 51 and 100 lb/A, increase P2O5 0.3 lb/A for each bushel of expected yield above 140 bushels. 3. If phosphorus soil test index is greater than 100, no adjustment is necessary."Source: University of Maryland Cooperative Extension Service. Soil Fertility Management, SFM-1		
DE Rules or Guidance	No rules or guidance found.		
VA Rules or Guidance	Rules for regulated: "Primary Nutrient Availability for Manures. Manure Phosphorus: Available P2O5 = Manure Analysis P2O5 If soils are testing M+ or above in phosphorus and the manure will supply enough phosphorus for the crop according to the formula Available P2O5 = Total P2O5, no fertilizer phosphorus should be used due to unlikely crop response and water quality concerns. For soils testing Medium or below, starter applications of fertilizer phosphorus should be made even if the manure contains sufficient phosphorus since it is contained in slow release organic forms. For soils testing low, higher levels of phosphorus starter fertilizer are recommended."Source: Virginia Department of Conservation and Recreation. Nutrient Management Standards and Criteria. Revised October 2005.		

Manure incorporation

Approximately half the Maryland and Delaware farmers report incorporating the manure they applied on corn cropland while none of the Virginia farmers said they incorporate. Eighty percent of Virginia farmers said they do not incorporate. There is a statistical difference between states to the 99% confidence interval.

MIC***	Table 3.15. Manure incorporated on corn		
p=0.009* **	**Yes**	**No**	**No response**
MD, N=30	47%	37%	17%
DE, N=20	55%	20%	25%
VA, N= 10	0%	80%	20%
MD Rules or Guidance	No rules or guidance found.		
DE Rules or Guidance	No rules or guidance found.		
VA Rules or Guidance	No rules or guidance found.		

None of the three states' laws have any regulatory requirements regarding incorporation of manure and I did not find any voluntary guidance either. Over the last few years, the scientific community has been increasingly advocating light incorporation of manure on flat crop fields in order to lower the loss of ammonia nitrogen to the atmosphere though there has been no formal guidance written on this manure management technique. The guidance is controversial, however, since the majority of Maryland's crop fields are under no-till management and it is uncertain how "light incorporation" of manure will negatively affect the no-till management that keep nutrients, soil, and carbon sequestered. In comparison to previous studies, Smith found that "plan" farmers were more likely than "no-plan" farmers to incorporate manure on the same day of application.

Reported phosphorus field conditions and possession of a P-based plan

Soil test phosphorus content in the majority of fields operated

About half the Maryland and Delaware farmers (57 and 55 percent, respectively) said that the soil phosphorus values in the majority of the fields they operate were "very high" or "excessive" while 30% of Virginia farmers said so. There is no statistical difference between the states. (see table below)

SPV	**Table 3.16. What are the soil phosphorus values in the majority of your fields you operate?**					
p=0.268	**Low**	**Moderate**	**High**	**Very High**	**Excessive**	**No response**
MD, N=30	10%	13%	13%	30%	27%	7%
DE, N=20	10%	10%	20%	25%	30%	5%
VA, N= 10	10%	10%	0%	20%	10%	20%

Two years after the Maryland nutrient management law, Extension scientists in Maryland revised their phosphorus soil test categories from pounds of phosphate (P205) per acre categories to a Fertility Index Value (FIV) system that had a 0 to greater than 100 scale. In addition, the scientists changed the qualitative terms describing the different categories. The table provided below lines up the "old" categories with the "new" categories.

Thus, it is clear that the old term, "very high" and the new term, "excessive" are terms that mean the same thing: additional application of phosphorus is unlikely to produce a response in crop yield. Thus, half the farmers in Maryland (57 percent) and Delaware (55 percent) and a third of the farmers in Virginia who report the majority of their fields are either "very high" or "excessive" likely warrant no more phosphorus application through manure or commercial fertilizer sources.

Table 3.18 Comparing Old to New Phosphorus Soil Test Categories

Old categories	**Very Low**	**Low**	**Medium**	**High**	**Very High**
lbs per acre P205	0 - 29	30 - 61	62 - 102	103 - 205	> 205
New categories		**Low**	**Medium**	**Optimum**	**Excessive**
Fertility Index Value (4 categories in 25 point increments from 0 to >100 scale)		0 – 25	26 - 50	51 - 100	>100

Possession of a phosphorus-based nutrient management plan

Since a third to half the farmers interviewed in this dissertation report that the majority of their fields are already "very high" or "excessive" in soil test phosphorus, it is likely that they should have obtained a phosphorus-based nutrient management plan in order to manage manure sources for phosphorus. However, because I did not determine conclusively whether all 55 regulated farmers I interviewed should possess a phosphorus-based plan, I cannot conclude that possession of a nitrogen-based plan is inappropriate.

Based on implementation schedule alone, all farmers interviewed in 2006 about their 2005 nutrient management practices should have been operating under the following state rules regarding phosphorus-based nutrient management plans since:

a) Maryland's original WQIA deadline was not altered by the Erhlich Administration's 2004 amendments to the law: By July 1, 2004, all manure nutrient users were to possess a nitrogen- and phosphorus-based nutrient management plan and by July 1, 2005, they were to implement those plans.

b) Delaware's NML allowed "early cooperators" in 2001 and 2002 to obtain nitrogen-based plans, but those farmers waiting till they were contacted to come into compliance between 2003 and 2005 were required to obtain phosphorus-based plans. Thus, even early cooperators who had three-years plans should have upgraded to a phosphorus-based plan in 2005.

c) Virginia's PWL required that all plans prepared after October 1, 2001 must be phosphorus-based and that plans updated after December 31, 2005 would incorporate any potential new changes in phosphorus science policy.

When I asked farmers, "Do you have a nitrogen-based or phosphorus-based nutrient management plan?" I found it very difficult to quantify their answer and thus the non-response rate was high for Maryland and Delaware (see table below).

NOP p=0.244	**Table 7.2. Do you have a nitrogen-based or phosphorus-based nutrient management plan?**			
# of Farmers	**No plan**	**Nitrogen-based plan**	**Phosphorus-based plan**	**No response**
MD=30	3%	10%	40%	47%
DE=20	0%	15%	20%	65%
VA=5	0%	40%	40%	20%

The high rate of non-response is interesting in and of itself because it may reflect: a) a "social desirability problem" given some farmers' desires to avoid acknowledging they are out of compliance with their state requirement and should have obtained or upgraded to a P-based plan, b) a persistent discomfort when discussing phosphorus issues, c) a lack of knowledge about whether their plan is N- or P-based, or d) a lack of awareness that they should have obtained or upgraded to a P-based plan.

Despite the high rate of non-response, it is worthwhile to review the results. Of the regulated four Virginia growers that responded, two appear to be in compliance with their law's P-based plan requirements. Of the 15 Maryland farmers that provided responses to this question, 12 reported having a P-based plan while three said they had an N-based plan. Of the seven Delaware farmers that responded to this question, about equal numbers have an N-based plan as have a P-based plan.

Although it cannot be determined exactly why some farmers still had not upgraded to a P-based plan, there are reasonable explanations suggesting considerable confusion about what which plans (an N-based plan or a P-based plan) farmers should have been in compliance with and by when in Maryland and to a lesser extent, some confusion in Virginia. Delaware's rule was very clear and never wavered, thus the farmers in Delaware that report still having an N-based plan cannot blame their non-compliance on confusion about what was expected of them.

At the 2003 Maryland Agricultural Nutrient Management Summit many suggestions for changes were raised. However, only a few of those changes made it into the 2004 legislative amendments to the WQIA, and then it took until 2005 to update the regulations to reflect those amendments. The new and significant changes were: (1) farmers no longer were required to submit the entire NM plan to MDA when the plan was updated (only the initial plan was still required to be submitted) and (2) farmers were required to file a one-page Annual Implementation Report (AIR) indicating what was grown and what types of nutrients and quantities were used to grow those crops in the previous year.

Thus, despite the WQIA original rule remaining in place - that all farmers using manure file their initial N-based plans by 2001 and then update those plans three years later to a P-based plan (2004), with implementation by 2005 – all of the changes and the time lag between proposal for changes at the Summit, the legislative phase, and then the regulatory phase generally left farmers and their planners confused about if and when they should have been updating their plans to manage phosphorus. One private consultant suggested, “The requirements changed so frequently under (the) Erhlich (Administration) that you didn’t know what to file when.” (Keen, personal communication, August 11, 2006)

There may also have been some confusion about upgrading to a phosphorus-based plan in Virginia too because the state’s “Nutrient Management Standards and Criteria” document was being revised in 2005 to reflect the updated science on phosphorus. However, since P-based plans were required as of 2001, it is less likely that the two regulated Virginia poultry growers should still be managing nutrients under nitrogen-based plans.

BMP program participation rates

I asked farmers about their participation in cost-share programs for five of the most common and important best management practices that can have significant upfront costs: 1) planting cover crops, (2) building a manure storage shed, (3) installing a conservation buffer next to streams, (5) using the manure transport program, (6) having a soil conservation plan. And because of the there is one federal program, the

"Environmental Quality Incentives Program" (EQIP) that offers cost-share for almost all of these practices (except manure transport), I asked if they participated in EQIP too. Each of the states in this dissertation have both state and federal agricultural conservation programs that pay between 50 to 87.5% of the cost of these protective practices.
It is important to note that non-participation in these programs could mean numerous things outside of the farmer's control, such as, lack of program funds, the farmer offering an application to the program that did not get accepted, or as in the case of building a manure shed, being a non-poultry grower. However, none of the farmers mentioned that they had submitted an application that had been turned down.

In only two of the six variables (cover crops and manure shed) did farmers demonstrate high participation rates in the cost-shared programs. And in only two of the variables were differences statistically significant between states (manure shed and conservation plan).

Cover crop program

About half to 70% of farmers in all states are participating in cover crop programs. According to a 1995 University of Maryland newsletter:

> "Cover crops are grasses, legumes, or mixes grown during the late fall and winter to take up excess nutrients, reduce soil erosion, and improve soil tilth. Some cover crops can be used to absorb residual nitrogen during months when field crops are not grown. Studies in Maryland have shown that a rye cover crop can reduce nitrogen leaching by 66 percent." (MCE, 1995)

CC	**Table 3.19. Cover crops program participation**		
p=0.508	**Yes**	**No**	**No response**
MD, N=30	**50%**	50%	0%
DE, N=20	**45%**	50%	5%
VA, N= 10	**70%**	30%	0%

Several farmers mentioned to me that they like planting cover crops on their own because of the soil tilth benefits that makes for a more productive and healthy soil. Farmers in all three states in this study are doing as well or better than farmers in the past. According to the 1997 Maryland Department of Agriculture (MDA) survey in the Pocomoke watershed, 45% farmer survey reported using cover crops. In contrast, Smith's study (1999) found that only 23% of farmers in her statewide survey reported implementing unfertilized cereal cover crops.

Manure storage program

All the Delaware and Maryland poultry growers in this dissertation report having a manure shed cost-shared by the state. Only three of the five poultry growers in Virginia have a manure shed and one regulated grower does not have a shed while the fifth regulated grower did not provide a response.

It is surprising, that an additional 15% of the Maryland farmers who are not poultry growers report having a state cost-shared shed. This situation likely reflects Maryland's commitment to helping even non-poultry grower farmers store manure in sheds to avoid application during inappropriate times.

MS* **	**Table 3.20. Manure shed cost-share program**		
p=0.005* **	**Yes**	**No**	**No response**
MD, N=30	**80%**	20%	0%
DE, N=20	**85%**	15%	0%
VA, N= 10	**30%**	50%	20%

Maryland and Delaware poultry growers in this dissertation appear to be doing a better job at having manure storage structures than in all three studies in the past. Michel et al's 1996 survey found that only 226 out of the 562 Delmarva poultry grower respondents (46 percent) reported having used some kind of waste storage facilities that ranged from “old barns, open ended sheds, old silos, and storage sheds approved specifically for the purpose of poultry manure.” The 1997 MDA study found in their interviews with 129 Pocomoke watershed farmers that of the farmers with animals, 73% used a manure storage facility. MDA did not specify the number of farmers that raised animals nor did MDA specify the type of animals. Smith’s 1999 study found that 65% of the plan farmers and 54% of the no-plan farmers used a manure storage facility.

Conservation buffer program

A large majority of farmers in all three states (73 to 85 percent) reported they do not participate in state or federal buffer programs. Only two farmers mentioned that they’ve planted streamside buffers on their own property themselves without public funds. Conservation buffers offer many environmental benefits, including restricting crop production and nutrient application near surface waters. Planting appropriate vegetation can trap sediment, take up nutrients, and provide wildlife habitat.

CBP	**Table 3.21. Conservation Buffer program participation**			
p=0.583	**Yes**	**No**	**No, but I do it myself**	**No response**
MD, N=30	**23%**	73%	3%	0%
DE, N=20	**15%**	85%	0%	0%
VA, N= 10	**10%**	80%	10%	0%

With only 10 to 23% of farmers in all three states report participating in conservation buffer programs, farmers surveyed in this dissertation are not doing as well as farmers in the past at installing buffers. The 1996 Lichtenberg survey of Maryland farmers found 38% reported they installed conservation buffers and the 1996 MDA survey of the Pocomoke watershed found that 30% reported they were using buffers.

Environmental Quality Incentives Program

A large majority of farmers in all three states (70 to 100 percent) said they have not participated in the federal Environmental Quality Incentives Program. EQIP is the nation's largest "working lands" conservation program that provides cost-share to farmers to primarily address water quality issues such as soil erosion and sedimentation and nutrient pollution but also addresses water quantity, air quality, and wildlife habitat issues. Though EQIP is the most generously funded of all the federal "working lands" conservation programs, the author of this dissertation, using USDA data, estimated that nationwide, from 2002 to 2007 which was the time frame of the last five-year farm bill, over 500,000 requests for cost-share worth $13 billion went unfunded (Perez, 2007).

EQIP	**Table 3.22. Environmental Quality Incentives Program**		
p=0.242	**Yes**	**No**	**No response**
MD, N=30	**20%**	77%	3%
DE, N=20	**30%**	70%	0%
VA, N= 10	**0%**	100%	0%

When I asked why they don't participate in EQIP, farmers in Virginia mentioned that "by the time the money gets to the Shore it's all gone" suggesting that the Eastern Shore is a low priority for EQIP funds. In contrast, Tom Morgart of Maryland Natural Resources Conservation Service that runs EQIP said that Maryland often does not receive enough contracts because the state cost-share programs pay 87.5% in cost share while EQIP only pays 75 percent.

Manure transport program

A large majority of farmers in all three states (80 to 100 percent) reported that they have not participated in their state's manure transfer program while just 3 farmers in

Maryland and two farmers in Delaware said they've used it. Farmers did not appear to be interested in the program and no farmers reported that their requests had been turned down due to program lack of funds or other reasons.

SMT	**Table 3.23. State Manure Transport Program participation**		
P=0.254	**Yes**	**No**	**No response**
MD, N=30	**10%**	90%	0%
DE, N=20	**20%**	80%	0%
VA, N= 10	**0%**	100%	0%

Since the state's developed manure transport programs after the enactment of the nutrient management laws, there are no previous studies to compare this variable to.

Soil conservation plan

There is a statistical difference between states in the numbers of farmers who report having a conservation plan. Half to 90% of farmers in all three states reported that they do not have a soil conservation plan. The largest proportion of farmers to say they do have a conservation plan is Maryland farmers (50 percent).

CP*	**Table 3.24. Possession of a conservation plan**		
p=0.064*	**Yes**	**No**	**No response**
MD, N=30	**50%**	50%	0%
DE, N=20	**30%**	65%	5%
VA, N= 10	**10%**	90%	0%

MDA describes a soil conservation plan as including "a range of farm-specific best management practices designed to minimize soil erosion, control nutrient movement and protect water quality." Soil Conservation Plans were first required nationwide by the 1985 Farm Bill by farmers receiving federal commodity subsidies and operating what was designated as highly erodible land (HEL). Thus, it is slightly surprising for any of the farmers in this dissertation to have a conservation plans since the Eastern Shore is very flat and unlikely to have the HEL land that triggers the federal eligibility requirement. Perhaps, the fact that half of Maryland farmers do have a conservation plan reflects the active engagement of Soil Conservation District staff in Maryland that collaborated with these farmers to prepare a conservation plan.

There is some indication that the various soil conservation practices outlined in the plan may not be maintained because several farmers guffawed when I asked them about their plan. They indicated that they "hadn't seen the plan since they first got it in the 1980s or 1990s" and it may still be in their filing cabinet. Several said that "nobody was checking on it" and they "didn't know what was in the plan."

In contrast to the 1997 MDA Pocomoke study wherein 78% reported having a conservation plan, just 10 to 50% of the farmers in this dissertation have conservation plans.

3.3. Insights into farming culture

After interviewing 60 farmers for the quantitative data and qualitative insights for this dissertation and over 40 policy stakeholders – many of whom are farmers themselves or live within farming communities, I gained some impressions of what "it means to be a farmer." Because I lack training in methods of anthropology or sociology, I present these next few sections with some trepidation about "feeling out of my element." My discomfort arises to the point where I imagine myself to be like the old Englishman narrating wildlife documentaries. Further complicating the matter is that I am nowhere near the enviable position of the ideal anthropologist, that is, an objective, outside observer. Instead, I am an urban-dwelling, young, female, half Filipino-half Caucasian American, full-time, professional environmental policy analyst different in almost every way possible from the rural-dwelling, older, male, Caucasian American, full-time, professional farmers I am observing. With these disclaimers of self-awareness out of the way, I sought to share what I have learned about the farmers I interviewed on the Delmarva Peninsula.

In the first section, I will share what I learned of how farmers view themselves and their profession. These observations helped me form some impressions about what I will refer to as "the farming community." In the second section, I will discuss what I learned about how farmers view themselves vis a vis the environment. I learned that there are many facets to the oft mentioned view that farmers have of themselves as "stewards of the land." And third, I will discuss the evolution of societal views of farmers and the changing paradigm of agricultural policy.

Impressions of what it means to be a farmer

When I was driving around the Delmarva Peninsula trying to locate the homes and farm offices of the 60 farmers I interviewed, I spent a lot of time off the main highways and on county roads and back country roads. I was very impressed when I spotted road signs bearing the family name of farmers I was going to interview, I had already interviewed, or were mentioned to me by other farmers I interviewed.

I recall immediately being very impressed by these road signs, realizing that I didn't know anyone is my own suburban neighborhood or urban work community who had road signs named after them. These back road experiences also made me realize that the names of streets and bridges in the suburbs and cities are often the names of “famous figures” in the nation’s history but are also the family names of people “who got there first.”

I recall feeling a small sense of pride that I was getting to talk to people who, themselves, or their fathers, or grandfathers were not necessarily “famous” were nevertheless “founding members of the community.” Although I do not know all that goes into getting a road named after your family, the most common sense approach is nevertheless impressive: be farming the land a long time ago, at a time when a road was being built and you may get the road that passes through or along your property named after you. These road signs imbued in me the feeling that many farmers likely feel a significant “sense of place.”

Indeed, most of the farmers I interviewed mentioned that they were third generation and even fifth generation farmers. Two of the farmers I interviewed in all three states proudly mentioned that they were “Centennial Farms”– that is their farm had been recognized as being at least 100 years old. Some farmers even walked me into the room to show me the framed original deed signed by their great grandfathers and the modern day certificates provided by historical societies that they indeed owned Centennial Farms. One farmer told me proudly:

> “This farm is in land preservation. This farm has been in the family since the early 1600s. I’ve got a land grant from the King of England. Bill Fontaine’s farm is the oldest one in the county. Part of the land grant was 1632.”

Rosenblatt (1990) who studied the 1980s farm crisis in Minnesota described a farmer’s sense of self- identity as a way of life:

> "For most people who farm, farming is far more than an occupation. It is an identity and a way of life. Many people interviewed resisted leaving farming because the loss of the farm would mean the loss of sense of self and a way of life that could never be duplicated were they to take up a different occupation.
>
> A way of life is a meaningful integrated whole that includes a sense of purpose, spiritual values, a sense that what one is doing is the right way to live and that alternative ways of living are inferior. For many people in family farming, the land is a symbol of family welfare and safety, of family status in the community and world, a sacred trust (for ancestors, other family members, future descendants, and God), and the source of family pride."

Furthermore, Dudley (2000) described the reliance on family name and moral character as a currency keeping farm business and their credit lending institutions in business together:

> "(Credit) and (l)oans were often based on character and reputation of family name, and were the preferred way of doing business. While economic considerations play a role, they often take a backseat to the value of social obligations that debt will create or reinforce…To be worthy of cultural credit,…you or a senior members of your family, must demonstrate the qualities of character that uphold the social order….Your fields and farm are the front stage upon which the assessment of your "back-stage" morality is continually based."

Over and over again, during my interviews, I heard farmers refer to their profession as a way of life and that their name and their word "was their bond." In addition to road signs recognizing farm families that had survived the Great Depression, the Dust Bowl, the oil crises of the 1970s, and the farm crises of the 1980s, I observed farmers "wearing many hats." That is, many of the farmers I interviewed or had informal conversations with at Farm Bureau gatherings and farm equipment fairs, etc revealed to me that in addition to being farmers, they were mayors of towns, members of the state General

Assembly, and were elected or appointed to serve on various agricultural panels, commissions, and nutrient management committees.

While sitting in many living rooms, kitchens, and farm offices, I learned of the many family members that were actively or had once been actively involved in the farm, ranging from grand fathers to farmers, uncles, cousins, and wives. Many wives were integrally involved in farming providing office managerial functions such as book keeping but also more traditional and no less indispensible services as preparing lunch for the members of the family and in some cases, hired help to come in and eat together. Indeed, even when there was only a one-man farming operation, these farmers were just as likely to use the pronoun "we" to describe their individual activities raising crops, growing chickens, following best practice guidelines, etc. as those farmers that farmed alongside other family members or with hired help. This tendency to refer to the "royal we" impressed upon me a sense of collective identity; that a single farmer thought of his farming actions as activities collectively carried out by the rest of farming community.

Even in farms that had not obtained the recognition of being Centennial Farms, there was nevertheless a great deal of discussion about inheriting the farmland, farm machinery, and farming know-how from the elders in the family. I heard a lot of talk about the pride farmers feel in being the recipient of their family's legacy of farming. And in some farm families with no children interested in or reluctant to take over the farm and other bachelor farmers who did not have children to pass the farms on to, I felt a serious sense of anxiety about what would become of the family land.

Indeed the famers' "sense of place" and tight knit communities is reinforced, if not maintained by the high cost of land. That is, children of non-farmers rarely grow up thinking of farming as a professional option. Most farmers who become the traditional commodity crop farmer (corn-wheat-soybeans) do so by inheriting large acreages of land (hundreds of acres) from their families.

In fact, it appears that the only way that “outsiders” – individuals who do not come from farm families enter farming it to enter the non-traditional farming communities that are described as “niche,” “specialty,” and ungenerously “hobby” type farms. For example, those operations that require very little acreage (under 10 acres) like organic farming, heirloom vegetables, and the new trend of “locavores” (eating what you grow and what’s grown within a certain short distance of your farm) are not considered to be “real farming.” But anyone wishing to get into “real farming” can’t afford to get in unless they inherit hundreds of acres of their family’s land to start off with.

In addition to the farm community that included many generations of family farmers, I got the impression that there existed an additional “farm community” of professionals that support farmers, including the Cooperative Extension Service practitioners and researchers, the Soil Conservation District personnel, the private crop consultants, fertilizer and chemical dealers, grain cooperatives, farm trade associations, equipment dealers, farm credit unions and banks, etc.

Indeed, the fact that land-grant universities in all states in the country had been established to support agricultural production and farmers underscores the importance of farmers to society and just how big the concept of “farm community” can be extended. During my interviews about the nutrient management laws, the new science, and new ways to manage manure, several farmers wanted to discuss the difficulty many of their neighbors have with the concept of “change.” One Maryland farmer described farm culture as resistant to change, in general and told a joke about his fellow farmers on the Eastern Shore of Maryland:

> "Most people don't like change and farming culture is particularly ingrained in their ways. I've been raised on the Eastern Shore all my life. The joke around here is, 'How many Eastern Shore farmers does it take to change a light bulb? Change? What's that?'"

Indeed, I heard another, less generous, joke referring to farmers' resistance to change from two people in two of the three states on the Peninsula – one was a Cooperative Extension personnel and another was a state Farm Bureau representative:

> "Question: How do you get farmers to change?
> Answer: One retirement at a time."

Though any economic sector's tendency is to want to things to continue "Business As Usual," these jokes indicate a special challenge facing environmental policy makers that wish to "change" the agricultural sector.

Several young and middle-aged (40s) farmers described some of their fellow farmers as "old and stuck in their ways." One farmer from whose family had just entered the potted plant flower business by leasing their crop land and transforming just a few acres into a greenhouse, said that neighboring farmers thought they were crazy. But as the prices for commodity crops continued to stagnate while fertilizer prices skyrocketed, Farmer 35 said that sooner or later, these neighbors will see that "you have to diversify to stay afloat." (3-9.1, Farmer 35, Wic) Indeed a few farmers I interviewed had decided to transform few acres of their crop fields into farm animal petting zoos, pick your own strawberry fields, and small fruit and vegetable roadside stands.

One entrepreneurially-oriented farmer described how many of his older neighbors "stick to their old ways and take some younger, bachelor farmers under their wing at the local coffee shop." This farmer jokingly cautioned me not to go into these coffee shops when "they are all there bitching and moaning about everything." He especially told me "not to get them started" when I asked him if they would be interested in talking about the nutrient management laws.

Interpreting what farmer environmental stewardship can mean

During my interviews with farmers and policy stakeholders, I sought to understand how farmers think of themselves vis a vis the environment. Immediately, I found most farmers interested in talking about themselves as "stewards of the land" whose economic well-being is intrinsically linked to the good use and maintenance of the land they own and rent.

As described by Paolisso (1999) who conducted informal, semi-informal, and formal ethnographic interviews and continuous participant observation of Lower Eastern Shore Maryland farmers during the development of Maryland's nutrient management regulations, farmers feel closely connected to the environment:

> "Among farmers, there is a widely shared and strongly held belief that they are the "real" environmentalists. While not dismissing the contributions that urban-based environmentalists and residents can make to protect the environment, farmers do feel that their environmentalism is unique and at minimum equally valid. This environmentalism is derived from daily interaction and dependence on the environment and natural resources to make a living.
>
> Such a close relationship requires farmers to maintain the natural base of their farm operations, in order to meet their immediate needs and long-term goals of preserving the value of their farm for future generations. But farmer environmentalism goes beyond economic motivations.
>
> Land as property is talked about as an extension of a farmer's home and family; and the care and management of the land is an important symbol of a farmer's status and position in the community. It is felt that this

> personalization of land internalizes a farmer's commitment to care for and nurture the land, which creates a relationship with the environment that is sustainable and mutually beneficial." (Paolisso, Fall 1999)

Paolisso and Maloney went on to note:

> "Maryland farmers also see themselves as the "real" environmentalists because they live with the environment everyday and are dependent on protecting the quality of their land and environment in order to make a living, and pass their farm on to future generations of family members. (Paolisso and Maloney, 2000) In fact a popular farmer-oriented bumper sticker created and distributed by the Chesapeake Farm Credit (now Mid-Atlantic Farm Credit) and later reproduced by Delmarva Poultry Industry, Inc. reads, "Farmers: The First Environmentalists."

During the portion of my interviews when farmers were responding to 26 Likert Statements, I included one statement about the farmer's relationship with the environment in order to encourage farmers to flesh out what it meant to be "stewards of the land." The Likert Statement was "Protecting the environment is part of what it means to be a farmer." Most farmers easily agreed with the Likert Statement but several of them admitted they were skeptical of the statement. This next section will provide what I learned from farmers during the interviews about the many views of what it means to "protect the environment" or more specifically, what it means to be "stewards of the land." In addition, I will discuss a minority view from a few farmers that expressed skepticism at this statement and cynicism at the moniker, "farmers: the first environmentalists."

When presented with the Likert Statement, "Protecting the environment is part of what it means to be a farmer," most farmers immediately began their comments using the term, "stewards of the land." Other than the obvious definition of "taking good care of the land" and explaining that "land was their investment," most farmers immediately gave what appeared to be evidence that they couldn't be anything but good "stewards of the land" because it isn't in their economic self-interest to hurt the land; which is their investment. One farmer from Virginia put it this way: "We treat rented land like land we own. If you take care of land, land will take care of you." (3-30.2, Farmer 1, Acc)

Just about every farmer explained to me in that the economics of farming works to protect the environment because they "cannot afford" to waste expensive commercial fertilizer or the valuable nutrients and organic matter in poultry manure, which in some parts of some counties on the Delmarva is in short supply. GS from Sussex county explained: "We can't afford to buy too much fertilizer. I just use my fertilizer as a starter. I'd like more manure but can't afford to buy it." (3-3.1, Farmer 58, Sus) This view of their role as stewards of the land suggests that the high price of inputs – chemical fertilizers, other farmers mentioned the high cost of diesel fuel to run their tractors, and less often the cost of manure – serves as a built-in barrier to farmers actually being polluters.

Within the same breath, however, Farmer 58 joked and revealed that this built-in economics barrier can also work against the environment: "If corn was $4 per bushel, we'd overproduce and use more fertilizer!" (3-3.1, Farmer 58, Sus) In fact, in 2008 and 2009, the prices for corn did sky-rocket to over $4/bu and as expected, farmers responded to this price signal, planting more corn acres instead of other crops and by bringing fallow land into production. Thus, there appears to be economic constraints to the notion of "stewards of the land."

The second constraint I observed was that farmers did not discuss stewardship of water or air – the other two environmental media – just that they were "stewards of the land.” Furthermore, the view of what responsibilities are entailed in being stewards of the land appears to be restricted to a view of the land as having an economic purpose. Thus, their responsibility was to cultivate economic productivity out of the land and prevent any loss of productivity that might arise from the erosion of fertile top soil or “robbing the soil of nutrients” to grow the crop. Thus, it appeared that maintaining soil fertility was the unspoken objective of being stewards of the land.

When I followed up and asked farmers if being stewards of the land meant also being stewards of the air and water, many appeared stumped at this question as though they had not thought about it before. Many followed up and said it didn’t make sense to get manure in the ditch, to “lose your top soil,” or to lose ammonium from the manure to the air – those were viewed as “lost resources,” a “waste of money,” and “plain dumb.” Again, protecting the water and the air as stewards was viewed in economic self-interest terms regarding what’s best for the farm.

One additional component to being stewards of the land involves preserving a farmer’s social self-interest by being a good neighbor. When explaining to me that manure incorporation will save him money by preventing ammonium form being lost to the atmosphere, Farmer 42 from Sussex also explained, “We put down chicken manure and need to work it in otherwise you have neighbors complaining about the smell. You work it in try to be a good neighbor. (3-23.1, Farmer 42, Sus)

Many farmers I interviewed choose normative words like “doing the right thing,” “good,” and “bad” to describe environmental issues. Several farmers got very animated describing to me how frustrated they get when their fellow farmers “don’t try to do the right thing” but do “dumb things like pile manure right next to the road or the ditch” or "apply manure on "snowed ground." These farmers described the other farmers as "bad apples making the rest of the apples in the barrel look rotten."

Most of the farmers when describing how they "protect the environment" provided examples of their adopting various BMPs because "it made sense." Many farmers in Maryland were particularly proud of their involvement over the years in the voluntary Nutrient Management Program. Most described switching from box spreaders to spinner spreaders in the early 1990s. Some even described most farmers on the Delmarva Peninsula as far more "environmentally progressive" than their colleagues out in Iowa as they understood many farmers there still moulboard plowed[13] when they had switched to no-till as early as the 1980s and 1990s. They raved about the many direct and indirect benefits of no-till and how it saved them time and money and how they think it is improving soil fertility. Most farmers described how they switched from looking at poultry manure as a waste product in the 1980s to listening to Cooperative Extension who were telling them to treat it as a valuable source of nitrogen.

Only a few farmers strayed from what began to sound like the "official party line" that a) farmers were the first environmentalists, b) that they were stewards of the land, and c) that they can't afford to pollute the environment.

During the interviews, the bumper sticker, "Farmers: The First Environmentalists," came up several times and a handful of farmers fervently acknowledged the motto fit their outlook. However, a minority of farmers derided the slogan as propaganda developed by DPI to fight back the negative image farmers were getting in the media

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[13] Moulboard plowing refers to the oldest and most aggressive form of plowing that involves digging deep into the soil and lifting an tire block of soil up out of the ground and turning it over before returning it to the ground. This form of tillage is highly discouraged by land-grant universities because it destroys results in a high degree of soil erosion, ruins the natural soil spaces that are important for air exchange, water movement, and microbial activity, and dries out the soil.

about *Pfiesteria*. These more cynical farmers pushed back at society's expectation that they had to be anything but good businessmen.

These farmers shared with me a more nuanced view of themselves and the environment. They impressed upon me the fine economic line they have to walk between environmental concerns and their main line of business – crop production. Farmer 56 from Sussex said:

> "Agriculture's economic environment is a very sensitive issue. It's a very delicate balance between environmental stewardship and economic success. You can't afford to be reckless with fertilizer inputs coz you'll waste money and be unproductive and eventually won't profitable. On the other hand, you can't be so conservative, because you only get a shot at a making a good crop once a year. Once that window has past, you can't say I wish I used more fertilizer or I wish I had planted at a different time." (2-23.2, Farmer 56, Sus)

Some farmers went so far as to draw the line in the sand and point out that there are limits to farmer environmentalism and limits to what society should appropriately expect of farmers:

> "If it weren't for cost-share, I wouldn't build (manure) sheds, I would pile it. If the general public wants it, they should help pay for it. If everybody wants the environment cleaned up, then everybody can help out to do it." (3-23.2, Farmer 51, Sus)

Farmer 7 from Accomack put it even more bluntly. In reaction to the Likert Statement: "Protecting the environment is part of what it means to be a farmer", Farmer 7 said:

> "That is frickin' hokey. I do protect the environment all the time. But if you want me to be more environmentally friendly, show me the money. They tell me to plant buffers on rented land, I say, pay me more and I may….Get real, you're not in it for the environment. I'm in business to make a living, not to make you a happier place to live….to beautify the landscapes. I don't owe anything to anyone. I have no moral obligation. So many farmers are under the stigma that we've got to keep America green and keep city folk happy with us. (3-1.3, Farmer 7, Acc)

Thus, farmers as “real environmentalists” or “the first environmentalists” or just “stewards of the land” was the dominant view of most of the farmers that I interviewed. However, it’s a view that can change under different economic conditions and it is comfortably restricted to issues of economic productivity in the investment of land rather than an expansive view that includes water and air. Finally, there is a skeptical minority who believe if there should be any societal expectation that farmers should be more than just business persons then society should share in the cost of environmental protection. The underlying assumption of this view suggests that farmers because they are property owners and managers of private property, have a right to pollute. Future research should review how the current literature on who has the right to pollute that includes the literature on property rights, the commons, the polluter pays principle, takings, etc. and how it may or may not apply to nonpoint source agricultural pollution.

Shifting societal views of farmers

Many farmers and policy stakeholders I interviewed explained that a shift in the public’s view of farmers occurred in Maryland when the Pfiesteria-related fish kill events occurred. They describe a kind of “fall from grace” in the eyes of the public wherein they were once upstanding citizens of society providing “food and fiber” and then when Pfiesteria happened, they were painted as “polluters who dumped manure into the Chesapeake Bay.”

Curiously enough, a similar shift in society’s view of agriculture was occurring at the federal level as well. The year before the Pfiesteria events, Congress passed the 1996 “Federal Agricultural Improvement and Reform (FAIR) Act, commonly known as the

“Freedom to Farm” farm bill which revolutionized farm policy, albeit for only a short period of time as many of the old, protective policies were eventually resurrected. Nevertheless, the debates leading up to the Farm Bill were unprecedented in their calls for reforms of the large government commodity crop subsidies. Proponents of the subsidies felt that their side had been unfairly painted as “greedy, corporate mega-farmers.”

In the words of one Maryland farmer who also was in a leadership position at state agricultural institution:

> “Before 1997, most farmers in Maryland and most farmers in America wore white hats. Like in the old Westerns, the good guys in Dodge City wore white hats. I don’t think it’s back today. I think we’re still viewed as bad guys. The media focused on it. We’re not held in the same esteem we had before. I don’t think we deserved what we got.” (3-9.3, Farmer 27, Som)

In 1997, agricultural economists Tweeten and Zulauf explained that the 1996 Farm Bill meant that “the era of government supply management of primary crops appears to be over” and discussed what the new appropriate public policy of US agriculture should be under this new paradigm. The authors explained what the old agricultural policy paradigm looked like and the likely ramifications of the new paradigm:

> “Farm fundamentalism was a cornerstone of the old paradigm belief system. It viewed the family farm as an essential part of our national heritage that must be preserved.” (Tweeten, 1989) Agriculture was synonymous with family farmers pursuing a way of life. Another cornerstone, largely originating in the great Depression was that government intervention was justified because market failure was viewed as common even for rival and exclusionary goods, such as farm commodities. This belief was one reason government was charged with transferring income to farmers with safeguarding food security by storing commodities itself or subsidizing private storage activity.

> Although the public traditionally viewed agriculture as family farms to be cherished (Jordan and Tweeten), partly because family farms possess valued moral and cultural traits (Drury and Tweeten 1997), in the future, the public image of agriculture will be that of a vertically coordinated or a high-technology, factory-type operation. This image creates a belief that agriculture is no different from other industries and justifies mainstreaming – treating agriculture the same as other businesses."

That future described by Tweeten and Zulauf came very quickly for Maryland farmers as the public and the media began viewing Maryland farmers, particularly poultry growers, as factory-type operations and no different than other businesses in the state that generated pollution and needed clean-up.

Over and over again, I heard from farmers in all three states explain that they felt disempowered by the attacks they perceived policy makers and the media were making on farmers in relation to the Pfiesteria fish kills. Many farmers in all three states mentioned that they were "just 2% of the population now" which is the percent I heard used by the national farm trade associations as a sign of their weak political power. Tweeten and Zulauf explained:

> "Under the old paradigm, agriculture had enough political votes to be an important player in the political coalition that governed the country, either through the number of votes it could command directly or indirectly through farm fundamentalism prominent even among urban residents (Jordan and Tweeten).
>
> The new paradigm recognizes that the growing importance of democratic capitalism, falling farm population, and declining relative contribution of agriculture to aggregate economic activity reduce the farm sector's plebiscite power."

What was even worse about feeling few, weak, and blamed for the Pfiesteria-related fishkills was that the farm community felt divided. In Maryland, many Eastern Shore farmers told me felt they didn't have the support and understanding of their brethren on the Western Shore whom some said were jealous of the fact that the Eastern Shore farmers had access to poultry manure allowing them to "farm cheaper." In Virginia, many poultry growers felt abandoned in their struggle to fight the impending legislation because the regulations would affect only poultry growers and not the rest of the non-poultry farming community. At the national level, Tweeten and Zulauf explained it this way:

> "Agriculture's plebiscite power has been further altered by the decline of the general farm and the rise of specialized production units, which have bifurcated agriculture into a few large farms producing most farm output and many small operations accounting for most farms."
>
> ….In the future, agriculture will depend less on plebiscite political power. Campaign contributions and direct links to members of Congress and the executive branch to influence legislation have been important components of agriculture's political tools for some time, and they will become even more important. Thus agriculture's strategy for political power will become more like that of nonfarm corporate business."

CHAPTER 4 – BACKGROUND: STATE POLITICS AND PRE-*PFIESTERIA* POLICIES TO REDUCE AGRICULTURAL NUTRIENT POLLUTION, PRE-1997

4.1. Introduction

For each state in this dissertation, chapter 4 will provide a description of the state's environmental and political culture and a historical review of the state's agricultural nutrient pollution policies prior to the 1997 *Pfiesteria* fishkill events. To understand why each state responded the way it did to the *Pfiesteria* fishkills, it is important to understand what kind of a role that a) Bay geography and environmental culture, b) political culture, and c) interest group power play in each state's environmental policy-making process. In each section regarding the states' pre-*Pfiesteria* policy approach to reducing agricultural nutrient pollution, I will outline the state's use of a) cost-share programs, b) educational and technical assistance programs, and c) regulatory policies.

This chapter will briefly touch on one of this dissertation's main themes. Each state's voluntary approach to reducing agricultural sources of nutrient pollution reflected their understanding of the workings of farm culture and recognition of how to achieve behavior change within the farming community.

Since the first of the three nutrient management laws was enacted in Maryland in 1998 in response to the *Pfiesteria* events, I will begin with Maryland. Virginia will be presented next as it was the second state to respond to the *Pfiesteria* events in 1998 but took until the following year to pass its regulatory statute. Delaware began their policy-development process in 1999 and passed their nutrient law before the end of that legislative session. I will end Chapter 4 with a discussion and comparison of the three states' political and environmental cultures and past agricultural policy approaches.

4.2 Maryland Politics and Pre-1997 Approach to Farm Nutrient Pollution

Maryland Politics

Maryland's Environmental and Bay Culture

The Chesapeake Bay and its tributaries play a major role in defining Maryland geographically and culturally. The Bay divides the 14 Western and Central counties of the state on the Western Shore from the 9 Eastern Shore counties on the Delmarva Peninsula. In fact, 90% of Maryland's landmass is in the Chesapeake Bay watershed and Maryland covers approximately half of the Bay's upper reaches. The majority of the population resides in the Central counties around the industrial and port town of Baltimore and the suburbs of Washington D.C. These areas have been predominantly blue-collar and professional counties and have politically liberal-leaning populations. The Eastern and Western shore counties are dominated with agricultural and forest land and are politically conservative. On the Eastern Shore, a burgeoning suburban and tourist economy is extending into the agricultural land, creating tension between rural and "outside" neighbors. On the Western Shore of the Bay, the third largest tributary to the Chesapeake Bay, the Potomac, serves as Maryland's southwestern border with Virginia.

In general, Maryland citizens are among the most environmentally oriented in the country, and specifically, Marylanders have a special affiliation with the Chesapeake Bay. According to Chesapeake Bay Foundation representatives, Maryland has a long and proud history of leading the nation in environmental policy innovation, including playing the leading role in forging the regional Chesapeake Bay Agreement in 1983 and developing Smart Growth policies in the 1990s that many other states have emulated. Today, the slogan “Save the Bay” is a ubiquitous bumper sticker and one-in-ten cars in Maryland have purchased “Treasure the Chesapeake” license plates, which raise funds for conservation projects (CBT, 2006).

Since the founding of Maryland as one of the original 13 colonies, Marylanders have relied on the Bay waters and its sandy shore soils for sustenance, commerce, and recreation. The Chesapeake Bay supplies half of the nation’s blue crab harvest which every year Maryland and Virginia watermen bring in about half of the total Bay harvest (CBC, 2005 and MSA, 2009). In addition to the importance of the commercial fisheries, the Bay draws tourists and locals alike for the seafood, the sport fishing, and a variety of water sports. Although an old estimate, the Maryland Department of Economic and Employment Development put the annual value of tourism and commercial activities directly related to the Chesapeake Bay at $31.6 billion (MDEED, 1989).

Maryland is one of the smallest states in the country in area (ranked 42nd in size; 12,407 square miles) yet one of the most densely populated (ranked 6th) with over 5.3 million people (ranked 19th) as of 2000. Though agriculture occupies 40% of the state’s land area, second only to forests (42%), the agricultural sector provides only 0.6% of the state economic output. (Barone and Cohen, 2006) And given the proximity to the federal government and Maryland’s own large state bureaucracy, a large portion of the workforce is in government (22% versus 72% in private sectors and 5% self-employed).

Maryland's Government Structure and Political Culture

Lippincott and Thomas (1993) characterized Maryland government as a highly centralized, one-party state with a large bureaucracy. The governorship in Maryland is one of the most powerful in the country given its appointment power, legislative veto, and power of the purse. In Maryland, only the governor may write increases to the state budget while the legislature is restricted to recommending decreases. This unequal division of power enables Maryland's Executives to govern without the need for much compromise.

Governor Glendening (D, 1994-2002), known nationally for being an environmentalist and promoting innovative Smart Growth policies, played a pivotal role in responding to the *Pfiesteria* event. As will be described in Chapter 5, several farmers and a few policy stakeholders repeated similar versions of the same story about Glendening's use of his powerful position. Glendening was known to take full advantage of his office's unique budgetary power by threatening to withhold funding for priorities deemed important to certain legislators if those legislators were to disagree with Glendening's policy preferences.

Like the executive branch, the legislative branch in Maryland is also highly centralized. Lippincott and Thomas find that both the Speaker of the House and President of the Senate in the Maryland General Assembly are power-centralizing positions. These two leadership positions, elected by a caucus of the majority party in each house, have the power to appoint all committee members, designate committee chairpersons, and control the schedule of legislation in their chambers. In addition, committee chairs exercise control over bill content and scheduling which bills the committee will consider.

Maryland has a part-time legislature, which meets for 90 days from January to April each year.

In terms of political parties, Maryland is considered a "one-party state," given that 55% of registered voters are Democrats, 30 % are registered Republican and 16% remain unaffiliated or with minor parties (Barone and Cohen, 2006). Until 2002, when the state elected Robert Erhlich, its first Republican Governor in 50 years, Maryland politics had been dominated by Democrats in the Governor's office and both chambers of the General Assembly. In fact, as of 2006 when the interviews for this dissertation were conducted, Democrats dominate the Assembly 7 to 3 (33 Democrats to 14 Republicans in the Senate and 98 Democrats to 43 Republicans in the House). Most Republicans hail from the agricultural districts of the Eastern Shore and the Western and Southern regions. At the federal level, Maryland's two Senators and six of eight Representatives are Democrats.

The third defining characteristic of Maryland's government is its large bureaucracy and high level of professionalism among state employees. As of 1993, 11% of the workforce was employed by state agencies, and half of them hold managerial, technical, or professional positions (Lippincott and Thomas, 1993). With one in five Marylanders employed in government jobs, 55% of voters registered as Democrats, and with the Chesapeake Bay dominating the geography and culture of the state, Marylanders make addressing environmental problems a policy priority and regard the government as providing the solution.

Maryland's Interest Group Power

According to Hrebenar and Thomas (1992), individuals or single interest groups can dominate the public policy process if the state lacks two-party competition or a professional bureaucracy. Thus, single group dominance can be a concern in Maryland since the state lacks significant two-party competition and because most elected officials are part-time legislators who often lack sufficient support services and may rely on interest groups for research and analytical assistance. Despite this situation in Maryland, Lippincott and Thomas (1993) categorize Maryland's interest group strength as "moderate." Interest group dominance over public policy is moderated in Maryland because the state has heterogeneous social and economic sectors, which makes competition among interest groups high. In addition, Maryland legislators have increased their incumbency, which can result in increased levels of experience and professionalism and less dependence on interest groups for information.

As of a 1987 survey of state legislators and lobbyists, both environmental and agriculture interest groups ranked low in terms of: a) numbers (17^{th} and 18^{th}, respectively, out of 23 groups); b) lobbying expenditures (30^{th} and 31^{st} out of 35 groups); and c) interest group strength (environmental groups ranked 8^{th} out of 11 groups according to lobbyists and 9^{th} out of 10 groups according to legislators, while agriculture groups were not ranked at all) (Lippincott & Thomas, 1993). Lippincott & Thomas explain the low ranking of environmental groups as a reflection of their narrow concerns. When analyzing why farmers did not appear in the ranking by either legislators or lobbyists, the authors suggest it is a reflection of "the movement of the state away from an agrarian economy, but it is still somewhat surprising given the trucking and poultry farms located on Maryland's Eastern Shore and the tobacco farms located in southern Maryland." Indeed, albeit an old study, this low ranking of agricultural group power resonates with what several Maryland farm trade association representatives told me in interviews; that is, they felt unprepared to cope with let alone effectively control the political and policy responses to the *Pfiesteria*-related policy proposals.

There are numerous environmental groups involved in Maryland and Chesapeake Bay water quality issues including state-focused groups (e.g., Maryland Environmental Trust, 1000 Friends of Maryland), over a dozen river-watershed organizations (e.g., Severn River Association, Chester River Association), and national groups (e.g., Sierra Club-Maryland, The Nature Conservancy-Maryland). Hunting and conservation groups are active in Maryland as well: Ducks Unlimited, National Wild Turkey Federation, and county hunt clubs that maintain private and county forests. The largest and most powerful environmental interest group operating in Maryland is the Chesapeake Bay Foundation, a regional non-profit organization with its headquarters in Annapolis, and offices in Pennsylvania and Virginia and over 200,000 members Bay-wide (CBF, 2010).

There are about a dozen or so trade associations focused on the main agricultural commodities produced in Maryland, including the Grain Producers' Association, the Soybean Grower Board, the Vegetable Growers' Association, and the Dairy Council, etc. However, the primary agricultural interest group in Maryland is the Maryland Farm Bureau (MFB), the state chapter of the national American Farm Bureau Federation. The MFB claims 27,000 member families in Maryland, though that number includes non-farmers as well since the MFB offers insurance at discounted rates and other membership benefits. The Delmarva Poultry Industry, Inc. is the regional trade association representing both the four integrators (Tyson Foods, Perdue Farms, Mountaire, and Allen Family Foods) and nearly 1,800 contract growers in the three states on the Peninsula. In Maryland alone, there are about 800 growers.

According to the 2007 Agricultural Census, there are approximately 12,800 farmers in the state, though over half of them earn less than $10,000 per year from agriculture and are considered “retirement” or “hobby farmers.” There are about 800 poultry growers in Maryland, all located on the Eastern Shore.

Maryland’s Pre-*Pfiesteria* Approach to Farm Nutrient Pollution

Prior to Maryland’s passage of the 1998 Water Quality Improvement Act (WQIA), the state’s policy approach to agricultural nutrient pollution focused on the provision of educational materials and technical and financial assistance to farmers in the form of voluntary, first-come-first-serve programs.

Maryland was the first state of the three in this case study to establish such a state cost-share program to pay for the majority of the cost of installing environmentally protective practices, called Best Management Practices (BMPs) and is among the most well-funded despite the state’s small size and relatively small population of farmers. In 1984, the Maryland Agricultural Cost-Share (MACS) program was established to implement the new regional Chesapeake Bay Agreement, which Maryland had just signed, for the first time, in 1983. According to the 2004 Annual Report for the MACS program, in its first year in 1984, MACS provided farmers with $41,000 in cost-share assistance to install 133 projects to control soil erosion and protect water quality. Twenty years later, MACS provided $4.8 million to install 1,500 projects in 2004. (MDA MACS, 2004)

Today, MACS pays farmers up to 87.5% of the cost of about 30 state-approved BMPs that range from annual practices like nutrient management planning, planting cover crops, maintaining filter strips and grassed waterways, to structural or otherwise permanent practices like manure storage facilities, fencing and alternative watering systems to keep cows out of streams, and riparian (streamside) forest buffers. The Maryland Department of Agriculture administers the state cost-share programs while the 23 Soil and Water Conservation Districts based in each county provide one-on-one technical assistance to help farmers and landowners to plan projects, procure cost-share funding, and install and maintain the best management practices.

In addition to the state voluntary cost-share programs, Maryland, like other states, receives federal cost-share funds, distributed through the county USDA Natural Resources Conservation offices (NRCS). Prior to the 1998 WQIA, Maryland NRCS offices received funds from the 1985, 1992, and 1996 Farm Bills to provide technical and financial assistance to farmers who voluntarily installed and maintained best management practices.

The two most important federal conservation programs for “working lands” operating in all three states of this case study are the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP). EQIP primarily funds livestock and poultry manure management practices, BMPS that control soil erosion and sedimentation, and other water quality projects but also pays for air quality and wildlife habitat projects. In the last decade or so, the federal EQIP Program in Maryland cooperates with the state MACS Program by providing the first 50 or 75% of the cost-share funds for a project and then MACS provides the balance of the funds to bring cost-share rate up to 87.5 percent.

CREP provides land rental payments to farmers and landowners for removing environmentally–sensitive portions cropland from production (near streams, low-lying marsh areas, or areas with steeply eroding slopes) and pays cost-share to install protective BMPs like permanent grassed buffers, animal fencing, and stream crossings.

The single largest federal “retirement program” is the Conservation Reserve Program (CRP) that pays 15 and 30 year contracts to farmers for taking entire farm fields that are considered environmentally sensitive out of production. The program is popular and controversial in Maryland as farmers wishing to expand regard the CRP as in competition with them for scarcely available land and thus, partly responsible for maintaining high land prices.

Over the years, the private sector in Maryland has also contributed funding to implement agricultural conservation practices. Environmental and conservation organizations like the Chesapeake Bay Foundation and Ducks Unlimited have partnered with the state and offered additional financial assistance. Many priority practices in Maryland can be funded by a combination of state, federal, and private funds bringing the total cost-share to 100 percent.

Along with its cost-share programs, Maryland has also had an educational and technical assistance approach to reducing agricultural nutrient pollution. Since its founding in the late 1859, the state’s land grant college, the University of Maryland and its Cooperative Extension Service have been providing educational materials, conducting research and disseminating their findings to farmers. However, university researchers have, for the most part until 1989 when the state nutrient management program was established, focused their attention on the improving various aspects of agricultural production rather than on limiting negative environmental impacts. For example, factsheets have included “The Economics of Leasing Versus Buying Farm Equipment”

(1987), “Managing Wheat for Maximum Economic Yields in Maryland” (1989) and “No-Till Corn Production: Achieving Maximum Nutrient Efficiency” (1990).

Another major provider of educational and technical assistance to farmers in Maryland are the state’s 23 Soil and Water Conservation Districts (SWCDs). And unlike the Cooperative Extension Service researchers whose research topics cover the spectrum of agricultural sciences and economics, the SWCDs have a singular focus on reducing soil erosion and sedimentation of streams and rivers. SWCDs were established in every state throughout the country by the federal Soil Conservation Service in the 1930s in response to the Dust Bowl to persuade farmers to switch to less erosive farming practices to “conserve the soil” and protect water quality. Like all other states’ SWCDs, Maryland’s provides educational programs and technical advice to farmers and landowners and helps them procure thru the application process state and federal cost-share funds to reduce stormwater runoff, soil erosion and sedimentation through the implementation of soil conservation best management practices. Only in the mid-1990s did SWCDs begin to widen their attention from soil erosion and sedimentation challenges posed by agricultural land use but to nutrient and manure management challenges as well.

Despite all these efforts, Maryland still lacked a direct focus on reducing agricultural nutrient pollution until 1989, when Maryland established one of the nation’s first voluntary Nutrient Management Programs. The state did so in response to the signing of the second Chesapeake Bay Agreement in 1987. That Agreement called for an ambitious 40% nutrient reduction goal for the Bay and established Maryland’s 10-watershed basin Tributary Teams to coordinate nutrient reduction efforts within the state. The so-called Nutrient Management Program would encourage farmers to allow Cooperative Extension agents to develop nutrient management plans for their operations. The new "nutrient management plans" (NMP) were designed to help farmers optimize (instead of *maximize)* crop yield while minimizing environmental loss of nutrients. Until then, most farmers were receiving "free" advice from the fertilizer companies they purchased fertilizer from while a few large farmers were paying crop advisors to develop crop fertilization plans. Although estimates for how widespread participation in the voluntary NM Program was in Maryland, cumulatively, over the decades of the program over 1 million acres were at some point in time under a voluntary NM plan. However, as will be described in Chapter 6, annual estimates of numbers of farmers or acres with a current plan were hard to come by.

The final and least effective pre-*Pfiesteria* approach to reducing agricultural nutrient pollution in Maryland is the regulatory approach, including implementation of Farm Bill conservation compliance requirements, implementation of the EPA CAFO permit program, and the failed attempts to regulate agriculture in the 1992, 1993, and 1994 General Assembly sessions.

The federal Farm Bill has only one quasi-regulatory requirement for farmers who receive farm subsidies. In Maryland, about 28% of all farmers receive federal commodity subsidies for either growing or owning land that is used to grow commodity crops like corn, soybeans, and wheat. If such farmers are operating on "highly erodible land" (HEL) then a pre-requirement for receiving these farm subsidies is their development of a soil conservation plan by the soil conservation district. This eligibility requirement has a limited effect in Maryland since the majority of farmers do not receive federal subsidies and few cropland acres in the state are designated HEL. Secondly, even the limited numbers of farmers who do have to comply are only required to manage soil erosion rather than manage nutrient pollution.

Maryland, like many other states, enacted its federal Confined Animal Feeding Operation (CAFO) program only after several lawsuits were filed. After over a decade, the program has a very limited reach. As of 2006, only 13 livestock operations (mainly beef and dairy) in Maryland were large enough to fall under the EPA's CAFO definition and had to file a National Pollutant Discharge Elimination System (NPDES) permit. As will be described in the Epilogue chapter, about half of Maryland's poultry growers signed up for a CAFO permit in 2008 after a strategic campaign orchestrated by EPA Region 3 and the Delmarva Poultry Industry encouraged them to do so. The CAFO NPDES permit include a Comprehensive Nutrient Management Plan (CNMP) that prescribes manure management systems for proper storage as well as manure use on cropland requirements for proper application rates, methods, and timing.

The last example of Maryland's regulatory approach to agricultural nutrient pollution before the *Pfiesteria* fishkills was the Maryland General Assembly's failed attempts to make nutrient management planning mandatory in the 1992, 1993, and 1994 legislative sessions. These laws were precursors to the 1998 Water Quality Improvement Act but failed each time to pass. Despite the fact that EPA concluded in 1983 (the same year as the first Bay Agreement) that agricultural runoff was the primary factor in the Bay's declining health and the Chesapeake Bay Commission[14] concluded in 1985 that voluntary educational and financial agricultural programs would be insufficient to restore the Bay,

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[14] The Chesapeake Bay Commission provides advice to the legislative assemblies of the three signatory states (Maryland, Virginia, and Pennsylvania) and acts as a liaison to the U.S. Congress. The Commission has 21 members comprised from each of the three signatory states, including each state's Governor, each state's Secretary of Natural Resources, five state legislators, and a citizen representative.

there was insufficient political will to regulate farmers even in one of the most environmentally progressive General Assemblies.

4.3 Virginia Politics and Pre-1997 Approach to Farm Nutrient Pollution

Virginia Politics

Virginia's Environmental and Bay Culture

Virginia's policy response to the *Pfiesteria* events reflects portions of the state's environmental culture and close geographic relationship with the Chesapeake but is tempered by the Bay's economic importance as a shipping and military hub and the state's long-time conservative principals.

The vast majority of Virginia is located on the "mainland;" that is on the western side of the Chesapeake Bay and only two of the state's 95 counties occupy what's known as Virginia's Eastern Shore of the Chesapeake Bay. Approximately half of Virginia's 21,719 square mile landmass is located in the Chesapeake Bay watershed (VDCR, 2005). Virginia's Chesapeake basin alone makes up one third (34 percent) of the entire Chesapeake Bay basin. Indeed about one-third of the lower portion of the Bay is found within Virginia's territory. Virginia's Bay basin is made up of four major river basins, the Shenandoah-Potomac, the Rappahannock, the York and the James, as well as the bayside rivers and creeks of the Eastern Shore. But because of its large size, most of Virginia is not near the Chesapeake Bay. Indeed the Shenandoah Valley which is the central location for the majority of the poultry production in the state is just 40 miles away from Virginia's western border and the Blue Ridge Mountains but 175 miles from the Chesapeake Bay.

Over 60 % of the state's population and the majority of its economic development are concentrated in several "urban corridors" which stretch westward from the Washington suburbs in Northern Virginia, and south to Richmond, the capital, and then east to the Norfolk-Virginia Beach-Newport News metro areas. (Whelan, 1992) The result is that the state's urban populations are segregated away from the agricultural and rural populations, which are dispersed throughout the western and southern two-thirds of the state's landmass.

As mentioned already, the blue crab catch every year in Virginia rivals that of Maryland making crab cakes just as important to Virginia seafood lovers as in Maryland. Virginia's seafood industry, according to one estimate, which does extend include harvest from the Atlantic Ocean, is the fourth-largest in the country, producing blue crabs, scallops, clams, croaker, spot, striped bass, and oysters. Virginians also connect with the Bay through the major port cities, ship-building yards, and military installations in Portsmouth, Norfolk, and Hampton Roads.

Unlike Maryland's environmental culture that is a major factor in the state's political culture, I do not have the same sense that Virginia has as strong of an environmental culture influencing the state's political culture. This is surprising because of the importance of the Bay to the state seafood industry and the military and shipping industries and the fact that the majority of the population does live within the four bayside river basins. But perhaps because the majority of Virginia occupies only one-side of the Bay - unlike Maryland that "straddles" the Bay - and, as will be described later, because of the dominance of the business culture in the state, environmental culture may not be as significant of a motivating political factor.

Virginia is a large state in both area (42,774 total square miles including water, ranked 35th in the country) and population (7.6 M in 2005, ranking it 12^{th} nationwide) (Barone and Cohen, 2005). There are 95 counties and 47 Soil and Water Conservation Districts. Although over 32 % of the state's land area is in 8.7 million acres of farmland (City Data), agriculture contributes just 1.3% of the state economy but about 20 % of Virginian jobs are in agriculture. (DEQ, 2008) One-third of Virginia's jobs are in the service sector. (National Geographic, 2008) Nearly a fifth of the work sector (19%) is in government, while 74% are in the private sector and 5% are self-employed (Barone and Cohen, 2005). Forbes Magazine named Virginia the best state in the nation for business in 2006 (VEDP, 2006).

Virginia's Government Structure and Political Culture

Virginia's governorship is strong and has a legislative clearance system, which requires the administrative agencies to clear legislative proposals with the governor's office. In addition, the governorship has centralized control agencies like the Department of Planning and Budget.

Despite this strength in the Governor's office, the Assembly is stronger than the executive branch because governors cannot run for re-election and the General Assembly selects judges and justices" (Strum, 1977). The Virginia General Assembly, according to Whelan (1992), remains one of the most stable state legislative bodies in the country having a strong committee system with continuous committee membership and seniority controlling access to the key leadership positions.

Due to its growing population, Virginia changed its constitution in the 1970s to establish annual legislative sessions. However, the period in between sessions, over the summer, has become a time of increasing legislative and interest group activity. Officially, the Assembly can use its interim months to conduct studies and investigations, which became the case when the 1998 Poultry Waste Law was postponed for further study and re-considered in the 1999 legislative session. Most interest groups use the interim period for "winning the battle before the legislature even starts" according to lawyer-lobbyist William G. Thomas, by organizing their membership and lobbying relevant policy makers. (Whelan, 1992)

Conservative principles "figure prominently in the state's political culture, as do its historical traditions." Political scientist, Larry Sabato says, "Virginia reveres her glorious past and looks to that past as much as to the future." (Whelan, 1992) Though Virginia does not register party voters, the state is predominantly regarded as a "red state" because the House of Delegates since 1999 has been dominated by Republicans. The Senate of Virginia has also been dominated by Republicans since 1999 but in 2007 transferred power to the Democrats. At the Governor's office since 1970 until 2010, six of the 11 Governors of the state have been Republicans. As will be described in Chapter 5, Virginia Republican Governor Gilmore (1998 - 2002) played a back-seat role in the development of the state's Poultry Waste Law while Delegate Tayloe Murphy, a Democrat from a district bordering the Chesapeake Bay took the lead role as policy entrepreneur.

Virginia's Interest Group Power

Most studies from the 1980s conclude that Virginia has a "moderately strong" interest group system which makes Virginia unique as a southern state since all other southern states are ranked in the "Strong" category. Despite this distinction, Whelan wonders why

Virginia's interest group strength isn't even weaker given the last three decades of increased economic development, urbanization, political party competition, and governmental professionalism that are associated with diminished interest group strength (Hrebenar, 1999). According to Hrebenar and Thomas's (1992) interest group power categorizing system, Virginia's interest group power is labeled as "Dominant/Complementary," meaning, sometimes, the groups play an "overwhelming and consistent influence on policy-making" and other times, they have "to work in conjunction with or are constrained by other aspects of the political systems."

A review in 1987 of the registered lobbyists in Virginia reveals that the business community retained the dominant set of interests represented at the Capital, with 65% of the registered lobbyists. There were only eight farm interest groups registered making up only 2% of the lobbyists in the state. However, several of those groups are federations with numerous smaller organizations as members (Whelan, 1992). Whelan suggests the limited representation of the farm lobby in the state capital is due to the legislative redistricting in the 1970s, coupled with the concentration of the population and economic interests in the urban corridors, resulting in the rural membership in the Assembly losing ground to the increasing numbers of urban and suburban legislators.

Given Virginia's large population and land area, it is to be expected that the state would have a significantly large number of environmental organizations, ranging from river/watershed groups (e.g. James River Association, Potomac Conservancy) to regional organizations (e.g. Chesapeake Bay Foundation, Alliance for the Chesapeake Bay) to chapters of national organizations (e.g. three Audubon Society Chapters, eight Sierra Club Chapters, and The Nature Conservancy). The largest and most influential of the environmental groups in Bay matters is the regional Chesapeake Bay Foundation (CBF), which was the lead group negotiating the 1999 Poultry Waste Law (PWL). It is important to note that two members of the Virginia CBF that were involved in negotiating the PWL later joined the Virginia Department of Conservation and Recreation (VDCR) as Director and Assistant Secretary. The VDCR is the agency that implements the both the state's voluntary and regulatory Nutrient Management Program.

According to the 2007 Census, there are 47,000 farms in the state and 1,200 poultry operations – 800 of which are broiler chicken farms while 300 of which are turkey farms. Virginia's agricultural sector is diverse with cattle, hay, tomatoes, soy and peanut farming playing significant roles. The majority of poultry chicken growers are located in the Shenandoah Valley while around 200 are on Virginia's Eastern Shore. Rockingham County in the Shenandoah Valley is the second largest poultry-producing county in the U.S. (VPF, 2008).

Aside from the many commodity crop and livestock trade associations, the two most important agricultural interest groups involved in developing the Poultry Waste Law were the Virginia Poultry Federation (VPF) and the Virginia Farm Bureau. VPF represents the 600 chicken and 300 turkey farms in the Shenandoah Valley and the eight poultry processing plants operating in the state: Cargill, George's Foods, Pilgrim's Pride Corporation, Perdue Farms, Tyson Foods, and Virginia Poultry Growers Cooperative, Inc. The Delmarva Poultry Industry, Inc. represents the remaining 200 poultry growers on Virginia's Eastern Shore. The Virginia Farm Bureau Federation has more than 148,000 members comprised of farmers and rural families that take advantage of the discounted insurance program and other benefits that VFBF offers. There are 88 county Farm Bureaus located throughout Virginia.

Virginia's Pre-*Pfiesteria* Approach to Farm Nutrient Pollution

Virginia's approach to agricultural nutrient pollution prior to their 1999 Poultry Waste Law was similar to Maryland's approach in that both states emphasized educational, technical, and financial assistance to reduce pollution from farms. However, Virginia's regulatory approach differed dramatically in one respect: Virginia developed a larger state animal permitting program than Maryland did. This section will highlight Virginia's three policy approaches to reducing agricultural nutrient pollution: a) state and federal voluntary cost-share programs, b) voluntary educational and technical assistance programs, and c) state and federal regulatory programs.

Virginia's Agricultural Cost-Share (VACS) program also started in 1984; a year after the state signed the first Chesapeake Bay Agreement alongside Maryland. The Virginia Department of Conservation and Recreation (VDCR) administers the program through the state's 47 Soil and Water Conservation Districts. Over the years, Virginia has increased the amount of cost-share funds its farmers can receive through implementation of the 1985, 1992, and 1996 federal Farm Bill EQIP, CREP, and CRP programs. The 47 Conservation Districts help farmers plan conservation projects, procure cost-share monies from the state and federal conservation programs, and install or construct the projects. The Districts receive technical assistance from the USDA NRCS field offices when developing projects with federal conservation funding. Unlike Maryland that publishes annual reports every year for its MACS Program, Virginia does not publish such reports and repeated requests for such statistics as the annual or cumulative dollars, projects, or acres of BMPs that have been funded by the VACS Program have gone unfulfilled.

Another major source of cost-share funds arrived in the spring of 1997, before the *Pfiesteria* fishkills occurred in the summer. The General Assembly passed the Virginia Water Quality Improvement Act, which established a Fund to grant state and federal money to local governments and groups to conduct projects to benefit water quality. Several provisions in the VWQIA directly benefited agricultural activities, including new best management practice programs that provide tax breaks and grants for the construction of poultry manure sheds and the purchase of poultry-manure specific manure spreaders. In addition, matching grants were provided to the poultry and swine industries researchers and Virginia Tech University researchers to study the effects of adding the enzyme *phytase* to hog and poultry feed and for Virginia Tech to develop a phosphorus site index.

According to Virginia Tech University scientist, Dr. Jim Pease, since Virginia's Poultry Waste Law did not require phytase (like Maryland's law did), he said the

> "use of phytase (in the chicken feed) varies widely across (poultry) companies in Virginia. You can tell which company is using it by the results of the manure (nutrient) test. The industry as a whole embraced it voluntarily because they'd seen what was happening up in Maryland. They got money from the government to investment in equipment." (Pease, personal communication, March 16, 2010)

Virginia has been providing educational and technical assistance to farmers for decades through the Virginia Tech University's Extension Service and the Soil and Water Conservation Districts. Extension agents conduct research, disseminate educational materials, and provide educational workshops to assist the state's farming community. As is the case in Maryland, the bulk of the research and focus has been on improving agricultural productivity and efficiency but in recent decades, the focus has switched to limiting and preventing negative environmental impact from farming activities. The Soil and Water Conservation Districts also provide educational assistance to farmers in the form of "field days" (demonstrations of BMPs on agricultural fields), in public meetings and through classroom programs. In addition, the Districts prepare soil and water conservation plans for farmers to either meet a) the Farm Bill's conservation compliance requirements for subsidy recipients on highly erodible land or b) because the Districts identify a soil discharge problem on the farm and are successful in convincing a farmer to solve the problem.

Virginia established its full-fledged, voluntary Nutrient Management Program just as Maryland did, in response to the 1987 Chesapeake Bay Agreement's Tributary Strategies' 40% nutrient reduction goal. However, Virginia took a different route in developing and implementing their NM Program. Instead of administering the program through the land-grant university Cooperative Extension Service system which was Maryland's approach, farmers in Virginia who volunteered to have a nutrient management plan developed for their operations went to the soil conservation districts instead. Farmers who volunteered to join the program received many free services. For example the District Conservationists would "pull" soil and manure samples from the farm operation, send the samples away for soil and manure nutrient analyses free-of-charge to the farmer, and develop a nutrient management plan to fit the farmer's crop rotation needs.

Virginia's regulatory approach to farm nutrient pollution differed from Maryland's approach. In response to the federal discussions in the early 1990s about regulating confined animal feeding operations (CAFOs), Virginia preempted the federal program and established its own state-level permitting system for dairy, cattle, and swine operations. These animal sectors were targeted because they have liquid manure management systems, which can discharge to the environment if not intensively managed. In 1994, Virginia introduced its Virginia Pollution Abatement (VPA) permit system for these specific animal farms. The VPA system set a 300 animal unit threshold for eligibility for a permit which is much stricter than the current federal CAFO permit system, which has a 1,000 animal unit requirement. Thus, far more animal operations in Virginia have been required to file a general permit and a nitrogen-based nutrient management plan since 1994 than if Virginia had waited for the federal program. Like the federal law, the VPA law prohibits discharges from feedlots into streams and requires proper storage for manure, soil and manure testing, and groundwater monitoring at selected sites.

Since poultry production generates solid manure, the poultry industry was not included in either the state or the federal CAFO permit programs. However, a year later, in 1995, in a move to pre-empt a possible extension of the VPA to the poultry sector, three of the four poultry integrator companies operating in Virginia began requiring their growers to get nutrient management plans with the state's voluntary Nutrient Management Program. By 1998, 854 of 985 poultry growers in the Shenandoah Valley already had plans. However, the 200 or so other poultry growers on the Eastern Shore of Virginia were not part of this voluntary effort.

In 1996, a year before the *Pfiesteria* fishkills, Virginia passed a quasi-regulatory law called the Agricultural Stewardship Act, also known as the Bad Actor Law. This law enabled citizens to complain about odor or pollution from farm activities and report those offenders to the Virginia Department of Agriculture and Consumer Services (VDACS). The law authorized VDACS officials to investigate those complaints and prosecute based on the state's nuisance laws. I am unaware of the number of complaints or penalties that have occurred because of this law.

4.4 Delaware Politics and Pre-1997 Approach to Farm Nutrient Pollution

Delaware Politics

Delaware's Environmental and Bay Culture

Delaware's policy response to the *Pfiesteria* events can be better understood by examining the impact of the lack of Chesapeake Bay frontage, Delaware's agricultural and business dominated conservative culture, and the perceived importance of agricultural voters to electoral politics.

Since Delaware is not contiguous with the Chesapeake, the Bay has never been a high priority or even on Delaware citizens' minds despite the fact that one-third of the state's land mass does drain into the Bay. The southwestern corner of the state – where the majority of the poultry production is concentrated drains into two Chesapeake Bay Tributaries – the Nanticoke River and Pocomoke River. The mouth of the Pocomoke River is where the largest Pfiesteria-related fishkill events occurred in 1997.

Delaware is shaped like a 90-degree triangle with the hypotenuse side of the state bordering the Delaware Bay and the Atlantic Ocean while the other two sides abut Maryland's Eastern Shore counties on the Delmarva Peninsula. Environmental issues related to agriculture in Delaware focus on the long-time debate about how to clean up Delaware's Coastal Inland Bays where eutrophication problems persist and agriculture, particularly poultry production, is identified as a major contributor of the excess nutrients. However, without any water frontage on the Chesapeake, most Delawareans have no direct relationship with the Bay or feelings of responsibility towards it.

According to Johnson and Pika (1993), there are two dominant sub-cultures dividing the state's three counties geographically and economically. The Chesapeake & Delaware Canal runs across the middle of the northernmost New Castle County and divides the "Upstate" industrial manufacturing, financial services, and many corporate headquarters from the "Downstate" counties of Kent and Sussex which are dominated by the poultry industry, commodity and vegetable farming, and the horse racing industry.

Ranking near the bottom of all states in terms of size (49^{th} in land area; 2,489 square miles) and population (44th with just 783,600 people in 2000), Delaware has plenty of economic successes to boast about calling itself "a small wonder" (Barone and Cohen, 2006). Delaware is well known for its pro-business culture establishing itself as the largest credit card, banking center, and company chartering zip code in the country. Once known as "a company town" due to the dominance of business and government by the DuPont Corporation and the DuPont family, Delaware remains a pro-business hub. Delaware has a long history of "carefully calculated economic development;" it's easy incorporation procedures and numerous tax and legal advantages have resulted in more than half of the Fortune 500 firms and half of all firms on the New York Stock Exchange being chartered in Delaware (Johnson and Pika,1993).

The state's industrial sector statistics shows agriculture playing a modest role: 1.1% in agriculture, 1% information, 5% public administration, 7% in construction, 11% finance, 14% trade, 18% manufacturing, 28% professional, and 11% other. The work sector shows surprisingly high employment in the government sector: 13%, 81% in the private sector and 5% self-employed (Barone and Cohen, 2006).[i]

There are approximately 2,400 farms in Delaware occupying 560,000 acres. The state's agricultural community occupies 45% of the state's land area but makes up less than 1% of the state's population of 807,385. The majority of the state's 400 poultry growers are located in the southernmost county of Sussex - the number one poultry-producing county in the country. Of the $949 million Delaware farms contributed to the state's economy (2006), $739 million was from poultry production (DDA, 2007).

Delaware's Government Structure and Political Culture

For insight into Delaware's policy response to the 1997 *Pfiesteria* fishkills, it is important to understand that the state has a small, close-knit group of powerful leaders in the executive and legislative branches, a limited government bureaucracy that turns to interest groups for support and a split political party system that makes working towards consensus a key element of Delaware policy-making.

Johnson and Pika (1993) concluded that "The style of politics in Delaware is highly personalized owing to the smallness of the state, the longevity of the members of the General Assembly, and to a lobbying community that has, among its most influential members, former legislators and state administrators as well as long-time lobbyists." Due to the lack of professional staff and the part-time nature of the General Assembly, the Delaware's Governor's office and the administrative agencies play a powerful role in state policy-making. Indeed, even the Governor has a chief lobbyist and team, which frequently lobby the legislators, and in the 1987 legislator survey, this lobbying team ranked as the most effective of all lobbyists (Lippincott and Thomas, 1993).

An example of this close and personal approach to policy-making are the weekly meetings which started in the DuPont administration, which include the governor, legislative leaders from both parties, key staff, and selected department secretaries. Thus, on a weekly basis, the governor sets the political agenda and outlines his policy position with this small and tight group of power shareholders. The result is bipartisan and consensual decision-making but also a limited involvement of most legislators in the discussion and analysis of policy issues. This political process is part of what's known as "the Delaware way." As will be described in Chapter 5, this small group meeting approach was precisely how Delaware tackled the policy challenge of responding to the 1997 Pfiesteria-related fish kill events.

In the legislative branch, since there are no limitations in Delaware on elected officials or state employees becoming lobbyists immediately after leaving public service, there is a rapidly revolving door between the private sector and the General Assembly. In fact, perhaps the key legislative leader involved in shaping Delaware's response to the *Pfiesteria* events was Wally Caulk, Chairman of the House Agriculture Committee. Mr. Caulk drafted the 1999 Nutrient Management Law while at the same the time was a member of the Delaware Farm Bureau. As of 2005 when I interviewed Mr. Caulk, he was serving as Administrator for Delaware Farm Bureau.

Another element of Delaware's policy-making culture is the Assembly's lack of a professional bureaucracy. Johnson and Pika (1993) noted that Delaware has a part-time legislature that devotes only modest resources to professional staffing. Thus, they surmised, “relying on legislators with other principal jobs creates a “Jeffersonian concept of the citizen legislator” but may inhibit the development of expertise in policy areas, especially without extensive professional staffing resources, and restrict the legislators’ areas of interests to their own business sector.” Although the study is old, it does show a snapshot of how limited resources can be in a small government within a small state. In 1990, only one committee in the legislature had full-time professional assistance while others had to rely on per diem employees. The nonpartisan research arm of the General Assembly, the Legislative Council, had only four full-time professionals, none of whom was a program specialist. Therefore, lobbyists played an important role in providing data and analysis and keeping the legislators informed of pending bills.

Johnson and Pika (1993) recognize that there is concern that the lack of professional staff and part-time status of legislators that are most often businessmen results in too much of a “club mentality: and reliance for information on people with vested interests in legislation. The counter to this concern is that due to Delaware’s small size, the fact that “everyone knows what everyone else is doing”, keeps the incidence of corruption and lobbying abuses to a minimum.

One of the key elements of “the Delaware way,” is the state’s split political party system. Delaware’s “robust two-party politics” according to Johnson and Pika (1983) is “an influential force in state-wide politics – quite possibly the most influential.” Being northeast of the Mason-Dixon line, the majority of Delaware citizens are registered Democrats (43%) while 32% are Republicans and 23% are unaffiliated or minor parties. Democrats dominate the State Senate but enjoy less of an advantage in the House of

Representatives. The Governor and two Congressional Senators are Democrats while the state's one U.S. Representative is a Republican. Not surprisingly, southern most Sussex County which is the poultry capital of the country, tends to vote Republican while northern most New Castle county votes Democratic and Kent County in the middle, (the second largest agricultural county) votes Republican by a narrow margin (Barone and Cohen, 2006).

Delaware's Interest Group Power

Given the state's small size, the part-time legislature, the revolving legislature door, and the Delaware way of consensual politics, interest groups are a key stakeholder in Delaware's political process. The Delaware way translates into the state officials talking and negotiating with the regulated industry to find and maintain political peace and find practical, industry-acceptable solutions. Johnson & Pika (1993) observe that "The media produce only a modest amount of investigative journalism and public-interest groups are few in number and not very influential." Thus, the regulated industries can easily access both branches of government to shape the regulations that affect them.

On the "Dominant-Complementary-Subordinate" spectrum of interest group power proposed by Hrebenar-Thomas (1992), Delaware ranks as "Complementary/Subordinate" which means that the state's interest groups alternate between being complementary and subordinate. During complementary time periods, interest groups work in conjunction with or constrained by the "robust two-party system," a strong executive branch, competition between various interest groups, the political culture or a combination of these. During "subordinate" time periods, the interest group system is consistently subordinated to one or more of the aforementioned aspects of the political system.

Given the capital of Delaware, Dover, is under a three hour car-ride from the furthest reaches of the state, face-to-face contact was rated by 68% of the state legislators in a 1987 survey as the most effective method for Delaware interest groups to get their message across. Another telling statistic in this survey is that 97% of legislators say they support legislation promoted by interest groups if it's supported by their constituents and only 71% said if it's supported by the general public (Johnson and Pika, 1993).

Highlighting the pro-business statutes that move frequently and quickly through the General Assembly, one lobbyist commented in 1989, "nothing goes through as fast as business (legislation). Business can't always stop something but they can generally get through what they need to get through." This sentiment foretells the state's handling of the discussion of mandatory controls of farming nutrient activities; Delaware farmers felt they could not avoid enacting a regulatory approach to agricultural nutrient pollution but they could aggressively shape the process and ultimately the regulations that would affect them.

In the 1987 survey of state legislators, environmental interest groups received a rank of 8 out of 10 in terms of most effective interest groups during the state legislative session while farm groups received no mention. However, during election time, environment groups received fewer mentions than farm groups as effective interest groups. Lippincott and Thomas (1993) conclude this suggests that at the time, environmental interest groups were more legislatively active but during the election cycles, it is the farm interest groups that play a powerful elective role.

Regarding Delaware's environmental interest groups, there are state-focused organizations (e.g. Delaware Nature Society, Green Delaware), river-watershed associations (e.g. Delaware River Keeper Network, Center for the Inland Bays), and chapters of national organizations (e.g. Nature Conservancy-Delaware Chapter, Delaware Audubon Society). The two most active and influential organizations are the Delaware Chapter of the Sierra Club and the Center for Inland Bays. Both groups would come to serve on the Delaware Nutrient Management Commission that implements the 1999 Delaware Nutrient Management Law.

Farm interest groups are highly influential with government agencies and legislators in Delaware. The largest and most highly influential is the Delaware Farm Bureau (DFB), which has 3,000 farm family members. About half of DFB members are non-farmers who enjoy the insurance and other benefits available with membership. Possibly the most influential farm interest group in Delaware is the peninsula-wide, Delmarva Poultry Industry, Inc which was founded in 1948 and represents nearly 1,800 chicken growers, the four poultry processing companies on the Peninsula, and affiliated industries. Though there is no state poultry trade association, the 800 chicken growers in Delaware and two of the peninsula's four poultry processing companies that are based in Delaware (Mountaire and Allen's Family Foods) played a key role in developing the state's 1999 Nutrient Management Law.

Delaware's Pre-*Pfiesteria* Approach to Farm Nutrient Pollution

Delaware's policy approach to reducing agricultural nonpoint source pollution prior to the 1997 *Pfiesteria* events was primarily to provide a) technical and financial assistance to farmers through the three Soil and Water Conservation Districts and b) educational factsheets and workshops from the University of Delaware's Cooperative Extension Service.

Delaware's financial and technical assistance programs mirrors the programs in Maryland and Virginia. The three Soil Conservation Districts (SCDs) in each of the 3 Delaware counties carry out the mission of the original 1930s federal Soil Conservation Services to control soil erosion and sedimentation and over the decades have expanded their attention to improving animal manure management issues. With funds from the State's Revolving Fund which provides cost-share monies for soil erosion control projects for agriculture as well for non-farm landowners, local governments, communities, etc., the three SCDs provide soil conservation planning services and implementation assistance. In addition, Sussex and Kent SCD provide equipment rentals to achieve the soil conservation projects which often include construction.

For example, the following are some of the services provided by Sussex SCD,[15] the number one poultry-producing county in the country, on a first-come first-served basis: Farmland Clearing, Spoil Leveling, Cleanout of Private and Tax Ditches, Relocation and Construction of New Ditches, Construction of Wildlife and Deep Fish Ponds, Installation of Culverts and Drainage Pipe, Shoreline Restoration, Stormwater Pond Cleanout and Maintenance, Special State and Federal Projects, Weed Wiper, and Financial Assistance.

Delaware has provided educational programs for farmers for decades. The state's land grant university, the University of Delaware through its Cooperative Extension Service integrates the efforts of various agricultural and economic departments that have been conducting research and producing educational materials and workshops for Delaware farmers. Examples of UDE Extension newsletters that are written for farmers and crop advisors include: determining realistic yield goals, diagnosing crop problems,

[15] Sussex County Soil Conservation District Equipment Services. http://sussexconservation.org/epuip.htm

determining if and when to replant corn, managing frost damage for silage corn. UDE's College of Agriculture and Natural Resources has provided farmers and crop advisors a "Weekly Crop Update" that, depending on the week, can include such information as crop pricing statistics, weather updates (rainfall, temperatures, and soil temperatures), emerging insects and insecticides, percent of crop planted each week, changes in corn herbicides for the growing season, temperature for proper storage of various corn herbicides, etc. And during the months when farmers are not in the fields planting or harvesting, UDE sends out "Agronomic Crop Newsletters" in December -February and August-September announcing various educational workshops, trade fairs, and various meetings for farmers to attend.

In terms of a stand-alone nutrient management program that provides NM planning services to farmers, unlike Virginia and Maryland that started their voluntary Nutrient Management Programs to implement their Chesapeake Bay Agreement Tributary Strategies goals, Delaware was not a member of the Agreement and did not start a Nutrient Management Program until the 1999 Delaware Nutrient Management Law passed in response to the *Pfiesteria* events.

Unlike Maryland and Virginia, Delaware did not have a regulatory approach to reducing farm nutrient pollution prior to the 1999 Delaware Nutrient Management Law. In fact, the NML not only established a mandatory nutrient management program but also developed the outline of the state's CAFO permitting program. In addition, due to the lack of significant slope in Delaware's topography, the Farm Bill's Conservation Compliance requirements largely did not apply to the state's crop subsidy recipients.

4.5 Summary

This summary section of Chapter 4 serves to compare and contrast the similarities and differences in the states' political systems and their pre-*Pfiesteria* approaches to reducing farm nutrient pollution. There were large differences in all three states' geographic and cultural relationships to the Bay, their political culture and policy-making styles, the relative levels of environmental, business, and agricultural interest group power, and their development of voluntary nutrient management programs and CAFO permitting programs. There were notable similarities in each state's educational and financial assistance policy approaches to reducing farm pollution prior to the 1997 *Pfiesteria* events.

Of the many differences, one important difference is the geographic location of the Chesapeake Bay vis a vis the state, the relevancy of the Bay to the state's citizens and the significant role the Bay plays in shaping the state's environmental self-identity. Given that Maryland figuratively "embraces" the upper reaches of the Bay and the state's tourist, recreational, and seafood industries benefit from the Bay's natural resources, Marylanders have the strongest logistical, economic, and emotional connection with the Chesapeake and strongly self-identify with the Bay.

Delaware's lack of any Bay frontage leaves little reason for Delawareans to care about the Chesapeake when they have the Delaware Inland Bays, the Atlantic Ocean and many beaches along their own coastline to capture their attention.

Virginians also benefit a great deal from the natural resources of the Bay with their large seafood, ship-building, and military industries positioned along the Western Shore. Because of their Bay frontage, Maryland and Virginia are Signatory States of the

Chesapeake Bay Agreement and Delaware is not.[16] However, when compared to Maryland's environmental culture, Virginia's is less fervent and less part of the state's identity. This is likely due to Virginia's being more business-oriented and located overwhelming only on one side of the bay.

The second obvious differences are of political party, power-sharing structures, political style, and policy-making processes in each state. Maryland is regarded as a "big D" state, Virginia until recent years has been regarded as a Republican-leaning state, while Delaware has enjoys a robust two-party system. To put it crudely, Democrats are viewed as "the party of big government" and it takes government power to address the environmental externalities that the market fails to properly price. Thus, Democrats looks to government "as part of the solution." In contrast, Republicans are viewed as "the party of business" and government is regularly seen as "part of the problem." Government is functioning best when it "gets out the way" of business. Thus, environmental policy would tend to be restricted as much as possible under a Republican-leaning political culture.

In Maryland, the Executive branch enjoys disproportionate power over the Legislative branch which seldom necessitates the need to compromise. In Delaware, primarily owing to the smallness of the state, there is a close-knit and consensual approach to agenda-setting and "keeping the peace" is very important. In Virginia, their legislative system has set up a unique approach to dealing with legislative disagreements by carrying over proposals for further study and negotiation during the summer session.

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[16] Pennsylvania is the third Signatory State to the Chesapeake Bay Agreement and though it has no Bay frontage, the state's Susquehanna River delivers 50% of the Bay's freshwater every year and thus approximately 50% of the nutrient and sediment pollution load as well.

Maryland's Governorship enjoys the power of the purse but when legislators disagree with the Governors' initiatives, their lack of budgetary power can leave many feeling powerless and excluded from the process. In contrast, Delaware's Governorship has a long history of weekly agenda-setting meetings with the leaders of the General Assembly and key Administrative agencies which make for an elite, collegial, and consensual approach to power sharing. In addition, the quickly revolving door between Delaware's legislative branch and business interest groups enables Delaware to get things done quickly and behind closed doors. Virginia's year-round legislative session and its summer of study and compromise enables it to foster negotiations and compromise between the opposing interest groups.

Many of these reasons (political party leanings, geographic relevancy of the Bay, environmental identity of the citizenry, the power-sharing relationship between the Executive and legislative branch, and the peculiar legislative calendar) help explain the relative powers of environmental and agricultural interest groups in each state.

In Maryland, environmental interest group power dominates over agricultural interests because environmentalists strongly align with the Democratic Party which sees "government as the solution," because the Bay and "environmentalism" is particularly important to state culture, and because the state's poultry industry is largely isolated on the Eastern Shore, far away from the legislative activities of Annapolis.

As for Delaware – with no geographic or regional policy relationship with the Bay, where agricultural interest groups are important constituencies in electoral politics, where the "door" between the Legislature and the private sector is always revolving, and where the state's tiny size makes consensual politics a hallmark of the political process – all of these characteristics help to explain if not the dominance of agricultural interest groups over environmental groups, at least their significant political strength.

In Virginia, the slight edge that farm interest groups have over environmental interest groups has to do with to the state's large size and long-time rural character, its pro-business friendly government ethic, as well as the limited geographic relevance of the Bay to the majority of the state's citizens.

Before discussing the final major difference between the states' pre-*Pfiesteria* regulatory approach to farm nutrient pollution, it is important to point out the overarching similarity in their educational approach. All three states relied on their land grant universities' Cooperative Extension Service to help farmers improve agricultural productivity and profit through educational materials, workshops, and field visits. In addition, all three states' relied on their Soil Conservation Districts to help farmers reduce soil erosion and sedimentation of surface waters and relied on federal and state cost-share funds to encourage farmers to install and maintain best management practice projects.

In all three states, it is clear that the voluntary program approach with financial and technical assistance to reducing agricultural sources of nutrient pollution took account of on-the-ground realities of farming and the workings of farm culture. The land-grant university Extension Service and the Soil Conservation Districts understood that their clients, as described in Chapter 3, were on average, older, had limited education, had limited financial resources, were slow to change and slow to trust new ideas, and had a great deal of pride in their farms and the manner in which they farmed which they learned from their fathers and grandfathers.

Thus, the voluntary approach focused on slowly building and maintaining relationships; on gaining trust and good will; on demonstrating a new practice or technology "saved you time and money" and letting the on-farm and off-farm (environmental) benefits speak for themselves; on letting the good news work its way by word of mouth slowly through the coffee shops; on not pushing too hard or expecting too much; and following the old adage that "honey works better than vinegar."

One major difference in the educational approach to reducing nutrient pollution was that Maryland and Virginia developed voluntary Nutrient Management Programs to implement the 1987 Chesapeake Bay Agreement while Delaware never had a voluntary Nutrient Management Program. Thus, for a decade prior to the 1997 *Pfiesteria* fishkills, Maryland and Virginia Extension Service agents and Soil and Water District conservationists were working one-on-one with farmers who volunteered to have a nutrient management plan developed for their farms to optimize crop yields while reducing nutrient loss.

One major difference in each state's regulatory approach to nutrient pollution was the presence or absence of the federal CAFO program. Prior to the 1997 *Pfiesteria* events, both Maryland and Virginia developed state versions of the federal CAFO program while Delaware did not. Maryland's implementation of the federal CAFO program continues to have a negligible reach (13 animal operations) and thus negligible impact on reducing livestock manure, nutrient, and sedimentation pollution. In contrast, Virginia's development of its own Virginia Pollution Abatement (VPA) permit program for more operations than would be affected by the federal CAFO program may be having a meaningful impact on reducing pollution from these 100 or so facilities. Only with the advent of the 1999 Delaware Nutrient Management Law, did Delaware begin outlining a federal CAFO program.

And finally, perhaps the most important difference between each state's regulatory approaches to agricultural nutrient pollution before the 1997 Pfiesteria focusing events was that Maryland had attempted, in the early 1990s, to regulate farmers by mandating nutrient management plans on all farms. Neither Virginia nor Delaware had ever introduced such legislation or any other comprehensive requirements for their entire agricultural sector.

CHAPTER 5 – FINDINGS & ANALYSIS: STATE RESPONSES TO PFIESTERIA FROM 1997 UNTIL 2006 AND FARMER OPINIONS

5.1. Introduction

Chapter 5 provides a chronological review of the three states' response to the 1997 *Pfiesteria*-related fish kills. For each state, I will provide a description of the policy response including: 1) how each state diagnosed the environmental and policy problem, 2) how each state developed their policy making process, 3) who each state regulates and what they require, and 4) how each state implemented those requirements over the years.

Throughout this chapter, I will present first-hand accounts of "what happened" from the farm and environmental groups, government and university institutional stakeholders that I interviewed. I will also rely on secondary sources such as newspaper articles, reports by government, university, and scientific panels, and organizational press releases. To reveal farmer opinion of their states' problem diagnosis, policy development process, and the implementation process, I will present results from my Likert Opinion survey of the 60 farmers I interviewed on the Delmarva Peninsula. Chapter 5 will end with a discussion of these findings and a comparison of the policy response and farmer reactions from Maryland, Virginia, and Delaware.

5.2. Maryland's Policy Response to the *Pfiesteria*-related fishkills

How Maryland diagnosed the problem

Fishkills on the Eastern Shore of Maryland

Three fish kills and four river closings in the summer and fall of 1997 focused national attention on Maryland's poultry industry and the role that voluntary and regulatory programs can play in reducing pollution from agricultural activities.

In October of 1996, in the Pocomoke River in Somerset County, Maryland on the Eastern Shore of the Chesapeake Bay, fishermen catching menhaden, a commercially important species, noticed that some of the fish they caught had skin lesions. Similar skin sores were noted on a variety of fish species by recreational anglers and commercial watermen the following year in March 1997. In April and May, the Maryland Department of Natural Resources (MDNR) tested 2,500 fish and discovered lesions in 10% of them. Water samples taken June 17th from 18 sites around the Pocomoke River and found the presence of the toxic microorganism, *Pfiesteria piscicida*, which was blamed for killing millions of fish in North Carolina in 1995 after hog waste storage lagoons spilled into the Neuse River. Maryland Governor Parris Glendening (D) took a boat tour with scientists studying the affected portions of the Pocomoke River near Shelltown (Mueller, June 30, 1997).

