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Too Pig to Fail: Considering Regulatory Solutions to the Environmental Damages Caused by Industrial Hog Farms in North Carolina

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INTRODUCTION

Arguably one of the most important innovations in all of human history has been the shift from hunting-and gathering towards agriculture. Many American states hold a rich agricultural tradition and have relied on the domestication of plants and animals for economic sustenance. Since the 17th century, the land of North Carolina has been utilized for the farming of a multitude of different crops. After World War II, America saw a dramatic shift in the nature of agricultural practices. Operations shifted from small-scale diversified production towards industrialized large-scale facilities that rely heavily on innovative technology and an increase in fossil fuel availability. These industrial agricultural operations have succeeded in providing the world with plenty of food at a low price.

Many tout industrialized farming as wholly beneficial. Often overlooked, however, are the multitude of risks such practices pose to human and environmental well-being. Over the past several decades, North Carolina has a seen a boom in the establishment of industrial hog farms along the mostly rural coastal region. While legislators and producers espouse the economic benefits of the industry's presence, the mostly poor rural citizens surrounding the operations are disproportionately suffering from an array of environmental hazards. Though lawmakers and producers consider laws enacted to reduce hog industry regulations to be economically beneficial, the health and well-being of surrounding communities has been largely overlooked. Pork producers in North Carolina rear livestock in high-density sows capable of housing hundreds of thousands of hogs at a time.[1] Each hog stored in these confined animal feeding operations, or CAFOs, produces almost four gallons of waste each day.[2] Waste is accumulated underneath the sows and flushed into lagoons. Lagoons are open-air pits that can cover over six acres of land and hold more than twenty million gallons of wastewater.[3] Swine CAFO wastewater is comprised of hog feces and urine containing high levels of

toxins. Hog manure also contains high levels of nitrogen and phosphorous. The wastewater is stored in lagoons until it can be applied as fertilizer to agricultural fields through a sprayer system. Because lagoons are not covered, they are prone to overflow and leak wastewater into nearby waterways and aquifers. Contamination also occurs when improper land application practices allow for excess water to run off into nearby water systems. These discharge events give rise to accelerated aquatic plant growth and algal blooms. Wastewater, filled with nitrates and pathogens, can also contaminate groundwater and cause a variety of severe health issues to adjacent communities. Industry leaders tout this lagoon/sprayer waste management system to be the most cost effective.

After outlining the scope of the problem, I will first look to North Carolina's agricultural history to understand just how much the landscape has changed. I utilize environmental economics in order to show how the profitability of these "low-cost" operations can only be considered as such when external costs are not taken into account. I will then look to relevant environmental laws and regulations to see how they tend to disproportionately favor the interest of the industry over the well-being of the citizens. Using environmental ethics, I will discuss the moral dilemma posed by formulating policy in such a way as well as how lawmakers ought to use moral consideration in formulating new regulatory policies. Finally, building on a policy analysis I performed this semester, I will formulate a policy that corrects for externalities without having severe economic consequences on the community.

DATA ON PROBLEM

A study performed by William McBride and Nigel Key entitled "Characteristics and Production Costs of U.S. Hog Farms, 2004," highlights the gradual progression of the hog industry from mainly small-scale operations towards more large-scale intensive hog farming methods.[4] The

study suggests that improved technology and rising costs of production over the past several decades have slowly made it less feasible for small-scale operations to compete with large-scale agribusiness. In an effort to meet the demand of a rising national and international market for pork products, the American hog industry has scrambled to establish a greater number of large-scale, low-cost operations. In 1995 the industry earned a net gain of $1 billion, nearly tripling its earnings over 5 years.[5] This not only benefits the industry but also the state, which receives numerous economic benefits through taxation and employment. As the hog industry raced to expand and increase its profits over the last 30 years, questions of land use and waste disposal seem to have become an afterthought. Between 1985 and 1998, North Carolina jumped from fifteenth to second largest hog producing state in America.[6] Despite this surge in production over the past several decades, the actual number of operations in the state has decreased. This is because traditional small-scale operations have been increasingly unable to compete with the highly centralized confined animal feeding operations (CAFOs) that have consolidated in the state's coastal plain region.

The decline in small-scale operations also gave way to a surge in the total population of hogs within the state. By 2000, approximately 10 million hogs were being reared in North Carolina, outnumbering the state's human population of about 7.5 million.[7] In 1992, Smithfield, Inc., the world's largest producer of hogs, built the world's largest meat processing plant in Bladen County, NC.[8] Corporate giants like Smithfield, with large sources of capital, have utilized CAFOs in order to minimize operation costs and maximize revenue. As a result, large-scale hog operations have employed thousands of residents and brought in billions of dollars in revenue to the state of North Carolina. In response, North Carolina lawmakers passed a variety of legislation ranging from tax breaks to zoning and regulatory exemptions meant to encourage industry growth.

Although the hog industry's presence in North Carolina is often praised for the tremendous economic benefits it brings to the state, legislators have been relatively lax in their instituting and enforcing of regulations. As a result, CAFOs have come to seriously contribute to the degradation of the quality of life of adjacent rural communities and ecosystems. In an effort to keeps costs low and profits high, operations utilize high density sows wherein livestock are reared in close quarters until slaughter. These conditions lend to a tremendous accumulation of animal waste that is collected in large pools for anaerobic decomposition and stored until it is applied to farmland using a sprayer system.[9] These pools, called lagoons, tend to be poorly lined, thus allowing wastewater to contaminate local groundwater.

This image from pewenvironment.org depicts a typical swine CAFO waste storage lagoon.

Because swine CAFOs in North Carolina are heavily concentrated in the coastal plain region, these lagoons often overflow into elevated water tables during times of heavy rainfall. Since lagoon wastewater contains high amounts of nitrates and pathogens, contamination of groundwater poses a serious threat to the health of adjacent communities.[10] Similarly, surface water contamination resulting from overflows often leads to a higher pathogen load and eutrophication of coastal waters. Swine CAFOs also produce airborne emissions at every level of production and can contain toxic amounts of ammonia, hydrogen-sulfides, hundreds of volatile organic compounds, and endotoxins.[11]Increased exposure to these chemicals is closely linked to respiratory dysfunction and a range of other health effects.

