AN ANALYSIS OF THE ENVIRONMENTAL JUSTICE CHARACTERISTICS OF THREE OHIO COUNTIES: FRANKLIN, CUYAHOGA, AND HAMILTON COUNTIES

A Thesis

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ABSTRACT

Environmental justice is defined by the United States Environmental Protection Agency (EPA) as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.” Environmental injustice research can be conducted using social stratification theory because such theoretical modeling examines the division of people into different levels of strata, while analyzing how and why this formation occurred.

This study examined the environmental justice characteristics of three Ohio Counties, Franklin, Cuyahoga, and Hamilton Counties. Data from the 1990 and 2000 US Census were used, as well as data from the Toxic Release Inventory (TRI). Socioeconomic data was compared with data describing the distribution of pollution in these three counties. The unit of analysis was the census tract. It is hypothesized from stratification theory that the amount of TRI pollution will be significantly related to socioeconomic variables. It is hypothesized that higher social status will be negatively related with high pollution levels within census tracts examined in the study.

Study data were compared using a discriminant analysis to predict whether or not census tracts were polluted or not. This was completed for the years 1990 and 2000 in
each county. Then linear regression models were calculated for both years in each county. The dependent variable is the log of the total pounds of pollution released and transferred. Also, the five most polluted census tracts in each county during each year were examined using a case study approach. This approach provides the reader with a deeper look at the socioeconomic and pollution characteristics of the polluted census tracts at that particular moment in time.

The overall conclusion is that the three Ohio Counties examined in this study are not environmentally unjust in terms of toxic industrial site location. That is, race and ethnicity play no role in the relationship of polluting facilities. However, there is some indication that low educational obtainment and low income may be related to high amounts of Toxic Release Inventory classified pollution. Future research should examine the link between when polluting facilities acquired property and any change in demographic variables.
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CHAPTER 1

INTRODUCTION

Environmental justice, as defined by the United States Environmental Protection Agency (US EPA), is “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2000). The issue of environmental justice first became a topic of national importance during the intensification of environmental movement in the early 1970's (Williams, 1999). Books such as Rachel Carson's Silent Springs have motivated Americans to begin to question the liberal and plentiful use of chemicals to solve everyday problems. In the late 1970's the residents of Love Canal became another example of the fallout caused by the Chemical Revolution (Bullard, 2000).

Many of the residents who face the brunt of environmental hazards, such as those mentioned above, have a lower socioeconomic status or are living in a predominantly minority populated community (USEPA, 1999; Williams, 1999). Some researchers believe that “socioeconomic conditions, not risky behaviors, are the primary origin of the racial stratification of health” (Hayward et al., 2000). For instance, African American men have a life expectancy of eight years less than their white, male counterparts (Sorlie
et al., 1995; Hayward et al., 2000; US DHHS, 2000). Also, the effect of pollution on children is greater when those individuals are of a lower socioeconomic status. This may indicate that pollution is one means by which socioeconomic status affects health (Neidell, 2004).

It has been argued that environmental quality is an indicator of public health. In 2000 the Department of Health and Human Services’ *Healthy People 2010* report estimated that 25 percent of all global, preventable illness can be attributed to squalid environmental quality (USDHHS, 2000). These degraded areas are more likely to be near African American, Latino American, Native American Indian communities, as well those neighborhoods with a high percentage of low income or migrant residents (Bullard, 2000). The causal relationship of pollution distribution is further explored in the environmental justice theory chapter. Since inequities may not occur on a national scale, broad-reaching policies may not be an effective way to combat the problems of environmental inequity (Williams, 1999). This is because often each environmental injustice situation is specific to the stakeholders involved, geographical location, and political climate (Szasz and Meuser, 1997).

In 1993 the Office of Environmental Justice (OEJ) was established by the US EPA and charged with the task of creating recommendations for environmental policies (whether national or local) that have efficacy and clarity. Shortly after the inception of the OEJ the National Environmental Justice Advisory Council was created. This body, composed of 26 members, advises the EPA Administrator on issues pertaining to environmental inequalities (USEPA, 1999). The mission of this group of scholars, industry professionals, grassroots and community members, and agency leaders is to
“provide independent advice, consultation, and recommendations to the Administrator of
the US Environmental Protection Agency on matters related to environmental justice”
(USEPA, 2001).

During the Clinton Administration, Executive Order 12898 (1994) initiated an
increase in funding and priority for environmental issues. This was followed by the
establishment of offices and counsels in both the United States EPA and regional offices
to ensure environmental disparities were taken into account during decision making.
Health and environmental quality problems related to socioeconomic status are more
prevalent in larger cities when examined in terms of emitted pollutants (USEPA, 1995).
Ohio contains several large, predominantly urban counties, including Cuyahoga,
Franklin, and Hamilton. Each county exhibits variability relative to income and
population characteristics. Given this diversity relative to significant environmental
justice variables, Ohio is an excellent state to assess the role of environmental justice in
industrial site location and for evaluating Ohio’s response to EO 12898.

Recently the US EPA created several goals to eliminate the unjust burden felt by
low income and minority communities. These goals include: increasing the priority
given to environmental equity issues by the EPA, identifying and targeting opportunities
to reduce high pollutant concentrations for specific populations, and greater inclusion of
low income and minority communities in policy-making decisions (Yamada, 2002, Faber
and McCarthy 2001). It is important to examine local neighborhoods relative to amount
and types of polluting industries to determine whether Ohio is meeting these objectives.
Following these EPA environmental justice guidelines is the first step to ensure the
pollution distribution is equitable and that all communities are equally protected from pollution-based health and safety issues.

The central hypothesis of this study is that the major urban counties of Hamilton, Franklin and Cuyahoga, in Ohio, will have a disproportionate amount of pollution in those census tracts with high minority populations and low socioeconomic variables, such as income and education. While this research is not inclusive of all parts of Ohio it will provide the basis and ground work for future evaluation of specific polluter histories.

Pellow (2000) claims that the comparison of toxic releases with indicators of community composition is often lacking, even though the data are usually available to do so. The purpose of this proposed research project is to evaluate the environmental justice characteristics of the counties containing Ohio's three largest cities. This will provide insight as to whether these urban counties are environmentally just.

This project is significant for several reasons. First, this study will provide a baseline analysis for the three counties of interest. Future studies replicating this method will be useful for tracking the historical trends in pollution placement. This will eventually permit planners in each of these counties to have a better understanding of community health characteristics, which can be used by researchers, community groups, and government officials to track health relative to pollution over time (Bryant, 1995).

The conclusions inferred from this study will be useful in future studies examining community attitudes towards pollution and polluting facilities. The public's understanding of the risks associated with living in close proximity to hazardous or noxious facilities are not well understood (Corburn, 2002). Often low income and minority residents are stereotyped as being forced to choose between "health or jobs"
(Bullard, 2000). Studies involving disadvantaged persons’ perceptions are limited and the existing research in predominantly minority communities often focuses on crime, poverty, unemployment, and family crisis (Bullard, 2000). This project will review the census tracts most at risk of high pollution levels by examining the demographic characteristics of these areas in depth. In future analyses these areas would be excellent case studies about residents’ attitudes, values, and perceptions of their environmental and self assessments of health quality, since the areas are degraded. Psychological impacts created by pollution may be visible (Coburn, 2002). However, examining a single, highly polluted census tract alone would likely give a false impression about the nature of the environmental justice characteristics of the county.

This study will also provide a greater lucidity of the characteristics of people living nearest to hazardous waste-producing facilities. Counties will be evaluated in the context of whether or not the urban areas assessed face environmental racism or injustice. This is important because the US EPA is interested in examining pollution permit distribution and facilities location. According to EPA’s Title VI Guidance Document, organizations receiving EPA financial assistance, such as state EPA’s, must comply with Title VI of the Civil Rights Act of 1964. Title VI prohibits discrimination based on “race, color, or national origin by any entity that receives Federal financial assistance” (US EPA, 2000). Therefore, the analysis of polluter facilities versus demographic and socioeconomic variables will further provide insight into whether or not Ohio is complying with Title VI.

Another benefit of the study is increased awareness of illness or disease associated with measuring pollution in each county. Poverty and race are the two leading
factors that influence disease susceptibility, as well as cancer and mortality rates (Alder et al., 1993). This study will provide information about the most polluted urban areas in Ohio. Further analysis of illness and disease trends will foster the creation of educational materials detailing health risks. By creating well informed educational materials for those living near these industries, a person's probability of developing a severe health condition may be lessened, if proper precautions are undertaken. A more targeted system of information distribution can be created by understanding the location and nature of the most polluted census tracts.

Finally, this study may lead to policy and programmatic changes in Ohio. Historically, the environmental justice movement has been centered in southern states due to strong community and religious organizations. Also, equality in policies and regulations is often examined by community leaders in the south (Bullard, 1993). Stakeholders in the environmental justice movement are also located in various cities, towns, and rural settings that have experienced environmental hazards, such as Halifax County, North Carolina (Minkler and Wallerstein, 2003). By examining Hamilton, Franklin, and Cuyahoga Counties in Ohio, infrastructure and policy adjustments can be recognized. This may help guide the Ohio EPA and help Ohio emerge as a state that is steadfast in its commitment to environmental health and equality.

Furthermore, this study will contribute to the study of environmental justice in several ways. First, this study indirectly assesses the usefulness of the Toxic Release Inventory (TRI) as a data tool for examining pollution placement. By including several variables from the TRI data, such as number of polluters, number of new polluters, number of different SIC classifications, and the natural log of the total amount of
pollution, study findings will identify emerging trends. For instance, does more overall pollution mean that there will be more standard industry classifications (SIC) or more polluters or both? Also many studies do not use TRI data exclusively and instead incorporate human health data. The inclusion of health data would be the next step in this project and may lead to more concrete conclusions about the direct health problems created by pollution.

Next, many studies in urban areas examine air pollution exclusively. By incorporating the pollution that is not only released into the environment, but also transferred to landfills, worker safety can be addressed. Many people with low education levels who are employed by a local large polluter in entry level positions are more likely to come into contact with toxic substances while on the job and in their home environment than their higher income, white counterparts (Bullard, 2000). Often employment opportunities are limited by education levels, and management positions are occupied by professionals living further away from the company (Bullard, 2000; Pellow, 2000).

Overall, this study will examine the common characteristics of those exposed to a disproportionately large amount of pollution and will further uncover where the gaps exist in environmental justice policy in Ohio. This study should be viewed as a first step in the process of creating a historical record and multidimensional analysis of Hamilton, Franklin, and Cuyahoga Counties. It will add baseline information to the existing knowledge base as well as make general conclusions about the condition of environmental equity in these counties between 1990 and 2000. Eventually, future studies incorporating human health data and future pollution and demographic trends will
be necessary to ensure Ohio complies with EO 12898 as well as Title VI of the Civil Rights Act of 1964. Failure to abide by these policies places Ohio at risk for reduced funding from the US EPA.
CHAPTER 2

LITERATURE REVIEW

To understand the problems and difficulties associated with environmental justice it is important to first comprehend the assumptions, definitions, and history of environmental justice in the United States. The US EPA defines environmental justice as:

The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA, 2000).

Bryant (1995) further clarifies the concise US EPA definition by stating:

Environmental justice...refers to those cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities where people can interact with confidence that the environment is safe, nurturing, and productive (Bryan, 1995; Pellow, 2000).

2.1 UNITED STATES ENVIRONMENTAL JUSTICE

It is commonly argued that environmental toxins are distributed unequally in the United States, causing minorities and low income Americans to face many health and safety hazards. This is the fundamental problem associated with environmental injustice.

Since the introduction of the Environmental Protection Agency (EPA) in the 1970s, the U.S. government has been committed to environmental quality (USEPA,
There has been an increase in air and water quality standards, an increase in the strictness of pollution outputs, and better general management of hazardous and solid wastes. However, increased health and safety benefits that are associated with increases in environmental quality are often a privilege of affluent, white Americans (Corburn, 2002).

There are two main circumstances that surround the inequity in US environmental conditions. First, land that has been degraded by some release of chemicals into the air, soil, or water is usually less expensive than unpolluted land. This makes it cost-effective for investors to build low-income housing in the surrounding areas. Residential populations in such areas are usually uneducated about potential risks and therefore do not fully understand the risks associated with the landscape (Brainwaite and Taylor, 2001).

In the second scenario an industry may move into a town or city without properly informing the residents. Since most inhabitants will not actively investigate all businesses that move into the area, a polluter may introduce a hazard with few people noticing. Usually it is only after the damage has been done, and residents begin falling ill, do changes begin to occur (Cole and Foster, 2001).

