

ENV872 course project: Pigs, Poop, and Public Health

https://github.com/mchan211/ChanJacob_ENV872_EDA_FinalProject

Natasha Jacob and Meilin Chan

1 Table of Contents

- List of Tables
- List of Figures
- Introduction
- Rationale and Research Question
- Dataset Information
- Analysis
 - Spatial Analysis
 - Visualization Analysis
- Results and Discussion
- Summary and Conclusions
- Resources

2 List of Tables

- Dataset information
- Counties used in our analysis
- Counties with high populations of hog farms

3 List of Figures

- Hog Farm locations in North Carolina
- Counties with High Populations of Hog Farms
- Population Distribution by County (%)
- Chronic Health Incidence Rates
- Health Accessibility
- Health Risk Indicators

4 Introduction

Hog farming is the practice of raising and breeding domestic pigs mainly for their meat and skin. Pigs are a popular form of livestock, with more than one billion pigs butchered each year worldwide, 100 million of them in the USA. The discharge of waste from hog farms is usually done by flushing the waste into giant holding ponds called lagoons. The liquid waste from the lagoons is then sprayed onto the farmers' fields to keep the lagoons from filling. The result, according to the farms' neighbors, is stench and insects and decay from dead hogs that are piled into open containers before they are removed. The EPA and federal politicians have drafted little to no regulation surrounding CAFOs to safeguard the environment and human welfare from their effects. Because manure lagoons are not connected to a moving water supply, there are little to no regulations surrounding waste disposal. As a result, they are not considered a serious threat to human or environmental health.

5 Rationale and Research Questions

Our main research question was if NC counties with higher concentration of hog farms would have higher health disparities compared to counties with lower hog farm concentrations. NC Hog farms dispose of pig poop by collecting enormous amounts of pig pools into lagoons and spraying the liquidy mixture out onto fields. As you can imagine, the fine mist can travel some distance and has led to strong odors and health impacts of neighboring communities. We were interested in seeing the distribution of populations near where hog farms are concentrated as well as if there were any disparities in health and health access. To research this, we looked at health and population distribution data for each NC county and specifically looked at data for counties with the highest concentrations of hog farms (Bladen, Duplin, Greene, Sampson, Robeson, Wayne) and comparing them to counties with low concentrations or no hog farms (Durham - as we are current residents of this county, Beaufort - as this is part of Duke's community, Martin, Wilson, and Warren). We wanted to gain a better understanding of the inequities and environmental justice issues that stem from NC hog farms and pork production economy.

6 Dataset Information

Our core analysis revolves around the use of spatial datasets of NC counties and hog farm locations, and a dataset containing population distribution and health data for each NC county.

- Spatial Data
 - cb_2018_us_county_20m.shp
 - Hog_Farm_Locations_NC1.csv
- Visualization Data
 - CountyHogs_HealthData.csv

Column Name	Description - all per county
Population	Total population
Child_Population_percentage	% (per county)
Elderly_Population_percentage	% (per county)
White_Population_percentage	% (per county)
Hispanic_Latinx_percentage	% (per county)
African_American_percentage	% (per county)
American_Indian_percentage	% (per county)
Reading_Proficiency_percentage	% literacy rate per county
Uninsured_Adults_percentage	% adults w/out health insurance
Medicaid_CHIP_enrolles_percentage	% individ. w/ Medicaid or CHIP
Primary_Care_Physicians	Physicians per 10,000 pop.
Low_Birthweight_percentage	% of low birth weight occurrences
Infant_Mortality_Rate	% rate of infant mortality
Cancer_Incidence	Incidence rates per 100,000 pop.
Heart_Disease	Death rates per 100,000 pop.
Poverty_percentage	% of pop. living under poverty line
Air_Pollution	avg. daily density of PM (ug/m3)

Table 1. Table showing description and units of variables used in the study

High density	Low density
Bladen	Wilson
Duplin	Warren
Greene	Martin
Robeson	Beaufort
Sampson	Durham
Wayne	

Table 2. Table showing North Carolina counties used in the study - counties with high and low densities of hog farms in North Carolina

Data Wrangling

The file was first converted from a .xlsx format to a .csv format since the csv file was found to be more compatible with the functions we used in R. A detailed explanation of the data wrangling process can be found below:

