

Hog Pollution in North Carolina: Policy and Legal Analysis

*Emma Wheeler**

North Carolina is renowned for its pulled pork. Residents are quick to debate the merits of Eastern-style versus Lexington-style barbecue, a sweeter and redder version of the vinegar-based Eastern variety. The state's affinity for the pig is no surprise given that North Carolina is the second biggest pork-producing state in the country, producing \$2.9 billion in hog sales in 2012.¹ With that revenue though, comes vast amounts of pollution in the form of hog waste, which pollutes the streams, rivers, and air. In this paper, I will establish that hog pollution in North Carolina is an environmental and public health threat, representative of the broader challenge of regulating Concentrated Animal Farming Operations (CAFOs). The state of North Carolina and the nation at large must take a hard look at ways of effectively regulating this industry within existing state and federal legal frameworks and through innovative policy solutions, as current permitting systems have proven to be ineffective.

I will begin by looking at the current state of affairs of hog farms in North Carolina to show that the hog industry has grown to the point that its pollution is no longer adequately regulated. I will then give an in-depth picture of the water and air pollution at stake, as well as the health risks implicit with this pollution. I will examine the role of the federal and state governments under the relevant federal environmental statutes, and will show that these statutes are ineffective as currently applied in North Carolina and the nation at large. Next, I will explore the extent to which hog pollution disproportionately affects minority groups and populations living in poverty. Finally, I'll look at the challenges of addressing CAFOs in general and make policy recommendations for better regulating this environmentally harmful method of raising animals. This is an urgent issue that has yet to be effectively addressed by the state or federal government, despite having been in the public eye for almost two decades, since the *Raleigh News and Observer* writers, Joby Warrick and Pat Stith, wrote a Pulitzer Prize-winning investigative series entitled, "Hog Boss" in 1995.² While the hog industry is vital to North Carolina's economy and culture, its natural resources are just as essential. Though I focus on the hog pollution problem in North Carolina, these concerns are not specific to the state – the conversation on using existing and new legal frameworks to effectively regulate CAFOs is one that is long overdue.

Background Information

Hog pollution in NC has become a wide-scale problem since the industrialization of the hog industry in the 1980s. Previously, farmers had few enough hogs that the waste could be used as fertilizer without overloading the fields or having a need to store the waste.³ Today, large-scale hog farming in NC consists of over 2,100 industrial facilities raising nearly 10 million hogs⁴, producing an excess of waste to be dealt with as hogs produce an estimated two to five times the amount of waste as a human.⁵ A congressional report by the U.S. Government

* Undergraduate at Harvard University, Class of 2017

¹ USDA NASS, 2012 Census of Agriculture.

² Warrick, Joby and Pat Stith, "New studies show that lagoons are leaking", *Raleigh N&O*.

³ Peach, Sara, "What to Do About Pig Poop?" *National Geographic*.

⁴ Dove, Rick, "Hog Pollution and Our Rivers" *Waterkeeper Alliance and RiverLaw*.

⁵ Kuo, Lily, "The world eats cheap bacon at the expense of the NC's rural poor" *Quartz*.

Accountability Office found that in 2002, hogs in five adjacent counties housing over 7.5 million hogs could have collectively produced 15.5 million tons of manure that year.⁶ By comparison, the entire state of North Carolina's human population numbers 9.94 million and generates approximately 7 million tons of human waste a year⁷, which is carefully treated and controlled.