Agricultural History of North Carolina

The British colony of Carolina was established in 1653 as Virginian colonists sought to move southward and establish permanent settlements along the region's coastline.[12]By 1700, there were about 4000 colonists living along the Albemarie Sound just south of Virginia. These colonists, along with their indentured servants and slaves, took advantage of the region's fertile soil and temperate climate to raise grain, tobacco, corn, and livestock.[13] North Carolina's geography, with its varied climate and landscape, has supported a multitude of agricultural industries.[14] As a result of the early settlers' widespread agricultural success, North Carolina underwent a rapid expansion in population from about 36,000 in 1720, to around 345,000 in 1775.[15] North Carolina farmers had been so successful in their endeavors that, by the end of the Revolutionary War, all easily cleared land had been claimed and the region was facing severe land pressure.[16] Rather than continue to expand to the south or west, people began draining swamplands and farming on newly exposed, highly fertile soil. Traditionally, the farms of North Carolina have been small operations wherein livestock were kept on free range, and labor-intensive cultivation depended entirely on human and animal power.[17]

After the Civil War, many industries in North Carolina had gone broke. In desperate need of money and industry revitalization, the State sold off a large portion of the region's remaining swampland to be drained and farmed. The state also sought to capitalize on the surge in timber demand following the Civil War and sold off swaths of virgin timber to large-scale mechanized timber harvesting operations.[18] Faced with a high demand for timber and a struggling economy, North Carolina had eventually depleted its timber reserves between 1860 and 1900. By 1900 cotton and tobacco had become economic mainstays in the region. Slowly, eager farmers from the northern states migrated to North Carolina and established land and labor-intensive operations on deforested plots and drained swampland.[19] These operations saw a temporary spike in prosperity as the US

entered into WWI and demand for food and forest products increased. At the same time, fertilizers were beginning to become available to farmers. In addition to improved crop rotation practices, fertilizers allowed farmers to cultivate on land that had been previously made barren by extensive monocropping.[20]

By 1933, years of rapid expansion and unsustainable farming methods finally caught up with the nation's farmers. In response to the dust bowl in the west and issues of severe soil erosion around the country, the U.S government formed the Soil Erosion Service.[21] The SES sought to encourage sustainable agricultural practices and implemented tree-planting programs over barren farmland. Congress also passed the Agricultural Adjustment Act in 1933 in order to regulate crop production and increase returns to farmers. The Act was designed to preserve small farms as the nation saw an increase in mechanization and the agricultural industry began to move towards large-scale operations.[22] World War II represents a major paradigm shift in North Carolina agriculture. By 1940, as a result of mechanization and a low availability of non-agricultural opportunities in the region, over 40% of North Carolina's residents lived on farms; nearly twice the national average at the time. WWII allowed the surplus rural population to leave their homes and join the military, exposing many of them to aspects of urban society for the first time. The War also expanded the market for farm products and provided higher income to farming operations. Increased revenue allowed for more of the small-scale farms to move towards mechanization and adopt modernized farming practices such as the use of petroleum intensive fertilizers and pesticides.[23]

Industrialization of the farming industry continued as a result of technological improvement and government subsidy programs. Although post-WWII North Carolina saw the largest number of farms, modernization and urbanization lead to a drastic decrease from 301,000 in 1950 to less than 60,000 farms today.[24] As advances in technological efficiency made it possible to yield more output

using fewer inputs, the number of farm workers quickly decreased while yields per acre skyrocketed. Though it has undergone significant changes over the last half of the 20th century and into today, agriculture in North Carolina has remained an economic staple. One of the biggest changes has been the shift from row crops to livestock production as the state's largest source of income.[25] Perhaps nowhere is this more apparent than in the meteoric rise of the American hog industry that began during the 1980s.

HOGONOMICS

In 2004, the USDA performed an Agricultural Resource Management (ARM) survey of US hog producers. The survey collected information such as facility type, size, production costs, practices, and financial characteristics.[26] The primary purpose of the ARM survey was to examine the average cost of hog production in the United States. In doing so, the survey highlights the economic trends that have come to shape the modern industrial hog complex. Hog production occurs in four phases: breeding and gestation, farrowing (birth until weaning), nursery (care until 30 to 80 pounds), and finishing (feeding until slaughter weight at about 225-300 pounds).[27] Traditionally, hog operations utilized small-scale farrow-to-finish (FTF) approach which encompasses all four phases of production. As the industry became increasingly industrialized, however, farm-to-farrow operations have come to be replaced by specialized units focusing on singular phases.

Figure A. Hog Production Phases and Completion Times (Source: Pew Commission on Industrial Farm Animal Production)

Production phase	Length of time
Breeding and gestation of producing female	15 weeks
Birth to breeding age	32 weeks
Gestation	16 weeks
Birth	
Weaning	2–3 weeks
Nusery, growing, backgrounding	6 weeks
Finishing	16–20 weeks

The ARM survey found that specialized farrow and weanling producers operated on land with an average of over $1 million in farm product value. Hog production accounted for 96 percent of total value in farrow-to-wean operations and 74 percent in wean-to-feeder operations.[28] Specialized hog finishing operations had similarly high average production values at about $900,000, 72 percent of which was directly attributable to hogs.[29] When looking at production value of farrow-to-finish operations, the ARM survey found average farm product value to be about $322,000 with only 59 percent of that attributable to hog production.[30] Although specialized units generally require significantly less acreage than FTF farms, they tend produce a much higher volume of hogs at a lower cost. Because small FTF operations utilize portions of their land to grow feed and dispose of waste, they are unable to focus resources exclusively towards hog production. Specialized operations, however, rely on third party contractors for those purposes and utilize land to build larger facilities.

The increased efficiency of the specialized model allows for more hogs to be produced at a significantly lower cost. As small-scale operations become increasingly less cost-effective, owners are increasingly compelled to leave the market and make room for CAFOs to take their place. Figure B illustrates how, since 1982, the number of hog farms in the United States has decreased while the total number of hogs produced has actually increased. CAFOs have greater access to capital and

technologies that allow facilities to process one hog unit significantly faster than smaller operations. Accordingly, Figure C from the ARM illustrates how production costs tend to decrease as the size of the facility increase.[31] The economic viability of the industrial hog complex has garnered wide-scale support and allowed the model to proliferate. In 2007, the hog industry generated an estimated $34.5 billion in US gross national product.[32] Lower production costs result in a greater availability of pork products at a lower cost to the consumer. Although the CAFO method of hog production appears increasingly efficient and overall beneficial, the current model fails to consider all of the production costs incurred.