To avoid repercussions once health issues arise, companies sometimes engage in a tactic known as a buy-out (Cole and Foster, 2001; Bullard, 2000). This is most likely performed in a discrete manner to prevent the media from alerting nearby residents. Companies will offer large sums of money to residents to purchase their homes and require that they forgo any future legal recourse. From a legal standpoint, this does not
always ensure that lawsuits will not be filed. Unfortunately most residents in poor communities are not familiar with these portions of the law (Cole and Foster, 2001).

Commonly there are three types of environmental inequities faced by minorities and low-income residents. The first is known as procedural inequity. This means that the enforcement and execution of laws are not always carried out in a fair manner. This unfair treatment usually stems from uneducated or undemocratic decision making, such as holding public hearings in a remote location or at an inconvenient time (Faber and McCarthy, 2001). Using only English to communicate with residents, whose primary language is not English, is another example of procedural inequity. Not only do low-income and minority populations face increased exposure to pollutants, they may also receive different treatment from some government officials and corporate representatives (Westra and Lawson, 2001).

A second form of inequality is caused by geographic location. Most hazardous facility sites are not randomly chosen, nor do communities that contain these unwanted land uses have a high property value. A report filed in 1990 by GreenPeac examined the "toxic donut" surrounding a Chicago community. Altgeld Gardens, located on the southeast side of Chicago, is home to approximately 150,000 residents. Of these 70 percent are African American and 11 percent are Latino (Brainwaite and Taylor, 2001). Surrounding this community are 50 active or recently closed commercial landfills, seven chemical plants, five steel mills, 103 abandoned toxic waste dumps and 100 different factories. These companies produce large amounts of toxic substances, imposing severe threats to the residents' health and safety. The data collected by the Illinois EPA demonstrate that each polluter is considered as an individual, and the combined effects of
the plants are not taken into account when granting permits (Cole and Foster, 2001). This type of pollution accounting allows polluting companies to receive easier access to permits. Also, minimum standards may be considered on a per company basis and not as a collective, leading to further inputs of toxic substances into the environment (Coburn, 2002).

The third classification of inequity is social discrimination. This occurs when socioeconomic factors, such as race, ethnicity, lifestyle, income, and class directly become factors in environmental decision making. When local governments in wealthy or predominantly white suburbs create strict environmental regulations and ordinances, they push industry to areas where the zoning laws are not so stringent. These are often towns where minorities and low-income families reside. Cerrell Associates, Inc conducted a government funded study that concluded "ideally...officials and companies should look to lower socioeconomic neighborhoods that are also in a heavy industrial area with little, if any commercial activity" (Montague, 1998). It is understandable to move industry into areas that lack commercial activity, for these areas may lack employment opportunities as well. However, it is unacceptable to suggest that hazardous commercial enterprises seek out communities of lower socioeconomic status (Montague, 1998).

The notions of environmental discrimination and inequality surrounding poor neighbors are seen throughout American history. For instance, immigrant workers, coal miners, and others have dealt with this extra health burden since arriving to America. Because of this situation, advocates for environmental justice reform have become more vocal recently, calling for a national change (Bullard, 2000).
2.2 UNITED STATES ENVIRONMENTAL JUSTICE POLICY

Insisting that all Americans should have access to the same environmental quality and health conditions is referred to as the environmental justice movement. While still in its infancy, the environmental justice movement has faced many difficulties, most stemming from a lack of legislation (Bowen, 2002). To combat this situation, the Clinton Administration proposed several bills advocating environmental justice. The first was the Environmental Justice Act (1993). This included a provision for the identification and ranking of highly impacted and degraded areas. The government would have been authorized to allot grant money to aid in the prevention of further destruction and the clean-up of existing hazards (Montague, 1998).

The second bill proposed was the Environmental Equal Rights Act (1993). This was created as an amendment to the Solid Waste Disposal Act. It would have authorized petitions against the construction of specific waste facilities scheduled for low-income communities. Residents would have been able to file a petition to prevent the issuance of an operating permit. Many cities contain ordinances such as this; however, the Act would have made it a nationally recognized option (Westra and Lawson, 2001).

Finally, another recommended piece of legislation sought to amend the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1990. This proposed Amendment, known as the Environmental Health Equity Act (1993) would have required the Agency for Toxic Substances and Disease Registry, which is the division of the EPA that handles most CERCLA dealings, to collect and maintain current information about the residents living near areas identified as contaminated or potentially dangerous sites. This legislation would have been simply a
data service and would have not served to protect or prevent health harm. It would have, however, provided the information needed for an in depth report of all illnesses potentially associated with each hazardous industry. Furthermore, this would have made establishing a causal relationship between symptom and industry much easier due to data availability (Cole and Foster, 2001).

Unfortunately, none of the previously mentioned bills passed both the House and Senate. This is because many were unfunded mandates and created new obstacles to large business. The proposed bills would have required that governmental agencies set aside money for programs, clean-up efforts, or educational purposes without providing additional federal funds. The EPA or other administering agencies would have been required to reduce money from one budgetary area to create funding for these new programs (Yamada, 2002).

Since the bills hindered business profits many companies vehemently opposed them. Some companies hired consultants to examine the cost-benefit impacts and found the results to be unfavorable. Business interests used their influence in the political arena and created advertisements describing the bills as reducing potential jobs. Corporations also began promising increased campaign funds to those Senators and Representatives opposing the bills (Cole and Foster, 2001).

2.3 ENVIRONMENTAL JUSTICE PRINCIPLES

According to Westra and Lawson (2001) there are four principles that policy makers and advocates alike must agree on to further the environmental justice agenda. These include the right of protection, harm prevention, the shift of the burden of proof,
and the abolishment of the intent requirement. These factors will add a much needed layer of protection to those communities who are the targets of poor environmental decision making (Westra and Lawson, 2001).

First, the principle of the right of protection from environmental hazards must be extended to all individuals, regardless of citizen status, income, age, race, lifestyle, or other qualifying feature. The most effective way to achieve this is through the implementation of national legislation. A fair environmental protection act with zero tolerance to environmental inequality is the first step. Similar laws and court-made precedents exist for housing, education, and employment (Westra and Lawson, 2001).

Another way to ensure greater protection is to enact more state and local regulations. For example, much of Louisiana is plagued with poor environmental conditions caused by toxic soil and water. Many of the citizens who live in the poorest environmental surroundings are those with the lowest incomes or are minorities. In response to constituents’ needs, the state has created strong legislation to extend the right of protection. The Louisiana Environmental Quality Act (1998) is similar in structure to the failed Environmental Health Equity Act, proposed by the Clinton Administration, and guarantees that an organization’s tax-exempt status will not be jeopardized because they are advocating environmental justice.

A final way to ensure that the right of protection is extended to all citizens is to follow the precedent recently set by Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, in 1994. This mandate met much opposition by corporations because they claimed it would lead to a loss in jobs and place a strain on the economy because of strict regulations. In *Faces of
Environmental Racism (2001), Laura Westra and Bill Lawson compare this scenario to the one presented to Congress just before the Civil War. Southern legislators, in favor of preserving slavery, claimed that ending the establishment of slavery would bankrupt plantations, increase wages, and create high unemployment rates, thus leading to devastating effects on the national economy (Westra and Lawson, 2001).

While this argument tugs on our emotions, it does have some validity. The effects mentioned above are also the means of correcting environmental discrimination. It is a task that will require changing an institutionalized way of thinking. While the economy was hindered after the Civil War, it eventually regained its prosperous standing. Although the road to environmental justice is long and uphill, it is a challenge that must be faced. Otherwise, the integrity of the Civil Rights Act as well as all environmental policy organizations is at risk (Cole and Foster, 2001).

The second principle to achieve environmental quality is the dedication to the concept of prevention of harm. Presently the federal and state governments take a retroactive approach to environmental health and safety, placing more funding into cleaning up past mistakes instead of preventing future occurrences. For instance, it is a known fact that many racial and ethnic minority communities face increased exposure to lead poisoning (Brainwaite and Taylor, 2001). This is mostly due to lead paint in low income housing and poorly renovated homes. President George H. W. Bush announced a national program to curb lead poisoning, including the removal of lead paint and stricter regulations for corporations running lead smelters. This proposal faced so much opposition by the National Association of Realtors that President Bush abandoned the
policies associated with both indoor and outdoor lead poisoning prevention (Brainwaite and Taylor, 2001).

The third principle required for accomplishing environmental quality is a shift in the burden of proof. Currently those persons that challenge polluters must prove that they have been harmed in some substantial way. This poses a huge problem to minority and low income neighborhoods because they often do not have the monetary resources to hire expert lawyers, consultants, and investigators. Also, blood tests and physical examinations of individuals are usually required as well for evidence, imposing unjust fees on the victims of toxic conditions (Shrader-Freshette, 2002).

One recommended way of combating this inequality is the creation of or an amendment to environmental laws, requiring Environmental Impact Statements (EIS) to examine the effects of pollutants from specific sources on surrounding communities. The harms imposed on the residents must then be justified and published for the community to review.

The fourth principle needed for achieving environmental quality is the abolishment of the evidence of intent requirement. It is extremely difficult to prove in a court of law that there is actual intent to discriminate against low-income and minority populations. Some courts view the costs of pollution as a trade-off to an increase in local jobs. In reality the jobs created do not always benefit those communities assimilating the environmental costs. Because of the proof of intent requirement it is difficult to effectively apply the Equal Protection Clause of the Constitution to environmental justice law suits (Westra and Lawson, 2001).
While the environmental justice movement is relatively young, there are ways to prevent the procedural, geographical, and social discrimination faced by low income and minority neighborhoods. Since residents of these low income towns and neighborhoods may lack education, basic legal knowledge, and public funding, it is nearly impossible to stop environmental, health, and safety threats unfairly imposed upon them. While the Clinton Administration worked diligently throughout the 1990s, Congress was unwilling to make the necessary changes. Only when the four principles of environmental justice are interwoven into all legislative and agency frameworks can all US Citizens begin to be treated fairly in the environmental and health arenas.

2.4 GLOBAL ENVIRONMENTAL JUSTICE

Environmental justice issues can be examined on several geographic levels: globally, regionally, and locally. By considering the underlying concepts and examples at each level further understanding of environmental justice history, causes, and remedies may be attained. The global geographical perspective will be examined first.

Global environmental injustices are perhaps the least well examined. Most theoretical environmental justice literature and studies focus on US environmental justice policies and communities. This may be a function of data availability as much as a function of the vast complexities surrounding multinational or global environmental problems (Westra and Lawson, 2001).

The main topics of study when discussing global environmental injustices are economic development, resource extraction, and exporting risks from wealthier nations (Szasz and Meuser, 1997). Hornborn (1998) proposes that the problems associated with
the distribution of ecological risks must not be separated from the problem of resource
distribution. The allocation of both risks and resources often lead to conflict,
environmental degradation, and reduced human health.

When studying environmental justice issues globally, the issue of pollution
placement as well as resource extraction creates a different scenario than policy makers,
social workers, scientists and governments face in the US. In the third world,
institutionalized inequity causes millions of rural poor to face environmental problems
(Parayil, 1998). In the US problems associated with environmental justice are also
associated with ethnic and racial minorities: particularly African Americans and Latinos
(Pellow, 2004, 2000; Bullard, 2000; Parker and McDonough, 1999; Bryant, 1998).

In the Third World, environmental problems most often discussed are
deforestation, soil erosion and degradation, mining, over-fishing, as well as dumping of
toxic substances in the water and land. This is a function of over population in developed
nations as well as political instability and poverty in less developed countries (Parayil,
1998). It is also a matter of employing economic strategies that sustain growth but do not
consider sustainable development. Economic gain is emphasized over human health and
safety (Parayil and Tong, 1998).

Parayil (1998) argues that sustainable development, though a step in the right
direction will not end global environmental justice issues without challenging the
“developmentalist ideology” of economic growth. This system is based on the idea that
maximizing economic expansion will eventually trickle down to all citizens. This is
clearly not plausible in Southern nations, where social welfare programs and
infrastructure are lacking, where infant mortality is high, and poverty is the norm (Westra
and Lawson, 2001). For example, in Brazil in the 1960s and 1970s economic growth was occurring. However, the gap between the rich and the poor was expanding. Eventually inflation and decreasing currency values lowered the standard of living for many people in the country (Parayil, 1998). This leads to the question of whether or not maximizing economic potential is always the best option.

Nations must examine the ethical issues of accepting payment for disposal of Northern nations’ toxic substances, though some economists argue that such exchanges are rational and beneficial in a market setting for both players (Westra and Lawson, 2001). Polluters will usually accept what Bullard (2000) refers to as the “path of least resistance.” That is, large-scale, pollution producing corporations will be willing to ship pollution to areas with less stringent environmental regulations if there is an overall cost-savings. Polluters may also be willing to purposely violate disposal regulations, if the fines and penalties imposed on them for violation are less costly than the cost of clean-up (Parayil and Tong, 1998).