From August 6 through 9, 1997, fisherman spotted thousands of dead menhaden floating in the Pocomoke River near Shelltown – the first major fish kill in the Chesapeake Bay and its tributaries in seven years. From August 7th through 13th, Glendening closed portions of the river to boating, swimming, and fishing so scientists could investigate the fishkills and determine if the medical reports from fishermen and scientists were associated with the dead fish. People coming in contact with the sick fish complained of getting the same skin lesions as the fish, as well as, nausea, headaches, and short-term memory loss. Again, water sample tests showed the presence of *Pfiesteria* *piscicida*. The fishkills got the attention of Maryland U.S. Senators Paul Sarbanes (D) and Barbara Mikulski (D) who left Capitol Hill to join boat tours of the affected areas. The Senators announced their request for help from the Center for Disease Control (CDC) and the National Institute of Environmental Health Services, citing an "urgent and potentially serious human health problem," Sarbanes also announced a $2 million federal appropriation to upgrade two sewage treatment plants along the Pocomoke River.

On September 10th, fish with skin lesions were spotted floating on the King's Creek off of the Manokin River, another Eastern Shore tributary to the Bay, located just two peninsulas north of the Pocomoke River, also in Somerset County. Portions of the river were closed for scientific investigation. On September 13th, another fishkill was cited in another Eastern Shore Bay tributary, the Chicamacomico River, located a couple of peninsulas north of the Manokin River draining Somerset and Wicomico County and it was closed temporarily.

Will Baker, President of the Chesapeake Bay Foundation recalled the Pfiesteria-related fishkill events:

> "It reminded me of the movie Jaws when the mayor had to decide whether to keep the beaches open for the upcoming Memorial Day weekend. In Maryland, it was the Labor Day weekend, and Governor Glendenning had to decide how seriously to take the *Pfiesteria* threat. He was wise to be totally transparent and report the medical team's findings. Doctors from Johns Hopkins University and the University of Maryland had found evidence of a direct correlation between something happening in the environment and impacts on peoples' brains. At CBF, we were getting calls asking if it was safe to visit the Bay and to eat local seafood. Some restaurants actually stated that their fish was NOT from the Bay to allay the fears. It was the first and only time I ever saw anything like this." (Baker, personal communication, March 10, 2010)

Policy makers and stakeholders react

From the middle of August to the first week of September, state agencies continued their diagnostic studies, environmental and farm interest groups aired their differences, and a legislator announced his intentions to make nutrient management mandatory in the next General Assembly.

The Maryland Department of Environment (MDE) set up water quality monitoring stations in the Pocomoke River and explained that the microorganism, *Pfiesteria,* can emerge from a dormant stage when excessive concentrations of nutrients flow into shallow, sunny water causing an algae bloom. (Shields, August 17 & September 8, 1997)

Speculation began about the likely sources of excessive nutrients flowing into the Pocomoke River on Maryland's Eastern Shore and all the likely suspects emerged: sewage treatment plants, septic systems, crop fertilizers, poultry manure. "Lt. Governor Kathleen Kennedy Towson (D) said fertilizer runoff from farm fields was "one possibility among our many leads," but she cautioned against blaming agriculture for the river's woes." Meanwhile, the Chesapeake Bay Foundation (CBF) announced it was calling for reforms to the way the poultry industry manages manure from the millions of chickens on the Eastern Shore. (Shields, August 12, 1997)

The Chesapeake Bay Foundation called for: poultry processing companies like Tyson's and Perdue to take responsibility for the manure their chickens were producing, a moratorium on new chicken houses in the Pocomoke area, and mandatory manure storage sheds for all operations. Whether or not farm runoff is linked to *Pfiesteria*, "environmentalists say the Pocomoke's troubles dramatize the need for accelerated efforts to protect the Chesapeake Bay and its tributaries." The fishkill was "a little alarm bell that we've got to be even more vigilant in our efforts," said Natural Resources Secretary, John Griffin. In 1997, there was less than three years until the Chesapeake Bay Agreements' 2000 deadline. And despite the Chesapeake Bay watershed states and the federal government spending $40 to $50 million per year on programs to clean up the Bay, it was becoming common knowledge that the states would miss their goal of reducing nutrients by 40 percent. (Shields, August 17, 1997)

In response to the growing finger pointing to Maryland farmers, the Maryland Department of Agriculture (MDA) announced it would survey 200 of the 543 farmers in Maryland's Pocomoke watershed to determine availability of manure storage sheds, which fertilizers and pesticides the farmers used, and the number of chickens grown. The Delmarva Poultry Industry (DPI) estimated that 47% of poultry farmers across the three-state Peninsula did have manure sheds. Lewis Riley, Maryland's Agriculture Secretary said that 72% of the 180,000-farmland acres in the Pocomoke watershed were under the state's voluntary nutrient management plan. Norman Astle, Maryland Farm Bureau spokesman, noted that even though the majority of farmers were participating in the state's voluntary program, "we're being whipped over the head and being told we're not doing enough. It's just hard to take." (Shields, September 8, 1997)

Washington Post journalist, Todd Shields, reported that a new concern with the state's nutrient management plans was their focus on nitrogen management and not on phosphorus which, Farm Bureau representative Astle said partly resulted in most farmland on the Eastern Shore having more phosphorus than was needed. MDE officials confirmed they did find higher levels of phosphorus in the Pocomoke River water samples. Michael Hirshfield, vice president of the CBF said, "There's a potential for nutrient management based on nitrogen setting up a time bomb with phosphorus.” Maryland Delegate James Hubbard (D-Prince George’s County) announced his intentions in the next General Assembly to propose legislation to make nutrient conservation techniques mandatory because “We aren’t doing anything to stop these fertilizers and nutrients and chicken (manure) from being dumped into the water,” Hubbard said.

The White House Summit

On September 11, 1997, the White House convened a meeting with President Clinton, five Governors of the Chesapeake Bay watershed states (Maryland, Virginia, Pennsylvania, Delaware, and West Virginia), and several cabinet secretaries to discuss the *Pfiesteria* fishkills in Maryland. At the end of the summit, Governor Glendening announced a multifaceted plan to address the *Pfiesteria* problem including a Citizen’s Blue-Ribbon Commission to study the problem and recommend new laws and strategies to fight *Pfiesteria* and a “Governor’s Summit” of the Bay watershed’s five states to share results of the scientific investigations and discuss policy options.

Glendening also suggested the possibility that nutrient management plans would be required especially of Eastern Shore chicken farms that, as Shields sensationally described, “wash large quantities of manure into tributaries of the Chesapeake Bay.” Glendening said, “It’s likely “we will have to go beyond the current status, which is voluntary compliance,” He added, “I know this will be difficult.” Agriculture Secretary Lewis Riley was quoted as saying, “It s going to be a change in operations.” “But I’m confident the industry will live up to its obligations and do it.” Pocomoke chicken grower Carole Morrison said, “The whole idea of regulating the farmers makes me sick to my stomach. Basically, we don’t own the chickens and we don’t own the feed they eat. The poultry farmers have done everything they possibly can for manure management. The poultry companies take no responsibility for this manure. Why are we responsible for the industry's waste?" (Shields, September 12, 1997)

Shields reported, "Glendening began stressing *Pfiesteria*'s potential dangers last month after doctors found minor brain damage in several people who had been exposed to waters harboring the toxic microbe." But at the White House Summit, "Glendening stressed again that seafood form the Chesapeake Bay is safe. He said there's no evidence that anyone has become sick from eating fish from *Pfiesteria*-affected waters."

Other announcements at the White House Summit include Maryland Congressman Steny Hoyer (D-MD) sponsoring an amendment to the House appropriations bill to give the Centers for Disease Control and Prevention $7 million to develop an emergency public health response to the *Pfiesteria* "attack" along the Atlantic Coast. Other sponsors were Representatives Gilchrest (R-MD), Michael Castle (R-DE), and Senator Mikulski (D-MD). Glendening pledged to spend $2 million to help farmer's plant cover crops to deter runoff.

Shields' article went on to describe the effect the *Pfiesteria* events were having on seafood sellers. According to Billy Ray White, of Captain White Seafood City, in Washington DC, seafood sales were "down 40% since the early August fish kills." White said, "Today's been terrible I tell ya…we have to educate our consumers… This is just a scare. It's like someone has a gun with no bullets in it. It still scares everyone." (Shields, September 12, 2007)

Throughout Shield's article, the journalist and policy makers each used sensational language to describe the situation which contributed to what would become known as

"Pfiesteria hysteria." Shields said that **Eastern Shore farms** "**wash large quantities of manure** into tributaries of the Chesapeake Bay." He said that Glendening had said "doctors found **minor brain damage** in several people who had been **exposed to waters harboring** the toxic microbe." And Congressman Hoyer referred to *Pfiesteria* as an **"attack."**

Reactions to a regulatory approach to agriculture

By the middle of September, debates began increasing over whether a voluntary or a regulatory approach to control fertilizers and manure was a better approach. Maryland Farm Bureau's Poultry Committee Chairman, Bill Carmean, a Worcester County farmer, said, "We're terribly concerned about what might come out of this – rules and regulations that would be unbearable, prohibit normal farming." Rick Nelson, president of the Somerset County Farm Bureau said "We're getting a little tired that every time something goes wrong in the water, they look on land…and automatically blame agriculture."

In reference to the state's 13-year old voluntary nutrient management program that pays almost 90% of the cost to control fertilizer and animal waste and shared the cost ($38 million to the state) of building manure storage sheds and drainage ponds to collect runoff, Nelson said, "Short of shutting down the operation, what more do you want us to do?"

In response to the increasing clamor for a legislative response, Maryland House Speaker Casper Taylor (D-Allegany County) said he wouldn't be forced into precipitous action before he sees solid scientific answers and "it's extremely important that none of us – farmers, fisherman, or government – overreact in either direction.” (Scully, September 13, 1997)

Eugene Meyer, a Washington Post reporter, on September 14, 1997 put the challenges with a voluntary approach into perspective and reviewed Maryland’s longstanding attempt to regulate agriculture. In 1992, 1993, and 1994, when Gerald Winegrad was Chairman of the Maryland Senate Environmental Subcommittee, Winegrad introduced bills that required poultry, dairy, and hog farmers to follow nutrient management plans or face penalties for noncompliance. The bills were able to pass the Senate but died in the House Environmental Matters Committee chaired by Delegate Ron Guns (D-Cecil) who represented an agricultural County north of Baltimore.

Winegrad questioned the effectiveness of the current voluntary nutrient management program saying, “The Maryland Department is exclusively a booster and promoter of Maryland agriculture. Depending on them to reduce nutrients is like putting the fox in charge of the henhouse.” Unruffled by Winegrad’s criticism, MDA Secretary Riley said, “I think my credibility as a farmer and legislator (former Wicomico County representative) and in this job is very well proven. I find my understanding of the industry is an asset in being able to work with the industry.” Riley did concede, however that since the nutrient management plans are voluntary, he can’t say for sure how many are actually being followed. “We can’t review 855,000 acres (a reference to the number of Eastern Shore acres enrolled at one time or another in a voluntary plan by cumulatively 7,000 farms). It’s guidelines for the farmer to follow. If they don’t follow the plan, we don’t have a penalty clause.”

The Governors' Summit

At the Governor's Summit in Annapolis on September 19, the five Governors from the Chesapeake Bay states (Maryland, Virginia, Pennsylvania, Delaware, and West Virginia) heard scientific presentations about *Pfiesteria* and signed a pledge to cooperate further. Maryland promised to release medical data on the 22 people who reported several symptoms including memory loss after contact with *Pfiesteria*-fishkill waters.

This time, at the Governor's Summit, Governor Glendening "furiously backpedaled from his stance a week before, when he pointed the finger of blame directly at the state's half-billion-dollar chicken industry." (Scully September 20, 1997) Glendening said of the cause of *Pfiesteria* and fishkills, "I said clearly that it is a problem on land. It may be urban, it may be rural, and it may be chicken farms. The only place I've seen any discussion of regulatory controls for poultry farmers or anybody else is in the newspapers." Scully quotes Delaware Governor Thomas Carper (D) as saying before the summit, "I think this is a matter of grave concern, but it's important for us to remember not to be hysterical." Virginia Governor George Allen (R) emphasized that cooperation between the states "is beneficial for the taxpayers. You don't have everybody doing everything separately."

The Media Makes the Case Against Agriculture

On October 3rd, 1997, Post reporters Joby Warrick and Todd Shields laid out a lengthy case against agricultural nutrient pollution. The reporters said that the nutrient imbalance on the Delmarva Peninsula was created in part by the concentration of poultry houses but also the nitrogen-based recommendations of the voluntary Nutrient Management Program. The reporters said the "voluntary programs for farmers have backfired in some areas by focusing on a single chemical – nitrogen- while allowing phosphorus in the soil to build to the point of saturation." The reporters said the phosphorus was then available to be washed away "in large quantities" with each new rain and migrate into groundwater and into waterways for decades. University of Maryland soil scientist Frank Coale told the reporters that soil samples sent to his lab from the lower Eastern Shore last year showed that 91% were so rich in phosphorus that farmers were told to not add anymore. University of Delaware soil scientist J. Thomas Sims said the phosphorus problem was "one of the real dilemmas with the management of poultry wastes. When you apply wastes based on the amount of nitrogen the crops need, you always apply more phosphorus than the crops need, by a pretty wide margin." Warrick and Shields dramatically stated, "The surplus has prompted some soil scientists to propose what was once unthinkable: a moratorium on phosphorus."

The reporters cited a new report by the EPA Chesapeake Bay Program that concludes there is a very strong association between the *Pfiesteria* microbe and high levels phosphorus and nitrogen in the water, which can come from agriculture as well as human sewage and auto exhaust. In addition, the report reiterated that half of U.S. watersheds are impaired with nutrients and the primary source is agriculture and that agricultural pollution in the Chesapeake Bay accounts for half of the total unwanted nitrogen and phosphorus. According to new and unpublished estimates by the EPA CBP, poultry manure on the Eastern Shore, accounts for one-third of the nitrogen and two-fifths of the phosphorus load to the Bay – more than double the proportion across the entire Chesapeake watershed. In addition, a new report by the U.S. Department of Agriculture, in a state-by-state study, identified the Delmarva Peninsula had more nutrients than the cropland acres can absorb. The reporters cite a study by a Delaware engineering firm that projects by 2000, Sussex County will have to look outside the region to dispose of 90% of its poultry waste.

The Blue Ribbon Citizens' Pfiesteria Piscicida Action Commission

Throughout September and October 1997, the Blue Ribbon Commission held 12 public hearings across the state soliciting testimony from scientific and agency experts regarding the causes of the *Pfiesteria* fishkills. Within two months, the Commission published their report on November 3, 1997.

The 11-member Commission, chaired by former Maryland Governor Harry Hughes, included Republican and Democrat members of Maryland's General Assembly, environmental and farm organization representatives, and various scientists. Key members included CBF President Will Baker, Delegate Brian Frosh (D-Montgomery County), Delegate Ron Guns (D-Cecil County), and Rick Nelson (Farm Bureau Somerset County President).

The key findings by the Commission were that:

1. **Agriculture in the Pocomoke watershed was the primary source of nutrient pollution**

On September 24, 1997, during one of the many public hearings, Maryland Department of Natural Resources Assistant Secretary Verna Harrison reported to the Commission that agriculture provided the highest sources of both nitrogen (74%) and phosphorus (72%) loadings to the Pocomoke River where two of the four fish kills occurred. The Pocomoke River drains portions of Delaware's Sussex County, Maryland's Wicomico and Worcester counties, and Virginia's Accomack County. In contrast, urban and residential runoff accounted for only 9% of the nitrogen and 7% of the phosphorus, and point sources contributed only 2% of the nitrogen and 9% of the phosphorus in the Pocomoke watershed.

2. **New phosphorus science says phosphorus moves but voluntary Nutrient Management Program had not been updated**

During the 1990s, new science was emerging in Maryland, the Bay region, and nationwide suggesting that phosphorus was not only found in a particulate form that adhered to soil particles but occurred also in a dissolved form that could runoff with water. Prior to the new science, scientists and Extension agents had always concluded and communicated to farmers that if soil erosion were prevented, phosphorus runoff would also be prevented.

3. **Lower Eastern Shore soils were very high in phosphorus**

In addition, the new science also found that high concentrations of phosphorus in the state's soils could exceed a saturation level and leach out of solution where it could become a surface water pollutant. The University of Maryland's soil test laboratory reported that 70% of soil samples tested as "high" or "very high" for phosphorus and the Lower Eastern Shore tests were the highest in the state. (Coale, 1997)

4. **The voluntary Nutrient Management Program (NMP) had some success with manure but had not been updated despite the new science**

Another key finding of the Commission was the revelation from the University of Maryland's College of Agriculture that the state's voluntary Nutrient Management Program, which had been operating since in 1983, had not updated their recommendations to reflect the best available science. The Commission did learn that the voluntary program was successful at getting farmers to regard poultry manure not as a waste product but as a valuable source of nitrogen which they could use instead of purchasing expensive commercial nitrogen fertilizer. However, the Program provided manure application recommendations for crops to meet the nitrogen needs of the crops knowing that that rate would apply up to four times as much phosphorus as the crop needed. The Program did not update farmers on the new phosphorus science or change their recommendations to only use manure to supply the crop phosphorus needs to account for this new information. (Fretz, 1997)

5. Concerns about the voluntary program

In addition, the Maryland Department of Agriculture reported to the Commission that just over half (56%) the farmers surveyed in the Pocomoke watershed reported having a Nutrient Management Plan while over three-quarters (78%) said they had a Soil Conservation and Water Quality Plan. Although the survey concluded, “there were no extraordinary circumstances occurring in the Pocomoke watershed,” it did disclose, “less than half the crop acreage in the watershed currently receives all the poultry manure generated.” (MDA, 1997) During one o the hearings, Senator Frosh (D-Montgomery) questioned MDA Secretary Riley about the voluntary nutrient management plans adopted at some point in time on 900,000 of the state’s 1.2 million acres of farmland. Riley confirmed that the state relies on spot checks to determine if the plans are being followed and in some instances, companies that sell fertilizer write the nutrient management plans.

During the Commission’s attempts to determine what% of the nutrient loading to the Bay could be attributed to the Eastern Shore, and attempted to learn more about the nitrogen-phosphorus imbalance on the Shore, Delegate Ronald Guns (D-Cecil) “criticized what he said is an unfair attempt to blame poultry growers for *Pfiesteria* outbreaks without considering other possible causes.” (Goodman September 25th, 1997) Guns said, “We may not be looking at a broad enough picture. I’m concerned that we’ve designed a single bullet, and that’s nutrient enrichment. I’m not comfortable with having that single bullet as our primary focus.”

While the hearings were going on in Maryland, in Washington DC, U.S. Senator Tom Harkin (D-IA) announced he was proposing legislation that day to tighten the national standards for animal waste management from large livestock feeding operations. (Goodman, 1997)

Finally, two weeks before the Commission was due to publish its findings, the panel of scientists studying the complex and novel micro-organism, *Pfiesteria,* issued its report, "The Cambridge Consensus" (since the scientists met in Cambridge, Maryland on the Eastern Shore). Though the panel concluded that the balance of science linking *Pfiesteria piscicida* to nutrient pollution, algal blooms, and fish kills, was sparse, it did determine that nutrient reductions might reduce the risks of future outbreaks of toxic *Pfiesteria*. Additionally, the panel concluded that nutrient reductions would be “generally good for aquatic life, human health, and water quality.”

The Blue Ribbon Commission’s Conclusions

In October, the Commission heard many ideas regarding alternative uses for excess poultry manure, including transportation to farm fields and counties that are nutrient-deficient, waste-to-electricity plants, producing compost for homeowners, and growing substrate for mushroom farmers.

The Commission had two controversial policy options to vote on for inclusion in their final recommendations. First, there was a proposal to place a moratorium on new chicken houses on the Delmarva Peninsula in order to limit the production of chicken manure.

Second, there was a proposal to make nutrient management plans mandatory. Both of these proposals were very controversial and intensely debated.

On October 28th, 1997, Post reporter Goodman revealed that the Blue Ribbon Commission had defeated a motion 7 to 3 by state Senator Brian Frosh (D-Montgomery County) to cap the number of chickens raised in Maryland. “The debate over limits on poultry production brought tempers to the fore. When Commission member, William Baker, president of the Chesapeake Bay Foundation, suggested the panel urge the governors of Virginia and Delaware to pursue limits on chicken production in those states as well, Frederick W. Nelson Jr., a second-generation chicken farmer and president of the Somerset County Farm Bureau, shot back. "I've got an idea," Nelson said. "Let's make an amendment that we take all the poultry growers and put them up against a wall and shoot them."” “On an unrecorded vote, apparently 5 to 3,” the Commission adopted the decision to make nutrient management plans mandatory in the state of Maryland. (Goodman November 1, 1997)

When I asked Baker about this exchange and whether agricultural and environmental stakeholders were adequately represented on the Commission, he said:

> “I remember there was some posturing and strong position statements in the meetings. But we had to come up with recommendations and we started to build trust and work towards common objective. I didn’t feel we were outnumbered or there as token representatives. The Commission was well represented on both sides.” (Baker, personal communication, March 10, 2010)

On November 3, 1997, the Blue Ribbon Commission submitted their report to Governor Glendening. Though the Commission provided recommendations for improving nutrient management from diffuse sources (urban and residential areas), as well as point sources (industrial and wastewater treatment plants), most of the recommendations focused on the agricultural sector. Recommendations included requiring commercial fertilizer lawn companies to conduct soil tests prior to fertilizer application, sewage treatment plants to implement nitrogen reduction technology in high priority, impaired watersheds, and that new septic systems include the best management practices to reduce nitrogen losses.

The Commission made the most recommendations for the agricultural sector including strongly recommending that the enzyme *phytase* be added by the poultry companies to chicken feed to lower the amount of phosphorus excreted in the chicken manure. And the Commission strongly encouraged more research, cost-share funds, and adoption of numerous best management practices to control nitrogen and phosphorus through ideal tillage practices, installation of buffer zones, and manure transport.

Regarding the mandatory plan recommendation, the Commission's report reads,

> "The Commission recommends that the State enroll all farmers in nutrient management plans by the year 2000. These nutrient management plans should be fully and demonstrably implemented by 2002, contingent upon the State supplying the appropriate level of education, outreach, technical support and financial resources necessary to meet these goals."

Delegate Ron Guns (D-Cecil) had proposed that new mandates should not be required until 2008, if at all while Delegate Frosh said, "To set a 2008 as a deadline, is like ordering a child to clean his room "and then counting to 7,000." "Guns noted that scientists have failed to prove that nutrient runoff triggers the toxic forms of *Pfiesteria*. But Alfred Sommer, a commission member and dean of the Johns Hopkins School of Hygiene and Public Health, said the "best science" thus far points to nutrient runoff. "We'll be laughed off the face of the earth" if the commission fails to seek statewide nutrient control practices by 2002, he said." (Goodman November 1, 1997)

Maryland's policy making process

Less than three months after the Blue Ribbon Commission released its report in October 1997, the 1998 General Assembly session began in January and the debate over agricultural regulations would consume the 90-day legislation session. Governor Glendening introduced the Water Quality Improvement Act of 1998 in the Senate on January 21, 1998 during the first week of the session, which largely followed the recommendations of the Citizens' *Pfiesteria* action Commission. (Simpson, 1998)

The initial bill required farmers to file and follow a fertilizer and manure management plan, included funds to upgrade 14 sewage treatment plans on the Eastern Shore within three years, required counties to limit pollution from new septic systems, required lawn care companies to test soils to determine fertilization rates, provided funds to promote Maryland's seafood and conduct *Pfiesteria* research, and provided funds to market new products made from chicken manure such as animal feed pellets and commercial compost.

Glendening's Initiative included a $5,000 fine for farmers who failed to file and follow nutrient management plans by 2002 but also provided a $4,500 compensation payment to farmers who might have to stop or reduce their manure use and start buying commercial nitrogen fertilizer without any added phosphorus. (Goodman, January 25, 1998)

Most environmentalists praised the initiative but others were disappointed that the Glendening proposal did not require the poultry processing companies to be held responsible for the manure produced by their birds. Goodman pointed out that 1998 was an election year for incumbent Governor Glendening and all 144 members of the General

Assembly. According to James Brady, Secretary of the Maryland Department of Business and Economic Development, Glendening's cautiousness reflected the "need to do everything we can to avoid creating the impression we are just not friendly to business. The poultry industry is a hugely important industry, and we have to be very respectful of that."

After encouragement by environmental groups, State Senator Christopher Van Hollen Jr. (D-Montgomery) introduced a bill that would force poultry producers to take responsibility for the manure generated at their contract growers' farms. House Speaker Casper Taylor Jr. (D-Allegany County) called Van Hollen's bill "extremist" and said it wouldn't live long in his side of the State House. Chairman of Perdue Farms, James Perdue cautioned that it would put Maryland poultry production at a competitive disadvantage if Van Hollen's bill passed, "This is a very, very competitive industry. When you start adding new costs on it that nobody else has to do anywhere else, it just makes it that much more difficult." (Goodman, January 25, 1998)

Towards the end of January 1998, a group of rural legislators introduced an opposing bill called the "Nutrient Management Improvement Act of 1998" which advocated for a voluntary nutrient management approach. The Act set incremental goals for enrolling farmland in an updated voluntary nutrient management program with a final goal of achieving 80% of all farmland by 2005. The bill was amended in committee to require nitrogen-based plans by 2003 and both nitrogen-and phosphorus-based plans by 2006. The House passed the bill in early March 1998.

The debate over responsibility for manure management was not as stereotypical as pro-business legislators advocating for a voluntary approach and pro-environment legislators advocating for an aggressive regulatory option. Indeed on March 2, 1998 in the Washington Times, the President of the Damascus Community Chamber of Commerce called Glendening's initiative, "a dagger pointed at the heart of every farmer in Maryland." However, the President went on to deliver a one-paragraph indictment against the poultry processing companies:

> "Sen. Christopher Van Hollen Jr., another Montgomery County Democrat has introduced legislation to require chicken processors to bear some of the financial burden of disposing of manure. This is a responsibility the chicken industry thought "integrated" projects, has stuck on their indentured servants (Maryland chicken farmers). Chicken companies have threatened to leave the state if the legislature places a tax on chickens to pay for the costs of dealing with the manure. Chicken agribusiness, like multinational corporations, recognizes no "social compact" between companies, farmers, communities or states. They feel they have the right to move wherever, to Virginia or Delaware or Mexico, to profit from cheap or slave labor and lax or nonexistent environmental protection."

Solutions to excess manure cause additional concern to farmers

Among the many hearings in the House and Senate environmental committees, there were many panels of experts discussing how to deal with excess poultry manure. Representatives from the British firm Fibrowatt that had been converting British poultry litter to electricity for many years testified that their technology could provide a major solution to the Eastern Shore manure problem. However, to construct and operate the facility, the government needed to subsidize the facility.

Other solutions for poultry manure included use as fuel for cogeneration projects at the poultry processing plants and use as fertilizer by forestry operations. Glendening's initiative included establishing an Animal Waste Technology Fund (AWTF) to pursue further study of these proposals. Reaction to these proposals was also mixed.

Most environmentalists welcomed these large scale proposals as serious solutions to the Eastern Shore's manure problems. In contrast, many farmers expressed serious fear that the waste-to-electricity plant, which the Fibrowatt representatives said would require at least 300,000 tons of manure per year to operate cost-effectively, would prevent farmers who rely on manure from being able to use it. In the words of one farmer from Worcester County, "There wouldn't be none left for the farmers."

With just a few days left until the end of the session, Speaker of the House Casper Taylor, announced "a deal" had been reached in a negotiation session behind closed doors with Delegate Ronald Guns. Governor Glendening's *Pfiesteria* Initiative remained largely intact as the 1998 Water Quality Improvement Act. Goodman reported that farming interests agreed to accept mandatory limits in exchange for a delay in their introduction and milder penalties for those who don't comply. Gerard Evans, lobbyist for Perdue Farms Inc. said, "We knew something had to be done. We consider it a victory."

Environmentalist Doug Siglin from American Rivers recognized the significance of the bill saying "Maryland is the first state to deal with farm runoff in a truly comprehensive manner." Goodman said, "Maryland now stands virtually alone in broadening the effort to encompass phosphorus." However other environmentalists like Thomas Grasso, Maryland executive director of the Chesapeake Bay Foundation said, "I'm interested in what happens in the short term, and the answer here is, 'Not that much.'" (Goodman April 11, 1998)

The 1998 Legislative Session had been dominated by debate over the WQIA and the two competing bills. The issue was being debated literally until the 11th hour as Delegate Stolfus, at 11:45 pm on April 13, 1998, the final day of the session was still trying to block certain provisions from the bill. One farmer from Calvert County who asked to remain anonymous told me that during the vote on the bill, every time the farming community believed they had a "no" vote from a representative from a rural district, "Parris would pull them aside and promise them a school. We couldn't compete with that." The House approved the Act unanimously and the Senate voted 39 to 7 in favor of the Act. The Governor signed the Act on May 12, 1998.

Recollections from Maryland farm trade associations

Kenny Bounds, Maryland Farm Bureau member and director of the Maryland Farm Credit Association explained in an interview the policy making process in Maryland from the agricultural perspective.

> "It was war. The rhetoric was so ferocious; there was no discussion. It was a triage situation…It was a lynch mob for farmers…Farmer representatives were there in the General Assembly hearings and hallways but we weren't heard. It was like we were a mouse squeaking in the corner with an elephant squashing us." (Bounds, personal communication, February 23, 2006)

An official at a Maryland trade association who asked to remain anonymous recalled:

> "Glendening demonized the farming community. He was a spiteful, vindictive person. Glendening bullied people into doing what he wanted them to do. Glendening wanted to get re-elected." (Anonymous, personal communication, August 22, 2006)

Buddy Hance, President of the Maryland Farm Bureau when I interviewed him in 2005, explained that farmers felt fear about the regulations being so stringent and anger at being treated as though they had committed a crime. Farmers thought the Governor and his legislative supporters didn't care about the impact the law might have on the agricultural industry in the state because of the rush to respond to the hysteria over *Pfiesteria*.

> “Agriculture was in a defensive mode from the day it started till the day it ended. We were seen as trying to protect offenders. They looked on us as criminals. But these growers on the shore, they didn’t know that there was a problem. One day you were doing the right thing and tomorrow you’re doing the wrong thing. Now, how am I supposed to solve a problem that I didn’t know about? If they had been given the information and the time to change things could have been different.” (Hance, November 18, 2005)

When recounting his recollection of the 1998 policy debates, a former elected official from the Maryland Farm Bureau indicated he held a view different from the rest of the membership:

> “To this day, I still believe the government has the right to regulate what I do. It’s crazy that farmers don’t think that they do. Nutrient management nearly destroyed the Farm Bureau.”(Anonymous, personal communication, December 8, 2008)

What Maryland’s regulations require

Requirements for Farmers and Other Regulated Entities

Key features of the Maryland Water Quality Improvement Act of 1999, included: the identification of who was affected by the law, categories for mandatory certification, guidelines for the nutrient management plans, record-keeping requirements, and timelines for implementation. In addition, the Law established requirements for poultry processing companies, established several financial assistance and research programs, and expanded the state budget to hire many more staff to implement the law.

The WQIA required that any agricultural operations with more than $2,500 gross annual income or eight animal units must comply with the law by a) obtaining a certified nutrient management plan from a certified state or private nutrient management consultant and b) following the plan. This expansive eligibility meant that traditional row crop farms, animal operations, and non-traditional farms, including vegetable growers, organic producers, nurseries, green houses, turf grass producers, and horse farms would all have to comply.

In addition, individuals who apply nutrients to land as a business were required to become a certified nutrient management consultant by going through the state's certification training program, sitting for a certification examination, and maintaining certification by completing six hours of continuing education each year. Individuals who apply nutrients to their own operations must complete a continuing education course on nutrient application every three years.

The law prescribed that the certified nutrient management plans would have the following elements:

- Plan identification: account identification number, County and watershed codes, etc.
- Field maps or aerial photographs
- Plan elements: nutrient recommendations, crop rotations, number of animals, amount of manure produced, manure used as crop nutrients, location for alternative, off-site use, etc.
- Field or management unit specific information: field specific data for where nutrients will be applied, including soil analysis, etc
- Summary of nutrient recommendations by field
- Plan maintenance: length of time plan is effective, etc.

In addition, the Law spelled out the information needed in order for nutrient recommendations to be prepared, including:

- Nutrient application rates
- Expected crop yield or production goal (average of the best 3 out 5 years)
- Soil analysis results
- Determination of the limiting nutrient
- Organic fertilizer analysis results
- Application method for nutrients
- Timing of nutrient application
- Manure management

The regulations established a two-stage implementation schedule for filing and implementing nutrient management plans depending on a) the type of fertilizer used and b) the limiting nutrient the plan would manage:

- Farmers using **only commercial fertilizers** were required to file nutrient management plans managing both nitrogen and phosphorus by December 31, 2001 and fully implement those plans by December 31, 2002.
- Farmers using **manure and commercial fertilizers** were required to file nutrient management plans managing **only nitrogen** by December 31, 2002 and fully implement those plans by December 31, 2002.
- Farmers using **manure and commercial fertilizers** were required to file updated plans managing **both nitrogen and phosphorus** by July 1, 2004 and fully implement those plans by July 1, 2005.

All nutrient management plans were decided to be part of a farmer's confidential business records and thus not subject to the Freedom of Information Act. Copies of the plans had to be submitted to the Maryland Department of Agriculture every three years. Submission of the plans included a granting of right of entry to MDA to evaluate compliance with the plan at mutually convenient dates and times.

Penalties for failing to submit a plan by the required deadline could result in a $250 fine after attempts were made to notify the individual of their non-compliance. In addition, an individual could be fined for failing to implement the nutrient management plan after being given the opportunity of an administrative hearing and being advised of how to obtain technical and financial assistance to implement the plan. After that, farmers could be fined up to $100 per violation not to exceed $2,000 per year. Penalties would be paid to the Maryland Agricultural Cost-Share Program (MACS). MDA had at its discretion the possibility of requiring the non-compliant farmer to repay cost-share funds related to the nutrient management plan.

Requirements for Poultry Integrator Companies

Poultry processing companies were required to include phytase or some other enzyme or additive that reduces the need for phosphorus to be added to the poultry diet by December 31, 2000, within two-and-a-half years from the enactment of the Act. In addition, poultry companies had to file a plan annually with the state detailing how they would provide their growers with technical and financial assistance to comply with the law.

New Programs Established by the WQIA

Several new programs provided technical and financial assistance to farmers, research and development grants, and additional field staff to carry out the regulations. A pilot Poultry Litter Transport Program was established and funded by both the poultry processing companies and the state to provide up to $20/ton for manure transportation and handling from farms with excess litter to farms or businesses (composting, mushroom, etc) that can safely use the manure. A special goal was established to remove 20% of the litter produced in Maryland's four Lower Eastern Shore counties: Caroline, Somerset, Worcester, and Wicomico. Beginning in fiscal year 1999, the State and the poultry companies agreed to provide $750,000 each to the program. A poultry litter matching service was established by MDA to link farmers with excess manure with nearby farmers who can use the litter safely.

A tax credit for additional fertilizer costs was also established to help farmers that would likely have to reduce or eliminate their use of animal manure to defray the cost of commercial fertilizer. The Act allowed for a State tax credit equal to 50 % of the additional cost of fertilizer up to $4,500 per year for up to 3 consecutive years. The Law also provided a tax deduction for the purchase of manure spreading equipment. Since many farmers would be restricted to applying very little poultry manure on several of their crop fields, this provision encouraged the purchase of newer manure application equipment that would enable the calibration of equipment to 1 ton per acre. The State allowed 100 % of the purchase price of the equipment deducted from the owner's state taxable income.

The WQIA provided $800,000 per year for three years of agricultural research and education programs to expedite implementation of technologies to help farmers meet the law's requirements. An Animal Waste Technology Fund was established to provide grants, loans, loan guarantees, or equity investments for research and development of new technologies to: reduce nutrient content of animal waste, alter the composition of animal waste, or develop alternative animal waste use processes. The fund opened with $1.3 million. In addition, the Act required the employment of 110 field personnel in the 23 County Soil and Water Conservation Districts raising the number of field staff significantly from 62.

How Maryland implemented their regulations

Challenges to Starting a Regulatory Nutrient Management Program

With the close of the 1998 Legislative Session in April and the three-year turn-around between the 1998 law and the first regulatory deadline in 2001, Maryland was under tremendous time constraint to develop and roll out its regulatory program. The state entered into the regulatory-writing stage with a frenzy, forming the Nutrient Management Advisory Committee that included both farm and environmental interest groups and the

Interagency Nutrient Management Committee, which included representatives from the departments of agriculture, natural resources, and environment.

Early on, the Committees realized the law had set a three-year schedule for compliance that would be a Herculean task to accomplish. Among the many challenges to roll out the regulatory Program, the state had to identify who was affected by the law and required to obtain a nutrient management plan. The Law specified only the individuals that actually handled nutrients were to be regulated. In a state dominated by farming of rented land, a nutrient handler was most often not the landowner making it very difficult to assemble the “right” database. The state compiled and crosschecked all existing databases: voluntary nutrient management program, the MACS program, the federal commodity payment programs, and the State Agricultural Property Tax Database.

Another major hurdle was developing the nation’s first Phosphorus Site Index diagnostic tool to be used by plan writers in the field. The University of Maryland’s soil scientists developed the PSI, a site-specific risk assessment tool for determining the risk of phosphorus loss from a field given the soil test results, soil type, topography, slope, crop choice, fertilizer choice, etc. Technical manuals and software programs had to be developed as fast as possible so planners could begin developing plans to meet the land-grant university’s new scientific standards. Finally, the state and the University’s Nutrient Management Program personnel had to train and certify public and private individuals to write the plans. Nearly 900 state employees, County employees, and private individuals were trained and certified with the newly developed manuals within the first few years after the law.

As soon as the database of who might be eligible to be regulated was assembled, the first of a series of letters to farmers were mailed out notifying them that they may be eligible for having to comply with the law that they file a mandatory nutrient management plan by 2001 and implement the plan by 2002. A critical detail to accomplishing this task on time was that farmers would have to collect representative soil samples, preferably in the spring before planting time and before the 2001 plan filing deadline, and have them analyzed as the basis for developing their nutrient management plan. In a move that infuriated the farming community and some in the state, Governor Glendening closed the University of Maryland College Park Soil Test Lab, citing “poor management,” which further complicated the process as public and private nutrient management advisors had to send their soil samples to nearby labs at the University of Delaware and to private labs in Pennsylvania, Virginia, and even Georgia.

Monies had to be allocated to the MACS program to provide farmers with cost-share funds to hire private nutrient management consultants to take soil samples, and do their plan for them as there would be insufficient state personnel to write all the thousands of plans likely required by the law. In addition, MDA hired and certified additional state personnel to review the incoming plans to ensure that the recommendations were appropriate. Six new regional inspection offices were established to conduct site visits of randomly selected and farmers receiving complaints.

Controversial Oversight

One of the first controversies with Maryland’s law was who would implement the regulatory program. Originally, the law gave the regulatory oversight to the agency that already had regulatory authority, the Maryland Department of Environment (MDE).

Complaints by the farming community and the MDA said that MDA would be a better agency to implement the program given their farming experience and long-standing relationship with the farming community. However, the environmental community expressed concern that the MDA would be unable to transition from its conventional role as a voluntary partner to a role as regulator and implementer of an unpopular program. Some even pointed out that nowhere in the MDA's mission statement is the word or concept of the "environment" mentioned questioning whether an agency dedicated to supporting and expanding agricultural enterprises could implement a program that sought to curtail certain business activities. (Anonymous, personal communication, January 2006)

The Early implementation problems

Early implementation of the program was difficult and compliance with the law was poor. Though detailed, annual administrative compliance data will be presented in Chapter 6, this section touches on a few key points about the challenges Maryland experienced implementing the regulatory program.

By 2001, when MDA estimated that there would be 8,000 farmers eligible for compliance with the law, only 30 % had turned in plans. To help cope with the backlog of plan-writing requests at the Cooperative Extension Service, MDA decided to allow farmers to file "Justification for Delay" forms by the compliance deadline to be counted as "in compliance" and 60% did so. Thus, MDA counted 90% of farmers in compliance with the first deadline. Acceptable reasons for filing a JD form included, "contacted a NM planner but they were too busy to provide me a plan." (MDA, 2001) However, as will be described in Chapter 6, several farmers I interviewed told me that “they heard” many farmers were filing a JD form simply because they did not want to get a plan.

One unintended consequence of the policy-making process which many farmers regarded as unjustified attacks against their character as “stewards of the land” was that some farmers no longer wanted to participate in the voluntary program during the interim years between the enactment of the law and the first deadline. Ann-Meredith Webster, a state nutrient management program staffer who became a private nutrient management planner recalls “a noticeable drop” in farmers coming to the state and County offices to update their plans annually as they had done every year in the voluntary program. She said farmers, especially in Somerset County and the Lower Eastern Shore, “dug in their heels” and refused to continue participating in the program now that it was mandatory and their efforts under the voluntary program were unappreciated.

When I asked for explanations about the poor early compliance rates, Buddy Hance said, “Many farmers spent several years upset…For three or four years after the Law, farmers had nothing good to say about the system.” Kenny Bounds explained, “I don’t think that agriculture gets a get out of jail free card. With the right amount science that’s proven, they’ll do it. They are the salt of the earth people. But if you question their integrity, they’ll dig fox holes while you’re talking.” (Personal communication, February 23, 2006) The integrity that Bounds was referring to here was their being “stewards of the land.”

Over the years, the compliance rates improved. Hance estimated that the compliance rates as of 2005, which were about 85 percent, were likely significant and real. “Now we’re down to 12 or 15% of farmers and acres left in Maryland yet to comply. My only comment is that 100% of people don't pay taxes like they should so we're not that far off. And, a major portion of the problem is with the lists of names. Maryland's had a hard time verifying who should be in the program or not." (Hance, personal communication, November 18, 2005)

The co-permit proposal

In response to the poor rates of compliance with the WQIA, Governor Glendening and the MDE proposed a co-permit to be shared between the contract poultry growers and the poultry processor permits. This proposal divided the grower community. Some growers thought that any idea to make the processors share some of the responsibility for the dead bird and manure management of the chickens that they owned was appropriate. Other growers, complaining of the already highly prescriptive requirements of raising the chickens from the processors including when they arrived, what they were fed, their litter clean-out schedules, the housing technology upgrades required, that any more interference from the processors of their crop growing and nutrient management activities was too much.

The Delmarva Poultry Industry, Inc. the poultry trade association, known to better represent processors than their grower members, was adamantly opposed to the proposal. The Delmarva Justice Poultry Justice Alliance, a small non-profit representing growers, chicken catchers and processing plant workers had to take no position on the proposal as their membership was divided. The poultry processors sued stating that MDE had overstepped the regulatory authority provided by the WQIA and two judges ruled in agreement with the processors. Even nutrient management experts hopeful for improved compliance on the growers' part expressed concern that the manner in which the co-permit was tied to the processor's wastewater permits was an unsound attempt to gain more involvement from the poultry processors (Simpson, personal communication, February 22, 2005).

Excess Manure Gets an Estimate

In 2002, University of Maryland agricultural economists published a report estimating the size of the excess poultry manure on the Eastern Shore. Lichtenberg et al. (2002) estimated that Maryland produced 100,000 tons of manure in excess of what could be applied at agronomic rates (to meet plant nutrient needs) in the surrounding County croplands. In particular, the three Lower Eastern Shore Counties (Somerset, Wicomico, and Worcester) plus one Upper Eastern Shore County (Caroline) accounted for the vast majority of the excess manure, which amounted to one-third the amount of manure produced annually by the Maryland poultry industry. The good news from the report, however, was that there was more than enough cropland in surrounding counties to accept the excess manure applied at agronomic rates. In addition, there was enough cropland on the Delmarva Peninsula to receive the excess manure from Sussex County, Delaware as well.

Changes to WQIA under the Ehrlich Administration

In 2002, Republican Gubernatorial candidate Robert Erhlich won handily against Lt. Governor Kathleen Kennedy Towson, largely seen by the farming community as a rebuke of the Glendening Administration. Nearly a year after taking office, Erhlich came through on his campaign promise to listen to farmer complaints about the WQIA by setting up a Poultry Action Task Force to determine the priority production and environmental issues related to the industry.

In July 2003, the Governor's new Department of Agriculture held a "State of the Science" briefing and then hosted an Agricultural Nutrient Management Summit in August. Over 300 farmers, environmentalists, agricultural association representatives, scientists, and government, and academic representatives met for one day to hear grievances about the regulations. Over 50 recommendations were made to improve the WQIA and many of them made it into the amendments a year later and then became part of the regulatory code in 2005.

The changes to the WQIA included allowing farmers to prepare and implement their own nutrient management plans, to no longer submit the plan to MDA but keep it on the farm and only submit a two-page form every three years with updated plan details, and to file an Annual Implementation Report with general summary information such as the aggregated amount of nutrients applied to the farm over the entire year rather than the rate of application per acre per crop.

Two important changes focused on the regulatory implementation style of the agency. The contentious automatic "right-of-entry" check box for on-site compliance reviews that made farmers livid was changed so that now MDA had to set up the farm visit with a 48 hour advance notice and MDA and the farmer had to agree upon a mutually convenient time and location for the meeting. Second, MDA decided it would focus on bringing farmers into compliance rather than enforcement such that penalties would be levied only as a last resort when no effort is made to comply.

The obvious impact of these proposed amendments was an increased uncertainty between 2003 and 2005 about the status of nutrient management requirements for farmers. Furthermore, there was increasing concern from the policy stakeholders that if the complete plans were no longer being filed with the state, MDA could no longer systematically analyze information about how well nutrients may have been managed.

In the fall of 2004, the University of Maryland and MDA revised their technical standards for manure application in the fall and winter months. Instead of merely encouraging farmers to avoid application during high-risk months, the new guidance which have the force of regulations, prevents manure application from November 1 to February 28. There is concern, however, that MDA never notified farmers of these winter application restrictions (Anonymous Maryland Extension Specialist, personal communication, November 2008)

In an attempt to improve compliance rates seven years after the WQIA passed, at the beginning of 2005, the four poultry processors operating in Maryland signed a Memorandum of Understanding with the Erhlich Administration. The processors agreed to increase their technical and financial assistance to their growers to ensure adequate implementation of the nutrient management regulations. In addition, the processors agreed not to place chicks with any grower not following the regulations.

Although all of these mid-stream corrections are aimed at being more responsive to feedback from farmers and making them feel more included in the policy process, as one private consultant suggested, “The requirements changed so frequently under (the) Erhlich (Administration) that you didn’t know what to file when.” (Keen, personal communication, August 11, 2006)

Enforcement stage delayed

Along with the announcement under the Ehrlich administration that the Department of Agriculture would not enforce the law by conducting site visits to determine if farmers were following the plan, confusion was created regarding the 2004 switch to phosphorus-based planning by manure users. Nitrogen-based plans held by farmers using poultry manure were required to update their plans to manage manure on a more restrictive basis so that only as much manure was applied as would satisfy the limited phosphorus needs of the crop.

Though MDA started announcing a 2004 deadline for farmers to file updated P-based plans, many farmers did not file updated P-plans until the 2005 deadline when they were to have been implementing those plans. One County Nutrient Management Planner, explained that the state was so focused on trying to get 100% compliance on merely filing a plan that that crowded out the effort to update the manure user plans. (Anonymous, personal communication, December 13, 2006) These executive decisions to alter the regulatory schedule in order to accommodate farmer complaints have had the result of weakening the government's ability to implement and enforce the regulations.

5.3. Virginia's Policy Response to the *Pfiesteria*-related fishkills

How Virginia diagnosed the problem

Fishkills versus fish lesions

When the second Pocomoke River fishkill began August 26 it was at first in Virginia waters of the Pocomoke Sound outside of the mouth of the Pocomoke River. The Pocomoke sound is comprised of Somerset County, Maryland and Accomack County, Virginia. Governor Glendening closed a 4.5 mile portion of the Pocomoke River (Lipton, September 18, 1997) while Virginia Governor Allen (R) temporarily closed a mile-long portion of the Pocomoke River and the Sound to boating, fishing, and swimming so that teams of federal and state scientists could sample the water and the fish. Governor Allen announced the formation of a Task Force in Virginia to study *Pfiesteria* while Virginia Lt. Governor Donald Beyer Jr (D) called for a legislative hearing on the link between *Pfiesteria* and nutrient pollution in state waters (Babington and Shields, September 12, 1998).

In September, reports of fish with skin lesions in the Rappahannock River on the Western Shore of the Bay (the second peninsula south of Washington D.C.) came in and the Virginia Institute of Marine Sciences (VIMS) began taking water and fish samples in the river. Although 50 to 76% of the fish sampled by VIMS were found to have skin lesions, there were no fish kills. (Babington and Lipton, September 20, 1997) Indeed, Virginia officials said that menhaden in the Rappahannock have shown skin lesions since at least 1983 without any documented fish kills. (Lipton, September 18, 1997) VIMS also revealed that water samples showed 600 cells per cubic centimeter of *Pfiesteria*-like organisms in Rappahannock water samples. Scientist Joan Burkholder determined that this was a high concentration but concluded that since the *Pfiesteria*-like organisms were in a non-toxic form, they posed no threat to human health. (Babington and Lipton, September 20, 1997)

Thus, Virginia decided not to close affected portions of the Rappahannock. Virginia stuck to this policy in September and October despite their newly establish hotline receiving calls from eight people who felt sick from contact with water with fish with skin lesions and who submitted themselves for medical examinations. In contrast, Maryland quickly developed a river closing protocol that would close river portions if 20% or more of the fish sampled had skin lesions -- whether they were dead or alive -- and closed portions of the Manokin and Chicamacomico Rivers where menhaden were found in distress and with skin lesions but were not killed.

Indeed, one Rappahannock fisherman Keith Wilmer who was interviewed by the Post about the finding of menhaden in the Rappahannock with skin lesions said, “I ain’t been sick; I have no sores; I don’t know anyone else that has.” (Lipton, September 18, 1997) Lipton reported that more than a dozen fisherman on the Rappahannock that he interviewed agreed with the government decision “to take a reserved approach, putting off stream closings until there is a confirmed fish kill or reports of human illness.”

Lipton wrote about the economic importance of the menhaden fishing industry to the Rappahannock and the rest of the Chesapeake Bay fishing industry. Menhaden – the fish that were dying in the Pocomoke River fish kills – is a small, oily fish that makes up the second largest fishery in the nation by volume and is important as the base of the food chain in the Bay. Menhaden are caught in the Bay and in the tributaries and processed in facilities along the Bay and turned into feed for poultry, hogs, and other animals as well as fish oil for margarine, tanning oils and other products. Zapata Protein Inc is the largest commercial menhaden processors in the Bay, one company representative said “To shut the river down, that would be an overreaction” though would not affect his commercial operation which catches the fish in the Bay. (Lipton, September 18, 1997)

The Governors’ Summit, from the Virginia Perspective

At the September 19th Governor’s Summit with five of the Chesapeake Bay watershed states’ and North Carolina’s governor and other officials, Governor Allen pressed Governor Glendening for access to the medical records Maryland was compiling on the fishermen and scientists who experienced a variety of skin and neurological symptoms. Allen impressed upon the other Governors that Virginia needed to review the data and draw their own conclusions. When reporters reminded Governor Allen that *Pfiesteria* had become a minor campaign issue in Virginia's gubernatorial race (in which Allen like all incumbents are not allowed to run), Allen said, "You know what the people of Virginia care about on this issue? They care about getting answers. They care about marine science. They care about medical science. They don't give a hoot about political science." (Babington and Shields, September 20, 1997)

On October 6, 1997 the House of Delegates Committee on the Chesapeake Bay and its Tributaries held a hearing on *Pfiesteria*. Committee members voted unanimously to recommend allocating funds to promote Chesapeake Bay seafood as healthy and safe though no amount was specified. (Washington Post Metro Around the Region, October 7, 1997)

Editorials compare Virginia and Maryland Governors

During this problem diagnosis stage in Virginia, the Washington Post ran an editorial on September 17 that compared the different approaches employed by Maryland and Virginia Governors to deal with *Pfiesteria* indicating that the Post favored the Maryland approach. The editorial pointed out that Glendening's approach included seeking expert advice, closing waterways temporarily, and assuring citizens that Maryland seafood continues to be safe. The editorial also brought up the more challenging question of what is causing the fish kills and how to curb the farm pollution being linked to the toxic *Pfiesteria* microbe.

In contrast, the Post highlighted Governor Allen's decision not to close affected areas of the Rappahannock on the basis that fish with skin lesions have been sighted since 1984. The Post quoted Governor Allen saying, "We don't think you should hype things up or cause a stampeding panic. We're trying to take a scientific approach. In the event of a threat to human safety, we'd close down a river." The Post ended its editorial with, "Yet what people in Virginia, Maryland, and other parts of the country are seeing in the air and water are the early warnings of far worse conditions if governments don't act." (Washington Post editorial, September 17, 1997) Since there have been no further instances over the years of the presence of *Pfiesteria* and though there have been fish kills they have been few and minor, it appears the Post's editorial board had been exceedingly dire in their outlook.

On October 17th the Post published an opinion editorial by Judy Mann who criticized Governor Allen's environmental record and cautioned that Republican Gubernatorial candidate Jim Gilmore would not be any better. The op-ed paints Virginia Republican leaders as excessively business-friendly at the expense of the state's environmental quality. Mann said:

> "The Allen record on the environment has been equally dismal, and Gilmore when he served as the state's attorney general, was at its center. He fought against federal regulations on car emissions inspections, and fought federal regulations that allow state residents to sue industrial polluters. In a state that produces everything from apples and beer to turkeys and wine, that's no small problem. He dragged his feet disgracefully before going after pork producer Smithfield Foods Inc for pollution violations – and then only after the federal government forced him into it.
>
> The Allen record on the environment is one of the unenforcement, indifference, and neglect. Nothing in Gilmore's history suggests that he will be any more vigorous…Real issues confronting Virginia involve education and the environment. Farmers in Virginia routinely fertilize soil with chicken manure; for example, creating the same excess nitrogen that is causing

> problems on the Maryland Eastern Shore. Don't expect Gilmore to take on the poultry industry, though."

Virginia's policy making process

Regulation poultry litter in Virginia is a new battle to an old war

Delegate Tayloe Murphy (D-Warsaw), representing several counties along the Chesapeake Bay's "Northern Neck" region, introduced a bill in January 1998 to include the poultry industry in Virginia's existing Pollution Abatement Permit program already regulating the cattle and swine industries. As Chairman of the House Subcommittee on Environment, Murphy referenced the long-time nutrient pollution problem in the Bay and the economic hardship it had created for his crab and oyster fishery constituents. Murphy rationalized that it was only fair to bring the only remaining animal production sector under the same rules governing the other livestock industries. The bill HB1207 passed the House of Delegates 55-44, February 22nd, 1998 allowing the State Water Control Board (SWCD), a division of the Department of Environmental Quality (DEQ), to write regulations for poultry-waste management. (Cain, February 25, 1998)

After the bill passed out of a special Senate Subcommittee on Confined Animal Feeding Operations in the state Senate on March 1, 1998, the Virginia Poultry Federation (VAPF) argued that the new bill, which would require poultry farms to be permitted and make nutrient management plans mandatory, was unnecessary. The trade association argued that since 1995, the poultry companies operating in Virginia had encouraged their growers to have a voluntary nutrient management plan for their operation. By the year 2000, the poultry companies like Tyson's, Perdue, Rocco, and WLR Inc. said they would cease contracting with any grower who did not have a nutrient management plan. As of

1998, 854 of the 985 growers in the Shenandoah Valley already had nutrient management plans. In addition, the poultry industry argued that they helped pass the 1996 state Agricultural Stewardship Act that established a system for reporting farmers who pollute. (Allison, March 1, 1998)

Newly elected Republican Governor Gilmore objected to the new regulatory approach to poultry waste management, preferring instead that the industry continue with its own nutrient management plans while the state studied *Pfiesteria*. Gilmore said, “I believe we’ve got to find out the scientific facts.” Virginia Poultry Federation president, Hobey Bauhan, cautioned that additional regulations could hurt “family farmers who operate on very tight margins.” In addition, he warned that the state make sure the remedy is based on “sound science” and attacks “a real problem and not an imaginary problem.” (Cain, February 25, 1998)

Environmental groups led by the Chesapeake Bay Foundation argued that the voluntary plans were insufficient to reduce the pollution coming from the poultry sector. Virginia director of CBF, Joseph Maroon said, “The state has no mechanisms in place for knowing if the plans are adequate, there’s no way to know if they’re being implemented.” The group pointed out that only the plans held by the 900 poultry growers were state-approved and the growers outside the Shenandoah Valley on the Eastern Shore and in Southside, who number about 400, did not have the voluntary plans. Delegate Murphy reasoned, “those who have done a good job…don’t have anything to fear. It will bring the entire number of operations up to uniform standards.” (Allison, March 1, 1998)

The Virginian-Pilot ran an editorial on February 22, 1998 detailing the problems with poultry manure and making the case for passage of Delegate Murphy’s bill in the Senate.

Citing the Chesapeake Bay Foundation estimates, the Pilot argued that the poultry industry generates the equivalent of the human waste from 1,800 small towns. "The Gilmore administration wants to postpone passage of the bill for a year while the problem of poultry waste is studied. But the problem of poultry waste is obvious: There's too much of it polluting the Bay and its tributaries with nitrogen and phosphorus."

And the Times-Dispatch reporter, Wes Allison, put Delegate Murphy's bill in context: "For Virginia's seafood industry, the poultry litter bill is a new battle in an old war: Reducing nutrient pollution is part of a regional, multibillion-dollar effort to restore the bay that dates to 1987, when Virginia, Maryland, Pennsylvania, Delaware (note: the reporter meant D.C.) and the federal government agreed to cut nitrogen and phosphorus loading by 40% by the year 2000."

On March 2nd, 1998, the Senate Committee on Agriculture, Conservation, and Natural Resources voted 12-3 to carry over the bill till the next General Assembly session in 1999, continue to deliberate the issue in the Fall Assembly session of 1998, and provided $15,000 to study the potential effect of regulations on farmers and on the environment. Facing a committee room filled with 150 farmers who opposed the bill, Senator Jackson Reasor, a Bluefield Democrat said, "There is a lot of concern, and I believe, confusion as to what this would mean." Virginia Secretary of Natural Resources, John Paul Woodley Jr, in defense of Governor Gilmore's preference to see whether the voluntary measures will work to reduce pollution before imposing state regulations said "The administration believes that 'regulations should only be applied if one is convinced that less restrictive means are not sufficient to protect the public interest. I'm not convinced of that today." (Nakashima and Goodman, March 3, 1998)

Poultry grower Wayne Revell, traveled across the Bay from Accomack County on Virginia's Eastern Shore, was quoted as saying, "They've never even proven that the poultry litter is what's causing this" (problem with sick fish). Another Eastern Shore grower, David Ward protested, "Just about all the farmers are taking voluntary measures. If they find out that (chicken waste) is what is causing the *Pfiesteria*, then something should be done about it. But don't do it before you know for sure." (Nakashima and Goodman, March 3, 1998) In exasperation, Delegate Murphy uttered, "All we are saying here to the poultry industry is, 'Help us restore the Chesapeake Bay." From the Northern Neck, to the Middle Peninsula and the Eastern Shore, "you'll see boarded up oyster houses, you'll see boarded up crab-picking houses. You'll see fewer work boats on the water because we don't have the resources there to harvest." (Cain, March 3, 1998)

Comparing Virginia to Maryland

Throughout the policy debates in Maryland and Virginia, reporter, policy-makers, and farm trade representatives compared and contrasted the different approaches taken by policy makers in both states. Cain pointed out the difference that the 1998 elections in Maryland may have been having on those policy makers. "While Virginia's governor wants to wait, Maryland officials may feel a stronger urge to act this year. Maryland's governor and all of its legislators are up for reelection this Fall… (while) Virginia will consider regulation of poultry waste again in 1999 when all 140 lawmakers are up for re-election." (Cain, March 3, 1998)

Nakashima and Goodman observed about the differences in perspective about the role of government and geography: "The contrasting approaches taken by Gilmore and Glendening reflect their differing believes over how much government should involve itself in regulating the environment. It may also result from different geography, said Donald Boesch, president of the University of Maryland's Center for Environmental Science. A greater percentage of Marylanders live close to the bay than do Virginians, he said, injecting more urgency into such issues in Maryland." (Nakashima and Goodman, March 3, 1998)

Delegate Murphy protested the Senate's down vote; "It's embarrassing for us in Virginia to have to defend our position of catch-up to our colleagues in Pennsylvania and Maryland." (Nakashima and Goodman, March 3, 1998)

The agricultural groups offered their political analysis as well. Martha Moore, chief lobbyist for the Virginia Farm Bureau said, "What Maryland's doing is a step in the wrong direction. I would hate to see (Glendening's) proposal surface here in Virginia." Even Jim Perdue, Chairman of his family's company said, "It's much more of an anti-business environment in Maryland. Glendening is listening almost totally to the environmentalists…The thing that bothers me is the rhetoric, the fear mentality. He's trying to scare everybody. That's not leadership." (Nakashima and Goodman, March 3, 1998)

The Fall 1998 Virginia session – Poultry Waste Law "take two"

From September through December 1999, Delegate Murphy tried to strengthen his case for a regulatory approach to managing poultry manure while a coalition of farm interest groups developed their own legislative proposal. During this same time period, several other poultry-related events were occurring in the news.

On September 16^{th}, the federal Environmental Protection Agency (EPA) unveiled their new Confined Animal Feeding Operation (CAFO) permitting rules. In Virginia, a

Tyson's processing plant in Hanover County was fined in October, 1998 by the federal EPA for exceeding their pollution discharge permitted amounts for nitrogen and phosphorus in the plants effluent to the Chickahominy River 20 times in the last four years. The EPA sought a $24,000 fine. (Springston, October 7, 1998)

Also in October 1998, with wide support from residents of Virginia's Sussex County, the Board of Supervisors unanimously voted to limit the number of chickens allowed on a farm to 100,000 defeating a proposal by a poultry company to build a 1.5 million chicken egg farm. (Geroux, October 16, 1998)

In the middle of September 1998, Delegate Murphy and two Senators from urban districts, Virginia Beach and Newport News, began holding hearings for their special joint, subcommittee studying what to do with Murphy's bill. Delegate Murphy opened the hearings calling the state's poultry industry "irresponsible" for not doing more to control its pollution saying "It is time for the poultry industry to step up to the plate and it is time for the state to deal with the poultry waste problem…. Please remember that each poultry house has the potential to contribute nutrient pollution in excess of a municipality of 6,000 people." In reference to his bill's controversial requirement that poultry companies share in waste management, Delegate Murphy read from a letter from an anonymous grower who said that without support from the companies, the issue of manure management would never be solved. (Harper, September 23, 1998) In reference to the EPA CAFO rules, Delegate Murphy said the federal strategy was too weak and would exclude about 90% of the chicken farms in Virginia since it would affect only farmers with more than 100,000 chickens, of which there are only a few. In reference to the CAFO eligibility rules, Murphy said, “There is a loophole large enough to drive a Mack truck through.” (Harper, September 23, 1998)

The Hearing included testimony from scientists from Virginia Tech University about the importance of inspecting poultry operations, findings of excessive use of manure on cropland, and the unintended consequence of focusing on nitrogen use for manure to the detriment of phosphorus build-up in the soil.

“Researchers from Virginia Tech told members of the state Senate subcommittee that the key to preventing water pollution is inspecting chicken farms to ensure farmers are following their approved plans for using manure as fertilizer and holding them accountable if they are not.” In addition the researchers recounted findings from a 1990 study that revealed poultry farms in Rockingham County, the state’s largest farming County, were applying 49 pounds more nitrogen and 137 pounds more phosphate per acre than needed. Secondly, Mark Alley from Virginia Tech said that a farmer who applies enough manure to meet his nitrogen needs – which is a standard practice – would have applied too much phosphorus to his fields. (Edwards, September 23, 1998)

In late November until December 16, 1998, two competing bills were debated in the special senate subcommittee – an updated version of Delegate Murphy’s bill and a new bill proposed by the Virginia Farm Bureau Federation. Martha Moore, Virginia Farm Bureau Federation’s public affairs director said their proposal addresses public concern that no one is confirming farmers are following through on the voluntary commitments to prevent water pollution.

The proposal would: a) require poultry growers to certify that they have a nutrient management plan and are doing what the plan requires, b) create an office of pollution prevention and enforcement within the agriculture department to spot check farms to make sure growers have the plans and are following them, c) require poultry processing companies to finance research on manure and alternative uses, and to pay for education of farmers on waste handling, and d) provide civil penalties against farmers and processors who fail to comply.

Delegate Murphy and environmental groups were taken off guard by the alternative proposal. Murphy, who had recently shared a revised version of his bill with farm groups, said he “was miffed that the farm coalition had not shared its proposal with him. He accused farm interests of trying to blindside him.” According to Moore, the claim is unfair because Murphy didn’t share his original bill with farm groups before he offered it to the General Assembly. CBF’s Maroon said, “he doubts the coalition’s sincerity given this “eleventh-hour proposal.” “The environmental community and citizens of the commonwealth will not accept putting the agriculture department in charge of guarding the chicken house” given the department at times was one of the strongest opponents to regulation. (Edwards, November 21, 1998)

The special subcommittee, after three hours of debate of the two competing proposals voted to accept and forward Murphy’s amended bill to the full committee for a vote on December 16. Delegate Emmet Hanger Jr (R-Augusta) introduced the alternative bill that placed oversight at the Virginia Department of Agriculture and Consumer Services, but never asked that it be voted on.

Passage of the Virginia Poultry Waste Law – January 1999

Though poultry growers and processors initially opposed the bill arguing that voluntary efforts to control pollution were sufficient and that the processing companies did not own the manure generated by their chickens, the poultry industry eventually agreed to a compromise with the law' supporters and the 1999 Poultry Waste Law was enacted in January, 1999. In fact, Joe Maroon, Virginia CBF Director described the legislation as a model for the nation. (Edwards, December 13, 1999)

The new law, requires a) owners or operators of poultry houses with 20,000 chickens or 5,000 turkeys or more to file a nutrient management plan by October 1, 2001, b) poultry growers to track and count for the waste they give or sell to farmers who are not also poultry growers, c) proper storage of manure to prevent runoff, d) poultry processors to provide technical assistance and education to store and manage manure, e) processors to help growers to market their manure and develop a litter transport program with the state, and f) the State Water Control Board with assistance of Department of Conservation and Recreation to develop a permit program for poultry manure similar to the existing regulatory program for hog, beef, and dairy operations.

The Virginia Poultry Federation's Presidents Message in the January 1999 newsletter was entitled "Fairness to poultry growers" and reminded their members that the agricultural coalition including the VPF and the Virginia Farm Bureau had reached a compromise on HB 1207 that "isn't perfect, it is a middle ground that hopefully all our growers can live with." The President's message clarified that while the original bill sought to place mandatory restrictions on the handling of poultry litter by growers, "the ag coalition compromise gives poultry growers until July 1, 2001 to develop and follow regulated nutrient management plans."

In reference to the concern that the standards would be developed by the Department of Environmental Quality (VDEQ) which was regarded as lacking agricultural expertise, the VPF President mentioned that the Virginia Department of Conservation and Recreation (VDCR), which had always run the voluntary Nutrient Management Program, would be responsible for the standards. Finally, the President clarified that "poultry processors will not be the owners of litter as originally proposed. Companies instead will set up hotlines to help growers better market their litter for use as fertilizer and other products. The companies will also offer growers technical assistance."

Poultry Waste Law weakened during regulation writing

An Advisory Committee was formed to help the Department of Environmental Quality's State Water Control Board develop the Law's regulations. The Committee included members of the Chesapeake Bay Foundation, Southern Environmental Law Center, Virginia Tech University, Virginia Poultry Federation, Virginia Farm Bureau, the Virginia Agribusiness Council, and poultry growers. One major sticking point was whether the law included oversight and how much oversight over manure use on cropland operated by an unregulated, non-poultry grower.

In September, 1999, Hobey Bauhan, VPF president sent a letter to the DEQ that the industry would not have agreed to legislation extending control of chicken waste sold off the farm for fertilizer. Indeed, Charles Horn, a poultry grower in Augusta County in the Shenandoah Valley who also sits of the local Soil and Water Conservation District board and on the Advisory Committee said that regulations that require tracking of litter beyond the farm will destroy the market for poultry litter. Rather than put up with the hassle, farmers will buy commercial fertilizer and poultry growers will be stuck with litter. (Edwards, December 13, 1999)

Delegate Murphy who might have thought his work proposing and defending the law was finally finished also wrote a letter to DEQ Director Dennis Treacy reminding him that a state agency's responsibility was to write regulations in accordance with the legislative statutes.

> "The law clearly calls for a regulatory program that 'provides for waste tracking and accounting.' Only by requiring an accounting of the final use of poultry waste transferred off the grower's farm can the state effectively monitor the pollution problems it can create. If you get rid of the waste and nobody happens to know what happened to it, you're not going to be any better off. Environmental regulations aren't anti-business, they make business more responsible." "If a polluter doesn't pay the cost, someone else will have to pay it."

Jim Pease, an agricultural economist at Virginia Technology University and member of the Advisory Committee said, "it would be hard to satisfy the law's requirements for monitoring the waste when only poultry growers are involved." (Edwards, December 13, 1999)

On October 28th, 1998, before the Advisory Committee completed its work, the Department of Environmental Quality announced that the agency had decided to strike from the proposed regulations a) the off-farm tracking provision (which the agency had initially proposed) and b) the law's requirement that poultry companies be held responsible for the poultry manure. SELC's Slaughter suggested the timing was political as the announcement came before the fall election. CBF's Jeff Corbin said, "People were literally putting on their coats to leave when these things were suddenly announced. I couldn't believe it." SELC's Slaughter balked, "To escape the regulations, all you'd have to do is give your wastes away and not worry about the rest." (Harper, November 11, 1999)

The significance of DEQ's backing away from its extension of the nutrient management plan requirements to end-users of manures was underscored by the Virginia Tech estimate that as much as three-fifths of the waste from Virginia poultry farms is removed for use elsewhere. Once the state switches from nitrogen-based nutrient management plans to plans based on a crop's phosphorus needs in the fall of 2001, the amount of litter disposed off the farm could increase to 80 percent. Professor Pease mentioned that his 1990 study found that farmers who buy the waste for fertilizer actually apply it to their crops in greater amounts than the poultry growers do. However, Pease added that the farming community is more aware of the environmental consequences of excess nutrients than they were in 1990. (Edwards, December 13, 1998)

"Bauhan of the Poultry Federation said the industry wouldn't object to requiring growers to keep records about who buys their litter but it opposes requiring those who buy litter to keep records. The industry also supports requiring growers to supply those who buy the litter with a fact sheet on its proper storage and use and with a recent analysis of its nutrient content." (Edwards, December 13, 1998)

Echoing the arguments from the poultry industry, Kathy Frohm, legislative coordinator with the DEQ said that "the department believes that improving more regulations and tracking requirements on manure would lower its value as a fertilizer, creating "a market disincentive" for farmers to put poultry wastes to good use." (Harper, November 11, 1999) The VDEQ said decisions were made after consulting with the patron, Delegate Murphy but Murphy said in an interview that the department has never contacted him.

Given the change in regulations from what was original enacted by the law made farm groups feel positive about Virginia's policy making process and environmental groups feel negative. John Chlada, director of environmental services for Perdue Farms Inc, one of the largest companies in the state said "It's been a cooperative process, and I feel very positive about the work that's been done." (Harper, November 11, 1999) In contrast, Jeff Corbin said, "We got out-lobbied." (Edwards, December 13, 1998)

Two years later, Virginia still battling to adopt regulations

In January 16, 2000 Donna Pugh Johnson, President of the Virginia Agribusiness Council wrote an editorial in the Richmond Times Dispatch in response to Edward's December 13 article. She stated that regulations for poultry waste had not been abandoned as implied in the news story but regulations were being developed:

> "to reflect the law that was negotiated by all interested parties last year. All points of view from the poultry industry and environmental groups are being considered…Unfortunately; there are interest groups who continue to push for additional and unnecessary burdens on poultry growers, processors, and end users of byproducts. Is their goal ultimately to destroy our state's No. 1 agricultural commodity? If so, the result will be more houses, malls, and urban sprawl in place of Virginia's precious farmland."

On March 29, 2000, the State Water Control Board released its proposed regulations for a 60-day public comment period. (Latane, March 30, 2000) In June 2000, four public hearings were held that drew considerable numbers of farmers, poultry growers, public citizens, and environmentalists. The EPA Administrator for the Mid-Atlantic states told officials at the Richmond Hearing in June that the proposed rules needed to be stronger if the state hoped to avoid federal intervention, citing in particular the lack of adequate tracking of the excess poultry litter off the generating farm and the inadequate leadership of poultry processing companies in the disposal of poultry wastes. In contrast, Wilmer Stoneman, a lobbyist for the Virginia Farm Bureau Federation responded, “If it gets too cumbersome to move, people won’t use it.” Stoneman also said “don’t tangle us in with the (poultry) companies.” (Edwards, June 11, 2000)

Virginia CBF’s assistant director Roy Hoagland testified at the Richmond hearing about the many shortcomings of the SWCB’s regulations: a) failed to prohibit the construction of new poultry houses in flood plains, b) failed to require immediate coverage and storage of poultry litter after its removal from the poultry house and before it’s placed on farm fields, and c) lack of specificity in the plans required of the poultry processors to detail how they will help growers manage the excess manure. Hoagland testified that some processors have refused to comply with the requirements to help fund alternative uses for litter or properly advertise the availability of excess litter.

Edwards highlighted the testimony of one small farmer in Page County, Nathalie Zuckerman who said that poultry growers’ fears that waste tracking would scare off manure buyers were unfounded. She compared the cost of using litter versus commercial fertilizer on a portion of her farm and found the litter was almost one-third cheaper. She said a farmer would not pass up those kinds of savings. Zuckerman also criticized what she saw as the poultry processors’ lack of involvement in dealing with the waste that their birds generate on growers’ farms. “How many U.S. corporations are committed to making their employees take care of their industrial waste?” she mused.

On September 19, 2000, after more than a year of drafting the rules, the State Water Control Board unanimously approved the Poultry Waste Law's regulations requiring all of the 1,309 poultry growers to obtain a state Virginia Pollution Abatement permit by October 2001, file a nutrient management plan, and report to whom they gave away or sold their excess manure. DEQ's director, Dennis Treacy described the new rules as "fair and reasonable" for the state's $700 million a-year poultry industry while "at the same time protective of the environment."

When I asked Jeff Corbin, then Senior Scientist with the Virginia Office of the Chesapeake Bay Foundation about the length of time it took to devise the regulations, Corbin said:

> "This is the south so we do everything slower down here. There was a lot of discussions and bartering back and forth. There was a lot of data gathering and not making decisions off the tops of our head. Even though it took two years, the average number of months it takes to roll out regulations that the regulators will quote you is at least 18 months in Virginia. But that's also because of the many steps in the administrative process that involves the attorney general's review, the executive branch's review.
>
> But the Nutrient Management Advisory Commission process to decide the regs took a very long time. There were over 30 people involved: enviros, state agencies, the poultry industry. It got very, very heated at times. There was a point, we were considering walking away from the table – we felt weren't being heard and were out negotiated by the poultry industry." (Corbin, personal communication, March 10, 2010)

What Virginia's regulations require

The Poultry Waste Law directs the State Water Control Board with the assistance of Department of Conservation and Recreation to develop a permit program for poultry waste similar to the existing regulatory programs for swine, beef, and dairy operations. The law applied to growers with more than 200 animal units, which translates into 20,000 chickens and 11,000 turkeys a year thereby bringing in about 900 of the 1,300 commercial poultry operations in the state.

The law required poultry growers to properly manage the manure and those growers who were also farmers were required to obtain and follow a nutrient management plan to properly use manure as a fertilizer source. All other farmers in the state who were not chicken growers - even if they used poultry manure to raise their crops - did not have to comply with the new law. Thus, any end-user of poultry waste was not required to obtain a nutrient management plan.

Both agencies involved in implementing the existing beef, diary, and swine VPA permit program were to expand the program to poultry operations. Thus, the Department of Conservation and Recreation (DCR), which manages the state's voluntary nutrient management program and provided the plan review quality assurance component of the VPA permit program, began implementing the poultry VPA program. The Department of Environmental Quality extended their permit inspection role to the poultry industry. The Law required DEQ to inspect poultry farms once a year for compliance and hired 11 additional staff members to carry out the inspections.

The law required anyone owning or operating a poultry farm to develop and file nutrient management plans by October 1, 2001, have proper waste storage to prevent runoff, and track the use of litter off their farm to ensure appropriate use or disposal. For poultry growers that did not also grow crops, the Law required them to develop and file a manure management plan, have proper waste storage, and to track who they gave their litter to and required them to provide various guidance documents about proper use of the litter to the receiving farmer.

The law required that plans prepared after October 1, 2001 would have to be upgraded and switch to phosphorus management which they defined as phosphorus application rates not exceeding the greater of crop nutrient needs or crop nutrient removal as determined by DCR. A second deadline to update plans was set for December 31, 2005 wherein plans developed after that date would have phosphorus application rates in accordance with the regulatory and standards in effect at the time by the DCR.

The nutrient management plan prepared by the Department of Conservation and Recreation or by state certified consultants was to be kept on the farm site and include at a minimum:

- Site map – location of waste storage facilities and fields where waste will be applied by the poultry grower.
- Site evaluation and assessment of soil types and potential productivities
- Nutrient management sampling including soil and waste monitoring
- Storage and land area requirements for the grower’s poultry waste management activities
- Calculation of waste application rates
- Waste application schedules

The regulations specified the where poultry houses and manure sheds could be constructed and had several requirements regarding outdoor storage of manure and manure management practices. The State Water Control Board prohibited new poultry houses or manure sheds from being built in 100-year flood plains. In keeping with the federal CAFO poultry litter stockpiling rules, Virginia growers will only be allowed 14 days to store their manure outside without a cover. After 14 days, manure stored outdoors must be covered to protect it from rain and wind and to ensure storm water does not run onto or under the stored litter. A minimum of two feet separation distance to the seasonal high water table or an impermeable barrier is required under the piles of poultry waste stored outdoors. When using an impermeable barrier such as concrete or compacted clay, a minimum of one-foot separation with the seasonal high water table is necessary.

The Law banned poultry waste application to ice or snow covered ground or to soils that are saturated. However, it did describe the conditions under which poultry waste may be applied to frozen ground: a) slopes not greater than 6%, b) minimum of a 200 foot vegetative or adequate crop residue buffer is maintained between the application area and all surface water courses, c) only on soils characterized by USDA as "well drained" with good infiltration, and d) at least 60 % uniform cover by vegetation or crop residue is present to reduce surface runoff and the potential for leaching of nutrients to ground water.

The Law also specifies the following buffer zones at waste application sites, of at least: a) 200 feet from occupied dwellings, b) 100 feet from water supply wells or springs, 50 feet from surface waters or 20 feet if same day soil incorporation, c) 25 feet from rock outcropping, and d) 50 feet from limestone outcroppings.

The Poultry Waste Law required that poultry growers that transfer poultry waste off the farm record the amount of waste transferred, the nutrient content of the waste, the locality in which the recipient intends to use the waste, and the name of the stream or waterbody nearest the waste utilization site. In addition, the grower had to provide the recipient of the manure with a copy of the most recent nutrient analysis of the poultry waste and a fact sheet approved by the Virginia Cooperative Extension Service and VDCR detailing the appropriate practices for proper storage and management of the waste.

Requirements for Poultry Processing Companies

The Poultry Waste Law required the poultry processors to submit an environmental stewardship plan by January 1, 2000. The plan required commercial processors to: provide technical and educational assistance to their growers to manage the waste; help growers market their waste and develop a program in conjunction with the state to help move waste to areas where it is needed as fertilizer; establish a toll-free litter transfer help number; participate in an equal match grant program with DCR to address poultry waste transportation and alternative uses to land application; conduct and research in nutrient reduction strategies in chicken feed, reduction of phosphorous in poultry waste, innovative BMPs, or alternative uses; and to report annually on what they have done to comply with the law.

How Virginia implemented their regulations

According to Russ Perkinson, Virginia Department of Conservation and Recreation's Nutrient Management Program Director, since most of Virginia's poultry growers are not also farmers, their plan requirements are manure management plans and not nutrient management plans. Thus, Virginia DCR and DEQ had a relatively easy experience rolling out their program for the 900 regulated growers. Because Chapter 6 will present and discuss detailed administrative compliance statistics for Virginia, just a few highlights about Virginia's implementation phase are presented below.

Less than one year after the SWCB rules were finalized, just about all 900 growers that met the eligibility requirements for becoming regulated had filed their permit and a nutrient or manure management plan by the October, 2001 deadline. Three years later, in 2004, when growers were required to renew their permit and plans, compliance was also nearly100 percent. Perkinson attributed the tiny incomplete compliance rate to farmers still having a nitrogen-based plan when they should have switched to a phosphorus-based management plans. Virginia has been conducting inspection visits of every single poultry farm every year since 2002. (Perkinson, personal communication, 2005)

In anticipation of the 2004 switch to manure management on a phosphorus basis which would likely lower the manure application rate poultry growers be allowed to use, the VAPF and three County Farm Bureaus jointly purchased three manure spreaders and made them available for rent by farmers to encourage the increased use of poultry manure in non-poultry areas.

The switch to phosphorus has hurt growers in two ways VAPF President Bauhan explained to me in an interview. First, phosphorus management would limit the manure use rate and thus would result in more excess manure for them to manage. Second, this would force them to buy more commercial nitrogen fertilizer to make up the deficit no longer filled by manure. (Bauhan, personal communication, 2005)

5.4. Delaware's Policy Response to the *Pfiesteria*-related fishkills

How Delaware diagnosed the problem

In contrast to Maryland's rapid and in-depth investigation of the *Pfiesteria* fishkills in the summer and fall of 1997 and Virginia's slower and constrained study of the problem that same year, Delaware did not begin to act until 1998.

Delaware was forced to respond to the *Pfiesteria* fishkills events in June 1998 after the Wilmington News Journal ran an expose on Delaware's poultry industry on Memorial Day Weekend, 1998 called "Delaware's Dirty Little Secret." The news story, according to one Department of Natural Resources and Environmental Control (DNREC) staffer, "was a huge slap in the face of the poultry industry." (Anonymous, personal communication, August 20, 2006)

Shortly thereafter, Governor Tom Carper (D) asked DNREC to study the *Pfiesteria* problem and determine its likely sources. In a phone interview with me, John Hughes, then Division Director of Soil and Water Conservation for DNREC said, "To be frank with you, we had lots of doubts about the validity of the *Pfiesteria* concerns but we had no doubts about impairment of water due to agriculture." (Hughes, August 23, 2006)

Indeed, Governor Carper's then Policy Director and Legislative Liaison, Philip Cherry explained to me in a phone interview, that though all the likely suspects pointed fingers at each other –agriculture, development, septic systems, lawns, etc, regardless of source of nutrient pollution, "*Pfiesteria* was understood to be a nutrient over-enrichment problem." Cherry said there was a perception that the frequency of fishkills was increasing in Delaware's Inland Bays, which are critically important to the state's tourism industry. "When some traces of *Pfiesteria* was found in there that was enough to raise the specter that a Pocomoke-sized die off could happen in the Inland Bays." (Cherry, August 22, 2006)

Prior to the 1997 *Pfiesteria* fish kills, Delaware's Committee on CAFOs had been focused on negotiating with EPA over the state's design of a CAFO program that would regulate poultry growers as point sources needing a federal permit and a comprehensive nutrient management plan. According to Philip Cherry:

> "There was a lot at stake politically for the Governor to respond to *Pfiesteria*. We had farmers in one corner and EPA in other corner breathing down our necks.
>
> EPA came up with CAFO rule under CWA and started flexing their muscle in direct jurisdiction over CAFO. We wrestled with 'what is a CAFO?' and 'how many CAFOs were there in Delaware' and 'which ones would be under EPA?' and 'did our NPDES program have authority over CAFOs?'
>
> This was the first time that we came up against the farming community in what was clearly a regulatory context." (Cherry, August 22, 2006)

The June 1998 News Journal expose on the Delaware poultry industry and the media attention on *Pfiesteria* in Maryland encouraged EPA Region Three Administrator Mike McCabe into stepping up his agency's pressure on Delaware to establish regulatory programs for agriculture.

In response to Maryland's 1998 Law and CAFO program pressure from EPA, Governor Tom Carper (R) appointed 10 farmers to an Agricultural Industry Advisory Committee on Nutrient Management (AIACNM) to develop recommendations for state action. This committee was rolled into the existing Committee on CAFOs.

Dale Ockles, one of the 10 farmers appointed to the committee, told me in an interview about one night prior to the appointment of the committee when DNREC officials asked to meet with some Delaware Farm Bureau members at one of their houses near Harrington Raceway. The DNREC officials told the farmers that the EPA was really pushing hard to get Delaware to move forward on the CAFO program and that they (EPA) would do something drastic if the state didn't move forward on its own. (Ockles, personal communication, January 25, 2006)

After that night, several farmers approached Governor Tom Carper to suggest that the agricultural industry develop its own response to the growing tide of agricultural nutrient management regulations being proposed by the federal government and neighboring states. Over the course of the Fall of 1998, the Agricultural Advisory Committee would meet several times and hold public meetings to receive input on nutrient management and water quality issues. The Committee's recommendations led to the legislation enacted in June 1998. (UDCE, August 11, 1999)

Delaware's policy making process

The Agricultural Industry Advisory Committee

In an interview, Dave Baker, a farmer from Sussex County described Governor Carper's role in establishing the farm advisory committee. "I was asked by Governor Carper to chair an advisory committee to come up with some way to help agriculture deal with the problem without crippling the industry." Describing Governor Carper's style, Baker said,

> "When he walks into a meeting, he asks for people's opinion. He asks the stakeholders, 'now how would you like to do this?' It was pretty brave for him to give us the reins to do what we wanted. It also took the heat off him to do something legislatively."

> “We struggled for months to deal with this and then came up with a recommendation to establish a commission with a large agricultural representation and other stakeholders to design the regulations and implement the program.” (Baker, personal communication, August 22, 2006)

The 10 farmers on the Agricultural Advisory Committee were divided over the idea of a Commission running the regulatory program and whether they were comfortable with environmentalists being a part the Commission. Baker recalled that a high ranking representative from the Delaware Department of Agriculture “hit the roof” during the discussion that environmentalists be allowed on the Commission. Baker recalled that many members were worried that “we’d be sidetracked by environmentalists while I said if the Commission was going to be successful, we had to have on it others other than farmers.” (Baker, 2006)

Another important recommendation from the Committee was the importance of providing education. When I asked Dave Baker to compare Delaware’s policy development process to that of Maryland’s, Baker said:

> “Maryland was developing top-down regulation that had no ag input. I personally know (Maryland) farmers across the state lines that were envious of us because they had early deadlines and the infrastructure wasn’t there to develop the plans. And farmers weren’t aware of the problem.
>
> A large part of our program was education and awareness. The Ag advisory committee recognized that if you’re going to have ag sign on, you had to get them to understand the magnitude of the problem. So we developed certification and training programs.”

Writing the Delaware Nutrient Management Law

In early 1999, Phillip Cherry, the Governor’s Policy Director and Legislative Liaison drafted a bill on behalf of the Governor that required a mandatory nutrient management approach. Wally Caulk (R), as the Chair of the House Agricultural Committee took the draft and worked with Representative Charles West, DNREC Soil and Water Conservation Director John Hughes and DNREC Water Resources Director Kevin Donnelley to write what would become the Delaware Nutrient Management Law. Hughes recalls that DNREC had the support of Governor Carper. “He gave us free reign. He said, “Solve the problem, guys. Bring this thing home.”

After incorporating much of the recommendations from the Agricultural Advisory Committee, Caulk’s group sent its draft to the poultry and agricultural industry for comments, including DPI, Farm Bureau, and Delaware State Grange. With the industry’s recommendations for changes and the help of the House attorneys, the 1999, Delaware Nutrient Management Law (NML) was proposed to the House. The bill emerged relatively unchanged and according to Philip Cherry, after two hours of debate in both chambers, the bill passed unanimously and became law in June 1999.

The NML resembled Maryland’s WQIA in one respect, it required all farmers to file and follow a state-certified nutrient management plan. It also established a CAFO program in Delaware for the first time. Most everything else about the bill was different from Maryland’s law. To write the regulations, implement the program, and ensure enforcement, Delaware created a new quasi-governmental agency, the Delaware Nutrient Management Commission, with seven of the 15 members being full time farmers, two being representatives from environmental groups and with non-voting members from the Departments of Agriculture, the Department of Natural Resources and Environmental Control, and the University of Delaware Cooperative Extension Service.

Given the dominant representation of the agricultural industry on the first Committee to provide recommendations for state action and the second Commission to write the regulations, several policy stakeholders in Maryland and Delaware described Delaware's regulatory system as "the fox watching the henhouse." With only one or two environmental representatives on these two Governor-appointed committees, there was initially a lot of skepticism from the EPA and environmental non-profit groups that the law and the subsequent regulations would result in meaningful nutrient reductions. After some negotiations between DNREC, DDA, and EPA, the EPA finally said the law was adequate. (Bunting-Howarth, personal communication, August 20, 2006)

One reason that the bill had such a relatively easy time moving through the General Assembly was the fact that the law provided cost-share funds to farmers who wanted to hire a private consultant to prepare their required plan. Furthermore, unlike Maryland and Virginia, which only covered a portion of the plan-writing costs and capped the total amount each farmer could receive, Delaware's law covered 100% of the cost and had no cap.

Reflecting on the policy development stage of the process, Hughes describes what he acknowledges was an accommodative regulatory approach on DNREC's part.

> "We realized early on that we had to deal with farmers – meet them at the table, listen to them, involve them in the process… If we had taken a strident regulatory position, we would have been defeated in two weeks. We had a job to do to satisfy EPA CAFO rules and knowing that we'd have to deal with TMDLs in the future."

> "I was the go-to person at DNREC because I was the only soft spot there. The basic premise that I always operated under was, look these people are under-regulated all to hell…But you can't rush into a regulatory position… You have to have some depth of knowledge and understanding of what they're up against."

When I asked him to clarify, Hughes explained that he recognized early on that there were clear realities he had to keep in mind as he tried to develop policies to reduce water impairment from agriculture, Hughes listed several points:

> "First, a farmer has no control over commodity prices. He can't ask grain buyers for more money to pay for a manure shed.
>
> Second, agriculture is a major component of Delaware's economy and owns a large proportion of the environment we're all concerned about. Thus anything counterproductive to the welfare of farmers gives the developers that are waiting in the wings their opening.
>
> Third, farming is an artificial practice. You can't farm clean. Nutrient uptake isn't perfect.
>
> And finally, farmers have heavy representation in Delaware's House and Senate."

Given all of these conditions, Hughes said, "The smartest thing we did in our lives was to tailor the bill to accommodate the farmers' needs…. The people involved in the early construction of the law, like Chip West and Tony Keen (one of the leading crop consultants on the Delmarva Peninsula), turned out to be smart as hell and good farmers. They took back to their Farm Bureaus and their Grange meetings some assurances that they weren't dealing with crazy people… Of course, we still had screaming and yelling and stomping out of the rooms at different times on both our parts…But, I think we each earned each other's respect. "

Phillip Cherry recalls that Hughes was the good cop while he was the bad cop. "Farmers felt that Hughes carried their water for them to (Governor) Carper and to (EPA Administrator) McCabe…I wore the villainous hat. I played the bad cop (for the Governor) and John would come riding in on his white horse and say, 'no, no, Phil, you can't do that.'"

EPA's Region 3 Administrator, Mike McCabe, played a key role in the development of Delaware's nutrient management law. Cherry explains, "Mike was a Delaware boy, he worked for Senator Biden in Washington before joining EPA…He has also a friend to Carper… Thus, he came to us and there was a collegial sense that we needed to do something. Mike carried the water for EPA and did it well in face-to-face meetings with farmers. Cherry said, "This commission idea was a model that we had moved away from 30 years ago so we weren't sure that it would meet muster with EPA. The last thing we wanted was to subject our farmers to dual jurisdiction to state and federal laws. They dragged Mike down (from the Region 3 office in Philadelphia) before they passed the bill and he reluctantly agreed the bill was okay. He was in a sticky situation…pushing this Delaware boy into agreeing to something that was outside the normal mode."

Hughes recalls that everyone used EPA as a "bogey man." "We would say, look, do you want EPA to come down to do this job? If we don't get the job done, the bogey man EPA will make us do it." Hughes explained that Mike saw how hard the Advisory Committee was working to design a good bill that farmers could accept. "The fact of the matter was that Mike (McCabe) was a brilliant and accommodating person. He's one of the finest people that walked the face of the earth. For his role in this, he is sanctified in the eyes of agriculture – almost in the literal sense. He's truly a great Christian. He's a personal friend now. Mike's leadership was uncharacteristic of the EPA. The traditional EPA couldn't have pulled this off…Mike is a deep environmentalist and is revered not only in Delaware but across the nation and also by environmental groups."

The Nutrient Management Commission and the Regulation-Writing

Part of the law included the establishment of a separate executive body, the Nutrient Management Commission (DNMC) that would be responsible for drafting regulations and implementing the regulatory program. All of the farmer members were members of the Delaware Farm Bureau.

Philip Cherry recalls how strange it was that the farmers on the Advisory Committee wanted a Commission created and that they got their way. Commissions had been written out of Delaware's law in 1970 when Delaware shifted to a Cabinet form of government. "Under today's form of government, there are lots of advisory councils out there but none of them are granted authority. The Nutrient Management Commission is the only exception."

Phillip Cherry recalls, "the Governor's commission would have had more of an environmental focus because a Commission dominated by one perspective (farming) is flawed…. The normal process to filling seats in a commission is for the Governor to appoint them all. But, the farmers didn't trust the Governor to appoint the right people and argued for appointments by Speaker of the House and President of the Senate…. The Governor favored the environmentalists. He's got a strong environmental ethic about him…Farmers hated the environmentalists. They were up in arms about how environmentalists were treating them; beating up on the farming community."

When I asked about the government's ability to regulate agriculture, Cherry revealed that though he had reservations about the commission regulatory approach; there is no other alternative to regulating farmers in Delaware. "In Delaware, our ability to regulate farmers is pretty minimal…Which is why the self-regulation commission idea is the only possible solution. Nothing else would pass the legislature…Delaware is a very big ag state. Most of the legislature comes from the farming community and if they cross the Farm Bureau, they'll have a problem. Trying to muscle a regulatory approach on farmers is difficult if not impossible."

The regulations decided by the DNMC set a five-year implementation schedule beginning in 2003 for 20% of the state's farmers to develop, implement, and maintain records by January 1 of each year. Not only was this implementation schedule different from that set in Maryland and Virginia where all eligible farmers (approximately 8,000 farmers in Maryland and 1,300 poultry growers in Virginia) were required to file a plan by their first deadline but the first year of implementation in Delaware (2003) was considerably later than the 2001 deadlines in Maryland and Virginia respectively.

One point of contention between the EPA and the Nutrient Management Law had to do with winter manure application rules. Under the federal CAFO program, the EPA rules allow poultry manure application to occur only as early as February and the manure must be incorporated within seven days. Farmers viewed that rule as ridiculous and unrealistic and sought to be allowed to continue their manure application all year long and have no requirements for how soon they had to incorporate the manure or whether they had to incorporate it at all. The law and subsequent regulations only included advising against winter application if storage was possible.

What Delaware's regulations require

Requirements for Farmers and Other Regulated Entities

House Bill 250 became Title 3, Chapter 22: Nutrient Management. The Delaware Nutrient Management Law had four purposes, to: (1) protect and improve water quality,

(2) establish a certification program, (3) establish a nutrient management planning program and (4) formulate a program that will maintain agricultural profitability and improve water quality in Delaware.

Key features of the bill include: the establishment of the Nutrient Management Commission, the identification of who was affected by the law, categories for certification, guidelines for both animal waste and nutrient management plans, and timelines for implementation. In addition the Law established a requirement for poultry processing companies and the Law also established Delaware's Confined Animal Feeding Operation (CAFO) program.