Municipal human waste is sent to wastewater treatment plants where it is collected, treated, and disposed of in such a way to “prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters”.⁸ In contrast to the treatment of human waste, hog waste is minimally treated and undergoes no standard or regulated treatment process. A typical hog facility in NC houses as many as 4,000 hogs, which are confined in close quarters, sometimes with little room for even basic mobility.⁹ When the contained hogs defecate in their stalls, the waste falls through slats in the floor and is then flushed into open-air lagoons. In the lagoons, exposure to naturally occurring bacteria causes the waste to turn an unsightly pink color, the only treatment the manure will receive. Once in the pond, thicker sludge sinks to the bottom, theoretically creating a barrier that will prevent leakage. The liquid at the top is siphoned off and sprayed onto nearby fields as fertilizer.¹⁰ The use of the waste as manure prevents the lagoons from regularly overflowing; however, the process brings its own myriad of consequences. Many residents live just feet away from the fields where the hog waste is sprayed. These neighbors complain of the offensive odor – a stench that fills their houses and makes their eyes burn. Additionally, the spraying process releases harmful air pollutants, and facilitates the contamination of waterways by runoff. The lagoon systems are prone to seepage into groundwater sources and have been known to overflow, especially during storms.¹¹ The hog industry has shown significant growth in recent decades, outgrowing regulations and wreaking havoc on the environment and nearby communities. The growth of the industry, coupled with the documented pollution effects and health risks associated with the waste necessitates a deeper look at the policy and law used to regulate the industry.

Pollution

An abundance of research has been produced since the 1990s clarifying the link between industrial hog farms and environmental degradation. Among the institutions researching this subject are the University of North Carolina at Chapel Hill, North Carolina State University and Duke University. Three major concerns are relevant in the conversation around industrial hog pollution: water pollution, air pollution, and health effects. Water pollution is perhaps the most documented of these effects. Studies have shown that sewage seeps from the lagoons into the ground water, allowing toxins to leak into potential water sources and deteriorate water quality. Not only does hog pollution affect ground water, it also affects the states' streams and rivers.¹² *Figure 2* in Appendix A shows the relative locations of swine CAFOs relative to the river basins they affect.¹³ The figure shows just how widespread the hog pollution is, and the large-scale

⁶ GAO Report, “CAFO – EPA Needs More Information...” p.5.

⁷ Calculated based on proportions of human waste in the GAO report, p.5.

⁸ NC General Statutes, Article 11, Chapter 130A, Section 33.

⁹ Lo, Mariana, “Hogwash from the Pork Industry” Earthjustice.

¹⁰ Kuo, Lily, “The world eats cheap bacon at the expense of the NC’s rural poor” Quartz.

¹¹ Peach, Sara, “What to Do About Pig Poop?” National Geographic.

¹² Warrick, Joby and Pat Stith, “New studies show that lagoons are leaking”, Raleigh *N&O*.

¹³ Harden, Stephen L. “*Surface-Water Quality in Agricultural Watersheds*”, USGS Report.

effects water pollution could have for major river basins in the eastern part of the state. High levels of nutrients and fecal matter in waterways are linked to low levels of oxygen in water, which can in turn cause fish kills.¹⁴ These results indicate that current waste disposal practices are insufficient in their prevention of seepage into groundwater sources, run-off into streams and watersheds, and leakage into surface water. Eastern North Carolina's landscape, which features high groundwater tables and floodplains, makes the lagoons especially susceptible to leakage and flooding, enabling the waste to contaminate nearby waterways. Additionally, excess spray runs off the land and into nearby creeks, streams, and rivers.¹⁵ The negative environmental effects associated with hog pollution are concerning if not potentially disastrous, and must be taken seriously by North Carolina's law and policy makers.

Health Risks

Equally concerning are the health risks associated with proximity to industrial swine operations with open-air lagoon and spray field waste management systems. Health effects are closely linked to air pollution and emissions from the hog facilities. The decomposition process of the waste can release as many as 400 volatile organic compounds into the air, including hydrogen sulfide, ammonia, dust, endotoxins, carbon dioxide, and methane.¹⁶ Many of these compounds are known to cause health concerns and to pollute the environment. Given the vast number of chemical emissions given off by the lagoon and spray field waste method and their documented health effects, it is no surprise that North Carolina residents neighboring hog operations often report eye irritation, nausea, coughing fits, breathing difficulties, asthma, wheezing, and elevated blood pressure.¹⁷ Studies have documented positive relationships between industrial agriculture output and infant mortality rates¹⁸, childhood asthma¹⁹, and blood pressure levels²⁰. Additionally, studies show that antibiotics used to keep the pigs healthy in close quarters may contribute to antibiotic resistance in human populations, which poses a major public health threat. The antibiotics are fed to pigs in large quantities, which often pass through the pigs and into the lagoons, where they may be sprayed onto fields or may seep into the groundwater, carrying the antibiotics, as well as resistant bacteria back into waterways and soil.²¹ Antibiotics are used to fight infectious diseases, but are ineffective when bacteria become resistant to them. In individuals with compromised immune systems, exposure to antibiotic-resistant bacteria can be deadly; in healthy adults, it makes treatment a longer, costlier ordeal. Given the severity of health and pollution consequences associated with the hog operations, it is astounding that they have been permitted to operate these hazardous waste management systems for so long.