- Select and de-select functions were used to remove rows and columns containing weblinks and other metadata
- A piped statement was used to select the counties of interest and rename the columns
- Transpose function was used to interchange data present in rows and columns (x,y) to for easier visualization
- A piped statement was used to rename column names due to the use of the 'Transpose' function which altered the column names
- A piped statement with the 'gsub' function was used to remove '%' characters from values

7 Data Analysis

7.1 Spatial Analysis

Hog Farms in North Carolina

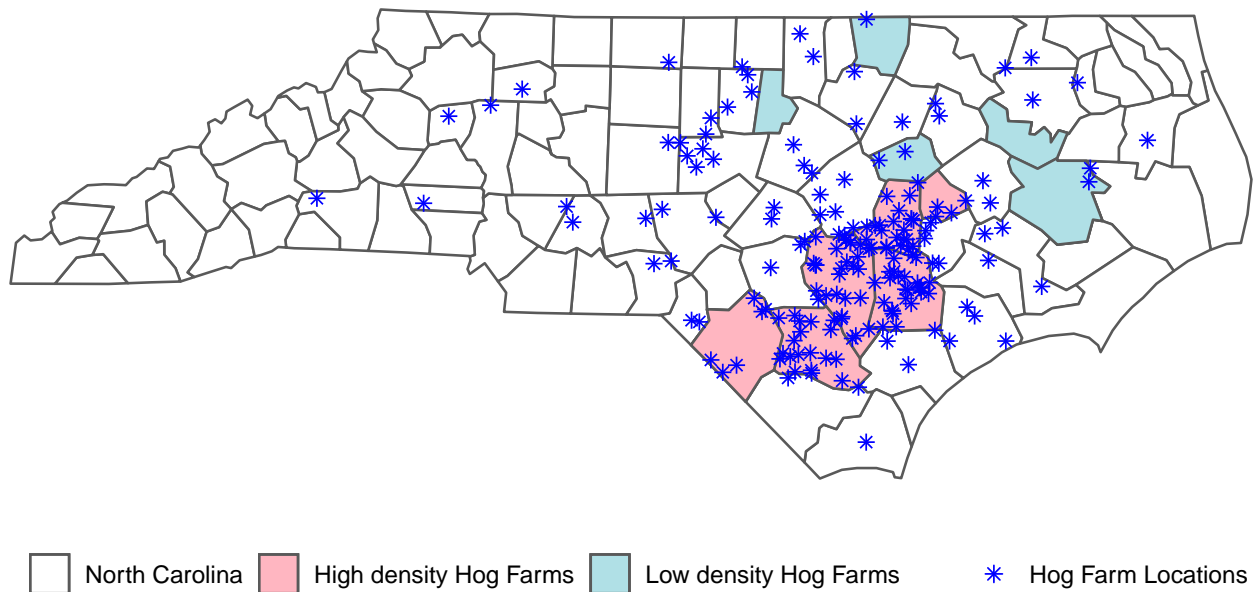


Figure 1. Map showing spatial extent of Hog Farm sites located in North Carolina

NC counties with high populations of Hog Farms

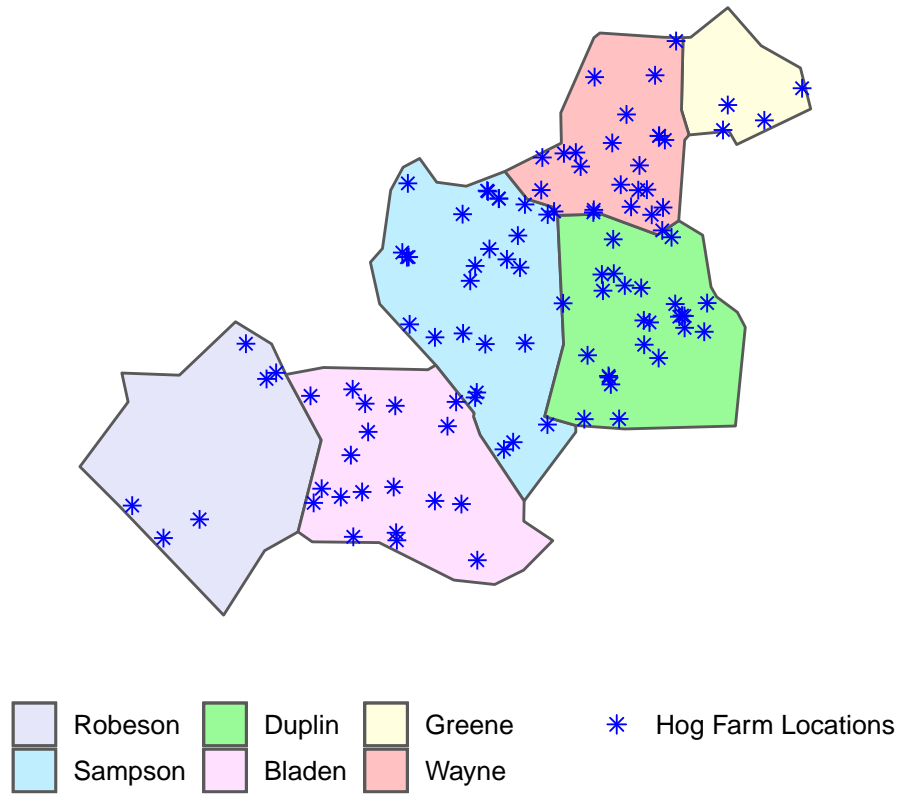


Figure 2. Subset map showing counties with high hog farm density in North Carolina

7.2 Visualization Analysis

Population distribution by county (%)

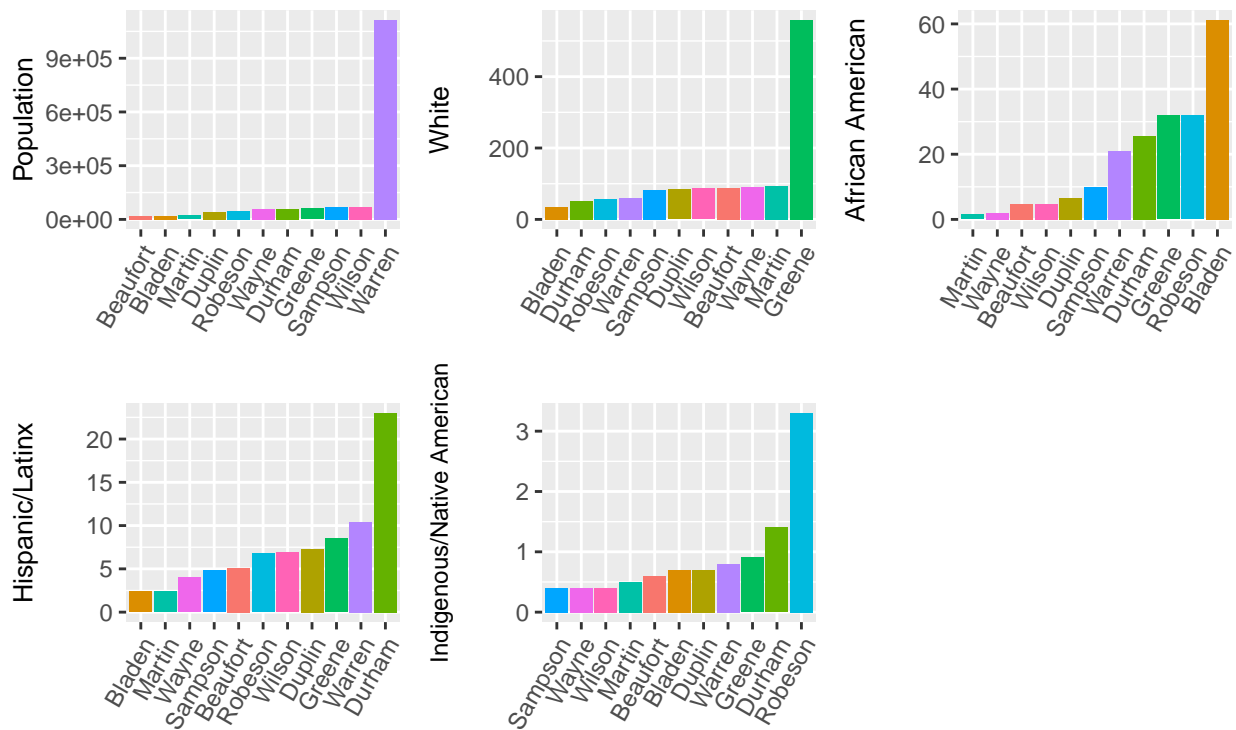


Figure 3. Population Distribution by County (%)