Figure B

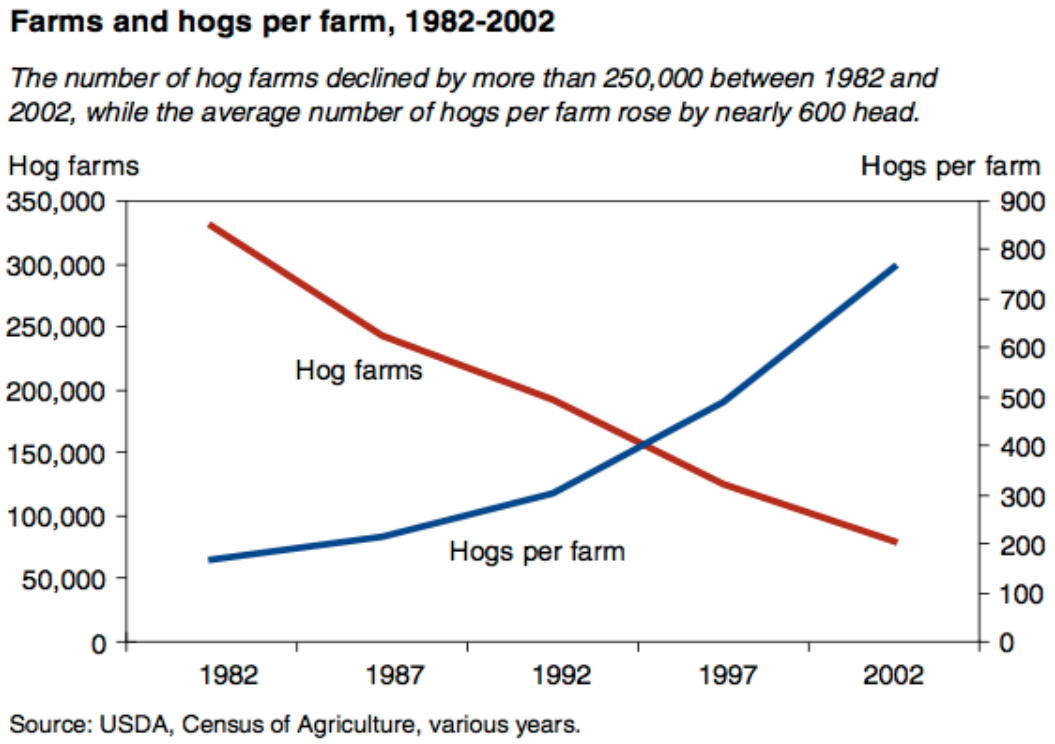
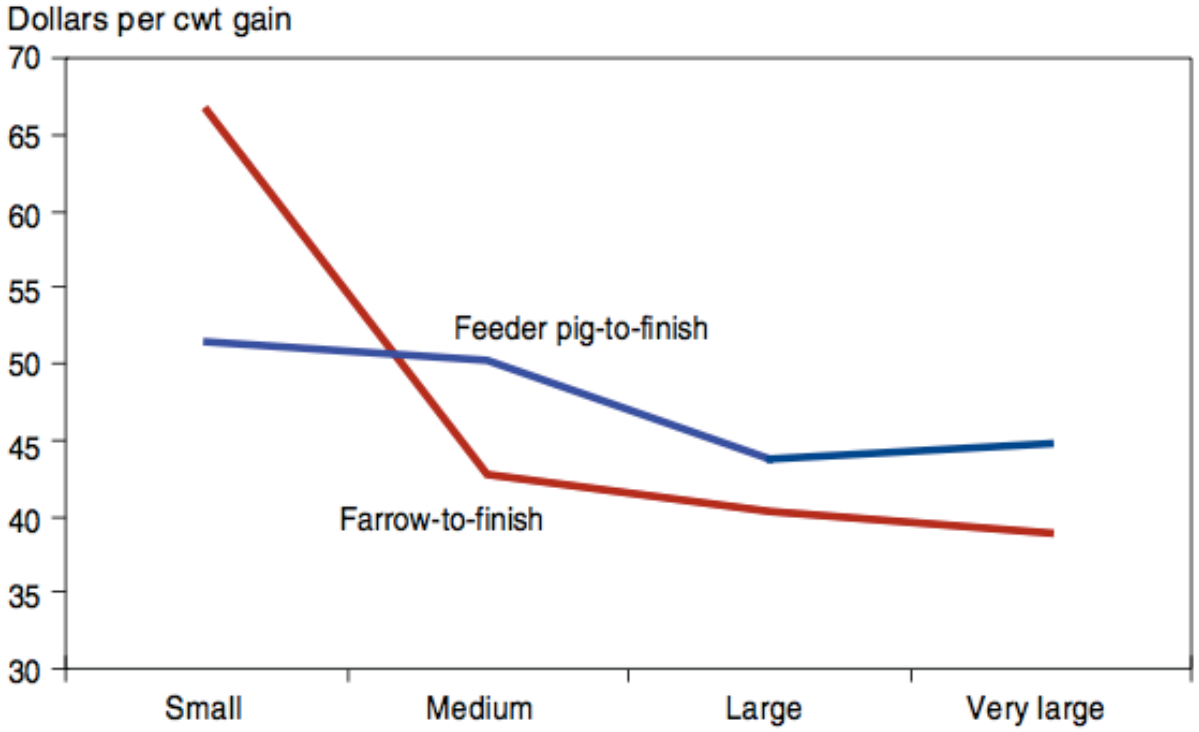


Figure C

Production costs by size of operation for hog producer types, 2004

Average operating and ownership costs declined as size increased, with the greatest decline occurring between small and medium farrow-to-finish operations.



Source: USDA, 2004 Agricultural Resource Management Survey.

Environmental economics uses the principles of economics in order to study the way actors manage environmental resources.[33] This is useful when analyzing how forces push markets in certain directions in relation to their effect on the environment. Because issue rhetoric so often focuses on economic factors, this approach becomes an increasingly useful tool when seeking a solution. In 2008, The Pew Commission on Industrial Farm Animal Production published a report entitled "The Economics of Industrial Farm Animal Production." The report uses environmental economics to show how the apparent benefits of CAFOs are far outweighed by their environmentally destructive

practices. The analysis develops a theoretical model that modifies current industry production models and seeks to internalize the external costs not accounted for.

Externalities are incurred when one party affects another party's production possibilities without being priced.[34] When a party is able to externalize the costs of certain actions, it holds no incentive to consider the effects of that action or ways to stop them. The hog industry has been shown to produce a wealth of externalities affecting the environmental quality of adjacent communities. The greatest source of external costs incurred is the manure generated. Traditionally, manure served as a cheap source of nutrients for small-scale operators who used it as fertilizer on crops.[35] Because large-scale operations are so concentrated, they generate considerably greater amounts of waste and have a harder time dealing with disposal. 98% of swine CAFOs in North Carolina utilize lagoons for waste disposal, which often result in leakages or overflows.[36] While CAFOs abide by certain waste disposal rules, lax regulatory guidelines and procedural loopholes have allowed them to impose external costs on adjacent communities through the pollution of air and water.

The contamination resulting from a CAFO's mishandling of waste can result in numerous health and ecological impacts.[37] The wastewater generated is high in nutrients like phosphorous and nitrogen, organic matter, pathogens, and odorous compounds.[38] Although regulatory guidelines address lagoon overflow prevention, discharge events can be attributed to limited oversight, poor maintenance, and extreme weather events. The wastewater can impact adjacent environments in several ways including runoff, erosion, direct discharge, spills, leaching into soil and groundwater, and release into the air.[39] When discharged into surface water, the excess nutrients in the wastewater often give rise to algal blooms. These blooms reduce the amount of oxygen in the water, thus disrupting aquatic ecosystems and killing off fish and shellfish populations.

Algal blooms not only pose a threat to the organisms within the ecosystem, but also to the communities that rely on the ecosystem services they provide. Most of North Carolina's hog farms are located along waterways that drain into the coast. In 1999, coastal tourism brought over $2 billion of revenue to the state and is considered a cornerstone industry of coastal economies.[40] Contamination poses a serious threat to the health of fisheries and nursery grounds along the region. While the polluting CAFO operator may pay little to no price for an accidental discharge event, surrounding communities and ecosystems are faced with the costs of damaged habitats and lost profits.