The Nutrient Management Commission was designed to have 15 voting members: the Director of the Soil and Water Conservation Division of DNREC, 7 full-time farmers, one commercial/agricultural nutrient applicator, one commercial nursery industry representative, one golf course/lawn care industry representative, two environmental group representatives, one nutrient consultant, and one public citizen. The bill spelled out which kinds of farmers would be represented: one dairy farmer, one swine producer, three poultry farmers, one grain row-crop farmer and one vegetable row crop farmer. Also detailed were which members would be appointed by a) the Governor, b) the Senate, and c) the House. The Commission was given "the power to develop, review, approve, and enforce regulations governing the certification of individuals engaged in the business of land application of nutrients and the development of nutrient management plans."

As for who was affected by the legislation, Delaware's law is very inclusive applying to any person or firm that operate an animal feeding operation in excess of 8 animal units or apply nutrients to more than 10 acres of land. Eight animal units translate into those who own at least 3,200 broilers, 8 beef cattle, 32 brood sows, 40 sheep, and 7 saddle horses. The acreage threshold means that virtually all agricultural operations, golf courses, turf and recreational facilities, and lawn care companies are regulated as well.

There are three requirements for the regulated community. Those with more than 8 animal units but less than 10 acres of land have to become nutrient management certified, file an *animal waste* management plan, and maintain certification. Those with more than 8 animal units and/or more than 10 acres of land have to become nutrient management certified, file a *nutrient* management plan, and maintain certification.

There are four certification categories each with different requirements for achieving and maintaining certification (see table below). Typically, one hour of certification education or continuing education qualifies as one credit. Thus to become certified, nutrient generators had to attend six hours of certification courses while a private nutrient handler has to attend nine hours of certification. Initial certification courses are three-hours long while maintaining education courses are often one and two hours long.

Table 5.1. Delaware Nutrient Management Law Certification Requirements

Categories for Certification	**Definition**	**Requirements**	**Maintaining certification**
Nutrient Generator	Generates nutrients (manure) but no land application	6 credits, no testing, 3-yr certification	6 credits during each 3-yr period
Private Nutrient Handler	Applies nutrients only to own land	9 credits, no testing, 3-yr certification	6 credits during each 3-yr period
Commercial Nutrient Handler	Applies nutrients as part of a commercial business	12 credits, test & fee required, 3-yr certification	9 credits during each 3-yr period
Nutrient Consultant	Writes nutrient management plans	12 credits, test & fee required, 1-yr certification	8 credits during each 1-yr period

The basic elements of a Delaware nutrient management plan (prepared by a consultant or a certified Soil and Water Conservation District conservationist) include:

- General information: contract information, acres, animal types and numbers
- Field maps
- Crop nutrients requirements:
  - Realistic yield goals (best 4 of the last 7 years)
  - Soil test results and manure analysis results
  - Nutrient source and expected dates of application

The elements of a Delaware animal waste management plan (prepared by the nutrient generator), include:

- Number and type of animals
- Method of manure storage
- Mortality disposal methods
- Amount of manure removed annually
- Location of where the manure was transported to

Delaware's Nutrient Management Law set a very slow pace in comparison to the implementation schedule in Maryland and Virginia. All affected individuals had until January 1, 2004 – five years after the 1999 Nutrient Management Law – to become certified. The law set a five-year, 20% implementation schedule for when nutrient management plans had to be filed with the state. That is, one fifth of the regulated population would be randomly selected for compliance by January 1, 2003 and then a second fifth would be selected for compliance by January 1, 2004 and so on until 2007.

When randomly picked to comply, farmers would have to return a postcard in the mail notifying the DNMC that they would be complying, that they already complied because they were an early cooperator, or that the law did not apply to them. Famers that had to comply needed to obtain their nutrient management plan or develop an animal waste management plan if they didn't also farm; both plans would remain on the farm.

After their initial compliance date, farmers would have to submit by March 1st of every calendar year a one-page Annual Report detailing: the amount of animal wastes applied, and the quantity of land it was applied to, the amount of inorganic fertilizers applied to land, and the amount of animal wastes transferred for alternative uses. Like Maryland and Virginia, these reports, the records of implementation or the animal waste and nutrient management plans are not considered public records under Delaware's Freedom of Information Act but the data may be used for data compilation and may be inspected by the Secretary and the Commission.

The requirements for record keeping include maintaining records of implementation for six years that should include:

a. Soil test results and recommended nutrient application rates or the nutrient management plan;
b. Quantities, analyses, and sources of nutrients applied to crop land;
c. Dates and methods of nutrient application(s);
d. Crops planted, yields, and residues removed from land;
e. Amount and type of manure exported from farm and the name, address, and organization of person(s) responsible for utilizing manure.

Unlike the regulations in Maryland, which until 2005 had no regulatory requirements for manure management but like Virginia's rules regarding outdoor storage, Delaware's regulations have always included these details. Should outdoor storage of manure become necessary, the regulations require that the poultry manure piles:

a. Be at least 100 feet from any body of water or drainage ditch;
b. Be at least 100 feet from any public road;
c. Be at least 200 feet from any residence that is not located on the person's property; and
d. Be at least 6 feet high and in a conical shape.

These requirements mirror those required by the federal CAFO rules indicating the impact that EPA had on Delaware's state nutrient management process.

Delaware's focus on phosphorus management differed from Maryland and Virginia's policies. Maryland and Virginia allowed manure-using farmers to first obtain a nitrogen-based plan by the first deadline in 2001 and then three years later upgrade to phosphorus based plans. Delaware encouraged farmers to be "early cooperators" by obtaining a nitrogen-based plan prior to the official start of the 5-year implementation phase in 2003. Once the 5-year schedule started, farmers called into compliance had to obtain a phosphorus-based plan.

Requirements for Poultry Integrator Companies

The Nutrient Management Law established one requirement for commercial poultry processing companies – to file a plan with the Commission prior to July 1, 2000 – one year after the law was enacted detailing how they will provide technical and financial assistance to their growers to better manage poultry manure. The plan would specify how the companies would directly or under contract with a third party would:

1. Provide technical assistance to growers with whom they contract on proper management and storage of waste in accordance with the best management practices approved by the Commission,
2. Provide continuing education programs on these topics,
3. Conduct or fund research and demonstration programs on these topics,
4. Formulate and implement nutrient reduction strategies that effectively minimize the addition of nutrients to the environment without having adverse health impacts on animals or reduction in the growth of animals, and
5. Report annually to the Commission on these activities.

Delaware's Phosphorus Science Policy

The Commission relied on the University of Delaware College of Agriculture and Natural Resources scientists to provide technical support to their determination of nutrient management policy regarding soils with high phosphorus content. The Commission defined a "high P soil" as one that had 150 FIV. Recall that the Fertility

Index Value, as explained in Chapter 3, rated a soil test phosphorus concentration that was greater than 100 as “Excessive.” Instead of making the Phosphorus Site Index an automatic step during the nutrient management plan preparation process like Maryland did, Delaware opted to make the PSI optional. Instead, Delaware determined that phosphorus application as commercial fertilizer or as manure cannot exceed a 3-year crop removal rate on high P soils.

Delaware scientists who wished to remain anonymous revealed that the Commission decided to not make the PSI mandatory given the Commission did not anticipate the tool would provide farmers operating in high P soil conditions any more flexibility to apply more manure than at a 3-year crop removal rate. In contrast, Maryland scientists anticipated the PSI tool would identify fields that would rank low in environmental loss risk and thus enable farmers to continue applying manure at nitrogen rates while other fields would rank high in environmental loss risk and thus would either call for a 3-year crop removal rate or an outright ban on any further phosphorus application through fertilizer or manure.

These Delaware scientists conceded that their law’s 3-year crop removal rate for phosphorus was arrived at as a compromise between science and policy given the reality that there were no alternative uses for manure and a ban on no additional manure would have a serious economic hardship on many farmers. They assured me though that a 3-year crop removal rate results in only putting down as much manure as can be taken up by three years of crops which neither worsens nor improves the problem of excess phosphorus in Delaware soils. This rate keeps the system in equilibrium, in essence. In contrast, Maryland’s system of a ban once a certain level of the PSI is reached results in a drawing down of stocks of phosphorus in the soil and thus helps reduce the excess phosphorus problem in Maryland soils.

How Delaware implemented their regulations

Initial program rollout by the Delaware Nutrient Management Commission went smoothly. Because annual administrative compliance statistics generated by Delaware will be presented in Chapter 6, this section provides a few highlights of Delaware's implementation regulatory program.

Since Delaware had four years to establish their regulatory program, finalize the regulations, train public and private nutrient consultants to write plans, the state's process was very calm and measured. This gave Delaware the opportunity to encourage early compliance by farmers by offering cost-share to obtain a nitrogen-based plan before the first 2003 official deadline began. . Farmers wishing to get a plan prepared for them for free could do so with the now-certified County Soil Conservation District agents. Farmers that wanted to use a private consultant (now-certified by the state) could make avail of a $5/acre cost-share payment to help pay for the preparation of the mandatory plan. In addition, the Commission provided $7.50 per test for soil nutrient analysis to enable farmers to get the necessary soil tests conducted. The Commission also established a poultry litter transport program providing up to $18/ton of litter transferred from a farm that had no use for the manure to farms that could justify manure application.

Industry Advisory Committee Chair, Dave Baker said, "We had a large voluntary sign-up the first couple of years. We've been personally pleased that we didn't run into more resistance." Unlike the 900 individuals that were certified to write plans in Maryland, only a few dozen individuals were certified in the first four years. Now, only about 20 private nutrient consultants operate in Delaware. In contrast to Maryland's hiring of state nutrient management advisors for each County Cooperative Extension Service Office to be the primary public NM planners, and Virginia's training their County agent of the state Department of Conservation and natural Resources (DCR), Delaware trained their Soil Conservation Districts agents to be planners.

Another key reason Delaware's implementation process proceeded easily was the Commission's specific intention to set multiple-year implementation schedule that started several years after the law. The Commission's Administrator, Bill Rohr, explained why the Commission chose the schedule they did and compared their decision to Maryland's rapid implementation schedule:

> "One of the mistakes that Maryland made was trying to bring in all the plans right from the beginning. How could they expect that their planners and private industry could meet that demand? We understood that private industry had a lot of investments to make and we had to space out of requirements. It wasn't a good idea to only have one or two years of (plan-writing) workload and then no work for three years until the next deadline.
>
> Plus Brokers had to invest hundreds of thousands of dollars in front end loaders and tractor trailers to move the litter. And Perdue had to spend millions to build the (AgriRecycle) plant and to keep it operating. Now 8 or 10 years later, they're finally seeing profits.
>
> When you're changing the industry for poultry manure, we knew you can't do it over night. A lot of good ideas came out of the Commission. We spent a lot of hours and late nights ironing out the details." (Rohrer, January 29, 2010)

It appears that Delaware's measured schedule and early cooperators incentives paid off. By the second year of the schedule, farmers were ahead of their state's five-year compliance schedule because 60% have already filed plans but only 40% were required to do so.

Phillip Cherry summed up the implementation stage of the Delaware Nutrient Management Law: “There was no way the (Carper) Administration was going to allow a voluntary solution because fish were dying and poultry litter was a problem…But at the end of the day, they got a mandatory program with a voluntary enforcement. They jawboned people to death and shamed them into compliance. They may not have fined anyone.” As will be described in Chapter 6, very Delaware has conducted about 20 random inspection visits on farms each year since 2003 and only one person has received a fine.

5.5. Comparing Farmer Reactions to their State’s Response to *Pfiesteria*

This section will provide the results of 14 Likert Opinion Statements revealing how farmers felt some eight years after their state nutrient management laws were enacted about a) their states’ problem diagnosis, b) the role that integrators and poultry growers should play in dealing with manure, c) their states’ policy making process, and d) the implementation phase of the regulatory program. Overall, farmer opinions about their states problem diagnosis and the roles different members of the farming community should play in addressing environmental concerns showed no statistically significant difference between the states. In contrast, three of the four statements on the policy development process and all three statements about the implementation of the regulations did show a statistically significant difference.

Before presenting those findings regarding opinions eight years after the state laws, I will present the findings of opinions two years after Maryland’s law was enacted. During six of the seven Nutrient Management Public Hearings held by MDA in 2000, University of Maryland anthropologists Paolisso and Mahoney analyzed the questions and comments on the regulations between the audience of mostly farmers and representatives of the state. The anthropologists found the words farmers used to describe the nutrient management regulations suggest that the:

> "(R)egulations run counter to the farmers' sense of morality. Farmers' moral code can readily be defined as their own socially and culturally derived understanding of what is right and wrong.
>
> For instance the words *wrong, unreasonable, and unfair* imply that farmers believe the regulations violate their system of justice and fair play.
>
> Similarly, the words *insulting, onerous, and offensive,* speak to the degree to which the regulations are personally injurious.
>
> Finally the words *ridiculous, absurd, and unnecessary* suggest that the regulations are not a rational act and are beyond the farmers' sense of reason and appropriateness.
>
> Farmer perception that the regulations are unjust, personally hurtful, and senseless – in effect violating their moral code – has created much animosity and anger within the farming community toward the regulations and those who are seen as supporters of it." (Paolisso and Mahoney, Fall 2000)

As will be demonstrated in the next section, most Maryland farmers I interviewed continued to use many of the same words identified above by the anthropologists nearly a decade later. Furthermore, farmers in Virginia and in Delaware used the same words to describe their impression of the regulatory process in Maryland too.

Farmers' Opinions on Their State's Diagnosis of the Problem

There were five Likert Statements regarding the problem diagnosis stage of the *Pfiesteria* fishkill events. In the following section, I present both the quantitative results of the five Likert statements and key qualitative comments that farmers offered in reaction to the Likert statement further illustrating how farmers felt about the *Pfiesteria* events nearly a decade later. None of the statements showed a statistically significant difference between states.

p=0.386	Table 5.2. Likert Statement: The science linking Pfiesteria to nutrient pollution from agricultural sources was:		
# Farmers	**Certain or Reasonable**	**Don't know**	**Weak or Disproven**
MD, N=30	3%	3%	93%
DE, N=20	15%	10%	75%
VA, N=10	10%	0%	90%

A very large majority of farmers in all three states (75 to 93 percent) said they thought "the science linking *Pfiesteria* to nutrient pollution from agricultural sources was weak or disproved." One Maryland farmer said, "It (the link) was very weak. Matter of fact, it was asinine." (2-16.2, Farmer 34, Wic) Another said, "It was disproved. *Pfiesteria* – that word I don't like." (2-24.1, Farmer 36, Wic) Several farmers provided alternative explanations for the fishkills and *Pfiesteria*, most often identifying sewage plants as the cause. "*Pfiesteria* started in Snow Hill (the city located on the Pocomoke River several miles upstream from the fishkills). There was lots of rainfall, the flood lagoons were opened up at the sewage treatment plant and it went right in the River where all the mess was." (3-22.2, Farmer 24, Wic)

Another Maryland farmer said that "*Pfiesteria* can come up naturally but not from ag (sic) lands but from rotting debris from timber land." In addition, several farmers said that fish with skin lesions is a common and long-time occurrence in Maryland. Another farmer explained "All the fish have lesions in the Bay right now." (3-15.2, Farmer 26, Som) Another said, "Watermen say it (skin lesions on fish) happens all the time so why was everyone making a big deal out of it?" (3-17.1, Farmer 15, Wor) "I feel it (the link) was weak and the reason I say that is from people I've talked to that are in their 80s claiming they saw the same fish problem when they were children when there wasn't as much poultry around." (3-15.4, Farmer 17, Wor)

One Virginia farmer told the exact same story as a Maryland farmer did about a sewage overflow incident upstream from the fishkills. "They ignored the fact that Snow Hill (sewage treatment plant at) overflowed three times that same summer because of excessive rains. Within about two months before *Pfiesteria* happened." (3-20.2, Farmer 1, Acc) Another farmer illustrated his awareness of the first case of *Pfiesteria* in North Carolina. "They tried to link it up here but it didn't work. But they did link it to hog lagoons in North Carolina." (8-9.1, Farmer 10, Acc)

Delaware farmers were just as adamant about the weak link. "How could they prove where it's coming from? (4-5.2, Farmer 44, Ken) "We were blamed as the scapegoat because we only make up two percent of the population." (3-29.1, Farmer 53, Sus) "They just assumed it was us because the farmland was there but the government (sewage treatment plants) wasn't going to take the blame for anything." (3-2.1, Farmer 43, Ken) Several farmers in Delaware conceded, however, "They didn't prove beyond a reasonable doubt that it was farmland…. Since they do have a lot of farmland down there (Lower Eastern Shore Maryland counties), it's reasonable that farmers done it. One or two farmers might have over applied manure." (2-10.2, Farmer 55, Sus)

One farmer from Kent County, Delaware was politically astute in his understanding that the state governments used the Pfiesteria as a focusing event to open the regulatory policy window but also indicated that Delaware's regulations and plan requirements may not have resulted in much behavior change in Delaware farmers:

"I don't think it's the end of the world that *Pfiesteria* caused the state to get this though. They used it as an excuse to get the Law through and that's not a bad thing. They had to use something to have the power to get it done...I'll strongly disagree that we fixed *Pfiesteria* with nutrient management though. I for one think we're really doing nothing different than from back then." (4-5.2, Farmer 44, Ken)

p=0.443	**Table 5.3. Likert: Agricultural sources from the entire Chesapeake Bay watershed make up a majority of the nitrogen and phosphorus entering the Chesapeake Bay.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	0%	13%	87%
DE, N=20	5%	15%	80%
VA, N=10	0%	0%	100%

p=NSS	**Table 5.4. Likert: Agriculture is being blamed for a greater share of the water pollution than it generates.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=28	93%	0%	7%
DE, N=18	94%	0%	6%
VA, N=10	100%	0%	0%

The vast majority of farmers in all three states disagreed (80 to 100 percent) with the factually correct statement that "Agricultural sources from the entire Chesapeake Bay watershed make up a majority of the nitrogen and phosphorus entering the Chesapeake Bay" and agreed (93 to 100 percent) that "Agriculture is being blamed for a greater share of the water pollution than it generates."

One farmer from Maryland commented, "The reason I don't think that ag is totally to blame is coz nobody's regulating the everyday homeowner. I know ag plays a big part. It's just that in my lifetime, there was two-thirds as much cropland when I as a kid but we didn't have a problem back then and now the land is in housing developments and now we have the problem."(3-15.1, Farmer 29, Wor) Another farmer offered, "People argue that ag is most because we have the most land but I'd argue that urban areas don't get filtered at its a point source and goes right into the river." (3-17.1, Farmer 15, Wor) One farmer from Maryland said, "I don't think we're responsible for over a fourth of it. The main sources are state highway water control runoff, sewage treatment plants, homeowners and golf courses." (3-9.2, Farmer 25, Som)

"I wouldn't think we're the largest. Golf courses and homeowners are the biggest sources." (3-25.1, Farmer 48, Sus) One farmer, despite already receiving six credits of continuing certification still had not learned this fact as he said, "I don't know, farmers shouldn't take all blame…Towns and cities have contributed to it…homeowners with nice green lawns." (3-2.1, Farmer 43, Ken) Farmer 57 from Kent said, "The biggest source of pollution is lawns. They put 3 to 10 times the amount of fertilizer onto lawns as we do on an acre. There was a study done in Maryland; boy had proof of it. The government didn't want to hear it." (3-2.4, Farmer 57, Ken)

p=0.639	**Table 5.5. Likert: In certain counties on the Delmarva Peninsula, there is more poultry manure produced than can be applied at agronomic rates in the same County.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	67%	10%	23%
DE, N=19	58%	5%	37%
VA, N=10	50%	20%	30%

Although there was no statistically significant difference between states, only about half (50 to 67 percent) of farmers in all three states agreed with the factually correct statement, "In certain counties on the Delmarva Peninsula, there is more poultry manure produced than can be applied at agronomic rates in the same County."

Of those who acknowledged this scientifically accurate statement, farmers identified Sussex County six times as an example of counties with excess manure while Worcester and Wicomico came up once, as did “the three Lower Eastern Shore counties.” As a farmer from Worcester County, Maryland put it, “There’s more chicken houses per square mile (in Sussex) than any other state in the country so there’s no way they can handle it all themselves.” (1-17.1, DP, Wor)

Of the farmers who expressed disagreement with this statement, several farmers acknowledged there may be excess manure produced on individual farms but could not agree that it was a County-wide problem in any County on the Delmarva Peninsula. A farmer in Sussex County said: “There are certain parts of counties that have more manure than they need. There are too many houses per acre in some parts, but other parts of County you’ve never had chicken manure (applied on the land).” (2-10.2, Farmer 55, Sus)

Other farmers expressed their disagreement with this statement based on their experience with insufficient supply and high demand for manure as one Worcester County, Maryland farmer said: **“**They fight over it down here. I’ve seen it happen. If one guy thinks he was getting the manure but doesn’t pick it up right away, the grower called someone else who came and got the manure out of the building. (4-6.3, Farmer 21, Wor)

p=0.112	**Table 5.6. Likert: In the past, it was customary practice for many poultry growers in my state to apply poultry manure on nearby fields for disposal purposes.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	67%	0%	33%
DE, N=20	50%	0%	50%
VA, N=10	70%	10%	20%

A small majority of farmers in all three states (50 to 70 percent) agreed with this factually true statement that, "In the past, it was customary practice for many poultry growers in my state to apply poultry manure on nearby fields for disposal purposes." One farmer admitted,

> "We piled it on to get rid of it at the old farm. Before we had management plans, the higher ground would get loaded up on it. Right outside the chicken house, it was hi and dry and might have got spread 10 times as much as anywhere else. Eddie (Wicomico County Extension Agent) stuck his probe right there – P levels were 370 and above. We used 6 to 9 tons/acre on corn before we bought the spinner spreader in 2000." (3-10.1, Farmer 28, Wic)

Recall that phosphorus concentrations greater than 205 lbs P2O5 per acre were considered "Very High" on the old phosphorus soil test scale and "Excessive" on the new scale while manure application rates on corn were recommended at 3 tons per acre to supply the nitrogen needs of the corn.

Another farmer who agreed with the statement but insisted it no longer happens said, "I don't think none of the farmers do this anymore – they was doing that 5 years ago before the Nutrient Management Law. There were some who didn't stop getting rid of their manure, but after the law, they stopped. We used to clean out a lot more often so we had to get rid of it. (4.7.1, Farmer 20, Wor)

Another farmer said. "I agree. There are some farmers that had to get rid of it but a lot of other farmers that needed it. This happened before *Pfiesteria*, most farmers have stopped dumping it." (1-25.2, Farmer 31, Som) One farmer insisted but also conceded in his statement, "We've been using 2.5 ton a good while now a good while now. Ever since we got to know better. When there's a total clean out though we'll spread it to get rid of it." (4-7.1, Farmer 20, Wor) One farmer who disagreed with this statement said that under certain economic conditions, manure became very scarce indicating that no one could treat the manure as waste: “I disagree. For years when nitrogen prices got hi, they started buying manure.” (3-22.2, Farmer 24, Wic)

Farmer Opinions on the Roles of Integrators, Growers, and Farmers

There were two Likert Statements attempting to elicit farmer opinion on the role they think farmers in general but also specifically poultry growers and the poultry integrator companies like Perdue and Tyson’s should play in addressing agricultural environmental problems. Neither was statistically significantly different.

p=NSS	**Table 5.7. Likert: Protecting the environment is part of what it means to be a farmer.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	100%	0%	0%
DE, N=20	95%	5%	0%
VA, N=10	100%	0%	0%

Nearly 100% of all farmers in all three states agreed that, “Protecting the environment is part of what it means to be a farmer.”

Despite feeling that the blame for *Pfiesteria* was laid unfairly and unjustifiably at the feet of agriculture and poultry growers specifically, farmers especially in Maryland felt their integrity was under attack but still agreed that environmental protection what part of their identity.

One farmer from Virginia explained the attack that farmers felt from the media attention and the policy makers and said why he wholeheartedly agreed with the statement:

> "There seemed to be a mindset that there was intentional over-application and allowing runoff. Farmers are the first conservationists they want the nutrients on the fields and not in the ditches. The margins have never been wide enough in ag to be wasteful. We've always tried to put on the proper rate. Ninety-five percent of farmers are applying manure in a way that was safe to the environment and productive to crops." (3-20.2, Farmer 1, Acc)

One farmer from Maryland said, "I don't want to see anything bad happen to it. Land is just like your tools, if you don't take care of it, you won't get anything out of it." Another farmer like many other farmers said, "Farming has such small profit margins, we can't afford to put on more than what the crop needs."

Delaware farmers added similar opinions: "I view everything on an economic basis – if we lose N or P through runoff, that's costing us money." (3-23.3, Farmer 12, Ken) "Ninety-five percent of farmers don't want to be doing bad to the environment. You take care of the land and it will take care of you." (3-23.1, Farmer 42, Sus) "I don't think there's a farmer who's told how to do the correct thing that isn't going to do it." (4-5.22 BM) "That's what we make our money off of – the land and the environment. We don't want to see it go to crap. I don't want my kids to have to leave coz it's a bad place. We don't go out there and waste money." (3-29.1, Farmer 53, Sus)

However, a farmer from Worcester County acknowledged financial constraints to being an environmentally-friendly farmer, "If you have profit, you have money to spend on various environmental practices. But even the most successful farmers have to have something else besides farming to get by like driving a school bus or their wife works off the farm." (4-7.2, Farmer 12, Wor)

p=0.141	**Table 5.8. Likert: Both integrators and poultry growers should be responsible for excess poultry manure.**		
	Agree	**Don't know**	**Disagree**
MD, N=29	72%	7%	21%
DE, N=20	80%	5%	15%
VA, N=10	70%	30%	0%

A large majority of farmers in all three state (70 to 80 percent) agreed that "Both integrators and poultry growers should be responsible for excess poultry manure."

Farmer 33 from Wicomico said, "Everyone should be responsible – the integrator, the grower, and the farmer." (2-16.2, Farmer 33, Wic) A few farmers mentioned the efforts taken by two integrators to help with the problem: "I'm not sure it should be just the integrators. They outta be able to work together. They have with the Perdue (litter pelletizing) plant." (2-16.2, Farmer 34, Wic) "They're becoming more involved. Allen's is trying to use manure to burn it. (Allen's Family Foods tried using poultry litter as a fuel in a co-generation system it built at one of its processing plants)" (3-23.2, Farmer 51, Sus)

Despite the large majority agreeing with this statement, several farmers vehemently disagreed but revealed the tension between contract growers and integrator companies over manure depending on the whether the grower values the manure as a fertilizer resource or views the manure as a waste burden. These disparate views underscore the challenge to the states to assign responsibility for manure in a vertically integrated business like the poultry industry.

On the one hand, some growers say" "Those are not my chickens; they're Perdue's and so Perdue should have some responsibility for the manure." (3-15.2, Farmer 26, Som) "They kinda contributed to the problem…integrators advertise that a family could build chicken houses on just a couple of acres of land and go to work off the farm. They advertise on TV: You only need 3 acres to make a living." (3-25.1, Farmer 48, Sus) "I would tend to agree because it is a byproduct of their business." (4-7.2, Farmer 12, Wor)

But on the other hand, other growers said: "I disagree because I might need it for my crops but the integrator might say, we're gonna take it this time so I might have to go and buy potash." (3-17.3, Farmer 19, Wic)

One farmer revealed some "bad behavior" by Perdue that evidently couldn't consume all the poultry manure brought to its AgriRecycle facility and thus temporarily became a manure transport program between farms: "AgriRecycle dumped manure too close to road. Should be 50 feet from the road." (1.25.1, Farmer 54, Sus). Famer 54 is referring to Delaware's rule that if necessary poultry manure that must be stockpiled be placed at least 50 feet from roads which representatives from AgriRecycle failed to heed.

Farmer Opinions about Their State's Policy Development Process

There were four Likert Statements meant to elicit farmer regard for how their states went about deliberating a policy response to the *Pfiesteria* events. Three of the four statements showed statistically significantly different opinions between states.

p=0.531	**Table 5.9. Likert: Updating and strengthening the voluntary nutrient management program would have been a better policy response than a regulatory response to the 1997 *Pfiesteria* events.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	83%	13%	3%
DE, N=20	85%	10%	5%
VA, N=10	60%	30%	10%

There was no statistically significant difference between states in response to the statement "Updating and strengthening the voluntary nutrient management program would have been a better policy response than a regulatory response to the 1997 *Pfiesteria* events." with a large majority of farmers in agreement (60 to 85 percent). A farmer from Somerset County said, "If they spent half the money they did on education instead of regulations, it would have worked." (3-15.2, Farmer 26, Som) A farmer from Worcester County figured that "Fifteen year ago, they said we had a nitrogen problem and they came out with an N-based plan and that helped us control the nitrogen. They could have done the same thing for phosphorus." (1-17.1, DP, Wor) Farmer 48 from Sussex County said, "I didn't know there was a voluntary program but I agree that they should have done it (the Law) voluntary." (3-25.1, Farmer 48, Sus)

A few farmers commented on the downsides to a regulatory approach: "I think the 1997 changes were so drastic that it turned agriculture off to cooperating with the state. Anytime something is voluntary, you're gonna get more response." Another said, "When they came out with a hammer, you get a backlash." (3-9.3, Farmer 27, Som)

One farmer even revealed possible unintended consequences of the regulatory approach; some farmers reduced the intensity of nutrient management they were engaged in before the law. "I was doing soil samples every year on 100% of my land. It's the cheapest and most important information that will save you more money. Now, it's stupid that a soil sample is only required every three years. I still do them every year but others have stopped doing them but for every three years." (4-6.1, Farmer 22, Wic)

p=0.000***	Table 5.10. Likert: Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations.		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	13%	13%	73%
DE, N=20	65%	20%	15%
VA, N=10	0%	10%	90%

There was a statistically significant difference in farmer reaction to the Likert Statement, "Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations." Between 73 and 90% of Maryland and Virginia farmers disagreed while 65% of Delaware farmers agreed with the statement.

A Wicomico County farmer explained why, "We didn't have no fair say in it. All the meetings I went to (in Salisbury), any time a farmer tried to say something, they didn't want to hear it. They would just disagree. It seemed like we were beaten before we ever talked." (2-24.1, Farmer 36, Wic) Another farmer from Worcester suggested that farmers were able to provide input even though they might not have been equal players: "They may not have had an equal seat but I felt they had input."

Several farmers compared the Glendening Administration to the Ehrlich Administration (2003-2007) in response to this statement. GD from Somerset County said, "Farmers didn't have any seat then. I'm in touch with enough people to know. We have a voice now. Erhlich is genuinely interested in our voice and opinion." (3-9.3, GD, Som)

In contrast, the farmers in Delaware paint a very different picture of how their state involved farmers: "They're trying in Delaware to work with the farmer as much as possible. Not this overbearing crap, my way or the highway, like in Maryland." (3-23.1, Farmer 42, Sus) "They saw what was coming down the road. Farmers said, Let's jump on this and get what we want versus what everybody else wants. (3-23.2, Farmer 51, Sus) Farmer 49 from Sussex put it this way: "We govern ourselves. We wrote our own rules. We worked things out so that farmers did it themselves." (3-8.2, Farmer 49, Sus)

=0.000***	Table 5.11. Likert: My state's policy approach focused on building consensus amongst the various agricultural and environmental stakeholder organizations.		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	23%	13%	63%
DE, N=20	80%	20%	0%
VA, N=10	30%	20%	50%

There was another statistically significant difference between states in response to the Statement, "My state's policy approach focused on building consensus amongst the various agricultural and environmental stakeholder organizations." About half the farmers in Maryland and Virginia (63 and 50 percent, respectively) agreed while 80% of farmers in Delaware disagreed with the statement.

Again, several farmers emphasized the differences between the Erhlich and Glendening Administrations. Farmer 23 from Worcester County said, "Only under this (Erhlich) Administration are they trying to build consensuses." (1-17.1, Farmer 23, Wor) A few farmers revealed that the environmentalists had the upper hand. "Everything was for the environmentalist. That's turned around some now." (4-6.2, Farmer 18, Wor) "The Bay Foundation had the upper hand – it's like saying anything against apple pie and mother that you're against the Bay." (3-17.1, Farmer 15, Wor)

p=0.002***	**Table 5.12. Likert: My state's agricultural nutrient management law is justified.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	40%	0%	60%
DE, N=20	60%	20%	20%
VA, N=10	20%	0%	80%

Another statistically significant difference occurred between states in reaction to the Statement, "My state's agricultural nutrient management law is justified." A majority of Maryland and Virginia farmers (60 and 80 percent, respectively) said they disagreed that the law is justified while 60% of Delaware farmers agreed that it was justified.

Despite the strong negative feelings about the states blaming *Pfiesteria* on agriculture and their feeling left out of the policy making process, several farmers from Maryland and Virginia were able to concede that the law was needed but objected to the manner in which it was developed.

"You needed something to stop the excess that was going on but you didn't need to do it the way they did it." (3-15.2, Farmer 26, Som) "You can justify anything but I don't think it was justified to do it in the spirit it was done…It took 20 years to get us where we've gotten. You told us to do nitrogen-based plans. Let's take three years to figure out what's going on with the plans and how to start reducing it." (3-17.1, Farmer 15, Wor)

In contrast to the majority of Maryland farmer views that the process was not a consensus, Farmer 29 from Worcester suggested that he thought there was compromise and the process was fair, "Despite farmers having no seat at the table, the law is still justified. CBF and the farmers didn't get everything they each wanted. They met in the middle and that's fair. (3-15.1, Farmer 29, Wor)

Many farmers conceded that there are advantages to the law. “I’d say it’s justified though I don’t agree with it. But I do agree that something needs to be done to make sure everyone’s doing their fair share.” (3-9.2, Farmer 25, Som) “Yes, it’s justified. It keeps people from doing too much.” (3-17.2, Farmer 16, Som) “There are some us farming that you gotta have someone looking over their shoulder. If you don’t have it, we’re not gonna do it.” (407.2, Farmer 12, Wor). “I agree it is a good practice to have nutrient management. It’s for the good and keeps some of the ones that wouldn’t have a good practice and keeps them in place.” (3-2.2, Farmer 47, Ken)

Another indication that Delaware’s law may not be requiring any behavior change in their farmers, Farmer 12 from Kent said, “I disagree because we haven’t changed anything since it come in. We have made no changes meeting what the law says.” (3-23.1, Farmer 12, Ken)

Farmer Opinions on Their State’s Implementation of the Law

There were three Likert Statements about the states process of implementing the regulatory program. All three statements revealed statistically significant differences between states.

p=0.002***	**Table 5.13. Likert: My state’s regulatory nutrient management program focuses more on farmers submitting the required documents than it does on educating farmers about the latest nutrient science.**		
	Agree	**Don't know**	**Disagree**
MD, N=30	73%	10%	17%
DE, N=19	16%	11%	74%
VA, N=10	50%	10%	40%

During my pre-interview trials, several farmers from Maryland complained about the one every three-year manure voucher certification training their law required them to attend while many farmers from Delaware had good things to say about their law's requirement that they attend several certification and continuing education events every year. Thus, I prepared this Likert Statement to detect whether quantitatively, differences were statistically significant. They were. The same portions of Maryland farmers (73 percent) agreed with this statement as Delaware (74 percent) that disagreed with it. Virginia farmers were split down the middle and highlighted the fact that half of the 10 interviewed Virginia farmers were regulated and were aware of the law's requirements while half were unregulated because they did not grow chickens but used chicken manure and were not as familiar with the law.

One Maryland farmer explained that in addition to infrequent educational events, the events do not appear to be on important topics. "There's very little going on. There are only 1 or 2 educational events per year and that's it. Most meetings don't have to do with what you need to know. That's almost as bad as commercial pesticide applicator licenses and it's an all day meeting. Two-thirds will be on the life cycle of the Colorado potato beetle. A little on worker safety and new chemicals. It's bizarre. (3-15.2, Farmer 26, Som) Another found the event overwhelming: "Maryland wants it all. They beat our brains out at the meeting but some guys won't absorb it." (2-16.1, Farmer 33, Wic)

In contrast, Delaware farmers said the educational requirements and the paper work were not a problem. "I attended a lot of meetings like certification classes. Two of my crew (out of 20) are certified. There's lots of continuing education classes. Only have to go to 3 but I went to Farm Bureau meetings on the regulations too." (3-29.3, Farmer 41, Sus) Another said, "There's a little bit of paper work but not that much. My crop advisor does it all. If I was getting all the paper work, I'd see things differently but I get very little of it." (3-2.1, Farmer 43, Ken)

p=0.002***	Table 5.14. Likert: My state is committed to fully implementing the Nutrient Management Program.		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	90%	10%	0%
DE, N=20	90%	10%	0%
VA, N=10	40%	40%	20%

During my pre-interviews, a few farmers indicated that since the 2003 Nutrient Management Summit that MDA was going to take it easy on farmers and not enforce the law while some farmers from Delaware indicated that hardly any on-farm inspections were going on their state. And given that all Virginia farms get inspected nearly every single year, I presented a Likert Statement to see if there was a difference between farmer impressions of how seriously their states were taking the law.

There was a statistically significant difference but the results were unexpected. Nearly all the Maryland and the Delaware farmers (both 90 percent) agreed with the statement "My state is committed to fully implementing the Nutrient Management Program" while only 40% of Virginia farmers did.

One Maryland farmer said, "The state is totally committed to get to their goal of X number of acres. They're spending a ton of money on it. I don't know anybody that doesn't have a plan." One said, "I think they're committed in the sense that they're not gonna say we've had 8 years now and not saying we're gonna back off. It will be on going in Maryland to be there." (3-17.1, Farmer 15, Wor) Another said, "I think the state government wants to implement it but they don't have the enforcement." (3-15.3, Farmer 11, Som)

Equal portions of Virginia farmers agreed their state was fully committed to implementing the law as said they didn't know (both 40 percent). Farmer 10 from Accomack admitted that despite the near annual inspections, because an inspector can't be there every time he applies his manure, he sometimes disobeys the law and applies outside the restricted time period. Farmer 10 said, "We've had someone check the records and the manure in the shed but they've not caught us in the field." When I asked him to explain what he meant, "They can spot check your fields to see if you're applying too much manure, if you're calibrating the equipment. But you're not allowed to do it (spread manure) but for a couple of months a year. By myself, I can't wait till the last minute to spread it." (8-9.1, Farmer 10, Acc)

One Delaware farmer said he agreed but then clarified, "I don't know if the state is committed as much as the Commission is. They're doing the best they can, trying to implement everything without being too hard on anyone. It's hard to do it to make everybody happy." (3-29.3, Farmer 41, Sus) Another farmer said,

> "I agree. I guess they are. Delaware's not pushing real hard. I think Delaware's law is being complied with more than Maryland's law. 'To hell with them!,' they said in Maryland. Most people work with somebody that asks you to do something than tells you to do it. Maybe things are better under Ehrlich. Don't be so heavy handed, he (Ehrlich) learned. A lot of farmers have conservative politics." (3-3.3, Farmer 60, Sus)

One farmer suggested that the law was really voluntary because there were no consequences for non-compliance and little ability to detect non-compliance. And despite an indication that Farmer 51 tries to apply a very low manure rate, he suggests that other farmers and their planners are just going through the motions of appearing to carry out the law:

> "There's no threat to go a long with a big stick. I think they're doing these plans to pacify the politicians that think farmers are the ones that are destroying the waterways. The politicians are happy but the people writing the plans feel like they're not doing anything. They're just doing it to get the politicians off our backs. Delaware got ahead of this to write and do it on our own. That's what it's all about. Governor Glendening is a pain in the butt." (When I asked him what other farmers would say, he replied, "They're probably saying they're not taking it too seriously because there are no repercussions. If you get out and speed, you're eventually gonna get caught. I calibrate the spreader and actually get 1.5 tons/acre but not 1 ton/acre. They're not concerned with that difference at this point. It's like the speed limit on the highway, if there were no policemen with radar guns, they'd go as fast as they can." (3-23.2, Farmer 51, Sus)

p=0.029**	**Table 5.15. Likert: With their own money and with cost-share funding from the state, all farmers have enough resources to prepare a nutrient management plan and to follow the plan.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	57%	13%	30%
DE, N=19	79%	5%	16%
VA, N=10	20%	10%	70%

Since I heard that many farmers were worried about being able to obtain and follow a plan because they thought it would cost them too much money, I prepared the Likert Statement "With their own money and with cost-share funding from the state, all farmers have enough resources to prepare a nutrient management plan and to follow the plan." There was a statistically significant difference with 57% of Marylanders and 79% of Delawareans agreeing that they had enough resources available to them to prepare and follow the plan while 70% of Virginia farmers disagreed.

The difference in Virginia is interesting. Just one regulated farmer and one unregulated farmer agreed they have enough resources from the state and on their own to prepare and follow a plan. Only one regulated farmer said he didn't know, while the rest of the seven farmers (three regulated, four unregulated) disagreed they would have enough resources. Thus, despite the availability of cost-share funds, the fact that most of them have hired private planners rather than rely on the free services of the state, and despite near annual inspections on their farm, three out of five regulated growers in Virginia essentially said, "they can't afford to follow the law." This issue of why farmers think they can't afford to follow their plans will be discussed further in Chapters 7 and 8.

One Maryland farmer explained why most of the farmers from Virginia said they couldn't afford to follow their plans:

> "Farmers can afford to do a nutrient management plan and follow it but they can't be in business for very long. If farming is their only income, the yields will be too low and they'll be robbing the ground of nutrients. Like crabbers do – take them out constantly but never putting them back. If you follow a nutrient management plan, you're just taking out and not filling up." (8-10.3, Farmer 40, Wor)

One farmer, who said he "didn't know," offered, "Farmers shouldn't have to use their own money to do this because I think it was unnecessary to have this law. There should be enough resources but not every County agent does the plan. Fortunately, Public Planner D (Maryland Extension Specialist) does do it and we've never had to pay for it. (3-17.1, Farmer 15, Wor)

One Delaware farmer said he agreed and that he hasn't taken state cost-share for nutrient management planning for 20 years. (4-5.1, Farmer 45, Sus) Expressing the opposite view, when I asked what would happen if Delaware stopped paying cost share for the nutrient management plan, "It probably wouldn't be good and will get more people who wouldn't fool with it. Why would the state do that? They'd be shooting themselves in the foot. They’re gonna have to keep money in it to keep paying the farmers to keep them in.” (3-25.1, Farmer 48, Sus)

5.6. Summary

There were major differences amongst the three states in the case study regarding how the states a) reacted to the *Pfiesteria* fishkill events and diagnosed the problem, b) developed their policy response to the perceived problem, c) decided which farmers would be regulated and what would be required of them, and d) implemented the law through the years.

These differences were perceived by the media, which ran several articles comparing the leadership styles of the Governors of Maryland and Virginia. In addition, the stakeholder groups I interviewed keenly felt these differences which they largely attributed to high level of involvement of farm trade association leaders in Virginia and the dominance of the environmental stakeholders in the policy process in Maryland. Most importantly, most of the regulated community I interviewed felt these differences. Farmers in the case study revealed through the Likert Statement exercise that they held very different opinions about their state’s policy development process and the implementation efforts. However, farmers were overwhelmingly united in their feelings about the problem diagnosis and the role of farmer stewardship, and to a lesser extent, in agreement about the need for shared responsibility for poultry manure between growers, integrators, and farmers.

How each state diagnosed the problem

Since the majority of the fishkills occurred in Maryland tributaries to the Chesapeake Bay, Maryland was burdened with diagnosing the problem. For approximately three months in 1997, federal and state scientists investigated the fishkills, the Governor's Blue Ribbon Commission conducted public hearings, and the Cambridge scientists came to consensus. Though the link between *Pfiesteria* and farm nutrient pollution was not conclusive, the scientists and the Commission concluded that reducing nutrient pollution to the affected bodies of water would likely help avoid the emergence of the toxic microbe and help improve water quality in general.

Though a fishkill did occur in the Virginia portion of the Pocomoke Sound adjacent to the fishkills in Maryland waters, Virginia Governor Allen and his team of scientists from the Virginia Institute for Marine Sciences determined their river closing policy would only take effect if fish died or there was a clear threat to human health. Thus, after seeing the negative economic impact on Maryland watermen of Glendening's aggressive fish closures, Virginia watermen were relieved that Allen took a "go-slow" approach and was conservative in his river closure policies. Delaware largely skipped over diagnosing the problem in 1997 while Maryland was in the midst of the process as the fishkills were occurring in Maryland tributaries to the Bay. Only in 1998 did Governor Carper ask his Department of Natural Resources to assess the cause of *Pfiesteria*.

Based on my Likert Statement survey, across all three states, by and large, farmers expressed disgust at the lack of data proving the link between *Pfiesteria* and agriculture. They are upset that this lack of scientific credibility was sufficient to justify regulating agriculture. Farmers were unconvinced that their sector is the largest source of nutrient pollution to the Chesapeake Bay and farmers feel unfairly blamed for more of the problem than their fair share. Finally, farmers by and large do not recognize the existence of an excess manure problem on the Delmarva.

Aside from the Likert Statements, during informal comments, farmers across all three states expressed they felt let down by the government officials who blamed the fishkills on farmers. A few select farmers that were involved with or close to the policy making process were particularly upset that the government did not take more of the blame for not changing their nitrogen-based nutrient management plan policy and for not informing the farmer that there was a problem. Farmers felt that they were being unjustly attacked by policy makers and the media for manure practices that were recommended to them by the state. Furthermore, they felt misunderstood and painted as uncaring about the environment when they see themselves as "stewards of the land" who believe they have little economic incentive to be wasteful or careless with poultry manure. Farmers repeatedly described the events of the problem diagnosis stage as biased against them, made them feel like criminals, and on trial in the public arena.

How each state developed their policy response

There were several striking differences between Maryland's and Delaware's policy development processes in terms of regulatory styles and involvement of the regulated community. In contrast, there were several similarities between Maryland's and Virginia's policy response process in terms of policy entrepreneur and the pressure of state legislative elections.

Maryland and Delaware approaches to agricultural regulatory policy development were practically opposite. Maryland's approach can be described as "top down" as the Governor's office, rather than a legislator from either the Environment or Agriculture Committee, drafted the bill that would become law. Glendening also positioned himself an environmentalist and by force of personality and because of his powerful Office, drove the policy-making process in Maryland. Governor Glendening's regulatory approach can be described as strident with little involvement from the regulated industry during the design stage of the legislation. Though farm trade association representatives were members of the Nutrient Management Advisory Committee, the regulatory-writing phase was just as contentious as the legislative phase between environmental, farm, and scientific institutional stakeholders.

In contrast, Delaware's regulatory policy approach was "bottom-up" with the regulated industry sitting in the driver's seat, during all policy phases: legislative, regulatory, and implementation. Delaware's Governor Carper played a key role though had an entirely different kind of leadership role than that of Glendening. Carper established a calm, cooperative policy response tone and delegated the policy-making, first, to a group of influential farmers and then, to his key administrative agencies. The initial policy agenda was set by a 10-farmer advisory committee and then by the Chair of the House agriculture committee. In cooperation with the Department of Natural Resources and Environmental Control legislators, many of whom were farmers themselves drafted Delaware's bill and sought feedback on the bill from the main farm trade associations. Thus, Delaware's regulatory policy process was accommodative. During the regulatory-writing stage, farmers in Delaware were in a leadership role, dominating the Delaware Nutrient Management Commission instead of merely serving in an advisory capacity.

Virginia's policy development process lies somewhere in between the process experienced in Maryland and Delaware. Delegate Tayloe Murphy served as Virginia's policy entrepreneur and was Chairman of the House environmental committee and a well-recognized environmental leader. Murphy positioned the bill as protective legislation on behalf of his watermen constituents and for the public's benefit of a cleaner Bay. Virginia's legislative process appears to have elements of both the top down and the bottom up philosophies and because of the summer-study-schedule, was inclusive of both the regulated and the environmental communities. Virginia's approach was not strident and the debate was civil though heated. Both sets of farm and environmental stakeholders along with scientific and economic experts were involved in the regulatory-writing phase.

The policy agendas that the three states' set in response to the *Pfiesteria* fishkill focusing events were very different. Maryland responded to the *Pfiesteria* fishkills because there was a serious threat to public health and used the hot light of media and public attention to frame the failed voluntary program approach to solving agricultural nutrient pollution as a policy problem that had to be fixed which would fix the environmental health threat. In addition, the Governor and state legislators who were all up for election in 1998 capitalized on the public attention to demonstrate strong, protective leadership. Thus, Maryland's motivation to respond to the focusing events was largely driven by internal sources of pressure.

In Delaware, the *Pfiesteria* fishkills forced the state into regulating farmers, primarily to satisfy an on-going legal dispute with the EPA, which was forcing Delaware to permit animal producers through the Clean Water Act CAFO program. Thus, a significant driver of Delaware's policy response was from external sources – both EPA and the pressure by the media and Maryland and Virginia to respond in kind.

Virginia saw the *Pfiesteria* fishkill focusing events as an opportunity to re-open their Virginia pollution abatement permit system to include poultry producers and achieve parity with the already regulated beef, swine, and dairy operations in the state which the Virginia Delegate believed would help his seafood industry constituents recover and the environmental stakeholders believed would help address the manure problems in the concentrated production areas.

The composition of the General Assemblies in all three states also played a role. The dominance of urban and suburban members of Maryland's legislature versus the importance of farm representation in Delaware's General Assembly played an important role in how the legislative stage proceeded. However, despite the dominance of Governor Glendening's power in legislative activities, the Water Quality Improvement Act had a difficult time passing. One reason for the protracted process was because rural legislators chaired several key committees responsible for the bill in the General Assembly. In contrast, due to the dominance of farmer legislators, the revolving door in Delaware, and the blessing the regulated community gave to the Delaware bill, that law sailed through the assembly. In Virginia, despite the rising power of the Northern Virginia suburbs, Virginia continues to have a strong rural connection and a pro-business culture that tends to limit government reach making it difficult to achieve the comprehensive scope of Maryland's and Delaware's laws that regulated all farmers.

The importance of electoral politics in Maryland's and Virginia's policy responses was a much noted and analyzed component of those two state's process as was the leadership styles of Governors Glendening and Allen. Many journalists noted that Maryland's Governor was up for re-election in 1998 and had lost the farm vote to his Republican rival in 1994. For an environmental leader, Glendening turned to "his base" – the urban and suburban, environmentally progressive voters. Many in the farm community that I interviewed contend that Glendening used the law to punish the farm community's lack of support for his first and second election. The entire Maryland legislature was also up for election in 1998. Reporters even commented that Virginia postponed their law till the election year.

Given these evident differences in each state's policy making responses to the *Pfiesteria* focusing events, it is no surprise that there were statistically significant differences in the Likert Opinion surveys regarding the policy-development process in each state. On one side, farmers in Maryland and Virginia, by and large, did not feel like they had an equal seat, did not feel like consensus was an important negotiating principle, and did not feel that their laws were justified. On the other side, farmers in Delaware felt the opposite on all three issues: they did feel represented at the policy-making table, they did believe that their state focused on building consensus between farm and environmental groups, and they did feel their law was justified. Also not surprising when asked for their opinion between a regulatory or a voluntary policy solution, farmers in all three states were unanimous in their thinking that a voluntary approach would be better than a regulatory approach.

What each state's regulations require

The requirements and regulatory programs for farmers differed across states in terms of eligibility, manure management, and level of certification and continuing education. Maryland and Delaware's law were the most comprehensive, requiring all farmers in their states plus commercial lawn care companies to be regulated. In contrast, only poultry growers in Virginia were regulated.

All three states required a nutrient management plan as their regulation while Virginia and Maryland went further by developing several additional manure management regulations regarding manure nutrient analyses and winter application rules. Delaware's focus on certification and continuing education was far more extensive than either of the two other states.

The requirements for the poultry processing companies were largely similar except in one respect. Each of the three states required the poultry companies to file plans with the state detailing how they would help their growers comply with the law through technical and financial assistance, develop and help fund a state manure transport program to move excess manures to locations for safe use, and research how they could lower the nutrient inputs to chicken feed in order to lower the nutrient content of poultry manure.

Maryland stood out from the other states in requiring that all processors operating in the state had to reformulate their chicken feed to include the *phytase* enzyme which would enable them to lower the amount of phosphorus they added to the feed and help reduce the amount of phosphorus in the waste. Two poultry companies also initiated alternative poultry manure use projects including a co-generation unit at Allen's processing plant in Maryland and a litter pelletizing plant by Perdue in Delaware.

Maryland's and Delaware's bills stood out from Virginia's in the amount of cost-share programs that were created to help implement the law. Maryland's law established a jointly funded manure transport program, created innovative tax credits and other instruments to help farmers cope with the tighter restrictions on manure use, and funded many alternative technology pilot projects and major research projects. However, much of the incentive programs for farmers went untapped in Maryland. Delaware also established a cost-share program and a nutrient relocation program solely with state and federal funds. Virginia provided only cost-share funds but a manure transport program to this day, has barley gotten off the ground likely owing to the fact that there already is a well-established informal network of manure sharing going on in Virginia.

Finally, Maryland's and Delaware's phosphorus science policy was different. Delaware early on, set a three-year phosphorus crop removal rate which in reality-enabled farmers to apply manure at a nitrogen rate once for every three crop rotations. This was a dramatic restriction but one that many farmers could live with and could implement given the challenge of calibrating manure spreaders below the typical 3 tons/acre nitrogen rate.

In contrast, Maryland's law did not establish policy on phosphorus immediately but discussed several options and left it to the Nutrient Management Advisory Committee to deliberate on use of the Phosphorus Site Index and whether there would be a moratorium on manure application on high P soils with high risk for loss. In the end, Maryland required that soils testing high in phosphorus had to have the phosphorus Site Index conducted on those fields which would likely provide farmers with the opportunity to use more manure in locations that were not determined to be at high risk for phosphorus loss.

However, this more flexible approach was more intrusive and required more government implementation capacity. In contrast, Delaware chose a less intrusive, simpler, single standard that required no extra involvement from a PSI-trained specialist, and is relatively easily to achieve by farmers.

How each state implemented those requirements through the years

The implementation phase of each of the three states' regulations was entirely different. The difference largely reflects the level of contentiousness of the policy-making process but also reflects the pace for regulatory implementation given the deadlines established by the states, and the size of the regulated populations.

Maryland's high intensity pressure "to do something" in response to the *Pfiesteria* focusing events continued on through the implementation stage as the state department of Agriculture and the University Cooperative Extension Service and Nutrient Management Program scrambled to set up a regulatory program, finalize the phosphorus science, figure out which farm individuals would have to satisfy the compliance requirements, and develop the PSI diagnostic tool and plan-writing software.

In Delaware, their five-year compliance schedule and distant first deadline afforded a relaxed implementation phase. Regulation-writing was a collaborative and relatively non-contentious exercise as farmers, environmentalists, and scientists devised the rules and developed programs that would generate early compliance with the regulations before the regulatory schedule began five years after the law passed.

In Virginia, the small regulated community of 900 growers was relatively easy to compel to comply and the VAPF was committed to ensuring their growers would comply on time. Inspections on all regulated farms were achieved in the first year they were required and continued more or less every year thereafter though not all farms were inspected every year as required.

For all three Likert Statements regarding farmer opinions on the implementation phase, the state differences were statistically significantly different with Maryland farmers switching sides between opinions shared with Virginia and then shared with Delaware farmers depending on the statement. Maryland and Virginia farmers agreed that their states were spending more time just getting them to file their plans than on providing educational events about the new nutrient science. Delaware farmers disagreed likely owing to the fact that Delaware farmers have many more hours of certification and continuing education requirements than Maryland and Virginia farmers do.

In statistically significant contrast to Virginia farmers, Maryland and Delaware farmers agreed on two Likerts – that their state was fully committed to implementing the law and that farmers are able to obtain and follow the plan with their own funds and with help from the state. Virginia farmers largely disagreed with these statements indicating that despite near annual inspections, Virginia farmers acknowledged that they could get away with non-compliant behavior if they wanted to and indicated that felt following the plan would lose them money. These themes will be described in Chapters 7 and 8.

CHAPTER 6 – FINDINGS & ANALYSIS: STATE ESTIMATES OF COMPLIANCE

6.1. Introduction

Chapter 6 presents estimates of farmer compliance generated by each of the state agencies responsible for implementing and enforcing state nutrient management laws. For each state, I present and discuss state statistics in two sections: (1) estimates for administrative compliance, i.e., possessing a current nutrient management plan and submitting other required reports and (2) adherence compliance, i.e., implementing the plan. Information about the state cost-share programs and manure transport programs that assist in implementation of the regulatory programs will also be discussed as will the state's quality assurance protocols to review plans prepared by the private-sector. Chapter 6 thus provides one dataset from each state that helps answer both my research questions: is there a difference in farmer compliance between states, and have farmers improved their nutrient management behaviors?

Just as the states differed in approaches to diagnose the problem and deliberate the appropriate policy response, states were also different in their efforts to determine and report administrative compliance statistics. Administrative compliance even meant different things at different times in each state. States provide different information about adherence compliance because they conduct different rates of on-farm inspections, but also because they report different types of data from those inspections. Efforts were also different in each state to evaluate the quality of plans prepared by the private sector.

Compliance data in general – from all the states – was poorly presented and difficult to interpret. I had to do my own calculations to determine simple statistics such as rates of inspection and violation rates. Thus, to distinguish between data reported by the state agencies and data I estimated myself, all the tables in Chapter 6 have data from the states printed in bold while data that I estimated are not bolded.

States provided very little discussion to clarify what their compliance statistics represented, that is, what they were counting and how they were counting it. The states also did not provide much interpretation about what their compliance statistics mean. Furthermore, with the exception of two estimates from Delaware, data is seldom analyzed or put into context to answer basic questions like: "Is the law working?" Thus, I am left with a nebulous impression of compliance estimates from the states.

6.2. Maryland's Estimates of Compliance

Every year, the Maryland Department of Agriculture (MDA) publishes a variety of statistics in numerous documents about the implementation of its Nutrient Management Program. This dissertation reviewed reports to the Nutrient Management Advisory Committee, Annual Reports from the Nutrient Management Program, Annual Reports from the Maryland Department of Agriculture, and Annual Reports from the Maryland Agricultural Cost-Share (MACS) Program. In addition to these publicly available documents, I requested and received additional program implementation statistics from Louise Lawrence, MDA's Nutrient Management Program Coordinator, and Renato Cuizon, MDA's Certification and Licensing Coordinator.

The data presented in each year in the following tables was taken primarily from each of the Nutrient Management Program Annual Reports unless otherwise stated. There are two complicating matters: (1) Maryland publishes its NM Program Annual Reports by its fiscal year but often presents calendar year data in the reports. For example, in its 2006 Annual Report, Maryland will report compliance statistics by saying "By December 31, 2006," indicating the information in its 2006 Annual Report represents calendar year data not fiscal year data; and (2) in 2008, Maryland did not publish a NM Program Annual Report but published a "Status Report" and an "Accomplishments Report," each with different reporting time periods.

Regardless of reporting timeframes, of all the three states, Maryland provides the most comprehensive set of data regarding administrative, inspection, and adherence compliance statistics. A clear picture emerges about the serious and negative ramifications of backlash from the regulated population who did not feel the regulations were justified and did not feel included in the policy-making discussions. In addition, the data demonstrate the different types of administrative compliance problems that can arise when the rollout of the regulatory program is rushed. Finally, policies that try to accommodate farmers may also backfire and be abused by individuals that do not view the regulations as justified and feel little deterrence effect from low non-compliance penalties.

Maryland – State Estimates of Administrative Compliance

When first drafted, the Maryland WQIA required that all farmers mail MDA a copy of their entire initial nutrient management plan in 2001 (see table below). Farmers using only chemical fertilizer had to submit plans that were both nitrogen- and phosphorus-based, while farmers using manure or biosolids only had to submit plans that were nitrogen-based and were given three more years to submit plans that were phosphorus-based. Full implementation of this first set of plans was required the following year, in 2002. Subsequent updates of the nutrient management plan (either every year or every three years, depending on farmer preference) were also required to be submitted to MDA.

Table 6.1. Maryland's 1998 WQIA Deadlines for Types of Plans to Submit				
	By Dec 31, 2001	**By Dec 31, 2002**	**By July 1, 2004**	**By July 1, 2005**
Farmers only using chemical fertilizer had to:	Submit plans managing both N & P	Implement the plans	Submit & implement updated plans managing both N & P	
Farmers using manure or biosolids had to:	Submit plans managing only N	Implement the plans	Submit updated plans managing both N & P	Implement the plans
Source: Simpson, T. "A Citizen's Guide to the Water Quality Improvement Act of 1998." University of Maryland Cooperative Extension Service.				

1. **To cope with implementation problems and low administrative compliance, MDA offers "Justification of Delay" forms**

As of March 30, 2001, with just eight months left to submit the first mandatory nutrient management plans, only 136 farmers in Maryland had actually turned in their plans to MDA (see table below). MDA was aware that 1,360 new plans and 2,360 updated plans had been developed by Maryland's Cooperative Extension Service and by private consultants in fiscal year 2000 (July 1, 1999 to June 30, 2000), but farmers were resisting actually submitting them to the Department.

Table 6.2. Maryland Compliance Statistics, FY2000		
FY 2000 = (July 1, 1999 to June 30, 2000)	**# Plans developed**	**# Acres**
FY2000 New plans	**1,360**	**98,900**
FY2000 Updated plans	**2,360**	**280,528**
Total developed	3,720	379,428
# Plans submitted to Nutrient Management Program as of March 30, 2001	**136**	**21,750**
Note: Data in bold are reported by MDA and data not in bold are estimated by Perez.		
Source: MDA. March 2001. Status Report on Development and Implementation of Nutrient Management Plans.		

A “Viewpoint-Counterpoint” article by Maryland Farm Bureau President Steve Webber in “The Delmarva Farmer” newspaper in October 2001 entitled “Nutrient management headed for ‘train wreck’” highlighted several problems explaining low compliance rates by farmers.

> “As it stands, a large number of farmers who wish to meet the deadlines cannot and the state is ill prepared to administer the program…
>
> First…is the regulatory monster that has been created to turn a voluntary nutrient recommendation system into a mandatory fertilizer limitation regime that has hamstrung the bureaucrats as well as private industry….Planners and farmers who use modern computer technology are being forced to hand-write data on forms and recreate nutrient management programs because computer systems are incompatible. Necessary filing forms have been delayed and are being related in the eleventh hour to a farm community that is in the middle of fall harvest. Soil analysis measurements and nutrient guidelines have been altered to the point that farmers and planners lack confidence in the formulas they are required to use to write plans.
>
> Second, there has been insufficient funding from the state. To get plans, 13,000 farmers must either compete for the services of a handful of state-employed plan writers available for free through the Cooperative Extension Service, or they must hire one of the 105 certified private consultants…Unfortunately, after the first year, cost-share funds were more than halved…Most fertilizer companies have made a business decision to write plans only for their fertilizer customers. This means that livestock producers and other users of organic fertilizer have no choice but to use Cooperative Extension planners.
>
> …Exacerbating the planning shortage is the fact that many farmers still do not know they must comply with this law. An inadequate effort has been made by the state to inform farmers. When the IRS wants your attention they send you a very official correspondence. While the state has made a minimal effort at notification, it has not captured the attention of the average farmer. Nor has it provided clear and complete information on how, when, where, and in what format farmers must apply for a plan. Regionally, state employees and extension agents are providing conflicting information. We understand that legally, ignorance is no excuse for missing the new law, but a farm community who has spent decades working with the state to improve water quality deserves better notification and clear instructions about this new mandate.”

One week after Webber's article appeared, MDA published a response countering Webber's criticism. MDA cited results from a December 2000 farmer survey by the state statistical service showing that in fact, 88% of farmers surveyed knew that the law required them to have a nutrient management plan by December 31, 2001, and 70% rated the Nutrient Management information materials MDA provided them as "good to excellent" (Mister, October 9, 2001).

The article by MDA went on to reiterate that to accommodate farmers who had been unable to obtain the services of a public planner, MDA provided a way for farmers to demonstrate some compliance effort:

> "While many farmers have submitted nutrient management plans, most have not, setting up a last minute rush that cannot be accommodated with existing staff resources. To ease this burden, MDA is providing farmers the opportunity to submit by Dec 31, 2001, a "Justification for Plan Submission Delay" signed by a certified nutrient management consultant before Nov 1, 2001…This will afford them a full year to get a plan written and to at least start implementation before the Dec. 31, 2002 deadline." (Mister, October 9, 2001)

During my interviews, many Maryland farmers told me that they had to file Justification for Delay forms because they couldn't get an appointment with their county Extension Nutrient Management Specialist and did not want to hire a private planner because they couldn't get access to the cost-share funds or because they didn't want to have anything to do with the regulators. Some farmers told me that they heard *other farmers* just filed the JD forms without even intending to obtain the required plan. Hence, the JD form option gave some farmers who never intended to obtain or implement a nutrient management plan the ability to be in administrative compliance with the law.

2. Justification for Delay Forms persist through 2005; an uncertain universe of regulated farmers and acreage fluctuates; peculiar methods employed to estimate compliance

Statistics from Annual Reports from Maryland's Nutrient Management Program and datasets provided upon request reveal that thousands of farmers continued to file Justification for Delay forms through 2005 (see table below). In fact, in 2001, the year of the first deadline, the number of submitted JD forms (2,993) surpassed the number of nutrient management plans (2,152).

In its 2002 NM Program Annual Report, MDA announced that:

> "In June 2002, 5,000 Maryland farmers received letters from MDA reminding them that they missed the December 31, 2001, reporting deadline for filing their nutrient management plan information. These farmers were given a range of options in order to avoid penalties and achieve compliance with the law."

Thus, by December 31, 2002 (see table below), the number of farmers filing plans rose significantly from 2,152 plans covering just 338,392 acres the year earlier to 4,300 plans covering 800,000 acres, while the number of JD forms dropped slightly from 2,993 a year earlier covering 757,535 acres to 2,400 forms covering 520,000 acres.

Table 6.3. Estimates of Administrative Compliance by Maryland Department of Agriculture, 2001 to 2005										
	As of Dec 31, 2001		**As of Dec 31, 2002**		**As of Dec 31, 2003**		**As of Dec 31, 2004**		**As of Dec 31, 2005**	
	# Plans or Forms	**# Acres**	**# Plans or Forms**	**# Acres**	**# Plans or Forms**	**# Acres**	**# Plans or Forms**	**# Acres**	**# Plans or Forms**	**# Acres**
# Nutrient Management Plans Submitted	**2,152**	**338,392**	**4,300**	**800,000**	**5,211**	**1,076,000**	**5,449**	**1,121,605**	NR	NR
# Justification for Delay Forms Submitted	**2,993**	**757,535**	**2,400**	**520,000**	1,500	**259,600**	**1,281**	**208,633**	NR	NR
Total # Plans or Forms and Acres	5,145	1,095,927	6,700	1,320,000	6,711	1,335,600	6,730	1,330,238	**6,491**	**1,225,030**
Percentage of Farmers or Cropland in Compliance	NR	**65%**	NR	**80%**	NR	**85%**	**79%**	**84%**	**79%**	**80%**
Computed or Reported Eligible Farmers and Cropland	NR	1,686,042	NR	1,650,000	NR	1,571,294	**8,561**	**1,573,400**	**8,223**	**1,523,808**
Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.										
2001 Source: MDA. 2001 Annual Report Maryland Nutrient Management Program.										
2002 Source: MDA. 2002 Annual Report Maryland Nutrient Management Program.										
2003 Source: MDA. 2003 Annual Report Maryland Nutrient Management Program.										
2004 Source: MDA. 2004 Annual Report Maryland Nutrient Management Program.										
2005 Source: MDA. 2005 Annual Report Maryland Nutrient Management Program.										

A significant challenge facing MDA was trying to figure out who met the WQIA's eligibility requirement of farmers who needed to submit a nutrient management plan, including a) farmers who grossed $2,500 or more annually or b) raised 8,000 pounds or more of live animal weight. The 1997 Census of Agriculture reported there were 13,254 persons in the State of Maryland that identified themselves as farmers because they owned or operated agricultural land, which represents the likely ceiling of individuals that could be eligible for compliance with the law. In the Viewpoint-Counterpoint 2001 "Delmarva Farmer" articles, Webber stated there were 13,000 farmers being regulated by the law, while MDA stated it mailed information about the law to 16,000 individuals derived from the databases it had compiled of potentially eligible persons.

As shown in the table above, it was only in 2004 and 2005 that MDA started to publish the percentage of farmers it thought were eligible to be regulated. In its 2004 Nutrient Management Program Annual Report entitled "Moving Forward," MDA reported that 5,449 nutrient management plans and 1,281 Justification for Delay forms had been submitted to date, and that 1,281 plans remained. Thus, in 2004, MDA thought the universe of farmers eligible to be regulated was 8,561 and reported that 79% of farmers were in compliance because they had filed a plan or a JD form. In its 2005 NM Program Annual Report entitled "Stepping Up to the Plate," MDA reported that 6,491 plans had been submitted (no longer distinguishing between plans and JD forms) and that 1,732 plans remained. Thus, in 2005, the universe of eligible farms was 8,223 and 79% were in administrative compliance.

Unlike the challenge of estimating the regulated universe of farmers needing to file plans, it appears that MDA found it easier to start estimating the acreage needing to come under plans. The 1997 Census of Agriculture reported there were 1,617,860 acres of cropland in the state, representing the ceiling of agricultural acres subject to the NM plan requirement. As early as its 2001 Annual Report (which did not have a title), MDA started reporting the acres and percentage of farmland in compliance with the WQIA. As of December 31, 2001, the first deadline, nutrient management plans covering 338,392 acres of cropland (20%) had been submitted, JD forms covering 757,535 acres (45%) had been submitted, and MDA reported there were 604,073 acres (35%) remaining. Hence, as of 2001, MDA thought that there were 1.686 million acres of cropland that were eligible for compliance, while the 1997 Census reports there were only 1.612 million acres of cropland in the state.

Thus, from 2001 to 2004 when the law's second deadline took effect, the number of filed plans began to rise from 2,152 plans to 5,449 plans, the number of Justification for Delay forms began to shrink from 2,993 to 1,281 forms. And by 2005, when the second set of plans was due for submission, MDA reported that 6,491 plans had been submitted, covering 1.225 million acres and representing 79% of the 8,223 plans and 80% of the 1.523 million acres the agency thought were eligible for compliance.

3. Regulated population and acreage continues to fluctuate between 2006 and 2009 as MDA switches from requiring submission of NM plans to annual reports

From 2006 to 2009, compliance data presented in MDA's Annual NM Program Reports reveals the continued challenge of identifying and accounting for the universe of farmers eligible for submitting a NM plan and those in compliance. In 2006, MDA estimated that 6,691 farmers were eligible to be regulated covering 1.339 million acres, but the regulatory universe dropped to 5,727 farmers covering 1.318 million acres in 2009. Further confusing matters is that MDA continued to suggest in its 2006 Annual Report that it thought there should be 12,000 famers complying with the law, when it reported in the same report that the total number of eligible farmers was just 6,691:

> "(The Nutrient Management) Program regulates about 12,000 farmers who are required by state law to have nutrient management plans for their farms or be subject to civil penalties that the department collects."

Table 6.4. Estimates of Administrative Compliance by Maryland Department of Agriculture, 2006 to 2009

Categories Reported by MDA	Submitted First Nutrient Management Plan		Submitted Annual Implementation Reports	
2006	**# Operators**	**# Acres**	**# Operators**	**# Acres**
Filed	**6,048**	**1,256,166**	**5,147**	**1,112,525**
Non-Compliant	**653**	**82,897**	NR	NR
Total Eligible	**6,701**	**1,339,063**	**5,969**	**1,228,541**
% In Compliance	**90%**	**94%**	**86%**	**91%**
2007	**# Operators**	**# Acres**	**# Operators**	**# Acres**
Filed	**5,899**	**1,295,338**	**5,707**	**1,252,087**
Non-Compliant	**179**	**22,750**	**373**	**18,486**
Total Eligible	**6,078**	**1,318,088**	**6,080**	**1,270,573**
% In Compliance	**97%**	**98%**	**94%**	**99%**
2008	**# Operators**	**# Acres**	**# Operators**	**# Acres**
Filed	**5,802**	**1,285,446**	**5,585**	**1,263,280**
Non-Compliant	**100**	**12,310**	**114**	**15,123**
Total Eligible	**5,902**	**1,297,756**	**5,699**	**1,278,403**
% In Compliance	**98%**	**99%**	**98%**	**99%**
2009	**# Operators**	**# Acres**	**# Operators**	**# Acres**
Filed	**5,715**	**1,316,409**	**5,457**	**1,295,530**
Non-Compliant	**12**	**2,346**	**57**	**10464**
Total Eligible	**5,727**	**1,318,755**	**5,514**	**1,305,994**
% In Compliance	**99.8%**	**99.8%**	**99%**	**99.2%**

Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.

2006 Source: MDA. 2006 Annual Report Maryland Nutrient Management Program and for AIRs: "Summary Compliance Status Dec 2006," provided by MDA upon request. Note: MDA's Category for AIR's "Total Eligible" reads "Eligible Dec 2005"

2007 Source: MDA. 2007 Annual Progress Report. Implementing Nutrient Management in Maryland. And "Summary Compliance Status Dec 2007." Provided by MDA upon request. Note: MDA's Category for AIR's "Total Eligible" reads "Eligible Dec 2006"

2008 Source: "Summary Compliance Status December 31 2008." Provided by MDA upon request. Note: MDA's Category for AIR's "Total Eligible" reads "Total Filed NM Plan (Eligible for AIR)" Note AIR Compliance is 88% for Operators as of May 31, 2008, as reported in the 2008 Status Report "Development and Implementation of NMPs" June 16, 2008.
2009 Source: MDA. 2009. Nutrient Management Annual Report.

It is interesting to note that rather than knowing the number of farmers that meet the eligibility criteria, MDA actually calculates “Total Eligible” by summing the number of plans “Filed” with the number of remaining farmers they are aware of who have not yet filed a plan. This approach cannot account for the number of farmers that MDA is not aware of who have not yet filed a plan.

In response to the feedback received at the 2003 Nutrient Management Summit held during the Ehrlich Administration, MDA adopted revised regulations in 2005 that made it no longer necessary for farmers to submit the entire plan and updates to the plan to the Department once the initial plan was submitted, but only required submission of an Annual Implementation Report (AIR). The AIR is a one-page document summarizing the amount and type of nutrient sources applied over the course of the year including the number of acres of each crop planted, and it gives only an overall, annual picture of what was grown in each farm and what amounts of nutrients were used to do so.

Equally interesting is the fact that the number of farm operators who filed or are eligible to file the newly required Annual Implementation Reports (AIRs) differs every year from the number who filed or are eligible to file nutrient management plans. Every year between 2006 and 2009, the number of AIR forms and corresponding acres filed is smaller than the number of NM plans and corresponding acres. Note that MDA in 2006, reports that 90% of NM plans covering 94% of the eligible acres had been filed and were in compliance, and only 86% of the AIRs covering 91% of the eligible acres had been filed and were in compliance.

By 2009, even though the universe of farmers filing plans and AIRs should be the same, MDA was reporting that 99.8% of the 5,727 farmers in Maryland that should submit their initial NM plan had done so, while 99% of the 5,514 farmers in Maryland that should submit their Annual Implementation Report had done so.

4. Selective reporting of AIRS non-compliance rates obfuscates continued compliance resistance

In addition to the other confusing methods to estimate compliance and the complications about the regulatory universe of farmers and acreage, MDA also selectively presents non-compliance data. Regarding compliance statistics for nutrient management plans, MDA in its 2008 Status Report published a table (see below) reporting there were only 100 farm operators that were non-compliant because they had not submitted the required nutrient management plan.

In the text of the same report, MDA reveals there were actually 371 such non-compliant farm operations at the beginning of fiscal year 2008, but due to MDA's enforcement efforts (mailing first notices, warning letters, or charge letters), that number fell to 100 by the end of the fiscal year. The excerpted text below details the enforcement efforts MDA has been engaging in since 2005 regarding nutrient management plans and its enforcement action in FY2008:

> "Since July 2005, first notices were sent to 1,732 operators informing them of administrative penalties, warning letters went to 239, and 48 charge letters were issued. Fourteen fines have been levied as a result of the enforcement process.

In FY2008, MDA started enforcement actions against 371 operators that had not filed a nutrient management plan or had not been responsive to MDA outreach."

Table 6.5. Maryland Department of Agriculture's Compliance Statistics from 2008

Categories of Operators Status	# Of Operations	Acres
First Plan Filing		
Total Operators Filed NM Plans	**5,802**	**1,285,446**
Total Non-Response Operations	**100**	**12,310**
Total Eligible Operations	**5,902**	**1,297,756**
Percentage Filed NM Plans	**98%**	**99%**
Annual Implementation Reporting		
Operators Filed Annual Implementation Reports	**5,585**	**1,263,280**
Out of Compliance for AIR	**114**	**15,123**
Total Filed NM Plan (Eligible for AIR)	**5,699**	**1,278,403**
Percentage Filed AIR's	**98%**	**99%**

Source: This table was taken directly from the online version of Maryland Department of Agriculture's "2008 Status Report, Development and Implementation of Nutrient Management Plans."(Colors from that report)

Regarding compliance statistics for the Annual Implementation Reports (AIRs, MDA also selectively presents favorable non-compliance rates like it does for non-compliance statistics with nutrient management plans. In their July 16, 2008, Nutrient Management Status Report, MDA reported that 98% of the eligible AIRs had been filed with just 114 farmers failing to file the AIR (see table above). However, the 2008 Accomplishments Report reveals that actually 1,700 farmers had failed to file the AIRs before the agency started enforcement activities:

> "Farmers are required to keep their nutrient management plans current and submit an Annual Implementation Report (AIR) to MDA by March 1 of each year describing how they implemented their plans. In 2008, MDA issued **1,700** warning letters to farmers who failed to file their AIRs, followed by 680

> notifications of pending fines. Fines have been levied against **114** farmers who remain out of compliance. As of December 2008, AIRs have been submitted for 99% of Maryland's farmland or 1.2 million acres."

Thus, because of the various enforcement actions, the number of operations out of compliance with the annual filing of the Annual Implementation Report dropped from 1,700 farmers to 114.

The same selective representation of non-compliance occurred in 2009 (see table below). Hence, because MDA only counted the number of operations that remained non-compliant after all the enforcement actions taken at the beginning of the enforcement period, MDA reports 98% and 99% compliance rates for AIRs in 2008 and 2009. Instead, as is presented in the table below, if MDA were to calculate compliance rates at the beginning of the enforcement period, there would only be 70% compliance in both years for AIR submission.

Table 6.6. Compliance Rates for Submission of Annual Implementation Reports (AIRs)		
	CY 2008	**CY 2009**
# Warning letters for failure to file AIR by March 1 deadline	**1,700**	**1,646**
# Notified of pending fine	**680**	**553**
Remain out of compliance & reported in Annual Statistic	**114**	**57**
COMPLIANCE RATE, BEFORE ENFORCEMENT ACTIVITIES:		
# Warning letters for failure to file AIR by March 1 deadline	**1,700**	**1,646**
Total Eligible Operations	**5,699**	**5,514**
Estimated % Non-Compliance	30%	30%
Estimated % In Compliance	70%	70%
COMPLIANCE RATE, AFTER ENFORCEMENT ACTIVITIES:		
Remain out of compliance & reported in Annual Statistic	**114**	**57**
Total Eligible Operations	**5,699**	**5,514**
Estimated % Non-Compliance	2%	1%
MDA Reported % In Compliance	**98%**	**99%**
Note: Data in bold reported by MDA and data not in bold estimated by Perez.		
MDA. 2009. Nutrient Management Program Annual Report 2009.		

MDA. 2008. Nutrient Management in Maryland 2008 Accomplishments Report.

5. Cost-share affects few farmers and acreage in Maryland and most plans are prepared by public planners

To help implement the WQIA, Maryland provided cost-share funds to farmers to help them hire private, certified consultants to prepare the required plans, but the state was slow to start the program and very few funds were actually provided over the years.

Maryland Farm Bureau President, Steve Webber, pointed out in his October 2, 2001, article, "When the law was written, legislators acknowledged the significant cost involved and authorized funding for a cost-share program." However, only in FY2000 did the Maryland General Assembly provide for changes to the WQIA that included authorizing MDA to establish a plan-preparation cost-share program (MDA, 2000).

The amount of the cost-share funding provided by the program ranged from a high of $735,000 in FY2003 to a low of $85,717 in FY2009 (see table below). Thus, only between 500 and 75 farmers covering 206,000 acres and 40,887 acres, respectively, actually benefitted from the program between 2001 and 2008. Thus, on average, each farmer participating in the program received between $1,470 per plan, or $3.57 per acre, in FY2003 and $1,143 per plan, or $2.10 per acre, in FY2009.

Table 6.7. Maryland's Nutrient Management Cost-Share Program, FY 2001 to 2009

	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009
Cost-Share	**$711,000**	**$459,951**	**$735,000**	**$271,549**	**$296,486**	**$352,963**	**$405,066**	**$227,409**	**$85,717**
# Plans Receiving Cost-Share	**375**	**337**	**500**	**196**	**256**	**314**	**343**	**185**	**75**
# Acres Covered by Cost-shared plans	**178,000**	**110,979**	**206,000**	**91,000**	**124,773**	**140,753**	**183,662**	**120,500**	**40,887**
ESTIMATING AVERAGE COST-SHARE RATES:									
$ Cost-Share/Plan	$1,,896	$1,365	$1,470	$1,385	$1,158	$1,124	$1,181	$1,229	$1,143
$ Cost-Share/Acre	$3.99	$4.14	$3.57	$2.98	$2.38	$2.51	$2.21	$1.89	$2.10
ESTIMATING PORTION OF NM PLANS RECEIVING COST-SHARE:									
# NM Plans filed or accounted for	**2,152**	4,250	5,250	**5,260**	**4,913**	**6,048**	**5,899**	**5,802**	**5,715**
% Plans Cost-Shared	17%	8%	10%	4%	5%	5%	6%	3%	1%
ESTIMATING PORTION OF ACREAGE UNDER NM PLANS RECEIVING COST-SHARE:									
# Acres under a NMP	**338,392**	**800,000**	**1,076,000**	**1,121,605**	**1,225,030**	**1,256,166**	**1,295,338**	**1,285,446**	**1,316,409**
% Acres Cost-Shared	53%	14%	19%	8%	10%	11%	14%	9%	3%
PORTION OF PLANS PREPARED BY PRIVATE PLANS:									
% Plans by Private Planners	**26%**	NR	NR	NR	**36%**	NR	NR	**19%**	NR

Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.

2001 Source: MDA. 2001 Annual Report Maryland Nutrient Management Program.
2002 Source: MDA. 2002. Maryland Agricultural Cost-Share (MACS) Program Annual Report.
2003 Source: MDA. 2003. Nutrient Management Program 2003 Annual Report.
2004 Source: MDA. 2004. Maryland Agricultural Cost-Share (MACS) Program Annual Report and 2004 Nutrient Management Program Annual Report.
2005 Source: MDA. 2005 Annual Report Maryland Nutrient Management Program and "Summary Compliance Status Dec 2005," provided by MDA upon request.
2006 Source: MDA. 2006 Annual Report Maryland Nutrient Management Program.
2007 Source: MDA. 2007 Annual Progress Report. Implementing Nutrient Management in Maryland.
2008 Source. MDA. Nutrient Management in Maryland 2008 Accomplishments Report.
2009 Source: MDA. 2009 Maryland Agricultural Cost-Share (MACS) Program Annual Report.

In an attempt to put this cost-share availability in perspective, in FY2001, when the first deadline occurred, 375 farmers received cost-share out of the 2,152 who actually filed plans, so only 17% of the regulated population had access to funding. Surprisingly, the 178,000 acres covered by these plans prepared by private consultants amounted to 53% of the 338,392 acres complying with the WQIA in 2001, reflecting the tendency for private consultants to accept clients with large operations.

By 2009, however, the 75 farmers that were able to receive cost-share represented only 1% of the 5,715 farmers who filed plans that year and their 40,887 acres made up only 3% of the 1.3 million acres covered by plans that year.

In terms of estimating the proportion of farmers relying on public-sector versus private-sector (crop consultants, fertilizer dealers, farmers themselves, neighbors) planners, regardless of cost-share funds, MDA only presented two estimates in three years. Within calendar years 2001, 2005, and 2007, MDA reported that 26%, 36%, and 19% of the submitted nutrient management plans had been prepared by private consultants (see table above).

To understand this further, MDA’s 2008 Accomplishments Report said that in 2007, 19% (1,022) of the plans were prepared by certified private consultants and about 81% (4,600) of the plans were written by Maryland Cooperative Extension specialists. Despite the majority of plans being prepared by government planners, additional data indicates that the number of acres in a plan prepared by government planners is very small while the number of acres in a plan prepared by private planners is very large. MDA’s Cuizon supplied me with 2007 data that showed 51% of the acreage covered by plans was in plans that were prepared by government specialists (Extension, NRCS, MDE, and other government specialists) while 48% of the acreage was found in plans prepared by private consultants (farming, fertilizer industry, independent consultants, etc.). Thus, despite the fact that only 19% of all plans are prepared by the private sector in Maryland, those plans cover nearly half of all cropland acres. Hence, "large" farmers – that is, farmers with many acres – are mainly relying on the private sector to write their plans. The 2007 data also provided the number of farmers who are certified to write their own plans (83 farmers, or about 1%).

Wrap-up of Maryland's Estimates of Administrative Compliance

Administrative compliance statistics published by the Maryland Department of Agriculture reveals the many hurdles Maryland experienced to implementing their nutrient management law. Initially, Maryland had poor compliance rates due to a myriad of implementation problems, including the state's inability to know who and how many farmers would be eligible for compliance with the law.

When Maryland switched rules mid-stream from requiring the initial NM plan to be submitted to requiring only an annual AIR, compliance became even more confusing. Over time, however, MDA reported that administrative compliance rates for both plans and AIRs improved to perfect rates in recent years. Finally, the compliance statistics from MDA's annual reports reveal that statistics in the same reports provide conflicting and confusing data about compliance depending on whether compliance is counted before or after the state's enforcement activities.

Maryland – State Estimates of Adherence Compliance

To find out if farmers were following their plans, MDA began conducting on-farm visits called "Plan Implementation Reviews" in 2005. Thus, MDA began the enforcement stage of its agricultural regulations seven years after the 1998 WQIA was enacted and six years after the initial plan submission deadline in 2001.

Maryland's on-farm Reviews investigate three categories of adherence compliance: Plan Status and Reporting, Record Keeping, and Plan Implementation (see text box below).

Figure 6.1. Maryland's Water Quality Improvement Act Compliance Requirements

Compliance Requirements:
Compliance requirements are grouped in three major categories as follows:

Plan Status and Reporting

- ✓ Having a **current/updated** Nutrient Management Plan for the entire operation
- ✓ Documenting **revisions** or **adjustments** to the Plan during implementation
- ✓ Holding valid **Nutrient Applicator Voucher** or **Nutrient Management Certification**
- ✓ Timely filing of **Annual Implementation Report**

Record Keeping

- ✓ Having **current soil** and **organic nutrient test results**
- ✓ Having **crop yield information** for the last 5 years
- ✓ Having **fertilizer/organic receipts**
- ✓ Having **Manure Management** Information
- ✓ Having **nutrient application records**

Plan Implementation

- ✓ Apply nutrients within acceptable range
- ✓ Acceptable application timing
- ✓ Using proper yield goals

Documentation of Deficiencies and Enforcement Actions:
Operator's failure, deficiencies, or infractions will be documented along with corrective action the operator needs to take to rectify the situation within an acceptable time frame.
The Specialist shall issue a 1st Notice of Agency Action warning when a major deficiency or violation is identified during an inspection. The operator will be warned for any of the following **major violations**:

- ✓ Nutrient Management Plan is not current/updated
- ✓ Nutrient application rates are not within acceptable range
- ✓ Application timing not acceptable
- ✓ Yield goals are improper

Source: Text box was cut and paste from an online version of Maryland Department of Agriculture's "2008 Status Report, Development and Implementation of Nutrient Management Plans."

1. On-farm inspections to estimate plan adherence begin in 2005 revealing mostly low inspection rates and opaque compliance rates

Originally, MDA intended to begin conducting on-farm inspections in 2002, the year after all farms were supposed to have filed their initial nutrient management plans and were implementing their plans. However, given the challenge of even getting farmers to file the plans, MDA put off on-farm inspections. And because of the outcomes of the 2003 Agricultural Nutrient Management Summit, MDA put off inspections until 2005. Recall that among the many changes that were made at the Summit, two focused on improving, from the farmer's perspective, the regulatory style of the agency. First, MDA was required to set up the farm visit with 48-hours of advance notice and the time and location for the meeting had to be mutually convenient. Second, MDA would focus its enforcement efforts on actually "bringing farmers into compliance" and levying penalties only if a farmer displayed no effort to cooperate.

Once MDA started its On-Farm Plan Implementation Reviews in 2005, the agency provided only minimal information about its enforcement activities. MDA reported that between 2005 and 2007, the agency visited between 500 and 1,100 farms and that a larger majority of those farms "were brought into compliance" (see table below). Thus, MDA did not report their inspection rates or what the non-compliance rates were before the Department helped the farms become compliant.

In an attempt to put the available statistics into perspective, I used MDA's "Total Eligible" operations data from each year, to estimate that the agency inspected 7%, 16% and 8%, respectively, in 2005 through 2007 of the farms with nutrient management plans. Given the available data about the number of farms that were "brought into compliance" in 2005 and 2006 versus the number that were inspected, it appears that 94% and 92%, respectively, cooperated with MDA in good faith. MDA did not explain what happened to the 39 and 88 farmers in 2005 and 2006 that were not "brought into compliance."

Table 6.8. Maryland's On-Farm Implementation Reviews and Inspections, 2005 to 2007			
	2005	**2006**	**2007**
ESTIMATING INSPECTION RATE:			
# Reviews Conducted	**607**	**1,100**	**500**
# Eligible	**8,223**	**6,701**	**6,078**
Estimated Inspection Rate (Reviews/Eligible)	7%	16%	8%
COMPLIANCE RATE, AFTER ENFORCEMENT ACTIVITIES:			
# Brought into compliance	**568**	1,012	NR
# Remain Out of Compliance	39	88	NR
Reported Compliance Rate % (Brought into Compliance/Reviews)	94%	**92%**	
Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.			
2005 Source: MDA. 2005 Annual Report Maryland Nutrient Management Program.			
2006 Source: MDA. 2006 Annual Report Maryland Nutrient Management Program			
2007 Source: MDA. 2007 Annual Progress Report. Implementing Nutrient Management in Maryland.			

2. **MDA reports details about the On-Farm Reviews for the first time in 2008 revealing 6 out of 10 farmers are adhering to the plan and the largest compliance problem is expired plans**

Three years into the on-farm inspections, MDA published, for the first time, data on the findings from those inspections in their 2008 Accomplishments Report:

> "In 2008, MDA conducted 450 on-farm plan implementation reviews and inspections to verify that nutrient management plans are current and being implemented properly. These inspections target farmers who submitted their AIRs late or have not yet submitted their AIRs, operations with a history of compliance problems and certain high risk animal operations and farms that use manure, imported organic wastes or sludge.
>
> Of the 450 farms inspected, 65% were in compliance. Approximately 25% were found to be out of compliance due to expired plans and 10% failed their inspections due to over application of nutrients and/or inadequate records. MDA has initiated actions to bring these farmers into compliance with program requirements."

Thus, MDA found moderately good news: that majority of farms, albeit a small majority (65%) of farms, were adhering to their nutrient management plan.

However, the Department reports that their on-farm reviews target farmers who a) submitted late AIRs or have not yet submitted AIRs, b) have a history of compliance problems, and c) have high risk animal operations and farms that use manure. Thus, a 65% compliance rate could be interpreted as quite impressive for this otherwise "non-compliant" or "high risk" sample.

It is interesting that there are only two non-compliance categories: (1) expired plans and (2) over-application of nutrients and/or inadequate records. As will be discussed later in the Virginia section of this Chapter, many more categories of compliance causing clear environmental problems could be discovered and categorized on visited farms, but MDA does not report them.

MDA also does not explain the ramifications of the two categories of non-compliance. For example, what does the category "over-application of nutrients and/or inadequate records" mean? This joint category of non-compliance likely highlights the challenge facing inspectors of actually proving that over-application of nutrients is occurring and thus, they use a proxy of inadequate records which suggests there may be over-application going on.

MDA's Accomplishments Report also does not discuss the ramifications of 25% of the 450 inspected farmers (90 farmers) having expired plans. For example, the report does not discuss how a farmer with an expired plan decides how much of what types of nutrients he will apply given. Thus:

- Did these farmers "re-use" their expired plans?
- If so, were those expired plans nitrogen-based and the farmer had not upgraded them as required to a phosphorus-based plan in 2005?
- If they were nitrogen-based plans, how much excess phosphorus was likely being applied by manure-users because of the failure to upgrade to a P-based plan?
- In general, what were environmental ramifications of 112 farmers having "expired plans"?

Table 6.9. On-Farm Plan Implementation Reviews & Compliance Results					
	2008			**2009**	
ESTIMATING INSPECTION RATES					
	# Reviews	**# Acres**		**# Reviews**	**# Acres**
# Reviews	**450**	NR	**# Reviews**	**400**	**101,500**
# Eligible	**5,820**	NR	**# Eligible**	**5,727**	**1,318,755**
% Inspected	8%		**% Inspected**	7%	8%
REPORTED COMPLIANCE RATES					
Compliance Categories in 2008	**Reported %**	**Computed #**	**Compliance Categories in 2009**	**Reported %**	**Computed #**
In Compliance	**65%**	292.5	**In Compliance**	**69%**	276
Non-Compliant: Expired Plans	**25%**	112.5	**Non-Compliant: Expired Plans**	**25%**	100
Non-Compliant: Over-Application of Nutrients and/or Inadequate Records	**10%**	45	**Non-Compliant: Inadequate Records or Failure to Allow MDA Staff to Conduct Inspections**	**6%**	24
Total Noncompliance	35%	158	**Total Noncompliance**	31%	124
Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.					
2008 Source. MDA. Nutrient Management in Maryland 2008 Accomplishments Report.					
2009 Source: MDA. 2009 Nutrient Management Program Annual Report.					

The table above presents adherence compliance information reported by MDA for 2008 and 2009 and my estimates of the numbers of farms corresponding to the reported compliance percentages. The inspection rate in 2009 was similar to that in 2008 – 7 to 8% and the compliance rates were also very similar though slightly better in 2009, with 69% of the inspected farms being categorized as "in compliance."

A new non-compliance category appeared in 2009 – "Inadequate records or failure to allow MDA staff to conduct inspections." Thus without the ability to tease out the number of farmers that had "inadequate records" or the number of farmers that "failed to allow MDA staff to conduct inspections" it's possible that up to 6%, i.e., up to 24 of the 400 farms reviewed in 2009 (11 years after the 1998 WQIA was enacted) refused entry of government inspectors to verify implementation of the law.

3. Penalties for all three categories of non-compliance are reported in 2009 and average penalty size is small

The 1998 WQIA established that if a farmer does not implement the required plans by the required dates, fines up to $100 per violation not to exceed $2,000 per year may be assessed. However, if a farmer takes action to implement the plan and correct the violations, then fines need not accrue.

Penalties for non-compliance were reported in 2009 only for 2009 data, despite the serious and many types of non-compliance problems that were a) inferred in MDA's Annual Reports since 2001 regarding failure to submit the required plans, b) officially reported from 2006 onwards regarding failure to submit the initial nutrient management plan and the annual implementation reports, and then c) discovered during the on-farm review reports in 2008 and 2009 (see table below). Furthermore, the amount of fines assessed and the likely average fine per farm was very small.