In Third World nations environmental justice situations are usually point-source problems, such as hazardous landfills. In the United States, and other developed nations, environmental justice issues may be point-source or nonpoint-source problems, such as air pollution from automobiles. This creates differences in the way each nation must manage their pollution inequalities. Thus, a standardized model cannot be applied to each nation. Instead situation-specific remediation and management techniques should be employed (Taylor, 2000).

There are many practices worldwide that lead to global environmental problems. These include practices imposed on developing nations by developed nations leading to
resource extraction and pollution deposition. Third World countries also often have less stringent environmental laws and are more willing to accept toxic substances from high-paying neighbors. Finally, economic policies that promote unlimited growth may also hinder the quality of life for some residents. Environmental injustices have not been studied extensively on a global scale. Future research and inquiry will hopefully lead to fewer environmental injustices.

2.5 REGIONAL ENVIRONMENTAL JUSTICE

Much research has been carried out in the field of environmental justice on a large scale. In 1995 the US General Accounting Office (GAO) undertook a national study of solid waste facilities. The study examined the percent minority and median household income of residents living within a one mile radius of municipal landfills. Study results showed that neither minority populations nor low-income people were found in disproportionately high numbers residing near landfills (USGAO, 1995).

This finding suggests several things about the distribution of municipal landfills on a national scale. First, inequalities are not distributed uniformly (Szasz and Meuser, 1997). This may be due to regional landscape variations, as well as political boundaries. Solid waste disposal facilities are not located in all cities and towns. Therefore, some areas with high minority or low income populations may not be close to a municipal landfill (Szasz and Meuser, 1997). The race and income of residents living in areas away from landfills will impact the aggregate data, just as those living near such facilities will.

The findings of the GAO study do not mean that nationally the United Stated does not have an environmental justice problem. It is likely that the importance of sub-regional
and local variations are not fully captured by such a large scale analysis since many other local studies show clear inequalities in the allocation of polluting companies (Bullard, Hofrichter, 1993; Bryant, 1995).

Another example of such oversight occurs in national studies of Superfund sites. Zimmerman (1993) studied 600 communities containing Superfund sites. She found that the number of Latino and African Americans in communities with Superfund sites was nearly double the national averages. However, when examining poverty, Zimmerman found the percent of households at the poverty line was consistent with the national average. Many studies have been undertaken, which demonstrate that household poverty in a community is indeed a factor in the siting of noxious and hazardous facilities (Westra and Lawson, 2001; Mohai and Bryant, 1992). This again shows that aggregate data may lead to false conclusions (Szasz and Meuser, 1997). This may create complacency in with state and federal leaders while community members face increasing illness and worsening environmental conditions.

2.6 REGIONAL ENVIRONMENTAL JUSTICE MODEL

Pellow (2000) created a model for environmental inequity formation on a regional level. Presently, the environmental justice literature focuses on research of outcomes of inequalities instead of examining the mechanisms that created these outcomes.

Pellow (2000) identified a common means of examining environmental justice problems called the “perpetrator-victim scenario.” This approach argues that when predominantly poor and minority people are exposed to health and safety hazards within communities they are less powerful than the corporations, military, or state polluters.
Local residents are the victims, while the polluters are the perpetrators. While this model may be appropriate in some situations, it is too simplistic to be applicable to all regional environmental injustices. This theory ignores key stakeholders and variability across different cases, both of which lead to theoretical complexity (Pellow, 2000).

Rather than use the “perpetrator-victim scenario,” Pellow introduces a model that has three linkages to investing environmental inequalities on a constructive level. First, the formation of environmental injustices must be looked at as a process instead of discrete situations. This requires thinking about what environmental inequalities are and how they emerge.

Next, there is a need to understand all of the key players in the area to better assess the relationship of polluters, community members, and bystanders. This area can be defined via demographic, political or infrastructure boarders. By realizing that there are multiple stakeholders who contribute to creating an environmental justice problem the tendency to rely on a perpetrator-victim relationship is reduced.

Finally, the toxin must be traced from inception to consumption. This will promote the examination of many areas, companies, and goods to fully understand to where hazardous substances are being moved and how they are being transformed. An analysis such as this may eventually lead corporations and consumers to understand the full life cycle of everyday goods and their unintended consequences (Pellow, 2000).

2.7 LOCAL ENVIRONMENTAL JUSTICE

Local communities involved in environmental justice studies are usually either rural or urban. Due to zoning and ordinances, few polluting industries are located on the
suburban-rural fringe. Urban community development is often thought of as the result of four traditions, prominent in the planning theory: social reform, policy analysis, social learning, and social mobilization (Burchell, 1988). A fifth dimension has gained prominence in recent literature, and more fully explains the movement towards developing communities that seek to concentrate their pollution. The “healthy community” approach suggests that it is the task of the local government to ensure that the public maintains a certain degree of health (Roseland, 1997).

There are two major classifications of factors that may influence the placement of noxious facilities. These factors are race and income. These variables are not mutually exclusive, and it is common for the degraded community areas to contain populations that would classify themselves as both poor and non-white (Bryant, 1995).

Historically, racial influences have led to a variety of inherently discriminatory policies, such as segregated housing, educational limitations, and barriers to employment (Bullard and Wright, 1986). Similarly, low income residents are constrained by affordability. These residents live where housing is inexpensive and often near to where they are employed (Westra and Lawson, 2001).

Also, low income residents may be at a greater risk for increased pollution once industry moves into the area. This is caused by a lack of jobs, a lack of local government involvement, and a deficient amount of community resources to educate citizens about neighborhood problems (Corburn, 2002). Polluting corporations may take advantage of this situation, and often local officials welcome any type of industry. This is because industry often creates the illusion that there will be an increase in local jobs, as well as a boost in both the state and local economy. State and local officials are proponents of
economic expansion, so long as it does not directly impact them or their neighborhoods (Adler, 1999). This causes workers and residents to choose between jobs or environmental quality and health. Often the jobs and economic opportunities created by polluting industries are not localized, thus forcing local communities to internal the costs while externalizing the benefits (Bullard, 2000).

Szasz and Meuser (1997) have proposed two scenarios explaining facility siting and community response. The first situation occurs when the facility is chosen for reasons other than demographics. These include proximity to resources, affordable land, sound transportation infrastructure, zoning, and optimal geographical conditions.

Three demographic situations are described by Szasz and Meuser in this scenario. First, there may be no residents in the area. Due to development and economic prosperity there is an in-migration of residents. As neighborhoods with more desirable amenities are developed further from the industrial site, residents move away.

Next, the facility site is demographically similar to the surrounding areas. Overtime the area becomes polluted and the neighborhood has less desirable environmental and health conditions. This causes housing prices to decline and low income residents to move in. Szasz and Meuser describe this situation as “environmental white flight,” however their assessment assumes that poor residents will also be minorities and that minorities with an average median household income will be more likely to stay (Been, 1994).

The third demographic situation in facility siting is when the area is demographically different than the surrounding areas, but this was not a factor in site selection. Instead the area is attractive for a variety of “firm rational” reasons (Szasz and
Meuser, 1997). These include factors that have already created neighborhood features that harbor minority and poor residents, such as closeness to noisy highways and land that is already industrialized, polluted, and/or devalued.

The next siting scenario that Szasz and Meuser (1997) describe is one where the industrialization occurs in a specific area due to the demographics. Three demographic situations result from this instance as well. First, the neighborhood is targeted because it is economically depressed. In this situation the local officials or the community is willing to accept the trade-off between potentially dangerous toxins and jobs. Residents are often promised community revitalization, decreases in crime and increases in the quality of education due to tax revenue generated by the corporation (Bullard, 2000).

Next, the area may be chosen because the residents are less able to resist the facility, or perceived to be unable to do so. The community may have less political access or the corporation may have political ties. Bullard (2000) in his study Dumping in Dixie concluded that those living in the most polluted areas are often underrepresented in local government. Also, people in the community may not be aware of the proper steps needed to prevent the facility from being built in the community or may not have residents who are willing to champion the cause. Finally, in the last situation offered by Szasz and Meuser (1997) the neighborhood is targeted due to racial, ethnic, or class discrimination.

The Szasz and Meuser approach requires that historical analysis be conducted to examine the community composition at the time of citing as well as present community make-up. Such a research methodology is required to assess whether or not racism or class factors affect industrial location. Once this is determined, other factors of
institutional discrimination, such as housing and transportation policies, may be examined (Bullard, 2000).

The community composition in areas surrounding noxious facilities may not start out as the result of discrimination. However, overtime market forces may cause a shift in population, thus causing an unjust condition. Unfortunately, most conventional environmental justice studies examine the socioeconomic and political characteristics of the existing community rather than the development of same (Been, 1994).

Another perspective addressing the formation of environmental inequities is formulated from social constructionist theory. That approach suggests that community groups identify, perceive, and define environmental problems by using shared interpretations of the meanings and assumptions. These interpretations are shaped by life experiences, race, class, gender, and location (Taylor, 2000).

Pellow (2004) proposed an environmental justice framework as a means of further defining those factors that create burdensome pollution distribution. This model shares some similarities with his environment inequity formation theory that is more regionally applied. In this model he combines place-specific and macro-level explanations to engender four dimensions common to most environmental justice conflicts.

First, environmental inequalities must be examined as “sociohistorical processes” rather than case studies or events of a finite time. For example, in Louisiana, land owned by several large-scale polluting businesses were once plantations or lands owned by sharecroppers and slaves. In this instance understanding the historical context is extremely relevant to understanding the formation of environmental inequity (Toffolon-Weiss and Roberts, 2001).
Next, a better understanding of the complex roles of stakeholders must be achieved. There is a clear struggle for access to unadulterated resources, as well as status and profit, power, and general ecosystem and human health (Pellow, 2004). This comprehension may best be achieved by first understanding the community norms and standards. This, however, poses a challenge for outsiders, since relaying ideas and assumptions is not a simple task (Taylor, 2000).

The third part of Pellow’s framework is an assessment of the effect of institutionalized social injustices on stakeholders. Political and social hierarchies may create situations where certain stakeholders have more power, such as well connected businesses, and others have less power, such as activists or community members. By further understanding the power struggles of all participants in the system, more widely applied knowledge may prevent future environmental justice conflicts (Pellow, 2004; 2000).

The final dimension in Pellow’s model is the agency that is, the “power of populations confronting environmental inequalities to stake the outcome of these conflicts” (Pellow, 2004). This is accomplished by grassroots activism, campaigning, petitioning, and general resistance. By examining the formation of inequalities and by investigating the scenarios where the stakeholders were successful in preventing or removing polluters, better policy formation can be realized.

Overall, environmental justice literature reveals a broad range of topics and ideas. Environmental justice has become better defined as researchers and activists work to
create a common understanding of terms and assumptions. The US has made progress in understanding the nature of environmental injustices. However, few pieces of legislation have been created to address the issue.

Environmental injustices occur in many countries and at global, regional, and local levels. Some believe environmental injustices are a function of institutionalized racisms and class factors. Others believe that environmental injustice is due to market forces acting upon a community once large polluters move into the area. Others believe some combination of these approaches is a more appropriate explanation. It is highly likely that understanding the roles of historical analysis and stakeholder impacts will provide greater understanding of environmental and social inequalities. It is unlikely that a single model will explain these inequalities. However by synthesizing several conceptual approaches using a geographical framework, the theoretical construct of environmental justice becomes more lucid. Such an approach will permit further insight to preventing environmental injustices from occurring instead of repairing the damage that they cause to communities and individuals.
CHAPTER 3

ENVIRONMENTAL JUSTICE THEORY

Pollution placement and environmental justice offers considerable potential for study. One of the promising theoretical approaches for studying this phenomenon is social stratification theory. If a theoretical model selected for development is to be effective in understanding environmental justice it must address the basic question of why environmental risks are distributed in an inequitable manner (Szasz and Meuser, 1997) and explain how such situations are permitted to arise (Pellow, 2000). Social stratification theory has potential for understanding inequalities because it examines the division of people into different levels of strata, while analyzing how and why this formation occurred (Hess, 2001).

There is little in the literature relative to explaining what ideal community industries do correctly. This is unusual because in some scholarly fields of study model individuals or organizations are discussed extensively. For instance, in the field of architecture there are numerous scholarly writings, case studies, and public accolades for those organizations who seek to design their offices, factories, and storehouses with human and ecosystem health in mind. These are known as “green” buildings and businesses, and they often serve as a paragon of what a socially responsible and
profitable corporation should achieve (Westra and Lawson, 2001). Hopefully the
development of a stratification theory that is focused on explaining environmental justice
will contribute to this end.

This chapter will evaluate the concepts of social stratification theory. These
notions will then be applied to understanding pollution placement and how specific socio-
economic factors of local residents can affect placement among census tracts. Finally
environmental injustice will be examined in the context of theoretical predictions
developed to guide the study.