The pollutants found within CAFO waste also have an impact on human health. There are over 150 different pathogens found in livestock manure that are known to cause health issues in humans.[41] Among the pathogens are bacteria like E. coli and Salmonella, which can cause severe illness if consumed in drinking water. Further, an elevated amount of nitrates in drinking water is known to cause nitrate poisoning, which is particularly lethal in infants. When groundwater systems become contaminated, citizens and municipalities are faced with increased costs associated with health care and water treatment solutions. This is especially problematic when private wells are contaminated and treatment methods are not immediately available. In North Carolina, more half of all hog CAFOs in the state are located in areas where more than 85% of adjacent communities rely on well water.[42] The pathogens can also cause infections in humans through activities such as fishing, swimming, or boating.[43] In this case, commercial aquatic recreation facilities that use the surface water must either shut down operations or pay to remove the contaminants that result from CAFO wastewater discharge.

CAFO waste also imposes costs on surrounding communities through air pollution. While CAFO regulations primarily address issues of water pollution, waste storage methods do little to

prevent pollution of the air stream. As a result, communities and residences downwind suffer external costs in the form of degraded air quality, depreciated land value, and health issues.[44] Although some CAFOs may compensate residents by purchasing their property, many have strong familial ties to the land and its worth goes beyond simple monetary value. The discharge of waste into the air poses a health risk to communities when the wastewater is aerosolized through sprayers during land application practices. In the past, residents have complained that they could not leave their houses during certain times of day because the odor was unbearable.[45] This represents a serious opportunity cost externally imposed on the residents of communities who are forced to stay in their homes rather than do something else.

After considering the various external costs CAFOs impose on adjacent communities, it becomes increasingly clear that the industrialized model is far less efficient than proponents claim. In an attempt to find the actual cost of swine CAFO production, the PEW report quantified these various externalities and included them with the costs of operations of different sizes. Because small and medium scale operations are less resource intensive, their external costs are considered to be zero. The social costs analysis also considers the total operating costs of CAFOs in comparison to traditional small-scale operations and a newer alternative system that exerts less pressure on the land. For small-scale operations, the study found that the social costs were equivalent to the direct cost at about $57.81 per cwt. The social cost was also equal to the direct cost for medium-scale operations, although direct cost was lower at $45.83 cwt. While industrial CAFOs had the lowest initial production cost, after accounting for subsidies and monetized externalities, the model found actual cost to be $54.75 cwt. The analysis also compared the social costs of CAFOs with that of pasture raised operations and hoop-raised operations. Because pasture and hoop methods do not produce the same environmental damages, external costs are considered zero. While CAFOs have the lowest

initial production cost amongst the three, after accounting for subsidies and externalities, CAFO FTF facilities operate at a total social cost of $55.40 cwt. Figure D illustrates the results of the analysis and shows how, when accounting for external costs, Industrial CAFOs are actually more expensive per hundred weight than almost every other method of production.

Figure D. Comparison of Social Costs for Various Social Costs.(Source: Pew Commission on Industrial Farm Animal Production, 2008)

Production System	Social Cost		Production Costs		Subsidies		Monetized Externailities		Non-Monetized Externalities
Small FTF	$57.81	=	$57.81	+	$0.00	+	$0.00	+	
Medium FTF	$45.85	=	$45.85	+	$0.00	+	$0.00	+	
Industrial CAFO FTF	$54.75	=	$38.94	+	$3.88	+	$11.93	+	
Grain subsidy							$3.82		
EQIP					$0.06				
Wastewater Treatment							$11.93		
AB Resistance									
Pasture-raised FTF	$48.82	=	$48.82	+	$0.00	+	$0.00	+	
Industrial CAFO FTF	$55.40	=	$43.41	+	$0.06	+	$11.93	+	
Grain subsidy					$0.00				
EQIP					$0.06				
Wastewater Treatment							$11.93		
AB Resistance									
Hoop-raised GTF	$37.17	=	$37.17	+	$0.00	+	$0.00	+	
Industrial CAFO GTF	$49.33	=	$36.91		$0.49	+	$11.93	+	
Grain subsidy					$0.43				
EQIP					$0.06				
Wastewater Treatment							$11.93		
AB Resistance									

ENVIRONMENTAL LAW

In an effort to address the environmental issues posed by CAFOs, several federal and state environmental laws have been passed. CAFOs are primarily regulated under the National Pollutant Discharge Elimination System (NPDES) of the Clean Water Act (CWA). In 1972, Congress passed a

set of amendments to the Federal Water Pollution Control Act of 1948. The purpose of the amendments, known as the Clean Water Act, was to improve existing state-based water pollution guidelines and address growing national concerns surrounding water quality issues. The central provision of the Clean Water Act can be found in Section 301. This section outlines effluent limitation guidelines and restricts the discharge of all pollutants into navigable waters except when in compliance with sections 302, 306, 307, 318, 402, and 404.[46] Under this provision, if a point source discharge falls within the definition of a pollutant being discharged into a waterway as defined in Section 502, it is prohibited.

In order to be in compliance with the law, point-source discharging operations need to apply for a permit through either the National Pollution Discharge Elimination System (NPDES) of Section 402, or the dredge-and-fill permit program of Section 404. Section 402's NPDES permit program is the more prominent of the two permit programs and was created in response to a multitude of litigation claiming that sources were discharging pollutants into bodies of water in direct violation of existing federal environmental laws.[47] The establishment of the NPDES allows for stricter limitations as to what operators can discharge into waterways and provides for a centralized mechanism for monitoring and abating pollutant discharge in waterways.

Section 402 of the CWA gives the EPA administrative authority to issue a permit for discharge as to facilitate operator compliance with the CWA and establishes procedural guidelines for State NPDES programs.[48] 402(a)(2) authorizes the Administrator to "prescribe conditions for permits and assure compliance…including conditions on data and information collection, and such other requirements as he deems appropriate."[49] This statute gives the EPA full discretion over the NPDES program and subsequent regulations. 402(b) gives the Governor of each State the opportunity to administer its own NPDES permit program if they choose to participate. The statute requires

Governors seeking to establish a State NPDES program to submit a "full and complete description of the program it proposes to establish and administer under State law or under interstate compact." The Administrator must review this proposed program and verify through a statement by the attorney general that laws of the State allow for the program to be carried out.[50] 402(d) requires States to submit a copy of all permit requests to the Administrator as they are received and to notify the Administrator of all actions taken towards each application. If the Administrator objects to the proposed issuance of a permit or permit action, it must submit a statement of reason and include the measures it would deem necessary for issuance.[51] Further, 402(f) authorizes the Administrator to promulgate regulations that "distinguishes among classes, types, and sizes within any category of point sources."[52] Once approved, the permit holder is legally allowed to discharge pollutants only under the conditions of the permit for discharge issued. 402(h) states that when a permit holder is found to be in violation of conditions pursuant to enforcement guidelines prescribed in section 212, either the State or the Administrator may "proceed in a court of competent jurisdiction to restrict or prohibit the introduction of any pollutant…." [53]