Table 6.10. Maryland Penalties for Three Categories of Non-Compliance in CY2009			
	Failure to Submit 1st Nutrient Management Plan (NMP)	**Failure to Submit Annual Implementation Reports (AIRs)**	**Failed On-Farm Reviews**
Fines Reported ($)	**$3,150**	**$31,250**	**$3,500**
# Operations Not In Compliance	**12**	**57**	124
Average fine if penalties were levied against those not in compliance	$262.50	$548.25	$28.23
Note: Bold data are reported by MDA and data not in bold are estimated by Perez.			
MDA. 2009. Nutrient Management Program Annual Report 2009.			

In Maryland's 2009 NM Program Annual Report, MDA reports that the 12 operators that failed to submit even their first nutrient management plan to the Department were fined $3,150. Thus, I estimate the average fine was just $262.50 per operation. The 57 operations that failed to submit their AIR that year were fined $31,250, or an average of $548.25. As for fines associated with the on-farm reviews, MDA reports only that $3,500 in penalties were assessed but does not indicate how many farms these penalties apply to. If we are to assume that all the farms categorized in 2009 as "non-compliant," were assessed these fines, that would be 124 farms and the average fine was only $28.23. As will be discussed in Chapter 8, a regulation with nearly non-existent penalties for non-compliance likely creates little deterrence effect, which may be one of the components of a successful regulatory regime.

4. **From the beginning, MDA established quality control protocols to audit private-sector prepared plans but compliance rates were reported for only a few years**

In terms of determining whether the nutrient management plans prepared by certified private consultants meet the standards of the WQIA, MDA has been systematically conducting quality control reviews on these plans. In its 2001 Status Report, MDA reported that it conducted 70 reviews of nutrient management plans prepared by certified private sector planners and that another 100 plans were reviewed because the operator had applied to the Maryland Agricultural Cost-Share (MACS) Program, which requires a nutrient management plan be prepared before a cost-share contract for other BMPs is awarded. MDA did not report the number of private-sector plans reviewed every year for quality assurances but did provide the data for five years (see table below), revealing that between 100 and 600 plans had been reviewed each year.

Table 6.11. Plan Quality Assessment - MDA Reviews of Private-Sector Prepared Nutrient Management Plans

	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**FY 2008**	**CY 2009**
# private plans reviewed	**70**	NR	**20**	NR	NR	NR	**80**	**200**	**320**
# plans reviewed that were required for MACS cost-share projects	**100**	NR	**600**	NR	NR	NR	**500**	**232**	**266**
Total plans reviewed for quality control	170	NR	620	NR	NR	NR	580	432	586
Pass rate of Plan Quality Reviews	NR	NR	NR	NR	NR	NR	**87%**	**89%**	**91%**
# all plans filed or accounted for	2,250	4,250	5,250	**5,260**	**4,913**	**6,044**	**5,899**	**5,802**	**5,715**
% of plans that were reviewed because they were private-plans or they were plans associated with MACS applications	8%		12%				10%	7%	10%

Note: Bold data are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.

2001 Source: MDA. March 2001. Status Report on Development and Implementation of Nutrient Management Plans.

2002 Source: MDA. 2002. MACS Annual Report.

2003 Source: MDA. 2003. Nutrient Management Program 2003 Annual Report.

2004 Source: MDA. 2004. MACS Annual Report.

2005 Source: "Summary Compliance Status Dec 2005." Provided by MDA upon request.

2006 Source: "Summary Compliance Status Dec 2006." Provided by MDA upon request. Note: MDA's Category for AIR's "Total Eligible" reads "Eligible Dec 2005"

2007 Source: MDA. 2007 Annual Progress Report; Implementing Nutrient Management in Maryland. Pass rate for 2007 was reported in the "2008 Accomplishments Report"

2008 Source: MDA. Nutrient Management in Maryland; 2008 Accomplishments Report.

2009 Source: MDA. 2009. Nutrient Management Annual Report.

It is difficult to interpret the percentage of quality control reviews of private-sector plans because a) it is not clear whether the plans for MACS applicants were actually private-sector plans or also included public plans and b) MDA has only reported the number of plans prepared by the private sector in 2001, 2005, and 2007: 26%, 36%, and 19%.

With these limitations in mind, I was only able to estimate the percentage of all nutrient management plans that had received a quality assurance review. For the five years of available, it appears that MDA reviewed between 7 and 12% of the nutrient management plans submitted or otherwise accounted for by MDA (see table above).

MDA also only reported the "pass rate" of these quality control reviews between 2007 and 2009 in their annual reports. The pass rates appear quite high, ranging from 87 to 91%. My interview with MDA's Cuizon about the pass rate during the early years led him to conclude that since 2003 approximately 70% of the randomly inspected plans were in compliance with the record-keeping, nutrient recommendations, and other requirements for plans.

Thus the 2009 91% pass rate indicates that private-sector plans and plans prepared for MACS applications have improved over time to conform to the law's requirements. These figures, however, reveal an additional concern about a plan-based approach to nutrient management regulations: the quality of the prepared plan may not meet the expectations of the law.

5. The Manure Transport Program with the help of poultry companies transports a substantial amount of excess manure every year but lacks program evaluation

In recognition of the excess manure problem in Maryland's Eastern Shore counties, the WQIA established a Poultry Litter Transport Program to share in the cost of relocating excess manure from poultry grower farms that may not grow crops, have too much manure for the cropland they farm, or after switching to the phosphorus-based plans find that they now have excess manure. The WQIA also required the poultry integrator companies to match the state funding every year, reflecting the recognition that the excess manure problem was the result of the concentration and magnitude of poultry production on the land-limited Delmarva Peninsula.

MDA publishes information about its manure transport program in its nutrient management program annual reports and the MACS Program annual reports. MDA does not discuss in any of these documents how many tons of excess manure is actually generated in the state every year and thus does not evaluate or discuss what percentage of the excess manure problem the manure transport program or nutrient management regulations is helping to solve.

Over the years, Maryland and the poultry companies have provided increasing amounts of funds to the state manure transport program ranging from a low of $222,000 in FY2000 to a high of $1.17 million in FY2009. This suggests an increasing commitment over time to addressing the problem of excess manure. On average, about 65,000 tons has been transported per year at an average annual cost of $596,000; just under half of this annual cost was provided by the poultry companies. Thus, the program paid on average $12.45 per ton or about $6,331 per project (see table below).

Table 6.12. Maryland's Manure Transport Program, FY 2000 to 2009

	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	Average:
Cost-Share from State	NR	NR	**$435,610**	**$233,444**	**$295,356**	**$239,196**	**$380,694**	**$490,000**	**$520,357**	**$663,177**	$407,229
Cost-Share from Poultry Integrators	NR	NR	$419,390	$229,645	$285,844	$200,113	$293,728	$357,000	$370,983	**$504,024**	$332,591
Total Cost-Share	**$222,000**	**$392,000**	**$855,000**	**$463,089**	**$581,200**	**$439,309**	**$674,422**	**$847,000**	**$891,340**	**$1,167,201**	$596,151
Tons transported	**13,400**	**20,000**	**47,500**	**28,556**	**115,000**	**36,329**	**69,000**	**99,300**	**99,817**	**119,892**	64,879
Projects	NR	NR	**115**	NR	**83**	NR	NR	NR	**132**	**154**	121
Average Cost-Share per ton	$16.57	$19.60	$18.00	$16.22	$5.05	$12.09	$9.77	$8.53	$8.93	$9.74	$12.45
Average Cost-Share per project			$7,435		$3,559				$6,753	$7,579	$6,331

Note: Data in bold are reported by MDA and data not in bold are estimated by Perez. "NR" represents data that was not reported by MDA.

2000 Source: MDA. 2000 Annual Report Maryland Nutrient Management Program.

2001 Source: MDA. 2001 Annual Report Maryland Nutrient Management Program.

2002 Source: MDA. 2002. Maryland Agricultural Cost-Share (MACS) Program Annual Report.

2003 Source: MDA. 2003 Annual Report Maryland Nutrient Management Program.

2004 Source: MDA. 2004. Maryland Agricultural Cost-Share (MACS) Program Annual Report and 2004 Nutrient Management Program Annual Report.

2005 Source: MDA. 2005 Annual Report Maryland Nutrient Management Program. Note that of the tons reported above, 12,175 were livestock manure (dairy, beef, and swine) not poultry litter. Cost-share from poultry companies covers poultry litter only.

2006 Source: MDA. 2006 Annual Report Maryland Nutrient Management Program.

2007 Source: MDA. 2007 Annual Progress Report. Implementing Nutrient Management in Maryland.

2008 Source. MDA. Nutrient Management in Maryland 2008 Accomplishments Report.

2009 Source: MDA. 2009 Maryland Agricultural Cost-Share (MACS) Program Annual Report.

Wrap-up of Maryland's Estimates of Adherence Compliance

The adherence compliance statistics published by MDA highlight the agency's late start on the on-farm plan implementation reviews, its limited inspection rates, high non-compliance rates, and tiny penalties levied for non-compliance. Between 2006 and 2007, MDA only inspected between 7 and 16% of all farms with a plan and was able to bring 92 and 94% of the farms with problems into compliance. MDA did not report what happened to the farms that refused to cooperate.

In 2008 and 2009, MDA inspected 8 and 7% of farms with plans and found only 65 and 69% of those farms in compliance. This compliance rate could be regarded as high though given MDA's sampling is not random but represents non-compliers and high-risk livestock farms. MDA does not explain the environmental ramifications of 35% and 31% of the inspected farms being non-compliant farms.

Only in 2009 – 11 years after the 1998 WQIA – does MDA report that it levied fines to 12 farms for failing to submit their initial plans and 57 farms for failing to submit the AIRs forms. Fines average out to only $262 and $548 per farmer. MDA does not specify how many of the 124 farms that failed their on-farm reviews received a portion of the $3,500 in fines it levied for failing on-farm reviews.

MDA's published data on its quality assurance/quality control procedures shows that between 7 and 12% of all submitted farms may have been reviewed over five years of available data. Pass rates are quite high (70%, 87%, and 91%) but hint that the plan – the regulatory mechanism employed by Maryland – may not meet the law's standards.

Finally, Maryland's Manure Transport Program, thanks to 50% of the funds coming from the poultry industry, is transporting a substantial amount of excess manure to locations where it can be safely applied. However, over the years, on average, the program can only provide funding for 69% of the total tons requested for transport.

6.3. Delaware's Estimates of Compliance

Every year, the Delaware Nutrient Management Commission publishes an Annual Report to the Governor and to the General Assembly about the implementation of the 1999 Nutrient Management Law. In addition to these publicly available documents, I requested and received additional program implementation statistics from Bill Rohrer, Jr., the Program Administrator.

On the issue of reporting timeframe, I reported the compliance numbers presented in each of the DNMC's Annual Reports that are published every April 1. Though the DNMC intends to report data reflecting its July 1 to June 31 fiscal year, the Annual Reports counted compliance data from the next year. For example, in its 2006 Annual Report published in April 2007, Delaware included the January 2007 data for number of acres cost-shared or prepared by public planners because a) it had the data and b) it had the time to include it. In contrast, because the deadline for the Annual Reports was March 1 every year, the DNMC did not include the March 2007 data in its 2006 Annual Report because it was busy writing the report for publication April 1.

Regardless of the confusing data time periods, the administrative and adherence compliance data published by Delaware highlights several positive and some negative outcomes. Because the Commission began encouraging farmers to obtain plans before the official start of the five-year implementation schedule in 2003, the DNMC Annual Reports stated early success with the law as compliance rates were ahead of schedule.

This positive outcome points to the benefits of gaining buy-in from the regulated community through the development and implementation of regulations by a Commission led by farmers and “blessed” by the agricultural community. The Commission made several key policy decisions that likely contributed to the early success of the law, which included: a slow start date for the implementation phase, a staggered implementation schedule, and financial incentives for “early cooperators” – all of which reflects a strong understanding by the policymakers of farm culture and the private sector’s ability to adjust to regulations. Delaware is also the only state that has attempted to evaluate the outcomes of its nutrient management law and two studies suggest that the law has had a significantly positive effect on addressing the nutrient imbalance and the excess manure problem in Delaware.

However, a closer look at the compliance statistics in these Annual Reports indicates that the DNMC is unable to fully account for the number of persons that may be in compliance with state nutrient management law. The administrative, inspection, and adherence compliance statistics published in DNMC annual reports is limited and in many cases lacking. An attempt was made to interpret the available data and several email and phone conversations with the DNMC Administrator helped clarify a few topics.

I conclude that because the DNMC only tracks acres that receive cost-share funding for plans developed by private consultants and acres for plans developed by public planners, Delaware is unable to know whether farmers who neither receive cost-share funding nor use a public planner are in compliance with the law. Hence, on average, over the last six years of data, Delaware can conclude that 80% of total eligible acres in the state are in compliance.

Delaware – State Estimates of Administrative Compliance

Just as Maryland had to determine what number of farmers from the 13,000 reported in the USDA Census would meet the eligibility requirements for its law, Delaware also had to identify the universe of farmers that met its eligibility requirements. In every Annual Report, the DNMC described its method for determining the regulated population in the state this way:

> "Any business operation that applies nutrients to greater than ten acres or manages 8,000 pounds of animals will be affected by mandatory nutrient management. These people will be randomly selected in 20% increments, which started in 2003 and will be completed in 2007."

To put together the initial database of potentially eligible farmers, Bill Rohrer, Administrator for the DNMC explained to me in an interview that the Commission consulted with Delaware's Agricultural Statistics Service personnel and County Administrators to see if they could use their available datasets. Rohrer concluded that the "right data didn't seem available" and "it was too complicated" to try to determine how to gather the data. Thus, the DNMC decided that it would be more cost-effective to hire a known private consulting firm that already had an existing database of agricultural, residential, and commercial property owners that it developed from the state tax assessment database to cull all the persons owning agricultural land (Rohrer, personal communication, January 29, 2010).

The consulting firm established a database of 6,775 persons owning agricultural property in the state of Delaware as the potential regulatory universe. This was more than double the 2,671 farms listed in the 1997 USDA Census of Agriculture. Every year, starting in 2003, 20% of those 6,775 individuals were notified of the need to comply with the law and the state required them to return a postcard indicating whether they:

a) had already volunteered as an “early cooperator,”
b) were eligible to come into compliance and that they were going to develop a nutrient management plan or an animal waste plan, provide the number of acres in their operation, and provide whether they intended to use a private or public planner,
c) owned property that did not meet the 10 acre or 8,000 pound animal unit requirements of the law,
d) no longer owned the agricultural property, or
e) lease their property and they would provide the name of the person they lease to.

Rohrer said individuals that ignored the Commission received second and sometimes third warning letters to comply.

1. DNMC publishes the number of eligible farmers in the fifth year of the five-year schedule but never publishes compliance rates for farmers

Due to the five-year phased in notification process, the DNMC was able to determine the total number of eligible farmers to be regulated by the Nutrient Management Law in the fifth year. Thus, in its fourth fiscal year annual report – the 2006 Annual Report – the Commission announced:

> “The Commission established a database of 6,775 property owners whose properties demonstrated characteristics that may require a nutrient management plan. All property owners were notified of the mandate during the summer, prior to each January.
>
> There were 1,158 property owners who responded as the person responsible for implementing nutrient management practices. 2,662 respondents indicated that they lease their property. The remaining property owners were not affected by the law for various reasons.”

Thus, some seven years after the 1999 Delaware Nutrient Management Law, the DNMC determined that only 1,158 farmers, or 17% of the 6,775 potentially eligible farmers in the state, met the requirements for being regulated. Administrator Rohrer explained that many property owners in the database turned out “not to be affected by the law” because there were duplicate records in the database as people sold their properties or changed their name or their farm name, etc. Rohrer also explained that individuals who said they “lease their property” but still identify themselves as farmers are absentee landowners who still earn agricultural income from land rental contracts but do not actively farm and thus are not handling nutrients. To put this into perspective, 1,158 farmers is just under half of the 2,600 farms identified in the 1997 Census. Thus, like Maryland, which cut its potential universe of farmers down from the 13,000 farms reported in the 1997 Census to just under 6,000 in 2009 (46%), Delaware also regulates about 43% of its farmers.

However, unlike Maryland, which annually publishes compliance statistics about its farmers, surprisingly, Delaware has never published a) the number of farmers that were in compliance with the law, b) the number of farmers who failed to obtain a plan, or c) the percentage of farmers in compliance. Furthermore, unlike Maryland that published a different total eligible population every year, Delaware did not publish any other eligible population size other than 1,158, which it announced in 2007. Thus, Maryland published statistics each year that were continually fluctuating, revealing the challenge of identifying the regulated population and accounting for compliance, while Delaware published one, unwavering estimate of the eligible regulatory population and no statistics on the number of farmers that are in or out of compliance.

2. **On average, the DNMC can only account for 81% of compliance because it only tracks acreage under cost-shared plans or plans prepared by public planners**

One of the reasons that Delaware has never published compliance statistics about the number or percentage of the 1,158 farmers that are eligible to possess a nutrient management plan is that Delaware, unlike Maryland and Virginia, does not require its farmers to submit the nutrient management plan to the regulatory agency for review. Thus, other than the initial postcard and the Annual Reports that will be discussed in the subsequent sections of this chapter, Delaware does not receive any communication from its farmers about whether they are or are not in compliance.

The only method employed by the Commission to determine administrative compliance with the law is if farmers receive cost-share to hire a private consultant to prepare the plan or if the farmer uses a public planner. Furthermore, the Commission does not publish in its Annual Reports the number of *farmers* receiving cost-share or the number of *farmers* using private consultants. Instead, the Commission only publishes the number of *acres* of plans receiving cost-share and the number of *acres* of plans prepared by private consultants.

The table below provides data published in the DNMC Annual Reports over the five-year implementation schedule (2003 to 2007) and the latest available year of data, 2008.

Table 6.13. Tracked Acreage Accounts for an 80% Average Compliance Rate in Delaware							
	FY 2003	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**FY 2008**	**Average:**
Private sector (Commission-funded)	**303,355**	**311,431**	**333,370**	**344,286**	NR	NR	323,111
Public sector (Conservation Districts)	**69,675**	**91,314**	**71,639**	**109,005**	NR	NR	85,408
Total "To date" or "Current" plan acres each year	**373,030**	**402,745**	**405,009**	**453,291**	**355,984**	**337,650**	387,952
Total Eligible Acres	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	480,000
Percentage of Eligible Acres Accounted for by "To Date" Acreage	78%	84%	84%	94%	74%	70%	81%
Note: Data in bold are reported by DNMC and data not in bold are estimated by Perez. "NR" represents data that was not reported by DNMC.							
Each year of data came from each Annual Report by the DNMC.							

To try and put these figures into perspective, I asked Rohrer what the regulatory universe of acres in Delaware was. Administrator Rohrer explained that the DNMC had to come up with its own methods to determine the eligible universe of cropland in Delaware because the statistic "land in farms" reported by the Census includes houses, barns, farm lanes, woods, etc.

Rohrer explained that he had a difficult task to identify eligible acres and had to work with the Delaware Agricultural Statistics Service personnel to count cropland from the number of acres planted but to be careful and subtract out any double-cropped acres in order to avoid double counting. From this exercise, Rohrer concludes there are 480,000 individual acres of cropland in the state (that includes both cropland and pastureland) that should be managed with a nutrient management plan. This figure resembles the "total cropland acres" in Delaware identified in the 1997 Census (491,489), the 2002 Census (457,201), and the 2007 Census (432,773).

Thus, given the administrative compliance determination method the DNMC has established for itself, on average, the Commission is only able to account for between 70 and 94% of all eligible acres having a plan. Note that the compliance rate drops in the last two years of available data (2007 and 2008) to just 74% and 70%, respectively, and that the DNMC only reported the total number of acres in compliance instead of providing the breakdown in acres under private, cost-shared plans and acres under public plans. On average, over the five years of available data, the Commission can conclude that 81% of eligible acres in Delaware are in administrative compliance with possession of a nutrient management plan (see table above).

On the one hand, an 81% average compliance rate with the law's requirement to obtain a nutrient management plan is quite a high compliance rate. On the other hand, by affording itself incomplete regulatory authority, and showing no intention to determine what the remaining 19% of eligible cropland acres in the state may be doing to comply with the law, and never reporting the number of farmers in or out of compliance, the Commission is susceptible to accusations of regulatory capture.

To put into perspective the number of acres that the Commission does not know if are in compliance, the 124,016 acres not tracked by the Commission in the 2007 Report and the 142,350 acres not tracked by the Commission in the 2008 Report, are approximately as much cropland as the 139,259 acres that were harvested in Kent County alone, according to the 2007 Census.

3. **Most of the acreage tracked by the DNMC are in plans receiving cost-share for being prepared by private consultants**

A majority of the acres under nutrient management plans in Delaware are prepared by private consultants. In the DNMC Annual Reports, between 76 and 81% of acres that are reported in the "acreage to date" category (see table below) are under plans prepared by private consultants.

Table 6.14. Percentage of Plans Prepared by Private Consultants							
	FY 2003	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**FY 2008**	**Average:**
% of "to date" or "current" acres that are covered by private-plans	**81%**	**77%**	**82%**	**76%**	NR	NR	79%
Note: Data in bold are reported by DNMC and data not in bold are estimated by Perez. "NR" represents data that was not reported by DNMC.							
Each year of data came from each Annual Report by the DNMC.							

As will be discussed in the following section on Delaware's attempts to determine adherence compliance with the law, the DNMC does not have a formal and systematic protocol in place to ensure that plans prepared by private planners are of the same quality as plans prepared by a public planner and that both adequately reflect the standards of the law.

4. **When farmers were required to submit Annual Reports, the DNMC does report compliance and it is low**

In its 2008 Annual Report, the Commission reported for the first time the number of farmers that submitted the Annual Reports required by the Nutrient Management Law. The NML stated that by March 1 every year, beginning in the year after mandatory nutrient management plan took effect, farmers were to submit a one-page nutrient information form summarizing the nutrients handled and applied. This meant that ARs should have been submitted every year, starting in 2004. Delaware’s one-page Annual Report (AR) resembles Maryland’s one-page Annual Implementation Report (AIR).

The 2008 Annual Report provides data only as early as 2006 (see table below), revealing that 548, 410, and 445 farmers submitted the AR in 2006, 2007, and 2008. Thus, on average, only about 470 farmers submitted the required one-page report every year. In an attempt to put these figures into context and estimate a compliance rate (without knowing how many farmers of the 1,158 total eligible population had complied by 2006), I assumed that 20% of the eligible farmers were complying on average every year. Thus, 926 farmers should have complied by 2006, the fourth year in the give-year schedule (.20 x 1,158 = 232 x 4 = 926). And since all 1,158 farmers should have complied by 2007 when the DNMC announced the total regulatory population, then the denominators for 2007 and 2008 are 1,158.

Thus, in 2006, 56% of the likely eligible population was in compliance because they turned in their Annual Report, but only 35% and 38% of eligible farmers were in compliance in 2007 and 2008. On average then, only 40% of Delaware farmers were in compliance with their law’s requirement that they submit Annual Reports every year over the three years of available data.

Table 6.15. Delaware's Compliance Rate with Submission of Annual Reports

	FY 2006	FY 2007	FY 2008	Average:
# of Annual Reports submitted each year	**548**	**410**	**445**	468
# of farmers regulated by the NML	**926**	**1,158**	**1,158**	**1,158**
% Compliance with AR submission requirement	59%	35%	38%	40%

Note: Data in bold are reported by DNMC and data not in bold are estimated by Perez. "NR" represents data that was not reported by DNMC.

DNMC. April 1, 2009. "2008 Annual Report of the Delaware Nutrient Management Commission to Governor Jack A. Markell and the 144th Delaware General Assembly."

The 2008 Annual Report explained:

> "This reporting process is one of the most challenging aspects of the law because the program only receives about half of the reports expected."

Administrator Rohrer explained that the low response rate for annual reports "is something we continue to struggle with." Rohrer also explained that the numbers reported above reflect only the annual reports they received that were completely filled out and thus they were able to enter into their database. There were many other AR forms that were submitted, but were not entered into the database because they were incomplete and the database was set up to automatically analyze the data and the incomplete reports might ruin the analysis.

Despite the low submission rate of the annual reports and the problem of incomplete reports, the DNMC has attempted to interpret the information in the ARs that are complete. In the 2008 Annual Report, the DNMC published the following:

> "The aggregated data, however incomplete, can be used to follow progress and trends such as the following:
>
> - 65% generate and/or handle animal manure.
> - 45% only grow crops and do not generate or handle animal manure.
> - 31% apply manure to the land they manage.
> - 77% apply commercial nitrogen at an average rate of 103 lbs. per acre.
> - 56% apply commercial phosphorus as phosphate at an average rate of 23 lbs. per acre."

Although interesting, these figures do not provide much useful information. For example, without knowing what crop, it is difficult to interpret the nitrogen and phosphorus average application rates as appropriate or inappropriate.

Wrap up of Delaware's Administrative Compliance Estimates

It appears that the Delaware Nutrient Management Commission intentionally does not give itself the regulatory authority needed to completely carry out the duties of a regulatory institution. By only enabling the staff to track acres of cropland receiving cost-share or prepared by public planners, the compliance status of an average of 19% of all eligible cropland acres (or 30% in FY2008) is unknown to the Commission.

Furthermore, there appears to be no effort on the Commission's part to identify the farmers managing those acres in order to determine if they are or are not in administrative compliance. Finally, poor compliance rates materialize when farmers are required to mail in their one-page Annual Reports and there appears to be no effort by the Commission to engage in enforcement activities with the 44% of the eligible farmers that are non-compliant, on average (or 38% in FY2008).

Delaware – State Estimates of Adherence Compliance

In contrast to Maryland – which began conducting on-site inspections in 2005, seven years after the 1998 Water Quality Improvement Act – Delaware began conducting on-site audits in 2003, four years after the 1999 Nutrient Management Law and the first year of the law's five-year implementation schedule. It appears, however, that several procedural decisions were made by the Commission that raise questions about the rate of inspection, the reporting of compliance statistics, and quality assurance protocols to ensure that private-sector written plans are sound.

1. **DNMC conducted on-farm audits from the beginning of the five-year schedule but inspection rates are low**

Each year, the DNMC conducted on-farm audits of a) farmers regulated by the Nutrient Management Law, b) the state Concentrated Animal Feeding Operations (CAFOs), and c) non-agricultural operations regulated by the law. Between 2003 and 2008, the number of farm operations the DNMC reported it visited each year ranged from 8 to 21 (see table below). On average, 14 farms audits were conducted between 2003 and 2008.

The NML established an audit goal of 10% of the regulated farms every year. Thus, in 2008, the year after the five-year implementation schedule was completed, the DNMC should have visited 116 farms to achieve the 10% goal. Instead, the DNMC visited only 21 farms, thus accomplishing only a 2% inspection rate.

Since the DNMC did not know its regulatory universe until January 2007, according to Rohrer, the DNMC interpreted the inspection goal set in the law as meaning 10% of the 20% of farms required to come into compliance every year during the five-year implementation phase. Thus, without knowing the actual number of farms that informed the DNMC by postcard that they had already come in to compliance as an "early cooperator" or they intended to come into compliance, it is impossible to know if the DNMC met their goal.

A rough, back of the envelope calculation (see table below), suggests that if we are to assume that, on average, 20% of the 1,158 farmers did come into compliance every year during the five-year time period, then 232 farmers would come into compliance every year. And to achieve its interpretation of the 10% goal, the DNMC should have visited 23 farms each year during the five-year implementation phase.

Thus, in 2003, 10 fewer farms were audited than should have been and in 2008, 95 fewer farms (were audited than should have been. Thus, between 2003 and 2008, the DNMC's audit rate ranged between 2 and 6%, or on average, 5% per year, instead of the 10% goal it set for itself.

Table 6.16. Delaware's On-Farm Nutrient Management Audits							
	Five-year implementation						
	CY 2003	**CY 2004**	**CY 2005**	**CY 2006**	**CY 2007**	**CY 2008**	**Average:**
# Farm operations audited	**15**	**13**	**15**	**10**	**8**	**21**	14
Interpretation by DNMC of the Inspection goal: Inspect 10% of each new batch of regulated operations that come into compliance each year							
20% of 1,158 regulated universe expected to comply each year	232	232	232	232	232	1158	
# farms, that should have been audited (10% Inspection goal for definition above)	23	23	23	23	23	116	
Inspection rate based on DNMC interpretation above	6%	6%	6%	4%	3%	2%	5%
Alternative interpretation of the Inspection goal: Inspect 10% of the regulated operations accumulating each year							
Accumulation of 20% of 1,158 regulated universe every year	232	463	695	926	1158	1158	
# farms, that should have been audited (10% Inspection goal for definition above)	23	46	69	93	116	116	
Inspection rate based on alternative interpretation above	6%	3%	2%	1%	1%	2%	3%
Note: Data in bold are reported by DNMC and data not in bold are estimated by Perez. "NR" represents data that was not reported by DNMC.							
# Operations audited reported in each DNMC Annual Report from 2003 to 2008.							

An alternative interpretation of the 10% goal, as applied to the 20% cohort of regulated farmers coming into compliance every year, is if the annual number of farmers was cumulative every year. Again, without knowing the actual number of farms that were coming into compliance and accumulating every year, the following is merely an exercise to demonstrate an alternative method for calculating Delaware's inspection rate.

Thus, in 2003, the first year of the implementation phase, 23 audits would represent the first 20% cohort, but in 2004, 46 audits would represent the new 20% cohort added to the first year's cohort, and so on. Thus, by 2007, the last year of the implementation schedule, 116 audits should occur to fully reflect 10% of the entire regulated population. If measured against this interpretation, Delaware only managed to visit between 1 and 6% per year, which turned out to be a 3% average audit rate.

2. **DNMC does not report adherence compliance statistics from its farm audits but focuses on bringing farmers into compliance**

Unlike Maryland that published the results of their on-farm plan implementation reviews in the last two years of available data (2008 and 2009), Delaware has only once published the results of its on-farm audits. In its 2004 Annual Report, the DNMC reported:

> "During 2004, program staff audited 13 agricultural operations and 2 non-agricultural operations. As a result of nutrient management audits all legal discrepancies identified involved a follow up meeting with farm management and in many cases, the certified nutrient management consultant. The most common discrepancy involved incomplete record keeping. Eight significant legal discrepancies were followed by formal administrative actions and three were forwarded to a compliance hearing."

Thus, assuming that the eight operations that received "formal administrative actions" were all farmers, then 61% of the 13 audited farms appear to be in violation of the law, but the DNMC worked with them to "bring them into compliance." The three that remained "non-compliant" (23%) forced the state to send them to a compliance hearing.

Upon request, Rohrer was able to share with me the results of his team's farm audits for 2006 through 2008. However, the number of audits Rohrer reports they conducted is larger than the number of audits published in the Annual Reports for the same years.

> "In 2006, the program staff conducted 46 inspections, six of which were related to complaints from the public, 10 were not in compliance and the Commission took formal action against all 10. In 2007, 24 inspections occurred and only two cases went to formal action. In 2008, 25 inspections occurred with four formal actions."

Thus, according to this set of unpublished data, it appears that adherence compliance rates determined through on-farm audits was 78% for 2006 (10/46 not in compliance), 92% for 2007 (2/24 not in compliance), and 84% for 2008 (4/25 not in compliance).

3. **DNMC does not have a systemic quality assurance protocol in place to review plans prepared by private sector consultants**

In terms of conducting quality control and quality assurance audits of the plans prepared by certified consultants, Rohrer explained that the Program Staff does not have a formal and separate protocol for evaluating plans but incorporates a review of the quality of the plans during the audit at the farm:

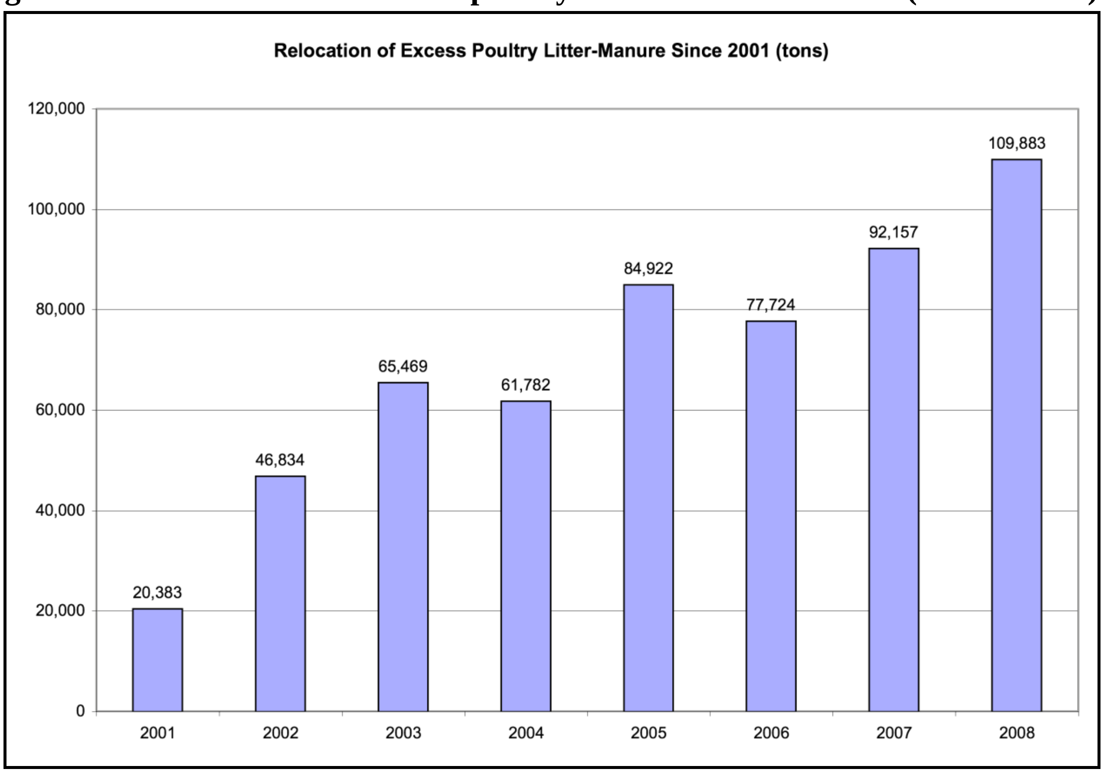
> "If we see a problem with the plan, we'll contact the consultant. The Commission was pretty adamant that they did not want the state to schedule meetings with the certified management consultants to review the plans but only to meet with the farmer at the farm."

Recall that a crop consultant on the Eastern Shore that prepares certified nutrient management plans in all three Peninsula states also sits on the Delaware Nutrient Management Commission. Though this dissertation points out the many positive outcomes of Delaware's emphasis on gaining "buy-in" from the farming community, this example suggests that the Commission is susceptible to accusations of regulatory capture.

4. **Delaware's Nutrient Relocation Program moves a lot of manure**

In terms of the manure relocation program established by the Delaware Law, Delaware has provided cost-share to relocate excess poultry litter since 2001 through its Nutrient Relocation Program. The chart below shows total tons of poultry manure transported in Delaware but it also includes tons whose transport was paid for by Perdue AgriRecycle rather than the state. In general, between 20,383 tons in 2001 and 109,883 tons in 2008 were relocated in Delaware (see figure below).

Figure 6.2. Tons of excess Delaware poultry litter-manure relocated (2001 to 2008)



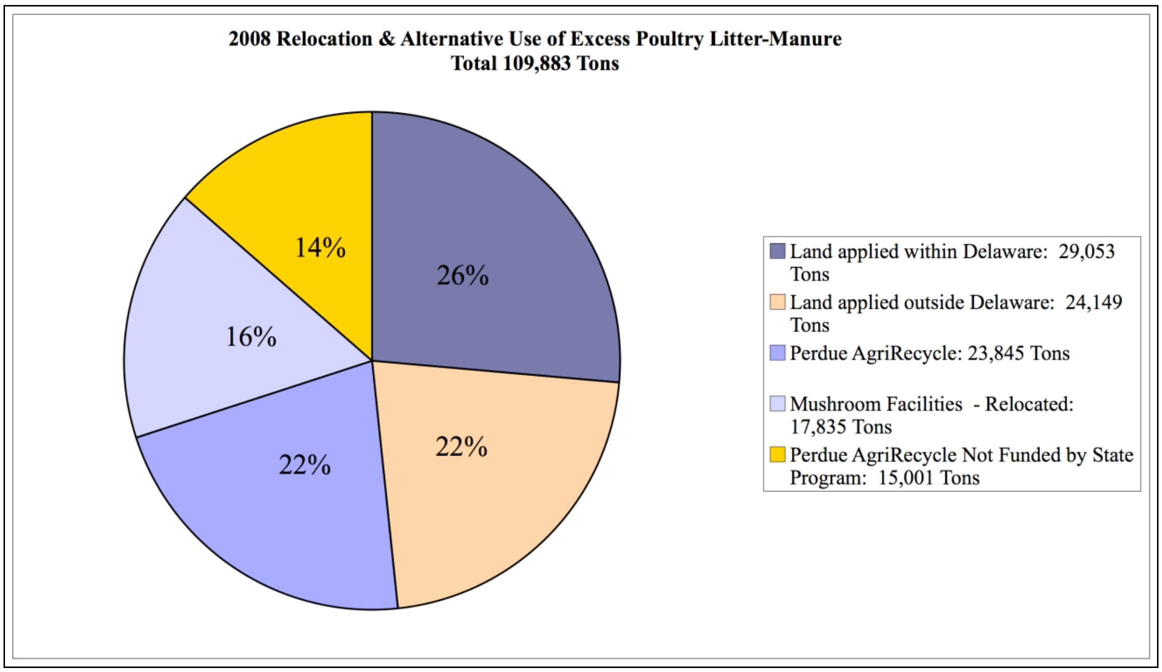
Source: Bill Rohrer, Program Administrator, Delaware Nutrient Management Commission. February 20, 2009.

Rohrer has estimated that approximately 330,000 tons of poultry litter is generated every year in Delaware. Thus in 2008, with 109,883 tons of manure tracked by

Delaware's Nutrient Relocation Program, roughly 30% of Delaware's poultry litter is transferred away from the generating farms.

The figure below shows where the manure goes. About 48% of the relocated manure was land-applied (half of which was relocated inside Delaware and half outside of Delaware), 22% was transported to Perdue AgriRecycle for pelletization (paid for by the relocation program), 16% was transported to mushroom farms in Pennsylvania, and the final 14% was transported and paid for by Perdue's AgriRecycle.

Figure 6.3. Relocation and Alternative Uses of 2008 Excess Poultry Litter



Source: Bill Rohrer, Program Administrator, Delaware Nutrient Management Commission. February 20, 2009.

5. Delaware evaluates its nutrient management law and finds large-scale success at lowering nutrient imbalance and reducing the excess manure problem

Unlike Maryland and Virginia that do not appear to publish or even conduct analysis to determine if their laws are having a positive impact, Delaware, in its 2007 and 2008 Annual Report, described the results of two efforts to quantify the benefits of the Nutrient Management Law.

The first effort was a nutrient mass balance study by Sims, McGrath, and Shober (2008), which the Commission published a summary of in its 2007 Annual Report. The University of Delaware and Maryland scientists studied the nutrient surplus problem that occurs when inputs, such as fertilizers and manures in a defined geographic area, exceed outputs, such as crop harvest and manure relocation. Nutrient surpluses "increase the potential for nutrient losses to air and water or nutrient accumulation in soils above values needed for optimum crop yields."

Overall, the researchers acknowledge that nitrogen (N) and phosphorus (P) surpluses have existed in Delaware for many years. But, due to changes in nutrient management practices since 2000, the surpluses have been reduced.

The researchers provide two methods to estimate the nutrient mass balance analyses for Delaware:

(1) Management-oriented approach – estimates of the amounts of N and P produced or sold (farm fertilizer tons and manure nutrients) compared to N and P recommended to attain economically optimum crop yields; and

(2) Input-output approach – estimates of N and P produced or sold and added to soils by biological N_2 fixation compared with the estimated amount of nutrients that left the state (or county) in harvest crops or by manure relocation.

Note that neither approach directly estimates actual nutrient application rates by farmers but uses other measures as proxies for this immeasurable data point.

Via the management-oriented method, the researchers estimate that Delaware's statewide surpluses for N have been reduced by 60% and for P have been reduced by 52% between 2005 to 2006 and 1996 to 1998. Via the input-output approach, they estimate that the statewide surpluses for N have been reduced by 55% and for P have been reduced by 97%.

Thus, in this case, nitrogen and phosphorus surpluses still exist but according to the input-output approach, the P surplus appears nearly solved.

The researchers attribute the declining surpluses to: a) reduction of fertilizer N and P tons purchased, b) decreases in manure N and P caused by lower N and P contents in broiler litters from dietary changes and lower livestock inventories, and c) the state manure relocation program.

The authors suggest that many additional policies should be considered to further decrease the remaining N and P surplus, including: a) strategies to deplete high P soils to optimum values and BMPs to prevent P loss by erosion and runoff, b) improvements in fertilizer N management because soil and climatic conditions in Delaware often lead to nitrate leaching, c) expanding efforts to find where P is not needed and finding alternative uses for broilers litters beyond cropland application, due to significant acreages of high P soils, and d) irrigating crops to help stabilize yields and prevent drought-related crop failures that increase nutrient loss to ground and surface waters.

Thus, the DNMC Annual Report publicizes scientific research that quantifies the benefits of their law and presents scientific-based policy recommendations for open consideration.

In the 2008 Annual Report, Administrator Rohrer also published an article estimating the amount of excess poultry manure in the State of Delaware. Rohrer estimates that the Nutrient Management Law's phosphorus crop removal restriction policy would result in 118,257 tons of excess poultry litter generated in Delaware. Rohrer estimates that 305,625 tons of poultry litter is generated annually given the standard rule of thumb that 1.25 tons of litter is produced per 1,000 birds and there were 244.5 million chickens in the state in 2006. Since in 2008 the Delaware Nutrient Relocation program relocated 109,883 tons to alternative use projects, Rohrer figures that Delaware's excess manure problem has shrunk to just 8,374 tons of excess manure.

I am aware of PowerPoint presentations that Rohrer has given in public that present two additional and higher estimates of the magnitude of the excess manure problem in Delaware, but Rohrer did not publish those higher estimates in the Annual Report.

Although the actual estimate of excess poultry litter and the portion successfully removed by the nutrient relocation program and proper phosphorus management will continue to be debated, it is clear that the Delaware nutrient relocation program is having a significant and positive impact on solving the excess manure problem in Delaware's section of the Delmarva Peninsula.

Furthermore, it is worth emphasizing that Delaware appears to be the only state attempting to quantify the magnitude of the problems associated with poultry manure and then calculating progress towards solving the problems.

Wrap up of Delaware's Adherence Compliance

Delaware's efforts to determine adherence compliance is minimal, as it only inspected 2% of the entire eligible regulatory population in the last year of available data (FY2008). Efforts to determine inspection rates during the five-year implementation schedule are imprecise but suggest that on average, between 1 and 6% of the eligible farms each year were inspected.

Delaware has also only once published the results of those on-farm audits which suggested that 60% of the farms inspected may had serious record-keeping violations and 23% of those evidently refused to cooperate with the DNMCs efforts to "bring them into compliance" and were sent to administrative hearings. Compliance rates provided upon request indicate that in the last year of available data (2008), 80% of the 25 audited farms were in compliance with the law. Delaware does not indicate whether any fines have been levied or the amounts of the fines.

In addition, the DNMC members have decided to not to establish any formal protocol to review the private sector–prepared plans to ensure they are up to land-grant university standards.

Finally, despite these unfavorable reviews of Delaware's efforts to determine adherence compliance, Delaware is the only state that has attempted to determine whether its nutrient management law is "working." Two studies by scientists and by the DNMC Administrator indicate that the law's nutrient management plan requirements, its three-year phosphorus crop removal policy, and its nutrient relocation program are having a positive effect on the state's nutrient surpluses and on the excess manure problem.

6.4. Virginia's Estimates of Compliance

Unlike Maryland and Delaware, Virginia does not publish annual reports about the 1999 Poultry Waste Law or about its Virginia Pollution Abatement (VPA) permit program for dairy, swine, beef, and poultry. One publically available document, a Joint Legislative Audit and Review Commission (JLARC) of the Virginia General Assembly report, "Review of Nutrient Management Planning in Virginia," published in 2005, did provide insight into the implementation of the overall Nutrient Management Program in Virginia (which includes voluntary efforts) and insight into the compliance.

Therefore, I requested and received compliance statistics from the two agencies implementing the nutrient management and VPA permit program: (1) Virginia Department of Conservation and Recreation (VDCR), which oversees the administrative compliance requirements of receiving and reviewing the nutrient management plans for quality control, and (2) the Virginia Department of Environmental Quality (VDEQ), which oversees adherence compliance activities to determine if farmers are following the plans and the other nutrient management requirements in the permit.

Regarding the timeframes for Virginia's compliance information, compliance data is limited for Virginia by the fact that personnel at the VDCR and VDEQ do not have access to some years of data prior to their joining the agencies in the late-2000s. Timeframes are less confusing in Virginia than in Maryland and Delaware, however, where there were fiscal year versus calendar year complications, but the state did switch from a state fiscal year to a federal fiscal year (September 30 to October 1) in 2004.

Virginia – State Estimates of Administrative Compliance

The 1999 Poultry Waste Law (PWL) required poultry operations with over 200 animal units – which translates into 11,000 turkeys or 20,000 chickens per flock – to obtain a Virginia Pollutant Abatement (VPA) General Permit, a certified nutrient management plan if they grow crops, or a waste transfer plan (WTP) if they do not grow crops. There are about 890 poultry growers that are regulated by the PWL, representing both turkey and broiler chicken operations. According to the Virginia Poultry Federation, there were 300 turkey and 880 chicken operations in the state in 2008. Thus, it is unknown what portion of turkey or chicken operations make up the 890 regulated poultry growers. Regardless, Virginia's PWL regulates approximately 74% of the poultry operations in the state.

Since neither agency publishes an annual report for the public, I requested and received administrative and implementation compliance statistics from Emily Aleshire, the VDCR's Nutrient Management Coordinator for Animal Waste who is responsible for receiving and reviewing the required plans and from Betsy Bowles, VDEQ's Animal Feeding Operations Program Coordinator who is in charge of permit and plan annual inspections.

1. Virginia requires all nutrient management plans to be submitted the year they are developed and every time they are updated

In contrast with Delaware, which has never required farmers to submit copies of their plans, and Maryland, which at first required submission of every plan but now only requires submission of the initial plan, Virginia has always required regulated poultry growers (and the other dairy, beef, and swine VPA-permit holders) to submit their nutrient management or manure management plans to the DCR's Nutrient Management Program for review.

When new nutrient management plans are written or updated, regardless of whether they are prepared by VDCR Nutrient Management Specialists, certified Soil and Water Conservation District employees, or certified private consultants, the plans are submitted to the VDCR's Aleshire before they go to the farmer so the staff can review and approve the plans. Thus, Virginia's protocol for quality assurance and quality control is the most systematic of all three states. Recall that Maryland only reviews 7 to 12% of all plans every year and Delaware does not systematically review plans other than the approximately 2% it reviews during on-farm audits.

2. Of all the plans submitted for review, only a fraction are nutrient management plans because most regulated poultry growers are not crop farmers, most plans are prepared by public planners, and plans are for hay, not annual crops

In 2003, VDCR estimated that 577,000 tons of poultry litter was generated in Virginia but 71% of that manure (411,000 tons) was transferred from the generating poultry operations to other farms (JLARC, 2005). Thus, Virginia's Poultry Waste Law may only be regulating manure use by poultry growers that generate just 30% of the manure from the entire poultry industry.

Virginia Pollution Abatement (VPA) poultry permit holders that raise poultry and do not also raise crops are required to prepare Waste Management Plans (WMP) detailing proper manure storage and Waste Transfer Plans (WTP) identifying to whom the grower gave his poultry manure. The WMP is updated at least every five years and is submitted to DCR for review every time a new plan is developed or updated, while the WTP is submitted annually.

Aleshire was unaware what fraction of the approximately 890 regulated poultry operations in Virginia raise crops and submit nutrient management plans versus those that do not raise crops and submit only WMPs and WTPs. However, Aleshire was able to provide information about the 209 plans submitted by poultry operations for approval in 2008. Of the 209 plans, 107 were waste transfer plans and 102 were nutrient management plans, covering 26,704 acres “for land application of litter, other organic sources of nutrients, and/or commercial fertilizer” (Aleshire, personal communication, February 2, 2009).

This one-year snapshot of updated plans in 2008 reveals a fundamental problem with the Virginia Poultry Waste Law. Since the poultry manure that is transferred off a poultry grower’s farm for use by a non-livestock operation is not regulated, use of the poultry manure generated by half the reporting poultry farms in 2008 is, in effect, not regulated.

Regarding the proportion of plans that are written by public planners versus private consultants, a large majority of Virginia’s poultry nutrient management plans are written by public planners. Although Aleshire provided data that did not specify whether the planner was preparing a nutrient management plan or a waste transfer plan, in 2008, 183 plans were written by VDCR Nutrient Management Specialists, 9 were written by Soil and Water Conservation District employees, and 17 were written by certified private sector planners. Thus, if I assume that private planners only take clients who require nutrient management planning services, then only 17% of the nutrient management plans submitted in 2008 were private-sector plans.

When I asked whether Virginia nutrient management plans are mostly annual or three-year plans, Aleshire explained that VDCR usually prepares annual plans for poultry growers who plant annual crop rotations like corn-soybeans-wheat and prepares three-year plans for growers who use the manure to grow hay.

As a Nutrient Management Specialist herself in 2000, Aleshire recalls that when the regulations started in 2000, “There was a huge influx of plans. Every three years after that, there is a large jolt of plans that come up for renewal but in the intervening years, there is a trickle of updated plans coming in for review.” On the issue of annual or three-year plans, Aleshire said:

> “There are very few plans that are written on an annual basis because most poultry farms in Virginia have hay operations which are not complicated crop rotations so they don’t need anything more precise than a three-year plan. For a farm with lots of crop rotations (corn-soybean-wheat and other vegetable rotations), DCR prefers not to write a three-year plan for them because it’s too complex and a one-year plan would serve the farmer better.”

Thus, Virginia’s Poultry Waste Law, in comparison to Maryland and Delaware’s comprehensive nutrient management laws, is also relatively easier to implement. Though there may be 900 regulated poultry growers, only one-third to one-half of them are actually farmers that require nutrient management plans. Furthermore, of those requiring nutrient management plans because they raise crops, the majority of those growers raise hay which requires less complicated nutrient management plans than those who raise crops in rotation.

3. Despite required plan submission, DCR does not evaluate administrative compliance rates

Despite VDCR's systematic plan submission protocol, VDCR does not systematically assess the number of growers in compliance with the Poultry Waste Law's administrative requirements to possess either a NMP or a WMP/WTP. As will be described shortly, the Virginia Department of Environmental Quality does assess administrative compliance when it conducts on-farm inspections but these reviews are dependent upon inspection capacity and, over the years, there has been insufficient staff to carryout annual inspections.

One reason that VDCR does not assess administrative compliance is the way VDCR has set up its data entry and management system. Unlike Maryland or to some extent Delaware, Virginia does not track the number of plans filed by year, let alone the number of plans and acres under a current plan, because, as Aleshire put it, "As a new plan comes in, I replace the dates in the database." Thus, Virginia's database system erases the previously entered data, including the date the last time the plan was filed. Because of this, Aleshire was able to provide only information for the last year of available data, 2008, for the number of plans and acres covered that came in to compliance or were updated in 2008. Thus, unlike Maryland that attempts to track the number of farmers that have an up-to-date plan and file the Annual Implementation Reports every year, and Delaware that tracks the number of acres receiving cost-share or that have plans by a public planner, Virginia's data software system does not allow them to track administrative compliance.

Given that the VDCR database erases data from the past when new data is entered and due to a split in implementation of the regulatory program between two state agencies, Virginia is limited in its ability to answer basic administrative regulatory questions (without a farm visit) such as, “how many and which farmers are in and out of compliance with the law’s plan filing requirements?”

4. Cost-share funds are available to develop nutrient management plans

The Virginia Agricultural BMP Cost Share Program (VACS) began in 1984 but only started providing cost-share to farmers wishing to hire private-sector nutrient management planners in 1998, one year prior to the 1999 Poultry Waste Law. VACS provides cost-share for farmers to obtain a three-year nutrient management plan and receive annual revisions to the plan. In addition, any operator of “agricultural land” – regulated or unregulated – may apply for cost-share funding to cover plan development for cropland, hayland, and pastureland “that receive mechanical applications of collected animal manure.” Because VACS does not publish an annual report like Maryland’s MACS Program, I obtained the following data about Virginia’s cost-share program for nutrient management plans from VDCR Program Coordinator Gary Moore (see table below.

Table 6.17. Virginia’s Cost-Share Program for Nutrient Management Plans

	2001	2002	2003	2004	2005	2006	2007	2008
$ Cost-Share	**$53,096**	**$25,212**	**$4,051**	**$198**	**$13,650**	**$14,037**	**$233,194**	**NR**
# of Plans	**435**	**155**	**145**	**6**	**92**	**119**	**949**	**852**
# Acres Benefitted	**13,727**	**6,929**	**8,380**	**89**	**5,835**	**14,144**	**113,519**	**145,354**
$ Cost-Share per	$122.06	$162.66	$27.94	$3.00	$148.37	$117.96	$245.73	

Plan								
$ Cost-Share per Acre	$3.87	$ 3.64	$ 0.48	$2.22	$2.34	$0.99	$2.05	
Source: Data provided upon request by Gary Moore, VDCR Agricultural Incentives Program Manager.								
Data in bold are reported by VDCR and data not in bold are estimated by Perez. "NR" represents data that was not reported by VDEQ.								

Virginia does not break down its nutrient management cost-share funds by regulated and unregulated applicant nor by animal type thus the data provided above reflects funds provided to all agricultural operations interested in hiring a certified private-sector nutrient management consultant.

Wrap-Up of Virginia's Estimates of Administrative Compliance

Unlike Maryland and Delaware, which have quality assurance protocols that only review between 2 and 10% of plans every year, Virginia requires all plans to be submitted for review when they are first developed and every time that they are updated. However, because as much as 70% of the manure generated at regulated poultry farms is not used by the poultry grower, between 30 and 50% (estimate for 2008) of all growers have nutrient management plans while the rest have waste transfer plans. Thus, the Poultry Waste Law regulates only 30% of the generated manure through nutrient management plans. Despite the systematic quality assurance protocols, unlike Maryland and Delaware, VDEQ does not generate annual administrative compliance statistics but relies on the VDEQ inspections to ensure that the regulated growers have a current nutrient management plan.

Virginia – State Estimates of Adherence Compliance

Unlike Maryland and Delaware, which publish annual reports with varying levels of adherence compliance statistics about their nutrient management laws, Virginia does not publish any annual reports about its Poultry Waste Law or its Virginia Pollutant Abatement (VPA) permit program. Thus, I requested and received compliance data from Betsy Bowles, VDEQ's Animal Feeding Operation Program Coordinator. Bowles provided both summary statistics and farm-level statistics for Virginia's Pollution Abatement Permit Program. However, the time periods of data Bowles was able to supply were restricted; Bowles explained this was because she only joined the agency in 2008 and does not have access to data prior to 2004. Thus, VDEQ was only able to provide (1) two years of summary statistics for federal fiscal years (FFY) (September 30 to October 1) 2006 to 2007 and 2007 to 2008, and (2) four years of farm-level statistics: 2004-05, 2005-06, 2006-07, and 2008-09. Thus, statistics from 2001 through 2003 were not available, though the Poultry Waste Law required the compliance by all eligible poultry operations in 2001.

In FFY 2007 and 2008, there were approximately 1,038 and 1,040 animal operations, respectively, with a VPA permit in Virginia – 80% of these were poultry growers (891 in 2007 and 894 in 2008). Because Virginia does not breakdown inspection statistics by animal category I am unable to present compliance statistics for poultry growers only and have to report inspection data for all permitted facilities including dairy, swine, and beef operations.

1. **Inspection rates in recent years in Virginia are very high but not necessarily 100%, as required by statute, and early years of the PWL had very poor inspection rates**

Although the 1999 Poultry Waste Law did not specify the rate of on-farm inspection, the Code of Virginia (Section 62.1-44.15 [5a]) does require VDEQ to perform annual compliance inspections of permitted animal feeding operations (JLARC, 2005).

Inspection goals in Virginia vary year to year depending mainly on the availability of inspection staff. In 2007, VDEQ set an inspection goal of 770 and in 2008 set a goal of 1,040 (see table below). Thus, the inspection goal for 2007 was 74% and was 100% in 2008.

In 2007, VDEQ accomplished 713 inspections, or 93% of their goal, and in 2008 they accomplished 962 inspections, also 93% of their goal. Thus, my interpretation of these statistics indicates that between 69 and 93% of permit-holders in Virginia were inspected in these two years.

Table 6.18. Virginia's AFO Inspection Rates

	FFY 07	**%**	**FFY 08**	**%**
Total permits (all animal operations)	**1,038**		**1,040**	
Inspections Goal (and goal as a % of permits)	**770**	74%	**1,040**	100%
Inspections Completed (and inspections as a % of permits)	**713**	93%	**962**	93%
Inspection rate (% of permit holders that were inspected)	**713** / **1,038**	69%	**962** / **1,040**	93%

Source: Data provided upon request from VDEQ's Betsy Bowles.

Data in bold are reported by VDEQ and data not in bold are estimated by Perez. "NR" represents data that was not reported by VDEQ.

There are six regional inspection offices in the state and the office covering the poultry growers in Accomack County is the "Tidewater" office. According to the 2005

JLARC audit of five VDEQ regional offices, JLARC determined that four offices were unable to meet the law's requirement of performing annual inspections every year, primarily due to lack of sufficient inspectors but also due to two outbreaks of avian influenza.

As for the inspection capacity of the Tidewater office, JLARC found that "the regional staff completed only a few annual inspections between July 2001 and April 2003," because the VDEQ inspector at the Tidewater office left to go to another regional office and VDEQ was unable to fill the position until May 2003. Two staff from the Virginia Beach office completed some of the annual inspections during this time period on a part-time basis. Thus, for the first two years of Virginia's Poultry Waste Law, the regulated poultry growers in Accomack County experienced very few and infrequent on-farm inspections.

JLARC also reported that two outbreaks of avian influenza prevented staff at several regional offices from visiting poultry farms, as is the established industry protocol to reduce spread of the disease. Thus from March 11, 2002, to September 11, 2002, and from September 8, 2003, to March 11, 2004, inspections of poultry farms were suspended in the Tidewater and other regions of the state. JLARC (2005) reports, "During FY 2004, the Tidewater regional office missed about 20% of their inspections due to avian flu. The majority of the inspections delayed by the avian flu outbreak in this region have since been completed."

Thus, given the staffing and disease outbreak challenges preventing VDEQ from carrying out the law's annual inspection requirements, reliance on these inspections as the method to determine basic administrative compliance has proven to be inadequate.

Though Virginia's intention to inspect all regulated farms annually may have had a significant deterrence effect, in contrast to the effect imposed by Maryland's and Delaware's the less than 10% inspection rates, the inadequate staffing and avian influenza outbreaks undermined that effect.

2. Summary statistics show nearly 90% of Virginia livestock and poultry operations in compliance, while JLARC's review indicate 32 to 50% of reviewed inspection files had at least one deficiency

VDEQ has three formal enforcement responses to issues of non-compliance: warning letters, notices of violation, and notices of violation that are referred to enforcement. Bowles explained that many minor compliance problems will not rise to the level of formal enforcement activity that warrants a Warning Letter. These minor problems should be documented in the inspection reports kept by each regional office and only the serious problems receiving one of three enforcement responses are reported to the central VDEQ office, where the formal enforcement actions are aggregated into summary statistics.

JLARC reviewed the regional office inspection files for 227 randomly selected operations over two years and found that 48% of the farms (109) had at least one deficiency requiring corrective action in one year, while 32% (73 farms) had at least one deficiency in the second year. Deficiencies included: out of date manure or soil tests, over-application of nutrients, incomplete field records, application of manure during improper months, and lacking records for calibration of manure spreader, amongst others. Of these deficiencies, only 17 operations were issued warning letters and five received notices of violation.

Thus, it appears that between 30% and 50% of the randomly reviewed farms had non-compliance problems, but only 12% of the farms with at least one deficiency received formal enforcement action and came to the attention of the VDEQ headquarters office. JLARC describes the enforcement style of VDEQ as “compliance assistance,” wherein staff prefer to use an “informal, educational approach” to enforcement as opposed to formal enforcement procedures.

Using the summary statistics from FFY 2007, various problems were discovered during the inspections prompting VDEQ to issue 71 Warning Letters, 28 Notices of Violation (NOVs), 26 of which were referred to enforcement proceedings (see table below). In FFY 2008, VDEQ issued 89 Warning Letters, 30 Notices of Violation, 27 of which were referred to enforcement. Thus, 13 to 14% of inspected permit holders had non-compliance problems indicating that 86 to 87% of farmers in Virginia in these two years were in compliance.

Table 6.19. Compliance Rates from Virginia's Inspections

	FFY07	**%**	**FFY08**	**%**
Inspections Completed	**713**		**962**	
Total Warning Letters (and % of inspections that resulted in WLs)	**71**	10%	**89**	9%
Total Notices of Violation (and % of inspections that result in NOVs)	**28**	4%	**30**	3%
NOVs Referred to Enforcement (and %)	**26**	93%	**27**	90%
Total Inspections Resulting in Formal Actions (and %)	**99**	14%	**119**	12%
% of permit holders inspected in compliance		86%		87%

Source: Data provided upon request from VDEQ’s Betsy Bowles.

Data in bold are reported by VDEQ and data not in bold are estimated by Perez. "NR" represents data that was not reported by VDEQ.

3. **Farm-level statistics show serious environmental problems at some farms but my estimates of compliance show even better rates than statewide summary statistics after non-manure generators data is removed**

To learn more about the specific violation problems prompting the issuance of Warning Letters and Notices of Violations, I analyzed the farm-level data for the same fiscal years that summary statistics were supplied (FFY 2007 and 2008). I discovered that a) the number of Warning Letters (WLs) and Notices of Violation (NOVs) in the farm-level spreadsheets did not match the numbers in the statewide summary statistics, and b) that 46 of the WL in FFY 2008 were actually litter brokers and not regulated animal feeding operations. Therefore, my analysis below of types of violations will show only 45 farms as having either WL or NOV violations (rather than 99) in FFY 2007 and only 74 farms with either WL or NOV violations (rather than 119) in FFY 2008. Thus, instead of the 14% and 12% non-compliance rates estimated from VDEQ's summary statistics, I estimate only 6% and 8% non-compliance from the farm-level statistics for FFY 2007 and FFY 2008, respectively.

In an attempt to understand what kinds of compliance issues were uncovered during the farm inspections, I grouped the compliance descriptions into the following 18 categories (see table below). Note that a farm could have more than one violation prompting it to receiving a Warning Letter or a Notice of Violation. However, for the analysis below, I choose only one violation per farm. When having to decide amongst violations, I chose what I considered to be the most serious violation. In only three farms were there so many violations that I decided to create a category called "multiple manure/mortality problems, multiple record-keeping problems, or lacking a plan," because I could not choose which was the most serious violation.

The top three most common compliance problems in the FFY 2007 inspections were:

1. “nitrogen loading rate exceeded” or “over-application of nitrogen,”
2. “phosphorus loading rate exceeded” or “over-application of P” or “crop removal rate of P exceeded,” and
3. records (lack litter transfer records, lack field application records, lack spreader calibration records).

The top three most common compliance problems in FFY 2008 were:

1. “nitrogen loading rate exceeded” or “over-application of nitrogen,”
2. records (lack litter transfer records, lack field application records, lack spreader calibration records), and
3. test (expired or lacked manure or soil tests).

Table 6.20. Interpreting Data from Virginia's AFO Compliance / Enforcement Status Reports (dairy, swine, beef, and poultry)

Problem Categories	**Description**	**Years 06-07**	**Years 07-08**
1	**"phosphorus loading rate exceeded" or "over application of P" or "crop removal rate of P exceeded"**	8	4
2	**"nitrogen loading rate exceeded" or "over application of N"**	9	13
3	**"manure applied to fields not scheduled to receive manure in NMP"**	0	3
4	**"manure discharge to waters of the state" or "wastewater discharge"**	3	0
5	**multiple manure/mortality problems, multiple record-keeping problems, or lacking a plan**	2	1
6	**liquid manure lagoon issues (insufficient freeboard maintaining, evidence of burrowing in lagoon berm, trees in the berm)**	1	3
7	**litter pile (poorly maintained, outside for more than 14 days)**	1	4
8	**mortality (improper disposal, improperly composting)**	0	3
9	**plan (expired NMP plan or lack a plan)**	4	4
10	**test (expired or lacked manure or soil tests)**	3	9
11	**permit (farm is an AFO that needs a permit, # of animals on farm exceeds # allowed in permit, new owner has not yet updated the permit)**	1	4
12	**record (lack litter transfer records, lack field application records, lack spreader calibration records)**	7	11
13	**"failed to attend training events"**	3	1

14	**"no response to warning letter"**	3	0
15	**"Null"**	0	5
16	**unknown or blank reasons**	0	8
17	**"noncompliance" with NMP or permit**	0	1
	Total	45	74
Source: Data provided upon request from VDEQ's Betsy Bowles.			
Data in bold are reported by VDEQ and data not in bold are estimated by Perez. "NR" represents data that was not reported by VDEQ.			
Note that FFY07 Summary Statistics reports 99 farms with inspection problems warranting warning letters or Notices of Violations. Using the farm-level data for this analysis, I found only 45 farms. The Summary Statistics for 07-08 showed 119 farms with WL or NOVs. Using the farm-level data, I found 120 farms but 46 were litter brokers and not end-users.			

In an attempt to better understand the severity of violations detected at each farm, I grouped the 18 categories of violations into the following four categories: (1) evident enviornmental problems, (2) expired plan or lack of plan, (3) record-keeping, and (4) failed to attend training and miscellenaeous (see table below). Therefore, of the 713 farms inspected in FFY 2007, I counted only 45 farms with violations, or only 6% were found to be non-compliant, and thus 94% of the inspected farms were in compliance with the VPA permit. (Recall that the dataset includes both poultry and livestock farms but that poultry operations make up 80% of the VPA-permitted population. Recall also that approximately 25% of poultry operations are actually turkey operations rather than broiler chicken farms.)

Over half the violations (24 of the 45 farms) I considered as "evident enviornmental problems," which include nutrient overapplication, improper use of manure, manure discharge into waters, problems with litter piles and liquid manure lagoons, animal mortalities, and the multiple problem category. A quarter of the farms (11 of 45 farms) had record-keeping problems, including expired or lacking manure or soil tests, missing litter transfer records or field application records or spreader calibration records, lacking a permit, or having a permit but raising more animals than allowed in the permit. Only four farms (9%) had expired plans or no plans.

Table 6.21. Analysis of Virginia's Farm-Level Inspection Statistics				
	FFY 06 - 07		**FFY 07 - 08**	
	Farms	**Percentage**	**Farms**	**Percentage**
Total inspected	713		962	
In compliance	668	94%	888	92%
Total non-compliance	45	6%	74	8%
Evident environmental problems (over application of N or P, manure on wrong fields, manure discharge to waters, problems with lagoon, litter pile, and mortality, multiple manure and mortality problems)	24	3%	31	3%
Expired or Lack a Plan	4	1%	4	0.4%
Record-keeping (expired or lacked manure or soil tests, lacked litter transfer records or field application records or spreader calibration records, lacked a permit or # animals exceeded permit	11	2%	24	2%
Failed to attend training, no response to warning letter, null, unknown or blank, "noncompliance"	6	1%	15	2%

Thus, even though the same deficiencies identified by JLARC in the regional staff inspection files are those that receive formal enforcement action, because the VDEQ staff emphasize “bringing farmers into compliance,” very few receive formal warning letters or notices of violation and those that do are likely farmers that continue to commit violations.

4. Only three fines have been assessed in Virginia but the penalties have been high

In the four years of farm-level statistics provided by VDEQ (2004 to 2008), I observed only three farms receiving penalties. One farm received a fine of $39,000 for “unauthorized discharge; violation of fecal coliform water quality standards,” indicating a liquid manure lagoon had spilled into waters of the state. Another farm received a $1,750 fine for “improper storage of poultry waste, expired litter analysis, expired nutrient management plan, failure to comply with NM plan, inadequate mortality disposal, failure to provide litter transfer records, and had received both a warning letter, and a notice of violation.” Of the three farms with penalties, this is the only farm that appears to be a poultry operation.

The third farm received a $2,500 fine for “required freeboard[17] not maintained, no current NMP.” The farm receiving the $2,500 fine does not appear to have as egregious a violation as the two other farms, but I did discover that this farm was listed with violations the two previous years as well.

Table 6.22. Farms Assessed Penalties for Non-Compliance in Virginia 2004 to 2008				
	2004-05	**2005-06**	**2006-07**	**2007-08**
# Farms Assessed Civil Penalties	**0**	**2**	**1**	**0**
Fine per farm		**$39,000**	**$2,500**	
		$1,750		
Data in bold are reported by VDEQ and data not in bold are estimated by Perez. "NR" represents data that was not reported by VDEQ.				
Source: Data for farm-level statistics provided upon request by Betsy Bowles, VDEQ, in spreadsheet for each fiscal year entitled, "VDEQ Animal Feeding Operations Permits Enforcement Summary.”				

Thus, in addition to the lowered deterrence effect because inspections did not occur annually for most farms, with only a 1.2% chance of getting fined (3 out of 219 non-compliant farms over the four years), farmers may view even Virginia’s law as carrying “a very little stick.”

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[17] Note that freeboard is the distance between the top of the liquid manure and the top of the lagoon.

5. Virginia's Poultry Waste Transport Program hasn't gained traction

Unlike the laws in Maryland and Delaware, the 1999 Poultry Waste Law did not establish a manure transport program but did require the commercial poultry processors to file a plan with the state:

> "…under which the processor, either directly or under contract with a third party, shall…participate in the development of a poultry waste transportation and alternative use equal matching grant program between the Commonwealth and commercial poultry processors."

The Law also required VDCR, VDEQ, and the state department of agriculture to recommend:

> "…ways that the Commonwealth should assist poultry growers and processors to improve the economic feasibility of transporting and selling poultry waste, and pursue alternative uses for poultry waste, including the establishment of the equal matching grant program referred to (earlier)."

In 2003, however, VDCR and the Virginia Poultry Federation jointly funded a pilot poultry litter transport program that was restricted to the top four most concentrated poultry production counties in the Shenandoah Valley. Thus, Virginia Eastern Shore growers in Accomack County were not eligible for participation (as they were not eligible for participation in Maryland's or Delaware's manure transport programs either). JLARC deemed the program unsuccessful in its 2005 report because: a) the initial reimbursement rate for receiving litter was only $6/acre in the first year and thus only 16 farmers applied and the program only moved 1,342 tons of litter, b) when the rate was increased to $10/acre in the second year, 43 applicants received cost-share and received 4,396 tons of litter outside of the generating counties, c) only $50,000 was available for the whole program so funds were exhausted within two years, and d) farms receiving the cost-share funds for accepting the manure were required to develop and implement nutrient management plans, which may have limited interest in the program.

In 2007, the state and VPF again established a poultry litter transport program and provided $600,000 for three years to transfer excess poultry manure from just two of the most concentrated poultry producing counties in the Shenandoah Valley: Rockingham and Pace Counties. I have requested data from VDCR regarding this 2007 program but have not yet received information. It remains to be seen how well used this second version of Virginia's poultry litter transport program is.

6. JLARC's farmer survey indicates nearly 40% of farmers think their plan is only sometimes or rarely realistic but 98% say they always or most of the time implement their plan

In its evaluation of nutrient management planning in Virginia, the JLARC conducted a survey of both regulated and unregulated farms with nutrient management plans and public and private consultants that prepare nutrient management plans. JLARC explained:

> "In order for the State's nutrient management planning program to effectively reduce agricultural pollution, NMPs must be properly implemented and consistently utilized over time. Farmer implementation and compliance is likely to result in one of two ways.
>
> First, if farmers perceive that their NMPs are realistic for their farms and beneficial for their farm operations, then as long as they understand the requirements of their plan, they are likely to implement them based on their own self-interest.
>
> Second, even if not perceiving their plans as positively beneficial for their farm, farmers may implement the plans in deference to the requirements of State law."

Thus, JLARC conducted a survey of 281 VPA-permitted animal operations (but JLARC did not distinguish between livestock or poultry facilities) that had nutrient management plans and asked "How realistic is the plan?" (see the table below excerpted from the JLARC Report for the results of the survey). About two-thirds of the regulated farmers said that the plan was realistic "always" or "most of the time," while just over a third said the plan was realistic "sometimes" or "rarely or never."

JLARC concluded:

> "The results suggest that a majority of farmers with NMPs may be willing to implement their plans all or most of the time simply on the basis that they view their plans as providing a realistic assessment of nutrient needs of their fields, and therefore it is in their self-interest to do so.
>
> However, the results also indicate that a substantial minority of respondents (40%) think that their NMPs are only sometimes or rarely realistic. Implementation and compliance with NMPs in this case is likely only achievable if these farmers wish to, or are compelled to, defer to NMP fertilizer recommendations due to legal requirements that they do so."

Table 6.23. JLARC: Farmer Views on the Extent to Which Their NMPs Are Realistic

Farmer Views on the Extent to Which Their NMPs Are Realistic

How Realistic Is the Plan?	Respondents With Operations Under Confined Animal Control Law		All Respondents With NMPs	
	Number	Percent	Number	Percent
Always	54	19.2	67	18.9
Most of the Time	119	42.3	162	45.6
Sometimes	86	30.6	103	29.0
Rarely or Never	22	7.8	23	6.5
Total	**281**	**100.0**	**355**	**100.0**

Source: JLARC staff survey of regulated confined animal and poultry feeding operations and JLARC staff and USDA Virginia Agricultural Statistical Service survey of farmers in Virginia, summer 2004.

Given Virginia's unwillingness to levy fines but for three farms out of 219 non-compliant farms, the 40% of regulated farmers that think their plans are only sometimes or rarely realistic may not be adhering to their plans.

JLARC provided farmers with reasons why they might feel their plan was only sometimes or never realistic and farmers could choose more than one response:

- 72% believed that the NM plan recommended amounts of nutrients/litter/manure that were too small,
- 62% said the plan does not adequately consider farm economic concerns,
- 36% said the plan has unrealistic assumptions about management of excess manure or transport of excess litter from the farming facility,
- 28% thought the plan provides impractical or inappropriate recommendations on the timing of fertilizer applications, and
- 24% said the NM plan recommendations are too complex and confusing.

JLARC also asked regulated farmers about the extent to which they implemented their plans and asked private and public planners the extent to which the plans they prepare are being implemented by farmers (see table below).

Overall, farmers overwhelmingly report that they either “always” (60%) implement their plan, or implement their plan “most of the time” (38%). In my opinion, this finding suggests a social desirability problem may be occurring, as 98% of farmers know the socially appropriate answer to this legally liable question asked by the state commission.

In contrast, only between 8 and 14% of the public and private planners, respectively, said that farmers “always” implement the plans they prepare. However, between 57% and 85% thought that farmers implement their plans “most of the time.” Hence, between 71 and 93% of planners also thought that farmers are always or most of the time implementing their plans. The fact that these estimates by planners are, overall, quite similar to the self-reporting by farmers may suggest there may not be a social desirability problem after all. However, the response categories always, most of the time, and some of the time, may be understood differently by each group of respondents as a large percentage of private planners said they thought farmers followed their plans some of the time.

Table 6.24. JLARC: Implementation Rates of Farmers with Required NMPs

Implementation Rates of Farmers with Required NMPs

Farmer / Specialist Response	Percentage of Farmers	Percentage of Non-DCR Specialists	Percentage of DCR Specialists
Always implement plan	60	14	8
Implement plan most of the time	38	57	85
Implement plan some of the time	2	29	8
Never implement plan	0	0	0
Total Respondents	**288**	**21**	**13**

Source: JLARC staff survey of regulated confined animal and poultry feeding operations and survey of nutrient management specialists.

Finally, JLARC matched up the responses of farmers regarding how realistic they regard their plan and the extent to which they implement their plans and found a) confirmation for the hypothesis that those who believe their plans are realistic are more likely to implement their plans and b) a likely example of a social desirability problem with their questionnaire (see table below). That is, of the 53 farmers who said their plan is always realistic, 94% said they always implement their plan. And of the 117 farmers who said their plan was realistic most of the time, 47% said they always implement the plan while 43% said they implement their plan most of the time. JLARC's comment about 22 farmers who said their plan was rarely or never realistic was:

> "Interestingly, whether due to deference to the requirements of the law, or overly optimistic self-reporting of compliance, among the relatively small group of respondents who felt that their plans were rarely or never realistic, half reported that they nonetheless always implement their plans."

Given the infrequent farm inspections that were occuring between 2001 and 2004 before JLARC's survey and the 1.2% chance of getting fined for non-compliance, farmers likely feel little "deference to the requirements of the law," and this response is likely suffering from a social desirability problem of underreporting bad behavior.

Table 6.25. JLARC: How Realistic Plans Are Versus How Often Implemented

Comparison of How Realistic Plans Are with How Often They Are Implemented

How Realistic Is the Plan?	Number of Respondents Whose Plans Are Realistic . . .	Farmers' Implementation of NMPs (Percentage of Respondents)		
		Always	Most of the Time	Some of the Time
Always	53	94	6	0
Most of the Time	117	57	43	0
Sometimes	84	40	56	4
Rarely or Never	22	50	36	14

Notes: The implementation rates are based on the number of respondents who believe their plan is always realistic, is realistic most of the time, is sometimes realistic, or is rarely realistic. For example, 53 respondents believe their plan is always realistic, and 94 percent of these farmers indicated that they always implement their plans.

Source: JLARC staff survey of confined animal and poultry feeding operations who are required to have a NMP.

7. **JLARC finds Virginia's "inspection and enforcement processes are weak"**

JLARC (2005) concluded that because a) VDEQ's "compliance assistance" approach continues several years into the poultry regulations when the law's requirements should be well understood, b) the process of determining adherence to the regulations is difficult, and c) insufficient inspection capacity, Virginia's inspection and enforcement processes for the required nutrient management plans have been weak.

JLARC observes that:

> "State inspections and enforcement efforts have placed a premium upon having amicable relationships with the regulated farmers. This priority is evidenced in the inspection and enforcement that is taken, including announced rather than unannounced inspections, and a presumption that noncompliant farmers need to be educated rather than penalized to help bring them into compliance."

JLARC concludes:

> "For farmers using required NMPs for the first time, this focus may be appropriate. However, most inspections that DEQ now conducts are repeat inspections, and to this point, DEQ has had weak enforcement. The degree of rigor that is appropriate for the State's inspection and enforcement program for NMPs is a policy choice. However the State may wish to consider whether the DEQ should proceed more vigorously in instances where there are serious or repeated violations of the NMP conditions."

Regarding the "inherent difficulty of the task," JLARC recognized that "it is difficult for DEQ staff to really monitor what is happening on farms at the time of nutrient applications." Inspections largely involve reviewing farm records and conducting a visual inspection of the facilities. The review of records is "a paper-driven process that focuses on soil and waste monitoring, land application information, and litter transfer records." During the visual inspection of fields, staffs focus on proper manure storage, mortality disposal or composting, and land application of waste, if possible.

JLARC observed that because "field inspections are not done during or immediately after field applications (of nutrients) have been made, DEQ staff were not able to confirm which application methods or amounts (of nutrients) were used."

DEQ staff explained to JLARC that:

- They distribute the workload of full-time inspectors throughout the year rather than managing staff to maximize inspection presence at times of field applications;
- DEQ staff believe that their presence at the time of field applications would be more disruptive of farm operations and would be unfavorably received by farmers;
- If farmers are applying nutrients at the time of an inspection, they are not free to produce records or answer many questions; and
- Farmers might use the proper application rates and timing simply due to the fact that they are being observed.

JLARC concluded that "the argument that the visits themselves might induce compliance simply due to the observation process is weak, given that obtaining compliance is a key part of the objective."

In addition to the challenge of detecting non-compliance outlined by JLARC, my interviews with Tidewater area VDEQ Inspector, Josh Dodson, revealed that inspectors face a cultural and legal challenge of proving non-compliance is occurring.

In response to my question about two Accomack County regulated growers that told me they apply 4.5 and 5 tons of poultry manure per acre, Dodson shook his head and exclaimed:

> "Five tons per acre is disconcerting and extremely irresponsible. I could probably take three or four guesses as to who it is but what as inspectors can we do but accuse them of falsifying records? Other than calling them flat out liars, what can we do?"

Since adherence compliance largely depends on a review of records, and nutrient application violations are difficult to detect or prove through simple calculations from paper work, compliance assistance is inevitable. Indeed, having sufficient proof of wrongdoing to justify the taking of formal enforcement steps – that begin with a warning letter, then a notice of violation, a charge letter, an administrative hearing, and finally the levying of penalties – is very difficult.

Wrap-up of Virginia's Estimates of Adherence Compliance

Due to lack of inspection staff and avian influenza outbreaks, inspections statewide – but particularly in the Tidewater region in which the farmers in this dissertation are located – have not achieved the 100% rate required by the state regulations. In recent years, inspection rates have improved to 69 and 93% of all VPA-permitted facilities, including livestock operations. Thus, in contrast to the under 10% annual inspection rates in Maryland and Delaware, Virginia's imperfect inspection rates are nevertheless exceedingly high.

Reviews by JLARC in 2004 of regional inspection files show that a third to half the reviewed operations had at least one deficiency but only 12% of those with deficiencies elicited formal enforcement actions. Thus, my reviews of VDEQ's summary statistics in 2007 and 2008 show only 14% and 12% of inspected farms with formal enforcement actions, indicating that VDEQ may still be relying on "compliance assistance" nine years into implementation of the 1999 Poultry Waste Law. Half of the formal enforcement actions in my review were for serious environmental problems while a quarter were for record-keeping problems. Furthermore my analysis of the last four years of available farm-level statistics shows that there is only a 1.2% chance of getting fined for non-compliance. Thus, Virginia's otherwise "big stick" regulatory opportunity fades when it fails to inspect all farms annually, rarely gives formal enforcement action for non-compliance, and even more seldom penalizes farmers.

6.5. Summary

Chapter 6 has demonstrated that it has been very difficult for all three states to know the answers to even the most basic questions about administrative compliance, such as who is regulated or if they have a current plan. The problem for Maryland was that it had a relatively large pool of potentially eligible farmers from which it had to determine who was eligible, the state was insufficiently prepared to carry out implementation of the regulatory program within the required three-year time frame, and most importantly, the state experienced major backlash from its regulated community. Maryland's agricultural regulatory experience is largely a cautionary tale of the negative ramifications of alienating the regulated farmers.

For Delaware, the state's problem with determining administrative compliance rests on its decision to hamper the regulatory authority's ability to fully account for the compliance status of all eligible farmers. Delaware's experience is also a cautionary tale of how the benefits of gaining buy-in from the regulated community, as will be reiterated below, may be undermined by regulatory capture.

Virginia's inability to determine administrative compliance appears least significant and technically solvable through changes to its inadequate database system.

Furthermore, it is even more difficult, if not impossible for the states to know if and how well farmers are complying with their nutrient management plans and other regulatory requirements. As observed by JLARC, plan-based agricultural regulations are very difficult to implement, monitor, verify, and enforce. Hence, in reality, plan-based regulations are really voluntary.

Given this reality, estimates of adherence compliance by all three states should be taken with a grain of salt. Furthermore, comparison of inspection and compliance statistics in each state is difficult because Maryland inspects "high risk" and "non-compliant" farms and only inspects about 10% of its eligible operations; Delaware inspects about 2% of its farms; while recently Virginia has inspected nearly its entire regulated population (see table below). Nevertheless, given the available data for calendar and fiscal years 2008, there does appear to be a major difference in compliance rates between states with Maryland showing the poorest rates (65%) and Delaware and Virginia showing similar rates (84% and 88%, respectively).

Table 6.26. Comparing State Inspection, Violation, and Compliance Rates							
		Maryland		**Delaware**		**Virginia**	
		CY 2008		**CY 2008**		**FFY 2008**	
Inspection rate:	# inspections	**450**		**25**		**962**	
	# regulated	**5,902**	8%	**1,158**	2%	**1,040**	93%
Violation rate:	# inspected with violations	158		**4**		**119**	
	# inspections	**450**	35%	**25**	16%	**962**	12%
Computed compliance rate:			65%		84%		88%
Note: Data in bold are reported by MDA, DNMC, or VDEQ and data not in bold are estimated by Perez.							
Note: Maryland's inspections are not random but target a) complaints, b) high risk manure users, and c) violation-prone farms.							
Note: Virginia reports inspections and compliance statistics without distinguishing between animal sector thus I cannot pull out just the poultry growers from the include beef, dairy, and swine permit-holders, though about 890 of the regulated are poultry growers.							

What is strikingly similar between all three states is that given the opportunity to employ a regulatory approach to agricultural sources of pollution, none of the states took advantage of the key factor differentiating a voluntary approach from a regulatory one: the deterrence factor. The economic theory of compliance assumes a firm, when choosing to comply, will trade off the marginal cost of compliance with the marginal benefit of compliance. Hence, “Marginal benefit of compliance often relates to the expected values of fines avoided, which is a function of the probability of inspection, likelihood a violation is found, and magnitude of the assessed penalty” (Brehm and Hamilton, 1996).

If farmers do not value their nutrient management plans, it is not surprising that many would choose to not comply, given a) “inherent difficulty” of detecting non-compliance with a nutrient management plan, b) the frequency of inspection is very low in Maryland and Delaware and even in Virginia in most years, c) the likelihood of formal enforcement action is very low because all states emphasize “bringing farmers into compliance,” and d) the likelihood of penalties, even small fines, is tiny.

Hence, given the inherent challenge to regulating farmers with a plan and the lack of interest on the part of the states to send a serious deterrence signal, maybe the best agricultural regulations are the ones that take account for the workings of farm culture and gain and maintain buy-in from the regulated community.

Delaware's emphasis on cost-share for developing nutrient management plans and for manure transport was critically important to gain buy-in from the regulated community and achieve early compliance with the law. These decisions, coupled with a lack of farmer backlash because farmers felt they had a say in the development of the law and the regulations, are credited with reducing the excess manure problem and reducing the nutrient imbalance problem in the state.

CHAPTER 7 – FINDINGS & ANALYSIS: MY ESTIMATES OF COMPLIANCE (RESEARCH QUESTION 1)

7.1. Introduction

As was revealed throughout Chapter 6, all three states in this dissertation experienced and continue to experience varying levels of difficulty estimating administrative and adherence compliance with their laws because of the built-in challenge of carrying out basic compliance activities: monitoring and verifying whether farmers possess a current plan that reflects land-grant university standards and whether the plan is being implemented properly.

In Chapter 7, I will present four datasets I generated myself from the 60 1.5-hour interviews I conducted with farmers which indicate both administrative and adherence compliance through quantitative data and qualitative insight. The first dataset presents information about three basic nutrient management practices required by all three states. The second dataset presents information about seven more nutrient management practices that at least one state requires. The third dataset presents reactions to six Likert Opinion Statements about the nutrient management plans and the state regulations. The fourth dataset presents counts of comments that either explicitly state or implicitly infer whether a farmer is in adherence compliance, that is, is he following the nutrient recommendations in his plan and implementing the other best management practices required by the law. All quantitative datasets were tested for statistical significance using the Fischer Exact Test for Contingency Tables. Throughout each of the four sections, I present commentary from farmers regarding several nutrient management issues to provide richer context and deeper understanding of the quantitative data.

Regarding statistically significant difference between states, three of the four datasets revealed that farmers in all states were more alike than they were different: (1) the three practices required by all three states, (2) the seven practices required by at least one state, and (3) the counts of comments regarding adherence to the plan or other requirements. Overall, compliance with the required practices or adoption of the recommended practices was poor. For the one remaining dataset, there was a statistically significant difference between states: five of the six Likert Opinion Statements about their plans and regulations. Thus, there is some evidence that a state's policy-making process does affect farmer compliance and some evidence that it does not.

Throughout Chapter 7, I will present some evidence for the main themes of this dissertation, including: a) plan-based regulations which prescribe how farmers should carry out their core business practices will not be followed unless the farmers view the plans as in their economic self-interest, b) some plans prepared by the private sector are different from those prepared by public planners and thus laws that allow both private and public planners can result in different regulatory standards, c) regulations that do not have significant enforcement activities or large penalties for non-compliance have a weak deterrence effect if the regulated community does not wish to follow the plan, and d) gaining buy-in from the regulated community may go so far as "regulatory capture" by the farming community.

7.2. My Compliance Estimates: Three Practices Required by All Three States

There are three practices that all states in this dissertation require either explicitly or implicitly from all regulated farmers: (1) possess a nutrient management plan prepared by a certified planner, (2) conduct soil nutrient analysis at least every three years, and (3) take residual nitrogen credits for previous legume crops and previous manure applications.

All three practices required by all three states showed no statistically significant difference between states, indicating that farmers were more alike than different. Because I had to establish a threshold for determining "good" versus "poor" compliance rates, I chose 60% and above as the cut-off point for concluding a "good" rate of compliance and below 60% as indicating a "poor" rate of compliance. Although one may regard this as a low bar for compliance, because my of my small sample size and because several practices have high non-response rates, I wanted to offer farmers the benefit of the doubt and chose the 60% threshold.

Thus, compliance performance is split for the three practices required by all three states. Farmers across the board showed "good" compliance (60% and above) for two practices (possession of a plan and soil test frequency) while compliance was "poor" (below 60 percent) for taking residual nitrogen credits for manure and for legumes.

1. Possession of a plan prepared by a state-certified planner

All five regulated Virginia poultry growers who are crop farmers and a very large majority of the regulated farmers in Maryland and Delaware (77 to 95 percent, respectively) report possessing the required nutrient management plans and thus are in administrative compliance (see Raw Data Table below). Differences between the states are not statistically significant though the largest group of regulated farmers that reported they did not possess a current plan and thus were not in compliance were from Maryland. The four Maryland farmers (13 %) who said they did not have the required plan all had their plans prepared by Cooperative Extension Service (CES) specialists. Three explained that they had yet to get back in touch with their Extension Specialist to pick up their second, updated three-year plan.

SCP p=0.313	**Table 7.1.a. Do you have a state-certified nutrient management plan? (Raw Data Table)**		
# of Farmers	**Yes**	**No**	**No response**
MD=30	77%	13%	10%
DE=20	95%	0%	5%
VA=5	100%	0%	0%

When the data responses are grouped into compliance categories and the five unregulated Virginia farmers are separated from the five regulated Virginia farmers, there is, as one would expect, a significant difference because none of the unregulated farmers possess a state-certified nutrient management plan. (see Compliance Table below) Of the five non-poultry growers who are not regulated by Virginia's Poultry Waste Law but do use poultry manure, three say they use nutrient recommendations from fertilizer companies, one has a private consultant, and one does not take advice from anyone nor does he use soil tests to inform his nutrient application rates.

Table 7.1.b. Do you have a state-certified nutrient management plan? (Compliance Table)					
Rule	**Compliance**	**Delaware n=20 regulated**	**Maryland n=30 regulated**	**Virginia n= 5 regulated**	**Virginia n= 5 unregulated**
SCP – Status of Current Plan Possession (p=0.428 regulated only) (p=0.000 w/ unregulated)** All 3 states require possession of a current Nutrient Management Plan.	In compliance	95%	77%	100%	0%
	Non-compliance	0%	13%	0%	100%
	No response	5%	10%	0%	0%

In comparison to one previous study, the regulated farmers from all three states interviewed in this dissertation are doing better or as good than the farmers in the past in terms having a nutrient management plan, and the unregulated farmers are doing worse than farmers in the past. The 1997 Maryland Department of Agriculture (MDA) survey of 129 Pocomoke watershed farmers found that only 56% had a voluntary nutrient management plan while 70% of farmers in all three Lower Eastern Shore counties had a voluntary plan.

The statistics from the Michel et al.1996 Master's thesis are difficult to interpret. Michel et al. found 192 out of 562 Delmarva poultry grower respondents (only 34 percent) had a voluntary nutrient management plan. But, given that only 210 growers in the study's survey said they raised crops, I would assume that only 210 would be inclined to get a nutrient management plan. Thus, if I assume that the 192 growers who said they had a nutrient management plan were crop farmers then perhaps 91% of growers (192 / 210) who are crop farmers had a plan. However, Michel et al. reported that when poultry growers were asked how they determine their manure application rate, only 78 of the 218 respondents to that question (36 percent) said they used a nutrient management plan. In addition to the curious finding that 218 growers apply manure to cropland but only 210 are crop farmers, potentially only 41% (78 / 192) of the growers possessing a plan actually using the plan to determine manure application rates on cropland.

2. Taking Soil Tests

All three state laws require farmers to take soil tests at least every three years. Conducting soil nutrient analysis is a basic diagnostic test and is a critical step in the process of developing a nutrient management plan because it provides information about phosphorus, potassium, and several minor elements and the acidity of the soil, which are key factors to growing crops.

When reviewing the Raw Data Table (below), differences between the states are not statistically significant, and a large majority of farmers (at least 73 to 95 percent) in all three states reported testing their soils at least every three years and thus are in compliance. In fact, 43 to 60% of farmers said they actually test their soils for nutrients every single year and thus are rigorously using this diagnostic test and exceeding the compliance standard. The one farmer who said he never tests his soils is the unregulated Virginia farmer who said he does not even use advice from his fertilizer company. (Note that the rules or guidance provided by each state for each nutrient management practice discussed in this chapter is provided in each data table.)

STF p=0.292	**Table 7.3.a. Soil Testing Frequency (Raw Data Table)**				
# Farmers	**Every year**	**Every 2 years**	**Every 3 years**	**Never**	**No response**
MD, N=30	**43%**	10%	20%	0%	27%
DE, N=20	**60%**	5%	30%	0%	5%
VA, N= 10	**60%**	0%	20%	10%	10%
MD Rules	Rules: "Soil analysis results for a plan are valid for **3 years**…"				

	Rule Source: The Nutrient Management Law. 15.20.08.05D Content and Criteria for a Nutrient Management Plan Developed for an Agricultural Operation.
DE Rules	Rules: Soil test included with the required Nutrient Management Plan can **be no older than 3 years** from a certified agronomic laboratory. Guidance: "Soil sampling is one of the main elements of a nutrient management plan." and "Have soils tested for P at least **every three years** to monitor build-up or decline in soil P." Rule Source: Delaware Department of Agriculture. "What is a Nutrient Management Plan?" DOC. NO. 65-01-12-01-02-07. Guidance Source: Delaware Nutrient Management Notes. "Soil and Litter Sampling for Nutrient Analyses." September 2000 Vol. 1, No. 9 Guidance Source: University of Delaware. “The Phosphorus Site Index: A Phosphorus Management Strategy for Delaware’s Agricultural Soils.” Cooperative Extension. Revision Date: 1/1/2002. J.T. Sims, A.B. Leytem, Department of Plant and Soil Sciences. ST-05
VA Rules	Rules for Permittees: "Soil samples for manure application fields will be analyzed **at least once every three (3) years** for pH, phosphorus, potassium, calcium, and magnesium in order to maximize the efficient utilization of nutrients." Guidance for Non-Permittees: "Soil sample fields where poultry litter will be applied...samples should be taken in late summer or fall." Rule Source: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance Source: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.

In the Compliance Table (below), differences between states do become statistically significant both when sampling only the regulated population and when the five unregulated Virginia farmers are included in the statistical analysis. However, not too much should be made of this difference since in the first instance the statistical significance comes from the 27% of Maryland farmers having no responses. This may be a reflection of those farmers hiding their soil testing rate from me given a perceived social desirability problem that they were not testing their soils as frequently as they knew they should. In the second instance, the 20% of the unregulated Virginia farmers that were non-compliant represents the one unregulated farmer who said he never takes soil tests. Hence, though statistically significant, it is not critically important for this dissertation except to note that there are some farmers who are farming without use of the basic diagnostic tools.