Social stratification affects many aspects of peoples’ lives, from the amount of
material items possessed to peoples’ overall physical and mental health. This system of
strata layers people according to their relative power, prestige, and property (Hess, 2001).
It can be applied locally, within a family, or across a nation. Most important is that social
stratification is not applied directly to individuals. Instead, it is a way of ordering people
into a hierarchy that illustrates their comparative advantages and disadvantages (Bottero,
2005).

Each society stratifies the members of its society in some way. In the US a class
system is used. Other forms of social stratification include slavery, a caste system, or a
clan system. The class system grants members of that society mobility between classes,
though barriers to upward mobility may be great for members of the lowest classes (Hess,
2001). It is these lowest class members that are usually subject to the most extreme
pollution generated by polluting industries. These conditions combined with other
environmental stressors, such as poor health care and low nutrition, leads to a general decrease in aggregate human health and quality of life for lower class individuals (Gee and Payne-Sturges, 2004; Bullard, 2000; Sorlie et al., 1995).

Two of the most significant contributors to understanding social stratification in industrialized nations were Marx and Weber. Marx and Weber had differing views of the causes and consequences of stratification due to class. Karl Marx argued that social stratification was determined by access to means of production. Means of production, in terms of Marx’s perspective, included the tools used to produce wealth. Marx argued that a person’s relationship to these means establishes their social class. The ownership of property or the means to gain material wealth leads to a higher social position. Marx called those who own means of production the bourgeoisie and those that do not the proletariat.

Marx also posited that as capital became concentrated in the ownership of the few, relations between bourgeoisie and proletariat would become more conflict-oriented. The proletariat would eventually view the bourgeoisie as oppressors and unify to rise up and overthrow them. Critics of Marx argue that the reason this did not occur was the emergence of a feeling of false consciousness. The proletariat begin to identify with the bourgeoisies because they aspire to one day have their own means of production (Henslin, 1997). These feelings for the bourgeoisie reduce the potential for conflict.

Bullard (2000) argues that this is why many poorer workers will tolerate reduced health and environmental conditions. Workers (proletariat) believe they must choose between health and jobs. Usually the job is chosen to sustain the employee’s quality of
life and because there is hope that one day they will move into a higher paying, less hazardous position, or perhaps even become a member of the bourgeoisie (Bullard, 2000).

Max Weber became a critic of Marx’s ideas of social stratification and formulated a different theoretical perspective (Gane, 2005). Weber argued that social class was determined by property, prestige, and power. Weber and Marx both agreed that owning property was an important component of social standing. Weber believed that control of property was significant in class determination. Property control is vital in determining a person’s opportunities to compete in a market setting. Thus Weber viewed class to be related to economics in that an individual’s ability to compete resulted in social mobility or immobility (Hess, 2001). While a manager of an industrial facility does not own the means of production, he/she controls it. The position of control may lead to personal gain by instituting large personal bonuses or salary and benefit increases. Owning the property (means of production) is not essential to receiving major advantages (Bogenhold, 2001; Henslin, 1997).

The second component of Weber’s version of social stratification theory is prestige. This concept suggests that people admire and aspire to emulate the wealthy. Prestige may or may not be derived from owning property (means of production). While prestige may eventually lead to property ownership, a person may have high prestige and thus high status without owning property. A well-known individual may receive gifts and benefits, which may allow them to purchase or control property in the future (Gane, 2005; Henslin, 1997).
Finally, the third part of Weber's view of social class is power. This occurs when people are able to control others, with or without the ruled knowing or agreeing. Classes or other stratification systems are essential for the distribution of power (Hess, 2001). Often it is a person's position or class that leads to power. Weber defined class in terms of individuals who had a particular lot in terms of life opportunities. Usually this led to similar income and position obtainment. This differs from Marx's view of class determination due to access to means of production. Most employees follow orders from supervisors because failure to do so jeopardizes their employment, regardless of whether the order endangers the employee or regardless of the relationship between employer and employee (Bogenhold, 2001; Hess, 2001; Henslin, 1997). In the US there are many industrial work regulations that are designed to protect the employer, however some employees may still be placed in danger when the workers rules are ignored (Hofrichter, 2001).

In the US people assume the class level of their parents at birth. From then on there is opportunity for mobility between classes, though most individuals strive for upward movement. This mobility is not always easily achieved. Those born into privileged environments seek to maintain their high social class status. This is accomplished by attending the best schools and receiving the best training that one can afford, as well as having status enhancing informal learning experiences. The informal learning experiences help to shape the values and behaviors compatible with those of the highest social classes (Gane, 2005).

Individuals not born into high social classes are sometimes able to achieve upward mobility due to a variety of factors. First, lower class members may gain prestige
by accomplishing some great task. Olympic athletes do not need to be born into wealth. However, they must have great physical skills that help them acquire prestige. In some instances prestige then provides the opportunity for property or material wealth. The Olympic athlete may receive offers for endorsements that will generate wealth (Henslin, 1997). This would not only provide the individual with capital gain but also increase their prestige. Finally, individuals in a lower socioeconomic class may obtain power, which will help propel them into higher classes. A hard working individual may eventually become a supervisor or manager. This will then give the person access to greater property.

It is difficult in many instances for members of lower classes to move into a higher social class, since fewer opportunities are available to people in the lowest classes compared those in higher classes. These opportunities may include better schools, safer neighborhoods, access to health care, disposable incomes, and so on (Hess, 2001).

Communities also function within the constraints of the existing class structure. Lower class individuals live in poorer communities. This occurs for several reasons. First, access to transportation or proximity to employment and daily necessities are important considerations in the location of residences. Lower class communities tend to be near public transportation routes so that grocery stores, churches, and other needed locations are accessible or near surrounding facilities that provide employment (Bullard, 2000). People in lower classes tend to live in rented or less expensive housing. Due to traditional methods of urban planning low income housing is typically grouped in segments throughout cities (Westra and Lawson, 2001). Since poor and wealthy people
do not live in the same neighborhoods, interaction among classes is limited and lower class people learn little about upper class decorum from informal interaction.

Social stratification is a universal phenomenon. Davis and Moore take a controversial stance in explaining why this occurs, using a functionalist perspective. Functionalists view societies as an integrated unit, which is made up of smaller, interrelated elements that work together (Hauhart, 2003).

Davis and Moore believe that inequity is ubiquitous because it helps societies endure. They develop four assumptions about society to explain why social stratification is inevitable. First, societies must ensure that certain positions are filled. Every society needs specific stakeholders to properly function. Next, some of these positions are more important than others (Hauhart, 2003). In modern US society a doctor may be seen as more important than a flower salesperson. Third, the most qualified people should be chosen to fulfill the most important positions. Usually the most important positions require the greatest amount of accountability and thus also require a larger portion of responsibility. Finally, society must offer the greatest compensation for the positions of highest importance to motivate the most qualified people to apply for these positions. Therefore, Davis and Moore would argue that a large salary and generous benefits are justified for a factory owner, while minimum wage may be acceptable for a part-time, entry-level factory employee (Henslin, 1997).

Davis and Moore’s ideas of social stratification have been refuted by other sociologists, specifically conflict theorists. Conflict theorists believe that social conflict instead of function is the basis for social class. Groups are continuously struggling to gain more access to limited resources. Lower classes or groups with less power are at
times preyed upon by higher classes for resources. Social institutions are put in place by
groups to ensure the group in power will remain so, and that other groups will remain in a
disadvantaged position. Conflict drives stratification, since resources are not distributed
equally and the most important positions and most qualified persons are difficult to
define (Henslin, 1997).

Recently social stratification theory has expanded to non-class forms of social
divisions. Examples of status groups, or non-class divisions, are ethnic, occupation,
political, gender and life style based classifications. It is important to remember that
status groups and classes often overlap or form an amorphous structure in society. Thus,
it is difficult to broadly attribute characteristics to status groups (Hess, 2001).

One area of focus that is important in many environmental justice situations is
ethnic or race status groups. Some view non-class formations, such as race or gender to
be a part of class categories. Also, affiliation with a particular social or ethnic group may
influence peoples’ class positions or the perception of their class (Crompton, 1998). This
perception of lower social status or self-perceived lower status may allow communities to
be mistreated by large corporations, if people living in the community are perceived to be
powerless (Anderton et al., 1994).

Ethnicity is often viewed as a factor affecting class ranking or as a means of
assigning class. In the US ethnic and racial minorities are sometimes thought of as being
congruent with lower class. This emphasizes the heterogeneity of ethnic groups, which
may instead have a hierarchical structure. Race can also be a catalyst for mobility in the
US. Asian international students are often viewed as intelligent. This may help propel them into better paying or more important positions more quickly, but often this is not the case (Anthias, 2001).

Ethnicity and race related social stratifications can be seen in a variety of areas, including housing, education, income, and health. Poor and minority citizens face institutionalized discrimination in housing policies, barriers to educational obtainment, which in turn leads to lower incomes and overall worse health conditions (Hofrichter, 2002). By examining each of these areas, which are influenced by social stratification, the underlying causes of environmental injustices and discrimination can be further assessed (Anthias, 2001).

Discrimination can be either individualized or institutionalized. Individualized discrimination is the negative treatment of one person by another due to some characteristic. Institutionalized discrimination, however, is the negative treatment of a minority group that has become a part of the society's institutions. Race and ethnicity has been used to make decisions about approval of home mortgages. When African Americans or Latinos apply for home mortgages they are 60 percent less likely than their Caucasian counterparts to receive a home loan. However, a disproportionate number of African Americans are members of lower classes, thus this result may be more dependent upon class than race (Henslin, 1997).

Education is another area of society where discrimination, whether direct or indirect, may be present. Social conflict theorists would agree that education is a tool used by the elites to maintain their social status by offering the most promising educational opportunities to those in the highest social classes. In addition the hidden
curriculum perpetuates the social norms and ideals of the class in power. Schools in middle or upper class neighborhoods teach children to speak with “proper” English and to act in a manner that requires well polished manners. This is because business and professional elites require refined language skills and manners among their managers and supervisors. Inner-city schools, on the other hand, focus less on refined speech and manners and expend more energy teaching students to obey the rules of the social institution (Henslin, 1997). Social conflict theorist suggest that elites do not expect these students to need training in proper language or manners, since they are destined to work in low status positions where they will be closely supervised (Hess, 2001).

When public school funding is considered on a local level, further inequalities are apparent. Most public schools are largely funded via local property taxes (Hess, 2001). Homes in the wealthier areas of the community are more expensive and the property taxes are greater, subsequently the schools have more money to spend per student than do poorer school districts. Wealthier communities are able to offer higher salaries to obtain the best teachers, purchase new textbooks and computers, offer courses in a greater variety of subjects, and serve higher quality food products. Those students who attend the best preparatory high schools will likely succeed in college and in turn succeed in maintaining their class’s social dominance (Henslin, 1997).

Finally, many standardized tests contain cultural biases focused on the majority culture. This may affect a student’s IQ score, which may then cause the student to be placed in remedial subjects and non-college tracks as opposed to an advanced or general
college preparatory curriculum. Most IQ tests also focus on mathematical and spatial abilities. However, intelligence may be comprised of more than just those subject fields (Henslin, 1997).

Access to health care is another area in which racial and ethnic minorities, as well as lower social class citizens, face inequity and discrimination. Access to medical care is stratified globally and so is life expectancy. In the most industrialized nations, the average age of life expectancy is about 70 years (Bottero, 2005). Life expectancy is much lower in poor countries and regions.

In the more industrialized nations, social class may have consequences on human health as well. There are differing death and illness rates for different social classes. Human life spans increase as income increases. Medical care is usually expensive, even when subsidized by the government, which means that people in higher class receive better health care. Mental health may also be better in the upper classes. Not only do people in higher social classes have better access to physiatrists and counseling, their class status affords them with greater control over the decision-making power of their lives. Being able to exert control over one’s own life is a key element to good mental health (Henslin, 1997).

One reason for the occurrence of environmental injustices is bias or discrimination against lower social classes. From Weber’s perspective, these classes lack property, power, and prestige. When examined more closely, this lack of attributes may lead to vulnerability in pollution citing.

First, many members of the lower classes do not own their homes or land. This may lead to a lack of community identity among renters. When individuals do not value
their neighborhoods or communities, they may be less likely to get involved in local organizations. Therefore, a mechanism to combat pollution, such as a home owners association, may not exist. The necessity to form community organizations makes it more difficult to resist external forces for change such as industrial location. Also, polluting industries may view these citizens as transitional and powerless. This may provide a rationale for citing noxious facilities in an area where many of the residents are likely to move within a few years time anyway.