Regulatory provisions pertaining to the EPA's administration of the NPDES permit program are outlined in 40 CFR 122-124. 40 CFR 122.23 contains permitting requirements for CAFOs. The regulations define CAFOs as point sources of water pollution that are required to apply for either an individual or general NPDES permit.[54] Effluent limitation guidelines and standards are the primary method of control under an NPDES CAFO permit. Depending on the characteristics of the operation, these ELGs dictate numerical limitations to the volume of pollutants being discharged. 40 CFR 122.42 states limitations must be primarily technology-based and determined through national ELG standards or site-specific evaluation. The technology-based limits relevant to specific CAFOs are promulgated under 40 CFR 412. This section outlines the necessary waste storage and discharge

protocol each CAFO must abide by depending on its size and the breed of animal produced. Since CAFOs are determined under 40 C.F.R. 122 to partake in industrial activity, an NPDES permit is also required to cover its stormwater discharge. The exception to this requirement is stormwater discharged from production areas being utilized for land application, this is defined as agricultural activity and exempt from the requirement under 33 U.S.C. 1342.

In 1975, the EPA delegated NPDES permitting authority to the North Carolina Division of Water Quality (DWQ). While the NPDES permit program provides a thorough regulatory framework, the extent to which guidelines are followed and violations are enforced is left largely to the discretion of the State administrator. Only fairly recently has public outcry and pressure from outside groups forced lawmakers to push for tighter regulations over the industry. During the late 80s and early 90s, legislators and administrators created a regulatory atmosphere that promoted the growth of the hog industry in certain rural areas of North Carolina's coastal plain. In 1997, the state legislator responded to outcry by issuing the Clean Water Responsibility Act. The bill placed a moratorium on the construction of hog farms with over 250 hogs and the expansion of existing farms.[55] In 1999, after Hurricane Floyd flooded the region's lagoons and caused massive discharge events, the state made the moratorium permanent but allowed for the unlimited construction of hog facilities utilizing "environmentally superior technologies."[56] Although the permanent moratorium helped to slow the growth of the industry, it put no additional regulatory pressure on existing operations.

In 2000, the Office of Inspector General published an audit report of EPA Region 4's oversight of North Carolina's NPDES permit program.[57] The primary objective was to ensure that Region 4 was properly monitoring compliance and enforcing guidelines. The audit also sought to ensure the North Carolina administering agencies had been taking appropriate enforcement actions and developed a permit for CAFOs that met all necessary CWA provisions.[58] The findings suggest

that regulators within the North Carolina Department of Environment and Natural Resources were relatively lax in enforcing guidelines and penalties seeking to prevent facility discharge. Specifically, the audit found that the DWQ fails to issue NPDES permit guidelines to facilities that were subject to federal CAFO regulations.[59] The report shows that North Carolina DWQ actually resisted EPA efforts to force them to issue NPDES CAFO permits in favor of their own state permit program. At present, the majority of swine CAFOs in North Carolina receive state permits but not NPDES permits. Despite the DWQ's claims that the state program meets all federal requirements, the EPA found the program to be deficient in several ways.

Compared to NPDES CAFO guidelines, the DWQ's conditions don't contain federal enforceability, adequate third party lawsuit coverage, sufficient public notice, and EPA oversight.[60] Although DWQ asserts its permit program is more stringent, failure to include these measures has allowed for operators to avoid penalties for certain discharge events. North Carolina officials claim that implementing an NPDES permit program would cause confusion amongst operators and lead them to believe that discharges were permissible.[61] DWQ's failure to include all applicable NPDES provisions in its state program increases the likelihood of CAFO discharge events and subsequent environmental damage. Under the CWA, EPA has the authority to take enforcement action against point source discharges. Because the NC DWQ does not actually issue NPDES CAFO permits to eligible operators, they are not required to share applicable data relating to operations. This lack of data hinders EPA's ability to monitor operation activity and take enforcement action. The audit found that between 1998 and 1999, eight of the twenty-four facilities reporting discharge met the federal definition of CAFOs and were eligible for an NPDES permit.[62] If those facilities received NPDES permits, EPA would have received knowledge and taken proper enforcement action.

The state permit is further inadequate in its failure to include provisions for third party lawsuits and public notice. The CWA allows a citizen suit provision when a member of the general public believes that a facility was operating in violation of its NPDES permit guidelines. Under the provision, a member was allowed to take legal action against a violator if the EPA or state regulator did not act.[63] In North Carolina, the state permit program does not include such provisions and appears to protect operators from citizen suits. The state CAFO permit program also fails to include any public notice provisions allowing for a 30-day public notice period prior to the issuance of a permit. Under state law, swine CAFO permit applicants were only required to notify adjacent property owners of their intent to construct. Federal guidelines, however, require NPDES permitting authorities provide public notice in a major local newspaper or in the Federal Register.[64] These contrasts illustrate the NC DWQ's failure to fully implement federal guidelines meant to protect the quality of the nation's waters

Moral Aspects

The disciplines of environmental economics and law have helped to inform the scope and causes of the issue. These are important to grasp because proponents of industrial swine CAFOs often assert the consequences of their activity to be legally and economically justified. While constructing counter claims using parallel rhetorical structure may encourage discourse, the approach fails to adequately represent why the issue is to be considered as necessarily bad. Ethics provides the issue with evaluative moral frameworks illustrating how behavior that infringes on the well-being of humans is inherently wrong and should be recognized as such. Using various ethical frameworks, we are able to consider the issue not in terms of dollars and cents, but in terms of individual well-being, both present and future. Specifically, environmental ethics considers the moral relationship that exists between human beings and non-human entities that comprise what is known as "the environment."[65]

Environmental ethics is a philosophical discipline that goes beyond traditional anthropocentric ideologies and seeks to consider the extent to which man has a moral obligation to consider his effect on the natural world.

The negative health effects and degraded quality of life experienced by residents of communities adjacent to swine CAFOs represent not only a case of costly externalities. In 2000, Environmental Health Perspective published the study performed by Drs. Steve Wing, Dana Cole, and Gary Grant entitled "Environmental Injustice in North Carolina's Hog Industry." The study analyzed location and operation characteristics of 2,514 industrial swine CAFOs in relation to the socio economic characteristics of surrounding neighborhoods. The majority of swine CAFOs in North Carolina are located along the coastal plain region, which is also considered to be a part of the southern Black Belt.[66] This term represents the region where agriculture-based economies were founded using African slave labor and where a large number of rural African Americans live today.[67] The study found that swine CAFOs were most concentrated in areas that had the highest disease rates, least access to medical care, and the most need for increased economic development and improved education systems.[68] Because hog production is concentrated in a generally poor region of the state, and because nonwhite poor residents disproportionately suffer health effects, this is largely an issue of environmental injustice.