Legal Frameworks: The Clean Water Act and Permitting

Several existing state and federal legal frameworks regulate industrial hog facilities, but have proven ineffective in controlling the North Carolina hog industry thus far. Hog operations

¹⁴ "What Is Nutrient Pollution?" *National Oceanic and Atmospheric Administration*.

¹⁵ Kuo, Lily, "The world eats cheap bacon at the expense of NC's rural poor" Quartz.

¹⁶ Marks, Robbin, "Cesspools of Shame", NRDC p.17.

¹⁷ Peach, Sara, "What to Do About Pig Poop?" National Geographic.

¹⁸ Sneeringer, Stacy, "Does Animal Feeding Operation Pollution Hurt Public Health?" p.124.

¹⁹ Pavilonis, Brian T. et al., "Relative Exposure to Swine Animal Feeding Operations".

²⁰ Wing, Steve et al., "Air Pollution from Industrial Swine Operations" EHP.

²¹ Marks, Robbin, "Cesspools of Shame", NRDC p.24.

can come into regulation under the Clean Water Act (CWA), the Clean Air Act (CAA), and even the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The EPA is the federal agency that oversees environmental regulations and the implementation of these federal acts; it is their responsibility to ensure that environmental pollutants are acknowledged and controlled. The extent to which industrial hog operations pollute nearby streams, surface water, groundwater, and watersheds makes the Clean Water Act an obvious avenue through which to regulate hog farming. The Clean Water Act is a comprehensive federal law controlling pollution of the rivers, lakes and wetlands of the United States.²² Under the Clean Water Act, a National Pollution Discharge Elimination System (NPDES) was established to limit the amount and type of pollutants from discrete facilities and point sources, which expressly include CAFOs. NPDES permits may be issued by either by states or the federal EPA, but are subject to enforcement by regulatory agencies.²³

Regulation at the State Level

North Carolina developed its own General Permitting System to regulate CAFOs, establishing several conditions that holders of Certificates of Coverage must meet each year. Among these conditions: facilities must be designed to “prevent the discharge of pollutants to surface waters or wetlands”; must be “designed, operated and maintained to contain all waste plus the runoff from a 25-year, 24-hour rainfall event”; must design a Certified Animal Waste Management Plan (CAWMP) with the help of a Certified Technical Specialist; waste must not be applied to fields at a rate faster than the nutrients can effectively be absorbed by crops.²⁴ The current General Permit is effective from October 1, 2014 until September 30, 2019. The North Carolina General Permit covers nearly all operation animal feeding operations, which are defined as feedlots involving more than 250 swine and a liquid waste management system.²⁵ While these provisions sound good in theory, in practice they have had almost no effect in regulating the industry for several reasons.

In 1997, the state placed a moratorium on the issuance of General Permits for construction of new hog Concentrated Animal Feeding Operations (CAFOs), and issued a prohibition on the expansion of existing hog CAFO operations. In 2007, the moratorium was made permanent under the Swine Farm Environmental Performance Standards act, banning new lagoons and requiring that new or expanded CAFO sites develop environmentally superior technology (ESTs). In order to remain permitted, sites undergoing expansions were required to reduce emissions substantially and prevent waste discharge into surface or ground water. Although the state offered a sizable cost-share program, which would allow site operators to upgrade their lagoons and implement ESTs, only 8 had participated, as of 2013. The law, though promising in theory, grandfathered in the vast majority of existing operations, thereby allowing them to bypass regulation. A later act in 2011 allowed CAFOs to make updates to their buildings without needing to upgrade to ESTs or address their waste management practices. This effectively allowed all hog farms to increase their building and herd sizes without addressing their lagoons, counteracting any good a permit might have done.²⁶ In September of 2014, the

²² “Animal Agriculture and the Clean Water Act”, The Pew Environmental Group.