Chronic Health Incidence Rates

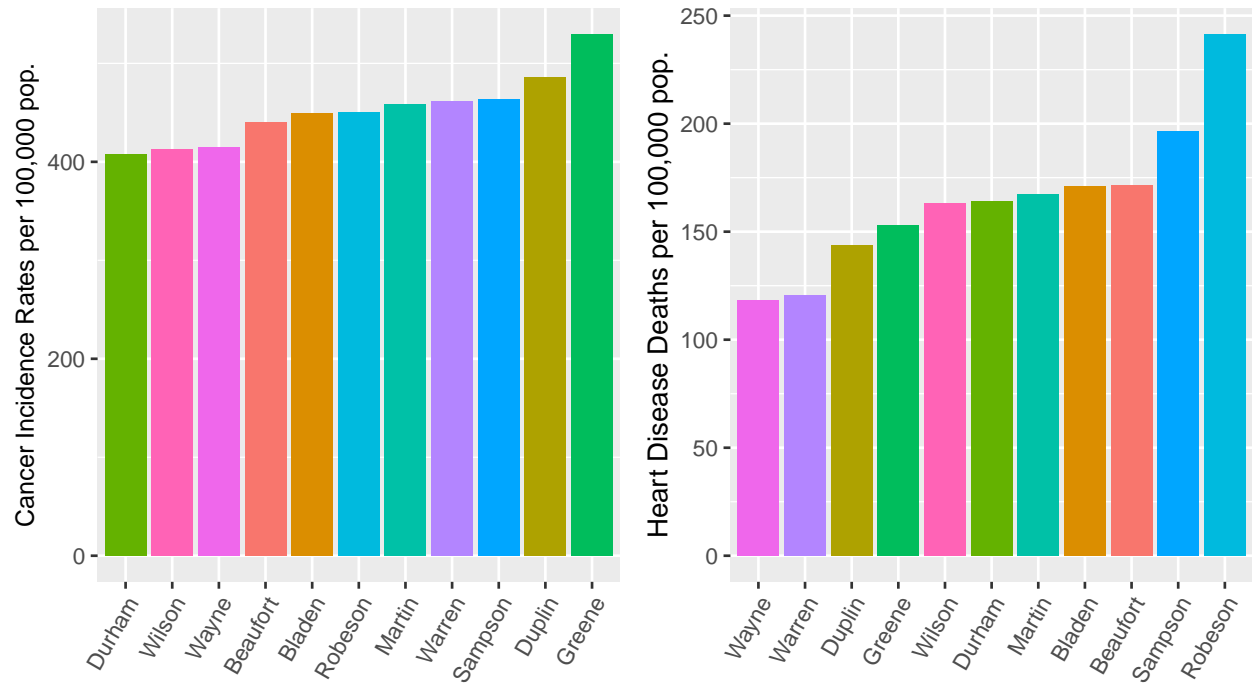


Figure 4. Chronic Health Incidence Rates

Health Risk Indicators

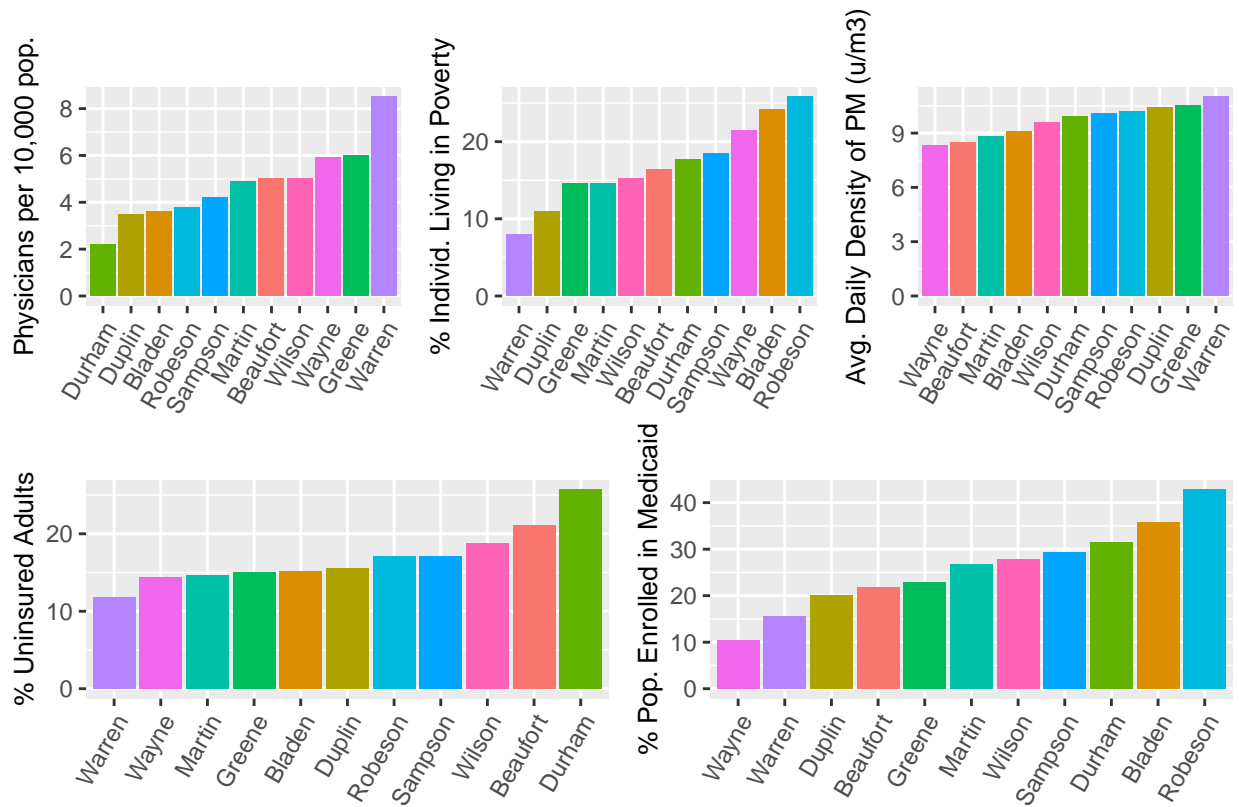