Table 7.3.b. Soil Testing Frequency (Compliance Table)					
Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
STF – Soil Testing Frequency (p=0.089* regulated only) (p=0.047 w/ unregulated)** All 3 states require soil testing at least once every 3 years.	In compliance	95%	73%	100%	80%
	Non-compliance	0%	0%	0%	20%
	No response	5%	27%	0%	0%

The comparison of farmers in this dissertation to those in the 1999 Smith study provides some insight though the comparison is not precise. Smith did not ask about the frequency of soil testing but rather asked whether farmers use soil tests to inform their nutrient application decisions. Smith found that 98% of “plan” farmers and 85% of “no plan” farmers reported using soil tests as the basis for their nutrient application rates. Thus, overall, farmers in this dissertation appear to be valuing soil tests as much as farmers in the past.

3. Taking residual nitrogen credits for manure and for legumes

None of the three state laws specifically require farmers to “take credits” for previous applications of manure or previously planted legume crops but the process of subtracting residual nitrogen that is leftover in the crop fields is a basic step in the development of the nitrogen application recommendations in a nutrient management plan. It is fair to expect farmers to report that they do take these credits even though most farmers do not prepare their nutrient management plans because: a) all the farmers I interviewed knew what the concept of taking residual nitrogen credits for manure and legumes involves, b) farmers have been exposed to this concept for decades either through the voluntary nutrient management programs in Maryland and Virginia or through their cooperation with the Soil Conservation Districts and Cooperative Extension Service in Delaware and c) most Soil Test Laboratories provide nitrogen recommendations and those heeding land-grant university nutrient recommendation guidelines should ask farmers to provide information about legumes and manure in order for them to take residual nitrogen credits into account.

In addition, because there is a concern that farmers are not following their plans (as has been discussed in Chapter 3 and 6 and will be demonstrated in this chapter and Chapter 8) but are determining their own nitrogen recommendations, one would like to know if they are calculating these residual nitrogen credits on their own. Farmers that do not take credits on their own or receive plans or soil test recommendations that do not take residual nitrogen credits are over-applying nitrogen.

Results show that most farmers in all three states are not taking residual nitrogen credits for manure (50 to 70%) or for legumes (45 to 70%) into account and are thus not compliant and are likely over-applying nitrogen. (see Raw Data Tables below). Differences are not statistically significant.

RNM p=0.183	**Table 7.4.a. Do you take residual nitrogen credits for previous applications of manure? (Raw Data Table)**		
# Farmers	**Yes, I take N credits for manure**	**No, I don't take credits**	**No response**
MD, N=30	17%	**77%**	7%
DE, N=20	20%	**50%**	30%
VA, N= 10	10%	**70%**	20%
MD Rules	Guidance: "Take nitrogen credits for legumes in rotation and past applications of manure and sewage sludge." Maryland Cooperative Extension. “Focus On Nutrients and the Hydrologic Cycle.” Nutrient Manager Newsletter of the Maryland Cooperative Extension Agricultural Nutrient Management Program. University of Maryland. College Park-Eastern Shore. Volume 3. Issue 1. Summer 1996.		
DE Rules	No rules or guidance found.		
VA Rules	Rule for Permittees: Table 8-3. Manure Residual Factors for Previous Applications* Historical Frequency of Manure Application on the Field & Residual Factor Rarely Received Manure in Past (0-1 years in last 5) = 0 Residual Factor		

	Frequent Past Applications (2-3 out of 5 years) = 0.10 Residual Factor Continuously Received Manure (4-5 out of 5 years) = 0.20 Residual Factor. *Accompanying text: If more detailed manure history information is available, a residual availability of the initial organic nitrogen content of .12, .05, .02 may be used for one, two, and three years respectively following application. Rule for Permittees VDCR. Nutrient Management Standards and Criteria. Revised October 2005.

RNL p=0.228	**Table 7.5.a. Do you take residual nitrogen credits for previously planted legume crops? (Raw Data Table)**		
# Farmers	**Yes, I take N credits for legumes**	**No, I don't take residual N credits**	**No response**
MD, N=30	23%	**70%**	7%
DE, N=20	25%	**45%**	30%
VA, N= 10	30%	**60%**	10%
MD Rules	Guidance: "Take nitrogen credits for legumes in rotation and past applications of manure and sewage sludge." Maryland Cooperative Extension. “Focus On Nutrients and the Hydrologic Cycle.” Nutrient Manager Newsletter of the Maryland Cooperative Extension Agricultural Nutrient Management Program. University of Maryland. College Park-Eastern Shore. Volume 3. Issue 1. Summer 1996.		
DE Rules	No rules or guidance was found.		
VA Rules	Rules for Permittees: No text) Table 7-1. Estimated Nitrogen Availability to Succeeding Crops From Legumes. Guidance: "When soils test very high (VH) in phosphorus, do the following calculations to obtain the proper litter application rate … Determine N need for the current crop (do not forget to credit N from previous legume crops)." Rule for Permittees? VDCR. Nutrient Management Standards and Criteria. Revised October 2005. Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.		

It is surprising that when the data for taking manure nitrogen credits was analyzed with just the regulated population (see Compliance Table below for “RNM”) there is no statistical difference between states but when the regulated population is tested for taking credits for legumes nitrogen credits (see Compliance Table below for “RNL”), there is a significant difference. This difference does not appear important, however, because it is likely due to the high non-response rate of 40% from the two regulated Virginia farmers.

Table 7.4.b. Do you take residual nitrogen credits for previous applications of manure? (Compliance Table)					
Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
RNL (p=0.192 regulated only) (p=0.291 w/ unregulated) Taking residual nitrogen credits for previous legume crops is a basic step in the nutrient management planning process and is in each state's Technical Manuals which have the force of law.	In compliance	25%	23%	20%	40%
	Non-compliance	45%	70%	60%	60%
	No response	30%	7%	20%	0%

Table 7.5.b. Do you take residual nitrogen credits for previously planted legume crops? (Compliance Table)					
RNM (p=0.077* regulated only) (p=0.100 w/ unregulated) Taking residual nitrogen credits for previous legume crops is a basic step in the nutrient management planning process and is in each state's Technical Manuals which have the force of law.	In compliance	20%	17%	20%	0%
	Non-compliance	50%	77%	40%	100%
	No response	30%	7%	40%	0%

In comparison to the 1999 Smith study, farmers in this study are doing "worse" regarding residual manure nitrogen credits than the farmers in the past. Of the 73% of farmers who used manure on crops in the 1997 Smith study, 42% said they took nitrogen credits for manure applied to fields in previous years, in comparison to just 10 to 20% of the farmers in this dissertation. There is no previous study on residual nitrogen credits for legumes with which to compare this study's data.

As for the reasons given by many farmers for not taking residual nitrogen credits, most said they don’t factor it into their nutrient application decisions because a) they think the amount left over in the soil is small, b) they feel they cannot rely on the residual nitrogen to be available to their crop, and c) if the residual amount does become available, farmers take that extra amount as a bonus “deposit in the soil bank.”

Many farmers used the metaphor of a bank and a savings account to describe their nutrient application philosophy of “feeding the soil.” By not taking residual nitrogen credits, many farmers said that leftover amount might be useful during the growing season “if we got a good rain.” Thus, many farmers explained they preferred not to reduce their nitrogen application by the residual nitrogen amount saying they wanted to “hedge our bets against bad weather and in the hopes of good weather.” As will be discussed in Chapter 8, the nutrient application philosophy of “feeding the soil” is discouraged by the land-grant universities because it results in over application.

Even one private nutrient planner, whom I shall refer to as A throughout this dissertation, who prepares plans in all three Delmarva states, appears not to value residual nitrogen either. Farmer 18 from Worcester County showed me what Private Planner A wrote in Farmer 18’s plan about residual nitrogen credits. Farmer 18 opened his nutrient management plan to one of his field’s pages and in the middle of the page was a comment that read approximately, “Taking residual nitrogen credits per Maryland’s requirements may result in under-fertilization.” (4-6.2, Farmer 18, Wor) Thus, Consultant A followed the state-certified protocol of taking residual nitrogen credits but undermined the farmer’s likelihood of following the plan with the printed comment.

In contrast to Private Planner A, Private Planner C who prepares the plan for Farmer 51 from Sussex does calculate residual nitrogen credits and actually discusses the plan with Farmer 51 and makes Farmer 51 comfortable with lowering his nitrogen rates. Farmer 51 said, "Private Planner C is our planner. If we're shooting for 200 bushels of corn, instead of applying 200 lbs of nitrogen, Private Planner C says we got 15 lb left over from the previous year so we only put down 185 lbs." (3-23.2, Farmer 51, Sus)

Farmer 55 from Sussex County demonstrated his acceptance of the science of residual nitrogen and gets his plan prepared by a certified planner at the Sussex County Soil Conservation District:

> "I don't never go over [above] the soil test recommendations. If they [the University of Delaware Soil Test Lab] say you need 150 lbs of N for a 160 bushel crop, I trust what they recommend." (2-10.2, Farmer 55, Sus)]

Thus, if 45 to 70% of farmers in all three states are not taking either manure or legume residual nitrogen credits this suggests that this fraction of farmers may be a) over-applying nitrogen by at least the residual nitrogen credit amount, which as described in Chapter 3 can be considerable amounts, or b) not be following their plans.

Wrap-up of Findings about Three Practices Required By All Three States

Regarding the three nutrient management practices required by all three states, there was no significant difference between states, and the rate of compliance was good for half the practices and poor for the other half of the practices. Compliance was good for possessing a nutrient management plan and for taking soil tests at least every three years. Compliance was poor for taking residual nitrogen credits for legumes and for manure.

Despite the lack of significant differences between states, the fact that Maryland farmers had the lowest rate of possession of the required nutrient management plans and the main reason given for lack of compliance was they did not pick-up the plan from their Extension Specialist appears to be another example of farmer backlash in Maryland to being regulated. This underscores the challenge of government to even compel farmers to get the required plans let alone adhere to the plans.

The high rate of annual soil testing and the high compliance rate with the three-year requirement across three states underscores the positive priority farmers in all three states continue to place on this basic diagnostic test.

Finally, the fact that so few farmers say they take residual nitrogen credits for previous applications of manure or legume crops is a concern and indicates that over-application of nitrogen may be occurring across all three states and further suggests poor adherence to nutrient management plans. The fact that Private Planner A writes in his plans that taking nitrogen credits may result in under-fertilization undermines the validity of his plans and underscores the fact that not all plans meet regulatory standards.

7.3. My Compliance Estimates: Seven Practices Required by At Least One State

There are seven practices that at least one state requires: (1) Virginia requires that manure nutrient analyses be conducted at least every three years; (2) Maryland requires manure tests at least every two years; (3) Virginia requires that soil nitrate tests be conducted at least every three years; (4) Virginia requires that additional commercial nitrogen fertilizer be made as a split application from manure; (5) Virginia requires that calibration of manure application equipment occur at least twice a year; (6) Virginia requires that manure is not spread within 10 feet of a drainage ditch, within 25-feet of surface water if manure is incorporated, or within 50-feet of surface water if manure is not incorporated; (7) Virginia requires that poultry manure is not spread for corn in January, February, the first week of March, the last two weeks of June, and July through December while Maryland prohibits manure application from November 16 through February 28.

Although it may not be fair to hold Delaware farmers to Virginia and Maryland's standards or to hold Maryland farmers to Virginia's standards, I think this is a useful exercise to see how well farmers have adopted these basic nutrient management practices that are commonly encouraged by each state's Extension Service and Soil Conservation Districts. And, it is important to see how well Virginia and Maryland farmers are complying with their own state's rules.

Only one of the seven practices reveals a statistically significant difference between states, indicating that farmers are more alike than different. And, regarding compliance or adoption of these basic nutrient management practices, given a threshold of 60% and above being "good," only two of the seven practices showed "good" adoption across all three states: (1) taking manure tests at least every three years and (2) split applying commercial fertilizer from manure applications as side-dress.

1. Taking Manure Tests – Virginia and Maryland standards

Like soil testing, conducting manure nutrient analysis is a basic diagnostic test that provides critical information about the concentration of nitrogen, phosphorus, and potassium nutrients in the manure sample, which is required input into development of the nutrient management plan. Virginia's law specifies a manure testing frequency of at least once every three years; Maryland's rule is once every two years, and Delaware's law does not specify manure testing but does encourage it through educational programs. All farmers were held to both Virginia's three-year and Maryland's two-year standards.

Overall, the Raw Data Table (below) shows no significant difference between states and that most farmers (60 to 95%) reported manure testing at least every three years with a majority (40 to 55%) testing as frequently as once or twice a year. Thus, about half the farmers in all three states are exceeding the basic three-year manure testing requirement in Virginia and meeting the more stringent two-year testing requirement in Maryland.

However, given that only 40 to 55% of farmers in all three states rigorously analyze their manure samples every year or a couple of times a year, most farmers are not actively keeping up with the changes to manure nutrient content caused by the addition of *phytase* to the chicken diet, allowing the integrators to add less phosphorus to the diet. But even without the changing diets, all farmers in this dissertation but for 12 individuals take manure from their neighbors' chicken houses which may produce for one of the four integrators on the Peninsula. The overall number of houses that farmers take manure from was 10.2 houses while state averages were 6.9 for Delaware farmers, 9 for Maryland farmers and 21.4 for Virginia farmers. Thus, without annual or more frequent manure sampling and with so many sources of manure grown for different poultry companies, it is unlikely that the majority of farmers really know the nutrient content of the manure they are applying.

MTF p=0.233	**Table 7.6.a. Manure Testing Frequency (Raw Data Table)**				
	Once a year or twice a year	**Every 2 years**	**Every 3 years**	**Never or 4 or more years ago**	**No response**
MD, N=30	**40%**	3%	17%	33%	7%
DE, N=20	**55%**	10%	30%	0%	5%
VA, N= 10	**50%**	0%	20%	30%	0%

MD Rules	Rule: "The consultant or operator shall conduct animal manure or waste analysis as close to the application time as possible, or a consistent baseline for nutrient content may be established and used from analysis results taken **at least twice a year** until a uniform value is confirmed, and then for **every second year** thereafter to verify its consistency." Rule Source: The Nutrient Management Law. 15.20.08.05F(3). Content and Criteria for a Nutrient Management Plan Developed for an Agricultural Operation.
DE Rules	Guidance: "(Cost-share) Rates include annual manure test reimbursement up to $25 per 500 animal units (50,000 chickens)." Guidance Source: Delaware Nutrient Management Notes. "Cost Share Funds are available." November 2000 Vol. 1, No. 11
VA Rules	Rules for Permittees: "Representative manure samples will be analyzed at a minimum of **once per three years** for TKN, ammonia-nitrogen, total phosphorus, total potassium, calcium, magnesium, and percent moisture. Rule Source: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance Source: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.

When these categories of responses are combined only into compliance or non-compliance categories, however, a statistical difference appears between states when farmers are held to Virginia's three-year minimum standard. (see Compliance Table below) Four of the five regulated Virginia farmers are in compliance with their state law (as are two unregulated farmers) while 95% of Delaware farmers would be in compliance if held to Virginia's standard. In contrast, just 60% of Maryland farmers test their manure sources at least every three years.

Table 7.6.b. Manure Testing Frequency – Virginia Standard (Compliance Table)

Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
MTF – Manure Testing Frequency - VIRGINIA (p=0.019* regulated only) (p=0.033* w/ unregulated)** Virginia requires manure testing a minimum of once per 3 years.	In compliance	95%	60%	80%	60%
	Non-compliance	0%	33%	20%	40%
	No response	5%	7%	0%	0%

When held to Maryland's more stringent standard of manure testing at least every two years, there is no statistically significant difference between states, and overall, compliance rates drop as only 43 to 65% of all farmers would be in compliance. Only 43% of Maryland's farmers were in compliance with their own state rule.

Non-compliance in Maryland appears to be serious since half did not meet the Maryland standard because nine farmers said they "never" test their manure, one said the last time he tested was four or more years ago (which is similar to a "never" response), and five said they test every three years. One of the three unregulated Virginia farmers said he never tests his manure either.

Table 7.6.c. Manure Testing Frequency – Maryland Standard (Compliance Table)

Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
MTF– Manure Testing Frequency - MARYLAND (p=0.615 regulated only) (p=0.756 w/ unregulated) Maryland requires manure testing at least once every second year.	In compliance	65%	43%	60%	40%
	Non-compliance	30%	50%	40%	60%
	No response	5%	7%	0%	0%

Attempts to compare these dissertation findings to previous studies are hampered by a) not knowing if the respondents in Michel's study were crop farmers and b) Smith not asking about frequency of testing.

Michel et al. (1996) reported that only 93 of the 562 Delmarva poultry growers (17%) surveyed said they "routinely analyzed manure and most did it annually." Again, the authors do not specify if those respondents were amongst the 210 crop farmers in the survey. If I assume they were, then 44% were analyzing their manure samples at least every two years. Farmers in Delaware (65%) and Virginia (60%) surpassed Michel's growers while farmers in Maryland in this dissertation matched Michel's growers (43%).

Smith (1999) did not ask the frequency of manure testing but asked whether farmers did manure testing or not. Smith reported that 70% of Maryland farmers with a voluntary plan and 35% of "no plan" farmers did analyze their manure sources for the nutrient value. Thus, in this dissertation, the fact that 33% of Maryland's farmers said they "never" test their manure suggests that these regulated farmers are as “bad” as the farmers who did not have a voluntary plan in the past.

2. Taking Nitrogen Diagnostic Tests

There are two advanced diagnostic tests that help farmers determine if a corn crop has adequate nutrients to carry it through till harvest or additional nutrients are would be beneficial: the Pre-Sidedress Nitrogen Test (PSNT) and the stalk test. The stalk test is similar to the PSNT test, but it measures the amount of nitrogen in the stalk of corn while the PSNT measures the amount of nitrogen in the soil. Virginia’s law is the only statute to require the PSNT test and specifies it should be done at least every three years. Maryland and Delaware encourage this test through their educational programs.

The Raw Data Table (below) reports a statistically significant difference between states with the smallest percentage of farmers in Virginia (30%) adopting this practice and the largest majority of farmers in Maryland doing so (70%).

PSNT p=0.075*	**Table 7.7.a. Use of Pre-Sidedress Nitrogen Test or “the stalk test” (Raw Data Table)**		
# Farmers	**Yes, I use the PSNT or stalk test**	**No, I don't use the PSNT or stalk test**	**No response**
MD, N=30	**70%**	30%	0%
DE, N=20	**50%**	50%	0%
VA, N= 10	30%	**70%**	0%
MD Rules	Guidance: "A dependable nitrogen soil test, combined with other best management practices, can be a valuable tool in improving profit margins for farmers and reducing the threat of nitrogen enrichment to Maryland's surface and groundwater." Guidance: Maryland Cooperative Extension. "Nitrogen Recommendations for Corn Using Pre-Sidedress Nitrate-Nitrogen Soil Testing." Fact Sheet 559. 1991.		
DE Rules	Guidance: "The Pre-Sidedress Soil Nitrate Test (PSNT) is a valuable tool for improving nitrogen management in corn." Guidance: "Use the PSNT for manured ground or soils with high organic matter levels to calculate crop needs in season." Guidance: Delaware Nutrient Management Notes. "Nitrogen Management."		

	May 2000 Vol. 1, No. 4. Guidance: UDE Grain Corn Nutrient Recommendations. Last Revised 3/03.
VA Rules	Rules for Permittees: "Soil nitrate test for manure application fields planted in corn or small grain should be analyzed at least once every three (3) years." Guidance: "It is always wise to perform a PSNT when using organic sources of nutrients." Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.

When the unregulated Virginia farmers are separated from the regulated farmers (see Compliance Table below), the statistical difference disappears. Only two of the five regulated Virginia farmers are compliant with their state law while 50% of Delaware farmers and 70% of Maryland would be compliant if held to Virginia's standard. Thus, the worst compliance rate is found in the farmers actually required to conduct this test – Virginia farmers – and the best adoption rate is by Maryland farmers, which may reflect the effects of Maryland's long-time voluntary Nutrient Management Program encouraging this practice.

Table 7.7.b. Use of Pre-Sidedress Nitrogen Test or "the stalk test" (Compliance Table)

Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
PSNT (p=0.290 regulated only) (p=0.127 w/ unregulated) Virginia requires use of a soil nitrate test (at least once every 3 years.)	In compliance	50%	70%	40%	20%
	Non-compliance	50%	30%	60%	80%
	No response	0%	0%	0%	0%

All farmers in this study are doing better at using the PSNT test than Maryland farmers in the 1999 Smith study wherein only 20% of corn farmers interviewed in 1996 and 1997 reported using the PSNT test. This improvement, over time, may reflect the effect of voluntary guidance from the state Cooperative Extension Services to adopt this cost-effective diagnostic tool.

3. Applying Commercial Fertilizer and Manure in a Split Application

Farmers should take PSNT or stalk tests to help them determine if additional commercial nitrogen fertilizer is needed when the corn is about a month old. The process of “split applying” fertilizer helps farmers a) minimize the amount of fertilizer they need apply overall and b) apply expensive commercial fertilizer at a time when the crop is growing and is taking up the nutrients. Only Virginia’s law says that farmers using poultry manure should split apply additional commercial nitrogen from the manure and apply it as a sidedress or a top-dress application.

A great majority of farmers in all three states (80 to 95%) report that they did split apply by using side-dress fertilizer on corn (see Raw Data Table below). This is a very large compliance rate for Virginia farmers and a very high adoption rate for Delaware and Maryland farmers. However, given that only 30%, 50%, and 70% of farmers, respectively, are using a PSNT or a stalk test to first diagnose whether additional fertilizer is necessary, some of these farmers may be applying sidedress fertilizer when their corn crop might not need it.

p=0.946	**Table 7.8. Do you apply commercial fertilizer and manure in a split application on corn? (Raw Data Table)**		
# Farmers	**Yes**	**No**	**No response**
MD, N=30	**80%**	10%	10%
DE, N=20	**85%**	10%	5%
VA, N= 10	**90%**	10%	0%
MD Rules	Guidance: "**Split-apply nitrogen fertilizer whenever possible**." Guidance: Maryland Cooperative Extension. “Focus On Nutrients and the Hydrologic Cycle.” Nutrient Manager Newsletter of the Maryland Cooperative Extension Agricultural Nutrient Management Program. University of Maryland. College Park-Eastern Shore. Volume 3. Issue 1. Summer 1996.		

DE Rules	Guidance: "Nitrogen applications should be split for greater N-use efficiency. One-quarter or less of the total N rate should be applied at or just prior to planting. The remainder should be applied as a side-dress application when plants are 12 - 15 inches tall and the period of maximum N uptake by the crop is beginning." Guidance: UDE Soil Testing Program's Subsection 3A: Nutrient Recommendations Agronomic Crops. Last Revised 4/03.
VA Rules	Rules: (When using poultry manure) "**Additional commercial fertilizer applications (especially nitrogen) should be made as a split application from the manure, either as a sidedress or topdress application."** Guidance: "On soils with a High nitrogen loss risk, at least 50% of the inorganic nitrogen applications shall be applied as a sidedress application. On Moderate and Low nitrogen loss risk soils this management method is preferred, but not required." "It is recommended that fields which contain high environmental risk soils for nitrogen loss where organic nutrient sources are used to meet most of the nitrogen need for corn should include a split application of nitrogen which is at least 33% of the nitrogen needs to be applied as a sidedress application." Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: VDCR. Nutrient Management Standards and Criteria. Revised October 2005.

4. Calibration of Manure Equipment

Virginia's law requires farmers to calibrate their manure application equipment at least twice a year or “whenever litter consistency is obviously different” to ensure manure is applied at the desired rate. Delaware's educational materials encourage a similarly rigorous calibration frequency, stating that calibration should be performed “each season” (i.e. before the planting of each crop using manure) “and as manure type and moisture content changes.” While Maryland's guidance documents do encourage calibration and explain various calibration methods, they do not specify a frequency.

In the Raw Data Table (below), there is an unimportant statistically significant difference between states which stems from the fact that there are many response categories and sample size is small, especially in Virginia. However, this table does reveal a serious lack of calibration across all three states. About half the farmers in all three states (43 to 60%) report poor manure management, as they said they either “never” calibrate their manure spreaders or "the last time was four or more years ago," which is very similar to "never" given the guidance to calibrate more than once a year.

Most importantly, only 10 to 20% of farmers in all three states rigorously calibrate their manure spreaders at least once year, and thus only a tiny minority of farmers in all three states likely know the manure rate at which they are actually applying. Given that many farmers told me they apply a range of manure levels a) to different crops and b) to different fields of the same crop because some fields have a history of being able to produce higher yields than other fields, farmers *are* trying to optimize their manure use. However, if farmers do not calibrate their spreaders to confirm that they are actually applying the varying manure rates they are trying to apply, it is unlikely they really know what is being applied.

CME* p=0.076*	**Table 7.9.a. Frequency of calibration of manure equipment (Raw Data Table)**					
	Once a year	**Every other year**	**Every 3 years**	**4 years or more ago**	**Never or I don't calibrate**	**No response**
MD, N=30	20%	0%	0%	13%	30%	37%
DE, N=20	20%	10%	5%	30%	20%	15%
VA, N= 10	10%	0%	10%	0%	60%	20%
MD Rules	No rules or guidance on frequency of manure calibration found.					
DE Rules	Guidance: "Calibration should be performed **each seaso**n [and] as manure type and moisture content change…and should be made to reflect changes in nutrient content of the litter." Guidance Source: Delaware Nutrient Management Notes. "Equipment for Effective Poultry Litter Application." Vol. II, No.1.Sping 2001.					
VA Rules	Rule: "Calibration of equipment will occur **at least twice a year** or when litter consistency is obviously different." Guidance: "Calibrate spreading equipment at least once a year or when litter consistency is obviously different." Rule Source: VDEQ "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance Source: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.					

In the Compliance Table (below), the statistical difference disappears when the number of response categories is reduced and Virginia farmers are separated into regulated and unregulated groups. Only one Virginia farmer is in compliance with his state law and only 20% of Maryland and Delaware farmers would be in compliance if held to Virginia's standard.

Table 7.9.b. Frequency of calibration of manure equipment (Compliance Table)					
Rule	**Compliance**	**Delaware n=20 regulated**	**Maryland n=30 regulated**	**Virginia n= 5 regulated**	**Virginia n= 5 unregulated**
CME (p=0.483 regulated only) (p=0.576 w/ unregulated) Virginia's rule: Calibrate equipment at least once a year.	In compliance	20%	20%	20%	0%
	Non-compliance	65%	43%	60%	80%
	No response	15%	37%	20%	20%

It is difficult to compare farmers in this study to farmers in past studies due to response rate and ambiguity about respondents in Michel et al.'s study, and due to lack of frequency information in Smith's study. In Michel et al.'s study we know that of the 142 respondents to this question, 104 of them (73%) said they calibrated their spreaders annually or more often (each application or twice a year) while 13 of 142 (8.4%) said they calibrate their manure spreaders "every two years" or "every three years." Michel et al. do not explain why only 142 of the 562 growers in the survey responded to this question nor did they identify if these 142 respondents are amongst the 210 growers that are crop farmers. Thus, it is unknown why potentially 68 growers (210 - 142) that may be farmers did not respond to this question about calibration. But, if I assume that 104 of the growers who said they calibrated at least annually were all crop farmers, then 50% (104 / 210) were doing so -- a much larger proportion than just the 10 to 20% that were doing so as noted in this dissertation.

Smith (1999) did not ask how frequently farmers calibrated their manure spreaders but reported that 54% of "plan" farmers said they calibrate their spreaders while only 35% of "no-plan" farmers said they did.

5. Manure Application Setback from Streams or Ditches

According to most farmers, Cooperative Extension Service personnel, and from my own personal experience riding in a spinner spreader truck and watching manure application, when applying poultry manure with a spinner spreader, manure will be sprayed from the rear of the vehicle in a 40 foot swath – or about 20 feet on either side of the truck. Thus, one basic manure management practice is to prevent direct application of poultry manure to ditches, streams, or ponds, or roads (as the manure can easily wash off into a ditch during a rain event).

Virginia is the only state that has formal rules for manure-free setback areas from surface waters. Virginia set three standards: (1) a 10-foot manure-free buffer zone from agricultural ditches, (2) a 25-foot manure-free buffer zone from surface waters like streams and ponds (if the farmer incorporates the manure after application), and (3) a 50-foot manure-free buffer zone from surface waters (if the farmer does not incorporate the manure).

To interpret how well Virginia farmers were likely complying with these state rules and to hold Maryland and Delaware farmers against Virginia's rule, I asked "How far do you drive your manure spreader from streams, agricultural ditches or other surface waterbodies like ponds?" To determine the likelihood that manure was entering the ditch or stream, I added 20 feet to each farmer's response to account for the 20 foot swath of manure that is sprayed on either side of the manure spreader.

Farmers across all three states are not statistically different in terms of how far back from ditches or other surface waterbodies they apply (see tables below). . Surprisingly several farmers said they “drive right up to the side of the ditch” (two Virginia farmers, one Maryland farmer, and four Delaware farmers) and thus are spraying manure directly in the agricultural ditches which connect to larger “tax ditches” and then on to creeks, rivers, and ultimately to the Chesapeake Bay. The largest group of farmers in all three states (30 to 47%) said they drove their manure spreaders between 10 and 29 feet away from any surface water. Given the manure swath is 20 feet, they are also likely getting manure in the ditch. Thus, half to 65% of farmers in all three states are applying manure in such a way as to put manure in the ditch or in other surface waters.

MASB p=0.901	**Table 7.10.a. Manure Application Setback from Streams or Ditches (Raw Data Table)**						
	“ I drive right up to the side of the ditch”	**Between 10 and 29 feet away**	**Between 30 and 44 feet away**	**Between 45 and 49 feet away**	**Between 50 and 74 feet away**	**More than 75 feet away**	**NR**
	Manure gets in the ditch	Manure gets in the ditch	Compliant with VA's 10 feet buffer from agricultural drainage ditch rule	Compliant with VA's 25 feet from surface water (if manure is incorporated) rule	Not in compliance with VA's 50 feet from surface water (if manure is not incorporated) rule	Compliant with VA's 50 foot buffer from surface water (if manure is not incorporated) rule	
MD, N=30	3%	47%	20%	7%	7%	3%	13%
DE, N=20	25%	40%	10%	0%	5%	5%	15%
VA, N= 10	20%	30%	20%	0%	20%	0%	10%

MD Rules	Guidance: When calculating a PSI, Maryland gives greater number of points for more environmentally risky manure application behavior. For example, the greatest number of points (8) is given if farmers say they want to apply manure less than 100 feet to surface water AND less than 25 feet of permanent vegetative buffer where no fertilizer or manure is allowed AND has less than a 25 foot "No P Application Zone." Thus, this farmer is applying manure P or commercial P just 25 feet from the surface water and is deemed the most environmentally risky. Rule for stockpiling: (No mention of MASB) "Manure shall be stockpiled outside and uncovered, only after all available storage is utilized to the fullest extent…The stockpile shall be located at least 100 feet from any surface water, drainage ditch, swale or gully' however if a functioning filter strip or riparian buffer is in place, the setback may be a minimum of 35 feet from any surface water." Rule: MDA. Nutrient Application Guidelines. Regulatory Citation COMAR 15.20.08.05. Also in Maryland Nutrient Management Manual Section 1 - Nutrient Recommendations, D- Timing of Nutrient Application.
DE Rules	No rules or guidance found.
VA Rules	Rule & Guidance: "Do not spread manure within the following buffer areas... **10 feet of an agriculture drainage ditch** (5 feet if injected)…**50 feet from surface water** (**25 feet if incorporated**)." Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.

In terms of compliance with Virginia's least restrictive 10-foot ditch buffer rule (see first Compliance Table below), only 40% of Virginia farmers, 37% of Maryland farmers, and 20% of Delaware farmers would be considered in compliance because they drive more than 30 feet away from the ditch. Surprisingly, three of the five regulated Virginia farmers are not in compliance with the 10 foot buffer rule and likely get manure in the ditch.

Table 7.10.b. Manure Application Setback from Streams or Ditches (Compliance Table)

Rule	Compliance	Delaware n=20 regulated	Maryland n=30 regulated	Virginia n= 5 regulated	Virginia n= 5 unregulated
MASB (p=0.698 regulated only) (p=0.794 w/ unregulated) Virginia requires that manure is not spread within 10 feet of an agriculture drainage ditch.	In compliance	20%	37%	40%	40%
	Non-compliance	65%	50%	60%	40%
	No response	15%	13%	0%	20%
MASB (p=0.979 regulated only)	In compliance	10%	17%	20%	20%

(p=0.967 w/ unregulated) Virginia requires that manure is not spread within 25 feet of surface water (if manure is incorporated).	Non-compliance	75%	70%	80%	60%
	No response	15%	13%	0%	20%
MASB (p=0.100 regulated only) (p=0.100 w/ unregulated) Virginia requires that manure is not spread within 50 feet of surface water (if manure is not incorporated).	In compliance	5%	3%	0%	0%
	Non-compliance	80%	84%	100%	80%
	No response	15%	13%	0%	20%

To be in compliance with Virginia's "25 feet from surface water buffer" rule if the manure being applied is incorporated, farmers would have to drive their spreaders at least 45 feet away to allow for the 20-foot manure application swath. Only two Maryland farmers (7%) adhere to this rule.

To be in compliance with Virginia's "50 feet from surface water buffer" rule if manure is not incorporated, farmers would have to drive their spreaders more than 75 feet from the surface water. One farmer each from Maryland and Delaware would be in compliance with this Virginia rule.

There is no previous study with which to compare this variable.

The two farmers driving the furthest distance from ditches, streams, or roads explained how far manure can be thrown out of the spreader and why they drive so far back:

> Because the spinner spread throws manure out 50 to 60 feet, we lay off the road and ditches 75 feet and just apply commercial fertilizer next to roads. We don't want to be a bad neighbor. That leaves 24 rows in the end rows with just commercial fertilizer. You don't see much of an impact [on yields without manure]. (4-6.1, Farmer 22, Wic)

> I stay away from a ditch by 80 foot. Well she'll [the spinner spreader] really throw it. You could stand 60 foot away when I'm spreading and it will hit you. Crust out is chunkier. No need putting it in the ditch. It makes the weeds grow in the ditch. You just don't want it in the ditch. It's pointless, in both an economic and stewardship way. (3-29.2, Farmer 46, Sus)

A couple of other farmers with more common setbacks provided the following comments. Farmer 47 from Kent County said, "I've been staying back 20 feet from the ditch as far as I can remember. The spinner spreader throws it out 20 feet. We don't see a decrease in yields in the rows close to the ditch." (3-2.2, Farmer 47, Ken) Thus, though Farmer 47 tries to be mindful by keeping 20 feet back from the ditch, because he is not driving 30 feet away, he is not maintaining a 10-foot manure-free buffer zone and if held to Virginia's basic standard, would not be in compliance. A regulated grower from Accomack, Farmer 7 said, "We stay 20 to 30 feet from ditch banks. Honest." (3-1.3, Farmer 7, ACC)

In contrast to these Delaware and Virginia farmers' calm awareness and acceptance of their state's rules, and their lack of concern about reduced yields in the ditch areas, one Maryland farmer expressed outrage that his plan requires him to maintain a 25-foot manure-free zone.

> "The nutrient management plan tells you to be 25 feet back from the ditch which is asinine since you plant right up to the ditch and I don't know any farmer than doesn't fertilize what he plants. It's a law like the 55 mph speed limit - they're intending for you to break it. Nobody follows the law." (1.17.1, Farmer 23, Wor)

Soil test phosphorus results in some of Farmer 23's fields were so high (>150 FIV) that Maryland's law required him to have a Phosphorus Site Index performed on those fields to determine the risk of phosphorus loss. Farmer 23 would have been offered a variety of best practice options to help lower his score on the PSI, allowing him to continue using manure after raising his level of environmentally protective practices. It appears he chose the 25-foot manure-free zone. This would require him to drive his spreader at least 20 feet away from the 25 foot mark to be in compliance; that is to drive 45 feet away from the ditch.

6. Months in which Manure is Applied to Corn

Avoiding manure application in winter months, when no crops are growing in the fields, is an important nutrient management practice as it prevents the inevitable loss of ammonia nitrogen through volatilization. In addition, applying manure to frozen or snowed ground increases the likelihood of runoff of nitrogen and phosphorus. Both Virginia and Maryland law prohibit manure application for corn production between November and February. No rules or guidance for winter manure application was found in Delaware, so Delaware farmers will be held to Virginia's and Maryland's standard.

There was no significant difference between states in either the Raw Data Table or in the Compliance Table when regulated Virginia farmers were separated from the unregulated. Between 30 and 80% of farmers in all three states report spreading manure for corn crops from November through February and thus are non-compliant with Virginia and Maryland laws. None of the five Virginia poultry growers are in compliance with the law of their state.

MAMC p=0.110	Table 7.11.a. Manure application months for corn (Raw Data Table)		
	Ideal months: Mar, Apr, May, Jun	**Detrimental months: Nov, Dec, Jan, Feb**	**No response**
MD, N=30	27%	44%	30%
DE, N=20	35%	30%	35%
VA, N= 10	0%	80%	20%
MD Rules	Rule: "If the manure is stackable (equal to less than 60% moisture, such as poultry litter), or if adequate storage is available, manure application is prohibited during the winter - **November 16 thru February 28."** (Note – There is no explicit prohibition of Fall poultry manure application from September 1 thru November 15 for spring-seeded crops. Only if manure is not stackable (thus, not poultry manure), and storage is inadequate, can manure application be made during the fall at levels up to the next year's warm season crops' phosphorus removal requirements.) Rule: MDA. Nutrient Application Guidelines. Regulatory Citation COMAR 15.20.08.05. Also in Maryland Nutrient Management Manual Section 1 - Nutrient Recommendations, D- Timing of Nutrient Application.		
DE Rules	No rules or guidance found.		
VA Rules	Rule: Poultry Litter Spreading Schedule: "Do not spread poultry litter during these shaded months (for corn): **January, February, first week of March, last two weeks of June, July thru December**." "Make manure applications at or near planting (within 30 days) or to existing actively growing crops to assure the nutrients are properly utilized." Guidance: "Apply poultry litter as close as possible to planting times or to an actively growing crop or cover crop to ensure proper nutrient utilization and to minimize loss to the environment. Do not spread litter when field conditions would encourage runoff (i.e. saturation or snow or ice covered). Poultry waste may be applied to frozen ground within the times indicated by the spreading schedule only under the following conditions..." (Poultry Litter Spreading Schedule provided) Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.		

Only a quarter of Maryland farmers and a third of Delaware farmers indicate they only apply manure for corn production during the ideal months of March through June. Thus, there appears to be significant opportunities for improvement in this practice by farmers in all three states.

Table 7.11.b. Manure application months for corn (Compliance Table)						
Rule	**Compliance**	**Delaware n=20 regulated**	**Maryland n=30 regulated**	**Virginia n= 5 regulated**	**Virginia n= 5 unregulated**
MAMC (p=0.140 regulated only) (p=0.179 w/ unregulated) Virginia and Maryland prohibit manure application for corn November through February.	In compliance	35%	27%	0%	0%
	Non-compliance	30%	44%	100%	60%
	No response	35%	30%	0%	40%

In comparison to previous studies, farmers interviewed in this dissertation appear to be doing as bad or worse in the application of manure during the worst agronomic and environmental months of November through February. The 1999 Smith study reported that just over half (54 percent) of both "plan" and "no-plan" Maryland farmers applied manure during the least desirable months while the 1996 Michel et al. study reported that 36% (98 of 272 of the Delmarva poultry growers that apply manure to their own land) spread manure during these four worst months. However, since only 210 of the 562 poultry growers in Michel's survey are crop farmers it appears that at least 62 growers (272 - 210) are land-applying manure for disposal purposes only.

In a nutshell, the most common reason I heard why farmers apply manure in winter is that they are told by their poultry integrator company to conduct the Total Clean Outs (TCO) in winter. Because the volume of manure and poultry litter from the TCO is many times larger than the capacity of manure sheds which are built to store only about six months of crust out manure (conducted after every flock), farmers have two options: store the TCO manure outside of the manure shed or apply the TCO manure directly to cropland. Farmer 7 succinctly described the problem "If we're cleaning out (in winter) and there's no place to store it, we'll spread." (3-1.3, Farmer 7, Acc)

A regulated farmer from Virginia, Farmer 8, explained in more detail the many constraints facing farmers regarding Total Clean Outs in winter. Farmer 8 actually told this story in reaction to a Likert Statement “My regulations are stricter than they should be,” but it is very illustrative of the many challenges facing states trying to restrict winter application of manure:

> “I agree with that (regulations are too strict). The reason I say that is the application time frames are certain dates for certain crops. Corn for example…you’re allowed to spread according to the regulations after first week of March. When you’re told to clean out the houses, when you do a Total Clean Out, it’s done most of the time in the winter for two reasons:
>
> In the winter, they (the poultry companies) make us have longer layout periods because of production prices. They want to keep more chickens off market in winter and produce more in the summer. That’s their marketing tool. They give you a 10-day layout or up to 21 days. So we have January and February to Clean Out and it’s best to spread right away coz it’s much more economical.
>
> But they (the State Inspectors) don’t like you to spread in January and February. But see, you can have poor weather conditions in March and good conditions in February. Off the record, the State inspectors use a common sense approach with this. They said, ‘If we have a complaint, we have to investigate. If you’re spreading in the middle of February because you had a Total Clean Out and it’s fine weather, just don’t spread it right next to Highway 13.’ I don’t know anybody that’s been fined as a result of manure application in February. I’d like them to change the regulations to a wider spreading window in winter time.” (3-31.1, Farmer 8, Acc)

The “blind eye” that the Virginia Inspector turned to the situation reflects the conundrum he understands this regulated farmer is in. The farmer is forced by his integrator to conduct the TCO in winter not does not have a large enough shed to store all the manure and does not want to spend the extra time and fuel to bring the manure from the house to the shed, then later from the shed to the fields.

Still other reasons for the winter application are valid but may draw less sympathy from Inspectors. Farmers explain that it takes too long to spread right before planting as uncooperative weather might prevent them from applying the manure, and they need to take advantage of the winter months to get the job done. (Note that both Virginia and Maryland winter manure rules provide farmers with five to six weeks to apply their manure before the April 15th corn planting date: a) Virginia allows manure spreading for corn after the first week of March and b)Maryland allows it after Feb 28.) Some farmers also said it is ideal to run the heavy equipment over frozen ground to reduce soil compaction, and that spreading manure on snowed ground makes it easy to see where they spread.

Farmer 31 from Somerset explained that he likes to spread manure in February even though he accurately recognizes the weather is not warm enough to break down the nitrogen in the manure from organic into inorganic forms that can be taken up by the crop. Farmer 31 inaccurately represents the benefit of extra time to break down the manure by spreading in February and ignores the fact that he loses the nitrogen to atmospheric volatilization if the manure is not applied within a two weeks of planting his crop in April. “Problem is, they (the State) don’t want us to put down in winter but that’s the ideal time to get it broken down in soil.” When I asked how the nutrients get broken down in the cold of winter, Farmer 31 said:

> “See, it takes either time or temperature to break the nutrients down. You don’t have the temperature in February but you do have the time. The ideal program is this - I’ll tell you how to farm cheap and have a bumper crop. You go out and spread 2 tons [of] manure in the middle of January and 2 tons in the two weeks before you plant. Now I don’t do this because I can’t afford to run across the ground twice. A guy in Virginia does this. He’s a big farmer. But you don’t want to tell anyone you’re spreading manure in January even

> though it wasn't frozen in January. I saw a lot of farmers applying in February coz it wasn't wet so we could get on the ground." (1-25.2, Farmer 31, Som)

Farmer 4 from Accomack, who is not a poultry grower, explained one practical reason why farmers like applying in winter. "We've done it on snow. You can really tell if you're doing an excellent job spreading. You can see the darkness of it in the snow. (3-30.3, Farmer 4, Acc-NP)

Wrap-up of Findings about Seven Practices Required By at Least One State

Regarding the seven nutrient management practices required by at least one state, only one practice – manure testing at least every three years – showed an important statistically significant difference between states. The lowest adoption rate with a 3-year manure testing rule was by Maryland farmers (60%) while the highest adoption rates were by Virginia (80%) and Delaware (95%) farmers. Thus, for the rest of the five practices, states are more alike than they are different.

Only two of the five practices showed "good" compliance or adoption rates (above 60% in all three states): manure testing at least every three years was above 60% in all three states, as was split applying commercial fertilizer.

However, as discussed, only 40, 50, and 70% of regulated farmers in Virginia, Delaware, and Maryland, respectively, use a diagnostic test like the PSNT test or stalk test to determine if additional commercial nitrogen is necessary before side-dressing, indicating there is some potential for over-application of nitrogen.

Compliance or adoption was particularly poor across all three states for several manure management practices indicating a high likelihood of manure nutrient pollution occurring at a majority of the farms in this dissertation: infrequent to no calibration of manure spreaders (only 20% calibrate once a year), ineffective to nonexistent manure application setbacks (only 20 to 40% maintain a 10-foot manure-free buffer zone), and inappropriate winter application of manure (only a third of Maryland and Delaware farmers are applying within restricted months).

7.4. My Compliance Estimates: Inference from Six Likert Statements

There are six Likert Statements that solicit farmer opinions on their state's regulations and provide indications of the likelihood of compliance with those regulations. Five of the six Statements reveal statistically significant differences among farmer opinions in the states. Delaware farmers stand out with largely "positive" opinions while Maryland and Virginia farmers largely express "negative" feelings about their state's regulations.

Three of these Likert Statements suggest there may be a serious difference in compliance between states, with the majority of Delaware farmers likely adhering to their nutrient management plans while the majority of Maryland farmers are likely not adhering to their plans. These differences reflect the overall positive opinions Delaware farmers had about their policy development process in contrast to the opinions held by Maryland and Virginia farmers. However, one intervening factor must be highlighted: most farmers in Delaware and in Virginia receive plans written by private planners while just under half in Maryland do. And as established by Smith (1999) and Lawley et al. (2007) and by numerous comments in this dissertation, plans prepared by private planners tend to recommend greater nutrient application rates than those prepared by public planners.

Though half of the 10 Virginia farmers are not poultry growers and thus not required to obtain a state-certified nutrient management plan, I asked those unregulated farmers to react to these Likert Statements as though they were regulated, given what they know about the required nutrient management plans. I then compared the responses given by the five regulated and five unregulated Virginia farmers using the Fischer Exact Test and found they were not statistically significantly different. Thus, I did not separate out their responses below, but I did make a point to distinguish between comments made by regulated versus unregulated Virginia farmers.

1. Strict adherence to my plan would make me satisfied with my crop

p=0.005*	**Table 7.12. Likert: If I were to strictly adhere to the application recommendations in my nutrient management plan, I would likely be satisfied with the crop I harvest.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	27%	0%	73%
DE, N=20	60%	15%	25%
VA, N=10	30%	0%	70%

There is a statistically significant difference to the 99% confidence level between states in their farmers' opinions about adherence to their plans. About 70% farmers in Maryland and Virginia disagreed that they would be satisfied with their crop if they were to strictly follow the recommendations in their nutrient management plan while just 25% of farmers in Delaware disagreed. In contrast, 60% of Delaware farmers agreed they would be satisfied.

Since all three states require farmers to follow nutrient management plans, a likely indication of how well farmers are doing following their plans is if they think the nutrient recommendation rates in the plans will enable them to produce a profitable crop. Thus, this Likert Statement suggests that 73% of Maryland farmers, 25% of Delaware farmers, and 70% of Virginia farmers may not be adhering to their nutrient management plan, with Delaware having the lowest non-compliance rate.

From the comments that farmers offered in reaction to this Likert Statement and the next Statement (which is a mirror image of this Statement though framed in a "negative" way), two main reasons emerge as to why many farmers disagreed that they would be satisfied with their crop if they strictly adhered to their nutrient management plan: a) they want to put more manure on than recommended in their plan and b) they do not want to use an average yield goal.

Two farmers from Maryland crystallized why farmers who say they would not be satisfied likely think the way they do. Farmer 15 from Worcester County said, "I disagree. I wouldn't be satisfied because we are all trying to maximize our yields so you have to maximize the inputs. If I put on less than I think it takes to grow a good crop, I'm sunk." (3-17.1, Farmer 15, Wor) Farmer 37 from Somerset, Maryland explained further:

> "I disagree. The recommendations (from Extension) are too conservative. Their recs are based on soil tests at the time, and they're trying to limit my production. They base everything on a 150 bu per acre yield goal. Well I want to grow 200 bushel per acre. That's our profit. That's where we make our money is by the increase (in yield) and not holding steady. Only thing we can do is increase production." (2-24.JB, Som)

Comments from two other farmers hinted at potentially short-lived adherence to nutrient recommendations and the technical difficulty of trying to follow manure recommendations. Farmer 39 from Worcester agreed with this Statement but explained that he may not be satisfied for long. "I do adhere to them (nutrient recommendations) but I do think it affects my yield. So far, I've been getting by but I don't know at what point I'll need to put more." (8-10.1, Farmer 39, Wor) Farmer 8, a regulated poultry grower from Accomack County, said that his application rate "is pretty close" to the rates in his required plan. Farmer 8 cautioned, "It can't ever be an exact science coz it's not an exact product. The density of manure is not uniform. Sometimes it's sawdust size and sometimes it's the size of a coffee cup." (3-31.1, Farmer 8, Acc)

Farmer 17 from Worcester highlights the philosophical view that a plan written by a public planner is not as trustworthy as one written by a private consultant. In addition, Farmer 17's comments indicate that government capacity is limited to write the plans and ensure that farmers receive and use their plans rather than get their actual nutrient recommendations from someone else.

> "If I went by the state's requirements, I'd disagree (that I'd be satisfied with my crop)." Public Planner D (Maryland Extension Specialist) hadn't called to tell me the plan is ready and I had to pay for those soil samples! I need my prescription so I called UAP (a fertilizer company) and he pulled samples and did the analysis." (3-15.4, Farmer 17, Wor)

In fact, three Maryland farmers that get their plans from Extension Specialists told me that they actually get their "true recommendations" from fertilizer dealers or the private soil test lab they use. Furthermore, three different farmers – one from Delaware and two from Virginia – that use Private Planner A told me they keep "double books" – one set of plans for their own use and one set to show inspectors. Surprisingly, Private Planner A also told me he prepares double books for his clients in Virginia given their near annual inspection protocol. One Maryland Cooperative Extension Specialist from the Eastern Shore said he had heard that farmers were keeping double books too and that some of them were from Maryland. These examples of deliberate regulatory evasion underscore the challenge of detecting non-compliance and enforcing plan-based regulations.

2. The recommendations in my plan are too conservative

p=0.000***	Table 7.13. Likert: The nutrient recommendations in my nutrient management plan are too conservative.		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	67%	13%	20%
DE, N=19	21%	11%	68%
VA, N=10	100%	0%	0%

Two-thirds of Maryland farmers and all Virginia farmers agreed with the Statement that the recommendations in their nutrient management plan are too conservative. In contrast, only one-fifth of Delaware farmers said so, while two-thirds of Delaware farmers disagreed. The difference is statistically significant (p=0.000) to the 99% confidence level. This Statement is the negatively phrased version of Statement #19 ("If I were to strictly adhere to my plan I would be satisfied with my crop"). Farmers that think their plan is too conservative are likely not to adhere to them, suggesting that 67% of Maryland farmers, 21% of Delaware farmers, and 100% of Virginia's farmers are not following their nutrient management plan.

Two farmers raised the issue of using an average yield goal again. Farmer 26 from Somerset Maryland said he strongly agreed with the statement "I don't think they're giving me enough for what the crop will use. My levels are up still and it will come to a point that the yields start dropping and it will be hard not to cheat." (3-15, Farmer 26, Som) Farmer 11 from Somerset explained the problem that farmers have with the average yield basis for the nutrient management plan's recommendations.

> "I agree with that and I'll tell you why. They (Extension) will only allow me to fertilizer for X number of bushels, which is my average yield. No matter how much moisture I get, it's unlikely I will exceed that yield. If I don't get adequate moisture, I will fall below that yield. Then every three years, they'll ask me for my average yield, and it will go down. Three

> years later it will be down here (motioning with his hands that his yield will keep dropping). If I can't fertilize for above my average yield, it's not fair; so you're never going to exceed the yield. The only way to make it is on big yields. There's going to be a day when we go out of business."

In a slip that demonstrates the distrust many farmers have for government-prepared plans, Farmer 14 from Worchester at first agreed with the Likert Statement that his nutrient management recommendations are too conservative but then disagreed. "My plan is with Private Planner B. No, I don't think they're too conservative. I was thinking of the state plans. I'm sorry." (4-7.3, Farmer 14, Wor)

Farmer 41 from Sussex chose "Don't know" and revealed the skepticism some farmers even have for the plans prepared by private crop consultants.

> "The nutrient management guy that we have (Private Planner A) tends to put on as much as he can. The consultant is doing your recs and the fertilizer dealers like selling to the farmers that use my consultant because he tends to over fertilize. Any little thing that can add to your plan to grow the crop like minor elements and such, he adds them. But that increases our cost. Our thing is that you might spend so much in fertilizer that you can't have a profit. You might have a nice looking crop but you can't make any money." (3-29.3, Farmer 41, Sus)

Farmer 56 from Sussex explained why he strongly agreed that his plan is too conservative and also demonstrated a lack of understanding of his manure analysis.

> "The levels of nutrients that the (manure) test are coming up with and the availability to the crop aren't the same. The nutrients might exist in manure but it may not be available to the crop. Breaking down nitrogen has to do with the temperature." (2-23.2, Farmer 56, Sus)

Farmer 56 said his manure is tested by the Delaware Department of Agriculture (DDA) but in actuality, the University of Delaware College of Agriculture runs the Soil Test Lab and produces a manure analysis, which displays the Plant Available Nitrogen and Plant Available Phosphorus in the manure. Thus, the UDE Soil Test Lab already calculates for the farmer how much nutrients will be available to the crop in each ton of manure.

3. My state's regulations are not always possible to comply with

p=0.000***	Table 7.14. Likert: My state's nutrient management regulations are not always possible to comply with given the technical, logistical, and economic realities of farming.		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	97%	3%	0%
DE, N=19	58%	5%	37%
VA, N=10	80%	20%	0%

An overwhelming majority of farmers in Maryland and Virginia agreed (97% and 80%, respectively) that they couldn't always comply with their state's regulations given the many challenges to farming. Just over half of Delaware farmers agreed with this statement while nearly 40% disagreed. The differences were statistically different to the 99% confidence level.

During my pre-interview conversations with farmers, other than disagreement about the appropriateness of their manure application rate, I learned about several other hurdles farmers perceive in trying to follow their nutrient management plans and categorized them as technical, logistical, or economic challenges. For example, many farmers complained about the technical challenge of spreading manure given the different consistencies and moisture levels of the two types of manure (i.e. the crust-out manure collected after every flock leaves the chicken house versus Total Clean Out manure that is collected every one, three, or five years or more depending on integrator).

They also mentioned the logistical challenge of driving manure from their manure piles or storage sheds to distant fields. And, they mentioned the economic conundrum they find themselves in when facing increasing fertilizer costs: a) all their neighbors start thinking about switching to more manure too which makes the demand for manure go up and makes it tough to procure and b) more manure hauling means more diesel fuel to run the manure spreader but diesel fuel prices rise when fertilizer prices rise making it more expensive to haul more manure. Thus, I chose to test this Likert Statement to elicit more comments about these additional hurdles to complying with their plans.

Surprisingly, in reaction to this Likert Statement, farmers hardly mentioned any of these three additional challenges and focused primarily on dissatisfaction with the nutrient rates in the plan when they agreed "It's not always possible to comply with the regulations." These three challenges to compliance did come up during other parts of the interview and have been or will be discussed in later sections in this Chapter (i.e. Calibration of Manure Spreader, Manure Shed Cost-Share Program Participation, and Change in Response to Commercial Fertilizer Prices).

Farmer 27 from Somerset, who is in a leadership position in a farm trade association, discussed the fact that he generates more manure than can be used on his few crop fields, and his state cost-shared manure shed cannot store the excess. Farmer 27 said:

> "I want to talk about this. We don't have adequate storage facilities. The cost share program (gives you enough to build a shed that) has a 180-day supply storage capacity. On my nutrient management plan, I'm allowed to spread 88 tons of manure on 45 acres (Note: that's about 2 tons/acre) and I'm not allowed to use any commercial fertilizer. I get 88 tons of crust-out after one flock, so what do I do with the manure from the other 4 flocks? I don't have enough capacity to store it. I might be able to sell it or give it away. I'm gonna try to adhere to the plan. We're gonna try it and see what kind of crop we can grow. I'm supposed to be setting an example. (3-9.3, Farmer 27, Som)

One farmer from Maryland agreed that compliance is not always possible due to disagreement about application rates while another farmer also agreed and revealed his suspicions that the rate his consultant is telling him to use is too high. Farmer 14 from Worcester said, “I agree it’s not always possible to comply.” When I asked him what he was referring to when he said it wasn’t always possible to comply with the regulations, Farmer 14 said, “If they say you can only put on 110 pounds of N and we think we need 190 pounds of N.” (47.3, Farmer 14, Wor) Farmer 11 from Somerset said,

> “I’m not sure where the state stands as of this time. Maybe I shouldn’t tell you this. They’re saying 1 ton of chicken manure will supply the phosphorus crop removal rate for corn and beans. So you’re only supposed to apply 1 ton per year. My consultant (Private Planner A) recommended me 3 tons manure on corn. And he knows, two years from now that same field will be in corn. So I don’t just know. That’s where I think the state falls down on the job, they should send out notice in layman’s terms to tell us just what the law is. (3-15.3, Farmer 11, Som)

Though a minority of Delaware farmers (four in 10) disagreed with this Statement, when Delaware farmers offered comments in reaction to this Likert Statement, almost all the comments demonstrated disagreement; they felt it was possible to always comply with their regulations. Their reasons ranged from having no problem with the rules because “farmers wrote the rules” to the feeling that if you adhered to your soil tests you’d be in compliance to satisfaction that following a consultant-written plan would save money.

Farmer 49 from Sussex said, “We govern our own selves. We wrote our own rules. We worked things out so that farmers did it themselves. I haven’t had to deal with the state on the rules.” (3-8.2, Farmer 49, Sus) Farmer 43 from Kent County said, “If you follow your soil tests, I ain’t got no problems with being able to comply.” (3-2.1, Farmer 43, Ken) Farmer 59 from Sussex said, “We make more money following the plan by saving on buying N and potash.” (3-3.2, Farmer 59, Sus)

Two other farmers in Delaware said they didn't know or they disagreed with the Statement citing two reasons related to nature that make it hard to comply: topography of the farm field and the size of the rain event. Farmer 58 from Sussex explained that since he only had one ditch on one of his farm fields he did not have any problems. "We're not bothered like some counties in Maryland. The more ditching you have, the more drainage you have. If you have chicken manure and ditches, you're gonna have a lot of manure in the ditch. So we're not as big a polluter as those with ditches." (3-3.1, Farmer 58, Sus)

Farmer 56 from Sussex explained that compliance was partly out of his hands as nature might make him non-compliant:

> "It's not always possible (to comply) because there are so many variables in farming. If you get a large rain, say 4 to 6 inches, at one time, you might lose a large percentage of your N. That's a complex issue, you'd have to monitor rainfall by farm to figure out who is and isn't in compliance." (2-23.2, Farmer 56, Sus)

While there is an element of truth to Farmer 56's statement, the degree of non-compliance resulting from a big rain event would be small if he were closely adhering to a plan that was true to the intent of the regulations.

4. Current regulations in my state are stricter than they should be

p=0.000*	**Table 7.15. Likert: Current agricultural nutrient management regulations in my state are stricter than they should be.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=29	79%	10%	10%
DE, N=20	20%	15%	65%
VA, N=10	80%	10%	10%

Eight in 10 Maryland and Virginia farmers agreed (79 and 80%, respectively) that their "nutrient management regulations were stricter than they should be" while just 20%

of Delaware farmers thought so. In contrast, 65% of Delaware farmers disagreed, suggesting they have a more positive outlook on their law's requirements than their counterparts in the two other states.

The comments shared by Delaware farmers indicate several potential reasons for this positive outlook. It may stem from the fact that a) Delaware farmers were significantly more positive about their state's policy development process than were Maryland or Virginia farmers (see Likert Statements presented in Chapter 5), b) Delaware farmers, overall, think their law's requirements are easy to follow, and c) Delaware farmers perceive less of a deterrence effect from their law than farmers in Maryland or Virginia feel in their states.

Overall, there were two main objections to the nutrient management laws that farmers perceived as too strict: timing and weather restrictions for manure application and the manure application rate. A regulated poultry grower who lives in Accomack County, Virginia but farms in both Accomack and Worcester, Maryland admitted that he breaks the law by applying manure in the winter and by putting more manure on than he is supposed to. However, Maryland's winter application rules for manure were established through regulatory guidance documents developed in 2004 and an Extension scientist suggested that the Maryland Department of Agriculture never formally announced these rules through the mail to all regulated farmers.

> "These rules and regulations is that we're not supposed to put manure on frozen ground and wet fields and when there's no crops growing. We're not supposed to put in on but 30 days before plant. We put all ours in a manure shed because you can't spread it but so fast. We use manure on 700 – 800 acres of corn. They make the law so we can break it. I break the law. I'm using 2.5 ton (poultry manure) per acre on corn for the last 5 years due to the regulations and also because I have more land and I want it (manure) to go further. Ten years ago, I was probably using 4 tons per acre. However,

> the State (Inspector) said we should be using 1.5 ton per acre. I break the law. On soybeans, I use 2.5 tons per acre too and probably apply a little less – we're trying to abide by the law as close as possible but I break it. (3-1.1, Farmer 2, Acc & Wor)

Comments from Farmer 31 from Somerset represented a general lack of awareness by farmers in Maryland about the restrictions governing timing and weather conditions for manure application. He complained that farmers are not being told what the law entails nor is there any enforcement effort occurring that could disseminate information about the rules and ensure compliance with the rules.

> "I heard rumors that were not supposed to spread on frozen ground but nobody come here and told me I couldn't do it. I went to manure certification (classes) and I don't think they said anything to us about it. (I went to) two certifications on it and didn't hear anything. I heard it through the grape vine and a friend at Soil Conservation (District) said so. Still, guys are doing it (spreading on frozen ground) and nobody's checking on it."

When I asked him what proportion of farmers are spreading manure on frozen ground, Farmer 31 responded:

> "A very small minority – almost non-existent. In the last 5 years, hardly anybody. But two years ago I saw him (a neighbor) spread on snow and he's over 150 P (soil phosphorus concentration on the Fertility Index Value). He's the one that spreads manure to get rid of it. He's 41 years. (He was) raised by an old timer. A lot of people aren't educated. A lot of farmers aren't educated on this. They don't know that putting too much does more damage than good. Most of them dropped out of school coz had to work on farms. I had farmers come to me for help in the field. I told them you're compacting manure on wet ground. If you spread manure before a snow, the snow lays on top and locks it in." (1-25.2, Farmer 31, Som)

Unfortunately, this farmer's advice to the less educated farmers is environmentally problematic since crops are not growing during snow conditions and applying manure before a snow can result in surface runoff since a crop is not actively breaking down and taking up the nutrients in manure.

Comments from three farmers in each of the three states who agreed with the Statement that “the regulations are too strict” revealed that they are not aware of the consequences of not complying with the law nor are they aware of any enforcement effort by the state. Farmer 17 from Worcester said:

> I don’t know what the penalties are. If the law doesn’t have any teeth in it, if they’re not gonna punish you, I don’t know if it’s stricter than it should be. What difference does the law make? Are the only ones you have to abide by the ones they enforce? (3-15.4, Farmer 17, Wor)

Though Farmer 1 from Accomack is not a poultry grower and thus not subject to any restrictions on his manure use, he still chose “strongly agree.” “The regs are stricter than they should be but since the enforcement isn’t strong, thank god they’re not enforcing them. (3-30.2, Farmer 1, Acc)

Farmers from each state offered comments suggesting that private consultants may be in collusion with farmers to: a) use higher manure rates than appropriate, b) stall switching to lower manure rates, and c) falsify the yield goal in the plan. Farmer 2 from Accomack said, “Fifteen years ago (we) started with Private Planner A as someone independent and before that (we worked) with fertilizer companies. The state doesn't like the 2.5 to 3 ton rate Planner A recommends and they said we had to use 1.5 tons per acre.” (3-1.1, Farmer 2, Acc)

Farmer 11 from Somerset also uses Private Planner A and revealed ignorance of the appropriate manure applications rates and suspicion that his planner is helping him put more manure on than the state might think is correct. “I really don’t know what the law is; what they’ll allow you to put on.” (Note: Farmer 11 has used 3 ton/acre for the last 5 years and before that, he used 5 tons/acre. Farmer 11 read off his soil test analyses saying that he sees his P levels going up on the fields he's still using manure on and the P levels are going down on fields he's not using manure on.) Farmer 11 continued,

> "I've asked him (Private Planner A) several times, 'Do we need to cut back on the amount of manure we're using?' He said, 'Let's keep using it until we hear otherwise.'… I'm not sure where the state stands as of this time. Maybe I shouldn't tell you this. They're saying 1 ton of chicken manure will supply the crop removal rate for corn and beans. So you're only supposed to apply 1 ton per year. My consultant recommended me 3 tons manure on corn." (3-15.3, Farmer 11, Som)

Farmer 47 from Kent County, Delaware shared the advice his consultant (Private Planner B) is giving him about the yield goal to put down in his nutrient management plan:

> "When we do a nutrient management plan, I sit down with my consultant. They (the consulting company) want us to project yields for corn and they write our plan based on that. If we say we want 200 bu on irrigated ground. They're not holding us back. I've been told by a couple of consultants to make yield projections high enough to cover our fertilizer needs. Otherwise, if your plan calls for 125 lbs N on corn but want you want to put down 175 lbs you've done more than your plan says. So you put in a higher yield goal but it's not like they're that off (Farmer 47 indicated that he was exaggerating the rates to make a point). Irrigated ground is probably 50 bu higher than dry corn. I probably pull 200 bushels irrigated (corn) and dry land (corn) will get 125 to 150 bushels per acre." (3-2.2, Farmer 47, Ken)

Farmer 47's comments indicate he is setting a fertilizer goal first and then establishing a yield goal second to justify his fertilizer rate.

Three other farmers indicated they were satisfied with the stringency of the regulations, though they did not specify what aspects of the regulations they were referring to. Farmer 20 from Worcester County, Maryland said, "Maybe it's not too strict. They're strict enough. We try to do what they want us to do and we've not had no problem as of yet." (4.7.1, Farmer 20, Wor) Farmer 43 from Kent County said, "Disagree. There's nothing wrong with them." (3-2.1, Farmer 43, Ken) Farmer 58 from

Sussex County said, “Disagree. It took a little tendering into the program. I think what they’ve come up with to this point is acceptable. (3-3.1, Farmer 58, Sus) Farmer 50 from Kent said he agreed and mentioned paperwork as the only downside to the regulations:

> “I haven’t had no problems with them [the regulations]. I get Planner B to do my nutrient management plan and I’ve not had any problems. Worst thing is coming home and doing the records and writing how many [manure] loads you did that day. A little aggravating doing all the book work.” (3-24.1, Farmer 50, Ken)

Despite all these objections, there were some farmers (even these two from Maryland) who were willing to recognize the societal validity of regulation. Farmer 17 from Worcester said, “I don’t have a problem with it. Some farmers have a problem with any kind of regulation. We do need some kinds of guidelines if not for public perception and we need rules and boundaries for everything.” (3-15.4, Farmer 17, Wor) Farmer 34 for Wicomico laughed when he read Likert 12:

> “I guess it’s not really strict but they need to know more on the phosphorus issue to know how much actually leaches or is used up…I’m all for no regulations. The less regulations, the better. But for the overall improvement for the quality of life around here, we gotta have them.” (2-16.2, Farmer 34, Wic)

5. My nutrient management plan is too complicated to be helpful

p=0.010* **	**Table 7.16. Likert: My nutrient management plan is too complicated to be helpful.**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=29	21%	17%	62%
DE, N=20	5%	10%	85%
VA, N=10	60%	0%	40%

Virginia farmers stand out from the others as two-thirds of them (three out of the five regulated growers) think that the required nutrient management plans are too complicated to be helpful. Surprisingly, the majority of Delaware (85%) and Maryland (62%) farmers disagreed. The differences are statistically significant to the 90% confidence level.

Thus despite the strong and consistent complaints from Maryland farmers during the interviews about the complexity and length of their Extension-prepared plans, 62% of Maryland farmers surveyed said their plan was not too complicated to be helpful. Perhaps this result indicates that despite their heated rhetoric about the quality of the plan, a majority of Maryland farmers are un-willing to concede that the plans are too complicated to be helpful despite their dissatisfaction with policy development and implementation processes in their state. I think farmers did not want to appear incapable of comprehending the nutrient management plan despite their opinion that following the plan would hurt them economically.

Two categories of comments about the plan's complexity stood out – a) the amount of information and numbers of pages in the plan and b) lack of understanding the Phosphorus Site Index section of their plans. Farmer 26 from Somerset complained:

> "Whenever they put the PSI in there, hell, I don't know what that means. It's a big plan and a whole bunch of stuff in there. [But despite all that information, it doesn't explain] why can I only spread this much if corn takes that much." (3-15.2, Farmer 26, Som)

Farmer 26 explained that his Extension Specialist upgraded his plan in 2004 to a phosphorus-based plan and performed a P-Site Index for him. However, many years prior, he has used Private Planner A:

> Last year was the first time I put on such a low manure rate (2 tons per acre). That was due to the PSI in my plan and we changed to a P-based plan in 2004. Previously, (Private Planner A) wrote me some plans for 5 tons per acre. Then (his Extension Specialist) wrote them for 3 tons per acre. Now it's 2 tons per acre. My plan calls for 1.2 tons to 2.4 tons per acre so I'm good with 2 tons per acre."

Farmer 57 from Kent also complains about the lack of user friendliness of his plan and subsequently demonstrated that he does not understand the Phosphorus Soil Index.

> "I don't know. A lot of it is not set up to find stuff. There's different kinds of forms in them. (One form has) something to do with your phosphorus test numbers. Like 150 or higher is bad but 100 is okay. I can't just open the book up and see we're at 100 and we're allowed 150. That's confusing to not know right away what're you're looking. (3-2.4, Farmer 57, Ken)

Farmer 27 from Somerset starts out emphatically denying that his plan is not too complicated but then paints a picture of a big, complicated plan with confusing tables. Farmer 27 uses a private planner but did not tell me who he or she is.

> I disagree. My plan isn't complicated: soil test and PSI – it's not complicated. We're small enough that we can use Extension. I don't necessarily agree with it but it's not complicated. The guy who does mine uses different colors of paper for different sections and has tabs so you can go through it easily. But it's just clutter. That's what government does: creates Greek for farmers – 3-inch binder instead of a few pages. I'm not so sure it's not intended that the average person can't do it themselves. They had to go and get a professional to do something. If you get a table that you don't understand, you don't follow it. (3-9.3, Farmer 27, Som)

There were four farmers who gave responses protesting that the plan was not too complicated for them. All four use private planners and three are from Delaware. "Not too complicated. It's pretty easy to follow," said Farmer 51 from Sussex County. (3-23.2, Farmer 51, Sus) Farmer 50 from Kent said, "It's not really too complicated, it's just a matter of writing down what you've done. (3-24.1, Farmer 50, Ken) Farmer 43 from Kent said, "I got a crop advisor and he tells me what should and shouldn't be done. Where manure should go. It's not complicated for me to read it once he's done. (3-2.1, Farmer 43, Ken) "It's pretty straightforward. Private Planner F is my consultant." (3-31.1, Farmer 8, Acc)

Two farmers admitted that they either don't use their plan or they don't trust it. Farmer 25 from Somerset, who gets his plan from an Extension Specialist said:

> "I don't know if it's too complicated. Truthfully, I haven't used it. Extension does that plan and I put it on file but they're not checking my rates and they're not even requiring you to send in the summary sheet at the end of the year (Note: is incorrect). I have never read it and that's a bad thing to say. I did look through it once to see what their recs are. They're recommending 1.5 and 2 tons of manure per acre. I'm putting down 3 and 3.5 tons on corn ground." (3-9.2, Farmer 25, Som)

Farmer 42 from Sussex said he'd agree with the Statement but only with the "helpful" part of it. "It's not too complicated to be helpful. It's just not helpful. It's a lot of hocus pocus. The federal people are jumping on state people and they're jumping on the farmers. The person to kick is the smallest dog; which is the farmer." (3-23.1, Farmer 42, Sus)

Farmer 26 from Maryland revealed that a State Inspector, during an Implementation Review of the farmers operations, disagreed with the plan's recommendations and that his public planner from his Extension office is tardy updating his plan.

> "Extension just tells me what I can put on. Last year I had some 1.2 tons per acre rates and some were 4 tons per acre. I talked to (State Inspector Z) and he said, 'Well that's not right, you can put almost 4 tons on anything.' They (Extension) haven't got it (the nutrient management plan) done yet though I've already started spreading manure. I just use 2.5 tons and hope that's what they're going to say this year. (3-15.2, Farmer 26, Som)

Farmer 26 may be calling up Private Planner A for nutrient recommendations because his Extension Specialist, he says, is slow in returning his plan to him. It is surprising that the State Inspector Z would suggest 4 tons per acre would be an acceptable rate.

6. Opinion on the penalties for non-compliance with the law

p=0.758	Table 7.17. Likert: The penalties for non-compliance with my nutrient management law are:		
	Large or Moderate	**Don't know**	**Small or Non-existent**
MD, N=30	37%	53%	10%
DE, N=20	30%	60%	10%
VA, N=10	50%	50%	0%

Farmers across all three states showed no significant difference in their reaction to the Likert Statement about penalties. The largest groups of farmers (half to 60%) said they didn't know what "The penalties for non-compliance with my nutrient management law are" while 30 to 50% said they were "large" or "moderate." Two of the five regulated growers from Virginia reported thinking that their penalties were large while three said they didn't know. Regulations without a significant and known financial penalty are not taking advantage of the deterrence effect that distinguishes regulations from voluntary guidance.

One farmer from Maryland said: "I don't know. They've not been enforced yet." (2-16.2, Farmer 34, Wic) Farmer 27 from Somerset explained:

> "Penalties? They're non-existent. I don't know if there are any penalties on the books. I know (an official at the Maryland Department of Agriculture) doesn't want to get to that phase. Might have to do it though. They were talking about severe penalties when this all first started but don't know what they are now."(3-9.3, Farmer 27, Som)

Surprisingly, one farmer said, "I want mine (manure shed) checked. You've got to have your manure sheds checked when they are two-thirds full and I called. Every taxpayer deserves to see that I'm using what they paid for right. I wanted to show them that I was using them to the specification." (4-6.3, Farmer 21, Wor)

Three farmers from Delaware said, "I don't know but I don't know anyone that hasn't gone along with nutrient management. I don't know if anyone's gone to jail or anything for not carrying out a practice." (3-2.2, Farmer 47, Sus) "I don't think they know what they'd do with someone who isn't doing it." (3-29.3, Farmer 41, Sus) "I don't know. I haven't heard of anyone being fined or reprimanded." (3-2.1, Farmer 43, Ken)

Another farmer who chose "penalties for non-compliance are moderate," said:

> "We've never had one (penalty) yet. Delaware works with you. They checked our plan one time and asked us to change it. We didn't have it written down when we applied stuff (fertilizers), so they wanted dates. Now we use a booklet. It's more bookwork. I don't appreciate that. I guess the book is helpful for knowing what you put on and when. But I wouldn't continue doing it if I didn't have to." (3-29.1, Farmer 53, Sus)

Despite the uncertainty about the size of the penalties, one farmer in Maryland who knew what the penalties were ($100 per violation up to $2,000 per year) told an interesting story about the size of penalty and the perceived economic losses from following the plan. The story takes place at one of the meetings the Maryland Department of Agriculture (MDA) held throughout the state in 2000 to disseminate information about the new regulations and answer questions. One farmer I interviewed said another farmer stood up in the middle of the meeting after the MDA officials discussed the penalties for non-compliance, pulled out his pocketbook, and said something like,

> "Who do I write this check to? I'm just gonna get it over with right now because there's no way I can stay in business and follow this plan."

Wrap-up of Findings from Six Likert Statements

Overall, five of the six Likert Statements showed statistically significant differences between states, reflecting the split in opinions farmers expressed in Chapter 5 about their states' policy development processes: the majority of Maryland and Virginia farmers have negative opinions about their plans and their state regulations while the majority of Delaware farmers express mostly positive opinions about their plans and their state regulations.

Two Likert Statements indicate that a large majority of farmers in Maryland and Virginia are dissatisfied with their nutrient management plans and thus may not be following their plans (see table below) while only a minority in Delaware

are dissatisfied with their plans and thus more Delaware farmers may be following their plans.

Table 7.18. Percentage of farmers dissatisfied with their plan, thus indicating potential non-compliance			
	Maryland (n=30)	**Delaware (n=20)**	**Virginia (n=10)**
Percentage who said they disagreed that they would be satisfied with their crop harvest if they strictly adhered to the application recommendations in their NM plan	73%	25%	73%
Percentage who agreed that their NM plan is too conservative	67%	21%	100%

Two more Likert Statements suggest that a large majority of farmers in Maryland and Virginia are dissatisfied with their regulations, indicating a high likelihood that they are not complying with their state's rules (see table below). A smaller minority of Delaware farmers are dissatisfied with their state regulations which may suggest a higher compliance rate with their state regulations.

Table 7.19. Percentage of farmers dissatisfied with their regulations, thus indicating potential non-compliance			
	Maryland (n=30)	**Delaware (n=20)**	**Virginia (n=10)**
Percentage who agreed they couldn't always comply with their regulations	97%	58%	80%
Percentage who agreed the regulations are stricter than they should be	79%	20%	80%

Less straightforward in interpretation are the responses to the Likert Statement "My nutrient management plan is too complicated to be helpful," as 21% of Maryland farmers and 5% of Delaware farmers agreed while 60% of Virginia farmers agreed.

The final Likert Statement did not show any statistical difference between states but did underscore the wasted opportunity of having a regulatory approach. Half to 60% of farmers in all three states did not know if the penalties for non-compliance were small, nonexistent, large, or moderate. Some 30 to 50% of farmers in all three states thought they were large or moderate.

7.5. My Compliance Estimates: Counting Comments about Plan Adherence

During my 1.5 hour long interviews, 36 of the 55 regulated farmers (65%) offered comments explicitly stating or implicitly indicating that they were or were not "following" or "using" their nutrient management plans (see table below). These comments were grouped into categories that overall indicate farmers were either in adherence compliance or not in adherence compliance with their nutrient management plans.

Table 7.20. Categories of Comments Indicating Adherence or Non-Adherence with the Plan

Comment Categories Indicating Adherence:	Counts	Percentage
1. Farmers explicitly say they are "following the plan"	6	
2. Farmer imply they are "using the plan"	6	
3. Farmers explicitly say they are "following soil tests"	2	
Sub-total:	14	39%
Comment Categories Indicating Non-Adherence:		
1. Farmers explicitly say they are "not using the plan" or "not following the plan" or they are "breaking the law"	7	
2. Farmers imply they are "not using" or "not following the plan"	9	
3. Farmers explicitly say they are applying nutrients at higher rates than recommended in their plan	4	
4. Farmers explicitly say they are writing false higher yield goals when developing their plan in order to justify higher nutrient application rates	2	
Sub-total:	22	61%
Total:	36	100%

Of the 36 comments farmers provided, negative comments dominated positive comments nearly 2 to 1, indicating that many more farmers may not be adhering to the nutrient application rates in their plans than are adhering.

The non-response rate was high for both Maryland and Delaware farmers and differences between the states was not statistically significantly different indicating the "social desirability problem" of farmers sharing information about their status of compliance with the law (see table below).

p=0.176	**Table 7.21. Differences in Comments Indicating Adherence or Non-Adherence with Plans**		
# Farmers	**Comments indicating adherence**	**Comments indicating non-adherence**	**No response**
MD=30	17%	47%	37%
DE=20	40%	20%	40%
VA=5	20%	60%	20%

Given the high non-response rates, I conclude that at least nearly half the Maryland farmers, just over half the Virginia farmers, and at least one-fifth of the Delaware farmers expressed comments explicitly saying or implicitly suggesting they were not adhering to their plans. As for comments suggesting adherence, at least 17% of Maryland farmers, 20% of Virginia farmers, and 40% of Delaware farmers offered comments indicating they were explicitly or implicitly adhering to their plans.

Though differences between states are not statistically significantly different, the results follow the general trends of findings in this dissertation. In general, most Delaware farmers expressed positive opinions about their state's policy-making process, their plans, and their regulations, and also offered many comments indicating they were adhering to their plans. In contrast, most Maryland and Virginia farmers expressed negative opinions about their state's policy process, their plans, and their regulations, and also offered few indications they were adhering to their plans.

COMMENTS INDICATING ADHERENCE:

Farmers who say they are "following" their nutrient management plan:

1. "We make more money following the plan by saving on buying N and potash. We have GPS'ed the fields and have a laptop in the tractor which switches from one rate to another…That's cut the rate down 22 percent." (3-3.2, Farmer 59, Sus)
2. "We used to apply 3 ton per acre on most of the corn for the last four years that we've been on a N-based plan (2001 to 2004). Now we're on a P-based plan in 2005 and 2006. We now spread a ton or ton and a half per acre…If shooting for 200 bushels per acre, you've got 15 pounds of N left over from previous year so we're only putting down 185 lbs (of nitrogen)." (3-23.2, Farmer 51, Sus)
3. "Having a plan has allowed me to not put nitrogen on in the fall like they do in the Midwest. Private Planner E (private consultant) is doing a stalk test on the corn in next few days." (8-10.2, Farmer 38, Wor)
4. "I do adhere to them (nutrient recommendations) but I do think it affects my yield. So far, I've been getting by but I don't know at what point I'll need to put more." (8-10.1, Farmer 39, Wor)
5. Farmer 8 said his application rate "is pretty close" to the rates in required plan. "With everything else associated it, I kinda like the nutrient management plan. It gives you a reason to get things (soil tests) done…Before I got the 2000 soil tests, it was probably 1996 or 1997 was the last time I got soil tests. (3-31.1, Farmer 8, Acc)
6. "Now with nutrient management plans, we're putting down just enough to grow the crop so it doesn't leave a whole lot to runoff. We used to use 30% N when corn got to be 18 inches and now we cut it down to 20% because we put more manure on to cut the commercial N. That's been 5 years or more that we're doing this. (3-15.1, Farmer 29, Wor)

Farmers who say they "follow" their soil tests:

1. "If you follow your soil tests, I ain't got no problems with being able to comply." (3-2.1, Farmer 43, Ken)
2. "I don't never go over the soil test recommendations. If (the University of Delaware recommendations) say you need 150 lbs of N for a 160 bushel crop, I trust what they recommend." Farmer 55 gets his plan prepared by the Sussex County Soil Conservation District. (2-10.2, Farmer 55, Sus)

Farmers whose comments suggest that they are at least "using" their plan (though it's unclear how closely they are following the plan):

1. "I look at the plan every time I plant." (3-8.2, Farmer 49, Sus)
2. "It's not really too complicated, it's just a matter of writing down what you've done. (3-24.1, Farmer 50, Ken)

3. "I got a crop advisor and he tells me what should and shouldn't be done. Where manure should go. It's not complicated for me to read it once he's done." (3-2.1, Farmer 43, Ken)
4. "The nutrient management law changed a lot of things…The nutrient management plan did encourage me to buy special agricultural software (for record keeping). We've been doing it four or five years. (3-29.3, Farmer 41, Sus)
5. "I'm gonna try to adhere to the plan. We're gonna try it and see what kind of crop we can grow. I'm supposed to be setting an example…I just got a P-based plan in 2006 and I'll try to follow it. It's dropping my manure rate from 4 tons per acre to 2 tons per acre." (3-9.3, Farmer 27, Som)
6. "My plan is with (Private Planner B). No, I don't think they're too conservative … I started testing my manure just in the last two years, Nutrient management made me decide to see if the P levels were changing. They're not. I still do it every other time I crust out … I agree it's not always possible to comply." When I asked him what he was referring to when he said it wasn't always possible to comply with the regulations, Farmer 14 said, "If they say you can only put on 110 pounds of N and we think we need 190 pounds of N. (47.3, Farmer 14, Wor)

COMMENTS INDICATING NON-ADHERENCE:

Farmers who say they are "not using" or "not following" their plan or say they're breaking some aspect of the law:

1. "Truthfully, I haven't used it. I don't look at it. It's too strict using College Park recommendations … They're recommending 1.5 and 2 tons of manure per acre. I'm putting down 3 and 3.5 tons on corn ground." (3-9.2, Farmer 25, Som)
2. "It's not too complicated to be helpful. It's just not helpful. It's a lot of hocus pocus. (3-23.1, Farmer 42, Sus)
3. "I disagree. I wouldn't be satisfied because we are all trying to maximize our yields so you have to maximize the inputs. If I put on less than I think it takes to grow a good crop, I'm sunk." Farmer 15 from Worcester said that though he stays in compliance with the law by getting a plan done with "Julie" a Cooperative Extension Specialist since 2000, but Farmer 15 also receives advice from a fertilizer dealer. (3-17.2, Farmer 15, Wor)
4. The Extension Service recommendations aren't worth the paper they're on because the nutrient management specialist is focused on everybody while the fertilizer dealer is focused on our operation. We really rely on our fertilizer company and A&L Lab's results for our true recommendations." (3-9.1, Farmer 35, Wic)
5. "If I went by the state's requirements, I'd disagree (that I'd be satisfied with my crop)." Public Planner D (Maryland Extension specialist) hadn't called to tell me the plan is ready and I had to pay for those soil samples. I need my prescription so I called UAP (a fertilizer company) and he pulled samples and did the analysis." (3-15.4, Farmer 17, Wor)

6. “Most of the time, my plan is on the shelf. I did have it in a pickup truck at one point but I was filing taxes and took the wrong book.” (1-17.2, Farmer 9, Acc)
7. “They make the law so we can break it. I break the law. The state doesn't like the 2.5 to 3 ton rate Tony recommends and they said we had to use 1.5 tons per acre. I’m using 2.5 ton (poultry manure) per acre on corn for the last 5 years due to the regulations and having more land and wanting it go further. 10 years ago, I was probably using 4 tons per year. However, the state said we should be using 1.5 ton/acre. I break the law...We try to have a manure set back of 50 to 60 feet away. That’s in our recommendations.” (3-1.1, Farmer 2, Acc & Wor)

Farmers who don’t come right out and say they are not using or not following their plan but whose comments suggest they are “not following” their plan:

1. “The nutrient management plan tells you to be 25 feet back from the ditch which is asinine since you plant right up to the ditch and I don’t know any farmer than doesn’t fertilize what he plants. It’s a law like the 55 mph speed limit - they're intending for you to break it. Nobody follows the law …Most farmers that follow their plan will be broke. Nobody wants to violate the guidelines but it’s a matter of you staying in business or not.” (1.17.1, Farmer 23, Wor)
2. “You have a lot of farmers throw up their nutrient management plan on the shelf and you do what you want to do anyway. You’ve got to grow a crop and if you don’t do it, you’ll be out of business. With today’s costs, they’re (farmers) not putting down more than what they need.” (3-15.1, HH, Wor)
3. “You can follow your plan but you can’t be in business for very long…because your yields will be too low and you’re robbing the ground of nutrients. It’s like what crabbers do – they take them (crabs) out constantly but never putting them back. If you follow your plan, you’re just taking (nutrients) out and not filling up.” (8-10.3, Farmer 40, Wor)
4. “There’ll be times you’re outta compliance if you switch to soybeans but you’ve already fertilized for corn but you have to switch because corn prices are dropping.” (2-10.1, Farmer 32, Wor)
5. “I disagree. The recommendations (from Extension) are too conservative. Their recs are based on soil tests at the time and they’re trying to limit my production. They base everything on a 150 bu per acre yield goal. Well I want to grow 200 bushel per acre. That’s our profit. That’s where we make our money is by the increase (in yield) and not holding steady. Only thing we can do is increase production.” (2-24.JB, Som)
6. “I don’t think they’re giving me enough for what the crop will use. My levels are up still and it will come to a point that the yields start dropping and it will be hard not to cheat.” (3-15, Farmer 26, Som)
7. “They (Extension) will only allow me to fertilizer for X number of bushels, which is my average yield. No matter how much moisture I get, it’s unlikely I will exceed that yield. If I don’t get adequate moisture, I will fall below that yield.

Then every three years, they'll ask me for my average yield, and it will go down. Three years later it will be down here (motioning with his hands that his yield will keep dropping). If I can't fertilize for above my average yield, it's not fair; so you're never going to exceed the yield. The only way to make it is on big yields. There's going to be a day when we go out of business." (3-15.3, Farmer 11, Som)

8. "It hasn't saved us any money but hasn't cost us anything either. Just time filling out the stuff. We have to go to class to keep up with the credits but my brother wouldn't go so I do it. Just one person on the farm has to have the certificate and license. (3-25.1, Farmer 48, Sus)
9. Farmer 16 from Somerset County, Maryland thinks that the nutrient management plan doesn't allow him to use starter fertilizer and he feels that he's "losing 20 bushels per acre" because of that restriction. (3-17.2, Farmer 16, Som)

Farmers who indicate they may be applying nutrients at higher rates than their plan recommendations:

1. "Once you get down say below 3 tons (of poultry manure) per acre, then the flow of material is not consistent and I'm afraid there could be problems with spreading patterns giving you inconsistent application." Farmer 56, from Sussex, called the 1.5-ton per acre rate in his plan "ridiculous."
2. "Adherence? That's getting personal now. I use the plan as a guideline. We do put it on extra in some areas where the land is poorer than others." (2-24.2, Farmer 37, Som)
3. In response to the question, "How are you doing things differently from the plan?" the farmer said, "Very little probably. You can't do everything to the letter but not much different than that. We don't fertilize for 200 bu corn crop but you have to fertilize for a little better than average." (8-9.1, W.R., Acc)
4. "We used to be in the voluntary nutrient program before the last 10 years that we've been with Private Planner A. Our current plan is different from our voluntary plan in the phosphorus part. Planner A's recommendations are less than the phosphorus in the mix of fertilizer we use. Also different is where we can spread the manure - that cuts down on P quite a bit." (4-7.2, Farmer 12, Wor/Wic)

Farmers who say they are manipulating plan information inputs (yield goal and residual nitrogen):

1. "When we do a nutrient management plan, I sit down with my consultant. They want us to project yields for corn and they write our plan based on that. If we say we want 200 bushels on irrigated ground. They're not holding us back. I've been told by a couple of consultants to make yield projections high enough to cover our fertilizer needs.
2. Farmer 18 from Worcester County, Maryland showed me what Private Planner A, preparing nutrient management plans in all three states, wrote in Farmer 18's plan about residual nitrogen credits. Farmer 18 opened his nutrient management

> plan to one of his field's pages and in the middle of the page was a comment that read approximately, "Taking residual nitrogen credits per Maryland's requirements may result in under-fertilization." (4-6.2, Farmer 18, Wor)

Wrap-up of Findings from Comments Indicating Plan Adherence

Overall, of the 36 farmers that provided comments indicating they were explicitly or implicitly adhering to their nutrient management plan, comments indicating non-adherence outnumbered nearly 2 to 1 comments indicating adherence. Comments were not statistically significantly different between states and the non-response rate was high for Delaware and Maryland farmers. Thus, at least 47% of Maryland farmers and 60% of Virginia indicated they may not be following their plans while at least 20% of Delaware farmers indicate they may not be following their plans. Conversely, at least 40% of Delaware suggest they following their plans while at least 17% of Maryland farmers and only 20% of Virginia suggest adherence.

7.6. Summary

Chapter 7 provided four datasets that shed light on how well farmers may be complying with their state nutrient management laws. Three of the four datasets did not show statistically significant differences between states while one did reveal significant differences. Thus, on the one hand, it appears that the different policy-making processes (as discussed in Chapter 5) do affect farmer opinions about their state's policy approach and do affect farmer opinions about their plans and regulations. However, three datasets measuring compliance with three practices required by all states, seven practices required by at least one state, and comments indicating adherence to the plan recommendations, suggest farmers in these three case study states are more alike than they are different and compliance appears poor.

Regarding the one dataset that shows statistically significant difference between states, five of the six Likert Opinion Statements about plans and regulations and the counts of comments regarding adherence to the plan or other requirements all indicate that the majority of Maryland and Virginia farmers may not be adhering to their plans while the largest group of farmers indicating adherence to their plans is from Delaware.

My estimates showed farmers in Maryland and Virginia reporting strong dissatisfaction with their plans and with their regulations, and greater satisfaction than dissatisfaction from Delaware farmers. This split between states mirrors the split in responses between the states to Likert Opinion statements in Chapter 5 which reveal Maryland and Virginia farmers mostly felt their states' policy development process was not fair and their regulations were not justified.

Given JLARC's observations in Chapter 5 that farmers who think their plan is realistic are more likely to follow their plan, my estimates posit that farmers who are satisfied with their plan or regulations are more likely to comply and, conversely, dissatisfaction leads to less compliance. Furthermore, with about half the farmers in all three states saying they didn't know what the penalties were for non-compliance, none of the states are significantly compelling farmers to follow the plans through serious deterrence efforts.

One complicating and serious factor in the apparent link between farmer opinions about policy making processes and compliance with regulations is the choice of planner. The qualitative comments presented in this Chapter provide evidence that plans prepared by private planners are significantly different from those prepared by public planners indicating that private plans tend to recommend greater nutrient application rates than do plans by public planners.

Hence, states that allow their regulatory mechanism to be prepared by public planners representing the state and by private planners representing their self interest should recognize that non-uniform regulatory standards will inevitably result. In addition, with a plan-based approach, the farmer has to like his plan in order to follow it. A farmer isn't going to like a plan that makes him change what he's doing. Since farmers, like most people, resist change, a plan that a farmer thinks is actually bad for business instead of reasonable and one he can still profit with, is likely to be ignored. Chapter 8 will go into more detail why farmers think the nutrient management plans prepared by public planners are bad for business.

Thus, since more Maryland farmers in this dissertation (and statewide) have plans with public planners than in Delaware (in this dissertation and statewide) and since public plans are likely more restrictive than private plans, more Maryland farmers are likely dissatisfied with their plans than Delaware farmers. The fact that most Virginia farmers in this dissertation are equally dissatisfied with their plans despite their use of private planners indicates that they may be unhappy with the frequent inspections they have to endure and the additional regulatory requirements their state imposes on them. Given the fact that Delaware farmers have six fewer requirements than Virginia farmers and two fewer rules than Maryland farmers likely makes their view of their regulations more positive than farmers in the other two states.

Regarding the three datasets that did not show statistical differences between states, overall, compliance with the required practices or adoption of the recommended practices was poor, suggesting that none of the states were particularly effective at getting farmers to comply with their rules or adopt practices that have long been recommended by the Extension and Conservation District practitioner community. Thus, despite the differences in policy making processes, farmers across the board are exhibiting mostly poor compliance rates.

I found "good" compliance (60% or above) among farmers possessing the basic plan – most were rigorously conducting soil tests even more frequently than required by all three states; nearly all were split applying nitrogen fertilizer as sidedress; and most were having manure nutrient analyses conducted every three years.