Next, lower income classes tend to have less power. Few political representatives hail from lower classes or low income areas. The pollution levels of these communities may be sometimes overlooked or not taken seriously, since there is little political capital to be gained from devoting much time and effort to lower class community causes. Large businesses, on the other hand, may have considerable power. Contributions to political parties and relationships with politicians can lead to favorable business ventures for polluting companies. Also, communities may view such industries as overall beneficial, since jobs and increased community revenue may be associated with a new industry. These polluters, however, do not usually disclose in a lucid manner the risks associated with living or working in community with a noxious facility. The legal requirements of fair notice and comment periods are usually followed. However, the manner in which such hazards are discussed is polished and refined to make the tradeoff of health versus jobs seem reasonable. Finally, areas with higher percentages of lower class concentrations are not seen as a threat to many large polluting industries. Managers charged with facility citing rely on citizens not organizing to resist a new industry.
Last, communities with many lower class residents are not afforded much prestige. These citizens are viewed as less valuable in terms of employment position. Often they are less-well educated and hold service positions rather than managerial ones. Because of this situation, polluters may be viewed as providing opportunities to residents of nearby facilities. Since many homes in lower class communities and neighborhoods are rented, trailers, or small dwellings, they are seen as replaceable by those in higher classes. The promise of a higher paying position might be enticing at first. However, giving up one’s home or community for industry expansion is not always a well-received option. Instead community members may feel marginalized and discriminated against. Finally, the land may have already been somewhat degraded, and thus living in such an area lacks prestige. Those deciding where to place polluting industries may find it a natural choice to not choose the most environmentally desirable areas within communities to locate their facilities.

Lower class people are often enticed with large settlements or sums for agreeing to live near pollution. This pay-to-pollute model is often seen on American Indians lands or occurring in the least industrialized countries. It may be cheaper for a company to pay for the transport and storage of pollution in another country due to US environmental regulations and the low standard of living in less industrialized nations. Scientific and health data may not be shared with residents or leaders of such nations. People in pollution-receiving nations may be subject to much greater health and environmental risks associated with the pollution than they realize.
3.1 STUDY VARIABLES

In this study it is hypothesized that the amount of TRI pollution will be directly related to socioeconomic variables. The correlation between high social status and pollution levels present will be negative. The relationship between the dependent variable (pounds of TRI pollution created in a specific census tract) and independent variables will be further explored.

It is predicted that the average median household income within census tracts will be negatively related to the dependent variable. Based on social stratification theory, it is expected that higher income residents will live in areas that have less pollution than people in lower socioeconomic classes. This is because citizens in higher social classes can afford to live in homes that have a higher value. These higher value residences are usually not located in close proximity to pollution or noxious facilities.

It is predicted that the percent of residents who are non-Caucasian within census tracts will be positively related to the dependent variable. Environmental justice advocates would assert that as the percent of non-white residents within a census tract increase, there will be an increase in pollution due to institutionalized discrimination in housing policies (Hofrichter, 2002; Bryant, 1995; Bullard, 1993. This is because a disproportionate percentage of minority residents in the United States are members of lower social classes (Bullard, 1987).

It is predicted that the percent of elderly residents within census tracts will be positively related to the dependent variable. Age alone will probably have little effect on the distribution of pollution. However, most senior citizens live on fixed incomes which are often very low. Lower income will increase the probability that the aged are also
economically poor. If the aged are disproportionately poor, they will tend to be in the lower class. Thus, the class arguments advanced above will be applicable.

It is predicted that percent of residents with a female household head and children under the age of 18 years within census tracts will be positively related with the dependent variable. Most often single mother households have one income, which may confine them to a lower social class. Also, other factors, such as time constraints, may limit community involvement and activism and the ability of the single parent to secure job training to have access better employment opportunities.

It is predicted that measures of education and training that individuals possess within census tracts will be negatively related to the dependent variable. It is expected that the percentage of people with higher educational achievement within census tracts will be negatively related to the dependent variable.

It is predicted that the percent of vacant dwellings within census tracts will be positively related to the dependent variable. Vacant dwellings are usually a sign of economic depression in an area. These areas will probably contain more members of the lower classes. Therefore, pollution may be more willingly tolerated or go unopposed due to a lack of power.

It is predicted that the percent of rented dwellings within census tracts will be positively correlated to the dependent variable. Poorer residents cannot afford to purchase homes, and therefore often rent. These lower class members also usually cannot afford to hire attorneys to combat large industry polluters. Also, poorer residents spend more time working and have less time to organize and spend effort improving the community.
It is predicted that the percent of foreign born residents within the census tract will be positively related to the dependent variable. Foreign born residents may be part of any social class when first moving to America. Their class position usually depends on their class position in their home country. Thus, foreign born residents who were born into the upper class in their native nation will likely be part of the upper class in America, and live in a census tract with less overall pollution. The opposite holds true for immigrants born into lower class families. A large percentage of people immigrate to the US from less industrialized nations, and are often disadvantaged from the start. This study makes no distinction between races or ethnicities; however it is likely that the majority of foreign born residents will be from less industrialized nations, such as Mexico and Latin American (American Fact Finder, 2005). Since many of these residents are born into lower classes they will likely remain in the lower classes of American society. Thus, the relationship between percent of residents who are foreign born and the amount of pollution will be positive.

It is predicted that the percent of residents who do not speak English well or at all within census tracts will be positively related to the dependent variable. An inability to communicate may prove difficult, and it may make an individual or community more susceptible to pollution. Most community newspapers are printed in English. If a resident is unable to acquire information about new polluting industries, or read about the health consequences, then they will be less likely to oppose polluting corporations. Those without a firm grasp of communication skills will also be less likely to be employed in positions of high importance, and therefore will probably have a lower income.
It is predicted that three polluter variables will be significantly related to the dependent variable. The factors are as follow: number of different Standard Industry Classifications (SIC), the number of different polluters, and the number of new polluters. While these do not represent socioeconomic attributes, it is noted that they will be positively related to the pounds of pollution per census tract. Greater numbers of polluters and greater amounts of different polluters will likely lead to more pollution.

There are other forms of discrimination, besides socioeconomic, that may cause unjust pollution practices. The data and conclusions of this study, however, refute that and instead it is asserted that income is the strongest factor driving pollution citing. This may be because lower classes lack property ownership and control, power, as well as prestige. The comparison of housing, education, and residency variables to the pounds of pollution created each year show that increases in social class status usually lead to less pollution.
CHAPTER 4

METHODS

This study utilizes secondary data from the Toxic Release Inventory (TRI) and the US Census to assess the utility of the theoretical model developed for explaining variability in the incidence of pollution within census tracts in Hamilton, Franklin and Cuyahoga Counties in Ohio. These data are commonly used sources of information for the conduct of research about many aspects of communities in the US (Neidell, 2004; Hayward et al., 2000; Sorlie et al., 1995). In the analysis of secondary data, those not involved in the original data collect analyze the data and report the results (Church, 2001). The data used in this study were produced by well-respected government agencies and are used extensively by scholars from many social and physical science disciplines. The use of data bases such as these often provides an efficient and economical way to analyze community indicators (Best 1999).

Limitations and assumptions of the data used and the methods used to collect the data must be considered when analyzing secondary source data (Best, 1999). The limitations of the TRI and the US Census will be discussed later in this chapter, as well as the accuracy and validity of each data set. Further, general information about the data sources is explored below.
The data used in this study was collected for three counties in Ohio: Hamilton County, Franklin County, and Cuyahoga County. These counties were selected for investigation because each contains one of the three most populated urban areas in Ohio. Given the research objectives, it was deemed desirable to have large urban communities within the sampling frame so that factors such as social class, ethnicity, race and other important factors would be represented in the data set. Finally, each county also has unique cultural and historical associations.

Hamilton County is located in the southwest corner of the state and contains Cincinnati, Ohio's third most populated city (American Fact Finder, 2005). Hamilton County contains the headquarters for one of America's largest and most well known industries, Proctor and Gamble. Franklin County is located in central Ohio and is home to Columbus, the most populous city in Ohio (American Fact Finder, 2005). This city is also the state capital of Ohio and home to the third largest university in the United States, The Ohio State University. Cuyahoga County contains Cleveland, the second most populated city in Ohio, and is located in the northern part of the state. This city is located near the Cuyahoga River, which has historical environmental significance. In June 1969 the Cuyahoga River caught fire and has since been a symbol of environmental degradation and negligence.

The unit of analysis for each variable is the census tract. Early studies utilized the zip code as the unit of analysis. However Anderton et al. (1994) argue that some findings are a factor of scale. Thus using the census tract as the unit of analysis produces more accurate results (Anderton et al., 1994).
A total of 20 variables were examined (see Table 4.1). The dependent variable is the natural log of the total amount of pollutants released or transported in a census tract, measured in pounds. This variable was transformed due to the curvilinear nature of the original scatterplot and the curvilinear relationship of the dependent variable to most of the independent variables (Berman, 2002).

This study contained two types of variables: those dealing primarily with the polluters and those focused on the community characteristics. The polluter variables were extracted from the TRI, while the socioeconomic variables were collected from the US Census. Similar environmental justice studies use comparable variables as a gauge of pollution distribution (Neidell, 2004; Macey et al., 2001; Fung and O’Rouke, 2000; Hayward et al., 2000; Sorlie et al., 1995).
<table>
<thead>
<tr>
<th>Data Sources</th>
<th>Variables Analyzed</th>
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<tbody>
<tr>
<td><strong>Toxic Release Inventory (TRI)</strong></td>
<td>In of the total releases and transfers (lbs/year)*</td>
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<td></td>
<td>number of different Standard Industry Classification codes (SIC)</td>
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<td></td>
<td>number of different polluting companies</td>
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<td>number of new polluters</td>
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<td><strong>Polluter variables</strong></td>
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<td><strong>US Census</strong></td>
<td>Census tract number</td>
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<td>Median household income</td>
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<td>Percent of population that are non-caucasian</td>
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<td>Percent of population that are elderly</td>
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<td>Percent of households with children under 18 and had a female household head</td>
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<td></td>
<td>Percent of residents with a graduate or professional degree</td>
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<td>Percent of residents with a college degree</td>
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<td>Percent of residents with some college education</td>
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<td>Percent of residents with an associates degree</td>
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<td>Percent of residents with a high school diploma or equivalent</td>
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<td>Percent of residents with some high school education</td>
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<td>Percent of residents with less than a ninth grade education</td>
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<td>Percent of vacant dwellings</td>
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<td>Percent of rented dwellings</td>
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<td>Percent of population that are foreign born</td>
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<td></td>
<td>Percent of population that do not speak English well or at all</td>
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</tbody>
</table>

* denotes dependent variable

Table 4.1. Variables used and sources of data in analysis of Ohio’s urban environmental justice characteristics.

4.1 TOXIC RELEASE INVENTORY

The TRI was created by the 1986 Superfund Amendments and Reauthorization Act, as well as the Emergency Planning and Community Right to Know Act (EPCRA) (USEPA, 2003). Section 313 of the EPCRA required all manufacturing firms meeting any of three criteria to report their annual emissions and transportation of approximately
650 toxins (Fund and O’Rourke, 2000). These three criteria are as follows. First, manufacturing operations must have a Standard Industry Classification (SIC) code beginning with 20 through 39. All federal facilities, regardless of SIC number, must report. Those facilities that are not operated by the federal government and contain SIC numbers below 20 and above 39 do not have to report the amount of pollution engendered each year (USEPA, 2003).

Next, the company must employ more than 10 full-time employees. If a company employs 10 or fewer full-time workers, or hires many part time workers, there is no requirement to report the amount of pollution created. Finally, the corporation must have processed or created over 25,000 pounds or otherwise used 10,000 pound of a listed chemical or chemical combination. There is a constant political struggle to have certain chemicals removed from the Toxic Release Inventory (Hofrichter, 2002). If a company meets any of these criteria they are required to report their emissions to the TRI.

These exceptions to reporting requirements create a gap in the information that is available to the public, as well as allows some businesses to go unregulated. If a business fails to meet any of these criteria, but still emits some pollution they may be exempt from reporting the amount of pollution created. Some states have additional regulations for reporting pollution. However, Ohio does not (USEPA 2005). Since the scope of this study only includes Ohio, and since the US EPA does not utilize state requirements in data reporting, only US EPA TRI data are included in this study.

There are two chemicals, persistent bioaccumulative toxics (PBT) and dioxin, which have lower reporting thresholds due to the extremely toxic and mobile nature of the substance. Any amount of use, processing, or creation of more than 100 pounds of
PBT must be reported. The TRI PBT chemicals include a subcategory for dioxin and dioxin-like chemicals which must be reported when use, processing, or creation exceeds 0.1 grams (USEPA, 2003).