Figure 5. Health Risk Indicators

Infant Health Disparities

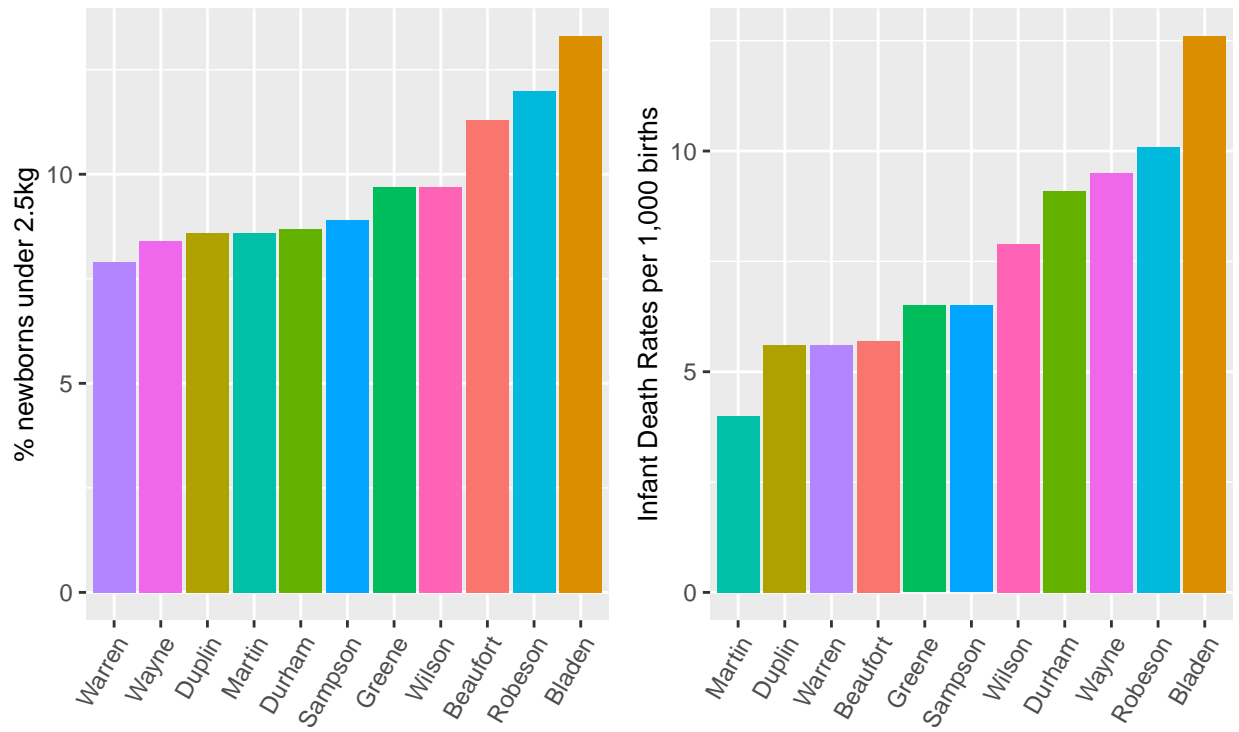


Figure 6. Infant Health Disparities

Vulnerable Populations