The study suggests that, though low land prices may account for the correlation, the pattern of industry settlement reflects "institutional factors and the political and economic power of local populations."[69] As low-income minorities, the rural residents of the region have significantly less political power than does the hog industry. In 2010, I conducted a phone interview with Maeena Mohammad, a community organizer in North Carolina who helped push for a grassroots movement against the industry's violations. Mr. Mohammad was extraordinarily passionate when speaking

about the issue and described to me how lawmakers have ignored the citizens' claims that their water and air is being polluted by these industrial CAFOs. He recalled one instance in which a group of residents held a rally in front of their town hall. The rally goers brought with them a large tank containing the CAFO wastewater that commonly flooded their yards. He explained that an official rushed out of the building and told them that if they did in fact empty the tank's contents, they would be arrested for spilling toxic waste. Mr. Mohammad said he then asked the official, "how come it's toxic waste when it's in your yard, and not when it's in mine?" This question is a powerful representation of how legislators in North Carolina have seemingly ignored the negative environmental impacts that CAFOs have had on these minority communities. By failing to strictly regulate CAFO waste discharges, it becomes apparent lawmakers have placed the interests of the people below those of the industry.

Ethics does more than say what is right and what is wrong, however. Ethics and its moral frameworks become powerful policy tools when used to construct and implement policy solutions to controversial issues. Through ethics, we are able to understand why certain actions can be considered morally imperative, thus requiring us to act. This can be especially useful when constructing policy that is likely to face heavy opposition from lawmakers and leaders. In this case, we can subvert North Carolina lawmakers by representing their support for the hog industry's interests over constituent interests as a moral issue that affects human well-being. If discussions surrounding sustainability policies, such as those addressing hog operations, focused less on corporate profits and losses and more on human and environmental well-being--both present and future--then perhaps an effective and meaningful resolution isn't too far out of reach.

Arguments for and against the issue of regulatory measures are often framed in two ways. Either they are ideologically favored in light of environmental preservation, or they are staunchly

opposed in light of corporate losses. While this dichotic representation of the issue helps political zealots further their cause, it fails to accurately depict sustainable farming practices as morally imperative. Three foundational frameworks of ethics that lend to a new political understanding of the implementation of sustainable measures are those of moral psychology, professional ethics, and moral philosophy. A proper understanding of moral psychology helps by allowing politicians and organizers to frame the debate in such a way that appeals to the different human moral triggers. Professional ethics is a useful tool in developing and emphasizing policy mechanisms used to regulate corporate behavior. Similarly, moral philosophy helps to define and emphasize the degrees of responsibility certain moral actors have to behave in a sustainable manner encouraging the well-being of others. If we can understand such issues as ethical issues that affect human well being, then perhaps polarized leaders and lawmakers can treat them as such.

Before we can make an ethical appeal for sustainability practices, we must first have a proper and broad understanding of what it is humans understand as "ethical" behavior and how they came to think that way. By doing so, we are able to strategically construct an argument that changes the current perception of the issue and have them realize it as a moral imperative. In his book The Righteous Mind, author and psychologist Jonathan Haidt presents his theory on the evolutionary development of human moral psychology. His work helps us to understand how human societies have approached issues of moral responsibility and developed methods of moral judgment. One relevant aspect is the historic struggle of social order and the ways in which societies have grappled with issues of meeting the needs of the individual while simultaneously meeting the needs of the whole. Historically, he asserts, ancient civilizations tended to utilize a sociocentric approach in which the needs of the whole are placed before the needs of the individual. It was not until the 18th century and the beginning of the Enlightenment that western societies had started to form a more individualistic

approach to social moral order.[70] As its name suggests, this approach was one that subjugated the needs of the whole while focusing almost exclusively on individual rights and protection.

This individualist approach has become a mainstay of American moral thought in particular, wherein the protection of individual human rights and liberties are of the utmost importance. To understand this "narrow moral domain" of Western cultures is to understand that humans tend to be less morally responsive to issues that don't pose an immediate threat to the well-being of the individual. It is especially vital to have a thorough understanding of this aspect of moral psychology when calling for certain policies that may require some to sacrifice certain behaviors for the sake of others. Despite the undue burdens industrial hog farming may place on entire communities, the far-removed consumer experiencing only the industry's benefits will more than likely still support the industry. This is because the individualistic consumer's interest in cheap and convenient pork takes precedence over the harms that result from its production. The further removed an individual is from the situation, the less morally obligated they will feel to do address the issue.

David Rodin's essay entitled "What's Wrong with Business Ethics" is especially helpful when considering the framework of professional ethics in light of corporate social influence and responsibility. He first highlights the two schools of thought most prominent in the field of business ethics; the normative stakeholder theory and the shareholder value model. While each theory provides a slightly different normative moral framework in terms of to whom corporations are morally obligated, Rodin argues that both are incomplete and calls for a new theory of corporate social responsibility. Though Rodin deems them incomplete, there is a value in properly understanding these two common moral approaches. It is important to understand the theories under which corporations consider themselves "moral" agents and determine their moral patients in order to understand how policies can sway corporate moral behavior towards more sustainable practices.

The stakeholder theory ascribes moral significance to all individuals, groups, or entities that are affected by the corporation's pursuit of its objective. As Rodin points out, recently there has been a growing effort to utilize this understanding of a corporate stakeholder in order to encompass a wider range of people and things. Rather than utilize a normative moral theory that proscribes responsibility solely to those who have a financial "stake" in the corporation, it is increasingly necessary to include a wider variety of entities affected by corporate behavior such as competitors, nonhuman creatures, natural resources, and future generations.[71] Corporations often utilize large amounts of natural resources on which they place a market-determined monetary value, but generally fail to incorporate the negative externalities placed upon the resources. This failure to account fully for their practices poses a moral dilemma, as human and environmental well being is often negatively impacted by these externalities. By forcing corporations to broaden their understanding of to whom they are morally obligated, perhaps they will be more willing to embrace sustainability practices that avoid such harm to the stakeholders. Policy makers are not the only ones who can bring about such a shift. If they also believe the corporations are morally obligated to such entities as natural resources and future generations, consumers can choose to only utilize goods and services provided by those that embrace this all-encompassing stakeholder theory. Under shareholder value theory, Rodin explains, a corporation is to be understood as an entity that owes no moral obligations towards those who do not own a share in the corporation.[72] This theory understands a corporation as a type of forum, through which those who own shares in the corporation and those charged with running it can effectively maintain their interests. This understanding of corporate moral responsibility similarly fails to incorporate the well-being of anyone or anything outside of the direct corporate circle. This is clearly problematic considering the far-reaching influence that corporate behavior such as industrialized hog farming has over society.