²³ “Animal Agriculture and the Clean Water Act”, The Pew Environmental Group.

²⁴ Swine Waste Management General Permit, NCDEQ.

²⁵ “Animal Feeding Operations Program” NCDEQ.

²⁶ Nicole, Wendee, “CAFOs and Environmental Justice: The Case of North Carolina”, EHP.

North Carolina Department of Environment and Natural Resources (NCDENR) approved an extension of the General Permitting system, making minimal changes to the process despite abundant information about the failures of the system. These permits will be in effect until September 30th, 2019.²⁷ Through ineffective policies, North Carolina has allowed its hog industry to grow at an accelerated rate while failing to regulate its rudimentary hog waste disposal systems, in spite of more than two decades of public-awareness surrounding the issue. This failure on the part of the NCDENR and the state necessitates a closer look at the policies that have prevented the state from taking firm steps toward addressing the problem of hog CAFO pollution.

The current General Permitting process lacks an oversight mechanism, which has partially contributed to its vast ineffectiveness. With no way to ensure that farms are operating as they should and a limited budget for enforcement and inspection, the permit system has been rendered ineffective at preventing pollution. Additionally, the permitting process does not currently include a requirement for facilities to monitor their waste or the groundwater near their lagoons. Required monitoring by the farms would facilitate the DENR's efforts to prevent groundwater contamination because farms would be more aware of their contamination, and the information would be more easily accessible. Public disclosure of this information might make the owners of CAFOs less willing to ignore leakage and pollution problems, knowing that there would be enhanced levels of public scrutiny. Though regulation at the state level has failed to effectively address hog pollution thus far, there are several actions the legislature and NCDENR could take to better protect the state's natural resources and the health of its citizens.

Regulation at the National Level

The failure to effectively regulate CAFOs extends much further than North Carolina's borders. Under the Clean Water Act only about 40% of the nation's 200,000 large livestock facilities are regulated, according to Jon Devine, senior attorney at the Natural Defense Council.²⁸ Given the scale of CAFOs and the environmental degradation that accompanies these massive operations, this lack of regulation is astounding. In fact, the Government Accountability Office report finds that the EPA does not have a "systematic and coordinated process for collecting and maintaining accurate and complete information on the number, size, and location of permitted CAFOs" and therefore "does not have the information it needs to effectively regulate these operations".²⁹ Without necessary information or even required reporting from CAFOs, the EPA has had a difficult time appropriately regulating the industry. Aside from the challenges already discussed, the EPA has also struggled with issues of jurisdiction and authority in regulating certain aspects of CAFOs, such as the waste disposal systems of livestock and poultry farms. This has been based on disputes over the wording of the Clean Water Act, which lists "agricultural storm water" as a non-point source, allowing some farms to skirt regulation.³⁰ These ambiguities only add to the difficulties inherent in revising the existing legal framework to better regulate the nation's CAFOs. The EPA is likely to continue to face lawsuits and obstacles from the industry as they make efforts to reduce the scope of the CAFO problem.

²⁷ Lado, Marianne Engelman, "Complaint Under Title VI of the Civil Rights Act", p.5.

²⁸ Peach, Sara, "What to Do About Pig Poop?" National Geographic.

²⁹ GAO Report, "CAFO – EPA Needs More Information..." p.17.

³⁰ *Rose Acre Farms v. NCDENR* (2015), American Farm Bureau Federation.

Environmental Justice

The rural poor of North Carolina are disproportionately affected by the location of the hog facilities, which are almost always located near rural, low-income minority communities. Residents whose homes neighbor industrial hog facilities face the following consequences: they are exposed to numerous health risks, must put up with the smells and fumes, often experience nausea and breathing problems associated with the spraying process, cannot leave laundry to dry outside, cannot use well water, cannot allow their children to play outside, often feel uncomfortable inviting guests to their homes, may not be able to get the smell of the hog waste out of their clothes, are at risk of exposure to raw waste during leaks and hurricanes, and may not be able to move because of property devaluation.³¹ The hog farms prevent neighbors from enjoying their property, destroy their quality of life, and cause undue stress.