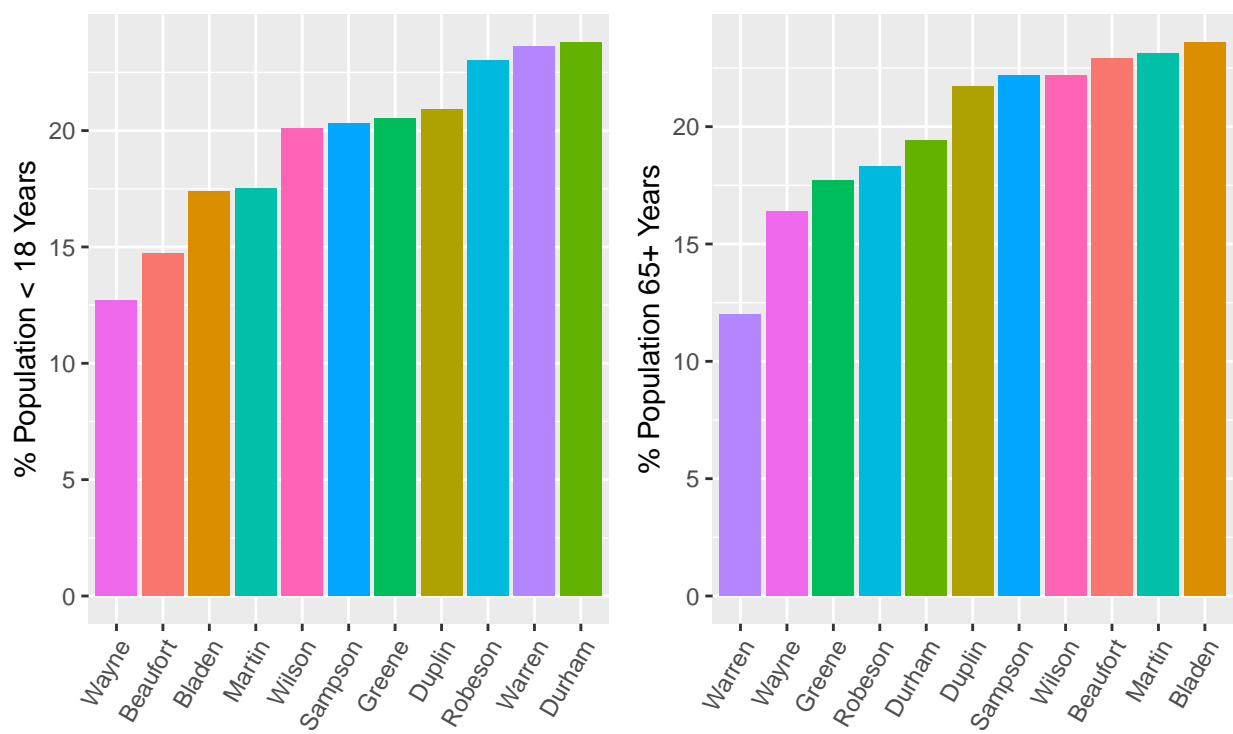


Figure 7. Vulnerable Populations

8 Results and Discussion

Question 1: Which NC counties have the highest concentration of hog farms?