In order to overcome the moral oversights that tend to arise through the utilization of either theory, Rodin proposes a new understanding of corporate entities and their obligations to self and others. Because of the abstract nature inherent in the definition of a corporation, he first calls for a concrete knowledge of all agents involved in and affected by corporate behavior and the driving interests behind it.[73] To understand corporate behavior in this way is to understand a new type of business ethic, whereas corporations cannot simply determine their behavior based on profit figures and management ideals. Instead, they are morally compelled to consider all of the consequences that may arise from their behavior and seek to act in a way that does the least harm to all those involved. This ethic calls for a drastic change in the way that the North Carolina hog industry would operate. While lower production costs allow for greater profits in the face of cheaper end products supplied to the consumer, the non-shareholders being affected must also be considered. Holding the hog industry responsible to the rural residents suffering from diminished air and water quality would force them to appropriate a portion of profit towards measures of curbing such pollution. Corporations may also be compelled to think of future generations who will presumably be relying on the same land they operate on today. Since it seems unlikely that corporations will adopt such an ethic anytime soon, it becomes increasingly necessary for policy makers to push for regulatory policies that compensate for a lack in corporate moral consideration.

Traditionally, the works of philosophers from Aristotle to Mill have been used in determining and expanding the moral status of the individual. Thus, moral philosophy serves a useful framework in further expanding the status of moral agents and patients addressed in policy. In his essay "Future Generations," philosopher Ernest Partridge seeks to utilize contemporary applications of philosophical frameworks in conveying the policy justification and implications of extending moral consideration towards future generations. Partridge begins his discussion by pointing out that, despite

the prevalence of the "future generation," in mainstream political discourse, contemporary philosophical questions of posterity questions only began to arise around the same time of the contemporary environmental movement.[74] Prior to this, humans held a considerably humble notion that no amount of anthropogenic activity could have a serious and lasting effect on the planet. Unfortunately, it is this mindset that continues to pervade the minds of those most staunchly opposed to regulatory measures involving sustainability. Partridge continues by pointing to the inherently problematic nature of present generations determining their moral responsibility to an unidentified group of persons they will never encounter.[75] The meta-ethical questions surrounding such an extension of the moral community highlight that present generations can never fully understand the needs of future generations and thus will have difficulty in determining how to preserve their well-being. Nonetheless, he states that ignorance of the future is an insufficient excuse to claim zero responsibility.[76] At face value it seems obvious that the unsustainable behavior of the North Carolina Hog industry poses a threat to the future generations of individuals who will occupy the land. Partridge points out that it is difficult cite a specific philosophical framework when approaching this unique question. Thus, he explains, contemporary moral philosophers have employed a wide array of moral philosophies in an attempt to either justify current unsustainable use of land and resources, or call for reform in the name of the future moral community.

Partridge examines such contemporary application of moral philosophy to issues of posterity as that of libertarianism, communitarianism, and Rawls' contractarian approach. The libertarian framework follows that, under a system of strictly private independent land ownership, individuals will seek to preserve the quality of their land indefinitely thus posing no risk to the well-being of future generations. This framework calls for a considerably drastic shift in property ownership norms while simultaneously removing all legislative regulations on land use.[77] Though this model holds that

individual owners will minimally degrade the land out of their own self-interest, it seems overly optimistic considering current industrial farming behavior. Partridge highlights Avner de-Shalit's communitarian approach in which future generations can be considered a part of the greater community to which we are morally bound. As discussed above, such a communitarian approach represents a departure from the Western individualistic mindset, and thus does not seem the most promising moral framework.

The moral philosophical framework that Partridge proposes as the most likely to influence meaningful sustainability policies in the name of posterity is John Rawls' contractarian approach. Introduced in his A Theory of Justice, Rawls' contractarian ethics seeks to establish a type of intergenerational justice wherein the interests of one generation is considered equal to the interests of other generations.[78] In order to properly ensure such a justice between generations, Rawls proposes the principles of a hypothetical contract be drawn under a "veil of ignorance," in which the contractors operate without knowledge of the generation they themselves are a part of. In constructing an intergenerational ethic, Rawls proposes contractors follow three rules from behind the veil of ignorance. These rules are "[1] preserve the gains of culture and civilization...[2] maintain intact those just institutions that have been established [3] put aside each period of time a suitable amount of real capital accumulation."[79] This use of the veil of ignorance is more hypothetical than a concrete method of policy formulation. Regardless, an approach emphasizing these three principles in a completely subjective manner can prove to be tremendously helpful to policymakers when seeking moral justification in pushing for the sustainability of factory farm operations. By emphasizing intergenerational justice through the maintenance and preservation of civilization and capital accumulation, Rawls' theory suggests current generations have a moral responsibility to utilize land in a more sustainable fashion out of duty to future generations.

SYNTHESIS

When I started my research I had planned on concluding by discussing small-scale alternatives as my ultimate policy recommendation. In fact, many environmental advocates call for the total elimination of the industrialized hog industry in favor of small-scale biodynamic operations. While such a conversion would surely decrease the amount of environmental harm created by hog production, it has become apparent that the industry's political influence and deep entrenchment in the state economy makes this alternative unlikely. Because the industry makes such tremendous contributions to the state, policy alternatives should seek to minimally affect the industry's current production costs and output levels. This semester, I performed an analysis considering policy alternatives that could curb the environmental damages caused by the industry while maintaining current economic benefits. Using the suggestions made in the Office of the Inspector General's audit, I first proposed that the NC Division of Water Quality strengthen its state permit program so that it meets all NPDES guidelines. A strengthened CAFO permit program addresses the issues raised by environmental ethics and economics because its regulations seek to correct for the harmful externalities existing operations impose on ecosystems and communities. By complying with EPA regulations, the DWQ can make permit guidelines federally enforceable, as well as provide the EPA with information about the state's swine CAFOs. Ensuring that all swine CAFOs are subject to NPDES enforcement will make it difficult for the DWQ to continue to ignore permit violations.

Members of the industry and many legislators view Federal enforcement programs to be burdensome and intrusive. The threat of federal enforcement serves as motivation for both parties to actively seek measures that would prevent the likelihood of a discharge event and subsequent federal involvement. An increased threat of permit enforcement and violation penalties will further disincentive operators from frequently discharging. Because the DWQ is currently slow to take

enforcement action, it is often less costly for operators to pay penalties for discharging than to invest in infrastructure improvements. Further, since penalties are rarely imposed, there is no economic incentive to invest in costly preventative measures. Under a strengthened NPDES permit program, violators are more likely to be charged a higher penalty or face other punitive measures. Regulators and industry proponents consider the lagoon/sprayer waste management system to be most economically viable and efficient. As illustrated through the application of environmental economics, this is only true when external costs that arise from mismanagement are not considered. Penalties should reflect those externalities as to make it more cost effective for operators to invest in preventative measures. While this approach may cause an initial decrease in industry profits, higher penalties will encourage better waste management practices and further decrease the likelihood of discharge events. One consequence of such measures would be the flight of the industry to another state with less stringent penalties. In order to compensate for this, regulators could work with lawmakers to provide further tax incentives to those producers actively working to minimize the likelihood of discharge and concentration of nutrients.