Figure 1 in Appendix A shows a map of North Carolina featuring dots to represent the location of hog facilities, and colored blocks to represent the percentage of minorities living in a given area. There is a strong correlation between areas with large minority presences and the location of the odorous, polluting hog facilities. The graphic comes from a UNC-CH study conducted by Steve Wing and Jill Johnston, from the Department of Epidemiology, which concluded that industrial hog operations in the state of North Carolina disproportionately affect Black, Hispanic, and Native American populations at a statistically significant rate, and seem to affect low-income minority communities significantly more than low-income white communities. They establish that the spatial pattern observed here is known as environmental racism.³² Environmental racism does not necessarily suggest that hog farms were intentionally placed neighboring rural minority communities. Often these locations are the paths of least resistance because the communities do not have the political or financial capital to prevent industrial hog operations in their communities.³³ Nevertheless, these populations are particularly vulnerable to environmental hazards and have reduced ability to relocate because of the industry's effects on property values. They disproportionately bear the brunt of the pollution and harm caused by the industrial hog farming operations, and the plight of these communities cannot be ignored in the discussion of hog CAFOs.

Some advocacy groups are fighting to address these concerns and to bring about positive change for the communities affected. Most notably, Earthjustice – a non-profit environmental law firm – brought forth a petition to the EPA alleging that the North Carolina Department of the Environment and Natural Resources (NCDENR) had failed to adhere to the 1964 Civil Rights Act in its hog pollution regulation. As mentioned above, the NCDENR is the state agency charged with protecting North Carolina's environmental and public health, and has the authority to issue permits consistent with this mission. This includes the authority to “regulate animal waste management systems at swine facilities”.³⁴ The complaint alleged that the NCDENR's General Permit issuance to industrial swine facilities in the state had allowed the hog facilities to operate with “inadequate and outdated systems of controlling animal waste” and with minimal oversight, which proved to be detrimental to neighboring African American, Latino, and Native

³¹ NC Hog Farm Factory Litigation Website.

³² Wing, Steve, and Jill Johnston, "Industrial Hog Operations in North Carolina. Disproportionately Impact African-Americans, Hispanics, and American Indians" UNC-CH.

³³ Nicole, Wendee, “CAFOs and Environmental Justice: The Case of North Carolina”, EHP.

³⁴ Lado, Marianne Engelman, “Complaint Under Title VI of the Civil Rights Act”, p.5.

American communities.³⁵ The complaint claims that because the NCDENR accepts funding from the EPA, the department is subject to the Civil Rights Act, Title VI regulation, which prohibits discrimination, and to the EPA's Title VI implementing regulations which state that "[n]o person shall be excluded from participation in, denied the benefits of, or be subjected to discrimination under any program or activity receiving EPA assistance on the basis of race, color [or] national origin". Earthjustice and the complainants allege that the NCDENR violated Title VI by allowing the hazardous lagoon and spray field systems to continue without restriction, citing evidence that the NCDENR ignored pleas from the affected communities to require more diligent waste disposal practices, and claiming NCDENR has been aware of the hazards of the currently accepted waste disposal systems since the mid-1990s. They claim that the NCDENR "finalized the permit without analyzing the potential for disproportionate health or environmental impacts on African Americans, Latinos, and Native Americans".³⁶ The complaint concludes by suggesting several less discriminatory alternatives for the DENR: that the department exercise their authority to require hog facilities to install monitoring and public reporting technology, waste management systems that minimize odors and pollution, and/or controls on confinement houses to filter air before it is emitted. Finally, they ask that the EPA "suspend or terminate EPA funding to DENR" should the DENR not come into compliance with the 1964 Civil Rights Act.³⁷