However, I found more "poor" compliance (less than 60%) for many more practices that either Virginia or Maryland required and that all three states have been encouraging for decades. I found that over-application of nitrogen is likely occurring because farmers were not taking residual nitrogen credits for previous applications of manure or legume crops. Farmers are infrequently calibrating their manure spreaders; hardly keeping any setback from ditches or streams when manure is land applied indicating manure is being applied to surface waters; and applying manure during winter months for the corn crop planted in the spring. There were some individual practices that stood out in individual states, such as most Maryland farmers did use the PSNT test and most Delaware and Virginia farmers were better adhering to Maryland's two-year manure testing frequency requirement than were Maryland farmers.

The poor compliance rates by Virginia farmers, and at times even worse than farmers in Maryland and Delaware that didn't have the same rules, highlights the potential reality of trying to regulate what Innes called, "unobservable waste handling practices," even when a state achieves near annual inspection of its regulated community.

CHAPTER 8 – FINDINGS AND ANALYSIS: MY ESTIMATES OF IMPROVED NUTRIENT MANAGEMENT PRACTICES (RESEARCH QUESTION 2)

8.1. Introduction

Regardless of how well farmers may or may not be complying with the nutrient recommendations in their plan or the additional fertilizer and manure management rules their state may require of them, it is important to find out if the state laws improved the way farmers were managing nutrients at all.

The underlying assumption in requiring a nutrient management plan in each state's nutrient management law was that farmers were over-applying nutrients and otherwise not taking steps to reduce loss of nutrients to the environment. Thus, it is important to ask if farmers have changed their commercial fertilizer and manure nutrient management behaviors in response to the law and what behaviors changed, if any. Equally important to understand is if the state laws were not the motivating factors for the changes in nutrient management practices, what are the other possible factors?

In addition, this chapter will focus on poultry manure application rates since the *Pfiesteria*-related focusing events shone a policy spotlight on poultry manure. Although none of the state laws established specific manure application rates, all of the laws established an approach to achieving appropriate manure application rates. I will present a dataset about poultry manure application rates for corn, revealing how much manure per acre was used in 2005 and used 10 years prior, and if and how much manure is being used on soybeans and wheat. In addition, I will present findings from a logit regression model analysis that attempts to discern whether a variety of policy, science, and demographic factors can predict a farmer's choice of manure rates.

Finally, all three state laws sought to codify the emerging soluble phosphorus nutrient science in order to achieve widespread adoption of new manure management practices. It is important to verify if farmers are aware of, understand, and ultimately, accept the new science.

8.2. My Estimates of Change Due to the Law or Other Factors

Change Due to the Nutrient Management Laws

The question, "Did you change commercial fertilizer or manure use because of the law?" suffers from a "social desirability" problem because farmers know that the "correct" response is "yes, I did change in response to the law." As is evident by the high non-response rates (roughly four in 10 farmers) in Maryland and Delaware, farmers found it difficult to respond to this question.

Some "no-response" farmers would speak in great detail in response to the question, but I found it impossible to interpret whether they had actually answered "yes" or "no" to the question and thus, had to log them as no-response. I did not press farmers on providing me with an explicit yes or no answer if they did not do so themselves because I felt that forcing them would make them upset and want to discontinue the interview.

Even for some farmers that previously in the interview explained that they were not complying with the law by telling me –"I break the law," "I'm not using my plan," "I put down more than what's in my plan," or "I got my recommendations from a fertilizer dealer because my state planner was taking too long" –were unable to answer "no" to this socially desirable question, likely because they feared legal liability.

Several farmers had spent much of the interview impressing upon me the fact that they were not doing anything wrong because they would be foolish to over-apply expensive nutrients. Thus, the law was not justified in suggesting they were doing something wrong that needed regulating. Given this worldview, it seemed they felt there was no need for them to change their manure or fertilizer use because of the law.

However, despite these explanations justifying the famers doing things the way they have always done, I still heard many farmers say that certain manure and fertilizer practices did change in the years following the law. Yet, they were unwilling to attribute those changes to the law because doing so would indicate that the law was justified. Hence, certain farmers appear to be in a catch-22 situation where they are forced to insist or merely infer that they are not doing anything differently, because admitting so would mean they were doing something wrong prior to the law and that would justify the need for regulations.

Despite these difficulties and the high non-response rate, it is worthwhile to try to interpret the quantitative results, and it is important to interpret the qualitative results.

As for the phrasing of the question, "Did you change commercial fertilizer and manure use?" I used the term "change" instead of the term "improve," because farmers during my pre-interview trials reacted negatively to the word "improve," which implied they were doing something wrong prior to the law. Thus, I hoped that the term "change" was a more neutral word choice to get at Research Question 2, "Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva Peninsula?"

Also, I purposefully employed the term "use" instead of "rates," because during the pre-interview trials, the term "rate" made farmers very sensitive. In addition, I wanted a term that was more expansive than just the concept of "rate" of nutrient application, and I felt the word "use" encompassed various fertilizer and manure management practices such as acreage of application, timing of application, ground conditions at time of application (snow or frozen), manure testing, calibration of spreaders.

Thus, at least 40% of Maryland farmers, 45% of Delaware farmers, and 80% of the regulated Virginia farmers said they did change their fertilizer or manure use in response to their state's law. (see table below)

Did you change fertilizer or manure use because of the law?

DYCL p=0.792	**Table. 8.1. Did you change commercial fertilizer or manure use because of the nutrient management law?**		
# Farmers	**Yes**	**No**	**No response**
MD, N=30	**40%**	23%	37%
DE, N=20	**45%**	10%	45%
VA, N=5	**80%**	0%	20%

Surprisingly, four of the five unregulated Virginia farmers also said they changed their fertilizer or manure use in response to the Poultry Waste Law. This indicates that the mere presence of the regulations in Virginia had a beneficial effect on manure and fertilizer management of unregulated farmers. Of those who said they did not change fertilizer or manure rates were one regulated and one unregulated farmer from Virginia, seven farmers in Maryland (23%), and two farmers from Delaware (10%).

One way to interpret the non-responses is to assume the farmers were answering "no" and add them to the farmers who did say "no" (they did not change their fertilizer and manure use in response to their nutrient management law). This would assume that all the farmers with non-responses were trying to evade answering this question due to the "social desirability problem," because they thought the "socially correct answer" was "yes." If this were the case, 55% and 60% of farmers in Delaware and Maryland may not be doing anything differently with their fertilizer and manure nutrient management practices in response to the law.

Qualitative Comments Regarding Changes Due to the Law

No matter what their answer was to this quantitative question, farmers shared many insights into various behavioral changes in response to the law. Farmer 39 from Worcester County put it best and summed up many similar statements from farmers across all three states:

> "Farmers are becoming better stewards because of the *Pfiesteria* thing. Environmental concerns of farmers have changed. When I was growing up, when something happened to your fertilizer tank, you just dumped it out on the ground. To tell you the truth, most of the farmers have become good stewards of the land – 99 percent. That's what's changed within the last 5 years (their becoming good stewards). In the first place, if I see somebody doing something, I would fuss with them about it. There's been a lot of pressure because of the *Pfiesteria* thing." (8-10.1, Farmer 39, Wor)

Without providing me with a "yes" or "no" answer regarding whether his behavior changed or whether his fellow farmers' behavior had changed, Farmer 41 from Sussex indicated that farmers are more aware of their opportunities to save money with nutrient management:

> "I don't know if they've (farmers) changed, they're just watching more closely what they're doing. I would say it probably has some positive benefit. Usually, when something has been brought to your attention it's a good thing. You can spend less money on fertilizer or know where you're going to apply what." (3-29.3, Farmer 41, Sus)

Others mentioned their nutrient management intensity had become more rigorous because of better use of soil or manure testing diagnostic procedures. Farmer 8 from Accomack explained that the regulations helped reduce procrastination:

> "With everything else associated with it, I kinda like the nutrient management plan. It gives you a reason to get things done. With me, I got current soil tests but if I didn't have this (the required plan), I'd put it off, and probably 10 years would have gone by and I wouldn't have done it (get soil tests). Everything else gets done first. Before I got the 2000 soil tests, it was probably 1996 or 1997 the last time I got soil tests. Most of the time, when I got a new farm, I'd do soil samples." (3-31.1, Farmer 8, Acc)

Many farmers explained that the state laws have motivated farmers to "regulate themselves" by applying compliance pressure within the farmer community. They told me that they themselves or they had heard of other farmers "telling on each other" for doing things they should not do. When I pressed a few farmers to explain what was motivating them to do that, I learned that some farmers complain about their neighbors because they regard those farmers as "bad apples making the rest of them look bad." Still others said they call in a complaint because of a sense of fairness. That is, they thought it was unfair that their neighbors were getting away with things they were trying not to do (like applying manure in winter months).

Farmer 54 from Sussex said, "Farmers call in to enforce compliance. Compliance occurs by word of mouth too." (1.25.1, Farmer 54, Sus) Farmer 13 from Somerset offered this insight on the Maryland law achieving what he thought was its intended effect:

> "I would say the intended – I have to watch what I say here – the intended benefit is water quality awareness – not necessarily better water quality. Water quality awareness is higher throughout the state of Maryland among everybody. Citizens may pay more attention to perceived environmental threat than 10 years ago. Everyone's motivated to call in a complaint." (3-22.2, Farmer 13, Som)

Farmer 53 from Sussex told a story that showed he actually felt good about being the reason for a complaint call:

> "Somebody turned us in two years ago saying we were spreading manure too early. We had three guys visit us at one time – the guy who checks the nutrient management plan, the state, and UDE (University of Delaware). When they were checking on us, they recommended that we stop buying commercial fertilizer mix with phosphorus in it to see if we could see a difference in our yields. Now we just buy 32% N." (3-29.1, Farmer 53, Sus)

Farmer 53's story indicates that despite Delaware not having formal rules about manure application in wintertime, someone nevertheless "turned him in," which provided the inspection team the opportunity to review his records. This review probably revealed that Farmer 53 had high soil test phosphorus, and thus it was unnecessary for him to purchase commercial phosphorus. Furthermore, Farmer 53's story indicates that either his nutrient management plan inappropriately recommends commercial phosphorus fertilizer or it indicates that he is not adhering to his nutrient management plan. Farmer 53 did not indicate whether the inspectors told him there was a problem with his plan or that they told him he was not properly following his plan, he only indicated that he felt something good came out of being inspected and the law.

Several farmers from all three states gave examples of specific nutrient management practices that have improved because of the law. Farmer 36 from Wicomico said:

> "I got a plan three years ago when it became mandatory (likely 2003, which indicates Farmer 36 was late in complying). Now I only use (commercial fertilizer as) sidedress instead of starter fertilizer coz I trust manure. I used to spread right after every crust out and right near the chicken houses. Now I store it in the shed and stockpile it till March." (2-24.1, Farmer 36, Wic)

Farmer 36's story revealed that he a) reduced his use of commercial nitrogen fertilizer, b) stopped applying manure in the easiest and closest fields, and c) is stockpiling manure for proper application timing instead of winter application.

Many farmers mentioned they have started testing their poultry manure. "I started manure testing in 2000 (the first year farmers were required to submit nutrient management plans)," said Farmer 29 from Worcester (3-15.1, Farmer 29, Wor). Farmer 14 also from Worcester said, "I started testing my manure just in the last two years. Nutrient management made me decide to see if the P levels were changing (in the manure). They're not. I still do it (test manure) every other time I crust out" (4-7.3, Farmer 14, Wor).

Farmer 51 from Sussex County gets "the gold star" for his improvement in many nutrient management practices, ranging from reduced manure application rates, increased manure application setback distance, taking residual nitrogen credits, and reduced nutrient application rates.

> "We used to apply 3 ton per acre on most of the corn for the last four years that we've been on an N-based plan (2001 to 2004). Now we're on a P-based plan in 2005 and 2006. We stopped taking manure from three houses just last year and we only took manure from one house. Private Planner 'C,' our scout of 10 years says we got to (stop using so much manure). We just can't do it anymore. We almost generate enough manure from our own two farms' six houses. If it weren't for the P, we could put the manure out there. We now spread a ton or ton and a half per acre. Private Planner 'C' writes our plan. When the thing came about – he's pretty thorough. If we're shooting for 200 bushels per acre, you've got 15 pounds of N left over from previous year so we're only putting down 185 lbs (of nitrogen). We use starter 30-0-0[18]." (3-23.2, Farmer 51, Sus)

[18] The commercial fertilizer mix Farmer 51 purchases is comprised of 30% nitrogen, no phosphate, and no potassium.

Two farmers told stories that show some of their nutrient management behaviors have improved, while others' have not or it's uncertain if they have. Farmer 1 from Accomack said, "I'm putting on more P than they recommended in my manure but I stopped buying (commercial) P in response to the law" (3-30.2, Farmer 1, Acc). Farmer 29 from Worcester said that he's using less commercial nitrogen but applying more manure:

> "Now with nutrient management plans, we're putting down just enough to grow the crop so it doesn't leave a whole lot to runoff. We used to use 30% N when corn got to be 18 inches[19] and now we cut it down to 20% because we put more manure on to cut the commercial N. I don't think you can buy 30% anymore. That's (the 20% commercial nitrogen application) just enough to get the corn through. That's been five years or more that we're doing this." (3-15.1, Farmer 29, Wor)

Two farmers from Delaware gave examples of how the law stimulated technological upgrade and innovation. Farmer 45 from Sussex explained that he developed a new apparatus for his manure spreader to prevent manure from getting in the ditch. "We drive up to the edge of the ditch with a curtain on our spreader. We devised it three years ago. Before, we didn't have any farms with ditches. Now we have a new 200-acre farm with a ditch" (4-5.1, Farmer 45, Sus). Farmer 41, also from Sussex, said that the law's record-keeping requirements made him digitize his paperwork and use satellite imaging software:

> "The nutrient management law changed a lot of things like having to go to school to apply manure (mandatory certification classes). Keeping updated on all books, hiring private consultants; it's more paper work. The nutrient management plan did encourage me to buy special ag software. You gotta keep records quick and it's too much to do by hand. I got it from a record-keeping firm in the Midwest. All fields are on there by satellite image. One of them, friend of mine went to college, set us up with computer programming and the Palm Pilot and everything. Now, one field man

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[19] Farmer 29 is applying a commercial fertilizer source of nitrogen that is made up of 30% nitrogen, and he is applying that as a side-dress application when the corn plant is about a month old.

> keeps track of the chemical and fertilizer records and it all gets uploaded to the computer. We've been doing it for four or five years now this way. (3-29.3, Farmer 41, Sus)

Farmer 13 from Somerset summed up a major positive outcome of the nutrient management law in Maryland: getting poultry growers with no cropland or insufficient cropland to give their manure to crop farmers who could use it.

> "The law has taken care of the bad apples. My neighbor has five (chicken) houses and 30 acres of land and he didn't want to give anybody his manure. Those were the bad apples. When the law came around, he started giving it to other farmers and participated in the transport program.
>
> Yes, the law hooked up the poultry grower with the corn farmer. You have to keep it in perspective; 20 years ago they (poultry growers) dumped it in the woods to get rid of it. They dumped it in the woods! How much more environmentally conscious have we become – from that extreme to what we're doing today? For people to tell you you've done nothing (Farmer 13 shakes his head); they just don't have a clue of the reality of it." (3-22.2, Farmer 13, Som)

There were two comments from farmers that suggested some advances would have happened without the law and that some farmers are just going through the motions of staying in compliance with the certification requirements of being regulated.

> "There's been good that's come out of it. Balancing the bird diets (with phytase) and making it (manure) more agronomically useful is a good thing. But, that was gonna take place on its own. There didn't need to be regulations for that to come about." (3-8.3, Farmer 30, Som)

Farmer 48 from Sussex explains that he's just going through the motions:

> "It hasn't saved us any money but hasn't cost us anything either. Just time filling out the stuff. We have to go to class to keep up with the credits but my brother wouldn't go so I do it. Just one person on the farm has to have the certificate and license." (3-25.1, Farmer 48, Sus)

A few farmers mentioned unintended and negative consequences of the law. Farmer 29 from Worcester said he's now planting continuous corn (instead of a corn-soybean rotation) to get rid of manure at the 3 ton per acre rate.

> “We used to plant corn, wheat and soybeans but then wheat price made it not feasible to plant anymore so I only planted corn and soybeans. But then the nutrient management law came along and they started enforcing it in 2001 so we made the transition to just corn because you can only put 1 to 1.2 ton manure on beans. So I plant all corn now every year because corn can use 3 ton per acre. When they started enforcing the law, a lot of farmers changed. They started growing hay coz they can use more manure on that and never have to till it.” (3-15.1, Farmer 29, Wor)

Farmer 29’s story highlights the surprising lengths that farmers will go to avoid purchasing commercial fertilizer and to hold onto their supply of manure for its nutrient content.

Another unintended consequence of the law, according to Farmer 47 from Kent, is that he changed to only testing his soils every three years instead of every two years because of the cost-share that is provided by the Commission to hire a planner:

> “I now do soil testing every three years. Before the law, I did it every two years. Now that NM (the State Program) is paying for it, they (soil tests) don’t get done as often. I like my old practice. Delaware pays it all. Maryland only pays 87%.” (3-2.2, Farmer 47, Ken)

Change Due to Commercial Nitrogen Price Signals

Farmers in my pre-interview conversations mentioned changing their commercial fertilizer and manure usage in response to rising commercial nitrogen prices in 2005 when the price of natural gas was rising rapidly. Nitrogen fertilizer is made from natural gas. Thus, I developed a question to count how many farmers were affected by this price signal. In addition, I anticipated it would be easier for farmers to discuss their change in behavior in response to economic conditions rather than policy conditions and I wanted to foster that conversation.

Did you change fertilizer or manure use due to nitrogen prices?

DYCCP p=NS	Table 8.2. Did you change commercial fertilizer or manure use in response to higher commercial nitrogen prices?		
# Farmers	**Yes**	**No**	**No response**
VA, N=10	**20%**	10%	70%
MD, N=30	**47%**	33%	20%
DE, N=20	**50%**	30%	20%

Due to the high non-response rate in Virginia, there appears to be a statistically significant difference in responses between states. However, when the non-responses are removed for Virginia, there is no statistical difference. About half the Maryland and Delaware farmers said they did change their commercial fertilizer or manure use in response to higher nitrogen prices, while only 20% of Virginia farmers said so. About one-third of farmers in both Maryland and Delaware, however, said they did not change in response to the higher commercial fertilizer prices, while one regulated farmer in Virginia said he didn't either.

When farmers said they did change their behavior in response to the higher fertilizer prices, I followed up and asked, "What changed?" I then grouped these responses for further quantitative analysis

What changed because of higher commercial nitrogen prices?

WCBCP p=0.429	Table 8.3. What changed because of higher commercial fertilizer prices?					
# Farmers	**No change**	**Lowered commercial fertilizer rate**	**Increased manure acreage**	**Increased manure rate**	**Planted less corn**	**No response**
MD, N=30	33%	23%	10%	7%	3%	23%
DE, N=20	30%	25%	5%	15%	5%	20%
VA, N=10	10%	20%	0%	0%	0%	70%

There is no statistically significant difference in how farmers responded to higher commercial fertilizer prices. Again, the non-response rate for Virginia farmers exceeded the 30% threshold. To reiterate, approximately one-third of farmers in both Maryland and Delaware and one farmer in Virginia did not change their nutrient management behavior. The largest group of farmers in each state that did change their behaviors said they lowered their commercial fertilizer rate in response to higher commercial fertilizer prices (20% in Virginia, 23% in Maryland, and 25% in Delaware). A handful of farmers in Maryland (10%) and Delaware (5%) said they increased their manure acreage in response to the higher fertilizer prices saying they tried to “make the manure go further” by lowering their current application rate and using the same amount of manure on more acres.

Two farmers in Maryland (7%) and three farmers in Delaware (15%) said they increased the rate of manure application in reaction to the higher commercial fertilizer prices. This action is likely problematic since using poultry manure as a nitrogen source to avoid purchasing commercial nitrogen can result in up to four times too much phosphorus for the corn depending on the phosphorus content of the manure. Only one farmer in Maryland (3 percent) and Delaware (5 percent) said that they would plant less corn (because corn is one of the most nitrogen-intensive of all commodity crops) in reaction to the high price of commercial fertilizer.

Change Due to Technological Evolution

While answering questions about change in commercial fertilizer and manure use in response to either their states’ nutrient management laws or in reaction to the higher commercial nitrogen prices, many farmers told stories explaining how farmers have improved their nutrient management behaviors over time because of the evolution of manure application technology. This section presents the most compelling and insightful comments.

Many farmers on the Delmarva Peninsula told me stories about their fathers' and grandfathers' "shovel and wagon" techniques to explain how much the evolution of manure application equipment has helped farmers lower their manure rates, avoid applying manure to fields right next to their chicken houses, and switch from disposing of manure to carefully using it as fertilizer. Farmer 55 from Sussex County told one version of this story:

> "We try to be good stewards. Each generation does better. My grandfather done things different from my Dad and I'm doing things different than my father. Each generation is more mindful of nutrient management. The land where we lived was so poor and the chicken industry started in little chicken houses. Dad and his brothers and my grandfather cleaned house because they couldn't afford fertilizer. At that time manure was so scarce. They planted corn on a grid system so you could cultivate it south to north and east to west with horse wagon. They would spread manure around each plant. They spread it by hand with a shovel because it was so scarce. The pilgrims planted a fish next to the corn, did you know that? Ground was poor but manure built the ground up. That's how they did it in the '40s." (2-10.2, Farmer 55, Sus)

Farmer 15 from Worcester explained why poultry growers used to apply manure in the fields closest to the chicken houses.

> "You look back at history, we did it (applied close to chicken houses) because of economics and what dad and granddad told us. We chose the land that was closest to the houses coz it was easier not to go so far. People were always standing around waiting to load the spreader. It'd take two weeks to clean out the house so you'd stayed as close as you could (you applied the manure in fields that were near the chicken house) and you were building the phosphorus over 20 years. Nobody thought different about then it but everybody was guilty." (3-17.1, Farmer 15, Wor)

Many farmers explained that the single most important technological innovation that came to the Delmarva Peninsula was the dissemination, in the early 1990s, of the revolutionary spinner spreader that replaced the box spreaders that were originally designed for dairy cow manure. Farmer 13 from Somerset explained:

> "With the box spreaders, they would just throw it (manure) up in the air, drive out from underneath it, and come back as soon as you could (to the chicken house for another load). My tractor couldn't pull my equipment – that's how deep the manure was being applied – 10 tons to the acre. When spinner spreaders came in, we went from 10 ton to 5 ton over night. Cut it in half overnight. We invested our money in that equipment coz it made us more money. Then the state says we haven't been doing enough. Hey don't you remember what we used to do?" (3-22.2, Farmer 13, Som)

Farmer 48 from Sussex pointed out that the latest trend on the Peninsula is custom application with variable rate planters.

> "(There are) new changes going on now. A lot of large grain farmers are getting new variable rate planters. And, most other farmers are getting Southern States (a fertilizer company) to use their variable rate planters to plant and fertilize according to GPS maps." (3-25.1, Farmer 48, Sus)

Despite the technological equipment upgrade, Farmer 56 from Sussex explained that he thinks it's still not easy to spread manure consistently and accurately below 3 tons per acre. He said, "Once you get down say below 3 tons (of poultry manure) per acre, then the flow of material is not consistent and I'm afraid there could be problems with spreading patterns giving you inconsistent application." Farmer 56 called the 1.5-ton per acre rate in his plan, "ridiculous."

Change Due to Education and Technical Assistance

There were many farmers who pointed out they did change their commercial fertilizer and manure usage and other nutrient management practices but attributed that change not to their state laws but to working with Extension agents.

Farmer 34 from Wicomico told a story about Extension helping them diagnose an excess manure application problem:

> "Lew Carr (Maryland Cooperative Extension scientist) said we were putting out 22 tons to the acre! He came to our farm, when we first built the manure sheds in 1987 and tested our manure spreader. He said, 'You're putting 22 tons to the acre.' I said, 'No way. That's impossible.' I was figuring we were putting out 6 or 7 tons with the old type spreaders, but 22! Now, with three modern spinner spreaders that hold 6 tons per load, we put just 3 ton per acre." (2-16.2, Farmer 34, Wic)

Farmer 34 went on to tell another story of how Extension helped improve their nutrient management practices and save them money.

> "Our commercial fertilizer application rate has dropped over time. We're putting on a lot less. Before nutrient management, for corn, we would spread manure, we used 40 pounds starter fertilizer, but I can't remember what mix it was, then came back with sidedress nitrogen in the summer. In '87, we cut out the starter fertilizer on no-till corn with manure and haven't used it since. Extension agent talked us into it. Nutrient management saved us a bundle of money and didn't affect our yields. In fact, they steadily went up year after year. No-till was harder to be talked into but we did it." (2-16.2, Farmer 34, Wic)

Farmer 25 from Somerset explained how Extension agents helped encourage farmers to join in the voluntary nutrient management program many years before the WQIA, which helped farmers improve their management behaviors.

> "Extension was making suggestions to cut back on manure over 15 years ago when the voluntary plan came out. Extension wanted everyone to get involved in it coz they knew farmers were spreading it too heavily. At one time manure was treated like a waste product. You get out of the house and spray it no farther than you had to. When voluntary program started, and we started doing manure sampling, we then realized that manure was valuable. People started buying it for $10 a ton. Then we started hauling it further and further from the house. Most of the farmers and me have cut back on their manure application. All of them have cut their rates by at least half. We did that six or seven years ago when doing it voluntarily. Getting our manure sampled. We were wasting money." (3-9.2, Farmer 25, Som)

However, Farmer 25 confessed he does not use his mandatory phosphorus-based plan because it recommends only 1 to 1.5 tons/acre of manure while he uses 3 to 3.5 tons/acre. Farmer 25 pointed out:

> "But eight or nine years ago, I was putting down 8 or 10 tons/acre. With all this information from Extension, I've realized it was a bad policy. We realized we were wasting the manure; we could cover more acres with it (if he cut back the rate). I've been sending in manure samples voluntarily all these years. We we're sending to the Lab at College Park and I'll go by that to decide what to put down. That's why I cut my rates down from 8 to 4 to 3.5 tons." (3-9.2, Farmer 25, Som)

Two more farmers from Maryland explained how with Extension's help before the law they improved their practices and saved money.

> "We haven't bought commercial P since the 1970s. Probably back with dry fertilizer beside the row – in '70s. We don't look at a mix. Even before NMP in early '90s we weren't using P and used a dry mix of 10-0-20. We knew then that P was available and the Extension people were as smart then as they are today. They said, 'You got P so you don't need to buy P. Common sense approach, economic approach, why buy P when you don't need it?'" (3-17.1, Farmer 15, Wor)

Farmer 55 from Sussex reminds us that farmers did have nutrient management plans in Delaware before the law, despite the state not having a voluntary nutrient management plan. Delaware farmers were required to get a nutrient management plan when they received cost-share funds for a manure storage shed, but Farmer 55 suggests that some farmers wanted to be good stewards before the regulations.

> "We were nutrient management–minded before the law. We've always tried not to spread (manure) so heavy next to a ditch. Before the law we had a (nutrient management) plan done by Soil Conservation (District) when we got our (manure) shed cost-shared by the state." (2-10.2, Farmer 55, Sus)

However, according to Farmer 20 from Worcester, despite learning new management practices (from Extension), old practices die hard when there's an excess of manure from a Total Clean Out: “We’ve been using 2.5 ton manure per acre a good while now on corn. Ever since we got to know better. But when there’s a Total Clean Out though, we’ll spread it to get rid of it” (4-7.1, Farmer 20, Wor).

Resistance to Change

During discussions of whether farmers changed commercial fertilizer or manure use or other nutrient management practices in response to their state laws, many farmers gave several reasons for why they did not change their behaviors. Two reasons dominated all of the comments:

(1) Objection to setting an average yield goal to start the plan development process; and
(2) Objection to using a phosphorus-based manure rate, because that required purchase of additional commercial nitrogen fertilizer to make up for the nitrogen no longer being supplied by the manure.

Possibly the most fundamental reason why farmers are resistant to following their mandatory plans is the first steps in developing the plan – the setting of an average yield goal. To farmers, taking the best three out of five years of yield results in each field and calculating an average from those results puts a ceiling on their yields, which they believe hampers profit. Farmers said they always wanted to set higher and higher yield goals, because that was the only way they could increase their profits given the continually rising costs of inputs like commercial fertilizer and land rental, and because crop prices were often low.

Farmer 11 from Somerset gave the most vivid explanation of the problem of setting an average yield goal in the plan when explaining his reaction to the Likert Statement that “the recommendations in plan are too conservative:”

> "I agree with that and I'll tell you why. They (Extension) will only allow me to fertilize for X number of bushels, which is my average yield. No matter how much moisture I get, it's unlikely I will exceed that yield. If I don't get adequate moisture, I will fall below that yield. Then every three years, they'll ask me for my average yield, and it will go down. Three years later it will be down here (motioning with his hands that his yield will keep dropping). If I can't fertilize for above my average yield, it's not fair; so you're never going to exceed the yield. The only way to make it is on big yields. There's going to be a day when we go out of business." (3-15.3, Farmer 11, Som)

When I asked Farmer 44 from Kent County about his yield goal, Farmer 44 talked about the corn contests that are held every year. This paints a picture that high and ever-increasing yields are part of what it means to be a successful farmer:

> "Our yield goal? As much as we can get. We've produced 200 bushel per acre. I shoot for 200 bushel or I can't get out of bed in the morning. Our average yield is 150 bu per acre but we get 200 bushel on about 20% of our acres. The yield goal in my plan is mainly 150 bushel per acre.
>
> There are corn contests, you know. To enter a corn-growing contest you have to pay an entry fee. I do it to see what works and to ratchet our yields up. Extension agents come out to check the yield and judge the contest.
>
> Most farmers have the attitude that those farmers who are in the contest are better than others. The yields in the contest will be more than what they find in their own fields and its only certain fields that will be in the contest.
>
> Most doing it (in the contest) to try to push yields coz it's the only way to make money."

When I asked to if it was cost effective and profitable to be so focused on increasing yields, Farmer 44 explained:

> "When land is a fixed expense, the more bushels you can get off that land – the cost per acre to rent then goes down. Say it costs $100 per acre to rent so with 100 bushels per acre that costs $1 per acre to rent and with 200 bushels per acre then it costs only 50 cents to rent (per acre)." (4-5.2, Farmer 44, Ken)

Equally important to why farmers resist following their plans is because phosphorus-based plans force farmers to lower their manure application rate to supply only the phosphorus needs of a crop. This lower manure rate creates a costly nitrogen deficit, which can only be filled by purchase of additional and costly commercial nitrogen fertilizer.

Thus, a phosphorus-based plan is very difficult to accept for most farmers who have always had access to poultry manure. Farmer 13 from Somerset characterized the farmer's relationship to manure as an addiction. Because of this addiction, Farmer 13 estimated there would be better compliance with nutrient management plans by farmers who didn't use manure.

> "There's probably more compliance in non-poultry settings (in Maryland); probably 60% of non-poultry manure users are in compliance. Like drugs, once you try it, you can't stop. Manure! (shaking his head) Manure saved me $70 per acre – times a thousand acres – that's a lot of money." (3-22.2, Farmer 13, Som)

It is noteworthy that Farmer 13's estimate of "better" compliance is just 60%.

Farmer 25 from Maryland revealed his awareness of the high P content of his soils and the ramification of the phosphorus-based plan for his operation – a temporary manure moratorium:

> "Then the main problem with the Water Quality Improvement Act was they wanted to go to P-based plans which we couldn't understand because that it would limit yield because yield is based on nitrogen. There's so many places you can't put any manure on the ground coz P is too high. For the majority of my land I couldn't apply manure on my ground for three to five years." (3-9.2, Farmer 25, Som)

Wrap-Up of Findings: Change in Practices Due to Laws and Other Factors

Despite the high non-response rate, at least between 40 and 80% of farmers in all three states were able to report that they did change their fertilizer and manure use in response to their state nutrient management law. This positive finding suggests that despite the poor compliance rates discovered in Chapter 7, the state nutrient management laws have improved nutrient management practices.

Between 20 and 50% of farmers in all three states also said they changed their fertilizer and manure use because of higher commercial fertilizer prices, which was expected. Surprisingly, raising their manure application rate on corn was not a major response to higher commercial nitrogen prices.

Furthermore, many farmers attribute changes in their manure use to technological improvements in the manure spreaders and to their collaboration with Extension, whose staff taught them and demonstrated to them that they were applying too much manure, even for nitrogen use.

The many qualitative comments from farmers reveal that many nutrient management practices have changed and improved: (1) the law matched poultry growers to the farmers which reduces the likelihood that manure disposal is occurring, (2) they stopped buying commercial phosphorus because they recognize their soils are high in P, (3) they reduced commercial nitrogen concentrations in their fertilizer mixes from 30% to 20%, (4) they reduced their manure rates from more than 3 tons/acre to less than 3 tons/acre, (5) they're testing their poultry manure or they've increased the frequency they test the manure, (6) they lowered or stopped using commercial starter nitrogen fertilizer and started sidedressing, (7) they're stockpiling the poultry manure in winter instead of applying it to fallow fields and they're not applying manure in the fields closest to the chicken houses, and (8) they've upgraded their record-keeping files to electronic systems.

There were a few mentions of some unintended consequences of the law. Some farmers in Delaware decreasing the frequency of their annual soil testing to every three years because the cost-share rates offered by Delaware cover a three-year plan. Some Maryland farmers with very small crop operations report choosing to grow continuous corn in order to keep using poultry manure.

Finally, I heard many farmers describe the emergence of a self-regulatory compliance effect that the law created within the farming community. There appear to be two primary reasons motivating farmers to self-enforce the laws by calling in complaints: (1) desire to scold the "bad apples" so they don't make the rest of the farmers look bad, and (2) desire to prevent other farmers from doing something they would like to do themselves but were trying not to do to stay in compliance with the law.

8.3. My Estimates of the Link between the State Laws and Manure Rates

The underlying assumption of all three nutrient management laws was that over-application of manure and commercial fertilizer was likely occurring amongst farmers and thus the intended effect of the laws was to lower nutrient application rates. Given the focus on poultry manure due to the *Pfiesteria* fish kills occurring on the shores of the Delmarva Peninsula and the birth of the modern broiler industry, the laws particularly sought to lower the manure rates to meet only the crop need for phosphorus if the crop fields were already high in phosphorus.

As described in Chapters 3 and 5, each state set a different phosphorus policy for farmers with soils testing high in phosphorus content. Delaware provided only one straightforward option: only apply manure to supply the phosphorus needs for the crop rotation over three years. Maryland required that the Phosphorus Site Index be conducted on fields with high soil test P to determine the risk of loss of P from that site and to what degree P application rates would be restricted – even to the point of no P being allowed. Virginia offered a choice of a threshold approach based on region or a modified version of the Phosphorus Site Index. In all cases, however, poultry manure on fields with high soil P would likely have to be lowered from a nitrogen-based rate to some kind of lower, phosphorus rate (or none at all).

Thus, this next section presents a set of quantitative data about manure application rates on corn, soybeans, and wheat. In addition, I attempted to determine whether manure application rates for corn were lowered in response to the law. A second set of data is presented from a logit regression model analysis which attempted to discern whether a variety of policy, science, and demographic factors could predict whether a farmer reports using a "low" or "high" manure application rate for corn.

It must be stated that there are several limitations to interpreting the manure application rate dataset. Because I am not an agricultural expert capable of reviewing nutrient management plans and determining adherence, my goal of the 1.5-hour interviews was not to replicate methods employed by the state enforcement officers. Indeed, an attempt to do so would likely have prevented me from gaining the insight I did about farmer opinions of their state's policy development process, their nutrient management plans, and their nutrient management practices.

Thus, during the interviews I did not ask to see either their manure nutrient analysis or their nutrient management plan. In addition, I did not clarify what stage of their crop rotation they were referring to when they reported their manure application rate on corn. Therefore, I am unable to interpret whether the rate they reported to me was a nitrogen-based rate or phosphorus-based rate. In addition, although I could attempt to calculate the nutrient content of the reported manure rates, because I can procure the 2005 average manure nutrient analyses from University of Maryland and University of Delaware manure samples, this calculation would be unwise because of the wide variability of manure nutrient content. Thus, it would be unfair to try to interpret whether the manure rates were appropriate or not for each individual farmer interviewed for this dissertation based on average manure nutrient analysis (instead of having access to the exact manure nutrient analyses he and his planner had access to, if they were taking manure analyses).

Furthermore, all of these manure application rates on corn are rates reported to me by the farmers themselves. I am unable to confirm whether these rates were prescribed in their nutrient management plans. Finally, many farmers answered my question, “What was your manure application rate on corn in 2005?” with a range of manure tons per acre, indicating that they varied their manure application by field. This is a good indication that farmers are trying to optimize their manure use to the different nutrient needs in different fields. Thus, when given a range, I calculated an average of the two rates or in some cases the highest and lowest rates if more than two rates were provided.

However, in order to give some context for the manure application rates reported by farmers, I provide four reference points for interpreting poultry manure application rates on corn:

(1) Based on my formal interviews and personal conversations with eight Extension scientists and specialists from all three states during 2005 and 2006, general guidance to farmers was to apply about 3 tons per acre to corn to provide most of its nitrogen needs.

(2) In the winter of 2006, I attended a presentation given by Dr. Greg Binford, University of Delaware soil scientist, at one of Delaware's continuing education classes. Dr. Binford showed a bar chart of poultry manure application rates and corn yield responses and explained to farmers that the balance of evidence demonstrated that rates over 3 tons per acre did not make economic sense because there was no additional yield response worth justifying the extra tonnage. Dr. Binford strongly encouraged farmers to use 3 tons of poultry manure per acre to supply the nitrogen needs for the corn.

(3) Parker and Li (2006), using survey data from 467 farmers in four Maryland poultry producing counties asked poultry farmers and farmers that did not grow poultry to report how much poultry manure they obtained for their most recent use and how much land they used the litter on to estimate manure application per acre. The authors calculated that average poultry manure application rates were lower for farmers that did not raise chickens (1.9 tons/acre) than for those who were poultry growers (4.4 tons/acre).

(4) When farmers in Maryland began to receive their first phosphorus-based plans, many complained to me during my interviews that their Extension agent would return their plans with less than ton per acre manure rates because the new phosphorus-oriented software reported those rates. Farmers thought this was ludicrous because they didn't think their manure spreaders were capable of getting manure application rates down to 2 ton/acre, let alone to 1 ton/acre or less than 1 ton/acre. Furthermore, they thought rates less than 1 ton per acre would provide so little nitrogen for the corn, which would force

them to spend a lot of time applying such a little amount of manure and a lot of money to buy commercial nitrogen to make up the difference.

Thus, given these four points of reference and the timeframe in which I learned them (2005 and 2006), it is reasonable to assume that a nitrogen-based manure application rate on corn would be 3 tons per acre and phosphorus-based manure application rates on corn would easily be less than 3 tons per acre.

Of course, complicating this simplistic interpretation of manure application rates is the fact that the phosphorus content of manure has been going down significantly as a result of integrators adding the enzyme phytase and lowering the phosphorus they add to chicken diets. In 2005, Hansen et al. from the University of Delaware reported that a typical three-year crop rotation of corn-wheat-soybeans-corn could allow a farmer who was using a manure from birds raised on a “normal diet” (no phytase) to apply about 2.7 tons of manure every three years to meet Delaware’s three-year crop phosphorus removal policy. In contrast, farmers using manure from birds raised on a “modified diet” (with phytase) could apply 4.2 tons of manure to corn every three years in a corn-wheat-soybeans-corn rotation to meet the state three-year crop phosphorus removal policy.

Given all of these complications, I will avoid trying to interpret the reported manure application rates except to point out obvious differences in magnitude of application.

Manure Application Rates on Corn, Soybeans and Wheat

Manure application rate on corn

Average manure application rates on corn were not significantly different when analyzed using simple statistics (see table below). The average manure application rate on corn for the entire sample was 2.8 tons per acre with a low of 2.6 tons/ac (+- .58 tons) in Delaware and high of 3.3 tons/ac (+-1.3 tons) in Virginia.

Table 8.4. Manure rate on corn (tons/acre)				
Simple statistics	**Mean (Std. Dev.)**	**Median**	**Min.**	**Max.**
Maryland, n=30	2.7 (.57)	3.0	1.4	4.0
Delaware, n=20	2.6 (.58)	2.6	1.3	4.0
Virginia, n=10	3.3 (1.3)	3.0	1.0	5.0
All, n=60	2.8 (.76)	2.8	1.0	5.0

But when the manure application rate reported by farmers on corn was analyzed in the following five one-ton per acre increment categories (see table below), there was a statistical difference across states (p=0.026**) to the 95% confidence interval, which may be due to the large number of categories.

Overall, 60 to 97% of farmers in all three states said they were using between 1 and 3.9 tons of poultry manure per acre. These rates at 3 tons per acre or less likely reflect appropriate and modern manure use rates. Only one farmer each from Maryland and Delaware reported using 4 or more tons per acre, as do three farmers from Virginia (two are regulated and one is unregulated). One unregulated Virginia farmer said he uses 5 to 5.9 tons per acre on corn.

MARC p=0.026**	**Table 8.5. Manure Application Rate on Corn in Categories (tons poultry manure/acre)**					
	1 to 1.9	**2 to 2.9**	**3 to 3.9**	**4 to 4.9**	**5 to 5.9**	**No response**
MD, N=30	7%	40%	**50%**	3%	0%	0%
DE, N=20	10%	**65%**	20%	5%	0%	0%
VA, N=10	10%	**30%**	20%	**30%**	10%	0%

The largest group of Maryland farmers (50%) reported using 3 to 3.9 tons per acre of manure on corn in 2005, while the second largest group (40%) reported using 2 to 2.9 tons per acre. The largest group of Delaware farmers (65%) reported using 2 to 2.9 tons per acre while the second largest group (20%) reported using 3 to 3.9 tons per acre. The largest group of Virginia farmers was identically split – 30% reported using 2 to 2.9 tons per acre while another 30% reported using 4 to 4.9 tons per acre.

It is a challenge to compare the reported manure rates in this dissertation to those of previous studies. Michel et al. (1996) reported the manure application rates on "crop acres" of 218 Delmarva poultry growers. Despite Michel et al. using different manure rate categories, it appears possible to compare the two datasets and it appears that farmers interviewed for this dissertation may be applying manure at higher rates than farmers in the past.

Table 8.6. Comparison of poultry manure rates on corn from my dissertation to Michel et al. study

Michel et al. (1999) **N=218 Delmarva poultry growers**	**Average manure rates on corn across all three states** **N= 60 crop farmers**
23% said 2 tons or less/crop acre/year	9% report using 1 to 1.9 tons/acre
37% said 2.1 to 3 tons/crop acre / year	45% report using 2 to 2.9 ton/acre
26% said, 3.1 to 4 tons/crop acre /year	30% report using 3 to 3.9 tons/acre
4% said more than 4 tons/crop acre / yr	13% report using 4 to 4.9 tons/acre
	3% report using 5 to 5.9 tons/acre

To give an example of how confusing it would be to try to interpret the manure rates farmers reported to me during the interviews, Farmer 10 from Accomack, a regulated farmer who said he does not use commercial starter or sidedress fertilizer to grow corn, explained:

> "I use 4.5 ton per acre on corn acres roughly every 3 years. Been doing it this way since I've been farming. Probably the last 24 years. But I have used sidedress a few times. I'm trying to avoid side dressing coz it's another run over the land." (8-9.1, Farmer 10, Acc)

Thus, Farmer 10's manure rate – 4.5 tons per acre on corn every 3 years – echoes the analysis of Hansen et al. (2005) that finds using manure from birds fed “modified diets,” 4.2 tons of manure could be applied to corn every three years to meet the three-year crop P removal rate policy. However, Farmer 10 said he has been using this rate for 24 years, while Maryland only required integrators to begin using phytase in 1998. Furthermore, Farmer 10 said he does not use either starter or sidedress commercial nitrogen fertilizer to grow corn. Thus, he is intending to supply the corn’s nitrogen needs entirely from poultry manure.

Amount of time using their 2005 manure application rate for corn

This question attempted to determine how many years each farmer had been using their manure rate in order to determine if a change in manure rate occurred after the nutrient management laws. Naturally, this question cannot tell us if the change occurred because of the laws, but since it was difficult to ask and receive quantifiable answers from some farmers if they changed their manure use in response to the law, this question can at least correlate a change in manure rates to before the law, soon after the law, or many years after the law.

I asked farmers, “How long have you used your current manure application rate on corn?” By current I meant their rate in 2005. Farmers gave me many different responses. Some said the number of years, some said which year they changed to their current rate, some gave a qualitative response like, “Oh it’s been a while now.” For those farmers who I could not pin down, I had to log as no-response. All other farmers that supplied me with a quantitative response I then grouped into three categories of years – two of which indicate that they likely changed to their current manure rate after the state laws and one category that indicates they likely changed to their current manure rate before the state laws were enacted.

There is no significant difference between states in terms of how long farmers have been using their current manure application rate (see table below). Between 30 and 47% of farmers in all three states said they changed to their current manure application on corn in the year after the state nutrient management laws passed, indicating the possibility that they did change manure rates in response the law. Between 32 and 40% of farmers in all three states said they have been using their current manure rate on corn since before the state laws.

HLRCC p=0.884	**Table 8.7. How long have you used your current manure application rate on corn?**			
	(Likely changed rates after the state laws)		**(Likely changed rates before the laws)**	
# Farmers	**For the last 1 to 4 years (~2005 to 2002)**	**For between 5 and 9 years ago (~2001 to 1997)**	**For 10 or more years (~1996 and earlier)**	**No response**
MD, N=30	27%	20%	33%	20%
DE, N=20	14%	23%	32%	32%
VA, N=10	20%	10%	40%	30%

Manure application rate on corn 10 years ago

When asked directly what their poultry manure application rate was 10 years ago (i.e., 1995, as I interviewed farmers in 2006 about their 2005 nutrient management practices), the non-response rate for Virginia and Delaware growers exceeded 30%. Some farmers were increasingly uncomfortable and irritated by my focus on their manure application rates. Farmers likely regarded this question as having a “social desirability problem” in that they know high manure application rates or disposing manure is associated with Bay pollution and the *Pfiesteria* fishkill events. Thus some farmers were resistant to discussing probable higher application rates in the past, as doing so would either be an admission of guilt for wrongdoing or evidence that the law was necessary.

Though most did not give me a rate, most gave various renditions of, “We were higher in the past.” For the quantitative analysis, I counted this as “no response,” but for the qualitative analysis this response suggests that manure rates for most farmers have come down in the last 10 years.

Overall, 30 to 47% of farmers in all three states that responded to the question said they used 4 or more tons per acre 10 years ago (1995). Most (30 to 40%) said they used between 4 and 9 tons of manure per acre of corn in the past. This finding suggests that before the 1997 *Pfiesteria* events and the three ensuing laws, one-third to two-fifths of farmers in all three states were applying manure at a higher rate than the accepted 3 tons per acre rate to provide nitrogen to corn. Thus, this finding indicates some justification for requiring nutrient management plans that would at least lower manure rates from excess to a nitrogen-based rate.

MRCPC p=0.207	**Table 8.8. Manure application rate on corn 10 years ago (tons poultry manure/acre)**				
# Farmers	**I didn't use manure 10 years ago**	**Less than or equal to 3 tons/acre**	**4 to 9 tons/acre**	**10 or more tons/acre**	**No response**
MD, N=30	0%	10%	**40%**	17%	33%
DE, N=20	10%	15%	**35%**	0%	**40%**
VA, N=10	10%	0%	**30%**	0%	**60%**

Manure use on soybeans

The largest group of farmers in all three states (40 to 80%) said they do not use poultry manure for soybean production. Although there is no rule against using poultry manure on soybeans, because soybeans naturally “fix” nitrogen for themselves by absorbing nitrogen out of the atmosphere, most Extension scientists and practitioners do not recommend applying poultry manure on soybeans. In fact, studies by a University of Delaware soil microbiologist, Dr. Vasilis, have shown that manure on soybeans can be detrimental to both the soybean crop and the environment. Only Virginia has any rules regarding manure on beans, but those rules only specify the timing of application, which restricts use of poultry litter on soybeans to certain months, rather than rates.

Many farmers told me they prefer saving their poultry manure for use in corn production, which is one of the most nitrogen intensive crops. In addition, several farmers explained they do not like using manure on beans because it is hard to get the application rate low enough to avoid making the beans too stringy, that is, too much manure causes the beans to limit the pod development in favor of the vines.

A large majority of farmers in Maryland (67%) and Delaware (80%) agree for various reasons that beans do not warrant manure application. However, 60% of Virginia farmers do use manure on soybeans – three of them use 1 to 1.9 tons/acre while three use 2 tons/acre. Of the 20% of Maryland farmers who said they used manure on soybeans, their rate was 2 to 2.9 tons/acre.

MRS p=0.116	Table 8.9. Manure application rate on soybeans (tons poultry manure/acre)					
# Farmers	**N/A, I didn't grow soybeans**	**Zero, I didn't use manure on soybeans**	**1 to 1.9 ton/acre**	**2 to 2.9 ton/acre**	**3 to 3.9 ton/acre**	**No response**
MD, N=30	3%	**67%**	7%	20%	3%	0%
DE, N=20	5%	**80%**	5%	0%	5%	5%
VA, N=10	0%	**40%**	30%	30%	0%	0%
MD Rules	No rules or guidance found.					
DE Rules	No rules or guidance found.					
VA Rules	Rules & Guidance: "Poultry Litter Spreading Schedule: Do not spread poultry litter during these shaded months for soybeans: January thru middle of April, July thru December." Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.					

There is no previous study with which to compare this study's variable.

Farmer 18 from Worcester told one interesting story about manure use on soybeans that revealed many things including: a) Private Planner B said manure on beans is not allowed in Maryland, b) Private Planner "A," who is Farmer 18's planner, told him it was okay to use excess manure on beans, and c) neither Farmer 18 nor Planner A were likely going to be proactive and clarify the rules in Maryland about manure on beans. Farmer 18's story is as follows:

> Farmer 18 explained that he likes to use excess manure from his corn application on his soybeans to reduce the amount of commercial nitrogen he'd have to buy for his beans. Farmer 18 said he ran this idea by his planner: "Private Planner A told me, 'Well, if you've got the manure…'" Farmer 18 explained that when he was doing custom harvesting for another farmer who happened to be the father of Private Planner B, Planner B told him, 'We're not supposed to put any manure where the soybeans go.' Farmer 18 explained to me, 'So, as tight as things are today with the fertilizer prices being so high, I'm not gonna stop using excess manure on beans until they come knocking on my door. I guess that might be the wrong attitude.' (4-6.2, Farmer 18, Wor)

Farmer 34 from Wicomico explained that he stopped using manure on beans 10 years ago because of "the phosphorus issue."

> “We stopped using manure on beans when phosphorus got to be a hot issue. About 10 years ago. We now farm about 700 acres of corn but 20 years ago, we only farmed 400 acres – 200 acres of corn and 200 acres of beans and a lot of chicken manure. As we picked up land, we used all the manure on corn. Once in a while, if we’ve got some (manure) to get rid of (after using it on the corn fields), we’ll use it on beans. They (beans) look a little better but yield wise, I’m not sure it pays for it. I would rather cut back on nutrients on beans than on corn.” (2-16.2, Farmer 34, Wic)

Manure application on wheat

Like the concern from the scientific community about use of manure on soybeans, manure use on wheat is also problematic because wheat can respond to the high nitrogen content of manure by growing too tall too fast and falling over, which reduces yields. There is no consensus from the Extension scientists and practitioners about use of manure on wheat, as some recommend it while others recommend against it. Only Virginia has rules on wheat, but they are rules about timing not application rates.

In addition to wanting to save their poultry manure for corn production, several farmers mentioned difficulty using poultry manure on wheat, because too much manure can result in excessive amounts of nitrogen at times in the wheat cycle when the plant cannot use the nutrient.

One-quarter to one-half of farmers in all three states no longer grow wheat (see table below).

MRW p=0.147	**Table 8.10. Manure application rate on wheat (tons poultry manure/acre)**					
# Farmers	**N/A, I didn't grow wheat**	**Zero, I didn't use manure on wheat**	**1 to 1.9 tons/acre**	**2 to 2.9 tons/acre**	**3 to 3.9 tons/acre**	**No response**
MD, N=30	50%	**33%**	3%	10%	3%	0%
DE, N=20	25%	**30%**	15%	25%	5%	0%
VA, N=10	30%	10%	10%	**30%**	10%	10%

MD Rules	No rules or guidance found.
DE Rules	No rules or guidance found.
VA Rules	Rules & Guidance: "Poultry Litter Spreading Schedule: Do not spread poultry litter during these shaded months for wheat: May thru August…Poultry litter applications are not recommended during this period (late fall–winter: December, January thru mid-February) but may occur if applied as follows...." Rule: VDEQ. "Nutrient Management Plan Special Conditions for Virginia Pollution Abatement (VPA) Permits." Guidance: Virginia Department of Environmental Quality. "Poultry Litter Storage and Utilization Sheet." Dec 1, 2000.

Of those farmers that do still grow wheat, (six Virginia farmers, 15 Maryland farmers, and 15 Delaware farmers), there is a statistically significant difference in those who use manure and do not use manure on wheat (see table below). A majority of Maryland farmers (67%) say they do not use poultry manure for wheat production. In contrast, a majority of Virginia farmers (83%) and Delaware farmers (60%) say they do.

WGMNM p=0.082*	**Table 8.11. Wheat Growers: Use of Manure**	
# Farmers	**Zero, I didn't use manure on wheat**	**Used manure on wheat**
MD, N=15	**67%**	33%
DE, N=15	40%	**60%**
VA, N=6	17%	**83%**

Of the five Virginia, five Maryland, and nine Delaware wheat growers who use manure on wheat, the largest group of farmers in all three states applies 2 to 2.9 tons of manure per acre of wheat (see table below).

WGMR p=0.966	**Table 8.12. Wheat Growers – What Rate of Manure? (tons poultry manure/acre of wheat)**		
# Farmers	**1 to 1.9**	**2 to 2.9**	**3 to 3.9**
MD, N=5	**20%**	60%	20%
DE, N=9	33%	**56%**	**11%**
VA, N=5	20%	**60%**	**20%**

There is no previous study with which to compare this study's variable.

Wrap-up of Findings Regarding Manure Application Rates

Overall, most farmers in all three states (60 to 97%) report using 1 to 3.9 tons/ac poultry manure on corn. The average poultry manure rate on corn was 2.8 tons per acre in all 60 farmers and the differences in the average rates for each state were not statistically significant. However, when analyzed by categories, there was a statistically significant difference and it does appear that 75% of Delaware farmers report using 2 tons or less per acre, while only 47% of Maryland farmers and 40% of Virginia farmers do so.

I am puzzled by this result because most Delaware farmers use private sector planners, and Smith (1999) and Lawley et al. (2007) demonstrate that private sector planners tend to recommend more nutrients than public planners do. There may be a social desirability problem occurring wherein farmers with private sector planners (who are aware that their planner is recommending more nutrient than a public planner would) are reporting a low manure rate to me that they think I want to hear, or perhaps reporting the rate they think they should be applying but are not. In contrast, as has been demonstrated, there may be a corresponding amount of non-compliance from farmers with public sector planners who actually get their true prescription from fertilizer dealers; these farmers could be reporting the true, higher manure rates to me rather than reporting what they think I want to hear.

Regardless of the believability of these manure rates or even if farmers know what manure rates they are actually applying (as was suggested in Chapter 7, given infrequent manure testing or calibration of manure spreaders), the overall trends suggests that manure rates have come down over time. Though the non-response rate was very high – likely due to the problem of recall but also a social desirability problem – most farmers were able to admit that they used higher manure rates on corn 10 years ago (1995) and the average across all states 10 years ago was 5.2 tons per acre. Thus, over time, there is some evidence to conclude that manure rates on corn have come down from excessively high rates to more appropriate rates.

However, only a third to nearly half the farmers in all states indicate they switched to their current 2005 manure rate after the law (30 to 47%), while a similarly sized proportion of farmers said they had already switched to their current rate before the law (32 to 42%). The remaining farmers did not provide a response, likely indicating a social desirability problem and the "catch-22" conundrum wherein some farmers did not want to admit that they might have lowered their manure in response to the law.

The results regarding manure rates on soybeans are positive. Most Maryland (67%) and Delaware (80%) farmers, but only 40% of farmers in Virginia, that grow soybeans do not use poultry manure on beans, which is a practice most Extension scientists and practitioners regard as indefensible. In contrast, the results regarding manure rate on wheat suggest that there is a statistically significant difference between states. Most Delaware (60%) and Virginia (83%) farmers report using manure on wheat, while most in Maryland say they do not (67%). There is less consensus about whether manure should be used on wheat or not.

8.4. Logit Regression Analysis of Factors Predicting Manure Rates on Corn

A great deal of attention in the three states that share the Delmarva Peninsula has been given to the importance of properly managing manure in the highly concentrated poultry production counties. Over time this attention has manifested itself as voluntary guidance from Extension scientists and practitioners to encourage farmers not to dispose of the manure as waste but to use the manure as a source of nitrogen, albeit while up to four times as much phosphorus was being added to corn crops. Then, given the emerging science that showed soluble phosphorus was a problem, the scientific community and farmers could no longer ignore the buildup of phosphorus in the soils and believe that preventing soil erosion would take care of phosphorus; thus, the state nutrient management laws were necessary to bring about a switch to using manure as a source of phosphorus to prevent the continued buildup of soil phosphorus.

Overall, the underlying intention of the state nutrient management laws was to lower manure application rates on cropland that was considered high phosphorus (and in Maryland, at risk of loss) to that of a phosphorus rate. Thus, it is important to determine what the likely factors are that may be driving farmers to the manure application rates that they use.

Using logit regression analysis, I built a model of factors likely associated with and predictive of whether a farmer was a “low user” of manure or not. In this model, farmers are considered “low users” if they told me they apply 2 or less tons of poultry manure per acre of corn production. Farmers that are not low users are those that told me they apply 3 or more tons of poultry manure per acre.

Again, it is important to recognize that I do not know if the rates farmers reported to me during the interviews are a) the rates called for in their nutrient management plan, b) the rates they think I want to hear, c) the rates they are actually trying to apply, or d) the rate that is actually being applied. And of course, without knowing a variety of input data (manure nutrient analysis, stage of crop rotation, soil test phosphorus values, whether a P-Site Index was conducted, and what the results were) it is impossible for anyone to determine if the manure application rates on corn reported to me are nitrogen-based or phosphorus-based applications. Thus, I cannot infer that a farmer with a rate of 3 or more tons per acre is not a good farmer if his nutrient management plan does call for that rate and his plan would withstand a quality assurance or quality control review by the state.

Data sources, variables, and model specification

From my interviews with 60 farmers on the Delmarva Peninsula, I generated a dataset of information for 30 Maryland farmers, 20 Delaware farmers, and 10 Virginia farmers. Five of the Virginia farmers in the sample were not poultry growers and thus are not regulated by their state nutrient management laws and were removed from the sample for regression analysis. Data was compiled into an Excel spreadsheet and then exported into Stata statistical software.

The logit model in this dissertation includes independent factors driving a farmer to decide between a low manure use rate and a high manure use rate. The factors include basic demographic factors, which state a farmer comes from, the farmer's opinion on the policy development process in his state, understanding and accepting new science about the environmental problems from manure use and phosphorus, policy implementation factors, and their perception of how compliance with the law will affect their profitability. Thus, the following formula represents the logit model in this dissertation:

LOW USER = f(DEMOGRAPHIC, STATE, POLICY OPINION, SCIENCE OPINION POLICY IMPLEMENTATION, PROFITABILITY)

A number of variables were identified as having the potential to influence a farmer's decision to use a low manure rate.

To develop a dependent variable, I asked farmers how much poultry manure per acre they used last year (i.e., in 2005) to grow corn. Responses were then grouped into those reporting they applied a "low manure use" rate of less than or equal to 2 tons/acre and those who said they used 3 tons per acre or more – categorized as a "high manure use" rate. Overall, 45% of the 55 regulated farmers were "low manure users," while 55% were "high manure users" (see table below). The dependent variable was labeled "low manure user;" a farmer that reported using a manure rate of 2 tons or less per acre received a value of "1" and farmers that reported using 3 tons or more per acre received a value of "0."

Table 8.13. Values of Variables Tested in Logistic Regression Models

Type of variable	Question	Response	Percentage of 55 regulated farmers
State	Percentage of 55 farmers in each state	Maryland	50
		Delaware	33
		Virginia	17
Poultry manure use	How much poultry manure did you use per acre to grow corn last year?	Low manure user (2 tons/acre or less)	45
		High manure user (3 tons/acre or more)	55
Policy opinion	Likert 7 – "Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations."	Agree	31
		Don't know	15
		Disagree	55
Science acceptance	Likert 3 – "Manure application on corn on a nitrogen-basis can result in up to three to four times as much phosphorus application as necessary for corn."	Agree	51
		Don't know	25
		Disagree	24
Policy implementation	Do you use a private nutrient management planner to prepare your plan?	Public planner	38
		Private planner	62
Demographic	Do you raise broiler chickens?	Yes	69
		No	31
Profitability	Likert 19 – "If I were to strictly adhere to the application recommendations in my nutrient management plan, I would	Agree	38
		Don't know	5
		Disagree	56

	likely be satisfied with the crop I harvest.”			
Policy implementation	Likert 17 – “The penalties for non-compliance with my nutrient management law are:	Large or Moderate	36	
		Don't know	54	
		Small or Non-existent	9	
Policy opinion	Likert 9 – “My state's agricultural nutrient management law is justified.”	Agree	44	
		Don't know	7	
		Disagree	49	
Science acceptance	Likert 1 – “The science linking *Pfiesteria* to agriculture was:	Certain or Reasonable	9	
		Don't know	5	
		Weak or Disproved	85	
Type of variable	**Variables**	**Mean (Std. Dev.)**	**Min**	**Max**
Demographic	How many broiler chickens do you raise per flock (production capacity in 1,000s)?	81.06 (88.2)	0	350
Demographic	What proportion of your household income comes from farming?	0.78 (0.26)	0.1	1
Demographic	How old are you?	49.8 (11.6)	25	82
Demographic	What was the highest level of education you received?	13 (1.8)	10	19
Demographic	How many cropland acres do you operate (both rent and own)?	1,484 (1,183)	81	5,000

Two **policy opinion** Likert Statements were tested in the model as possible predictors of whether a farmer would choose a low or high manure rate (see table above). Thirty-1% of farmers in the sample “agreed” that “Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations” (Likert 7), while nearly 70% said they “didn’t know” or “disagreed.” Forty-4% of farmers in the sample agreed with the statement, “My state's agricultural nutrient management law is justified” (Likert 9), while 56% said they didn’t know or disagreed. It is expected that farmers who agreed with both of these Likert Statements might be more willing to accept using a lower manure application rate.

Two **policy implementation** variables were included as potential factors driving manure application rates (see table above). A likely significant factor in the manure application rate farmers report using is which type of planner farmers chose to write their required nutrient management plans. Thirty-eight percent of the sample used a public planner (certified Extension specialists), while 62% used a private planner (certified crop consultants or fertilizer dealers). Also a likely factor to how well farmers are adhering to their plan is their perception of the penalties for non-compliance. Thirty-six percent of farmers in the sample said that "penalties for non-compliance with their nutrient management plan were large or moderate, while 63% said they didn't know or thought penalties were small or non-existent. It is expected that farmers who perceive a serious deterrence threat from significant penalties are more likely to be low manure users.

It is expected that farmers who use private planners are more likely to be high manure users and those that use public planners are more likely to be low manure users. Recall that Smith (1999) found that private consultants recommended the application of more nutrients (over and above nitrogen credits) than did Extension agents. Lawley et al. (2007) found fertilizer dealers and independent crop consultants recommended increases in commercial fertilizer application rates more frequently than all other plan preparers. Extension and other certified personnel (typically farmers preparing plans for other farmers) recommended no change in application rates most of the time and otherwise recommended decreases. Farmers preparing plans for their own operations almost always recommended decreases.

Two variables represent how well farmers **accept the science** surrounding nutrient pollution and poultry manure and are likely determinants of how much manure farmers choose to use. Just over half the farmers (51%) said they agreed with the basic manure-corn science that "Manure application on corn on a nitrogen-basis can result in up to three to four times as much phosphorus application as necessary for corn" (Likert 3), while just under half (49%) said they didn't know or disagreed with this rudimentary scientific fact. Just 9% of farmers agreed that "The science linking *Pfiesteria* to agriculture was "certain" or "reasonable," while 90% said they "didn't know" or that the science was "weak" or "disproved." Farmers that agree with both of these science Likert Statements are more likely to accept a low manure rate on corn and thus be "low manure users."

There was one **profitability** variable that was testable in the model. Thirty-eight percent of farmers in the sample said they agreed with the statement, "If I were to strictly adhere to the application recommendations in my nutrient management plan, I would likely be satisfied with the crop I harvest" (Likert 19), while 61% said they didn't know or disagreed.

In addition to the policy opinion, policy implementation, science, and profitability variables, five **demographic** variables were including in the model runs as potentially important factors driving farmer manure application rate.

Sixty-nine percent of farmers in the sample were **poultry growers**, while 31% were not but took manure from poultry growers to grow corn. The average production capacity of broiler chickens per flock (any given time) of the sample was 81,000 birds, ranging from zero (not poultry growers) to 350,000 birds. Parker and Li (2006) estimated that average poultry manure application rates were lower for farmers that did not raise chickens (1.9 tons/acre) than for those who were poultry growers (4.4 tons/acre). Thus, I expect that being a poultry grower will likely predict being a high manure user.

Lawley et al. (2007) found three factors had statistically significant positive impacts on decisions to adopt a voluntary nutrient management plan in Maryland in 1998: farm size; the share of corn, soybeans, and small grains in total crop acreage; and the number of cattle. Lawley et al. (2007) also found that the greater the number of head of cattle increased the probability a farmer would obtain a voluntary nutrient management plan because Extension personnel regard animal farms as more prone to environmental risk, and thus public planners make it a priority to encourage livestock farmers to obtain a voluntary plan.

The average number of **cropland acres operated** (both rented and owned) in the sample was 1,484, with a minimum of 81 acres to a high of 5,000 acres. The larger the farm, Lawley et al. (2007) hypothesized, the likelier to be targeted by private crop consultants for plan development because of economies of scale.

The mean **proportion of household income coming from farming** for the sample was 0.78, with a minimum of 0.1 and a maximum of 1. Regarding the dependence on farming for household income variable, SriRamaratnam et al. (1987) and Babcock (1992) suggest that households dependent on farming may be more sensitive to the risk of yield loss from under-application of fertilizer and hence more likely to be over-applying fertilizer prior to having a nutrient management plan. In this light, Lawley et al. (2007) found that farmers more dependent on farming as a source of income are more likely to receive recommendations that they decrease commercial fertilizer application rates.

The average **age** of farmers in the sample was 50 years old, ranging from 25 to 82. The average level of **educational attainment** was one year of college, ranging from tenth grade to a three-year master's degree in agricultural science (19 years of school).

Model Specification and Estimation of Being a Low-Manure User

Model Specification

Since the dependent variable, "low manure user," is dichotomous (i.e., 0 or 1), an ordinary least squares (OLS) multivariate regression analysis is not possible, because OLS models require continuous variables. Thus, a logit regression model is required for a dependent variable that has only two diametrically opposed values (yes – no, 1 – 0). The logit regression is well-known among statisticians to be a relatively complex model with coefficients and overall fit values that are difficult to interpret. In addition, it is well established that it is difficult to achieve high overall fit with logit models (Ashenfelter et al., 2003; Hamilton, 2003; Lewis-Beck, 1980; Wiley, 1977).

When interpreting logit regression models, most scholars ignore the "pseudo R-square" value because it does not provide a clear and confident interpretation. Instead of the pseudo R-square value the "prob>chi-square" value is regarded as the most important value representing overall fit of the model. As with any regression model, parsimony is important because as more variables are added to the model, the overall fit creeps upward. Thus, it is important to keep the number of variables to a minimum to avoid creating an extraneous variables problem. At the same time, one has to add enough theoretically important independent variables that predict the dependent variable to avoid the omitted variables problem.

In addition, independent variables added to a model must not be collinear with each other. Thus, a correlation matrix test was run with each model discussed in this chapter, demonstrating the absence of the multicollinearity problem. This correlation matrix was useful in “throwing out” some important predictive variables that were unfortunately collinear with other important independent variables.

An additional peculiarity about the logit model is that the coefficients are very difficult to interpret and many scholars who use logit models use the logistic command in Stata to generate “odds ratio” values instead of coefficients. The odds ratio represents the ratio of the probability of success over the probability of failure. Thus, the odds ratio represents the likelihood that an event will occur. Thus, if the probability of success is 0.8, then the probability of failure is 1 – 0.8, or 0.2. Then, the odds ratio of success is 4 to 1.

Odds ratio values that are 1 represent a 50-50 chance that the event will occur. Odds ratio values less than 1 represent a greater probability of failure than success. Unlike coefficients in a logit command or coefficients in an OLS regression model, there are no negative values for odds ratios.

Model Results

The table below presents results of six logit regression models estimating the likelihood of farmers being low manure users, including odds ratio values and standard errors of the independent variables. I conclude that Model 3 is the best model predicting the factors that drive farmers to choose low manure rates because it had the best overall fit (prob>chi-square= 0.0086) with the fewest variables (10). It even had a better fit than models 4 though 6, despite the tendency for regression models to increase in overall fit as more variables are included. Thus, the likelihood of being a low manure user was systematically associated with five of the 10 variables in Model 3, including: Likert 7 for policy opinion (equal seat at policy table), Likert 3 for science opinion (manure on corn for nitrogen results in too much phosphorus), planner type for policy implementation, broiler capacity per flock, and education.

Table 8.14. Logit Regression Model of Poultry Manure Application Rate						
Dependent Variable: Low Manure User (2t/ac or less)						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Number of variables	6	8	10	12	12	12
Number of variables that are statistically significant	3	3	5	5	5	5
Prob>chi-squared	0.0125	0.0193	**0.0086**	0.0105	0.0208	0.0116
	Odds Ratio					
Likert 7 – "Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations" ("Agreed." Reference group said "Don't Know" or "Disagreed")	7.19*	8.47**	12.04**	13.27**	13.93**	10.22*
Likert 3 – "Manure application on corn on a nitrogen basis can result in up to 4 times the amount of phosphorus as needed to grow corn." ("Agreed." Reference group said "Don't Know" or "Disagreed")	2.42	3.4	5.25*	4.98*	5.12*	4.85*
Used a private planner to write their plan	3.48*	4.23*	8.99**	9.87**	8.64**	10.62**
Broiler capacity per flock (in thousands)	1.01*	1.01*	1.01*	1.01*	1.01*	1.01*
Maryland (in reference to Delaware)	1.34	1.48	1.03	1.14	0.95	1.13
Virginia (in reference to Delaware)	0.34	0.25	0.16	0.18	0.15	0.24
Proportion of household income from farming	-	0.97	0.98	0.97*	0.98	0.97*
Age	-	0.79	0.97	0.97	0.98	0.97
Education	-	-	0.62*	0.97	0.61*	0.65
Total acres operated (sum of rented and owned acres)	-	-	1.00	0.999	0.999	0.999
Likert 19 – "If I were to strictly adhere to the application recommendations in my nutrient management plan, I would likely be satisfied with the crop I harvest." ("Agreed." Reference group said "Don't Know" or "Disagreed")	-	-	-	4.2	-	-

Likert 17 – Thought penalties for noncompliance with NM plan were “Large or Moderate.” (Reference group said “Don’t know” or “Small” or “Non-Existent”)				1.66	1.41	1.92
Likert 9 – “My state's agricultural nutrient management law is justified.” ("Agreed." Reference group said "Don't Know" or "Disagreed")	-	-	-	-	-	3.38
Likert 1 "The science linking *Pfiesteria* to agriculture was "Certain" or "Reasonable." (Reference group said “Don’t know,” “Weak” or “Disproved”)	-	-	-	-	0.6	-
Number of observations	51	51	51	51	51	51

*** Significant at the 99% level (p=<0.01)
**Significant at the 95% level (p=<0.05)
*Significant at the 90% level (p=<0.1)

As expected, the odds ratio value on Likert 7, “Farmers had an equal seat at the policy table,” was greater than 1 and statistically significant from zero, indicating that farmers who agreed with this statement were 12 times more likely to be low manure users than farmers who responded “disagree” or “didn’t know” to the statement. This variable is significant at the 95% confidence interval. Therefore, farmer perception of the regulatory policy-making process as being inclusive and participatory appears to be an important driver in predicting whether farmers will use a low poultry manure rate or not.

Also as expected, the odds ratio value on Likert 3, “Manure on corn for nitrogen results in up to four times too much phosphorus,” was significant at the 90% level. Farmers who agreed with this basic science were five times as likely to be low manure users as farmers who disagreed or said they did not know. This suggests that an understanding that nitrogen-manure rates lead to excess phosphorus application rates appears to be an important predictor of being a low manure user.

Surprisingly, the odds ratio on the “type of planner” variable was not less than 1 as expected, but was greater than 1 and significant at the 95% confidence level. Thus, farmers who chose private planners to write their plans were nine times as likely to be low manure users as those who chose public planners. This contradicts findings by Lawley et al. (2007) and Smith (1999) who found that private planners are more likely to recommend higher nutrient application rates than public planners. There are a few possible explanations for this contradictory finding, which will be discussed later in this section.

Also surprising, given findings by Lawley et al. (2007) and Parker and Li (2006), was that being a chicken grower and the size of the broiler flock represents only a 50-50 chance of whether the farmer will be a low manure user or not. Thus, for every 1,000-bird increase in broiler operation, the odds ratio is 1.01, and there is a 50% chance of being a low manure user. Thus, despite being statistically significant at the 90% level, this variable does not clearly predict a farmer's manure rate either way.

The fifth and final variable in Model 3 that was statistically significant was education, and the results are counterintuitive. For every additional year in education, farmers were 0.62 times less likely to be low manure users. This finding suggests that the more education farmers have the less likely they were to accept the new science that requires them to lower their manure rate.

Five variables in Model 3 were not statistically significantly different from zero: the two state variables, the proportion of income from farming, age, and total acres operated. Thus, merely being from Maryland and Virginia did not significantly differentiate these farmers from those in Delaware in this logit model. The dependency on farming for household income did not have a significant impact on manure rate choice, nor did age.

And the number of acres operated by a farmer did not seem to drive the rate at which they applied manure.

Other variables that were considered as likely to have an impact on a farmer's choice of manure rate did not prove to be statistically significant, including the "profitability" variable in Model 4 (Likert 19 "adherence to my plan would make me satisfied with my crop"); the variable representing perception of penalties; the variable "linking *Pfiesteria* to agriculture" (Likert 1) in Model 5; and the "policy opinion" variable (Likert 9 "my law is justified") in Model 6.

Wrap-up of Findings from Logit Regression Analysis

This logit regression model of factors that likely predict low manure use followed its well-established characteristics of being a relatively complex model with odds ratios (coefficients) and overall fit values that were difficult to interpret. Overall, only five of 10 variables in the model identified to represent the best fit proved to be statistically significant. Surprisingly the variable "state" did not prove to be a significant predictor of a farmer being a low manure user or a high manure user, indicating that merely operating in a state and being subject to that state's regulations did not directly affect manure rates.

Only three of those five variables indicate strong predictive values: a) farmers who agreed that they had an equal seat at the policy-making table were 12 times more likely to be low manure users than those who disagreed or said they "didn't know," b) farmers that agreed with the basic scientific fact that pre-phytase, a nitrogen manure rate on corn, resulted in up to four times too much phosphorus were five times more likely to be low manure users than those who disagreed or didn't know, and c) farmers who used private planners were nine times more likely to be low manure users than those who used public planners.

As for the first two variables, the logit analysis suggests that perception of the regulatory policy-making process is an important factor driving whether a farmer will accept a low manure rate or not and acceptance of basic science justifying a low manure rate is also an important factor. Thus, states may consider these two findings when trying to regulate farmers or otherwise influence behavior change.

However, the third factor – that farmers with private planners are more likely to be low manure users was unexpected, as it contradicts previous studies and contradicts many of the stories told to me by farmers interviewed for this dissertation about private planners. There are several possible explanations for this contradictory finding.

First, farmers with private planners may be aware of the “social desirability” problem with the questions surrounding manure application rates, making them report to me a lower manure application rate than they were actually using.

Second, because the choice of planner was not random in this dissertation sample, it likely suffers from bias. The most commonly understood bias as described in Lawley et al. (2007) is that farmers with large operations tend to select private planners while farmers with smaller operations tend to select public planners. Private planners may actually be the limiting factor, as they are more likely to want larger acreage clients because of the economies of scale advantage making it cheaper per acre to prepare plans for larger operations. This was how Private Planner A described his criteria for accepting clients. Therefore, larger operations with private planners may be low manure users, as many farmers told me they “try to make the manure go farther.”

Conversely, farmers with smaller acreage may gravitate toward public planners, and if they are poultry growers may have more manure than can be applied on their operation, indicating that they reported to me higher manure application rates than what was actually called for in their plans.

Thus, even though the variables for crop acreage, being a poultry grower, or the size of the flock were not statistically significant, the variable for planner may inherently reflect these differences.

Third, the finding may be a manifestation of Delaware's three-year crop phosphorus removal policy. The majority of 20 Delaware farmers (85%) report using a private planner, while less than half of the 30 Maryland farmers do (40%) and just over half of the five Virginia farmers do (60%). While the state variable was not significant, the private planners in Delaware swamp the private planners in the other states, which may allow Delaware's P-policy to be the intervening factor that makes farmers with private planners report as low manure users.

8.5. Acceptance of Key Nutrient Management Tenets

The nutrient management laws were developed, in part, to enable the state and federal Extension Service and Soil Conservation District communities to stress the importance of phosphorus-based nutrient management in areas of high poultry concentration, such as the Delmarva Peninsula. Heretofore, these communities were unable to encourage P-management because it would involve significant economic cost and no economic benefit to the farm. It took a regulatory policy to enable the switch. Thus, it is important to determine whether the nutrient management regulations were effective at disseminating the new dissolved phosphorus science, getting farmers to understand and accept the new science, and most importantly getting farmers to change their manure nutrient management behavior.

There are four remaining Likert Statements that elicit farmer opinions about nutrient science. In addition, I asked farmers which of the three main nutrient application philosophies they subscribe to: (1) Maintenance approach, (2) Cation Saturation Ratio approach, and (3) Sufficiency concept. This section sheds light on whether farmers in each state are aware of, understand, and accept fundamental manure, corn, and soil nutrient concepts necessary to agronomically and environmentally manage manure applications on corn fields. None of the five variables revealed a statistical difference between states, indicating that farmers across states are more alike than they are different. Furthermore, responses to these Likert Statements indicate that there was still poor acceptance of the new phosphorus science nearly a decade after the laws were enacted. In addition, responses to the question about nutrient application philosophy indicate that most farmers were poorly informed about the pros and cons of the three approaches.

Nutrient Application Philosophies

As described in Chapter 3, as early as 1994, the Maryland Cooperative Extension service was publishing newsletters explaining the three major philosophies or approaches to making nutrient recommendations: (1) the Maintenance Approach, (2) the Cation Saturation Ratio Approach, and (3) the Sufficiency Approach.

The Maintenance Approach caters to the “feed the soil” philosophy, and according to Extension its major shortcoming is that it ignores the nutrient reserve capacities of many soils. If this approach is used on soils already containing adequate levels of nutrients, it can decrease profitability. The Cation Saturation Ratio Approach is built upon the belief that there is an ideal ratio of exchangeable cations in the soil, but Extension concludes no such consistent relationship between crop yields and cation ratios has been determined. This approach can lead to unrealistic nutrient recommendations that would increase costs with no concurrent increase in yields. Finally, the Sufficiency Approach, known as the "feed the plant" philosophy, believes that there is a critical soil-test level for every nutrient above which there is no yield increase when additional nutrients are applied. Thus, if soil test levels are above the critical values, no nutrients need be applied. Extension concluded that soil test labs associated with most land-grant universities adhere to the sufficiency approach because it is agronomically and economically defendable.

Given these determinations, farmers who subscribe to the Sufficiency concept will be regarded as having an appropriate nutrient application philosophy and those that subscribe to the other nutrient approaches will be regarded as having inappropriate philosophies.

To ensure that farmers and I were defining the three philosophies the same way, I provided farmers with a piece of paper that described all three approaches in the following way:

Have you seen these nutrient application philosophies before?
__ Yes __ No

Which best describes your nutrient application philosophy?

____Build and maintain – "feed the soil" – always apply at least enough nutrient to meet crop removal no matter what the soil nutrient concentration is.

____Sufficiency concept – **"feed the plant"** – only apply nutrients if soil test is below critical concentration.

____Cation balance – apply fertilizer to balance cation exchange sites.

The first surprising finding from my interviews was that only one-fifth to one-third of farmers in all three states said they "had seen the three nutrient application philosophies before" (see table below).

Table 8.15. Most farmers are unaware of the three main approaches to nutrient recommendations

	MD, N=30	DE, N=20	VA, N=10
% Farmers who had seen the three "Nutrient Application Philosophies" before:	33%	20%	20%
% of Farmers with each "Nutrient Application Philosophy:"			
1. Build and maintain – "feed the soil" – always apply at least enough nutrients to meet crop removal no matter what the soil nutrient concentration is.	53%	40%	60%
2. Sufficiency concept – **"feed the plant"** – only apply nutrients if soil test is below critical concentration.	13%	35%	20%
3. Cation balance – apply fertilizer to balance cation exchange sites.	10%	10%	0%
Farmers who do not understand that each approach is mutually exclusive:			
Sum of the farmers below:	**23%**	**15%**	**20%**
Farmers who said they used all three approaches	7%	0%	10%
Farmers who said they used a combination of approaches 1 & 2	7%	10%	10%
Farmers who said they used a combination of approaches 2 & 3	3%	0%	0%
Farmers who said they used a combination of approaches 1 & 3	7%	5%	0%

Second, I was very surprised that 15 to 23% of farmers said that they used a combination of these philosophies, which reflected their lack of understanding that these philosophies are mutually exclusive.

Third, as for farmers that did choose only one nutrient application approach most (40 to 60%) choose the "Maintenance approach," suggesting that roughly half the farmers in all three states have an inappropriate nutrient application philosophy. The Extension newsletter described the maintenance approach as a concept that was disseminated in the years after the "Dust Bowl" in the 1930s "in response to widespread exploitation of soil resources in many regions of the country" as a way to "replenish… nutrients removed by crops and apply… nutrients regardless of soil test." Given the opposite problem is occurring today on the Delmarva Peninsula with soils saturated with excessive phosphorus, it is surprising that roughly half of all farmers interviewed for this dissertation would still subscribe to this philosophy.

Acceptance of N:P ratio in poultry manure and N:P needs of corn

This scientifically true Likert Statement was chosen to test whether farmers understand a) how much phosphorus corn needs to grow and b) what the phosphorus and nitrogen concentrations are in poultry manure (pre-phytase). Note that these are not environmental concepts but are crop production concepts.

To be fair, before choosing a response, several farmers clarified if this statement should be interpreted as the situation occurring before or after the integrators started using the enzyme *phytase* in their chicken feed, which Maryland's law required. This clarification indicates these farmers understand that phytase helps the bird absorb more phosphorus and helps the integrator reduce the phosphorus input in the feed, thereby reducing the phosphorus content of manure. I told these farmers to interpret the statement for manure conditions before the advent of phytase and they all correctly agreed with the statement.

Across the states, approximately half of the farmers in each state “agreed” with the scientifically correct statement that “manure application on corn on a nitrogen-basis can result in up to three to four times as much phosphorus application as necessary for corn.” However, half of the farmers in each state either “disagreed” or responded “don’t know” to the statement. This suggests that half of the farmers in this sample do not understand that though manure (pre-phytase) has about equal amounts of nitrogen and phosphorus, corn only needs a fourth of the amount of phosphorus as nitrogen. Hence, half the farmers in this sample do not understand that manure application on a nitrogen basis results in about four times too much phosphorus for corn, which results in buildup of phosphorus in soils.

p=0.645	**Table 8.16. Likert: “Manure application on corn on a nitrogen-basis can result in up to three to four times as much phosphorus application as necessary for corn.”**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	**47%**	33%	20%
DE, N=20	**55%**	15%	30%
VA, N=10	**50%**	20%	30%

Many farmers responded in a way indicating they did not either know the 4 to 1 nitrogen to phosphorus ratio needed by corn or the 1 to 1 nitrogen to phosphorus ratio in pre-phytase poultry manure by focusing on the variability of manure by sample or by integrator. Both are valid sources of variability, but neither of these sources should significantly change these scientific ratios. Farmer 28 from Wicomico County said:

> "Don't know. I really don't know. How would I know? I want 120 pounds of N for a good corn crop but I don't know what levels of P that would cause. It depends on your manure sample and it varies by farm and by integrator." (3-10.1, Farmer 28, Wic)

Farmer 50 from Kent County chose "Disagree." "I don't know how anybody knows this – every load is different. No two loads are the same" (3-24.1, Farmer 50, Ken). Farmer 21 from Worcester said, "That's a weird one. It depends on how much manure we put on there" (4-6.3, Farmer 21, Wor).

Surprisingly, many farmers proceeded to discuss soil nutrient content rather than manure nutrient content in reaction to this Likert Statement. Farmer 1 from Accomack, for example, disagreed and said, "Soils can have a large test value but all that P is not available to the crop – this is where I disagree with the nutrient management plan recommendations" (3-30.2, Farmer 1, Acc). Farmer 29 from Worcester said,

> "You can take this a lot of different ways. From a farmer's perspective, when you look at the soil test, the lab can tell you that it's (the soil sample is) high in P and no way for a farmer to tell if that's right by looking at it. You need P to make the seed germinate. The nutrients are locked up. You can have high P levels in your soils but if it's locked up you need to add more P. Lime locks a lot of nutrients in the land. A lot of phosphorus in manure do go in the soil and get locked up. Corn really shows when its three inches and it's yellow that there's not enough P. Guys these days, we're not making much anyway so you got to put down what you need to get a crop. So it makes you mad when you are told in soil tests you can't put down any more P." (3-15.1, Farmer 29, Wor)

Farmer 29 revealed through this story that even though soil test laboratories do provide "plant available phosphorus" results to farmers – that is, the amount of phosphorus in the soil that is available to the crop – Farmer 29 thinks they provide him with the total amount of phosphorus in the soil (some of which is available, some of which is not). Thus, Farmer 29 does not know how to properly interpret his soil test results and it upset him that they do not prescribe any phosphorus be applied given the sufficient amount of plant available phosphorus in his soil sample.

Revealing frustration with this Likert Statement, Farmer 53 from Sussex County said,

> "I've never – I'm not a scientist. But I don't believe it. I don't believe the phosphorus could leach out. It takes a while for stuff to leach out. I'd say it'd be gone from the time it takes to leach from the field to river." (3-29.1, Farmer 53, Sus)

It is interesting that Farmer 53 chose the word "leach" to describe phosphorus movement. Leach is a term associated with nitrogen moving down through groundwater, while the term associated with phosphorus movement is runoff over the surface of the land or "subsurface lateral flow" underground, wherein phosphorus discharges into surface waters like streams and ponds.

A few farmers, however, correctly explained the introduction of phytase as having a benefit in lowering the N to P ratio. Farmer 22 from Wicomico said, "Now, with phytase in the feed, the ratio's gone down – three would be the most" (4-6.1, Farmer 22, Wic). Farmer 60 from Sussex started out saying he didn't know: "I don't know if that's correct or not. The phytase helped it come down 40%." After I clarified that this statement applies to the situation before phytase was added, he said, “So I guess I’ll agree. You find it hard to agree that you’re doing something wrong” (3-3.3, Farmer 60, Sus).

Only a few farmers in each state provided comments suggesting they understand the nitrogen to phosphorus ratio needs of corn. An unregulated farmer from Virginia provided an example of those comments: “The manure puts a lot more P on the corn land than what corn requires. It does do that. That’s why we only use 1 ton per acre. I know some people who use 5 ton per acre” (3-30.3, Farmer 4, Acc). When I asked why farmers would use that amount of manure, Farmer 4 said, “Coz they don’t put anything else on,” meaning they are relying entirely on manure to provide all the nitrogen needs of the corn crop (3-30.3, Farmer 4, Acc). Finally, Farmer 1, an unregulated farmer from Accomack, admitted, “I should know about how much P a bushel of corn needs but I can't tell you that off the top of my head” (3-30.2, Farmer 1, Acc).

Acceptance of new soluble phosphorus science

Across the states, a large majority of farmers either “disagreed” or said they “don’t know” in reaction to the scientifically correct statement that “dissolved phosphorus can runoff of fields even without soil erosion occurring.” Specifically, a third of all farmers said they didn’t know while a third to a half said they disagreed (see table below). This Likert statement reveals there is a great deal of farmers that do not believe or are uncertain about the existence of soluble phosphorus. Extension scientists have published journal articles on this topic since the mid-1990s, but only after the law did they begin preparing factsheets for the farmers and providing guidance. That is, the majority of farmers in each state continue to believe in the “old” phosphorus science that dominated the discourse before the 1997 *Pfiesteria*-related fishkills. That “old” rule of thumb about phosphorus was that, if “you control soil erosion, you control phosphorus, because phosphorus adheres to soil particles.”

p=0.496	Table 8.17. Likert: “Even without soil erosion, it is possible for dissolved phosphorus to runoff from soils with Very High Phosphorus soil test values.”		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	17%	30%	53%
DE, N=20	15%	30%	55%
VA, N=10	40%	30%	30%

This Likert statement generated a huge number of discussion responses. The majority of comments disagreed with the true Statement and farmers wanted to explain why they disagreed that phosphorus could still runoff without soil erosion occurring. It is apparent that many farmers did not understand the difference between soil erosion and surface water runoff. Still, others insisted that because “phosphorus is not water soluble” it is not an environmental problem if soil erosion is controlled. These farmers ranged in age and education from being young and educated (39 and having an Associate’s Degree) to being in their 50s and having a high school degree. Particularly troubling was the denial of this new science by a farmer who has a leadership role in an agricultural trade association where he is in a position to influence the opinions of many farmers and he comes in direct contact with scientists that explain the new science, whom he seems to be disregarding.

Several farmers simply restated the Likert Statement in disbelief, and Farmer 22 from Wicomico represented several similar reactions from farmers: “If you don’t have soil erosion, how is it going anywhere? If water is running off it’s not carrying soil with it” (4-6.1, Farmer 22, Wic). Farmer 39 from Worcester said, “I had to read it twice. I don’t hardly believe that. Without erosion, I don't see how you get it off" (8-10.1, Farmer 39, Wor). Farmer 23 also from Worcester denied the statement, saying,

> "Phosphorus is not water soluble. P buildup in soils over time is not bad for the environment because it is locked up into the soil. The only way it gets into the water is if mud and dirt got into the water." (1-17.1, Farmer 23, Wor)

One farmer revealed that he trusts the science from the 1980s while another farmer revealed that he does not trust modern day soil tests when it comes to phosphorus. And a third farmer explained that his meeting with a preeminent soil scientist from Delaware led him to conclude that the scientists have not formed a consensus on the issue (which is incorrect, as they have). Farmer 59 from Sussex said, "I just sat with Dr. Sims at the Environmental Studies place in Lewes and the jury is still out. They're not exactly sure how sure or how fast. It has to have soil erosion is what I believe" (3-3.2, Farmer 59, Sus).

Farmer 26 from Somerset chose disagree because he read articles by Purdue University (based in Illinois) that said P adheres to the soil and it shouldn't runoff. When I followed up with him about these articles, Farmer 26 admitted the last article he read on this subject was in the 1980s (3-15.2, Farmer 26, Som). Farmer 3, an unregulated farmer from Accomack, also revealed that he does not believe that his soil test laboratory reports to him the "plant available phosphorus":

> "I disagree, there's too much P that gets tied up. The soil test doesn't give as good a picture as it could of what's actually available to the plant. Micronutrients are plant available but not P." (3-16.2, Farmer 3, Acc)

A few farmers mentioned unique topographical and soil conditions on the Delmarva Peninsula as they explained why they disagreed with the Statement. Farmer 2, a regulated farmer from Accomack, protested:

> "I think it's bullshit. Especially over here but I'm not gonna say it's not a problem in the (Shenandoah) Valley where there's lots of hills. I don't think there's a problem with leaching and shallow groundwater here on the Shore." (3-1.1, Farmer 2, Acc & Wor)

Farmer 31 from Somerset revealed his awareness of high soil phosphorus concentrations but insisted the situation was not an environmental problem. "There's been phosphorus in this ground since the beginning of time. There are places on the Delmarva that are through the roof on phosphorus that never had manure. It cannot go anywhere" (1-25.2, Farmer 31, Som).

Farmer 25 from Somerset pointed out that his understanding of how immobile phosphorus is makes him conclude that phosphorus is not a problem and thus not a justification for reducing manure use:

> "I haven't seen any science to prove that P is mobile. P is supposed to stay stationary in the soil and it won't move within six inches from where it's been placed. It's not moving within six inches of where it's placed! If it moved 1,000 feet I can see how it would be a problem." (3-9.2, Farmer 25, Som)

Several farmers said they would choose "don't know" because they thought phosphorus would not be a problem if appropriate best management practices were maintained. This decision on their part is interesting because it is logically true that best practices help lower the risk of loss of phosphorus but this same logic should have allowed them to agree with the statement. Farmer 28 from Wicomico said, **"**I just don't know scientifically. I would think if you've got a cover crop you'd be better off. You'd have to be a soil scientist to know this" (3-10.1, Farmer 28, Wic). Farmer 7 from Accomack pushed back, "How can it (runoff) if there are buffers and using the proper amounts and staying with your nutrient management plan?" (3-1.3, Farmer 7, Acc). Farmer 8 changed his initial response from "don't know" to "agree," saying, "It depends on the practice. If you're conventionally tilling the land you have bare soil, the chances are a lot greater because water will runoff faster than in a no till situation" (3-31.1, Farmer 8, Acc). Disagreeing with the statement, Farmer 45 from Sussex said:

> "I agree that P moves laterally but it's in your BMPs. If everyone stays educated it's not a problem. You give yourself a five foot buffer strip to keep the ditch and the ground from eroding away. I don't really believe the new science on dissolved P. How come they all of a sudden invented it? Dissolved P gets taken up by the plant and gets used by the crop. My theory is, it's taken up by plant. I don't think it dissolves any more than it can take." (4-5.1, Farmer 45, Sus)

Two other farmers mentioned "farming as an art" and therefore "farming is not a science" since "you cannot control rain" and "soil testing will give different results based on temperature and moisture levels." Still, these two farmers conceded that even if the dissolved phosphorus science were true, the magnitude of the environmental problem was trivial. After a long time thinking about the Statement, Farmer 30 from Somerset said,

> "I put disagree but that's not necessarily what I think. I don't trust the science or Russ Brinsfield or his associate, Ken Staver. If we're putting 200 pounds of P and only 2 pound is leaving, that's not a big deal. They haven't provided answers on how to prevent that. If I knew a 5-inch rain was going to come I'd know when not to apply nutrients to keep it (runoff) from happening. That's the art of farming; to have a feel and sometimes you win and sometimes you lose." (3-8.3, Farmer 30, Som)

Farmer 45 from Sussex said, "I just don't believe P flows unless you have a flood. But ordinarily I don't believe it moves down or sideways. If it did move, why are we still having high P after all these years?" (4-5.1, Farmer 45, Sus).

One farmer used a banking analogy to explain how he thinks of nitrogen as a checking account where you can take out as much as you put in and phosphorus as a savings account where you put in more than you withdraw.