To ensure the quality of the data, EPA has created several surveying and compliance assistance tools. These include workshops, documents, and surveying instruments for engineers and scientists creating the TRI reports (USEPA, 1998). In 2001 the TRI-ME (Toxic Release Inventory - Made Easy) software was included in the Reporting Forms and Instructions package, which guides the user through all steps of the TRP reporting process. EPA also uses a double key entry process for all data, which has resulted in 99.9% error free reporting (USEPA, 2003).

When the data is entered into the database a Facility Data Profile (FDP) is created. The database automatically checks for data irregularities and notes these on the FDP. Each facility is then required to make revisions to their data. If a corporation has more than one commercial facility, TRI data must be collected and reported at each site. In 2001 there were approximately 10,000 revisions to data (USEPA, 2003).

The US EPA transmits submitted and corrected data to the state EPA. The state EPA verifies that the data reported to the state and the data reported to the US EPA are the same. The US EPA also submits a list of the 100 individual facilities with the largest releases and transfers of pollution. This list is then checked by the state, and cite visits maybe be made as necessary (USEPA, 1996; USEPA, 2003).

TRI data are reported in pounds of chemicals, which can be in any chemical state, and these data are reported to both the states and US EPA. In 1990 the TRI was expanded by the Pollution Prevention Act, which requires data collection on toxic
substances treated on-site, recycled, or combusted (USEPA, 2005; Toxic Release Inventory Program, 2003). The data was downloaded from the Right-to-Know Network website (http://www.rtknet.org), which is a service of the nongovernmental organization OMB Watch.

The TRI provided data for four of the polluter variables in the three counties of study. The data harvested is from 1988 to 2002. The natural log of the total amount of pollutants released and transferred is the dependent variable. This variable is transformed to control for potential curvilinear relationships with independent variables which could result in the regression coefficients being underestimated (Berman, 2002).

The number of different SIC codes is included as an independent variable to account for the diversity of polluting industries within a census tract. Substance diversity may also correlate to industry diversity. A wide range of toxic substances has a greater diversity in the types of pollution to which individuals and communities are exposed. This may lead to compounding environmental stressors, which could in turn, have an adverse effect on human health (Gee and Payne-Sturges, 2004).

The number of polluting companies is included in the study because it is assumed that more polluters will produce more pollution. While a census tract could have many companies that pollute a small amount, producing overall less pollution than a tract with one very productive polluter, this is probably the exception and not the rule (Coughlin, 1996). The magnitude of pollution is accounted for by the dependent variable.

Finally, the number of new polluters is examined because an increase in the number of polluters is a possible indicator of an increase in the amount of toxins released and transferred. This number considers only the number of new polluters between 1989
to 1990 and 1999 to 2000. This coincides with the years of data available from the US Census.

4.2 UNITED STATES CENSUS

The US Constitution, Article 1, Section 2, mandates a general count of all US residents every ten years. The Decennial Census records the population and housing units in the United States and is also used for a variety of research and statistical analyses, as well as for political seat apportionment within the House of Representatives. However, it is also an assessment of many community variables and is widely used in other studies (Yew et al., 1997).

The accuracy of these data is ensured by several methods employed by the US Census Bureau. First, individual confidentiality must be maintained, mandated by Title 13 of the United States Code. This is achieved by two means. The first is a disclosure limitation where the US Census Bureau “modifies or removes the characteristics that put confidential information a risk for disclosure” (US Census Bureau, 2000). This is done by swapping data with other households that have identical attributes and are in neighboring geographic areas within the same state. Since the swap occurs with a close-by household the marginal totals for the area remain valid (US Census Bureau, 1990; US Census Bureau, 2000).

Also, nonsampling errors occur from human and computer errors. These consist of not obtaining complete information from all participants, obtaining incorrect or inconsistent information, and non-response. These errors are negated in a variety of ways
including having questionnaires in a variety of public locations, forms in other languages, training of crew, and editing of unacceptable data (US Census Bureau, 1990; US Census Bureau, 2000).

All census tract numbers in Hamilton, Franklin, and Cuyahoga Counties were included in this study, including census tracts with and without polluters. Two data sets, 1990 and 2000, were utilized. All data was downloaded from American Fact Finder, the US Census Bureau’s online database. These data sets are located at http://factfinder.census.gov under “data sets.” Both data sets were classified as Summary File 1, which denotes variables using 100 percent of the data collected, and not a sample. Sample data can be found using Summary File 3 (American Fact Finder, 2005).

Variables derived from the US Census data include poverty and demographic indicators. The first variable included in the study is median household income. This is the total income that a household received in 1989 and in 1999 (US Census Bureau, 1990; US Census Bureau, 2000). This variable is a proxy measure of the standard of living of the household inhabitants as well as community wealth (Lever, 2000).

Education is often used as an indicator of class. Subsequently, several variables representing different levels of education are included in the study. Achieving a high level of education such as a professional or graduate degree will likely translate into a higher income than another individual with lower educational obtainment, controlling for other variables. Education is relevant to understanding the occupational health, or position at work for members of a community (USEPA, 2000). Hollis (2000) considers education a “cultural variable” and states that cultural variables are relative to determining the health of a population. Seven education variables were included in this
study, ranging from the percent of residents per census tract with less than a ninth grade education to the percent of residents per census tract with a graduate or professional degree. Educational data were broken down into such specific categories in an attempt to accurately assess at what level education is significant in pollution citing.

A third indicator of standard of living is the percent of households with single mothers and children under the age of 18 or the percent of elderly residents. A variety of circumstances associated with these classifications results in less disposable income. In fact, single mother families are more likely to live in poverty than two-parent households (Zhan and Pandey, 2004).

The percent of rented dwellings is used in this study as a fourth indicator of income. Higher income usually contributes to home ownership, which means that census tracts with a higher percentage of rented units will likely have lower incomes (Hollis, 2000). Percent of rented units is often used in the US EPA’s EnviroMapper program, which creates maps and assessment tools for community pollution characteristics. Percent of rented dwellings is used as a means of “environmental justice geographic assessment information” (USEPA, http://www.epa.gov/enviro/html/em/index.html)

Finally, the percent of vacant buildings can be an indicator of poverty status for an area (O’Flaherty, 1993). A high percentage of vacant dwellings is often assumed to represent condemned or uninhabitable buildings. This may lead to increased crime, safety and health issues, as well as a source of unresolved contamination because these buildings are usually unmanaged (Bullard, 2000). An emerging counter-assumption is that areas with a large percent of vacant dwellings may be quickly developing suburbs. In these areas the income is generally higher.
A number of demographic variables were included in the study. First, the percent of nonwhite residents was examined. If an area’s policies are inherently environmentally discriminatory, then it will have a higher amount of pollution in those census tracts with a higher percentage of non-white residents (Bullard, 2000). Percent of nonwhite residents per census tract is not collected by the US Census. Such indicators must be computed from other data. To accomplish this task the total number of Caucasian residents was subtracted from the total number of residents in a particular census tract to determine the number of non-white residents. The number of nonwhite residents was then divided by the total number of residents to compute the percentage of nonwhite persons within a given census tract.

A second variable considered in this study is the percent of residents who are foreign born. Immigration in the US has increased 500 percent since the 1930s, which means the expanded workforce and community are composed of persons born outside of the United States (Chiswick, 1982). Foreign born residents are more likely to be without health insurance than native born citizens, which could make the foreign born population more susceptible to environmental hazards (Pol, et al., 2002). However, this assumption is largely dependent upon from where the immigrants come and their cumulative wealth.

The percentage of residents who consider themselves to be non-English speaking was included in the study. This is a self-determined variable on the US Census questionnaire. These residents may be more susceptible to incoming polluting industries than their English speaking counterparts, since reading local newspapers and community bulletins may not be as common. Polluters are required by legislation to inform residents
and allow ample time for notice and comment. Non-English speaking residents may miss opportunities to voice concern and objections to incoming polluters (Bryant, 1995).

4.3 STATISTICAL METHODS

Discriminant analysis was computed for each study county using the Statistical Package for the Social Sciences (SPSS). This included all census tracts, regardless of pollution status. The discriminant variable was determined to be whether the census tract contained outputs of chemicals on the Toxic Release Inventory or not. If there was TRI classified pollution present the census tract was coded as “1.” The non-polluted census tracts were coded as “0.” Discriminant analysis was computed twice for each county. The first model was computed using the polluter variables. The model was computed a second time, without the polluter variables, to control for potential collinearity caused by the inclusion of these variables. For instance, the census tracts that had any amount of pollution or polluter present would always enter the model as a “1” (Berman, 2002). The polluter variables included the number of different SIC codes, the number of different companies and the number of new polluters from the previous year. The models were computed once for the 1990 data sets and once again for the 2000 data sets. The goal in creating models for the two time periods was to compare the results from 1990 with those derived from 2000 data. Comparison of the data sets overtime made it possible to observe changes or trends.

Linear regression models were computed for each county, including only the polluted census tracts. The dependent variable was the natural log of the total amount of TRI pollutants released and transferred. All other variables were treated as independent.
These models utilized the 1990 data sets and the 2000 data sets. The purpose of this analysis was to investigate the role of selected independent variables in explaining the variability in the dependent variable.

The five most polluted census tracts in each city in 1990 and in 2000 were examined more in-depth. This served as a case-study to further support the statistical models. The local polluters and their SIC codes were more closely examined, as well as the amount of pollution created by each company. US Census data that were of interest were noted. The most polluted areas that occurred both in 1990 and 2000 were mentioned.
CHAPTER 5

FRANKLIN COUNTY, OHIO

This chapter describes the environmental justice situation of Franklin County, Ohio. Descriptive statistics for both 1990 and 2000 will be discussed and compared. The five most polluted census tracts in 1990 and the five most polluted census tracts in 2000 will be highlighted. Five census tracts were chosen for each year as an arbitrary number to provide a snapshot in time of the industrial and demographic descriptive characteristics of Franklin County.

Columbus is located in Franklin County and is one of the urban centers examined in this study. Currently the population of Franklin County is 1,068,978, with an average age of 32.5 years. The population is 51.4 percent female and 22.8 percent non-white. By examining US Census data from 1990 and 2000 it is possible to observe changes in the population demographics, education levels, and housing characteristics (Table 5.1 and Table 5.2). In 1990 there were 252 census tracts in Franklin County. This number increased by 4.8 percent to 264 census tracts in 2000.

In 1990 the mean percent of non-white residents was 20.9 percent, ranging from census tracts with zero percent non-white residents to one with 96.5 percent non-white residents. The percentage of non-white residents in the county increased by 7.7 percent
to 28.6 percent in 2000. The range in percentages for 2000 data included census tracts with a zero percent non-white to 97.0 percent non-white. While there was an increase in the overall minority residence percent, the minimum and maximum per census tract remained relatively constant. The national increase in percentage of non-white residents for 1990 to 2000 was 5.1 percent (American Fact Finder, 2005).

The mean percent of elderly residents in 1990 was 11.1 percent and was slightly less in 2000 (10.8 percent). The standard deviation in both years was large. The standard deviation for 1990 data was 8.2 percent and 6.5 percent for the 2000 data.

The mean percent of vacant dwellings in 1990 was 6.6 percent with a range of zero percent to 82.1 percent. In 2000 the mean percent of vacant dwellings was 9.1 percent, which ranged from zero percent to 38.1 percent. This was a 38.9 percent increase in vacant dwellings in Franklin County.

In 1990 the average percent of rented dwellings was 44.4 percent, which ranged from zero percent to 100.0 percent. The standard deviation was 26.5 percent. The mean percent of rented dwellings decreased in 2000 to 7.1 percent. The minimum percent was zero percent and the maximum is 37.1 percent, with a standard deviation of 5.4 percent.

The average percent of households with a single mother and children under the age of 18 in 1990 was 0.1 percent. The data for this variable ranged from zero percent to 1.7 percent, with a standard deviation of 0.2 percent. In 2000 this variable increased to a mean percent of 44.0 percent. The range also increased with a minimum average percent of 2.1 percent and a maximum of 100.0 percent. The standard deviation in 2000 was 25.3 percent. The large increase in the percent of single mother households with children between 1990 and 2000 should be noted.
In 1990 the median household income was $30,089.80. This variable ranged from zero dollars to $81,791.00. The standard deviation was $13,959.40. In 2000 the median household income in Franklin County increased to $43,283.50, and it ranged from $6,136.00 to $116,020.00. The standard deviation was $19,067.00.

The mean percent of residents with less than a ninth grade education in 1990 was 3.7 percent. This ranged from zero to 26.7 percent with a standard deviation of 3.6 percent. In 2000 the average percent of residents with less than a ninth grade education increased to 4.0 percent. The data ranged from zero percent to 26.4 percent. The standard deviation was 3.6 percent.