In February of 2015, the EPA announced that it would accept the complaint and would launch an investigation of the state agency. Though an investigation does not guarantee that any of the complainants' demands will be met, it is a step forward towards holding the NCDENR responsible for fulfilling its regulatory role. Depending on the outcome of the EPA's investigation, the DENR may be forced to revisit its permitting process and eventually work towards reducing pollution connected to hog farms. Regardless, this complaint has served to bring the North Carolina industrial hog farming back into the public eye, and has brought much needed attention to the underlying discrimination in the North Carolina hog industry. While the EPA investigation may not solve anything by itself, it may prompt the DENR to make adjustments to its permitting process, and to consider ways of more effectively and fairly regulating hog operations. It is a shame that current state legislation fails to adequately safeguard the interests of the low-income communities who most need protection or to effectively regulate the industrial hog industry in a way that requires compliance with basic environmental standards. Earthjustice's approach of invoking the 1964 Civil Rights Act in order to bring about environmental justice to the communities affected by hog pollution is an innovative legal solution. It is this type of legal solution that may be necessary on a large scale to address CAFO pollution if legislators at the state and national level fail to provide policy solutions.

Recommendations and Conclusion

Up to this point, the North Carolina legislature has made futile attempts at regulating an industry that has shown blatant disregard for North Carolina's communities, air, rivers, and groundwater. The failure of legislation to regulate the existing industry is inexcusable. Even without broad federal legislation regulating CAFOs, it is the state's prerogative to bring hog pollution under control. One effective strategy for doing this would be to replace the moratorium on new hog facilities with technology-based compliance standards, effective immediately for

³⁵ Ibid. p.3.

³⁶ Ibid. p.11.

³⁷ Ibid. p.45.

new and modified hog facilities. New regulations should remove exemptions for old hog farm facilities, and should instead give older facilities a set number of years to come into compliance. Non-compliance should be a fineable offense, and to minimize the extent to which administrative and inspection positions become necessary, the new regulations should feature citizen-policing measures. Such measures would allow citizens to receive a percentage of a non-compliance fine for bringing suit against a facility suspected of non-compliance. Fines should be set-aside in a fund to help moderate environmental damage already caused by the hog farms, and to cover relocation costs for families wishing to move away from the polluted areas. The current permitting system instituted by the NCDENR fails to implement proper control and oversight of the hog operations, and should be revised to prioritize the health of communities situated near industrial hog operations, and to minimize emission, leakage, seepage or overflow of harmful environmental pollutants. An improved approach would not grandfather in existing facilities, but would also encourage efforts to reduce the damaged and pollution caused by current and future farms.

As a nation, there are several viable avenues through which to begin to better address the problem. The EPA and state agencies can continue to work under the same CWA permitting system as they currently are, making incremental improvements to the process and battling industry leaders in the courts as they struggle to retain authority. This leaves the fate of the vulnerable communities disproportionately affected by CAFOs at the mercy of the EPA and state agencies that do not have a track record of protecting the needs of the rural minority populations. Alternatively, Congress could pass new legislation regulating CAFOs. If Congress were to do so, the policy should ensure that existing facilities are expected to come into regulation within a reasonable number of years. The policy would also do well to include provisions for heavy fines for non-compliance, mandatory-monitoring systems with monthly public disclosure requirements, and incentives to continually improve existing technology standards. Comprehensive federal regulations would be preferable for many reasons. It would prevent a race to the bottom among states at the expense of their rural poor populations, and would remedy the inconsistent regulation of CAFOs that currently exist throughout the nation. Additionally, other avenues for regulation of CAFOs remain relatively unexplored. The Clean Air Act was once considered as a means to regulate emissions for livestock facilities, but the lack of available data on emissions made writing feasible regulations for CAFOs under the CAA difficult. The EPA agreed that operators who monitored their own air quality were exempt from regulation during and prior to monitoring.³⁸ Depending on the success of Earthjustice's complaint using the 1964 Civil Rights act, future suits and complaints on the basis of environmental discrimination could be a viable short-term solution.