Counties with the highest concentration of hog farms in North Carolina are Bladen, Duplin, Greene, Robeson, Sampson and Wayne (Table 2).

County	Number of Hog Farms
Sampson	28
Duplin	25
Bladen	19
Robeson	6
Greene	4

Table 2: NC counties with high density hog farms

Question 2: Are hog farms more prevalent in communities with higher BIPOC populations?

Counties with higher concentrations of hog farms tend to have a higher distribution of Hispanic/Latinx and Native American communities compared to counties with low concentrations of or no hog farms (Figure 3). In particular, Robeson county has the highest proportion of Native American individuals compared to all the other counties we analyzed. Sampson and Duplin have the highest number of hog farms compared to all the counties we identified, and also has the highest proportion of Hispanic/Latinx individuals compared to the counties we analyzed.

Question 3: What health inequities are most prevalent in counties with high concentrations of hog farms?

Counties with high concentrations of hog farms tended to have lower number of physicians per 10,000 people compared to the other counties we observed (Figure 5). Further, these counties also had higher % of adults without health insurance. Robeson county, which also had the highest distribution of Native American individuals, also had the highest % of its population living in poverty (Figure 5). Counties with higher concentrations of hog farms also had slightly higher air PM density measurements - it should be noted that Durham is considered metropolitan compared to the other analyzed counties and thus would have a higher average density of PM. The counties with the highest concentrations of hog farms in particular (Sampson, Duplin) has a population where a quarter is under 18 years old which is a population vulnerable to environmental health impacts (Figure 7).

9 Summary and Conclusions

Our analysis was just a surface level look at potential connections between hog farm location in NC, BIPOC communities, and health disparities. From our visualizations, we see that higher concentrations of hog farms tend to be in counties with higher distributions of Hispanic/Latinx and Native American communities compared to counties with low or no hog farms. Further, communities with higher concentrations of hog farms also tended to have lower numbers of available physicians per population size, higher % of adults without health insurance, higher average daily density PM measurements, and higher % population of children (under 18 years old). Although our analysis did not find strong relationships between counties with high concentrations of hog farms and public health impacts on chronic diseases and infant health, it is possible there are specific health impacts that are unreported. Our data set did not provide data on respiratory health or other less deathly health impacts (ie: headaches, nausea, etc.) that individuals living near hog farms could be experiencing more frequently.

Future studies could dig further into the impact of hog farm feces disposal methods on air quality and water quality of Wayne, Bladen, Greene, Robeson, Sampson, and Duplin counties. With air quality, a study could measure and visualize daily air quality measurements and see if there are any increases in PM specifically during periods where the lagoon feces mixture is sprayed into the air. One could also look into if there are any unreported health impacts due to inaccessability to health care in counties with high concentrations of hog farms (ie: no health insurance, low number of physicians compared to population).

10 References

- [Environmental Working Group Map - Distribution of Animal Agriculture Farms] <https://www.ewg.org/interactive-maps/2020-fields-of-filth/map/>
- [NC Farms and Floodplains] https://sites.tufts.edu/gis/files/2017/06/Moore_Emily_UEP232_2016.pdf
- [Democracy Now! Video on NC Hog Farms] <https://www.youtube.com/watch?v=eyAFNV4Afgw>
- [Cartographic Boundary File] <https://www.arcgis.com/sharing/rest/content/items/05f6d4797e2a428d96c15aba40088159/info/metadata/metadata.xml?format=default&output=html>
- [Locations of Hog Farms in North Carolina] <https://www.google.com/maps/search/hog+farms+in+north+carolina/@35.2918991,-79.6807785,8z/data=!3m1!4b1>
- [NC Health News] <https://www.northcarolinahealthnews.org/2020/12/04/neighbors-of-hog-farms-say-recent-appeals-court-ruling-gives-them-hope/>
- [Phantom Buster] <https://phantombuster.com/>
- [Environmental Health and impacts of pig farming] https://en.wikipedia.org/wiki/Pig_farming#Environmental_and_health_impacts