> "The theory is that there is P left (in the soil) and you'll pull some out (when you grow a crop), so that's 40 pounds out of the saving account. It's like a bank. Nitrogen is a checking account – it never stays there but phosphorus is like a savings account and it keeps building over 210 years. You can't take out enough to get it down. Over a period of time you will reduce your savings. With a phosphorus-based plan, the idea is to take out more than you put in. After 10 years you've reduced 400 out." (3-17.1, Farmer 15, Wor)

Finally, one farmer quite accurately and eloquently traced the evolution of the changing science over phosphorus and no-till farming recommendations from the University and expressed his frustration at not knowing if the science was true.

> "I don't know. In the 1980s, your fertilizer companies would give dinners and I went to many dinners. The university chose people who would give seminars at these dinners and they always preached, 'Don't worry about P.' Now they say it leaches, so who do you believe? I got no way to tell. Do you believe them now or then? They're supposed to be in the driver's seat – do you believe anything they say? Their excuse now, is that no-till – we've all gone to that – has made the concentration of phosphorus in the top of the soil so high that the soil can't absorb any more P. Now, they're preaching till. Yet they don't show the science to back it up. So I don't know how to answer that." (3-15.3, Farmer 11, Som)

Acceptance that nutrient pollution occurs normally on crop fields

Only 40% to nearly 60% of farmers in all three states were able to agree with this scientifically correct statement that it's normal for nutrients to leave crop fields via air volatilization, leaching through groundwater, or running over the surface of the field because of normal hydrologic conditions (see table below). This leaves 40 to 60% of the remaining farmers either saying they did not know or disagreed. To be fair, some farmers had to clarify what the word "hydrologic" meant and I would explain that the term meant "the normal weather cycle of evaporation of moisture off the land, rainfall from the sky, water flowing overland through streams, and water moving through the soil column in the groundwater."

p=0.357	**Table 8.18. Likert: "Due to the normal hydrologic (air-water-soil) cycle, nutrients do volatilize, leach, or runoff my crop fields."**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	57%	23%	20%
DE, N=20	45%	10%	45%
VA, N=10	40%	20%	40%

Many farmers revealed they do understand the basic ways that nutrients can leave their crop fields and were able to agree with this Statement. Farmer 11 from Somerset said, "Nutrients do volatilize. If you don't incorporate chicken manure on the ground, you lose 50% of it and nitrogen leaches away. And if you have erosion, it will runoff fields. There's no way you can stop nutrients in a big rain" (3-15.3, Farmer 11, Som). Farmer 8 from Accomack said:

> "Yeah, that's a proven fact that nitrogen left on the surface will volatilize, leach, and run off. That's one of the drawbacks to no-till is that you're leaving everything on the surface. But the benefits of not tilling outweigh that. No-till doesn't have as much runoff as a conventional field (does)." (3-31.1, Farmer 8, Acc)

Farmer 60 from Sussex explained, **"**This is hard to admit. I guess I can agree. Nitrogen you know does leach but potassium and phosphorus it's less clear because they adhere to the soil better" (3-3.3, Farmer 60, Sus). Farmer 43 from Kent said, "I agree. If you get a big rainstorm, 2–3 inches, I'd say some of it could run off" (3-2.1, Farmer 43, Ken).

Maryland has published factsheets in its voluntary nutrient management program that state 35% of applied nitrogen, on average, is lost to the environment through volatilization, leaching, or runoff. Thus, they encourage a suite of nutrient management practices, including the right application rate at the right time, cover crops, and conservation buffers to help take up some of the nitrogen that is otherwise not taken up by the crop and lower the average rate that is actually lost and potentially harmful to water bodies. This next comment from Farmer 5 from Accomack indicates that he's unaware of the magnitude of average nitrogen loss if aggressive best management practices are not well maintained: "Life is life. A little bit of stuff will run off but I don't think that it's critical or killing the bay" (3-31.3, Farmer 5, Acc-NP).

Other farmers revealed they did understand the hydrologic cycle but were unable to agree with the Statement because they felt the few BMPs they were using were taking care of any potential problems. Several farmers insisted that by using a few BMPs there are no problems with nutrient loss from their fields. Farmer 48 from Sussex disagreed and said, "I don't think so because we always disk (incorporate manure) all ours in as soon as we spread. We'll plant right away. We'll start spreading end of this month (March), disk in, and plant corn April 15th" (3-25.1, Farmer 48, Sus). Farmer 12 from Kent said, "If you do a good job of cover crops you'll cut down on that" (3-23.3, Farmer 12, Ken). Farmer 23 from Worcester explained:

> "I'd say no because my sediment pond that drains my farm and five other farms above it was dipped out four years ago and they pulled soil samples which showed it was low in everything. The soil consultants say it shows my pond was working and doing what it's supposed to." (1-17.1, Farmer 23, Wor)

Thus, instead of being able to agree that his farm and the five others above it did have nutrients and sediment leaving their fields, which were being collected in the sediment pond where they were decomposing, Farmer 23 uses the success of his best management practice as his justification for denying that the pollution problem occurred in the first place and disagreed with the Statement.

Farmer 37 from Somerset shed some insight as to why Farmer 23 and others may have had difficulty agreeing with this Statement: “Pollution. That word is the problem. Farmers don’t like to think that what they do is polluting. Change that word” (2-24.2, Farmer 37, Som).

Interest in receiving more nutrient management educational materials

Despite farmers in all three states complaining about the paperwork and the Delaware farmers complaining about the required continuing education credits, surprisingly, the majority of farmers in all three states (50 to 73%) said they would like to receive more nutrient management education materials (see table below). There was no statistical difference between states.

p=0.356	**Table 8.19. Likert: “I would like to receive more nutrient management–related educational materials.”**		
# Farmers	**Agree**	**Don't know**	**Disagree**
MD, N=30	73%	7%	20%
DE, N=20	50%	10%	40%
VA, N=10	60%	20%	20%

“I guess there’s always room for more,” said Farmer 3 from Accomack (3-16.2, Farmer 3, Acc). “I agree,” said Farmer 15 from Worcester. “Despite all this, (education) just goes with your business, I still want to understand it even thought I don't agree with it. I'd still like better ways to use manure. I want to know it. There's nothing wrong, we're all out here trying to be profitable and be stewards of the land" (3-17.1, Farmer 15, Wor). Farmer 31 from Somerset agreed, and when I asked him if he uses the Internet (which I only asked of a handful of farmers), he said yes. "I do use it for everything. I check out USDA sites. It would be nice to go and read up on the latest stuff; you know, the do's and don'ts" (1-25.2, Farmer 31, Som).

When sharing opinions on this Likert Statement, several farmers from Maryland and Delaware indicated that there may be a significant difference between the two states in terms of their perceptions of: a) the amount, frequency, and type of educational materials provided in the mail, b) the amount of contact with Extension agents, c) the amount of educational class opportunities, and d) the quality of educational classes.

Farmer 23 from Worcester said:

> "I get information every three years when I have to renew my manure license. I don't get regular newsletters on nutrient issues – only letters letting you know about the meetings. Most of my information comes from Cooperative Extension. Extension has changed and now we don't get as much from them as we used to." (1-17.1, Farmer 23, Wor)

I met Farmer 18 from Worcester at the "Lower Eastern Shore Agronomy Day," an event with a variety of speakers on various agricultural topics and where farmers could re-certify their manure application licenses. Farmer 18's story below indicates he wasn't very pleased with the event. In response to this Likert Statement, Farmer 18 said: "I agree. I don't get anything (educational materials in the mail). Maybe a little from the Extension office once in a while. Like you're telling about the P, I don't think I've gotten anything in the mail about that." I asked if there are many continuing education classes for him to go to and he said, “I don’t think there are too many. I’ve just been to get my manure spreading license. It was pretty good. It dragged out didn’t it?” (4-6.2, Farmer 18, Wor).

In contrast, Farmer 57 from Kent County sang the praises of Greg Binford, the UDE Extension scientist who teaches the continuing education classes. Farmer 57 and I met at the event where Binford gave a presentation showing that greater than 3 tons of poultry manure per acre for corn production was not worth the time and the money to apply.

> “Yes, they have some good stuff. It’s valuable to us. They’re doing a lot more studies on the plant uptake. I try to go to a lot of meetings. They are valuable. One guy at UDE, Greg Binford; he can really talk to people. People can understand him. He explained what was what. If it wasn’t working like it should be, he would tell you. If you get someone like that, it makes a difference.” (3-2.4, Farmer 57, Ken)

Other farmers, mostly from Delaware which requires six hours of continuing education every three years (roughly two one-hour classes a year), disagreed that they did not need any more educational materials. Farmer 50 from Kent said, “There are three workshops already. Because you were forced to go to it, you don’t like it. It’s kind of a pain to stop what you’re doing, come home, and take a shower. But once you were there it was okay” (3-24.1, Farmer 50, Ken). Farmer 43 from Kent also disagreed that he needs more educational materials because he’s getting so much already. Farmer 43 said that he actually enjoys the certification classes he goes to and said:

> “They were very practical; showing the do’s and don’ts of manure spread next to ditch and dead birds piled wrong. I get mail probably once a week on this thing. I get letters from Gordon Johnson (the Kent County Soil Conservationist). See here, on Monday, March 6 (Farmer 43 reads the

> topics that will be covered at the next meeting) – cover crops, soil-building rotations, long-term no-till." (3-2.1, Farmer 43, Ken)

A farmer from Maryland explained why he disagreed with the statement:

> "The research has to be done to provide better information on the latest science to farmers but we don't need more meetings. The biggest slap in the face is the voucher training we have to go through. Farmers have been tilling for four decades but we need a license to be able to apply nutrients, otherwise, we're not in compliance." (3-8.3, Farmer 30, Som)

When I asked Farmer 30 if the law has changed the relationship between farmers and the state, he said, "Yes, it's had a negative effect: We now all think, 'Oh, lord, not another meeting'" (3-8.3, Farmer 30, Som). This last response is interesting because Maryland farmers only have to attend one one-hour manure applicator voucher certification and continuing education course every three years. In contrast, Delaware farmers have to maintain six credits of continuing education every three years, which could be one two-hour class every single year or two one-hour classes every single year.

A couple of farmers from Delaware indicated that the level of educational information provided at Delaware's certification classes may be more advanced than can be understood by some of the farmers. Farmer 51 from Sussex, who is 49 and has a high school degree, said:

> "I got enough information now. You have to go to nine hours of courses (nine hours is the initial certification requirement). Some of what they taught was way above me. They get down into the different chemical symbols. Like what do you call the symbol for water? Yeah. For those that

> didn't attend college, it was too much for them. You sit there for three hours and after one hour you're daydreaming. And sometimes it's too high tech for the average farmer. You take my Dad or the typical farmer who's over 60 years old. They're done. They're not there to learn; they're there to put the time in." (3-23.2, Farmer 51, Sus)

One 25-year-old, college-educated farmer from Sussex also disagreed with the Statement and said, "They talk over your head. I do have a college education. I'm not a doctor in the way soils act but it'll be way over our heads for a while." When I asked him what was hard to understand, Farmer 53 mentioned, "The breakdown of the soils and compounds and different elements." When asked if he gets information in the mail or if he uses the Internet, Farmer 53 said, "Yeah I use the Internet. I check the UDE website to find out when the classes are but not to get newsletters. I get the UDE mailers. They're nice. But they tend to get lost in the bills" (3-29.1, Farmer 53, Sus).

Wrap-up of Findings from Nutrient Science Likert Statements

There was a lack of statistically significant differences across the four questions regarding nutrient science, revealing that farmers in all three states are more alike than they are different and they do not believe basic or modern nutrient management science. There is reason to be hopeful, however, that farmers interviewed for this dissertation are leaving the educational door open, as 50 to 70% said they were interested in receiving more educational materials about nutrient management.

It is a serious concern that a large majority of farmers in all three states had not seen the three nutrient application philosophies before, and that in all three states – after they read the definitions of each philosophy – the largest group of farmers chose the Build and Maintain or "feed the soil" philosophy, which results in over-application of nutrients.

Furthermore, roughly half to most of the farmers in all three states disagreed or said they didn't know in reaction to the three Likert Opinion Statements about basic manure, nutrient, soil, and hydrologic science.

Given that all three state nutrient management laws empowered their land-grant universities to establish nutrient management plans based on these basic and modern scientific facts, it is not surprising that so many farmers do not trust the nutrient management plans that are built on these fundamental scientific principles.

8. 6. Summary

This chapter demonstrates that even though there are poor compliance rates with required nutrient management practices (as revealed in Chapter 7), nutrient management laws, past and continued assistance from the extended educational community, and technological innovation in manure spreaders have improved the way farmers manage fertilizer and manure a great deal. Thus, even though most farmers have not experienced any enforcement directly, the law's presence and the farmer-driven self-regulating complaint system have helped improve nutrient management practices.

This chapter fleshes out more of the reasons farmers resist accepting their plans as good for business, as was also highlighted in Chapter 7. The first problem is cultural and economic: farmers do not want to set average yields goals because they are in a community that identifies success with ever-increasing yields and more bushels per acre means the costs to rent land decrease. The second problem is simply economic: farmers do not want to use poultry manure only for its phosphorus content because they do not want the extra cost of purchasing the commercial nitrogen fertilizer to make up the nitrogen they are no longer getting from the manure. The third problem is scientific: farmers, by and large, do not accept modern phosphorus science or basic environmental concepts, nor do they realize their nutrient application philosophy is likely costing them time and money.

Many comments from farmers presented in this chapter indicate that many find themselves in a **“**catch-22” situation. On the one hand, farmers don’t think they did anything wrong to warrant begin regulated and they feel insulted that all the strides they’ve made over the years aren’t appreciated. On the other hand, it is awkward to demand gratitude for ceasing bad behavior such as dumping manure on the nearest field to the chicken house or dumping it in the woods and would be admitting to bad behavior in the past. Admitting to bad behavior in the past might offer environmentalists and policymakers an opportunity to prove that the regulations are warranted.

However, most farmers did not seem aware of the irony of wanting to get credit for ceasing bad behaviors. In addition, most farmers did not make the connection between bad behaviors in the past as contributing to the current nutrient management problems.

Finally, the serious lack of understanding of nutrient science reinforces the reality that plan-based regulations are voluntary if farmers do not believe the science behind the plan.

The manure rates on corn reported by farmers in this dissertation pose an interpretative puzzle, given that when the average manure application rate is analyzed by state there is no statistical difference, but when the rates are analyzed by categories a significant difference does appear and three-quarters of Delaware farmers report using 2 tons or less per acre while only four in 10 Maryland and Virginia farmers do so. Because the majority of Delaware farmers use private sector planners and because this dissertation and other studies demonstrate that that private planners tend to recommend greater application rates than public planners do, this finding is difficult to interpret.

There could be a social desirability problem wherein farmers with private sector planners are reporting lower rates than they are actually applying, while farmers with public sector planners may be reporting the rates they are applying, which may be higher than the rates in their plan. There is also the problem that farmers may not know what rate they are applying given the infrequent use of manure testing or calibration of manure equipment.

The logit regression analysis generates findings that contradict existing literature and other findings in this dissertation. The logit regression model indicates that farmers interviewed for this dissertation that have a private planner may be nine times more likely to be low manure users than those with a public planner.

If all farmers included in this dissertation were reporting the true manure application they believe they are applying, there may be an indirect effect of Delaware's three-year crop removal policy actually resulting in a low manure use rate in Delaware farmers. However, this may not be the case, since only 20% of Delaware farmers said they had a P-based plan, 15% they had an N-based plan, and 65% did not respond to the question. The logit model does suggest two additional factors may predict whether a farmer will be a low manure user: if he felt his state's policy-making process was inclusive of farmers and if he believed in the basic scientific fact that manure use on corn for nitrogen over-applies phosphorus.

CHAPTER 9 – ANALYSIS: GOVERNMENT CAPACITY TO REGULATE FARMERS

9.1. Introduction

Chapter 9 provides a comparative political analysis of government capacity to regulate farmers in each state in this dissertation. The chapter is divided into five main sections reflecting the five major stages of the policy process: (1) problem diagnosis, (2) political response, (3) deliberating policy options, (4) implementation, and (5) enforcement. Throughout Chapter 9, I will weave in relevant scholarship first introduced in Chapter 2 to provide context and insights into how each state proceeded through each policy stage, including, theories about how focusing events open policy windows and set policy agendas, why states pursue policy responses the way they do, why some policy options do not seem to be chosen rationally, which factors make for better implementation of laws, and whether certain enforcement styles are more effective than others.

In addition to analyzing if and how existing theories may or may not help explain the processes in these case study states, I will compare the differences in each state's performance. Overall, three of the five policy stages proceeded very differently in each state: the problem diagnosis stage, political negotiations phase, and the regulatory program implementation phase. However, what was very similar between the states was their failure to adequately define the problem, their limited policy option deliberation, and the way each state enforced the regulatory program.

I found that the problem diagnosis stage in each state was initially different due to the different political cultures, but in the end all three states failed to adequately define the problem of farm pollution and the problem of the existing voluntary policy approach. I found the relative strengths of the agricultural and environmental interest groups were very different in each state as was the overall policy-making style. These differences had a significant impact on the attitudes of the regulated community, the design of the regulatory program, and the initial list of regulatory requirements.

In contrast, the government capacity to rationally deliberate policy options was, across the board, weak in all three states. Partly because of the implementation choices made in the legislative and regulatory development phases, the states experienced very different program implementation phases, and one state was particularly effective in its roll out phase while the other two states suffered a number of setbacks. Finally, all three states were similarly weak in their ability to wield the theoretical enforcement power afforded by a regulatory approach and all emphasized “compliance assistance” as the enforcement style instead.

9.2. Capacity to Define the Farm Pollution Problem: Limited in All States

The 1997 *Pfiesteria*-related fishkills in the Pocomoke Bay shared by Maryland and Virginia’s Eastern Shores of the Chesapeake served as a focusing event that opened a window of opportunity for government to set a policy agenda. Each state in this case study reacted to the focusing events differently, reflecting the states’ differing political and environmental cultures. However, all three states failed to use the focusing event to adequately define agriculturally related pollution problems or to adequately explain the problems with the existing voluntary policy approach to farm nutrient pollution. In Maryland, in particular, where most of the problem diagnosis stage occurred due to the majority predominance of the fishkills occurring in Maryland waters, there was little consensus on the problems highlighted by the focusing event, thus, it was hard to gain buy-in to a regulatory approach. This failure to gain consensus about farm-related environmental problems persists to the present day and continues to undermine the implementation of the regulatory program, as many program implementers and farmers are failing to uphold the nutrient management standards of the law.

In this first section in Chapter 9, I will draw from the scholarship on focusing events to analyze the factors that make them powerful in opening policy windows but also make them ultimately weak in setting effective policy agendas. I will compare and contrast the differences in problem definition and valuation between states. I will then analyze the reluctance of agricultural institutions in each state to define agricultural pollution problems and the delay in quantification of the problems until many years after the *Pfiesteria* events and the state laws. I will analyze the ramifications of the failure to gain consensus on the environmental problems associated with agriculture. Finally, I will analyze the ramifications of failing to take partial responsibility for the phosphorus problem and the perspective of the problem diagnosis stage from the farmers' viewpoint.

Focusing events open windows but may not effectively set policy agendas

Kingdon's (1995) classic "multiple streams theory" helps explain why certain issues gain political attention over others and compel policy makers to open policy windows. Kingdon posits that when the so-called three "streams" come together, a window of opportunity for government to act opens. The streams he refers to are the *politics stream* (the state of politics and public opinion), the *policy stream* (potential solutions to the problem), and the *problem stream* (a focusing event that has thrust a problem into the public or elite consciousness, some indications that a problem may be getting better or worse, and whether there are alternative solutions available in the policy stream to solve the problem).

Likewise, Baumgartner and Jones (1993) describe the process of policy-making as "punctuated equilibrium" in which the policy monopoly and balance of power remain relatively stable until "their dominant construction of problems breaks down." A focusing event that gains media attention is a typical way that will cause the "problem breakdown" because a sudden shift in the public's understanding of the problem will result in rapid policy changes.

Indeed, when the series of *Pfiesteria*-related fishkills in 1997 was being discovered in bays, rivers, and creeks along the Lower Eastern Shore of the Chesapeake Bay, the media and policy makers shone a bright spotlight on a toxic microorganism that was thought to be making people sick and fish die. The *Pfiesteria* dinoflagellate had previously been nicknamed "The Cell from Hell" in its first emergence in North Carolina when Hurricane Agnes destroyed liquid hog waste lagoons and it killed millions of fish and made researchers sick. Thus, for it to be discovered in the Chesapeake Bay raised the long-time problem of nutrient pollution ailing the Bay to a new level of appreciation.

The *Pfiesteria*-related fishkill focusing events awakened the "problem stream" for the media, which would otherwise not cover the relatively boring, technical, and invisible issue of nonpoint source nutrient pollution. *Baltimore Sun* environmental reporter, Tim Wheeler, described the media attention to *Pfiesteria* as a "horse race" between the *Sun* and the *Washington Post*. Finchman, with Maryland Sea Grant College, estimated that the *Post* assigned 24 reporters to cover *Pfiesteria* and wrote 130 stories, while the *Sun* assigned 21 reporters to the story and published over 170 stories. Given the *Post's* national distribution, the media attention expanded not only into neighboring state newspaper outlets but also to television and the national networks, making the "*Pfiesteria* hysteria" a nationwide story (Finchman, 2007).

Part of the "political stream" involved the electoral aspirations of Maryland Governor Glendening, who many in the stakeholder communities and the media concluded used the summer 1997 *Pfiesteria* focusing events as an issue to boost his ratings in the public opinion polls for his second term elections in the fall of 1998. Likewise, the media commented that Virginia postponed voting on their Poultry Waste Law in 1998 until 1999, when both the executive and legislative branches were up for election.

Part of the "policy stream" involved the long-time dissatisfaction of Maryland policy makers with the voluntary program approach addressing farm pollution. Given the voluntary approach had been questioned since 1983, when the first Chesapeake Bay Agreement was signed, and given Maryland's three failed attempts to regulate agriculture in the early 1990s, this focusing event provided a welcome opportunity to try and reopen the regulatory policy window. On the policy front in the other two states, the *Pfiesteria* focusing events highlighted the fact that Virginia's state VPA permit program did not include poultry farms and they also intensified EPA's pressure on Delaware to initiate their long-overdue federal CAFO program.

The *Pfiesteria* fishkill focusing events enabled all three "streams" to come together and "punctuate the equilibrium" of the long-time voluntary approach to the problem.

Farmers had been enjoying the "policy monopoly and balance of power" that the voluntary approach had afforded them (i.e., provision of financial and technical assistance and gentle encouragement to adopt BMPs) until the focusing event called into question the effectiveness of this approach.

Kingdon also cautioned that focusing events can be transient and weak unless they are accompanied by: a) preexisting perceptions of the problem, b) a firmer quantification of the problem, and c) confirmation that the crisis event was not an isolated fluke. All three states were unsuccessful at achieving these three factors, making the 1997 *Pfiesteria* focusing events a weak driver of policy.

First, the *Pfiesteria*-related fishkills were weak in confirming preexisting perceptions of the problem. On the one hand, the fishkills served as a powerful symbol of what was already on the minds of elite stakeholders – the problem of excess poultry manure on the Delmarva Peninsula and the inadequate voluntary policy approach to farm pollution. The agricultural community across all three states, by and large, did not share these perceptions and thus the fishkills to them became a powerful symbol of the insulting and incorrect regard policy makers, environmentalists, and the media had for farmers.

Second, the government capacity to quantify the problem was not solid but was nuanced. On the one hand, the Maryland Blue Ribbon Commission quantified the problem as a failure to disseminate the new phosphorus science to farmers, while on the other hand estimates of participation in the voluntary program showed relatively high levels of farmers on the Lower Eastern Shore as having a nutrient management plan and a soil conservation plan. So, the voluntary approach wasn't necessarily the problem because most farmers had plans, but the problem was that the science underlying the nutrient recommendations in those plans needed updating.

Finally, the *Pfiesteria* fishkills turned out to be an isolated event, as no second or third discovery of *Pfiesteria* was made, though sporadic and small fishkills did continue to occur. Dan Terlizzi, an Extension scientist, suggests that another toxic dinoflagellate, *Karlodinium micrum,* which resembles *Pfiesteria* but is only harmful to fish and not humans, had been discovered in 1996 at an aquaculture farm using water from the Chesapeake Bay, in the 1997 fishkills attributed to *Pfiesteria,* and then again in another small fishkill in 1999. Terlizzi posits that had the fishkills in 1997 been attributed to *K. micrum* instead of "The Cell From Hell," the fishkills' value as focusing events would have been limited. Terlizzi suggests that the WQIA could be justified by concerns about oxygen depletion in the Bay and the loss of underwater grasses, and said some have described the WQIA as "the right law for the wrong reasons" (Terlizzi, 2006).

a. Without effective problem definition, focusing events that become weak lose the justification they created for opening the policy window and setting the agenda

Kingdon reminds us, "There are great stakes in problem definition" and that there are at least three factors involved in policy stakeholders defining conditions as problems: a) how the stakeholders value the problems and whether they view government action as warranted, b) whether the stakeholders see comparisons that make a response to the problem compelling, and c) whether stakeholders place problems into effective categories.

Due to the state differences in relative power between agricultural and environmental interest groups, the underlying political and environmental culture, and outlook on the appropriate role of government, each state defined the focusing events differently. In the Bay- and environmentally-oriented state of Maryland, environmental interests dominated the policy process, reflecting the state's strong environmental political culture. Maryland's Democratic executive, mostly Democratic legislature, and environmental group stakeholders viewed the *Pfiesteria* fishkills not only as a problem "appropriate for government action" but as a crisis warranting rapid and significant policy response. Furthermore, Maryland policy stakeholders classified the *Pfiesteria* fishkills in an expansive way: they were a sign that the voluntary approach was not working and a clarion call that if a different solution didn't materialize the Bay would continue to reveal signs of catastrophic decline.

In the less Bay-oriented and more business-oriented state of Virginia, agricultural interests tend to have an edge in the policy process. This reflects the dominant view in Virginia that government intervention is warranted to address environmental problems but it should be limited. Hence, Virginia's Republican executive took a "go slow" approach while one Democratic legislator in the mostly Republican General Assembly took the policy lead to craft an incremental and measured policy response. Virginia categorized the focusing events in a very limited way, or as an indication that only one more animal industry needed regulating.

In the Atlantic Ocean- and Inland Bays-oriented and more business-oriented state of Delaware, agricultural interests have a powerful edge over environmental groups as many of the members of the General Assembly come from farming families and return to farm trade associations as leaders. The Democratic executive branch and mixed Democratic-Republican legislative branches defined the condition primarily through comparison. That is, Delaware took a "wait and see" approach, observing what Maryland and then Virginia would do in response to the focusing events and only acted after feeling pressure from the EPA, the public, and the media to respond in kind. Because Delaware turned over the policy-making reins to the regulated community, the state ultimately decided the *Pfiesteria* fishkills warranted only limited government intervention, as farmers customarily regard "government as the problem." Thus, Delaware's categorization of the problem was also limited and political rather than environmental: EPA's pressure on Delaware to initiate a CAFO program needed to be fulfilled and because Maryland had chosen a regulatory approach, Delaware couldn't respond with a voluntary approach but would regulate farmers "the Delaware way."

b. Despite the differences in approaches to the problem diagnosis stage, all three states failed to adequately define the long-term agricultural nutrient pollution problems associated with the focusing events

i. Agricultural institutions are reluctant to discuss pollution and are not trained to do so

Lowi (1964) explained that environmental policy is an example of protective regulatory policy intended to reduce the negative effects of private activity on behalf of the public interest. Thus, the first steps for government when providing this protection are to define environmental problems and then solve those problems. Governments in all three states in this dissertation continue to struggle with defining and discussing the environmental problems associated with agriculture. Perhaps the most difficult issue is that the key institutions related to agriculture – the state and federal departments of agriculture, the university cooperative extension service, and the soil conservation districts – are all reluctant to engage in problem definition regarding agriculture.

When I asked one Maryland scientist if he had any thoughts to share on my dissertation chapter about "the role of government capacity to design, implement, and enforce nutrient management plans," the scientist provided the following written comments in an email. Although the comments are focused on Maryland, they resonate with what I believe to be the case with corresponding institutions in Delaware and Virginia. The emphasis in bold is my own:

> "I think that the major problem in Maryland has been that all the primary government ag institutions including UMD ag college including extension, NRCS and MDA have a history of being **strictly advocates** when it comes to agriculture and **have had trouble even dealing with the issue that ag causes water quality problems.**
>
> The research in ag has **focused on production** and those faculty (who tend to hang around for a long time) were **not trained to address water quality** issues and were **not comfortable** doing it anyway. The outreach folks (extension) had always been the **farmer's friend** and **wanted nothing to do with delivering bad news.** NRCS was more or less like extension in terms of a mindset. So **in private, they were telling the farmers that there really wasn't a problem anyway.**
>
> And on enforcement, MDA also strictly wanted to be an **advocate to the ag community** so was very **hesitant** to undertake any meaningful evaluation or enforcement. Plus from top to bottom MDA is sorely **lacking in technical ability to deal with water quality issue**s. So the **research didn't get done** to evaluate whether or not nutrient management **plans actually worked** (almost no baseline data), the outreach community really wasn't interested in nutrient management once it got **beyond saving farmers money**, and MDA wanted to be in charge of enforcement **to make sure that it really didn't get done**. This attitude got reinforced during the Ehrlich administration that was heavily supported by the rural sector. **The payback was a lighter touch** on nutrient management enforcement, which was already pretty soft.

> Now all of this has been more or less headed in the right direction for a long time, but it has been painfully slow for reasons that are evident when you look at the situation. If the solutions had been effective and painless everything would have worked out just fine but that has not turned out to be the case.” (University of Maryland Scientist A, April 2009)

As the Maryland scientist points out, “the outreach community really wasn't interested in nutrient management once it got beyond saving farmers money,” and thus, the emergence of the new phosphorus science posed significant cultural problems for the agricultural institutions. First of all, the “new” science contradicted the advice these agricultural institutions had been giving to farmers and what was commonly accepted by farmers: that phosphorus was not an environmental problem if soil erosion was controlled. Second, the agricultural institutions had to admit that their advice to use manure for its nitrogen content actually resulted in over-application of phosphorus, causing soils to become saturated and discharge to the environment. Third, agricultural institutions had to admit that the new solutions to the problem of nonpoint source pollution would raise costs because farmers would have to reduce their manure application rate, purchase commercial nitrogen fertilizer, and safely find alternative uses for the manure. Because of these three issues, pre-1997 agricultural institutions in all three states were reticent to begin addressing the issue of phosphorus in the voluntary, educational program era.

None of the three states had developed any educational materials on phosphorus prior to 2000, when Maryland’s Cooperative Extension Service Newsletter published a “Focus on Phosphorus” fact sheet. Earl Hance, who was the President of the Maryland Farm Bureau when I interviewed him in November 2005, said:

> "I've farmed all my life and knew phosphorus wouldn't leach. But in 1998, in the General Assembly I heard a researcher from Maryland stand up and say phosphorus would leach. Now how am I supposed to solve a problem that I didn't know about?"

Even before the emergence of the new soluble phosphorus science, agricultural scientists studying the Delmarva Peninsula's environmental conditions knew that a nutrient imbalance problem existed on the Peninsula, given the surplus of nutrients from the animal manure generated and commercial fertilizer applied and the amount of nutrients removed in the crop harvest. However, little research about the imbalance or attempts to quantify it had been published before the state nutrient management laws. In fact, it was several years after the state nutrient management laws in 1998 and 1999 before much progress to quantify the problems had been made, including the following advances in understanding:

- In 2002, researchers from nine of the region's land-grant universities formed the Mid-Atlantic Water Program and began a research project to quantify the area's nutrient imbalance problem.
- In 2004, University of Maryland researchers estimated for the first time the size of the commonly known "excess manure problem" on the Delmarva Peninsula based on phosphorus-based management of manure.
- Also in 2004, the Chesapeake Bay Foundation released a seminal report on the three manure "hot spots" in the Bay watershed (Delmarva Peninsula, Shenandoah Valley, and Lancaster County).
- In 2008, University of Delaware researchers estimated the size of the remaining nitrogen and phosphorus surpluses in the state that they contend has shrunk in part due to the state nutrient management law and nutrient relocation program.
- In 2009, the Delaware Nutrient Management Commission generated three methods to estimate the size of the excess manure problem in Delaware.

When I asked one representative at the Maryland Department of Agriculture, who wished to remain anonymous, about the lack of quantification of the excess manure problem in Maryland before the law, he said, “At MDA, we didn’t want to stick our necks out to estimate what was excess.”

ii. Educators, conservation program implementers, and farmers shy away from agricultural nutrient pollution terminology

It is clear that agricultural institutions in all three case study states are reluctant to acknowledge publicly that farmers pollute. This reticence to define agricultural activities as sources of pollution results in farmers’ cognitive dissonance with science that suggests they are not only part of the Chesapeake Bay problem but are the single largest source of the nutrient and sediment pollution causing the problem. As evidenced by several Likert statement results and many informal comments, farmers across all three states think of themselves as stewards of the land, they disagree that agriculture is the largest source of nutrient pollution to the Bay, and agree that agriculture is unfairly targeted. The most common misperceptions by farmers are that lawns and golf courses are a larger source of Bay pollution than is farmland. Each of these misconceptions largely goes uncorrected by the agricultural institutions.

Even the very notion that the term “pollution” could be mentioned in the same sentence with the word “farmers” is very uncomfortable for farmers to hear, indicating a cultural challenge of finding common language between environmentalists, scientists, and farmers. For example, during my pre-interviews when I was testing the wording of Likert Statements, one farmer reacted to the following statement, “Due to the hydrologic cycle, nutrient pollution does occur on the fields I operate through volatilization, groundwater leaching, or surface water run-off,” by saying, “Pollution. That word is the problem. Farmers don’t like to think that what they do is polluting. Change that word” (2-24.2, Farmer 37, Som).

Even the agricultural institutional community identified earlier avoids using the word “pollution” to describe the unintended negative consequences of farming. Furthermore, the term “environment” is seldom used in farmer-oriented literature. Instead, the term “conservation” is commonly used to describe the environmentally protective activities of farmers. The term originated as “soil conservation” in the 1930s Dust Bowl era as a solution to the soil erosion problems that were caused, in part, by overly aggressive tillage practices. Now, the term “conservation” refers to all things “environmentally protective” with regard to farmers. Instead of “environmental benefits” to describe the improvement of water quality, air quality, and wildlife habitat from the installation of best management practices, they are “conservation benefits.” Instead of “environmental protection funds” they are “conservation funds.” Such a consistent avoidance of the word “environment” when describing agricultural activities suggests that overall the term “environment” has a negative connotation to farmers.

Though the 1997 *Pfiesteria*-related fishkills could be considered one of the worst environmental pollution problems ever linked to agricultural activities, it is ironic that farmers appropriated the term “environmentalist.” To counter the negative media attention farm trade associations felt their members were receiving, they printed bumper stickers that read, “Farmers: The First Environmentalist,” which quickly became a mantra of the farming community. However, as I learned in my interviews with farmers, being “the first environmentalist,” or more commonly a “steward of the land,” was restricted to just one environmental medium – land, and specifically soil conservation – and it was not easy for farmers to view either moniker as applying to water or air.

One critical challenge to defining environmental impacts of farming is that the agricultural institutions, as posited by the Maryland scientist and as I had heard several people suggest during my interviews, do not regard them as a part of their mission, which has been largely been limited to improving agricultural productivity. Each state's departments of agriculture, land grant university cooperative extension service, USDA NRCS offices, and soil conservation districts have always focused on helping agricultural production become more profitable. Helping farmers minimize their environmental impact is a secondary objective and most commonly seen as an ancillary benefit to the primary objective of improving the "bottom line."

Hence, in general, there is unwillingness by agricultural institutions to identify and define environmental policy problems clearly and explicitly. And without the ability to define environmental problems associated with agriculture and to communicate those problems with farmers to gain agreement on the problems, these governmental institutions are unable to effectively set pollution reduction goals, design solutions, and evaluate achievement of those goals.

I posit that because of the difficulty defining problems associated with agriculture, the cultural tendency to avoid language regarding pollution and the environment, and the narrow mission and self-identity of agricultural instructions, all three states would not have been able to deal with the new science and the excess manure problem had a focusing event not turned public scrutiny on the situation.

iii. Even law implementers continue to resist believing in the new phosphorus science

Even nine years after the 1997 *Pfiesteria* focusing events that brought the new phosphorus science out into the open, many members of the agricultural institutions that are writing nutrient management plans whom I interviewed in 2006 still do not fully accept the new science; members of the private and public sector implementing the mandatory nutrient management program are still skeptical of the phosphorus science. Three quotes are provided below to demonstrate the resistance of both private- and public-sector planners to accepting the modern P science on which the basis of their preparing nutrient management plans rests. I have shown these quotes to several land-grant university agricultural scientists who all conclude that these individuals are incorrect in their understanding of phosphorus science.

Tony Keen, a long-time crop consultant on the Delmarva Peninsula turned private planner said, “I don’t think soluble P leaves the field at an FIV of 150. We’ve run soil samples in ditches and haven’t had any runoff. I don’t think it has an environmental impact” (Keen, personal communication, August 11, 2006).

Accomack County Cooperative Extension specialist, Jim Beloite said,

> “There’s still no agreement that P moves. It’s still a big debate among the authorities. I don’t think it moves as much as other people think. There’s no question about nitrogen moving though. Most is running off with sediment and down with groundwater.” (Beloite, personal communication, August 22, 2006)

One public planner with the Maryland Extension Service, who asked that his remarks be kept confidential, said:

> “I’m convinced all soils are high P in the woods because of the seafloor calcium phosphate in seashells 10,000 years ago. The only way P will move is if it’s super

> saturated which is an FIV in the 1000s. P does erode but doesn't move two inches in solution. If you have an FIV higher than 150 but lower than 1000, it won't run off but it will erode with the soil." (Nutrient Management Specialist with Maryland Cooperative Extension Service, August 10, 2006)

Private- and public-sector planners who remain unconvinced of the agricultural-environmental problems their nutrient management plans are meant to address pose a significant hurdle to the proper implementation of the regulations in all three states.

iv. Agricultural institutions did not appropriately acknowledge their role in creating the soil phosphorus concentration problem

One additional aspect of the challenge to define the environmental and policy problems underlying the *Pfiesteria* focusing events was the issue of government responsibility and government capacity to admit wrongdoing. Two quotes below from policy stakeholders demonstrate the indignation expressed by many farmers in all three states for the way their governments handled the problem diagnosis stage.

Jim Beloite, Virginia's Extension specialist in Accomack County, pointed out that the land grant universities and the departments of agriculture should have acknowledged their roles in promoting practices that accidentally created a phosphorus problem.

> "Virginia's manure application recommendations were 3 to 5 tons per acre in the past. Now they said you can't put out as much manure as you used to – just a ton and half per acre. Changing (from a voluntary approach) to regulations meant the state was wrong. But nobody was gonna admit they were wrong."

About a year after the WQIA passed, Maryland Agriculture Secretary Lewis Riley resigned from his position, returning to his farm as a full-time farmer. Addressing the "Maryland Ag Dinner" in 2000, Riley concluded that the state should have acknowledged some responsibility for the problem and that an updated voluntary approach would have been a better alternative, given the success of the voluntary nutrient management program in Maryland:

> "We put 1.1 million acres under voluntary plans with nitrogen. Why didn't the state simply come back and say, guys we've got a problem with phosphorus, we need to figure it out. Let's add a P component to these nutrient management plans, voluntarily, you did such a good job with N, let's do it with P…I think that most farmers are insulted, just by the very fact that the state hasn't really stood up and acknowledged their role in this thing." (Paolisso and Maloney, 2000)

Both quotes underscore the conundrum the state was in. On the one hand, the state could have admitted part of the blame for the excess soil phosphorus condition and pursued a voluntary program approach. But on the other hand, the state thought that a voluntary approach was inferior to a regulatory approach because, despite the assertions by Riley above, it was voluntary and thus would not be able to compel sufficient participation rates. In actuality, Riley's statistic above obscures the reality that though Maryland's voluntary nutrient management program did over the life of the program cumulatively have 1.1 million acres under voluntary N-based plans, only about 200,000 acres or so at any given time were under a current plan.

v. Chasm of understanding the problem remains between "the state" and the regulated

As demonstrated in this dissertation, as of 2006, many farmers in all three states continue to resist acceptance that there is a major agricultural-environmental problem and do not accept most basic and modern scientific facts related to nutrient management. On the one hand, farmers cannot understand how agriculture is a major source of nutrient pollution if farmers are inherently against nutrient pollution because they can't afford to waste nutrients or money. Farmers feel they participated in the voluntary programs in good faith and thus they had "done their part" and had "come a long way" since the early days of "dumping manure in the woods." More importantly, the problem wasn't of their own making; they were just following what Extension and the Districts told them to do: "applying manure at a nitrogen rate would save you money." No one told them that practice was creating a phosphorus problem and they were told that if they managed their soil erosion, which they do, that phosphorus wouldn't be an environmental problem.

Finally, farmers were shocked and embarrassed by the attacks they felt the media, environmental groups, and policy makers were making against them. They felt these attacks amounted to calling them both careless and intentional polluters and questioned their integrity as "stewards of the land." These direct attacks, as Paolisso and Maloney would put it, questioned their morality and made farmers feel shamed and a loss of face.

On the other hand, there remains a wide gap between good nutrient management and what most farmers in this dissertation report they are doing. This gap suggests that the scientific community has not successfully explained how much money farmers are currently losing with their nutrient approaches nor has fully explained the environmental effects of not better managing nutrients.

9.3. Capacity to Deliberate Regulatory Solutions: Different Among States

To analyze the political processes and relative negotiating power of the agricultural and environmental stakeholder groups in the three states, I draw on several theories to help explain why each state responded the way it did to the *Pfiesteria* focusing events.

Scholarship by Montpetit and Coleman (1999) provide political analysis insights into the agricultural and environmental groups' a) policy community membership, b) policy network structures, c) policy feedback, and d) modes of negotiation that help explain why

Maryland chose more regulatory requirements than Delaware. In contrast, Virginia's political and policy development approach resists explanation by Montpetit and Coleman's theories.

Wilson's (1995) insights into cost-benefit typology suggest that Maryland's political process resembled "entrepreneurial politics," while Delaware's process could be considered "clientele oriented politics;" Virginia demonstrates some of both typologies.

Shover et al.'s (1986) explanation that the high level of deference Delaware and Virginia afforded the regulated industries ensured that these two states would carry out a "negotiated" regulatory style that affected all policy stages from statute formation to rule application. Maryland's initial low level of deference to the regulated community in the early stages of the policy process explained their "enforced" regulatory style. Later in Maryland's implementation and enforcement stage, however, greater deference was given to the regulated community, resulting in a negotiated style resembling Delaware and Virginia.

Lowi's (1964) observations about protective environmental regulatory policy processes and the role of Congress as broker between the regulated and the regulators only accurately reflected the political process in Delaware, but did not reflect what was happening in Maryland or Virginia.

Regarding the theories by Montpetit and Coleman, the authors do not explain whether the different levels of agricultural-environmental policies in their study areas of Quebec and Ontario are more or less effective at getting farmers to implement best management practices or whether either province has evaluated the environmental impact of their policies. In addition, they do not indicate whether either province selectively regulates portions of the agricultural sector or if all farmers subject to some form of environmental regulation. Finally, the authors ignore the role of policy makers such as those in the chief executive office or legislative branch of government and focus only on the agricultural and environmental ministries. Nevertheless, their four-point theory is useful in explaining the level of comprehensiveness and intrusiveness of the regulations of the three states in this case study. Montpetit and Coleman define comprehensiveness as the range of required agricultural practices and intrusiveness as the required degree of change in the agricultural practice.

As discussed in Chapter 7, though there were three practices that all three state nutrient management laws required of their regulated farmers, Virginia went further, requiring six more practices than Delaware and four more practices than Maryland. In contrast, the regulations in both Maryland and Delaware were far-reaching, regulating nearly practically all farmland and thus nearly all farm operators. Virginia's law was very constrained in its reach, regulating only the poultry industry and leaving the super majority of farmland in the state unregulated.

Montpetit and Coleman suggest the differences for these more or less comprehensive and intrusive agro-environmental policies between states can be attributed in part to the "membership of the policy community," that is, how much involvement the ministries of agriculture and environment play in regulating the agricultural sector and whether farm and environmental stakeholder groups are present in the policy discussions. In addition, their theories on "policy network structures" focus on the relationships between the stakeholder interests and the state institutions to determine the institutional framework for formulating agro-environmental policies. The authors also point to the importance of "policy feedback," which will be discussed in greater detail in later sections in Chapter 9, but in brief is the tendency of policy makers to maintain "path dependence," that is, to be influenced by policies of the past. Finally, the authors explain that the "mode of negotiations" reveals whether the dominant stakeholders and ministries share or have divergent missions and may involve what they refer to as "monetary side-payments" (also known as financial assistance or cost-share) in exchange for greater regulatory requirements.

Maryland

Throughout Maryland's pre-legislative, legislative, and regulation-writing phases, the political process was dominated by environmentally friendly policy makers and environmental groups who enjoyed greater political power than farm groups and farmer-friendly legislators. These elite members of the Governor's office, the General Assembly, and the stakeholder groups held the reins of decision-making and policy-development very tightly and were skeptical of the regulated community who were insisting they were innocent of any wrongdoing and that a voluntary approach would be more effective. This lack of deference to the regulated community highlights Shover et al.'s "enforced" regulatory style. In addition, the active leadership role played by Maryland's Governor reflects Wilson's typology of entrepreneurial politics that often arises when costs are concentrated among very few people (farmers) while the benefits (of a cleaner Bay) are distributed among many people.

Regarding Montpetit and Coleman's "policy community membership," all expected stakeholder groups and institutions were present at the policy-making table in Maryland. However, the relationships between stakeholders, the institutions, and the policy makers in the “policy network structure” were strained. In particular, neither the Maryland Department of Agriculture nor the Department of Environment wanted the responsibility of carrying out the regulatory program. MDA officials and staff did not want to become regulators despite farmers preferring MDA over MDE. MDE officials and staff did not want to expand the agency’s existing tiny CAFO regulatory program or shift its primary focus from urban regulatory activities to agricultural nonpoint sources in which they felt they had very little expertise. Thus, rather comically, though the MDA and MDE had divergent missions, they shared a common disinterest in becoming farm regulators. Most importantly, the Governor’s office and most of the environmentally oriented Legislature and environmentalists did not trust MDA to regulate its own constituents. Thus, MDA was in between a rock and a hard place wherein it was a member of the policy community but they were very reluctant, uncomfortable, and uncertain members.

Maryland’s political process demonstrates that Lowi’s (1964) explanation about the role of Congress as a broker between the regulated and the regulatory agency does not apply. Lowi pointed out:

> “Because businesses resist regulation while regulatory agencies insist that they are acting in the public interest, protective regulatory policy tends to be highly contentious…
>
> Decisions are reached based on negotiation and compromise, because in most cases, neither business nor the regulators can entirely dominate policy making; Congress and its committees are often put in the position of broker, mediating between the goals of the regulatory agency and business interests.”

Since the Maryland General Assembly was divided in their support for a regulatory approach, with many legislators siding with the Governor and environmental groups while other lawmakers sided with the farm groups, the role of broker was played reluctantly by MDA. Given the conundrum MDA was in about trying to protect the farmers it had worked to support over the decades from a regulatory approach, it was also aware of the proverbial “writing on the wall” that the time had come for a regulatory option and many MDA staff were admittedly aware of the inadequacies of the long-time voluntary approach.

Regarding Montpetit and Coleman’s “policy network structure,” though all Maryland farm groups can concede they were members of the policy community, there were mixed reviews over whether farm groups had adequate input into the legislative and regulatory stages of the policy development process.

When I asked Maryland Farm Bureau President Earl Hance why there appeared to be significantly different and negative opinions from Maryland farmers about their law versus opinions from Delaware and Virginia farmers, who seemed to be content or at least resigned with their laws, Hance said:

> “The biggest difference was the policy-making process. In 1998, farmers weren’t involved in drafting of the bill. In Delaware and Virginia, the farming community was requested to participate in drafting the bill. In Maryland we weren’t asked. The Governor didn’t seem to care what the farmers thought of the law.”

In contrast, there are two first-hand accounts that provide a different perspective on the level of involvement that members of the farm trade associations had during Maryland’s policy-making process. Both of these countering views suggest that farmer views were adequately represented during both the legislative and the regulatory development process. However, *both* stories suggest that the Maryland Farm Bureau chose to play an obstructionist role during these policy stages.

One current representative of the Maryland Department of Agriculture who was then a lobbyist on the WQIA for an agricultural trade association pointed out that farmers were at least involved during the legislative negotiations. In addition, this lobbyist commented that the elite members of the farm trade associations did not manage their membership's reactions as well as he thinks they could have to reduce the backlash (emphasis mine):

> "During the mark-up of the House bill, there were things that the Senate bill didn't have in it like the manure matching service and the transport program so they went into Conference Committee which was unprecedented. They usually work out the details between the committee staffs. And **this was the first time** that the **stakeholders provided input** into the conference committee. They were all there: Chesapeake Bay Foundation, Sierra Club, Royden Powell (representing MDA), Farm Bureau, DPI, and me.
>
> In my 13 years prior to this, I've never seen anything like it before. So for the ag organizations to say that they weren't a party to the development of the WQIA, that's not true. They were there. I get upset when farmers balk at the law. I tell them, listen, **Farm Bureau participated**, as did other organizations.
>
> I don't think there should have been the upheaval that there was. **Farm Bureau didn't do anything to limit the reaction**. They could have said, **'This was inevitable, and we're going to make the best of it.**' They **could have done more to mitigate that.**
>
> During the regulatory hearings and public meetings on the regulations, Farm Bureau just sat there while farmers were yelling and were upset. There were three of four meetings on the proposed regulations and the programs and Farm Bureau just sat there." (Anonymous, personal communication, August 22, 2006)

According this lobbyist, lawmakers went out of their way to invite the stakeholder groups into the conference committee process to negotiate the final details of the bill. The lobbyist's analysis of the events indicates that Maryland Farm Bureau representatives demonstrated weak leadership in not trying to contain the backlash from their members.

To their defense, by being silent during the regulatory hearings, the Maryland Farm Bureau may have been trying to accurately represent the angry and negative views of their members by letting the members speak freely and directly for themselves in the open forums. However, during the legislative phase, recall the story from Chapter 5, which revealed there was a distinct rift between the central leaders of the Farm Bureau that tried to work productively within the legislative process and the county presidents that wanted them to resist any regulatory proposals. This tension regarding the appropriate way to represent farmers in Maryland appears to have some leaders of Farm Bureau insisting that regulations were not justified, obstructing the regulatory process, and not trying to calm tempers, while other leaders of the Farm Bureau (who believed the regulations were inevitable), tried to engage as constructive players. Thus, the leadership of the MFB was confused over the choice to "fish or cut bait" – contribute to making the best of the regulatory policy for farmers or protest it.

Montpetit and Coleman explain that Quebec has more comprehensive and intrusive requirements for their agricultural sector because of the divergent missions of the environmental and agricultural ministries. Given this divergence, Quebec recognized the importance of sharing the distribution of cost and benefits of agro-environmental policies by providing monetary side-payments in exchange for more intrusive state regulation.

Thus, given the divergent missions between the Maryland environmental stakeholders and legislators and the agricultural stakeholders and their legislators, it is surprising that the 1998 WQIA did not result in greater "side-payments," that is, financial assistance than it did. Recall that there were many and significant new grants established for various scientific studies by the WQIA; the poultry integrator companies were required to provide 50% of the manure transport funds; and a $4,500 tax credit was offered for farmers facing new commercial nitrogen purchases from phosphorus management. However, the nutrient management planning cost-share program was only established in the amendments to the WQIA in FY2000. This suggests that the Governor's "power of the purse" was not used to a great extent to assist farmers in complying with the nutrient management law.

After the WQIA passed, during the regulation-writing phase representatives of both agricultural and environmental groups participated as members of the Nutrient Management Advisory Committee, which offered suggestions to the Interagency Nutrient Management Committee that was developing the regulations. Thus, Maryland's regulatory "policy network structure" kept the elite members of the farm and environmental groups at arms' length from the departmental representatives actually writing the regulations. This indirect participation in the regulatory phase made farmers feel left out, as Hance pointed out:

> "Farmers were included marginally to draft the regulations that would impact us tremendously. Most people knew that the impact of anything we might do on the Bay would take a long time. There seemed to be a rush to get regulations in place without forethought on the impact on the industry. People always assume there will always be farmers and it's not true." (Hance, November 18, 2005)

Hance pointed out that the rushed process of regulation writing and the excessively fast implementation schedule established in the statute reflected the lack of deference to the agricultural community's needs and/or opinions on whether the schedule was realistic and could be achieved. To the farm groups, these were all signs that other stakeholders in the process did not care about the likely negative economic impact the regulations would have on farmers.

In contrast, a University of Maryland nutrient management specialist (who asked to remain anonymous) that was a member of the Advisory Committee said that the “bad behavior” they witnessed the Farm Bureau and DPI exhibiting at the hearings and public meetings continued at the Committee meetings:

> “These meetings were ‘highly contentious…Farm Bureau and DPI wouldn’t give an inch…They refuted all the scientific evidence we had on phosphorus build up in the soils and made deciding on the phosphorus regs so painful…You had the enviros on one side wanting the world and the ag groups on the other side giving nothing. People were screaming and yelling.”

It appears the main fight the farm groups were involved in during the regulatory development stage was still over the science rather than constructively developing a regulatory program that was implementable.

Thus, theories on policy networks by Montpetit and Coleman and theories about regulatory style and the degree of deference given to the regulated group by Shover et al. do help explain why Maryland’s nutrient management law was dubbed “the most comprehensive in the country:” it was the first time any state had required nearly all farmland to be operated under a nutrient management plan.

However the theories do not fully explain why the number of practices (comprehensiveness) and the degree of change required by those practices (intrusiveness) puts Maryland’s WQIA in the middle position after Virginia’s PWL and before Delaware’s NML.

Virginia

In Virginia, like Maryland, the elites of the Legislature and the elites of both farm and environmental stakeholder interest groups were members of the policy community and actively involved in deliberating a regulatory solution. The Chairman of the House Sub-

Committee on Environment, Delegate Tayloe Murphy (D-Warsaw), initiated the conversation about a regulatory response to the *Pfiesteria* events, drafted the first bill that would become law, and was involved in the regulation-writing phase.

The farm interest groups, led by the Presidents of the Virginia Poultry Federation, the Virginia Farm Bureau, and the Virginia Agribusiness Council, and the environmental interest groups led by the Virginia Chapter of the Chesapeake Bay Foundation and the Southern Environmental Law Center, were integrally involved in the policy-development process.

As is not uncommon in the Virginia legislative process, the House-passed bill could not find a mate in the Senate Committee on Agriculture. Thus the Committee proposed that the matter be carried over into the next session and that all interested parties continue to negotiate over the summer.

Demonstrating an entirely different policy network structure than Maryland, the legislative policy entrepreneur and the leaders of the key stakeholder farm and environmental groups and the Department of Environmental Quality that carries out the Virginia Pollution Abatement Permit program for dairy, swine, and beef operations continued to meet with each other throughout the summer in Virginia. All throughout the fall of 1998 and into the spring of 1999, these stakeholder groups had a seat at the negotiating table. Hobey Bauhan, President of the Virginia Poultry Federation, explained his recollection of the positive tone of the policy-making process (emphasis mine):

> "In the summer of 1998, the Poultry Federation entered into negotiations with CBF and Delegate Murphy. And by the end of the fall of 1998, we agreed to compromise legislation. The General Assembly adopted that legislation in 1999. The die was cast that it would be a regulatory program. The regulations took two years to write.

> Since the bill passed there has been a strong measure of cooperation between the poultry industry and between DEQ and DCR to educate the industry on the requirements and work cooperatively. So maybe Virginia's a mix of Maryland and Delaware. We (VAPF) **started out very contentious but then ended up working very cooperatively**." (Bauhan, personal communication, June 27, 2005)

In contrast to this favorable review of the policy process, wherein the Virginia Poultry Federation felt like they were an equal party to the deliberations, the Chesapeake Bay Foundation and Delegate Murphy likely felt shortchanged at the negotiating table.

When I asked Jeff Corbin of CBF's Virginia Office whether he felt the agricultural interest groups had more of an upper hand during the policy-making process in Virginia, Corbin said:

> "Absolutely the ag interest groups had more power and had upper hand. I don't mean to be derogatory but they are well-connected to the legislature and they're a big industry and people listen to them."

When I asked him further, "why do people listen to them?" Corbin said,

> "Part of it is because we're a more conservative state. And parts of Virginia are dominated by poultry and those government officials listen to what the ag officials tell them. The reality of it is they are a strong lobbying and political force in Virginia. They are a huge piece of the economic sector in the state and the poultry industry is the biggest part of the ag sector. Most people are surprised to know that ag and forestry is the biggest economic sector in the state; they're about an $80 billion business. That's what still amazes me to this day is that the poultry industry has gotten a fair amount of exposure over the years but if you ask the average Virginian where most of the country's turkeys and chickens are raised, they won't say here. But we're sixth in the nation!" (Corbin, personal communication, March 10, 2010)

At the last minute during the legislative negotiations, on the issue of what rules would govern poultry manure leaving the generating farm and being used by an unregulated non-poultry grower, the Department of Environmental Quality sided with the Poultry

Federation and the Farm Bureau saying, “The Department believes that improving more regulations and tracking requirement on manure would lower its value as a fertilizer creating a ‘market disincentive’ for farmers to put poultry wastes to good use” (Frohm in Harper, November 11, 1999). Thus, despite having divergent missions, the environmental agency and the regulated industry were able to agree on this point.

The environmental groups and the bill’s policy entrepreneur were very disappointed by the results of the negotiations and felt that they were not involved in these last minute discussions. CBF’s Jeff Corbin said, “We got out-lobbied” (Edwards, December 13, 1999), while Delegate Murphy denied that the DEQ had consulted him about their last minute decision.

These examples suggest that the policy-making process, like beauty, may be in the eye of the beholder. That is, whichever party feels like it’s getting the short end of the stick (e.g., the Farm Bureau in Maryland and the Chesapeake Bay Foundation in Virginia) perceives the policy-making process as unfair. As the policy winner in Virginia, VAPF’s Bauhan described the process as initially “contentious,” likely owing to the fact that there was confusion about which farmers would be required to do what. But in the end, despite it taking two years of wrangling, Bauhan viewed the process as “cooperative,” likely owing to the fact that vast majority of PWL’s members would not feel much regulatory constraint. Given that Bauhan would describe Virginia’s policy-making process in a press statement to his grower members as a “negotiated compromise,” the amount of deference the regulated industry was able to achieve in Virginia resembled Shover et al.’s negotiated regulatory style.

As was the case for Maryland, Lowi’s positioning of Congress as the broker between the regulated and the regulators does not reflect the events in Virginia, since the Virginia DEQ found itself as the broker between Delegate Murphy and CBF on one side and the farm trade associations on the other.

Thus, Virginia farmers were well represented by the leadership of their various trade associations at the policy-development and regulation-writing tables. Virginia was able to limit the backlash against the law by limiting the law’s reach to only one small sector of farmers. Furthermore, it is likely that only 30% of the members of the Virginia Poultry Federation that were regulated by the Poultry Waste Law really felt any regulatory burden, because they were crop farmers, while the remaining 70% had to only deal with the Waste Transfer requirements. The majority of the membership of the Virginia Farm Bureau – farmers that do not use poultry manure – were unaffected by the proposed regulations.

Thus, again, Montpetit and Coleman’s theories do not help to explain why Virginia was able to enact a law that regulated only a tiny fraction of all cropland in the state nor why Virginia’s law ranks first in the comprehensiveness and intrusiveness of the practices that the regulated poultry growers who farm are required to implement. According to Shover et al.’s theories, Virginia’s policy process more closely resembled a negotiated regulatory style rather than an enforced style because of the significant amount of deference given to the regulated community in both the legislative and regulatory stages. That is, Delegate Murphy decided to only propose a law to extend the existing VPA permit program to poultry growers instead of a far-reaching law like that of Maryland. And during the regulatory stage, VDEQ was convinced by VAPF’s arguments that tracking manure off the farm would strand manure at the generating farm. Thus, given this deferential treatment, according to Montpetit and Coleman's analysis, Virginia's regulatory requirements should have resembled the less comprehensive and less intrusive requirements of Ontario and of Delaware.

Instead, perhaps Virginia made up for the tiny regulatory reach of its PWL by requiring comprehensive and intrusive practices. Virginia requires six more practices that Delaware and four more practices that Maryland. And, Virginia's manure application timing restrictions are more restrictive than those in Maryland, though its manure testing frequency is less stringent than Maryland's.

Furthermore, perhaps this bargaining between the option of a) limiting the reach of the regulations to just one animal industry and b) requiring a fraction of those regulated facilities to have numerous and intrusive requirements eschewed Montpetit and Coleman's theory that monetary side-payments are necessary to accept government intrusion. That is, Virginia's regulated community did not demand a large nutrient management planning cost-share program and preferred not to have a cost-shared manure transport program. On the latter issue, it is likely that the regulated community preferred its informal, unregulated manure market to the oversight that would accompany a government-funded manure transport program.

Delaware

Delaware's government capacity for deliberate regulatory solutions to agricultural environmental problems was very different from Maryland and Virginia's capacity. Right from the start, the Governor's office and leaders at the Delaware Department of Agriculture and Department of Natural Resources and Environmental Quality (DNREQ) decided that in order for Delaware to deal with agriculture, they “had to get farmers to deal with themselves.” John Hughes, then Director of the Division of Soil and Water, said, “We had to deal with farmers; we had to meet with them, listen, involve them versus take a strident regulatory position” (Hughes, personal communication, August 23, 2006). Thus, Delaware displayed an immediate and significant amount of deference to the regulated community, demonstrating Shover et al.’s negotiated regulatory style.

Elite members of the Governor’s Office and DNREQ met with elite members of the farming community to agree to form an Advisory Committee. Then-Governor Carper appointed 10 farmers to the Committee to develop a legislative proposal. Hearing that the state was under serious pressure from the EPA to develop a CAFO program, and that Maryland and Virginia had responded to *Pfiesteria* with regulatory approaches, the Committee decided that a regulatory approach was unavoidable.

The committee envisioned a new quasi-government agency to carry out the regulatory program, effectively bypassing the government capacity at the Delaware Department of Agriculture and at DNREC. Taking the suggestions of the farmer advisory committee into account, Representative Wally Caulk, then Chair of the Agriculture Committee and now Delaware Farm Bureau Administrator, drafted the bill with input from DNREQ and the Governor’s Office. Caulk then circulated the draft of the bill to the various farm trade associations for their input and feedback.

Delaware’s process slightly resembles Lowi’s positioning of Congress in-between the regulated and the regulators, with Chairman Caulk and colleagues on the state Agriculture Committee serving as the broker between all parties. However, unlike the polarized sides to the negotiations processes in Maryland and Virginia, where agricultural stakeholders and legislators were on one side and environmental stakeholders and legislators were on the other, it appears that there weren't such distinctions in Delaware, owing to "the Delaware way." In fact, until the formation of the Nutrient Management Commission, which provided two seats to environmental group representatives, it seems that environmental groups were not members of the policy community.

Delaware's policy network structure was significantly different than in the other two states. Indeed, by establishing a brand new and only quasi-governmental agency to develop the regulations and run the regulatory program, Delaware effectively likely forced the existing environmental and agricultural governmental agencies into the background of the process of regulating farmers. This situation resembles the description provided by Montpetit and Coleman regarding Ontario, wherein the main provincial environmental law does not provide the environmental ministry with "agro-environmental" responsibilities.

Once again, though the Delaware agricultural and environmental agencies have divergent missions, because of the "Delaware Way" and because the state allowed first a committee of individual farmers and then the legislative Committee on Agriculture and the trade associations to develop the law and dominate the membership of the regulatory body, the Ontario experience largely applies to Delaware's experience. In Ontario, the agriculture ministry and the coalition of farm organizations share "convergent strategic objectives" that is, "to increase value-creation to farms" and "focus on sustaining farmer incomes." These convergent missions helped emphasize "self-regulation and less intrusion into farming practices." This accurately reflects the fact that the law and the regulations developed by the DNMC require the least comprehensive and intrusive practices from the regulated community. However, unlike Ontario, wherein payouts to farmers pale in comparison to those in Quebec, Delaware's farmers benefit from large side payments, that is, financial assistance. About 80% of all compliant farmers in the state take advantage of the cost-share program to hire a private planner and the manure transport program has received increased funding year after year such that Delaware believes they have effectively solved their excess manure problem.

9.4. Capacity to Design Effective Regulatory Solutions: Limited in All States

The *Pfiesteria* focusing events captured public concern sufficiently for policy makers who have long preferred a regulatory approach to agricultural nutrient pollution to effectively "get their way." The focusing events helped overcome the cultural and political hurdles that prevented treatment of farmers as regulated targets rather than voluntary program participants. However, the very nature of focusing events does not lend themselves well to calm, thoughtful, and constructive policy development.

Breyer notes that focusing events tend to lend a "panic-stricken character" to regulatory policy-making. Pierson (2000) suggests that the policy options of the past tend to keep policy makers on a "path dependence" of recycling previous policies. Kingdon reminds us that human beings are limited in their ability to rationally and comprehensively make decisions. Lindblom contends that incremental policy-making is understandable.

The *Pfiesteria*-related fishkills appeared to pose an alarming health crisis given thousands of fish had died and fisherman and scientists had reported feelings of nausea, headaches, and short-term memory loss from contact with the dead fish. However, the focusing events also afforded a political opportunity for a second-term Governor who appeared to be struggling in the polls. According to one Maryland policy stakeholder:

> "It was really Glendening's aggressiveness that drove everything. Glendening was having a hard time connecting with voters. He was not popular and having a hard time finding an issue to connect on. Late in June 1997, the Bay people and the Cabinet staff were saying, 'There isn't a problem.' But he was looking at pictures of rockfish with lesions and said, 'Don't tell me there isn't any problem.' He got a positive public response by his taking an aggressive stance and that pushed him further and further along. He finally found something that he could get a decent approval rating on. He's an arrogant, egotistical so and so and I voted for him twice!" (Anonymous, August 2006)

The pressure to act decisively and respond adequately to what appeared to be a serious health and environmental scare did not allow for meaningful policy deliberation. Thus, when the Blue Ribbon Commission recommended all farmers should be required to obtain and follow nutrient management plans, there was surprising little public debate about the enforceability of mandated plans or the adequacy of plans to effectively solve Bay problems or prevent *Pfiesteria* from happening again.

Indeed, Pierson (2000) describes this condition as path dependence wherein, "once a country or region has started down a track, the costs of reversal are very high. There will be other choice points, but the entrenchments of certain institutional arrangement obstruct any easy reversal of the choice."

Many proponents in the Maryland Legislature and in the environmental community of a regulatory response to the *Pfiesteria* fishkills appeared to have been motivated by the opportunity to finally regulate agriculture after failed attempts in the early 1990s. This unfulfilled policy preference to regulate agriculture likely short-changed the policy deliberation process since the policy makers simply recycled the failed regulatory proposals of past legislative sessions (1992, 1993, and 1994) that mandated use of a nutrient management plan.

During the two months that the Maryland Blue Ribbon Commission held hearings with expert witnesses, the Commissioners did find out that nearly 60 and 80% of farmers in the Pocomoke watershed and the Lower Eastern Shore did have a nutrient management plan. However, the Commissioners never asked whether farmers in the voluntary nutrient management plan program follow their plans or whether the plans "work" to lower nutrient application. Nor did the policy makers focus on the potential hurdles to getting farmers who hadn't participated in the voluntary program to accept and follow nutrient recommendations in a mandated plan.

Though the results of the Smith study were not ready for presentation to the Commission, there could have been sufficient anecdotal evidence from the Extension and Conservation District communities to share that a) farmers more closely adhere to plans prepared by private planners than to those by public planners and b) that private planners tend to recommend more nutrients than public planners.

However, because the agricultural institutions did not want to be seen as promoting a regulatory approach, they likely kept their opinions to themselves. And, even if they had been asked about the feasibility of a plan-based regulatory approach, the two-month time frame given to the Blue Ribbon Commission to investigate the problem and recommend solutions left very little opportunity to debate the pros and cons of requiring nutrient management plans or an opportunity to debate the merits of alternative regulatory requirements.

Kingdon (1995) reminds us through the works of other political analysts (March and Simon, 1958; Lindblom, 1959; Wildavsky, 1979) that policy makers are incapable of "rational, comprehensive decision-making."

> "If policy makers were operating according to a rational, comprehensive model, they would first define their goals rather clearly and set the levels of achievement of those goals that would satisfy them. Then they would canvass many (ideally, all) alternatives that might achieve these goals. They would compare the alternatives systematically, assessing their costs and benefits, and then they would choose the alternatives that would achieve their goals at the least cost."

Kingdon summarizes the reasons developed by the other scholars on "why such a model does not very accurately describe reality," given that a) human beings are simply much more limited in capacity than this idealized approach, b) they are unable to canvass many alternatives and cannot compare them systematically, and c) they do not usually clarify goals, and in some cases doing so would be counterproductive when trying to convince others of their policy preference regardless of whether they can agree on the goals.

Indeed Charles Lindblom in his famous tome, "The Science of Muddling Through," defended the incremental approach to policy-making, as described here by Kingdon:

> "Instead of beginning consideration of each program or issue afresh, decision makers take what they are currently doing as given, and make small incremental, marginal adjustments in that current behavior. By taking that tack, they need not canvass formidable numbers of far-reaching changes, they need not spend inordinate time defining their goals, and the comparisons they make between the current state of affairs and the small adjustments to be made in current behavior are entirely manageable. The result is that policy changes very gradually, in small steps."

Thus, the Blue Ribbon Commission and the legislative debates in all three states did not establish goals for their legislative proposals nor did they adequately discuss many alternative regulatory proposals (other than voluntary approaches in Maryland). Aside from a goal of requiring all eligible farmers to obtain and follow a nutrient management plan, none of the states explored what they could expect should that goal be realized. That is, there were never any performance goals nor any environmental goals associated with the prescriptive goal of requiring nutrient management plans.

Policy makers did not ask, “How much nitrogen and phosphorus can we expect to be reduced from fertilizer purchases?” “How much manure might need to be transported because of reduced manure application rates?” “How much N and P loss to the environment might be reduced from the various practices required in the legislation?” “Will we be able to tell a difference in local or Bay water quality because of the law?” or “When and how will we know our laws have worked?”

And, because of the “panic-stricken character” of focusing events and as Kingdon and Lindblom contend, human beings even under the best circumstances are limited in their ability to rationally canvass alternative options and effectively weigh those alternatives.

For example, neither Maryland nor Virginia sought to discuss how to regulate farmers needed to achieve their existing Chesapeake Bay Agreement Tributary Strategy goals. Maryland’s infamous “Table 2” in its 1995 Report, *Maryland's Tributary Strategies for Nutrient Reduction: A Statewide Summary,* listed the number of acres and units of best management practices needed from the agricultural sector, but making some of those practices mandatory was not discussed.

Will Baker, CBF President remembered:

> “At the time, we didn’t have all the numbers for the Trib Strategies. We may have had a list of practices for each sector but we didn’t have the

> exact pounds of reduction numbers. We just knew that we needed a stringent, well-enforced strategy. That's the bottom line. The whole concept of nutrient management plans was never questioned. People widely agreed that they were beneficial." (Baker, personal communication, March 10, 2010)

None of the states took the opportunity to discuss ways to improve the targeting of the voluntary conservation cost-share programs. Neither did any of the states open up debate on the mandatory adoption of simple and verifiable best management practices. And, none of the states discussed how to increase the likelihood that farmers would follow their nutrient management plans by offering a "yield insurance" program against potential financial losses that might occur from lower nutrient application rates.

Likewise, none of the states considered solutions to the problem of poultry integrators telling their growers to conduct Total Clean Outs of the chicken houses in winter months. Also not on the list was requiring growers or poultry integrators to have second or third manure sheds to ensure sufficient capacity to store Total Clean Out litter in winter. And, though the "nutrient imbalance" problem on the Delmarva Peninsula was discussed, a regulatory policy option to achieve a Peninsula-wide "nutrient balance" was not.

9.5. Capacity to Implement Regulatory Programs: Limited in All States

Mazmanian and Sabatier (1989) represent the "top-down" approach to implementation policy analysis theories and posit that there are six conditions that should be satisfied to ensure effective implementation of a policy. Farber (1999) and others who focus their attention on the "bottom-up" analysis suggest that what's most important in implementing a program is the interaction between the network of actors implementing the law and the regulated targets or clients they are serving.

This section of Chapter 9 will reveal that the first two of the six factors considered important for effective policy implementation by Mazmanian and Sabatier were not sufficiently realized in all three states. Then, two of the remaining four factors were experienced differently among the three states, highlighting the differences in government capacity to implement the state nutrient management laws.

Since I find the top-down approach only moderately useful in helping to understand why the implementation phases of some states proceeded better than others, a large part of this section will focus on a bottom-up analysis of the network of actors at the local level involved in carrying out the regulatory programs.

I will start with the degree to which key government institutions in each state had to change their mission and institutional identity to carry out the regulatory program. Then, because all three states lacked sufficient government capacity to write plans for all the regulated farmers, I will analyze the advantages and disadvantages of regulations implemented by both the public and private sector. This will lead to a discussion of the necessity of public financing to implement the law. Finally, I will close this section with a discussion on policy and government capacity to educate the regulated community about nutrient management.

a. States do not satisfy all the top-down conditions to ensure proper implementation of their laws; of the conditions that are satisfied, states differ in their capacity to implement regulatory programs

Mazmanian and Sabatier contend there are three factors involved in successful implementation of a program that include enacting a policy with 1) clear legal objectives, 2) satisfactory causal theory, and 3) an implementation process that is structured adequately to enhance compliance by the bureaucracy and the targets of the policy.

Three additional factors address the political and socioeconomic factors during the implementation phase including: 1) implementing officials who are committed and capable of achieving the policy objectives, 2) support of interest groups and political officials, and 3) socio-economic conditions that do not undermine either the causal theory or political support.

All three states failed to achieve the first two conditions of clear objectives or satisfactory causal theory in their state laws mandating nutrient management plans. As described in previous sections of this chapter, all three state laws responded to a focusing event which scientists could only weakly link to agriculture. The causal theory thus was complicated and layered and went something like this: there had been detection of a toxic *Pfiesteria* microorganism, there were fishkills which are often related to eutrophication which is caused by nutrient pollution, and much of the Bay's nutrient pollution stems from agricultural production, and in particular, from poultry manure.

Furthermore, all three states were challenged to convince the implementing institutions and the regulated farmers of the even more complicated causal theory that justified the laws, and their narrative went something like this: "old" science about phosphorus was wrong and old guidance on manure application rates resulted in a high phosphorus concentrations on the Delmarva Peninsula, but only in certain fields with specific hydrologic conditions was phosphorus a clear environmental problem. And again, none of the states adequately spelled out what policy objectives would be achieved once all eligible farmers obtained and followed their nutrient management plans.

On the third factor ensuring successful implementation of a regulatory program, the states did structure different implementation processes. Maryland's WQIA designed a policy that ensured neither the bureaucracy nor the regulated targets would be able to meet the deadlines for compliance. Though 3.5 years until the first deadline appeared to some environmentalists and policy makers as very generous, because Maryland had to determine who was eligible for compliance from the unknown but large regulated population and had yet to determine regulatory standards let alone update plan-writing software, and train and hire planners, the schedule in hindsight was unrealistically fast.

In contrast, Delaware's NML ensured that its small bureaucracy, the private sector, and the regulated targets would be able to easily meet the first deadline four years after enactment, only required portions of the regulated population to come into compliance over a phased-in time period, and encouraged early compliance with financial incentives. Delaware's phased-in schedule reflected the input that private planners had in the process, who were able to communicate their preference for a distributed workload over many years.

Virginia's PWL was even more successful at devising an implementation process that would work because a) the jurisdiction of the regulation was restricted to only one animal industry that in effect had already practically complied with the law, and b) only a fraction of the regulated population had to get complicated plans. Because the voluntary five-year phase-in agreement signed in 1995 between the poultry integrators, the poultry trade association, and the poultry growers had been nearly accomplished by the time the 1999 PWL was enacted, it was relatively easy for all that had to obtain actual nutrient management plans to do so.

Regarding the remaining three factors, I found that there were no socio-economic conditions that undermined the causal theory or political support, though the skepticism and cynicism that *Pfiesteria* was real or the fishkills were linked to agricultural production remained many years after program implementation began. I found that there were major differences between the states in the amount of support they received from the interest groups and political officials.

Delaware's regulatory program enjoys the support and blessing of the agricultural and environmental stakeholder groups, the public officials, the agricultural and environmental departments, the agricultural support community (Extension and the Districts), and private and public planners. By and large, Maryland's regulatory program does not receive favorable reviews from any stakeholder group, with many public and private planners expressing a certain amount of "negative energy" and tension about the program. However, as will be demonstrated shortly, some public planners seem to be generally positive about their ability to write effective plans for farmers. Representatives from MDA reveal varying levels of pride about how far their program has evolved over time and what they have been able to accomplish in spite of the early backlash, while others at MDA reveal continued cynicism that there is any need to regulate farmers at all. Virginia's regulatory program continues to receive support from the agricultural stakeholders but, as will be described in Chapter 11, the environmental groups and the environmental agencies have been dissatisfied with the limited authority over manure that leaves the generating farm.

Finally, I found that all three states had leaders and program staff at the implementing agencies that were committed to realizing the statutory goals of their regulatory programs, but they have all committed to not carry out the penalty options afforded to them in their laws, opting instead to have their staff engage in compliance assistance. Furthermore, it seemed that overall these leaders and staff lacked sufficient capacity to varying degrees and at varying times during the implementation stage.

However, Delaware stands out from the other two states in its decision not to determine if all of its eligible farmers are in compliance and not to pursue any enforcement action against the large fraction of farmers that are not submitting the required Annual Reports. Delaware's Nutrient Management Commission continues to only have two to three full time staff to carry out all the administrative and adherence compliance activities. The DNMC staff only inspects 2% of the regulated population every year. And the DNMC restricts the staff from conducting quality control over the plans prepared by private-sector planners.

b. To implement the regulatory program, only one government agency needed to alter its mission, which hindered its capacity to implement the regulatory program

One of the findings of this dissertation is that for governments to have the capacity to even attempt to successfully implement a plan-based regulatory approach, they need to have the necessary network of committed actors at the local level to implement the program from the "bottom-up."

One major factor in each state’s ability to develop and carry out the regulatory nutrient management program was whether or not the implementing agency had to change its mission or its “standard operating procedures.” That is, it is important to understand if the implementing agencies in all three states had to undergo an institutional identity change, as this process would stall implementation of the regulatory program.

Maryland is the only state among the three in this case study that had to alter its institutional mission. Because the Maryland Department of Agriculture (MDA) was chosen to become the regulatory agency instead of the Maryland Department of Environment, which carried out the state’s point source environmental regulations and the small federal CAFO program, MDA was forced to change its identity from being a booster for agriculture to becoming a regulator. This was and continues to be a challenge for the department.

MDA struggled to do a good job implementing the regulatory program and communicating its efforts to the public and other agency peers through its Annual Reports. At the same time, the department struggled to deal with a resistant regulatory community. The agency experiences a conflict over how strict to be to gain compliance with the basic plan filing requirements without further alienating or embarrassing their constituents.

In addition, the University of Maryland Cooperative Extension Service’s voluntary Nutrient Management Program also experienced an institutional identity struggle. Because these scientists and practitioners had the knowledge and the skills to develop the regulatory infrastructure for MDA’s regulatory program – the UMCES NMP had the scientists to develop the new science and software, the ability to train new public and private planners, and the infrastructure to oversee the new public planners – in effect, these voluntary, university NM Program staff had to implement the regulatory program for MDA.

In Virginia, the two agencies assigned to carry out the regulatory program simply continued what their departments had been doing before the Poultry Waste Law, and thus the new law did not require these agencies assume an identity change. The Virginia Department of Conservation and Recreation (DCR), which runs the state conservation cost-share programs and writes voluntary nutrient management plans for farms, continued with its mission intact. The Department of Environmental Quality (DEQ), which runs the dairy, swine, and beef Virginia Pollution Abatement (VPA) Permit Program, expanded this program by 900 poultry operations. Thus, the new Virginia regulations did not change the existing division of labor or responsibility of each agency.

In Delaware, the brand new Nutrient Management Commission essentially had a "clean slate" to work from as it developed its identity. They were unfettered by any existing institutional identity and thus, unlike MDA that had to "break their mold," the DNMC was free to determine "who they wanted to be."

c. To write the required plans, governments had to rely on both the public and private sector

All three states turned to the private sector to prepare the required nutrient management plans to implement the program. This reliance on both the government and private sector has obvious advantages and disadvantages given the mission of each group of plan writers and given the findings from Smith (1999), Lawley et al. (2007), and this dissertation that there is a significant differences between plans prepared by private and public planners.

Since Maryland hired so many new Cooperative Extension Service planners for each county office, a raft of new, mostly young, mostly non-farmer personnel were put in place to implement the regulatory program. Aside from the age difference and lack of farming background, many farmers felt it difficult to relate to someone new in the county office and thus found it hard to trust the plan prepared for them. There were several comments from Maryland farmers that revealed they thought poorly of the new hires who, in the words of one farmer, "didn't know anything about farming but only knew book learning."

i. New, young public planners faced a challenge to their authority and conundrum in exercising their authority

Several farmers in one of the Maryland counties included in this dissertation gave the excuse that their county nutrient management advisor was late in preparing their plan as the reason they did not possess a current plan. However, when I interviewed this Advisor, he pointed out that several plans were stacked on his shelf ready and waiting for farmers to pick them up. When I asked the Advisor why he didn't get MDA's enforcement staff to help deliver the plans to the farmers, he responded that he did not want to be associated with the "regulators" while he was trying to maintain his identity as a part of the Cooperative Extension Service community, that is, a member of the scientific, educational, and practitioner community. Thus, this planner was in a difficult spot, as through his inability to inform the official regulators of the non-compliance he was enabling it and allowing farmers to take advantage of the situation.

One factor that may have contributed to the dislike of the new staff that were trying implement the regulatory program was their strict adherence to the newly developed software programs that tended to generate technically unrealistic manure application rates. Several farmers told me how mad they got when they saw their public planners recommended manure rates below 1 ton per acre. Rather than interpret this software result as an indication that manure should not be used on those fields with technically unachievable manure application rates, the problem was treated as a software problem. Maryland Inspector Woody Barnes explained that the problem of unrealistic manure application rates actually lay with the private sector planners:

> "When we see nutrient management plans with say, 0.7 ton/ac rates we call Dan Schwanniger (Certification officer) to correct it with the planner because it's unrealistic to achieve that rate. Initially this was the private folks because the new software just spit it out. New consultants will make those mistakes and pass it along to the farmer. Our Nutrient Management Advisors know what they can maneuver around and still meet state standards." (W. Barnes, personal communication, August 22, 2006)

ii. The benefit of a well-established and respected government capacity implementing the regulatory program

As for the long-time Cooperative Extension Specialists, Jenny Rhodes (Queen Anne's County Nutrient Management Specialist) and Eddie Johnson (Wicomico County Agricultural Educator), contend the switch to a mandatory nutrient management program did not negatively affect their good working relationship with farmers. Given that Rhodes and Johnson were well-established members of the Extension community and are well respected by farmers, Rhodes explained that her relationship with farmers has not changed. She did explain, however, that she's busier than she was before the law because of the heavier workload of writing plans and she spends less time working on a one-on-one basis with farmers in their fields because of it.

Rhodes also highlights the benefit of having a well-established and respected government capacity implementing the regulatory program. She explained that when the law was enacted, she continued writing nutrient management plans for the farmers she was working with when the program was voluntary. However, she immediately started using the new Phosphorus Site Index tool to develop the new mandatory plans, which the law did not require until 2004. In addition, Rhodes decided she would convince her farmers to continue updating their plans annually despite the law only requiring updates every three years. She said she did all these things because a) she knew the PSI would eventually be required for her manure users, b) the three-year plans are too convoluted to prepare and follow, and c) manure test and soil test results change more frequently than three years. Because she was able to maintain her good working relationship with farmers, they agreed with her.

iii. Government capacity to maintain diagnostic infrastructure and the challenge of using private labs outside the states

According to poultry grower Carol Morrison, who is also head of the Poultry Worker Justice Alliance, a small association working for better contracts and working conditions for the Delmarva poultry growers, Maryland's Cooperative Extension Service was overwhelmed with requests for pulling soil test samples (C. Morrison, November 29, 2004). It may have been unwise for Maryland to close its University of Maryland Soil Test Lab shortly after the passage of the Water Quality Improvement Act. Although many in the College of Agriculture at UMD said the lab was poorly managed and students could not keep up with the onslaught of new requests for soil test analysis, closing the lab forced farmers to rely on either the nearest soil test labs at the University of Delaware or Virginia Tech University or on private sector labs. In addition, Maryland lost its opportunity to maintain its soil test database and analyze data and determine trends in nutrient concentrations in soils.

The majority of farmers in this case study use out-of-state private sector soil test labs for their soil test analyses, and the analyses also provide nutrient application recommendations. This is one more hurdle to proper plan development because soil test analysis and recommendations from labs outside of Maryland must be converted to conform to Maryland's nutrient policies and certified plan-writing software. In addition, nutrient recommendations that accompany soil tests from outside the state are made by individuals with no primary knowledge of the key conditions important to providing nutrient recommendations, e.g. soil types, climatic conditions, topography, and yield potential. For example, one farmer said he personally believes in Maryland's rule of thumb that it takes 1 pound of nitrogen to raise 1 bushel of non-irrigated corn, but that the A&L Lab he uses for his soil test results recommends 1.1 to 1.3 pounds of nitrogen to raise a bushel of corn because the lab is based in the Midwest, or in the Corn Belt which has far greater yield capacity than the Delmarva Peninsula.

The University of Delaware's Soil Test Lab has remained open and provides soil nutrient analysis and nutrient recommendations to Delaware farmers using public planners and to some Maryland and Virginia farmers. Several Delaware farmers praised the lab for quickly returning soil test analysis and for providing nutrient recommendations that are very easy to understand. Farmer 55 from Sussex County especially liked the colorful bar graphs that show how much of each nutrient each soil sample contains according to low, medium, optimum, and excessive categories.

iv. Advantages to involving private sector planners

One positive aspect to farmers using private sector planners for their required nutrient management plan is that there is likely an inherent trust between private consultants and their clients because as one planner put it, "they are in business together where the success of one is the mission of the other." Woody Barnes, Maryland's Compliance Inspector, points out often private consultants are able to get access to more records or more accurate information from the farmer, which helps them prepare a more accurate nutrient management plan (Barnes, personal communication, August 22, 2006).

Indeed, UMCES Nutrient Management Program Director, Dr. Patricia Steinhilber, said that many of her county Nutrient Management Advisors complained that when they were preparing to write the nutrient management plan they could not get records from the farmers for their yield results (such as weigh tickets at the grain cooperative) or manure test results, so they were forced to use county average yield goals and state average manure nutrient analyses (Steinhilber, November 21, 2008). Another advantage is that private planners often write one-year plans while only a few public planners have a good enough working relationship to write one-year plans if manure is involved.

v. Disadvantages to private sector planners

To state the obvious, the primary goal of a private sector planner is not to implement the state nutrient management law but to increase yields and profits for their clients. Of course, the goals of a certified nutrient management plan – to set realistic and proven yield goals to optimize crop yields while minimizing purchase of fertilizer inputs and also environmental losses – should be in line with the mission of a private sector planner.

Unfortunately, as the comments from farmers and private planners indicate, they regard the required plans as antithetical to their economic interests because the primary business objective of both farmers and planners is to continually increase crop yields and profitability. And when the private planners represent a fertilizer company, their primary business is to sell more fertilizer.

This disconnect between the goals of the regulatory program and the goals of a private planner was evident in many quotes by farmers that use private consultants. For example, Farmer 47 from Kent County said that Private Planner B told him to make his yield goals high enough to "cover" his fertilizer needs (3-2.2, Farmer 47, Ken). And, Private Planner A stood by while his clients did not comply with Maryland's law that required them to submit plans. Thus, on the one hand, Planner A is helping the agency by writing plans for farmers, but on the other hand he is standing by while MDA is expending staff resources to send warning and enforcement letters to Planner A's clients.

In addition to the evidence that private consultants are not properly reflecting the nutrient application recommendation standards of the land-grant universities, private sector planners may not be serving their clients properly either. There are concerns that Private Planner A also provides identical recommendations to different clients rather than tailoring his recommendations to each field's soil test information, yield history, and other management factors.

Finally, the potential upside that farmers may be more closely adhering to a plan prepared by a private sector planners is not assured, as even Private Planner A told me that he thinks his farmers aren't following his plans to a "t." Many of Planner A's clients did indicate to me that they think he is too generous in his recommendations and they know he has a business relationship with a fertilizer company. Some farmers even said that it bothers them that Planner A sends their plans to the fertilizer dealer before they get to review the plan and decide whether they want to follow it or not.

One private sector planner, Private Planner G, said that she did not think that farmers were following her plans closely either. In her case, it seemed that she was closely applying the nutrient recommendation standards of the Maryland Cooperative Extension Service and thus her plans likely resembled a plan prepared by the Extension Service and were regarded as too conservative by her clients.

vi. Despite not upholding the land-grant university standards for a plan, private sector plans may be better than what farmers were doing in the past

One perspective on the complicated issue of the varying quality of plans prepared by different planners is a glass half full view. Despite the serious concern that some private sector plans are not adhering to university standards, the very fact that farmers are at least looking at their plans and potentially following them to some extent is a great improvement over fertilization approaches of the past.

Farmer 11 from Somerset revealed that though private consultant plans may not be the most environmentally oriented plans, they are nevertheless a lot better than what farmers were doing on their own with advice from fertilizer companies.

> "Prior to our soil consultant, Private Planner A, who we hired in 1995 (before the law), we'd use the fertilizer companies and we'd come up with one program for corn and one for soybeans. Every acre of corn got that program. Now, with Planner A, we have corn 1, corn 2, and corn 3." (3-15.3, Farmer 11, Som)

This consultant's nutrient management approach appears to involve three sets of nutrient recommendations, representing an average of three different field conditions. In contrast to a public planner that would prepare a unique nutrient recommendation for each field, this private planner is preparing just three unique recommendations.

On the one hand, this planner appears to have improved Farmer 11's nutrient management behavior because prior to Planner A, Farmer 11 was getting fertilizer recommendations from fertilizer companies and only one recommendation for all his fields. On the other hand, Planner A's recommendations are likely not as unique and tailored as those prepared by a public planner. However, Farmer 11 may be more motivated to follow a simple set of recommendations rather than as many recommendations as he has fields (depending on total number of acres and acres per field, farm operations can have 10 to 50 fields on the Delmarva Peninsula).

d. To achieve regulatory participation, governments had to provide financial incentives

To compensate for lack of government capacity to prepare the required plans, and to enable farmers who might not otherwise be able to afford the services of a private sector consultant, all three states established cost-share programs for nutrient management plan development.

In Delaware, the cost-share program for planning services is largely responsible for the approximately 80% currently complying acres. There is a widespread misconception about Delaware's cost-share program, however, that reveals unrealistic expectations from farmers about their obligations to comply with the law in the long-term. It is erroneous but widely believed that Delaware's Nutrient Management Law stipulates that if the state fails to provide the cost-share funds, farmers do not have to obtain a plan. In fact, I first heard about this interpretation of the law from the architect of the law himself. When I asked him how implementation of the law has gone, Wally Caulk, Chair of the House Agriculture Committee who wrote the bill, said:

> "So far, it's been very easy to implement and carry out the program. What's unique and different about Delaware is that the state pays for nutrient management plans that the farmers are required to have and if funding is not made available then the farmers are released from the filing obligation. So far they have not had insufficient funds." (Caulk, November 14, 2005)

The Administrator of the Delaware Nutrient Management Commission said that this is not the correct interpretation of the law, but he is aware that this is a common interpretation by farmers.

When I asked one farmer what would happen if Delaware stopped providing cost-share funds for developing the required nutrient management plan, Farmer 48 from Sussex reacted negatively:

> "It probably wouldn't be good and will get more people who wouldn't fool with it. Why would the state do that? They'd be shooting themselves in the foot. They're gonna have to keep money in it to keep paying the farmers to keep them in." (3-25.1, Farmer 48, Sus)

In recognition that poultry manure management on a phosphorus basis in highly concentrated poultry production areas would likely result in excess manure, the nutrient management laws in Maryland and Delaware established poultry litter transport programs that help pay for the cost of moving manure from generating farms to farms that can safely use the manure. Virginia only started a pilot poultry litter transfer project in 2003, but after two years it ceased to exist, and a second transfer project began in 2007 that remains in operation but is very limited.

e. To help achieve acceptance of the required plans and regulations, states differed significantly in their development of educational requirements

The nutrient management laws in each of the three states differed significantly in terms of the amount of educational and certification requirements they placed on the regulated farmers, with Delaware requiring the most education and Maryland and Virginia requiring the least. Both Maryland and Virginia only require their regulated farmers to attend a manure application certification event and then attend a continuing education event once every three years.

In significant contrast, Delaware farmers receive three to four and a half times (depending on whether they are poultry growers with or without crops) the amount of educational programming just to get certified, and then obtain three times the amount of continuing education to maintain their certification. Delaware's emphasis on education stems from a basic understanding of the regulated target. David Baker, then Vice-Chairman of the Nutrient Management Commission and member of the 10-farmer Advisory Committee explained:

> "A large part of our (regulatory) program was education and awareness. Because farmers weren't aware. The Advisory Committee recognized that if you're going to have ag sign on, you had to get them to understand the magnitude of the problems. So we developed certification and training programs."

9.6. Capacity to Wield Enforcement Power: Limited in All States

Scholars offer conflicting evidence over whether stringent environmental policies for point sources or at least policies that are stringently enforced result in better environmental outcomes than those that have a more cooperative enforcement phase.

Ringuist (1993) and Andrews (1998) find that environmental group strength and representation from specific types of environmental groups is positively related to strong environmental policies. In addition, these authors found that more stringent environmental policies are associated with better environmental outcomes and better environmental quality.

In line with these findings, Harrison (1995) reported that the more cooperative Canadian approach to enforcement actually led to lower rates of compliance with the "best practicable" pollution control technology requirements and water effluent requirements within the pulp and paper industry. Harrison contends that the U.S.'s more rigid interpretation and enforcement of its standards and frequent reaction to noncompliance with prosecution yielded better compliance rates.

Harrison explained that Canadian regulators tended to approach implementation in a cooperative manner and would "bend the rules" when they perceive that regulated firms were making good faith efforts and negotiated informal compliance schedules when firms failed to comply. These techniques resemble those described by Farber as "compliance slippage." That is, non-compliance is occurring but rather than report it formally, inspectors will devise strategies to solve the problems informally with the facility managers rather than immediately resorting to administrative enforcement actions and penalties. These findings suggest a concern about the prophecy of the adage, "you give them an inch, they take a mile."

In contrast to these studies, Church and Nakamura (1995) found that more accommodating strategies were more successful in getting Superfund sites cleaned up than were more prosecutorial strategies. These authors explain that accommodation strategies tended to emphasize common goals between the government and the potentially responsible parties for the polluted site, assumed a certain amount of responsible corporate citizenship and good will on the part of the industrial parties, and deemphasized legal adversarialness. Thus, in perhaps the most contentious regulatory arena in U.S. environmental policy – Superfund – it is striking to find that a cooperative approach works best. Perhaps the adage appropriate here is, “If all else fails.”