We should be deeply concerned about the growth of industrial agriculture, and its impacts on our environment and natural resources. Though this paper focused on hog CAFOs in North Carolina, CAFOs are a national problem, with over 200,000 operating across the nation. The same failings in regulation of CAFOs at the North Carolina level are present nationally as well. Meat and products produced in CAFOs are artificially inexpensive, with hidden costs including the damage they cause to water, air, and public health. The food we eat, and the organizations we support through food choices, have real and palpable effects on the environment. Public scrutiny is necessary to bring about positive change, as are conscious choices by the public to support

³⁸ Sneeringer, Stacy, "Does Animal Feeding Operation Pollution Hurt Public Health?" p.124.

farms and organizations that do not recklessly poison our waterways and fields. The state and federal governments have failed to regulate industrial agriculture operations in a way that prioritizes human health and the environment. This failure is indicative of the challenges in adequately regulating these powerful companies. It is essential that we continue to modify existing legal frameworks and explore innovative policy solutions in order to most effectively regulate NC hog pollution at the state level and to address the nationwide problems of CAFOs.

Appendix A: Charts and Figures

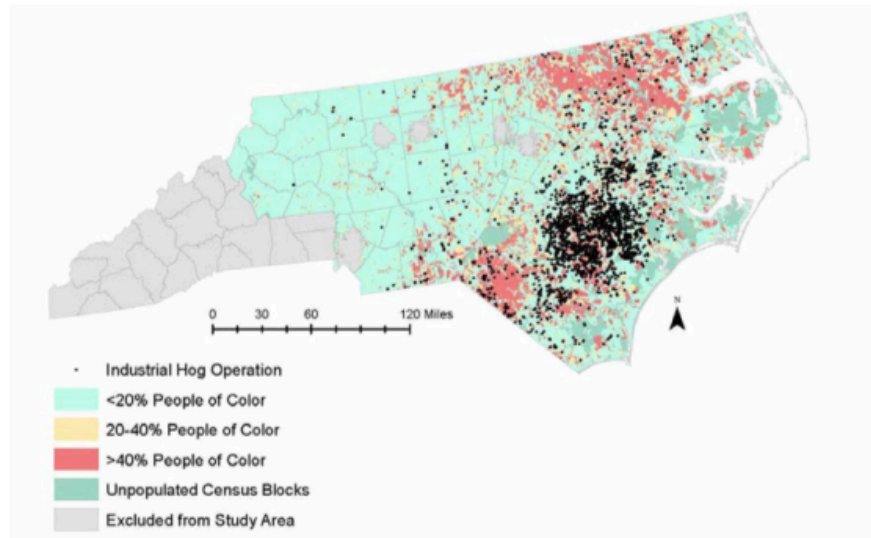


Figure 1: This graph shows the location of industrial hog operations in the state of North Carolina relative to areas that are more heavily populated by minorities.

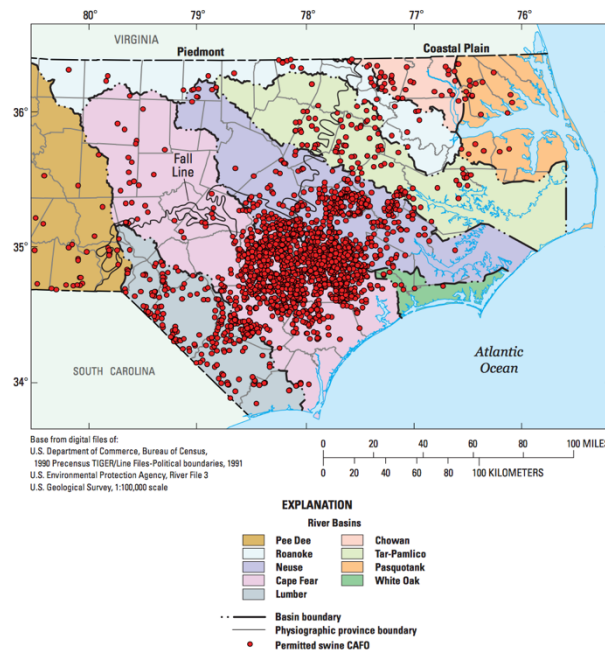


Figure 2: This chart shows the locations of permitted swine CAFO operations in NC relative to the river basins they affect.

³⁹ Wing, Steve, and Jill Johnston, "Industrial Hog Operations in North Carolina Disproportionately Impact African-Americans, Hispanics, and American Indians" UNC-CH.

⁴⁰ Harden, Stephen L. "Surface-Water Quality in Agricultural Watersheds" USGS Report.

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