In 1990 the average percent of residents per census tract with some high school education, but no diploma or equivalent was 9.8 percent. The range was from zero percent to 51.2 percent with a standard deviation of 7.0 percent. In 2000 this variable increased to 12.7 percent, ranging from zero percent to 53.8 percent. The standard deviation in 2000 was 10.0 percent.

The percent of residents with a high school diploma or other equivalent per census tract in 1990 was 18.6 percent. This variable ranged from a minimum of zero percent to a maximum value of 37.5 percent in one census tract. The standard deviation was 7.4 percent. This variable increased in 2000 to 28.0 percent, and ranged of 2.4 percent to 49.0 percent. The standard deviation in 2000 was 11.5 percent.

In 1990 the average percent of residents with some college education, but no degree was 12.1 percent. This ranged from zero percent to 21.1 percent with a standard deviation of 3.8 percent. The average percent of residents with some college was 21.0
percent. The minimum percent per census tract was zero percent and the maximum in 2000 is 37.0 percent. The standard deviation was 5.1 percent.

The mean percent of residents in Franklin County in 1990 with an associate degree was 3.3 percent, which ranged from zero percent to 13.5 percent. The standard deviation was 1.6 percent. In 2000 the average percent of residents with an associate degree was 5.3 percent. This ranged from zero percent to 11.8 percent, with a standard deviation of 2.1 percent.

The average percent of residents in 1990 with a college degree was 9.9 percent. The minimum percent of residents with a college degree was zero percent and the maximum percent was 36.0 percent. The standard deviation was 7.9 percent. In 2000 the mean percent of residents with a college degree increased to 19.2 percent, and ranged from zero percent to 52.9 percent. The standard deviation was 12.7 percent in 2000.

In 1990 the mean percent of residents with a graduate or professional degree per census tract was 5.4 percent. This ranged from zero percent to 23.8 percent, with a standard deviation of 5.8 percent. In 2000 the average percent of residents with a graduate or professional degree was 10.0 percent, which ranged from zero percent to 49.0 percent. The standard deviation was 9.5 percent.

The mean percent of residents who were born outside of the US from Franklin County in 1990 was 3.1 percent. The data for this variable ranged from zero percent to 35.3 percent, with a standard deviation of 3.0 percent. In 2000 the average percent of foreign born residents was 5.8 percent, ranging from zero percent to 52.2 percent. The standard deviation was 5.7 percent.
In 1990 the percent of residents who do not speak English well or at all, as defined by the US Census, was 0.7 percent. This variable ranged from zero percent to 7.1 percent, with a standard deviation of 0.9 percent. The percent of residents with limited English ability increased in 2000 to 8.8 percent. This ranged from zero percent to 55.4 percent and had a standard deviation of 6.4 percent.

The mean number of different Standard Industry Classifications (SIC) in 1990 was 0.2 classifications per census tract. The minimum number was zero and the maximum number was four, with a standard deviation of 0.5 different SIC numbers. In 2000 there was also an average of 0.2 classifications per census tract. The values in classifications ranged from zero to four, with a standard deviation of 0.8.

The average number of polluters per census tract in 1990 was 0.2. These data ranged from zero polluters to seven, with a standard deviation of 0.7. In 2000 the average number of polluters in each census tract was 0.2, which ranged from zero to eight. The standard deviation in 2000 was 0.8.

In 1990 the mean number of new polluters per census tract, as compared with 1989 was 0.2. These data ranged from zero to one new polluter, with a standard deviation of 0.1. In 2000 the average number of new polluters per census tract, as compared with 1999, was zero. The minimum number of new polluters was zero and the maximum was one. The standard deviation in the 2000 data was 0.1.

The mean of the dependent variable, the natural log of the total pounds of toxins released or transferred per census tract per year, was 1.2, and ranged from zero pounds to 15.4 pounds. The standard deviation in the 1990 data was 3.5 pounds. In 2000 the
average of the natural log of pounds of toxic substances created increased to 1.3, and ranged from zero pounds to 15.5 pounds. The standard deviation was 3.7 pounds.
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Table 5.1. Descriptive statistics for Franklin County, Ohio as reported by the 1990 US Census.
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Table 5.2. Descriptive statistics for Franklin County, Ohio as reported by the 2000 US Census.
5.1 POLLUTION TRENDS

Ultimately the amount of pollution engendered in Franklin County shows no distinct trend (Figure 5.1). The first year of toxic substance releases and transfers recorded in Ohio was 1987. The average amount of pollution in Franklin County overtime has been 12,393,403 pounds per year. In 1987 the amount of toxins dispersed was 14,318,882 pounds, which is a relatively high amount. This is an indication that many polluters complied with the requirements of the Toxic Release Inventory and did not resist disclosing the amount of pollution engendered. It is also possible that the amount of pollution reported was inaccurate.

![Columbus total pollution trends overtime](image)

Figure 5.1. Total amount of pounds of pollution released and transferred, in Franklin County, over time.
Over the next three years pollution levels in Franklin County fell to an all time low. In 1990 the amount of pollution reported was 7,068,615 pounds. This may have been caused by negative media coverage created by the public nature of the Toxic Release Inventory. Also, several years previous two federal regulations were passed that may have limited the quantity and diversity of toxins produced.¹

In 1991 the pollution levels more than doubled to 14,879,216 pounds. Pollution levels stayed mostly constant until decreasing again in 1995 and 1996. In 1996 the total amount of pollution released and transferred in Franklin County, Ohio was 11,843,445 pounds. In 1998 the pollution levels rose to the highest point to date, when corporations in Franklin County produced 16,281,422 pounds of toxic substances. Since then pollution levels have been decreasing, and in 2002 there were 9,671,458 pounds of toxins released and transferred, which is well below the long-term average of 12,393,403 pounds per year for Franklin County.

¹ The first regulation is the Superfund Amendments and Reauthorization Act (SARA) of 1986. This regulation had three major impacts. First, it reauthorized the remediation mission of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. Secondly, it clarified several definitions, increased enforcement authority, created site-specific amendments, and added technical requirements to CERCLA (42 USC 9601). Thirdly, Title III of SARA created the Emergency Planning and Community Right-to-Know Act. This law requires the appointment of a State Emergency Response Commission. States were divided into Emergency Planning Districts and each district was to appoint a Local Emergency Planning Committee.

The next piece of legislation that may have caused a sharp decrease in pollution levels was the Pollution Prevention Act of 1990. This law brought together industry, government and communities to reduce the overall amount of pollution present through “cost-effective changes in production, operation, and raw materials use” (US EPA, 2005). The decrease in pollution seen between 1987 and 1990 may have been in response to industries complying with these two newly formed regulations.
5.2 MOST POLLUTED AREAS

In 1990 in Franklin County, Ohio, the five most polluted census tracts occurred at locations across the county and ranged in characteristics. These census tracts included the following numbers: 88.12, 25.10, 93.37, 60.00, and 19.00. Each of these five census tracts exhibited a high number of different standard industry classifications, a relatively high number of different polluters, and a relatively high number of new polluters between 1989 and 1990. It is to be expected that there is a high quantity of each of these pollution variables, since these tracts are the most polluted. There is high variability among the census tracts in terms of socioeconomic variables including race, income, and education.

The most polluted census tract in 1990 was 88.12 with 4,807,933 pounds of toxic substances released and transferred (Figure 5.2). It contained three polluting companies, with two different SIC codes. Coca-Cola USA Fountain, owned by Coca-Cola Co. Inc. produced “flavoring extracts and flavoring syrups, not elsewhere classified” (Toxic Release Inventory, 1990). The SIC code for this company was 2087. Next, Sherwin-Williams Co. Columbus, owned by Sherwin-Williams Co. was also located in this census tract. Its Standard Industry Classification described a company that created “paint, varnishes, lacquers, enamels, and allied products” (Toxic Release Inventory, 1990). The SIC code for this company was 2851. Finally, Georgia-Pacific Resins Inc., owned by Georgia-Pacific Corp. was located in this area. This company’s SIC code was the same classification as Sherwin-Williams Co. Columbus. The categorization for Georgia-Pacific Resins Inc. was “plastic materials, synthetic resins, and nonvulcanizable elastomers” (Toxic Release Inventory, 1990).
This census tract contained the 24th highest percentage of non-white residents in Franklin County out of 252 total census tracts. The percent of non-white residents was 70.6 percent. This census tract also had two different standard industry classifications, which was the 6th highest amount. Finally, there were three different polluters, which was the 4th largest number in Franklin County.

Figure 5.2. Census tract 88.12

Census tract 88.12 had surprising characteristics. First, it had the 18th lowest percent of vacant dwellings. This could indicate a strong economy in the area or it could
signify a lack of development of local businesses and homes. Next, this census tract had the 15th lowest percentage of foreign born residents at 0.3 percent.

The next most polluted area in Franklin County was census tract 25.10 (Figure 5.3). There were 1,689,347 pounds of pollution released and transferred in this tract in 1990. This census tract had one different standard industry classification, as well as one different polluting industry. Although these numbers seem insignificant, the maximum different SIC codes for Franklin County in 1990 was four, and the maximum different polluters was seven. Yenkin-Majestic Paint Corp. was responsible for the creation of over 1.6 million pounds of toxic substances. It was classified by the Toxic Release Inventory (1990) as a producer of “paints, lacquers, varnishes, enamels, and allied products.” Its SIC code was 2851.

This census tract had the 8th highest minority population, with 91.5 percent non-white. Next, this census tract had 19.1 percent elderly, which was the 28th highest amount in Franklin County. There were also 8.9 percent of residents obtaining less than a ninth grade education. Though this percentage was low, when compared with the other census tracts it was the 18th highest. This was an indication that a larger amount of residents have low education levels when compared with the average. The mean amount of residents with less than a ninth grade education in Franklin County was 3.8 percent. A high amount of residents with low educational obtainment was also an indicator of lower income. In census tract 25.10 the percent of residents who do not speak English well or at all was zero.
Census tract 93.37 was the third most polluted area in Franklin County, Ohio in 1990 (Figure 5.3). There were 677,050 pounds of toxic substances released and transferred in this census tract in 1990. This census tract also contained one different SIC code and one different polluter. Tomasco Mulciber Inc. was classified as engendering "more vehicle parts and accessories" (Toxic Release Inventory, 1990).

Census tract 93.37 also had the 39th highest minority population in Franklin County, with approximately 49.7 percent non-white residents. Further research should
focus on the historical changes in the community composition as well as changes in pollution levels. This census tract had mostly average values for the county for the other independent variables.

Figure 5.4. Census tract 93.71

The fourth most polluted census tract was census tract 60.00 (Figure 5.4). It had 633,808 pounds of pollution released and transferred in 1990. Census tract 60.00 also had one different SIC code and one different polluter. This amount was identical to the second through fifth highest census tracts in Franklin County. The polluter in this area
was Oi-Neg TV Products. It was classified as a producer of "pressed and blown glass and glassware, not elsewhere classified," as SIC number 3621 (Toxic Release Inventory, 1990).

This census tract had the 33rd lowest income, where an average resident made about $14,400 each year. This census tract also exhibited high variability relative to education variables. For instance, it had the 18th lowest percent of residents that obtained a graduate or professional degree, with only 0.3 percent achieving this level. Furthermore, only 6.1 percent of residents had some college education, which was the 19th lowest when compared with other census tracts. There were also 20.2 percent of residents with some high school education, but no degree. This was the 18th highest in Franklin County. The percent of non-white residents in this area was 33.3 percent, which was higher than the average of 20.9 percent minority residents for Franklin County.
Figure 5.5. Census tract 60.00

Finally, the fifth most polluted census tract in 1990 was 19.00 (Figure 5.5). The number of different polluters and different standard industry classifications was one. Magntek National Electric Coil released and transferred 566,315 pound of pollution. Its SIC code was 3621, which indicated a producer of motors and generators.

It also had the 27th highest percent of rented residences, with 84.2 percent of homes not owned by the tenant. Approximately, 6.3 percent of residents held an associate’s degree, which is the 6th highest.
Figure 5.6 Census tract 19.00

Ten years later, in 2000, the most polluted census tracts were similar. The ordering was the same. However census tract 93.37 decreased its pollution levels drastically. It was the 231st most polluted census tract in 2000. Census tract number 79.42 took its place as the third most polluted community. Overall there were 264 different census tracts in 2000. The total amount of pollution released and transferred in 2000 was 12,288,282 pounds. The five most polluted census tracts contained 9,497,130 pounds of released or transferred pollution, which was 77.3 percent of the total amount of pollution in Franklin County in 2000. This means that the majority of toxic substances in
Franklin County were concentrated within very few census tracts in 2000. Therefore, it was critical to understand the demographic commonalities between these areas to assure no bias had taken place.