In 2000, industry leaders and the North Carolina Attorney General entered into what is called the Smithfield Agreements. Smithfield, Inc., agreed to fund research and development of "environmentally superior technologies" that could replace current lagoon/sprayer mechanisms. Researchers concluded in 2006 that none of the considered "environmentally superior technology" could be applied to existing swine CAFOs in an economically viable manner. This conclusion was made considering a static regulatory atmosphere. If lawmakers and regulators were to inform their decisions using environmental economics and ethics, application of certain alternatives to the lagoon/sprayer system may be more feasible. Current regulations already require all new hog operations to adopt the types of environmentally superior technologies considered in the report. In

order to facilitate the adoption of these alternatives amongst existing facilities, new permit guidelines can require operators to gradually implement these ESTs. In the second part of my analysis, I compared two alternative ESTs with the current swine/lagoon system to determine which technology a revised permit should mandate in its guideline. Aside from cost, the success of an alternative can be judged by its effectiveness at preventing likelihood of discharge events and reducing potential harm. For a standard CAFO housing 4,320 hogs, total construction costs of lagoons and sprayer systems are estimated to be about $200,000. Annual operating costs are about $10,000. The study found that the amount of nitrogen applied to land through lagoon effluent was 19,299.96lbs/year, and the total amount of phosphorous was 2,846.08lbs/year.[80]

The first type of alternative EST that permits can require hog operators to adopt is called the "Closed-Loop System." The CLS treats the liquid portion of the waste generated so that it can be reused for flushing hog sows and as drinking water for the hogs. The study found this technology to be environmentally superior by considering the project's technical feasibility, pathogen reduction, nitrogen emissions, and economic feasibility. The system collects flushed waste in a buffering tank before pumping it through an inclined-screen separator.[81] The separated solids are then collected and composted before being applied according to the facility's nutrient management plan, or sold as fertilizer. The liquid is treated with chemical sanitizing agents before being stored in a settling tank that collects remaining solids to be removed and composted. The remaining liquid is reused as flush water or combined with well water to achieve a quality consistent with human drinking water standards to be used as hog drinking water.[82] Any excess water is stored in a tertiary tank system until it can be processed.

This system is considered environmentally superior because it effectively stores all wastewater in containers, thus greatly decreasing the likelihood of discharge. The separation of solids

decreases the nutrient load of waste used for land application. Treatment and recycling wastewater further reduces likelihood of water contamination. Because all water is stored in a closed system, levels of air pollution are reduced significantly. The study also considers the possible environmental harm that can arise from the use of sanitizing agents and found no immediate environmental concerns.[83] Overall, land application of composted solid waste generated from the CLS contained 8,331.42lbs/year of nitrogen, and 3,606.75lbs/year of phosphorus. Initial investment for an operation rearing about 4,320 hogs is $335,859. Annual operating costs amount to $30,040.

The second form of waste management alternatives a revised swine CAFO permit can encourage is the Constructed Wetland System. The system operates by flushing accumulated waste once a week from beneath storage sows into a primary collection tank with a solids separator.[84] The separator captures solids with a perforated screen panel and discharges the dewatered material into a manure wagon to be used for land application. The liquid continues into a secondary gravity-settling basin where it sits for 30 minutes before flowing into one of two constructed wetland cells. The cells are similar to lagoons but contain planted cattails. The system allows the microbial colonies found in the roots of the cattails to facilitate accelerated denitrification. The presence of plant life allows for nitrogen reduction to occur with less odor and ammonia emissions.[85] After 12 days, the treated liquid is returned to a lagoon where it is stored until land application or recycled to flush the pits. The resulting effluent was shown to contain 97% lower nitrogen concentration than barn outflow, and 91% lower phosphorus concentration. Installation of this system for a CAFO housing 4,320 hogs costs $583,690 and annual operating costs are $7,848. The total amount of nitrogen in the liquid effluent used for land application was 6,666.59lbs/year and the total amount of phosphorus was 725.17lbs/year.[86] Because this system utilizes an open-air wetland/lagoon system, likelihood of discharge events is not lessened. However, lower effluent concentrations of nitrogen and phosphorus

suggest that discharge events would be less destructive because the wastewater would contain lower concentrations of nutrient and pathogen loads.

In order to determine which alternative the revised permit program should mandate existing operations adopt, I considered the criteria of costs, wastewater nutrient content, and likelihood/damage of discharge events yielded by each. The matrix below illustrates the comparative advantages and disadvantages of each system. While the lagoon/sprayer system has the least amount of overall cost, it yields significantly higher levels of nitrogen, and has a high likelihood of discharge. The Closed Loop System is least likely to give rise to a discharge event, but at $30,000/year, it has the highest annual operating cost. The constructed wetland system has the greatest initial investment cost at over $500,000, but has the least expensive annual operating cost at just under $8,000/year. Although the constructed wetland system does not significantly reduce likelihood of wastewater discharge, it yielded the lowest nutrient load of the three. Even though the constructed wetland is just as prone to discharge in the event of severe weather as the baseline system, a lower concentration of nutrients means that the adverse effects on water and air quality would be lessened overall.

Storage Type	Construction Cost ($)	Annual Operation ($)	N Concentration (lbs/year)	P Concentration (lbs/year)	Likelihood of Discharge (more/less than baseline
Lagoon/Sprayer	**200,000**	**10,000**	**19,299.96**	**2,846.08**	**----**
Close Loop System	**335,859**	**30,040**	**8,331**	**3,606**	**Least**
Constructed Wetland	**583,690**	**7,848**	**6,666.59**	**725.17**	**Less**

I found that, because the Constructed Wetland poses to yield the lowest concentration of nitrogen and phosphorus at the lowest annual operating cost, revised swine CAFO permit guidelines should mandate existing operations convert their lagoons into this system. This alternative represents the most effective solution to the major environmental issues caused by the hog industry in North Carolina. Retrofitting operations with the constructed wetland system is additionally beneficial because it utilizes existing lagoon structures. This would prevent operators from having to pay to have lagoons drained or leave large parts of their land unused which would occur if they were to adopt tank treatment methods such as the CLS. The Constructed Wetland System is likely to be well received by environmental advocates because it utilizes natural ecosystem services for remediation rather than fossil fuel intensive processes. Additionally, the constructed wetland can provide a viable habitat for different native plants and animals.

Industry proponents are less likely to initially favor this solution because of its high price tag. In order to garner support and avoid flight, lawmakers can use the income from increased penalties

and the industry's tax base to subsidize portions of construction costs. The subsidies represent a wise investment as the proliferation of this EST decreases the various external costs created by the discharge of concentrated nutrient loads into water sources. Further, once the initial investment costs are covered, the industry will actually face lower annual operating costs and be allowed to maintain existing levels of profit.

Because the industry is so powerful and considered so important in the state, it is unlikely that more radical shifts in the system can occur. This recommendation represents a moderate approach to the solution by working with industry polluters to gradually resolve issues. Although strengthened permit guidelines and a constructed wetland system will not completely resolve the issue, I feel these solutions can be realistically applied and will provide tangible relief to affected communities.

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