An important distinction between a regulatory approach to agricultural nonpoint source pollution and a voluntary approach is the expectation of adherence with the regulatory requirements and the opportunity for inspection and enforcement of compliance. However, all three states focused on “bringing farmers into compliance,” or “compliance assistance,” rather than a formal procedural enforcement approach, likely reflecting their long-term knowledge of the difficulty of getting farmers to change behavior which was learned through decades of effort in their voluntary programs. In addition, given that all three states knew how difficult it is to detect and prove non-compliance, the compliance assistance approach makes sense and may be the only approach open to states.

A key component to achieving both administrative and adherence compliance with a regulation is the inspection of the regulated entity (Kagan, 1983). I found that each state approached farmers during inspections with a positive outlook, regarding farmers as “corporate citizens” rather than “amoral calculators.” Proceeding through the inspection process on the assumption that the farmer is a corporate citizen assumes a farmer is willing to work with the regulator to achieve common goals.

Farber (1999) suggests that many policies and environmental regulations in particular are implemented through creative negotiations between the agency and regulatory target. Though some might suggest collusion, others suggest that informal collaboration with regulated targets can help achieve the spirit of the law through non-specified and unintended ways, though sometimes the letter of the law may not be fulfilled.

Indeed, even in Virginia, where the traditional regulatory agency – DEQ, which manages the point source regulatory programs – conducts the farm inspections, as one Virginia farmer put it, the inspectors convey a sense of "wanting to work with you instead of against you." To bring farmers into compliance, these inspectors prefer to work informally with the farmer to devise a solution to the problem. Inspectors resort to formally writing up violations if there was a serious lack of cooperative effort on the farmer's part or no progress demonstrated on a follow-up visit.

In contrast to the cooperative spirit, Charlton (1985) outlines four elements of deterrence critical to a state agency trying to prevent noncompliance: 1) credible likelihood of detection of the violation, 2) swift and sure enforcement response, 3) appropriately severe sanction, and 4) each of these actions is perceived as real.

None of the states fulfill Charlton's deterrence criteria because it is very difficult to monitor and detect violations with a nutrient management plans; even Virginia is unable to annually inspect the regulated population while Maryland and Virginia barely make it above 10 %. None of the states have chosen to levy penalties or, when they do fine violators, the fines are insignificant.

Virginia's annual inspection, discovery, and reporting of violations fulfill the first two criteria, but Virginia rarely uses formal enforcement techniques such as penalties to drive compliance. Given the frequently high rates of non-compliance reported to me by the five regulated Virginia growers, it appears that many regulated growers may not perceive these deterrence actions as real or serious enough to warrant adherence to their plan.

The Delaware Commission's inspection rate of about 2 to 4% per year is hardly sufficient to demonstrate a credible likelihood of detection of violation. Delaware has also only fined a couple of farmers $100 each for requiring a court of appeals' time to hear their grievances against the Commission, rather than a penalty for the non-compliance detected during the on-farm audit.

Maryland's inspection frequency beginning in 2005 reaches only about 8% of farms per year, and Maryland delayed levying penalties until 2008. The fines appear on average to be a few hundred dollars per farmer. MDA may not appear to farmers as very serious about compliance given the thousands of warning letters and several other kinds of communications that it has gone through for many years before it considers any penalties.

Regardless of the frequency of inspection, given the evidence that some farmers and private planners interviewed for this dissertation have reported that farmers using public planners may get their true nutrient application recommendations from a fertilizer dealer or a crop consultant, and that farmers using private planners may maintain double books, detection of non-compliance with a plan is very difficult.

The one promising aspect that I heard from several farmers in Maryland and Delaware was the emergence of self-enforcement. One component of Wasserman's (1992) behavioral school of compliance theory states that individuals within a firm are motivated by social influence from a relationship with the regulator, peers, and social and moral norms. I found that some farmers seem to be motivated by the corporate sense of citizenship that makes them call in complaints about farmers they perceive as “bad apples” that they do not want to give the rest of the community a bad name. I also found that other farmers appear to be motivated out of envy to want to stop neighboring farmers from doing what is illegal since they would like to be doing it as well and do not want their neighbor to have a competitive advantage and get away with a prohibited activity.

Finally, farmers may inherently expect a compliance assistance approach to implementation of a regulatory program. Given farmers have been accustomed to the decades-old voluntary assistance system of relationships with state representatives, some farmers, indicate they expect to be asked to comply with the law. For example, even though a few farmers suspected that their private planner was giving them higher manure application rates than they thought they should be using and they heard they should not be using manure on soybeans, these farmers showed no inclination to investigate the rules themselves. Instead, they said, until someone comes to check on them, they will keep doing what they’re doing.

Indeed, when I asked for comment on the poor initial compliance rates in Maryland, Earl Hance, the 2006 Maryland Farm Bureau President (and current MDA Secretary) explained, “Compliance is like a tax code, some will hold out till they get a knock at the door.”

Thus, it is a challenge for states to decide when their compliance assistance is being taken advantage of and it may be appropriate to resort to formal, legal procedures to enforce the law.

9.7. Summary

In Chapter 9 I found that the most important differences between the three states' policy development processes occurred during their problem diagnosis, political negotiations, and regulatory program implementation phases. Thus, the differences in state estimates of compliance and my estimated differences in compliance are likely associated with farmer regard for how they were treated by their governments in the problem diagnosis stage, the amount of deference farmers felt they were given during the legislative and regulatory stages, and how effectively each state was able to roll out its regulatory program.

Given all three states largely enforce their nutrient management regulations in a similar fashion and employ cooperative approaches to gain compliance rather than stringent, prosecutorial approaches, farmers that are "corporate citizens" may respond better to the infrequent on-farm inspections in Maryland and Delaware and the near annual inspections in Virginia. However, farmers that are "amoral calculators" are likely to take advantage of the situation and continue with non-compliance. Since state inspectors may not find it easy to tell the difference between these two types of regulated parties and because nonpoint source agricultural pollution is "insidious" and detecting plan adherence or non-adherence is practically, for all intents and purposes, impossible, compliance assistance appears to be the best option for plan-based regulations.

CHAPTER 10 - CONCLUSION

10.1. Introduction

Chapter 10 serves as the dissertation conclusion. I will summarize answers to both my research questions and I will summarize the main themes revealed throughout this dissertation. Throughout Chapter 10, I will discuss the policy implications of my findings.

This dissertation began by recognizing calls for a regulatory approach to agricultural environmental pollution in the Chesapeake Bay began early in the 1980s and continued throughout the 1990s. Several prominent agricultural economists in the U.S. and Canada also advocated for regulatory policy solutions. Napier (1994) concluded that "compulsory approaches will be required to motivate a significant number of land operators to adopt and continue using farming system that minimize degradation of environmental quality." Tweeten and Zulauf (1997) contended that since agriculture was evolving into a new, industrial production paradigm that "requiring compliance with environmental requirements would bring agriculture in line with standard procedures applied to other industries." Stonehouse (1997) said despite the "insidious nature of nonpoint source pollution," and the fact that "farmers who contribute to this pollution, can if they choose, ignore the damages…and are often motivated to do just that because most measures aimed at remediating the damage cut into their profits," that more regulatory approaches are needed.

However, the estimates of regulatory compliance provided by the regulatory agencies in Maryland, Virginia, and Delaware, and my own estimates of compliance lead me to conclude that there is a major difference between “saying so,” then “making it happen,” and most importantly, “making it work.”

Since agricultural sources of nutrient and sediment pollution continue to be identified as among the leading causes of impaired waterways in the U.S. and around the world (Selman et al. 2008), and the voluntary technical and financial assistance program approach has been unable to adequately solve these problems, policy-makers and the public are becoming increasingly interested in regulatory approaches.

Through this dissertation, I sought to determine if the manner in which states develop their regulatory policies affects how well farmers comply with the regulations and improve their nutrient management behavior. Along the way, I learned about the limitations of nutrient management plans as an effective regulatory policy to address agricultural nutrient pollution.

10.2. Summary and Discussion of Answers to the Research Questions

My research questions were:

1) Did the regulatory policy development processes of nutrient management regulations in Maryland, Virginia, and Delaware in response to the 1997 *Pfiesteria* events affect farmer compliance?

2) Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva Peninsula?

I begin by pointing out a major finding of this dissertation: the tremendous challenge of determining farmer compliance with nutrient management plans and the realization that compliance is inherently “unknowable.” Given the undetectable nature of “insidious” nutrient pollution and for all intents and purposes, the un-verifiability of adherence to recommended nutrient application rates or adherence to some required practices, there is an inherent hurdle to determining whether farmers are following the state laws.

Further complicating the matter is the high likelihood that plans prepared by private sector planners may not reflect land-grant university standards as well as plans prepared by public planners. Thus, farmers adhering to plans that recommend more nutrients than university standards undermine the spirit of the law while technically following the letter of the law. Finally, since farmers and private planners revealed numerous ways in which they try to evade the law, answers to both research questions should be taken with a grain of salt. There is also a further need for studies that determine how farmers differ in their actual nutrient application rates, that is, if farmers with public planners are applying greater rates of nutrients than are called for in their plans and if farmers with private planners are applying at lower rates than are called for in their plans.

Due to the social desirability problem of asking the regulated population questions about compliance with a law, I knew it would not be easy to ask direct questions about compliance or whether farmers improved their practices because of the law. Therefore, I generated several datasets to try to get at the question both directly and indirectly, quantitatively and qualitatively. Thus, depending on which set of metrics is examined, there are both “good” and “poor” levels of compliance, and there are both statistically significant differences between states and no difference. Further complicating results is the catch-22 of farmers explaining their state law was not justified, making it difficult for them to admit that they had indeed changed some nutrient management practices as a result of the law. These farmers were more likely to attribute their improved behaviors to continued cooperation with Extension and the Soil Conservation Districts or technological improvement rather than the law.

In this conclusion I will not re-present the many indicators that reveal how and why states did things differently in their problem diagnosis stage, their policy negotiations phase, and their implementation period, or detail why their enforcement was mostly similar. For a review of the states' political and environmental cultures that influence their policy-making styles, I direct readers to Chapter 4. For a review of how each state responded to the *Pfiesteria* focusing events, proceeded through each stage of the policy-making process, and for 14 Likert Opinion Statements regarding farmer opinions about the main stages of the policy process, see Chapter 5. And for analysis on each state's capacity to regulate farmers and design effective policies to reduce agricultural nutrient pollution, see Chapter 9.

Answering Research Question 1

The answer to my first research question, "Did the regulatory policy development processes of nutrient management regulations in Maryland, Virginia, and Delaware in response to the 1997 *Pfiesteria* events affect farmer compliance?" is, overall, "yes." However, depending on which of the six metrics of compliance is discussed, there can be "no" answers as well.

Rather than reiterate the details of each dataset I generated to help answer Research Question 1, I direct readers to Chapters 6 and 7 and note that brief answers and analyses are found in the summary sections and the "wrap-up" sub-sections of these chapters. Overall, three sets of compliance metrics indicate that the different policy-making styles in each state did have a significant impact on farmer compliance, while three other compliance metrics datasets indicate that the states did not achieve statistically different outcomes.

It does appear that the way states diagnose the agricultural-environmental policy problem, negotiate policy responses to the problem, design the regulatory policy, and carry out the regulatory program during the implementation phase has a significant impact on:

(1) **The administrative compliance rates**[20] **measured by the state regulatory agencies (Chapter 6) –** By the time of each state's initial deadlines, Maryland farmers had the lowest rate of compliance, as only 30% had submitted the required nutrient management plan and 60% filed Justification for Delay forms; more Delaware farmers obtained a plan than was necessary and thus exhibited "early" compliance; and nearly all Virginia poultry growers had obtained either a required nutrient management plan or a manure management/waste transfer plan.

(2) **The adherence compliance rates**[21] **measured by the state regulatory agencies (Chapter 6) –** Using 2008 on-farm inspection data published or obtained from the state agencies, it appears that only 65% of Maryland farmers were deemed in compliance while 84% of Delaware farmers and 88% of Virginia farmers were considered in compliance. Inspection rates and sampling techniques do vary by state, which may influence these adherence compliance estimates. Maryland inspected about 8% of its 5,902 eligible farmers but sampled what it calls "high risk" and administratively "non-

[20] In this dissertation, I have defined "administrative compliance" as possession or submission of the required nutrient management plans and submission of required annual reporting documents.
[21] I have defined "adherence compliance" as following the nutrient application rates recommended in the required nutrient management plans and following the various best management practices associated with carrying out the plan.

compliant" farms; Delaware inspected a random sample of 2% of its 1,158 eligible farms; and Virginia inspected 93% of the 1,040 animal operations that have a Virginia Pollutant Abatement permit (about 800 of which are poultry growers).

(3) **The farmer opinions I measured through Likert Opinion Statements regarding satisfaction with their plans, laws, and regulations (Chapters 5 and 7) –** The majority of Maryland and Virginia farmers reported that a) they would not be satisfied with their crop harvest if they strictly adhered to the application rates in their nutrient management plan, b) their nutrient management plan is too conservative, c) their regulations are stricter than they should be, and d) their state law is not justified. In contrast, the majority of Delaware farmers reported the opposite views: they would be satisfied with their crop if they followed their plan, their plan is not too conservative, their regulations are not too strict, and their state law is justified. These Likert Statements regarding satisfaction with the required plans and the state laws indicate Delaware farmers may be more closely adhering to their state law than farmers in the other two states (though they have fewer requirements and their plan recommendation rates may be different). Differences were statistically significant.

These three sets of indicators lead me to answer the first research question with a "yes."

However, three more sets of compliance metrics indicate that "no," farmers in each state are more alike than they are different when measuring their level of compliance with or adoption of basic nutrient management practices. Thus, the differences in each state's policy-making process did not have a statistically significant impact on:

(1) **Levels of compliance with three practices that all three states require (Chapter 7) –** The majority of farmers in all three states were compliant with (i) their laws' requirements that they possess a certified nutrient management plan and (ii) the requirement to conduct soil nutrient analyses at least every three years. However, the majority of farmers in all three states were not compliant with the basic step of (iii) taking residual nitrogen credits for previous applications of manure or legumes crops; thus, they are likely over-applying nitrogen.

(2) **Levels of compliance with seven practices required by at least one state (Chapter 7) –** Farmers across all three states show poor levels of compliance with or adoption[22] of three of the seven basic nutrient management practices that have been encouraged for decades by the scientific, Extension, and Conservation District communities. Compliance or adoption levels are good for two practices and mixed for two other practices.

The majority of farmers in all three states are (i) not calibrating their manure spreaders annually or before every crop season, which may result in applying the wrong rate and not knowing what rate they are actually applying; (ii) not keeping a safe distance from ditches or streams when applying poultry manure and thus getting manure into surface waters; and (iii) applying manure in the prohibited winter months, thus losing nutrients through volatilization and runoff.

For the two practices required by at least one state that showed good rates of compliance or adoption, farmers are (i) manure testing at least every three years and (ii)

[22] I use the term "adoption" instead of "compliance" to describe Delaware and Maryland farmers in the instances when the practice is required only by Virginia but not required by Delaware or Maryland. Virginia's law requires six more practices than Delaware's law and four more practices than Maryland's law.

split applying commercial fertilizer from manure applications, which helps farmers apply the sidedress nitrogen fertilizer when the corn crop is ready to absorb it.

For the two practices showing mixed results: Most farmers in Maryland are using the PSNT test or the stalk test to determine if and how much nitrogen should be split applied before they apply the sidedress application while most farmers in Delaware and Virginia are not. In contrast, most farmers in Delaware and Virginia are compliant with Maryland's two-year manure testing rule while most Maryland farmers are not compliant with their state's standard.

(3) **Counts of farmer comments that explicitly state or implicitly imply adherence to the plans (Chapter 7) –** Of the 36 farmers (65%) that provided such statements, comments indicating non-adherence with their nutrient management plans outnumbered those indicating adherence nearly 2 to 1. Most Maryland and Virginia farmers who supplied a comment indicated they were not adhering to their plans, while most Delaware farmers who supplied a comment indicated they were adhering to their plans but differences between states was not statistically significant. The high non-response rate reflects that challenge of discussing compliance with a law suffers from a social desirability problem wherein the socially optimum and legally correct answer is "yes I follow my plan."

Answering Research Question 2

The answer to my second research question, "Have these laws resulted in improved nutrient management practices of poultry growers and grain farmers on the Delmarva

Peninsula?” is also, overall, “yes,” though there are some “no” answers as well depending on which of the six metrics of “improvement” are discussed.

Of the six datasets regarding improvements in behavior that I generated, presented, and analyzed in Chapter 8, four datasets do indicate that farmers have improved the way they manage nutrients, one dataset indicates no improvement in the acceptance of modern nutrient science, and the last dataset shows mixed levels of improvement in the acceptance of agricultural-environmental problems. Regarding statistically significant differences between the states, only one of these six datasets indicates differences are statistically significant. Thus, by and large farmers in all three states are more alike than they are different, and overall they appear to be managing nutrients better than they have in the past though there is still room for much improvement.

Thus, across all three states regulating farmers does appear to have improved:

(1) The use of commercial fertilizer or manure – Of the 34 farmers (62%) that provided an answer to this question (which suffers from a social desirability problem), more farmers in all three states said “yes,” they did change their commercial fertilizer or manure use in response to their state nutrient management law, than said, “no.” Again, non-response rates were high in Maryland and Delaware, indicating a catch-22 situation wherein admitting they had changed their nutrient management behaviors in response to the law would conflict with their comments that the laws were not justified.

(2) A variety of fertilizer or manure practices – Farmers provided many examples of how they had changed their commercial fertilizer and manure use in response to their state law, including but not limited to: an overall “greater awareness of nutrient management;” reduced purchases of commercial phosphorus; lowered nitrogen concentrations in fertilizer mixes; lowered poultry manure rates (from 5 or 3 tons/ac down to 3, 2, or less than 2 tons/ac); increased frequency of manure nutrient testing; and reduced manure disposal, because poultry growers with no cropland have been matched up to crop farmers or with the state manure transport programs.

(3) Manure application rates on corn – Overall, 60 to 97% of farmers in all three states reported using 3 tons/ac or less to grow corn, which reflects modern and defensible poultry manure application rates. There was a statistically significant difference between states, however, with the majority of Delaware farmers (75%) saying they use 2 tons/ac or less while only 47% of Maryland and 40% of Virginia farmers saying so. Though non-response rates were high, about a third of farmers in all three states indicated they changed to their current manure application rate after the law, while a third indicated they had been using their current rate since before the law, and a third to half the farmers in all three states reported they used 4 or more tons/ac on corn before the state laws.

The logit regression model of factors influencing low manure application rates indicates three factors did predict whether a farmer in this dissertation would report using a "low" poultry manure application rate (2 tons/ac or less). However, the state variable in the logit regression model did not prove to be a significant predictor of a farmer being a "low manure user." The three variables with strong predictive values suggest farmers who a) "agreed" with the Likert Statement that farmers had an equal seat at the policy-making table were 12 times more likely to be a low manure user; b) "agreed" with the Likert Statement that a nitrogen manure rate (using pre-phytase manure) on corn resulted in up to four times too much phosphorus were four times more likely to be low manure users; and c) used private planners were nine times more likely to be low manure users than those who used public planners or “disagreed” with or said they “didn’t know” to these two Likert Statements.

The two additional datasets show either no improvement or mixed levels of improvement in:

(1) Acceptance of basic and modern nutrient science concepts – None of the Likert Statements regarding acceptance of nutrient science indicated an improvement in farmer understanding of basic and modern nutrient science, which suggests the potential for over-application of nutrients. Only half the farmers in all three states demonstrated an understanding of the basic manure and crop science findings that using poultry manure (pre-phytase) to meet the nitrogen needs of corn would result in up to four times too much phosphorus. Only a minority of farmers in all three states agreed with the modern phosphorus science that even without soil erosion it is possible for dissolved phosphorus to runoff from soils with very high soil test phosphorus values. Of the farmers that were able to select just one mutually exclusive nutrient application philosophy, the majority chose the “Maintenance” approach (instead of the university-approved “Sufficiency” approach), which suggests that roughly half the farmers in all three states are likely applying more nutrients than necessary.

(2) Acceptance of basic agricultural-environmental problems – The Likert Statements on agricultural-environmental problems show mixed results, as the majority of farmers are willing to recognize some farm-related problems but others are not. Half to the majority of farmers in all three states are willing to accept that it was customary practice for many poultry growers in their state to apply manure for disposal purposes on nearby fields and some counties on the Delmarva Peninsula have more manure than can be applied at agronomic rates in the same county. In contrast, the majority of farmers across all three states do not agree with the scientific and environmental communities that "agriculture is the largest source of nitrogen and phosphorus pollution to the bay" and thus, not surprisingly, feel that "agriculture is being blamed for a greater share of the water pollution than it generates."

Discussion of which approach "works" best to regulate farmers

Although it is not directly a goal or requirement of this dissertation to determine which state's approach works "best" to regulate farmers, I will attempt to discuss this question. I will judge "best" based on three underlying assumptions about agricultural nonpoint source nutrient pollution, the government's ability to regulate it, and what key factors seem to be important when regulating farmers to stimulate a change in behavior.

As established by Stonehouse (1997) and Favero and Abdulla (1997), agricultural nonpoint source nutrient pollution is "insidious," largely invisible, highly dependent on site variability, subject to long lag times between behavioral change and evidence in environmental outcomes, and can be ignored by farmers as environmental externalities because the negative impacts are felt by downstream users and cannot easily be traced to a specific source.

Innes (2000) and the JLARC (2005) report remind us that rarely can government representatives be onsite when farmers are actually applying nutrients, managing manure, or carrying out numerous best management practices that accompany good nutrient management. Governments do not have the capacity to be on every farm field operated by every farmer that is preparing to plant corn in March and April to verify that farmers have properly calibrated their manure spreaders or are applying manure such that it's not entering the ditch or surface water. Nor can they return six to eight weeks later when farmers should be conducting the PSNT or stalk test to determine whether they should sidedress commercial nitrogen, and when they do, that the concentration of the commercial nitrogen mix and the application rate is correct. Nor can government representatives drive through all farm regions during the winter months to make sure no one is applying manure.

Furthermore, for decades, state and federal governments in the U.S. have addressed agricultural nonpoint source nutrient pollution primarily via voluntary, educational, and technical and financial assistance programs that rely on the government representatives' ability to convince farmers to collaborate with them to address these "issues." Only in the mid-1990s did the federal government decide that very large CAFOs were point sources they were justified in regulating – in part because of the amount of concentrated nutrient pollution but also because there are liquid manure lagoons and discharge pipes they could focus their regulatory authority on.

Given these underlying challenges presented by agricultural-environmental pollution and the constraints on government capacity to effectively design requirements that can be easily monitored, verified, and enforced, this dissertation underscored just how hard it is to effectively regulate farmers and agricultural sources of pollution.

Over the course of preparing this dissertation, I have come to conclude that there are at least three key components to successful agricultural regulations. First, I conclude that obtaining the farmer's cooperation is ironically the key to successfully regulating farmers. Farmers need to feel that the state is justified in regulating them; that is, farmers need to be willing to be regulated.

Second, another key component to changing farmer behavior is obtaining a farmer's willingness to hear what's wrong with his current approach and be convinced that the new approach is better for his farm and for the environment. Third, even for practices that provide some direct or indirect economic benefit – but especially for practices that have solely environmental benefits – a key component to successful regulations is financial assistance.

Not surprisingly, these are the same core components that make for successful farmer participation in voluntary technical and financial assistance programs. The primary difference is that a regulation establishes society's expectation that all eligible farmers achieve a specific environmental standard, while society does not expect that all eligible farmers participate in a voluntary program.

Since none of the states exercised their power to enforce their regulations coercively but opted for a "compliance assistance" approach, it remains to be seen if the conventional characteristics of regulatory enforcement can "work" with farmers and nonpoint source pollution. Perhaps, states lack the skills to design regulations and inspection regimes that can easily monitor for non-compliance and would signal to farmers a credible and likely threat of detection of non-compliance. Perhaps states lack the political will to establish enforcement penalty regimes that make the marginal costs of non-compliance higher than the marginal costs of compliance. One has to wonder whether states are capable of implementing "compliance assistance" and the conventional enforcement deterrence simultaneously, or perhaps even consecutively. Perhaps some farmers would respect the states more if the states took enforcement of the laws more seriously.

Thus, given my three definitions of “the best” approach to regulating farmers (based on this three-state case study dissertation), Delaware is the clear leader.

Delaware has experienced success of its policy through fulfilling these three key components of effective regulation. Delaware suffered very little backlash to its law or undue complications during implementation of the regulatory program. Most Delaware farmers repeatedly expressed a sense that they were “fine” with being regulated, they were willing to follow their plan, and that there was an overall greater awareness of nutrient management issues and environmental concerns. Farmers turn out in high numbers at the frequent educational events the State of Delaware offers. Delaware farmers are just as good at employing four practices that farmers in the other two states have adopted (possessing a nutrient management plan, taking soil tests at least every three years, taking manure test at least every three years, and split applying commercial nitrogen fertilizer). Delaware farmers even report using lower poultry manure application rates on corn than their neighbors.

The DNMC reported early administrative compliance and discovered very few non-compliance issues during on-farm audits. The DNMC works in close partnership with the university scientific community and seems to care about the state law and about water quality. The DNMC, in cooperation with UDE scientists, has evaluated the effects of the state law and found a dramatic improvement in the excess manure problem and the nutrient surplus problem in the state. Thus, by these two evaluations alone (which have not been conducted by the other two states), Delaware’s law has likely been effective at reducing agricultural nonpoint source nutrient pollution. There were, however, some downsides to Delaware’s approach, which are discussed later in this chapter.

10.3. Discussion of the Main Themes of This Dissertation

In the introductory chapter of this dissertation I posed five hypotheses in the form of questions that were related to the important themes of agricultural nutrient management regulations:

1. Is a plan-based regulatory approach to agricultural nutrient pollution an enforceable regulatory tool?
2. Can plan-based regulations that allow plans prepared by both the public and private sectors result in uniform nutrient management standards?
3. Does it matter if the target of agricultural regulations, i.e., farmers, feel included or excluded from the policy-making process?
4. Do regulations that account for on-the-ground realities of farming and state regulatory capacities have better administrative, behavioral, and environmental outcomes than those that don't?
5. Can focusing events that turn out to be weak undermine the justification for and compliance with new regulatory policies?

Throughout this dissertation I discussed these issues and will summarize my answers here using evidence of the similarities and differences between states.

Plan-based agricultural regulations are in reality voluntary

Overall, I found agricultural-environmental regulations that require farmers to obtain and follow nutrient management plans to be problematic regulatory mechanisms, because in practice the nutrient application recommendations in the plans remain optional. Because nutrient management plans seek to alter production decisions, that is, the core inputs into the farmer's business, if farmers do not think the plan will be good for their business, they will not follow it. Thus, successful plan-based regulations rest on the pre-condition that a farmer is willing to follow the plan. The gap between the plan recommendations and what farmers think they need for successful crop production likely determines how closely farmers follow their plan. Hence, successful plan-based regulations require the gap in agreement to be small.

This dissertation found two primary reasons farmers gave as to why they did not want to follow their university-standard nutrient management plan: (1) they disagreed with the first step of sound planning – establishing an “average” yield goal for each field, and (2) they did not want to purchase additional nitrogen fertilizer to make up for the reduced nitrogen application required by their phosphorus-based nutrient management plan. Both instances reveal that farmers who do not believe plans are in their best economic interest are likely not going to follow the required plans.

Plan-based agricultural regulations are a very intrusive regulatory option for regulating nutrient pollution. Unlike point source water or air regulations, which are largely technological solutions applied to discharge pipes or smokestacks to manage the waste stream at the end of the industrial process, plan-based agricultural regulations instruct farmers how to farm. Hence, if there is a disagreement between the approach a farmer believes is most profitable and the one he finds written in his required nutrient management plan, he is not going to use the plan.

In addition to the challenge of regulating nutrient pollution via plans, there is the difficulty of getting farmers to agree with the state that pollution is occurring. Due to the insidious nature of nonpoint source agricultural nutrient pollution, which unlike soil erosion or sediment pollution is not readily visible on crop fields and in ditches or streams, nutrient pollution is largely invisible. Ammonia volatilizes from manure applications to cropland invisibly into the air, nitrogen slowly leaches downwards through the soil column to join groundwater, soluble phosphorus seeps laterally through subsurface flows to discharge into surface waters, while both soluble and particulate phosphorus is carried over the surface of the soil either in surface water runoff or with soil erosion. Only occasionally do the ramifications of excess nutrient concentrations in water bodies reveal themselves in dramatic ways such as fishkills. The more common manifestation of nutrient pollution is eutrophication or low oxygen levels which in comparison is un-dramatic and not a headline-grabber.

Furthermore, adherence to nutrient management plans is tremendously difficult for a state to monitor and verify. This dissertation revealed the many downsides to mandating plans and demonstrated how easy it is to sidestep the regulations (see Chapters 7 and 8). Farmers not willing to accept university-standard nutrient application recommendations reported corroborating with their private nutrient management planner to falsify their yield goals in order to justify higher nutrient application rates; keep “double” books – one that is presented upon request to inspectors for review and one that is actually used by the farmer; and not take residual nitrogen credits. Or, if farmers receive their NMP from a public planner and are not willing to accept the university-standard nutrient application recommendations, they reported getting their “true” recommendations from their fertilizer dealer or simply applying manure or commercial fertilizers at rates higher than what was called for in their plans.

Each of these purposeful forms of evasion is practically impossible for state inspectors to detect during their farm inspections because farmers can “fudge” the paperwork (e.g., fertilizer receipts, manure application logs, crop yield tickets). If a farmer does not go to these lengths to create corroborating paperwork, he can simply say he did not keep paperwork, which may or may not result in a warning letter or escalate to greater levels of enforcement action.

On top of the difficultly of detecting and verifying adherence to nutrient management plans, none of the states employed common enforcement techniques to signal a credible deterrence threat to farmers. Inspection rates in Maryland and Delaware are low, penalties are rarely levied, and the handful of fines for non-compliance that have been issued were very small. Thus, if a farmer does not believe a plan is good for business, none of the states have established a serious deterrence effect to motivate farmers to still comply with their nutrient management plans.

All of this effort by some farmers in all three states to avoid university-standard recommendations rates to “optimize crop yields while minimizing environmental losses” points to a huge gap in perspective about nutrient science between some farmers and the state. This dissertation points out that a significant amount of effort is expended by all three states to help farmers prepare, update, and maintain the required nutrient management plans and complete the additional annual reporting forms. All of this administrative effort, in reality, can yield little guarantee of nutrient pollution reduction if farmers do not agree with the recommendation rates in their plans.

Policy recommendations:

All three states should investigate the gap that exists between some farmers and the state that prevents farmers from believing it is in their best interest to adhere to the required nutrient management plan and seek to develop solutions to close that gap.

States should devise effective educational campaigns to convince some farmers that following university-standard plans that are designed to “optimize crop yields while reducing environmental losses" can in fact save them money, by among other things following the Sufficiency concept philosophy of nutrient application, taking residual nitrogen credits, testing manure frequently, calibrating their manure spreaders, and using a PSNT test to determine if additional sidedress nitrogen fertilizer is necessary.

For the practices that cost farmers more money rather than generate savings (e.g., switching to phosphorus-management), states should consider providing cost-share funds to help purchase additional nitrogen fertilizer for an initial period of time during the policy transition. States should expect to share in the costs of environmental protection under these circumstances for a limited amount of time due to the difficulty in verifying adherence to a phosphorus-based plan.

States should consider using the conventional deterrence power that traditionally accompanies regulatory approaches to make penalties for non-compliance high enough that any economic losses associated with adhering to the university-standard plan are lower than the penalties for non-compliance.

In the future, these three states and other state governments should investigate if there is a greater likelihood of administrative and adherence compliance success if the requirements focus on easily verifiable nutrient management practices such as permanent and measurable vegetative buffers along ditches and other surface waters where no manure or commercial fertilizer may be applied and prohibiting the application of manure fertilizer during winter months. In addition, future agricultural regulations of areas with excess animal manure should establish policies that directly quantify the magnitude and characteristics of the problem, establish quantifiable policy goals to solve the problem, and design and implement direct solutions to achieve the policy goals.

Plans prepared by private and public planners create non-uniform standards

Many comments by farmers, private planners, and public planners I interviewed reflect the findings of Smith (1999) and Lawley et al. (2007) who found that private planners tend to recommend higher nutrient application rates than public planners, who are likely to prepare plans according to university standards of nutrient application.

I learned that there are some advantages to farmers using private planners, such as greater trust and access to farmer records. However, these benefits likely do not compensate for plans with excess application recommendations. I also found that farmers may not be strictly following recommendations in their private plans because they recognize their planner has a tendency to recommend overly high application rates. Some farmers are also aware that their planners have business agreements with fertilizer dealers and recognize this relationship results in their planner having an economic interest in recommending high fertilizer application rates.

Thus, in practice, farmers with private planners may apply fewer nutrients per acre than their plans recommend. Conversely, farmers with public planners may apply more nutrients per acre than their university-standard plans recommend. Future research should attempt to conduct another study like that of Smith (1999) to estimate the current difference between nutrient application recommendations in private sector plans versus public sector plans as well as the potential differences in actual application rates by farmers. It is possible that actual application rates of farmers who modify plans prepared by public and private planners may be quite similar. This is a topic for future research.

Policy recommendations:

Just as it is important for states to implement a compelling educational campaign and more rigorous deterrence effect with high penalties for non-compliance for farmers, it is important for states do the same for private sector planners and fertilizer companies to reduce the likelihood of their undermining the state laws with formal recommendations or informal advice that exceeds university standards. Policy-makers should consider levying penalties for such actions and the magnitude of the penalties should be severe enough to deter subversive behavior.

Likewise, adequate checks and balances should be established between the state enforcement officers and the state employees writing the plans to ensure adequate compliance. In the case of the public planner who did not want to be seen as the regulator, he enabled some of the farmers he writes plans who were not picking up their plans by not reporting their non-compliance. To get around this problem, the enforcement branch should systematically check in with the public planners to unearth such enforcement problems and correct them accordingly.

Gaining "buy-in" may achieve better overall outcomes, though compliance may be higher because standards are lower

This dissertation generated insights into the positive outcomes that ensue from gaining buy-in from the regulated community during the policy development process and the negative outcomes that result from alienating the regulated community. However, I also presented evidence that a fine line can exist between buy-in and regulatory capture.

Gaining the support of the regulated industry was very important to Delaware policy stakeholders who contend it was the only political approach that would work in the state.

Pressure to act came primarily from external sources, as Delaware had long been experiencing pressure from the EPA to develop a CAFO NPDES program and was pressured to respond to the *Pfiesteria*-related fishkills as Maryland and Virginia had taken action. “Buy-in” in Delaware went beyond the conventional “negotiated regulatory style” of policy-making and meant that not only were the regulated industry, their supporters in the General Assembly, and leaders of their trade association integrally involved in all stages of the policy process, but that they were in *control* of the policy-making process.

Buy-in in Delaware likely resulted in many positive outcomes, including passing unprecedented mandatory agricultural nutrient management legislation, establishing the regulatory institution and regulations relatively quickly, gaining early compliance with the law, high participation in the plan-writing cost-share and manure transport program, keeping the policy community stakeholders very interested in addressing the excess poultry manure and nutrient imbalance problems and actively evaluating whether they’re making progress. Analysis to date by University of Delaware scientists suggest the law is helping to lower fertilizer purchases and solve the excess manure problem (see Chapter 6). The stakeholders and farmers in my interviews indicated that all parties are content with the policy-making process and outcomes and overall they express a feeling of pride in their efforts.

In contrast, indicators in Maryland suggest that the policy-making process alienated farmers, their trade association leaders, and the department of agriculture (which would become the regulatory agency), all of which resulted in negative outcomes. Maryland failed to gain buy-in from the regulated industry for a number of reasons. Maryland tends to have an “enforced regulatory” approach to developing policies, which polarizes policy stakeholders instead of encouraging them to work together to achieve a common goal. Since the *Pfiesteria*-related fishkills occurred in Maryland waters, the focusing events were unprecedented in that they made people sick, which brought significant media attention to the state. In addition, an incumbent governor was finding it hard to connect with voters, and members of the General Assembly saw the opportunity to finally enact a regulatory approach to agricultural nutrient pollution.

Though a variety of Maryland policy stakeholders contend the agricultural industry was involved in every step of the policy process, the environmental community had the upper hand in the generally pro-Chesapeake Bay and pro-environment State of Maryland. Furthermore, because the agricultural community was under attack as the cause of the problem in the problem diagnosis stage, they had to fight battles on two fronts: (1) they had to defend their integrity as environmental stewards and oppose the regulations outright and (2) they had to negotiate to limit the comprehensiveness and intrusiveness of the potential regulations.

One major factor that alienated Maryland farmers that was mentioned by farmers, farm trade association leaders, and even retired agricultural agency leaders, was their perception of the lack of integrity by the state in not admitting partial responsibility for the phosphorus problem, as the state failed to change its manure application guidance in light of the new phosphorus science. Because the state was not presenting itself as an equal partner to the agricultural community to solve the problem together, Maryland farmers did not respect the will of the state as the state government did not respect them by admitting its shortcomings. Further complicating the process was the unfair treatment the farm community felt they were receiving in the intense media coverage of the *Pfiesteria* fishkill events. Farmers felt that not only were policy stakeholders and the media branding them as wasteful users of nutrients (which would not be in their economic self-interest nor could they "afford" to apply more nutrients than necessary), farmers also felt they were being accused of not caring about the environment.

Alienating the regulated community in Maryland resulted in many negative outcomes during all stages of the policy process. The problem diagnosis phase was highly contentious and unsuccessful at getting farmers and scientists to concur that agricultural nutrient pollution was a serious problem. The policy-making process was highly contentious and there were differing opinions about the level of inclusivity of farm trade association leaders in the legislative and regulatory phases. The regulation-development phase was filled with harsh fighting. Farmers, in the implementation stage, "dug in their heels," and many refused to comply with the first deadline while others took advantage of the "Justification for Delay Forms" as an excuse for not obtaining a plan for at least six years after the initial deadline. According to Maryland's statistics for their on-farm implementation reviews, Maryland farmers showed the highest non-compliance rates.

Virginia's policy experience may reflect a situation somewhere in the middle of the buy-in in Delaware and alienation in Maryland. Buy-in in the Delaware experience meant agricultural stakeholders seized control and led the policy-making process. Alienating the regulated community in Maryland meant the environmental community seized control and led the process with moderate participation by the agricultural stakeholders. In Virginia, the "negotiated compromise" approach did not appear to result in either stakeholder group controlling the process. However, one could interpret certain elements of Virginia's process as exhibiting both buy-in and alienation characteristics. For example, though the Virginia Delegate and the environmental stakeholders did lead the policy-making process, the farm stakeholders were able to gain the upper hand in restricting the jurisdictional reach of the regulatory policy to just one agricultural sector (poultry) and further able to restrict oversight to only about 30% of the manure generated and used on the regulated poultry farms.

In the end, the stakeholder group that expressed feelings of being alienated from the policy-making process was the environmental community. After two years of deliberations between the agricultural and environmental stakeholders over the regulations, the policy entrepreneur and the environmental groups felt left out of the last-minute negotiations between the poultry industry and the regulatory environmental agency when the policy outcome was not to their liking.

Thus the dynamic of gaining buy-in from versus alienating the regulatory community may largely depend on a) whether the regulated industry is in the position of leading the policy-making process or b) whether the environmental stakeholders felt they had achieved their policy goals or not. "Winners" will likely feel they had buy-in to the process while "losers" will likely feel alienated.

However, as this dissertation has demonstrated, there are limits to how much the regulated industry can regulate itself. Delaware's policymakers and the agricultural industry developed a law that was the least comprehensive and intrusive of all the three states in that six more practices are required of regulated farmers in Virginia and two more practices are required of regulated farmers in Maryland. The DNMC never required farmers to submit their nutrient management plans to the state and thus the DNMC does not know what number or percentage of eligible farmers or acreage is in compliance with the state law other than those with plans prepared by public planners and those that received cost-share to hire private planners. Thus the DNMC knows only that 80% of the eligible acres are in compliance with their law and does not publish the corresponding number of farmers managing these acres.

The DNMC does not have a quality control process in place to systematically review plans prepared by private planners to ensure they are in line with university-standard recommendations. Only about 2% of all eligible farms are inspected every year compared to 10% inspection rates in Maryland and nearly annual inspections in Virginia. Less than half the farmers in Delaware are complying with the requirement that they submit Annual Report forms. In addition, the number of acres counted as in compliance with the law appears to be declining as of 2007 – the final year of the five-year implementation schedule.

Despite these clear indications of non-compliance with both the nutrient management plan and the Annual Report requirements, the DNMC has made no effort to begin any investigation into the 20% of acreage that should have a plan to determine if the land is being managed by a farmer with a certified plan nor has the DNMC made any effort to take enforcement actions against the 50% of farms that are not submitting the Annual Reports.

In addition to highlighting concerns about the DNMC's ability to effectively implement and enforce Delaware's nutrient management law, this dissertation demonstrated that gaining buy-in from the regulated industry has also not resulted in Delaware farmers accepting basic and modern nutrient and environmental scientific facts any more than they are accepted by farmers in Maryland or Virginia. Thus, it appears that neither approach, gaining buy-in, alienating the regulatory community, or the Virginia "negotiated compromise," appears effective in getting farmers to see eye to eye with the scientists.

Policy recommendation:

It is unclear whether, going forward, any of the case study states in this dissertation can resist their natural tendencies to develop policies in the same way they always have. As for lessons for other states, states that pursue agricultural regulatory policy approaches that try to be inclusive of the regulated community and try to minimize their alienation will likely result in better administrative, behavioral, and even potentially environmental outcomes.

Regulations that account for on-the-ground realities of farming and state regulatory capacities have better outcomes

Throughout this dissertation, I found there were several policy choices that reflected an understanding of the regulated communities' needs and helped create good outcomes, including administrative outcomes (early or on-time compliance), behavioral outcomes (improvements in actual nutrient management practices), and environmental outcomes (reductions in the excess manure and nutrient imbalance problems that are proxies for improvements in water quality, though they are difficult to measure and attribute to the state laws due to lag time and inadequate monitoring stations).

These effective policy choices include a slow and staggered compliance schedule, provision of cost-share funds to develop the required plans and transport excess manure, requirements and involvement of the poultry integrator companies, and compliance assistance. One other policy choice – educational requirements – remains theoretically important, because I did not observe a good behavioral outcome regarding acceptance of nutrient science or agricultural-environmental problems.

I learned that the pace that is set for the regulatory program's implementation and compliance schedule is critically important to the government's capacity to carry out its regulatory program duties; for private-sector planners to assist in implementation of the regulations; and for farmers to have the ability to obtain a plan. Even at two and a half years, which to most Maryland policymakers and environmentalists seemed very slow, the implementation schedule in Maryland was unrealistically rapid given the myriad of tasks needed to roll out the regulatory program. These tasks included finishing the Phosphorus Site Index, developing the plan-writing software, hiring and training new public planners, certifying private planners, identifying the farmers needing to comply with the law, communicating the new requirements and new phosphorus science to farmers, and getting the first set of plans written. Such a stressful implementation phase exacerbated the existing farmer backlash and fostered cynicism that Maryland did not care about farmers and did not care about effectively implementing the regulations.

In contrast, Delaware's five-year staggered implementation schedule starting four years after the law was enacted did appear shockingly slow but was manageable for both the regulated farmers and the plan-writing community. The phased-in schedule with a late start date was specifically advocated for by the private sector community, who argued that such a schedule would enable public and private planners to distribute their plan-writing workload over several years. This would ensure that the farmers could ease into compliance and planners would have ample time to prepare the plans and would benefit financially from a steady stream of work over many years. In addition, the private sector recognized that it would take years to invest in manure application spreaders and manure transport trucks and loaders and for a market of third-party manure transport brokers to be able to carry out the Delaware phosphorus-based policy.

In contrast to Maryland's "all at once" implementation approach, Virginia's "all at once" approach was more doable in terms of administrative compliance since the regulated population was only about one-sixth of the regulated population in Maryland and many Virginia poultry growers had already obtained a voluntary nutrient management plan. Furthermore, most growers ended up not needing a plan since they did not grow crops but only needed a manure management/waste transfer plan. However, Virginia's goal to inspect all 900 growers within the first year of compliance was unrealistic. Given that the previous Virginia Pollution Abatement (VPA) population was only about 150 Animal Feeding Operation (AFO) facilities, Virginia was not able to fill the additional inspection staff positions quickly enough to achieve the annual inspection goal of 900 growers.

Cost-share was the second critical policy choice that Delaware made that can be directly linked to the state's success at gaining early compliance and achieving up to 80% compliance of eligible acres. In addition, Delaware scientists credit the cost-share provided in the state's nutrient relocation program with nearly eliminating the excess manure problem and with helping to reduce the nutrient imbalance surplus. However, Delaware's emphasis on paying the cost-share for a plan with a private planner may have created the unintended belief held mistakenly by many farmers that they do not have to obtain a plan if the state does not provide them with cost-share.

Maryland did make an important commitment to sharing in the cost of transporting excess manure away from farms that should not be using the manure and was successful at getting the poultry industry to pay for half the manure transport program and share in the responsibility of the waste product of their industry. However, because Maryland has not evaluated its manure transport program, estimated the past and current size of the excess manure problem, or estimated the potential improvement in the nutrient imbalance problem in the state, it is impossible to say what kind of a positive effect the program is having on the remaining problems.

I also found that the involvement of the poultry integrator companies has been a critical policy choice in Maryland and Delaware and has led to significant environmental outcomes, though there is room for improvement. Given that agricultural production on the Delmarva Peninsula is dominated by the vertically integrated poultry industry and the soil phosphorus problem was in part caused by the excess phosphorus in chicken diet and therefore manure, Maryland's law required the poultry companies to begin using the enzyme *phytase*. This additive allows the poultry companies to reduce the phosphorus they add to the bird diet because it improves the bird's ability to absorb phosphorus. This, in turn, has reduced the amount of phosphorus excreted in the manure. Though Delaware did not have a similar requirement for the poultry companies operating in the state, the same poultry integrators operate in Maryland as operate in Delaware and the "First State" benefited from Maryland's policy going first. Because Virginia's law did not require the poultry integrators to add phytase, only some of them have, which is readily evident in the manure nutrient analyses from growers working for different integrator companies.

Maryland’s law also required the integrator companies to pay for 50% of the manure transport program, which is having a positive impact on moving manure away from areas of excess in Maryland. Perdue’s construction of the AgriRecycle manure pelletizing facility in Delaware was a result of the company’s own initiative, and this facility has been a major policy solution to the excess manure issue. Furthermore, each of the states benefits from working cooperatively with the integrator companies to help compel some uncooperative growers to come into compliance.

However, states should consider reopening the continuing issue of “spreading Total Clean Out litter in the winter to get rid of it” for policy deliberation. Growers, farmers, integrators, environmentalists, and the state departments of agriculture and environment in all three states should be at the policy deliberation table to identify causes of the problem and develop effective solutions to it.

The one policy option that still remains theoretically important to agricultural regulations is educational programs. I contend that educational requirements are critical to getting farmers to accept the nutrient recommendations in their plans and to adopt nutrient management practices, but it is puzzling why all three states have not been more successful at narrowing the gap of nutrient management beliefs between farmers and scientists.

During the development of their law, Delaware policymakers were deliberate in their requirement that farmers achieve nine educational credit hours every three years (three hours per year) to attain and maintain certification with the nutrient management law. Several Delaware policymakers told me they believed that farmers were not aware of the environmental problems associated with farming and felt that understanding these problems would help achieve “buy-in” to the regulations. In addition to providing educational programs about the benefits of nutrient management, frequent interaction with the state at these events help the DNMC and the Extension scientists communicate the regulatory requirements to farmers and teach nutrient management science and economic concepts. In contrast, the laws in Maryland and Virginia required farmers to attend certification and educational events only once every three years, suggesting a lack of appreciation of the magnitude of disbelief in modern and basic nutrient science.

However, educational programs remain only theoretically important because Delaware farmers do not appear to be any different from Maryland and Virginia farmers in their scientific belief. By and large, Delaware farmers do not accept the Sufficiency concept, and thus are wasting time and money over-applying nutrients. They also do not believe that agriculture is the primary source of nutrient and sediment pollution to the Chesapeake Bay and that even without soil erosion soluble phosphorus can still runoff farm fields.

There are at least four possible explanations for this lack of understanding by all farmers in this case study: (1) state agricultural educators and extension scientists are not teaching these critical topics at their educational events; (2) the educators are teaching the right information but not delivering it in a compelling way to make farmers become “believers”; (3) farmers resist believing the science because doing so would mean accepting that their worldview is misinformed and change is difficult to accept; or (4) farmers resist believing some of the science because they realize it would mean buying nitrogen fertilizer to comply with the phosphorus rules.

Focusing events that turn out to be weak can undermine the justification for and compliance with the new policies

This dissertation revealed that the *Pfiesteria*-related focusing event was very powerful at opening the policy window but ultimately distracted scientists, environmentalists, and policymakers from having the "real" conversation with the farming community about a) the ongoing excess manure and nutrient imbalance problem, b) the low adoption rate of nutrient management practices, or c) the low participation rate in voluntary technical and financial assistance programs. Each of these topics addresses the root of the unintended agricultural nutrients polluting local waterways and the Chesapeake Bay, but they took a backseat to the *Pfiesteria* fishkills.

Pfiesteria as a focusing event did what effective focusing events do: it galvanized public attention, engaged policymakers, justified new policy approaches, and established funding commitments to address the problem. However, because the *Pfiesteria*-related focusing event was too sensational and the media horserace created a level of hysteria, it prevented serious dialogue about the true ongoing and long-term problems. The media were too glib in their characterization that poultry manure was washing off farm fields into the bay, that farmers intentionally waste manure and commercial fertilizers, or that farmers do not care about the environment.

There are two likely reasons why policymakers and stakeholders were unable to set a better policy agenda during the open policy window to make more effective use of the *Pfiesteria* focusing event. First, as Kingdon (1995) and others have established, human beings find it very difficult to engage in rational, comprehensive decision-making and are especially limited from engaging in effective policy deliberations during a crisis. Second, in 1997, there had been little quantification by the scientific community of the excess manure problem and little quantification of the nutrient imbalance problem; thus, scientists and environmentalists had little “proof” of the magnitude and therefore the severity of these problems.

Policy recommendations:

In the future, before another focusing event materializes, scientists and environmentalists should use the non-crisis time period to dialogue with the farming community and collaboratively identify farm practices that result in nutrient pollution that may be worth addressing. Policymaking should try to occur during non-crisis times and at least the relationships should be developed, the educational groundwork should be laid, and investigations into various policy solutions should be started.

Then if no policy progress can be made in between focusing events, when the next focusing event occurs, at least some groundwork will have been laid. However, it may be naïve to think that all parties could compartmentalize assigning blame for the *Pfiesteria* fishkills and separate it from the process of agreeing on the long-standing farm-related nutrient pollution problems. Nevertheless, while focusing events open policy windows, in the future it would be wise to try to shift policy attention away from the new, unproven indicator to the old and long-time indicators.

10.4. Summary

A regulatory approach to nonpoint source agricultural nutrient pollution will turn out to be voluntary if the state is unable to compel, monitor, verify, or enforce compliance. Thus, successful regulations of nonpoint source pollution likely have to be developed cooperatively with the agricultural industry. Even more importantly, farmers have to be convinced that it is in their economic self-interest to comply with the regulations either because the environmentally protective practices can save them money or because the cost of non-compliance exceeds the cost of compliance.

Overall, this dissertation concludes that it does appear worthwhile to regulate farmers, because despite the understandable backlash, farmers are likely to be managing nutrients better than before the law.

> To ensure even greater future administrative, behavioral, and environmental outcomes, governments should be mindful of the tone and overall regulatory style so that the policy-making process is respectful and inclusive; choose regulatory requirements that are straightforward to implement and easy to verify; establish effectively designed educational campaigns to convince farmers of the economic and environmental benefits of the required practices; and provide cost-share for practices that only have environmental benefits for some initial period of time. Given the enormous effort involved in regulatory policy-making, governments would be wise to establish regulatory policies that have quantifiable administrative and behavioral goals that are directly linked to specified, desired environmental outcomes.

CHAPTER 11 – EPILOGUE

11.1. Introduction

Chapter 11 of this dissertation serves as the epilogue for this case study on state regulatory responses to an environmental focusing event linked to agricultural sources of pollution. I will first provide an update on policies dealing with agricultural pollution in the Chesapeake Bay that have been introduced since I completed the original data collection phase of this dissertation in 2006. I will then discuss these policy proposals, drawing insights from the answers to my research questions and the main themes of this dissertation. Finally, I will suggest future research topics important to agricultural-environmental policy.

11.2. Recent Policy Events from 2007 to 2009

A number of developments in the agricultural-environmental policy arena have occurred at the national, regional, and state level since I conducted the farmer and stakeholder interviews in 2006. By and large, these policy proposals and changes have not affected the implementation or enforcement of the three state nutrient management laws reviewed in this dissertation.

In 2008 and 2009, several federal and state policies addressing agricultural sources of water pollution have been proposed that affect the three dissertation case study states, including, in chronological order: the announcement that the voluntary Chesapeake Bay Agreement would not succeed by 2010 and thus a regional Total Maximum Daily Load (TMDL) will be developed for the Chesapeake Bay watershed, Maryland's proposal to establish a state-level animal feeding operation permit program, EPA Region III's campaign in Maryland and Delaware to enroll poultry growers in the new 2008 federal NPDES CAFO permit program, President Obama's Executive Order on the Chesapeake Bay, and Senator Ben Cardin's (D-Maryland) and Representative Elijah Cummings' (D-7th District Maryland) bill to reauthorize the Chesapeake Bay Program under the Clean Water Act. Each of these policies and proposals will be discussed in turn.

In the fall of 2008, Maryland Governor Martin O'Malley and Virginia Governor Tim Kaine announced at their annual Chesapeake Bay Executive Council conference that they would not be achieving the Chesapeake 2000 Agreement to clean up the Bay by 2010. The Governors acknowledged they will miss the cleanup deadline because they had not implemented all of the Tributary Strategy practices needed in the wastewater treatment plant sector, the agricultural sector, or the urban and suburban stormwater runoff sector. By missing this deadline, the Bay will remain on the EPA's "Impaired Waters List," which enables the EPA to exercise the next policy option afforded the agency by the 1972 Clean Water Act – to implement a Total Maximum Daily Load (TMDL) for the Chesapeake Bay.

To achieve the upcoming TMDL to clean up the Bay by 2025, the six states in the Chesapeake Bay watershed are required to submit Watershed Implementation Plans (WIPs) every two years starting in the fall of 2010. These plans outline their strategies to accomplish their state's nutrient and sediment reduction goals for point and non-point sources to achieve their state's portion of the TMDL. The states will decide whether the TMDL load allocations for non-point agriculture sources will become mandatory or remain voluntary while it is anticipated that the waste load allocations for the regulated

CAFO sector will likely become mandatory and enforceable. EPA announced in January 2010 that it will issue a new rulemaking by 2012 to consider “expanding the universe of CAFOs and requiring more stringent permit standards to control nutrients” to “more effectively address pollutant reductions necessary to achieve the objectives of the TMDL for the Chesapeake Bay.” EPA said the rulemaking could affect the CAFO program nationally as well (USEPA, 2010).

In December 2008, Maryland’s Department of Environment established a state-level animal feeding operation permit program to bring poultry growers under Maryland’s existing federal CAFO program that permitted under a dozen beef and swine facilities. The proposal was criticized by environmentalists for not covering enough poultry growers (only about 200 of the largest 900 or so growers would need a permit) or requiring sufficiently protective practices (only a 10-foot vegetative buffer from ditches and surface waters was required in addition to the nutrient management plan and manure storage requirements). Agricultural groups also criticized the proposal for being a redundant regulation because all poultry growers already have to comply with the state nutrient management law. EPA has objected to Maryland’s permit proposal, because among other things, it is not a federal program, and no facilities have yet received a state permit.

In early 2009, EPA Region III began collaborating with the Delmarva Poultry Industry, Inc. to hold a series of meetings with poultry growers in Maryland and Delaware. The EPA 2008 Final CAFO Rule did away with the Large, Medium, and Small size categories that established CAFO permit eligibility and installed a new eligibility threshold that a facility demonstrate it “discharges or proposes to discharge.”

Many CAFO programs in the Chesapeake Bay are unclear about how to apply this new ruling to their existing programs because they do not know how to define “discharge or proposal to discharge” for the 13 CAFO animal facility categories.

Region III took the initiative to define “discharge or propose to discharge” for poultry growers in Maryland and Virginia as any farm that has a swale or other water conveyance in-between two chicken houses that carries stormwater from the production area to a ditch or other surface water and on to waters of the state and the U.S. Thus, Region III essentially defined *all* poultry farms as discharging and thus needing to obtain a federal CAFO permit. About half of all of Maryland’s growers agreed as did about a third of Delaware’s growers by filing a “Notice of Intent” form, which is the precursor paperwork to obtaining a permit. Thus, EPA Region III’s initiative to interpret the 2008 Final CAFO Rule and partnership with the poultry trade association on the Delmarva Peninsula has brought poultry facilities under the federal CAFO permit system. It is unclear, however, if the new layer of federal oversight will result in significant environmental improvements on these farms since they are all already under the state nutrient management plan requirements.

In May 2009, just five months after taking office, President Obama signed an Executive Order on the Chesapeake Bay, requiring five federal agencies[23] to accelerate cleanup of the Bay by identifying and strengthening their existing regulatory authorities. The Executive Order Reports prepared by the EPA and USDA focus on agricultural water pollution. The EPA proposed to strengthen its existing federal CAFO program by increasing the number of CAFOs participating in the program and raising the

[23] EPA, USDA, Department of Defense, Department of the Interior, and NOAA

environmental performance standards of those CAFOs to include mandated practices in the non-production area, such as requiring cover crop plantings on agricultural fields. The USDA report proposed to approach the problem voluntarily by targeting the federal conservation program funding and technical assistance to the three animal production regions: Delmarva Peninsula; the Shenandoah Valley; and Lancaster County, Pennsylvania.

It is remains to be seen if these proposals are adopted and how much of a significant impact they will have given the limitations of federal jurisdiction. The EPA Chesapeake Bay Program estimated that the federal government's regulatory reach over pollution from all sources to the Bay is limited to just 40% of the nitrogen pollution, 35% of the phosphorus pollution, and 4% of the sediment pollution. Furthermore, the existing federal reach over the agricultural sources of Bay pollution is just a fraction of the nutrient pollution sources:

- 43% of the total nitrogen load to the Bay comes from agriculture but only 6% is regulated by the federal government.
- 45% of the total phosphorus load to the Bay comes from agriculture but only 8% is regulated by the federal government. (Subcommittee on Water Resources and Environment Staff memo, 2009)

There is also concern that the EPA will not exercise what limited regulatory authority it does have. Chuck Fox, the EPA Chesapeake Bay Advisor, said on a conference call about the Order Reports that he hopes the states will take the lead in expanding and strengthening the federal CAFO permit programs they are implementing, since rule-making at the federal level takes two to five years (Fox, September 10, 2009).

In October 2009, Senator Ben Cardin introduced a bill to reauthorize the Chesapeake Bay Program under the Clean Water Act and Representative Cummings introduced a companion bill. The bills officially establish the TMDL for the Bay and set a cap of 175 million pounds of nitrogen (from the 300 million pounds currently being discharged into the Bay) and 12.5 million pounds of phosphorus (down from the 14 million pound load) to clean up the Bay. The bills detail the Watershed Implementation Plans (WIPs) each of the three Signatory States (Maryland, Virginia, and Pennsylvania) must submit every two years to demonstrate they are implementing practices to achieve their portion of the Bay TMDL. The bills also require that these WIPs aim to realize implementation of practices that will achieve 50% of the TMDL pollution reduction goal by 2017.

The bills also establish a bay-wide nutrient trading program to help lower the costs of compliance with the TMDL and create a new source of funding from sewage treatment plants to pay farmers to install best management practices. Preliminary analysis of a future mature bay-wide trading market by the World Resources Institute (WRI) (where I now work) indicates that the revenues to farmers from nitrogen trading could rival or exceed the funding currently provided by the federal and state agricultural cost-share programs within the Bay watershed (Jones et al., 2010).

The Bay TMDL will be a first for the nation and continue the Chesapeake Bay states' tradition of setting innovative policy. However, there have been few pragmatic discussions thus far by the states as to how they will achieve the mandatory TMDL, since two-thirds of the necessary and upcoming reductions will likely be assigned to the agricultural sector as it has the lowest cost per pound to reduce nitrogen and phosphorus. There has been little to no discussion about the significant lack of state or federal cost-share funds to achieve the agricultural load reductions voluntarily. Likewise, little to no discussion has occurred about issuing additional state regulations to achieve the reductions by mandate. Drafts of the Watershed Implementation Plans are due June 1, 2010, while final reports are due November 1, 2010, for Phase I of the process. Phase II WIPs are due on the same dates in 2011 and will effectively launch the first two-year effort to clean up the Bay.

Thus, there is some concern that the states will not be able to provide the necessary "Reasonable Assurance" that they can achieve the TMDL and therefore risk drawing the EPA's punitive response that involves a) withdrawal of the federal delegation of the Clean Water Act programs to the states, b) rescinding all Clean Water Act funds to the states, and c) raising point source reduction requirements over which EPA has jurisdiction. The first two actions are counter-productive for the Bay cleanup effort and also offer little deterrence effect since EPA does not have the capacity to take over the state Clean Water Act programs and the state CWA funds are a tiny fraction of the funds they receive from the USDA agricultural conservation programs and the state cost-share programs (Perez et al., 2009).

11.3. How my Dissertation Findings and Themes Bear on Recent Events

I will discuss the recent policy events in light of my dissertation's findings and main themes, including: recognizing that nutrient management plans are in reality voluntary requirements, the importance of gaining buy-in and not alienating the agricultural stakeholders, and developing policies that are sensitive to the needs of farmers.

First, the dominant policy proposal affecting all three of this dissertation's case study states is the upcoming TMDL, whose development is being aided by the Executive Order Reports, the Cardin/Cummings legislation, and the federal CAFO implementation efforts. By setting specific caps of the amount of nitrogen, phosphorus, and sediment loads that can enter the Chesapeake Bay, the TMDL is a quantitative and goal-oriented approach to achieving better water quality. A major shortcoming of the policy window opened by the 1997 *Pfiesteria* focusing events was that no pollution reduction goals were established and only the most challenging best management practice – a nutrient management plan – was required as the policy mechanism to reduce agricultural sources of nutrient pollution.

Nutrient management plans, however, will play a role in the agricultural nutrient reduction efforts that states are starting to discuss. Since states are deliberating this year about how to divide up their state-level N, P, and sediment caps, first by sub-watersheds, then by source sectors (WWTP, stormwater, and agriculture), states will likely be interested in how well farmers are currently adhering to their mandatory or voluntary plans and what additional practices should be encouraged or required to help achieve the agricultural pollution caps. This dissertation reveals that adherence to nutrient management plans is likely low and thus additional efforts will need to be made to convince farmers with plans to follow them.

In addition, because states and the EPA's Chesapeake Bay Program Bay Watershed Modelers are already counting on a certain level of pollution reduction being achieved by the mandatory nutrient management plans, given the findings of this dissertation, they are likely over-estimating the amount of pollution reduction that has been achieved thus far. And, should states like Virginia and Pennsylvania consider making plans mandatory for all farmers like they are for farmers in Maryland and Delaware, then all four states will have to confront the challenge of getting regulated farmers, private planners, and fertilizer dealers to agree that it is in all of their economic self-interests that farmers adhere to university-standard nutrient management plans.

Overall, there are several promising examples of instances where policy makers in the TMDL arena are interested in gaining buy-in from agricultural stakeholders, though the approach appears slow going. At the federal level, the Executive Order Reports announced a new EPA-USDA cooperation agreement to accelerate cleanup of the Chesapeake Bay. Despite this new initiative, both agencies seem eager to continue their traditional approaches to agricultural pollution reduction in isolation. EPA's report emphasized its regulatory goal to expand the CAFO universe to more animal feeding operations and raise their environmental performance while USDA's report repeated its commitment to a voluntary approach to nutrient and sediment reductions while improving the cost-effectiveness and targeting of its cost-share programs.

At the state level, I am aware that at least Virginia has formed various stakeholder advisory groups that include agricultural trade association representatives to help the state develop its Watershed Implementation Plans. This is an important opportunity to bring agricultural leaders to the negotiating table from the start of the process which will hopefully inform the agriculture community through these agricultural leaders the hurdles that each pollution source sector is going to face to achieve the TMDL. In addition, I am aware that there are a few behind the scenes meetings starting to take place between environmental and agricultural stakeholder groups, which may help establish trust and effective working relationships. The example of the Delmarva Poultry Industry, Inc.

collaborating with EPA Region III to organize meetings with Maryland and Delaware poultry growers to convince them to obtain a CAFO permit was an example of the positive outcomes of gaining buy-in and avoiding alienating the agricultural industry.

I am also aware that some agricultural stakeholder groups in Virginia have begun a media and lobbying campaign to warn Congressional representatives and state-level policy makers that they are very concerned about what the TMDL might mean for farmers. Wilmer Stoneman, Associate Director of Governmental Relations of the Virginia Farm Bureau, announced in a press statement that, “The Bay is a priceless shared resource, and farmers are willing to do their share to protect it…However, proposed regulatory increases and expansions will effectively shut farmers out of future discussion on how best to preserve the Bay.” This last sentence was in reference to the EPA’s intention to expand the CAFO program to smaller animal facilities. (Stoneman, October 15, 2009).

While discussing the Bay TMDL before a U.S. Congressional Committee, Stoneman said, “The Virginia Farm Bureau believes that Chesapeake Bay water quality needs to be addressed. We want to restore Chesapeake Bay,” he added, “But we’re also saying agriculture has done its part.” Although it is unclear what “part” Stoneman is referring to, he could be referring to farmers participating in Virginia’s voluntary nutrient management program since 1987 or the oft repeated metric that baywide, the agriculture sector has achieved 50% of the Tributary Strategy goals. (Szkotak, November 29, 2009).

There are large differences among the states in terms of their level of interest in achieving the TMDL, which are due to proximity to the Bay and their Bay-environmental culture. Thus, there are also differing levels of interest to contributing toward Bay cleanup. Based on my personal experiences attending Principle Staff Committee[24] meetings, I observe that policy stakeholders from Maryland not surprisingly are the most motivated to help restore the Bay, followed by stakeholders from Virginia. Representatives from the rest of the Bay watershed states appear reluctant (Pennsylvania and Delaware), disinterested (West Virginia), or adamant that they need not participate (New York). As for Delaware, to the extent that the Bay TMDL caps agricultural nutrient pollution, the DNMC may be able to gain buy-in from the farming community to tackle the TMDL policy goals as a way to help them achieve the DNMC's goals to solve excess manure and nutrient imbalance problems.

Finally, policy discussions to date about the TMDL have paid surprisingly limited attention to the workings of farm culture and the needs of farmers to engage in large-scale pollution reduction efforts. For example, there has been very little discussion about the serious lack of cost-share funding to achieve additional pollution reductions and there have been no innovative funding mechanisms discussed. Even the proposal to expand the existing and nascent state-level nutrient trading programs into a bay-wide trading program, which would provide new revenues to farmers, has been met with mediocre enthusiasm from farm groups and with hostility from some environmental groups that worry about an unintended consequence of poorer local water quality in some streams.

Also, though the EPA Chesapeake Bay Program has held nearly 100 town hall–type educational events across the Bay watershed to educate the general public and specific stakeholders (including agricultural groups) about the upcoming TMDL, more outreach needs to be done with farmers. This dissertation underscored the large gap between

[24] The Principle Staff Committee is comprised of each of the Bay watershed states' secretaries of the departments of agriculture, environment, natural resources, and their deputy staff.

farmers and scientists about the size of the pollution problem coming from agriculture and the economic benefits of many best management practices. Thus, more tailored educational events should be developed and disseminated to farmers in the watershed to begin the slow process of changing minds, one nutrient management practice at a time.

The rapid schedule of developing the TMDL goals, writing the Watershed Implementation Plans, and setting the two-year milestone goals indicates that the TMDL policy-making process is rushed. Once the plans are finalized, states will need to find more money to fund new cost-share programs or develop regulatory requirements to establish new performance or practice-based standards for farms. States will barely have accomplished the legislative and regulatory process – let alone had time for the agricultural community to have responded to the new sources of funding or to the new regulations – before the first two-year milestone has been reached.

And finally, since no discussions about potential new state regulations have occurred, there has been no discussion about the feasibility or political will to employ conventional deterrence efforts to gain widespread adoption of nutrient reduction practices.

11.4. Suggestions for Future Research

Several ideas for future research surfaced during the writing of this dissertation, including research that addresses: a) farmer concerns about the potential for yield loss from following a university-standard nutrient management plan, b) the potential lack of discussion by Extension and Conservation District personnel with farmers about agriculturally related water pollution problems, and c) farmer and farm trade association concerns that more agricultural regulation will drive farmers out of business.

Establishing a yield goal based on the average of the best three out of five past yield results for each farm field is at the heart of a well-designed nutrient management plan, but to many farmers interviewed in this dissertation it is also the plan's Achilles heel. The prevailing economic and cultural norm for farmers is to push each field's yields to produce more bushels of crop per acre every year to maximize potential profits. Thus, getting farmers to accept and follow their nutrient management plan and getting them to accept optimization of yield instead of maximization of yield is a Herculean task.

Researchers who care about achieving widespread adoption of nutrient management plans should consider developing studies that test the two sets of farmers – those that follow their plans and those that don't – and estimate the impact of both behaviors on profits and on nutrient and sediment pollution. Special effort should be made to quantify the various direct and indirect economic costs and benefits to the farmer and the environmental impacts from adopting the Sufficiency concept of nutrient application, taking residual nitrogen credits, conducting annual soil tests and manure tests before each crop season, calibrating manure equipment before each crop season's application, using a PSNT test to determine whether additional commercial side-dress fertilizer is necessary, keeping manure-free buffer zones next to ditches and surface waters, not applying manure during winter months, and selling excess manure or participating in manure transport programs.

Should the results of a series of well-designed studies indicate that strict adherence to a nutrient management plan and other important nutrient management practices have a negative impact on yields and even on profits, states should consider the benefits of a yield reserve fund as evaluated by Virginia agricultural economists in 2008 to compensate farmers who pledge to follow their required nutrient management plan but prove they suffered yield losses (Metcalf et al., 2008).

Researchers should conduct a survey of state Cooperative Extension and Conservation District programs personnel and review their educational materials, including workshop, seminar, and conference presentations, to evaluate whether the existing educational and technical assistance system is adequately linking farming practices to environmental problems.

The results of this dissertation’s questions and Likert Statements about the role of agriculture in the Chesapeake Bay pollution and basic manure and soil sciences suggest that farmers do not believe their activities are linked to significant environmental harm and do not appreciate how much of a positive impact various best management practices can have on the environment.

Indeed, several researchers indicated surprise that factors like distance to impaired waterways, presence of impaired water, or other environmental problems were not at play in farmers adopting best management practices (Lawley et al., 2007; Ribaudo et al., 2007). Inherent in the researchers’ surprise is the assumption that Extension personnel were including impaired waterways as a discussion topic in their educational workshops or during their explanation of nutrient management planning concepts to farmers. States should explore if this is occurring and instruct their educational providers to teach farmers about the link between agricultural production practices and environmental problems and teach about the specific locations of environmental problems relative to individual farms.

Researchers should also explore and deconstruct the understandable gut reaction from the farming community that more agricultural regulation will drive farmers out of business. Given that achievement of the upcoming TMDL largely rests on the agricultural sector's achievement of its portion of the TMDL, it is necessary to pay specific policy attention to formulating effective combinations of voluntary and regulatory approaches to achieving practice-based or performance-based nutrient *and* sediment pollution reductions.

Researchers should consider working with groups of willing farmers in different size categories and different agricultural sectors (livestock, poultry, crop, turf, vegetable, fruit, etc.) to estimate the costs and benefits of adopting the most cost-effective best management practices beyond a nutrient management plan that avoid, control, and trap nutrient and sediment pollution with and without any public cost-share funds. Both direct costs and benefits and indirect costs and benefits (those that have unquantifiable or uncertain monetary values like the soil tilth benefits of cover crops or the organic carbon benefits of conservation tillage) should be evaluated. Likewise the environmental impacts of individual practices and suites of practices should be estimated across these agricultural sectors to help communicate how much farmers are able to contribute toward achieving the TMDL goals.

Such information will help policy makers, agricultural and environmental stakeholder groups, and the state and federal agricultural and environmental agencies devise effective combinations of additional regulatory requirements and cost-share funding to assist farmers in making additional nutrient and sediment pollution reductions. In addition, such information can help foster participatory dialogue about which practices society should expect farmers to pay for themselves, due to significant on-farm economic benefits, and which practices farmers should expect society to help pay for that only have environmental benefits.

APPENDIX

Appendix A - Stakeholders I interviewed

Formal 30-minute to 1.5 hour interviews:[25]

Aleshire, Emily, Nutrient Management Coordinator -- Animal Waste, Virginia Department of Conservation & Recreation

Allen, Patsy, CAFO NPDES Permit Specialist, Maryland Department of Environment

Astle, Norman, Director, Manure Transport Program, Maryland Department of Agriculture, and during the WQIA debate, Lobbyist for Maryland Grain Producers

Baker, Will, President, Chesapeake Bay Foundation

Baker, David, Chair, Industry Advisory Committee.

Barnes, Woody, Regional Inspector, Maryland Department of Agriculture, Nutrient Management Program

Bauhan, Hobey, President, Virginia Poultry Federation

Beloite, Jim, Agricultural Educator, Accomack County Cooperative Extension Service, Virginia

Bounds, Kenny, President, Mid-Atlantic-Farm Credit

Bowles, Betsy, Animal Feeding Operations Program Coordinator, Virginia Department of Environmental Quality

Bryce, Joe, Chief Legislative Officer, Maryland Governor Parris Glendening Administration

Callahan, Howard, Inspector, Maryland Department of Agriculture

Caulk, Wally, Administrator, Delaware Farm Bureau, and during the NML debate, Chair of the House Agriculture Committee in the Delaware General Assembly

Chalada, John, Environmental Manager, Perdue Inc.

Cherry, Philip, Policy Director and Legislative Liaison, Governor Tom Carper Administration

Corbin, Jeff, Advisor, U.S. Environmental Protection Agency and during the PWL, was Staff Scientist, Chesapeake Bay Foundation Virginia

Cuizon, Renato, Certification and Licensing Coordinator, Maryland Department of Agriculture, Nutrient Management Program

Dodson, Josh, Inspector, Tidewater Region, Virginia Department of Environmental Quality

Green, Doug, Chair, Maryland Agricultural Business Forum

Hance, Earl (Buddy), President, Maryland Farm Bureau

Hansen, Dave, Associate Professor, Nutrient Management Program, University of Delaware, Cooperative Extension Service

Hughes, John, Secretary, Delaware Department of Natural Resources and Environmental Control

Johnson, Eddie, Agricultural Educator, Wicomico, Somerset, & Dorchester County, Maryland Cooperative Extension, University of Maryland

[25] Titles of these individuals reflect their positions at the time of the interviews.

Joyner, Ed, Nutrient Management Planner, Virginia Department of Conservation and Recreation
Keen, Tony, Private Nutrient Management Consultant, Keen Consulting, Inc., Georgetown, Delaware
Lawrence, Louise, Co-Director, Nutrient Management Program, Maryland Department of Agriculture
Layfield, Pete, Nutrient Management Specialist, Somerset County Cooperative Extension, Maryland
Lewis, Trent, Broiler Manager, Tyson Foods, Temperanceville, Virginia
McCabe, Garth, Delaware Office for USDA Natural Resources Conservation Service
Moore, Don, Private Nutrient Management Consultant, AET Inc.
Morrison, Carole, Director, Delmarva Poultry Justice Alliance
Ockles, Dale, Member, Delaware Agricultural Industry Advisory Committee on Nutrient Management
Pease, Jim, Professor, Virginia Tech University
Perkinson, Russ, Director, Nutrient Management Program, Virginia Department of Conservation and Recreation
Pinto, Julie, Nutrient Management Specialist, Worcester County Cooperative Extension, Maryland
Powell, Royden, Undersecretary of Natural Resources, Maryland Department of Agriculture
Rhodes, Jenny, Nutrient Management Specialist, Queen Anne's County, Maryland Cooperative Extension, University of Maryland
Rohrer, Bill, Administrator, Delaware Nutrient Management Commission
Samadani, Fred, Co-Director, Nutrient Management Program, Maryland Department of Agriculture
Satterfield, Bill, President, Delmarva Poultry Industry
Schanniger, Dan, Certification Consultant, Maryland Department of Agriculture, Nutrient Management Program
Simpson, Tom, Professor and Coordinator Chesapeake Bay Programs, College of Agriculture and Natural Resources, University of Maryland
Steinhilber, Patricia, Director, University of Maryland, Nutrient Management Program
Webster, Anne-Meredith, Private Nutrient Management Consultant, Maryland and Delaware
West, Charles, Member, Delaware Nutrient Management Commission

Informal interviews:[26]

Bedford, Chris, President, Maryland Sierra Club Chapter
Binford, Greg, Associate Professor, University of Delaware
Brinsfield, Russ, Executive Director, Maryland Center for Agro-Ecology, Inc.
Bunting-Howarth, Kathleen, Delaware Department of Natural Resources and Environmental Control
Coale, Frank, Professor, University of Maryland
Clayville, Brooks, Private Nutrient Management Consultant, Eastern Precision Services, Snow Hill, Maryland
Garrett, Walter "Turp", Reinterred Agricultural Educator for Worcester County Cooperative Extension, Maryland
Greer, Jack, Director, University of Maryland Environmental Finance Center
Hollenbeck, Steve, Inspector, Delaware Nutrient Management Commission
Hudson, Nathan, Private Nutrient Management Consultant, Hudson Consulting, Maryland
Johnson, Gordon, Agricultural Educator, Kent County Cooperative Extension, Delaware
Larimore, Connie, Member, Delaware Nutrient Management Commission
Lewandowski, Ed, Executive Director, Delaware Inland Bays and Member, Delaware Nutrient Management Commission
Lewers, Robin, Representative, Atlantic Tractor, Tasley, Virginia
Malone, Bud, Extension Poultry Specialist, University of Delaware
Maroon, Joe, Secretary, Virginia Department of Conservation and Recreation
McGrath, Josh, Professor, University of Maryland
Moore, Gary, Virginia Agricultural Cost-Share Program Coordinator, Virginia Department of Conservation and Recreation
Perdue, Jim, President, Perdue Inc.
Phillips, Steve, Soil Testing and Plan Implementation Assistance, Virginia Experiment Station, Accomack County, Virginia
Quillen, Allen, General Manager, Hoober, Seafood, Delaware
Rew, Mike, Fertilizer Dealer Representative, UAP Northeast, Girdletree, Maryland
Riley, Lewis, Secretary, Maryland Department of Agriculture
Rutter, William (Bill), Mid-Atlantic-Farm Credit
Scott, Doug, Assistant Secretary for Nutrient Management, Maryland Department of Agriculture
Solberg, Carl, Member, Delaware Sierra Club and Member, Delaware Nutrient Management Commission
Staver, Ken, Research Associate Wye Research and Education Center
Stoneman, Wilmer, Associate Director, Virginia Farm Bureau
Walker, Derby, Nutrient Management Advisor, Sussex County Extension, Delaware
Webber, Steve, Member, Maryland Farm Bureau

[26] Titles of these individuals reflect their positions at the time of the interviews.

Appendix B – Information sheet for stakeholders I interviewed

INFORMATION SHEET FOR POLICY STAKEHOLDERS

Project Title	**How do state policy development processes affect farmer nutrient management? A three-state case study of regulating agricultural nutrient pollution on the Delmarva Peninsula**
Who is conducting this research?	This research is being conducted by Michelle Perez, a PhD Student at the School of Public Policy, University of Maryland, College Park. Her contact information is: (C) XXX-XXX-XXXX. Email: xxxxx@umd.edu. PhD Lab, Van Munching Hall, School of Public Policy, University of Maryland, College Park, 20742. Her Advisor is Dr. Robert Nelson of the School of Public Policy. His contact information is: (O) XXX-XXX-XXXX. Email: xxxxx@umd.edu. 2101 Van Munching Hall, School of Public Policy, University of Maryland, College Park, 20742.
Why is this research being done?	The project is part of a PhD dissertation for Michelle Perez. The purpose of this research project is to determine how the policy development processes of the nutrient management laws in Maryland, Virginia, and Delaware impacted farmer willingness to comply and to change nutrient management practices.
What will I be asked to do?	Michelle will interview key policy stakeholders that were either: a) involved in developing the original agricultural nutrient management laws in the three states or are, b) involved in the implementation of these laws. These stakeholders will be interviewed, in person, at a mutually convenient location or over the telephone for a 30 minute to 1-hour interview. Michelle will ask each stakeholder about their involvement in the policy development process, their impressions of how well the laws are working, their impressions of how farmer nutrient management practices may have changed, why each state's policy developed the way it did, and whether a regulatory approach was necessary or effective. In order for the interviewer to be fully engaged in the interview and to accurately represent the stakeholders' comments, Michelle will ask each stakeholder if she can tape record the interview.
What about confidentiality?	If asked, Michelle will keep entire stakeholder interviews or sections of interviews confidential and anonymous. To help protect confidentiality, Michelle will keep all tapes and transcripts of the interviews in a locked filing cabinet. She will use password-protected computer files. Quotes of stakeholder comments may be used in publications and attributed to a stakeholder, unless s/he requests that certain quotes be kept anonymous.
What are the benefits of this research?	This research is not designed to help you personally, but we hope that, in the future, people might benefit from this study through improved understanding of the effect that agro-environmental regulatory policy-making may have on its intended target, farmers.
May I stop participating at any time?	Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time.

Appendix C - Interview template for stakeholder interviews

<u>GENERAL QUESTIONS FOR ALL POLICY STAKEHOLDERS:</u>

First-hand, open-ended accounts of the *Pfiesteria*-related fish kill focusing events:

- Briefly describe the 1997 *Pfiesteria*-related fish kill events that prompted all three states to develop agricultural nutrient management plan requirements

Awareness of the developments in nutrient science and agricultural contributions:

- When did you begin hearing about a poultry manure-related phosphorus problem on the Delmarva Peninsula?
- When did you begin hearing that there was a dissolved form of phosphorus in addition to a particulate form?

First-hand, open-ended accounts of the policy development process in each state:

- Briefly describe the legislative and regulatory development process of the agricultural nutrient management plan law in your state.
- Was your state's policy-making process inclusive or exclusive of the agricultural community?

Stakeholders' view of their role and the role of other stakeholders in the policy development process:

- What was your role and your organization's role during each major stage of the policy development process (legislative, regulatory, implementation, enforcement)?
- How much influence did your organization have on the different stages of the policy process?
- Did you feel you had an equal seat at the policy-making table?
- How well did you work with other stakeholder organizations during each stage of the policy development process?

Explanations for differing farmer compliance rates in each state:

- What do you think are some reasons for the different reported compliance rates in each state by the first deadlines? (VA was about 100% compliant by the first deadline, DE was ahead of schedule, and MD had 30% of farmers filing plans while 60% filed Justification for Delay forms)?

Expert opinions on whether farmers have improved their nutrient management behavior:

- Have farmers improved the way they manage nutrients?
- Which nutrient management practices are most likely to have improved?
- Are farmers following their nutrient management plans?
- Would the state be able to tell if farmers are following their nutrient management plans?
- Is your state law resulting in improved nutrient management by farmers?
- Is your state law resulting in improved water quality?

Appendix D - Map of the counties and states on the Delmarva Peninsula

Source: http://www.greatersalisbury.org/userfiles/image/home-map.jpg

Appendix E - Information sheet for farmers I interviewed

<u>**INFORMATION SHEET FOR FARMERS**</u>

Project Title	**How do state policy development processes affect farmer nutrient management? A three-state case study of regulating agricultural nutrient pollution on the Delmarva Peninsula**
Who is conducting this research?	This research is being conducted by Michelle Perez, a PhD Student at the School of Public Policy, University of Maryland, College Park. Her contact information is: (C) XXX-XXX-XXXX. Email: xxxxx@umd.edu. PhD Lab, Van Munching Hall, School of Public Policy, University of Maryland, College Park, 20742. Her Advisor is Dr. Robert Nelson of the School of Public Policy. His contact information is: (O) XXX-XXX-XXXX. Email: xxxxx@umd.edu. 2101 Van Munching Hall, School of Public Policy, University of Maryland, College Park, 20742.
Why is this research being done?	The project is part of a PhD dissertation for Michelle Perez. The purpose of this research project is to determine how the policy development processes of the nutrient management laws in Maryland, Virginia, and Delaware impacted farmer willingness to comply and to change nutrient management practices.
What will I be asked to do?	Michelle will interview approximately 60 farmers that use poultry manure or grow chickens on the Delmarva Peninsula. These farmers will be interviewed, in person, at their farms or at a mutually convenient location for a 1 to 1.5 hour interview. Michelle will ask each farmer questions about themselves, their farms, their attitudes about their state's policy processes, and about their nutrient management practices. In order for the interviewer to be fully engaged in the interview and to accurately represent the farmer's comments, Michelle will ask each farmer if she can tape record the interview.
What about confidentiality?	Michelle will keep all farmer interviews confidential and anonymous. To help protect confidentiality, Michelle will keep all tapes and transcripts of the interviews in a locked filing cabinet. She will use password-protected computer files. Quotes of farmer comments may be used in publications but they will not be attributed to a farmer or in a way that may personally identify them. Should Michelle wish to cite a farmer's name in reference to a quoted response in her publications, she will only do so if she first receives consent from the farmer for identification.
What are the benefits of this research?	This research is not designed to help you personally, but we hope that, in the future, people might benefit from this study through improved understanding of the effect that agro-environmental regulatory policy-making may have on its intended target, farmers.
May I stop participating at any time?	Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time.

Appendix F - Interview template for farmer interviews

FARMER #:

Farm Demographic Characteristics

1. **Location - Which county(ies) did you farm in last year in 2005?**
2. **Size of farm - Last year, how many acres did you grow crops in? How many of those acres do you own and how many acres do you rent?**
3. **Do you farm with other family members?**
4. **C-W-S – Was that a corn-wheat-double crop soybeans rotation?**
5. **Size of corn & soybean acreage in 2005 - How many acres of corn, wheat, and soybeans did you raise in 2005?**
6. **How many acres of corn, wheat, & soybeans did you use manure on last year?**
7. **How often does the same acre of land receive manure?**
8. **Irrigation- What proportion of your fields are irrigated?**
9. **No-till - What proportion of the fields are no-till?**
10. **Soil type - What kinds of soils dominate the fields you operate?**
11. **Poultry production - Do you raise poultry? What kind?**
12. **No. houses - How many chicken houses did you have last year?**
13. **Size of poultry production - What's your production capacity per flock?**
14. **No. of flocks/yr - How many flocks do you have per year in 2005?**
15. **Integrator influence - Which Integrator do you contract with?**
16. **Time with Integrator - How long have you been with them?**
17. **No. growers - How many other growers do you get manure from?**
18. **No. other houses - How many other chicken houses is that?**
19. **Change - Has any of this crop or poultry production system changed significantly since 1995?**

Farmer Demographic Characteristics

1. Age - How old are you?

2. Education - What is the highest educational degree you've earned?

3. % of income from farming - What percent of annual net household income comes from farming?

4. Change - Has the % of net household income changed significantly since 1995?

5. Group membership - What farm / environmental associations are you a member of?

LIKERT STATEMENTS SHEET PROVIDED AT THIS POINT IN THE INTERVIEW

BASIC PICTURE OF MANURE PRACTICES

1. **History of plan possession- When was the first time you had a NM plan prepared?**
2. **History of nutrient advice - Before your mandatory NM plan, who prepared your voluntary NM plan?**
3. **Source of nutrient advice - Who gave you advice in the past on manure and fertilizer applications?**
4. **Usefulness of soil tests – When you look at your soil analysis, what information do you pay most attention to? Have you noticed your phosphorus values change over time?**
5. **Status of current plan possession - Do you have a current plan? How old is it? Is it an N-based plan? When was it prepared?**
6. **Use of plan – How useful is your NMP to you? How do you use your plan?**
7. **Process - What do you do with the manure each time you crust out? TCO?**
8. **No. sheds - How many manure sheds do you have?**
9. **Capacity of shed - What capacity is each shed built to hold? How fast does it fill up?**
10. **Stockpile shape - Do you stockpile manure outside in winrow shape or in conical piles? How high do you get the pile using a loader?**
11. **Procedures with other growers - When and how do you receive manure from the other chicken houses?**
12. **Distance to spread - What's the furthest distance and average distance you drive between manure source and the field you land apply the manure?**

13. **Time spreading - How long does it take, how many people, with how many vehicles to spread manure on your corn acres?**

QUANTIFIABLE NM PRACTICES

1. **Yield goal for corn - What was your yield goal for corn in 2005?**

2. **Yield goal by field? -Last year, did you have one yield goal for all fields or a different yield goals for each field? In 1995?**

3. **Manure application rate on corn - What was your manure application rate on corn in 2005? In 1995? Was it higher, lower, or about the same in 1995?**

2005 – **How much PAN are you relying on in your manure?**
When did you apply it?
How long have you used that rate?
What rate did you use before?

4. **Manure application rate on soybeans - What was your manure application rate on soybeans in 2005? When did you apply it? In 1995? Was it higher, lower, or about the same in 1995?**

2005 –
When did you apply it?
How long have you used that rate?
What rate did you use before?

5. **Manure on wheat - What was your manure application rate on wheat in 2005? When did you apply it? In 1995? Was it higher, lower, or about the same in 1995?**

2005 –
When did you apply it?
How long have you used that rate?
What rate did you use before?

6. **STARTER - Commercial N application rate - What was your starter commercial N application rate on corn in 2005?**

2005 –

7. **BROADCAST - pre-plant - Did you broadcast commercial N pre-plant?**

8. **SIDE-DRESS - Commercial N rate –In 2005, did you side-dress on corn? What was your side-dress commercial N application rate on corn in 2005?**

2005 –
How did you decide whether to use side-dress? Did you use a PSNT test or a stalk test tissue analysis?

9. **Residual Nitrogen - In 2005, do you take residual nitrogen credits for the previous year's manure application or previous legumes crops?**

10. **Commercial P application rate - What was your commercial P application rate on corn in 2005?**

2005 –

How long have you used that rate?

11. **Causation due to policy - Did you change your commercial fertilizer or manure use in response to your state nutrient management law? If not, the law, what was the influencing factor?**

12. **Plan basis – Is your plan an N-based, P-based plan?**

13. **Causation due to market- Did you change your commercial fertilizer or manure use in response to the recent increases in the price of commercial nitrogen?**

14. **Manure testing - In 2005, did you do a nutrient analysis of the poultry manure you used in your fields?**

2005 –
How often do you take manure tests?

15. **Proportion of fields receiving Soil testing each year- In 2005, did you take soil samples test them?**

2005 –
How often do you take soil samples?

16. **Soil Test Lab - Where are your soil samples being tested? How long have you been using them?**

17. **Awareness of Soils P values - Do you know your phosphorus soil test values?**

18. **Awareness of Proportion of Fields w/ Hi P - What proportion of your fields have high soil test phosphorus values?**

19. **PSI Awareness - Have you had the PSI done on your hi P soils? Has that brought your soil P value down so you can apply manure or more manure?**

20. **Do you know what the phosphorus crop uptake rate of corn is?**

21. **Calibration of Manure Equipment - In 2005, did you calibrate your manure spreader?**

2005 –
How often do you calibrate your manure spreader?

22. **Manure Application Season - In which months did you apply manure on your fields in 2005?**

23. **Manure Incorporation - In 2005, did you incorporate the manure on the same day as applied? How long have you been doing it that way?**

24. **Manure Application Weather - In 2005, did you apply manure on frozen ground? On snowy ground?**

25. **Manure Application Set-back - In 2005, how close did you drive your manure spreader to your ditches or streams?**

Have you seen these nutrient application philosophy philosophies before? **__Yes __No** **Which described below best represents your philosophy?** **____Build and maintain – "feed the soil"** – always apply at least enough nutrient to meet crop removal no matter what the soil nutrient concentration is. **____Sufficiency concept** – **"feed the plant"** – only apply nutrients if soil test is below critical concentration. **____Cation balance –** apply fertilizer to balance cation exchange sites.

Please circle your response to this question:			
How important is cost-share funding to your decision to install and maintain nutrient-related Best Management Practices?	Very Important	Important	Not Important
Comments:			

How would you rank the various sources of nutrients entering the Chesapeake Bay watershed? **Rank the sources from 1 to 5 with 1 being the most contribution and 5 being the least contribution:** ____Septic tanks ____Sewage treatment plant ____Agriculture ____Power plant and vehicle emissions ____Urban and residential stormwater

Use of Nutrient-related Best Management Practices (BMPs):	
Best Management Practices:	**CHECK if used:**
Pre-Sidedress Nitrogen Test (PSNT) or stalk test:	
Fall-winter cover crops	
Conservation Buffer	
EQIP Program	
State Manure Transport Program	
Conservation Plan	
State-approved Manure Shed	

Appendix G - Likert Statement questionnaire

	Likert Statements	Circle your responses					
1	The science linking *Pfiesteria* to nutrient pollution from agricultural sources was:	Very Certain	Reason – able	Don't Know	Weak	Disproven	1
2	In the past, it was customary practice for many poultry growers in my state to apply poultry manure on nearby fields for disposal purposes.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	2
3	Manure application on corn on a nitrogen-basis can result in up to three to four times as much phosphorus application as necessary for corn.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	3
4	Agricultural sources from the entire Chesapeake Bay watershed make up a majority of the nitrogen and phosphorus entering the Chesapeake Bay.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	4
5	In certain counties on the Delmarva Peninsula, there is more poultry manure produced than can be applied at agronomic rates in the same county.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	5
6	Even without soil erosion, it is possible for dissolved phosphorus to runoff from soils with Very High Phosphorus soil test values.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	6
7	Farmers had an equal seat at the policy-making table in my state during the development of the nutrient management law and regulations.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	7
8	My state's policy approach focused on building consensus amongst the various agricultural and environmental stakeholder organizations.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	8
9	My state’s agricultural nutrient management law is justified.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	9
10	Both integrators and poultry growers should be responsible for excess poultry manure.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	10

11	Updating and strengthening the voluntary nutrient management program would have been a better policy response than a regulatory response to the 1997 *Pfiesteria* events.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	11
12	Current agricultural nutrient management regulations in my state are stricter than they should be.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	12
13	I would like to receive more nutrient management-related educational materials.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	13
14	My nutrient management plan is too complicated to be helpful.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	14
15	My state is committed to fully implementing the Nutrient Management Program.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	15
16	My state's regulatory nutrient management program focuses more on farmers submitting the required documents than it does on educating farmers about the latest nutrient science.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	16
17	The penalties for non-compliance with my nutrient management law are:	Large	Moderate	Don't Know	Small	Non-existent	17
18	Protecting the environment is part of what it means to be a farmer.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	18
19	If I were to strictly adhere to the application recommendations in my nutrient management plan, I would likely be satisfied with the crop I harvest.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	19
20	Due to the normal hydrologic (air-water-soil) cycle, nutrients do volatilize, leach, or run-off my crop fields.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	20
21	With their own money and with cost-share funding from the state, all farmers have enough resources to prepare a nutrient management plan and to follow the plan.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	21
22	My state's nutrient management regulations are not always possible to comply with given the technical, logistical, and economic realities of farming.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	22

23	The nutrient recommendations in my nutrient management plan are too conservative.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	23
24	It is the responsibility of Delmarva farmers to control and prevent water pollution originating on their land.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	24
25	Integrators should be more involved in disposal of poultry mortality.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	25
26	Agriculture is being blamed for a greater share of the water pollution than it generates.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree	26

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