First, the most polluted area in 2000 in Franklin County was census tract 88.12. Ten years prior to this date, it was the most polluted census tract. This census tract had 5,127,563 pounds of pollution that had been released or transferred in 2000. Two of the polluting companies were the same as in 1990. Sherwin-Williams Co. Columbus and Georgia-Pacific Resins Inc. both were major pollution contributors in 1990. A new company, Columbus Coatings Company, was the third polluter in census tract 88.12. This business was owned by LTV Steel Co. Inc. and was considered an “electroplating, plating, polishing, anodizing, and coloring” company (Toxic Release Inventory, 2000). Its SIC code was 3471.

This census tract had the 33rd highest percent of minority residents (72.8 percent). Though the percentage of non-white residents had increased since 1990, its comparative ranking had decreased from the 24th largest percentage of non-white residents to the 33rd highest. Next, this area had the 36th lowest percent of residents receiving bachelor’s degrees. Only 4.8 percent of all residents obtained a college degree in 2000. This area also had two different Standard Industry Classification (SIC) codes, which was the third largest amount. It also had three different polluting industries.

The next most polluted census tract was 25.10. It contained 1,594,094 pounds of pollution and was also the second most polluted area in 1990. Census tract 25.10 had one
polluter and one SIC code. This polluter was the same as ten years prior, Yenkin-
Majestic Paint Corp. The amount of pollution created in 2000 was 95,253 pounds less
than 1990.

The residents of this census tract were 20.4 percent elderly, which was an increase
since 1990. This census tract had the 22\textsuperscript{nd} most elderly population. The census tract
contained the 17\textsuperscript{th} highest population of nonwhite residents. Eighty-six percent of the
residents in this area were non-white.

There were two surprising characteristics associated with this census tract. First,
28.6 percent of all residents had some college coursework, which was the 13\textsuperscript{th} highest in
Franklin County in 2000. Next, this neighborhood had the 35\textsuperscript{th} lowest percent of foreign
born residents. With 1.5 percent of all residents born outside of the United States, these
residents might have been taken advantage of due to their citizen status.

Census tract number 79.42 was the third most polluted census tract in 2000
(Figure 5.7). There was 1,490,761 pound of toxins released and transferred in this area.
It contained two polluters, both with a different SIC code. First was ISP Fine Chemicals
Inc., which was the subsidiary of parent company International Specialty Products Inc.
The SIC code was 2834, which indicated pharmaceutical preparation (Toxic Release
Inventory, 2000). Next, AFP-Ohio, owned by Austin Foam Plastics contributed the
remaining pollution. It was classified as a creator of “plastics [and] foam products” by
the Toxic Release Inventory (2000), and it had a SIC code of 3086.

This census tract also had a population with only three percent elderly. This was
the 22\textsuperscript{nd} lowest elderly population. About 9.2 percent of all residents living in this area
had an associate’s degree, which was the 10\textsuperscript{th} highest in Franklin County. Overall, since

79
1990 two new polluters moved into the area, which created over a million pounds of pollution each year. The demographic and socioeconomic features of the community were average, with few noticeable characteristics.

Figure 5.7. Census tract 79.42

The fourth most polluted area in Franklin County was census tract 60.00. Its one corporation produced 717,896 pounds of pollution. This was also the fourth most polluted area in 1990, engendering 633,808 pounds of toxic substances at that time. Techneglas Inc., which was located at the same address as the 1990 polluting company, was a producer of “pressed and blown glass and glassware, not elsewhere classified” (Toxic Release Inventory, 2000). This was probably the same company that reported in 1990,
with an officially different name or it was simply reported under a different name.

In 2000 census tract 60.00 had the 8th highest percentage of single mother households with children present. Also, in this area 17.6 percent of all dwellings were vacant. That was the 16th greatest percentage in Franklin County. These uninhabited homes and apartments damage the cohesiveness of the community and thus residents may be less likely to organize to prevent increases in pollution levels (Bryant, 1997). Next, census tract 60.00 had the 22nd lowest average income levels, with a mean annual salary of $21,271. This is because many residents in this area have only completed the most basic levels of education. For instance, only 0.6 percent had graduate or professional degrees and 11.4 percent had less than a ninth grade education, which was 11th highest in Franklin County. Also, only 2.9 percent held bachelor degrees (the 13th lowest percent in Franklin County) and 34.7 percent had some high school education (the 10th highest amount). This may mean that community members will be willing to overlook the known health and environmental harms in order to accept employment. This area had one polluter with one Standard Industry Classification.

Finally, census tract 19.00 was the fifth most polluted community Franklin County. In 2000 566,816 pounds of pollution were created in this area. Ten years previous the amount produced was roughly the same, 566,315 pounds. This census tract had only one polluter with one SIC code. National Electric Coil Inc. was the same corporation that was present in 1990. Census tract 19.00 also had the 23rd highest percent of rented dwellings, with 85.8 percent of all homes rented.

This area had several unusual demographic characteristics for an area with a high amount of pollution. First, it had the 10th lowest percent of single mother households, 81
with only 1.6 percent. Next, it had the 33rd highest amount of residents with a bachelor's degree. In fact, 36.0 percent of the population in census tract 19.00 had university degrees.

Overall, many speculative conclusions can be drawn from examining the descriptive statistics and five most polluted census tracts in 1990 and 2000. Without further research about the history of each polluter, as well as in-depth deed records no definitive statements about polluter intention to discriminate can be justified. In a following chapter regression models will be computed to provide further insight about pollution distribution and demographic features.

5.3 DISCRIMINANT ANALYSIS

Canonical correlation findings revealed that approximately 84.1 percent of the variance in the dependent variable is explained by six variables. The
<table>
<thead>
<tr>
<th>Entering variable</th>
<th>Polluted (n=27)</th>
<th>Not Polluted (n=225)</th>
<th>Eigenvalue</th>
<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of dwellings rented</td>
<td>52.29</td>
<td>43.33</td>
<td>5.267</td>
<td>0.917</td>
<td>0.160</td>
<td>453.309</td>
<td>0.00</td>
</tr>
<tr>
<td>Percent of residents with less than a 9th grade education</td>
<td>6.43</td>
<td>3.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of residents with some high school education</td>
<td>15.19</td>
<td>9.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of residents with an associates or 2-year college degree</td>
<td>2.69</td>
<td>3.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of different Standard Industry Classifications (SIC)</td>
<td>1.44</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of different polluters</td>
<td>1.67</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.3. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Franklin County 1990 (n=252). This includes all variables.
significant variables are as follows: percent of dwellings rented, percent of residents with less than a night grade education, percent of residents with some high school education, percent of residents with an associate degree, number of different SIC codes, and number of different polluters (Table 5.3).

The average percent of rented dwellings in polluted census tracts is 52.3 percent, which is greater than the amount of rented dwellings in non-polluted census tracts, 43.3 percent. This is to be expected since homeownership is typically lower in an area with a depressed socioeconomic status. According to environmental justice theory residents of lower socioeconomic status endure a greater amount of pollution than their wealthier counterparts (Bullard, 2000; Byant, 1995).

In those census tracts that are polluted the percent of residents with less than a ninth grade education is higher than in census tracts without pollution. In polluted census tracts the average percent is 6.4 percent, compared to 3.4 percent in non-polluted census tracts. Since jobs offering higher wages usually require more than a ninth grade education, it is not surprising that there is more pollution in areas where education levels are low.

The percent of residents with some high school education in polluted census tracts is 15.2 percent, which is greater than 9.2 percent, the mean percent of residents with the same level of education in non-polluted census tracts.

The average percent of residents with an associate or two-year college degree is greater in census tracts where there is no pollution. In those census tracts without pollution present the mean percent is 3.4 percent, as compared with 2.7 percent in polluted census tracts.
The average number SIC codes for those census tracts that are polluted is 1.4 classifications, which is more than in non-polluted census tracts. In those census tracts with no pollution there are no different Standard Industry Classification. This is logical-in those areas with no pollution there are no polluting industry classifications.

In the polluted census tracts the number of different polluters is 1.7, whereas in those census tracts with no pollution, the average number of different polluters is zero. Again, where there is no pollution we find that there are no polluters.

These variables are both socioeconomic variables (percent of dwellings rented and percent of residents with less than a ninth grade education, percent of residents with some high school education, percent of residents with an associate or two year college degree) and polluter variables (number of different SIC and number of different polluters). This indicates that education levels as well as the amount of homeownership are relevant in the distribution of noxious facilities in Franklin County in 1990. Also, since the polluter data is significant, this is an indicator that the Toxic Release Inventory system of pollution classification in 1990 is logical and valid in describing pollution sources.

The polluter variables, including the number of different SIC codes, the number of different polluters, and the number of new polluters between 1989 and 1990 were removed from the model (Table 5.4). Three variables entered the model as significant. The Canonical correlation is 0.338, which means that 11.4 percent of the variance in the dependent variable is explained by three variables that entered the model.
<table>
<thead>
<tr>
<th>Entering variable</th>
<th>Polluted (n=27)</th>
<th>Not Polluted (n=226)</th>
<th>Eigenvalue</th>
<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of residents with some college education</td>
<td>9.21</td>
<td>12.42</td>
<td>0.129</td>
<td>0.338</td>
<td>0.886</td>
<td>30.063</td>
<td>.000</td>
</tr>
<tr>
<td>Percent of residents with a high school diploma or equivalent</td>
<td>18.01</td>
<td>18.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of residents who do no speak English well or at all</td>
<td>0.58</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.4. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Franklin County 1990 (n=252). The variables number of different SIC codes, number of different polluters, and number of new polluters between 1989 and 1990 were removed.
The average percent of residents with some college education is 9.2 percent in the polluted census tracts. This value is higher in non-polluted census tracts. The mean value for non-polluted census tracts is 12.4.

In the polluted census tracts the average percent of residents with a high school diploma or equivalent is 18.0 percent. In the non-polluted census tracts the mean increases to 18.7 percent.

Finally, the average percent of residents who do no speak English well or at all is higher in the non-polluted census tracts. The average for this variable in the polluted census tracts is 0.6 percent, whereas in non-polluted census tracts the average is 0.7 percent.

In Franklin County in 2000 the data create a similar set of conclusions as the 1990 data. The Canonical correlation shows that 80.3 percent of the variance is accounted for by the above variables, percent of vacant dwellings, percent of residents with a graduate or professional degree, number of different SICs, number of different polluters, and number of new polluters between 1999 and 2000 (Table 5.5).

The average percent of rented dwellings, 9.3 percent, is greater in the polluted areas than in the non-polluted census tracts, 6.8 percent. This situation is similar to the 1990 data, which also shows a higher percentage of rented dwellings in those census tracts with pollution present.
<table>
<thead>
<tr>
<th>Entering variable</th>
<th>Polluted (n=32)</th>
<th>Not Polluted (n=232)</th>
<th>Eigenvalue</th>
<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of dwellings rented</td>
<td>9.28</td>
<td>6.75</td>
<td>4.067</td>
<td>0.896</td>
<td>0.197</td>
<td>421.128</td>
<td>.000</td>
</tr>
<tr>
<td>Percent of residents with a graduate or professional degree</td>
<td>9.49</td>
<td>10.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of different Standard Industry Classifications (SIC)</td>
<td>1.50</td>
<td>0.00</td>
<td>1.50</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
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<tr>
<td>Number of different polluters</td>
<td>1.72</td>
<td>0.00</td>
<td>1.72</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of new polluters</td>
<td>0.13</td>
<td>0.00</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.5. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Franklin County 2000 (n=264). This includes all variables.
The mean percent of residents with a graduate or professional degree is higher in those census tracts that are not polluted. In the non-polluted areas the average percent is 10.0 percent, whereas in those census tracts with pollution the average percent of residents of residents with an advanced degree is 9.5 percent.

The average number of different SIC codes is higher in those census tracts that are polluted: 1.5 different classifications compared to zero classifications in the non-polluted tracts. This is intuitive; those census tracts with no pollution should have no polluters, and thus no polluter classifications.

The mean number of different polluters in polluted census tracts is 1.7 polluters, whereas the number of polluters in those census tracts that are not polluted is zero. Again, this makes sense; there are no polluters in the areas where there is no pollution.

The average number of new polluters between the years 1999 and 2000 is greater in areas where there is pollution, 0.1 new polluters. In the census tracts with no pollution there is no change in the number of different polluters. In 2000 the number of polluters was zero, so we can deduce that the number of polluters in 1999 was zero as well.

These variables are both socioeconomic variables (percent of dwellings rented and percent of residents with a graduate or professional degree) and polluter variables (number of different SIC, number of different polluters, and number of new polluters). This indicates that education levels as well as the amount of homeownership are relevant in the distribution of noxious facilities siting in Franklin County. Also, since the polluter data is significant this is an indicator that the current system of pollution classification is logical and valid in describing pollution sources.
<table>
<thead>
<tr>
<th>Entering variable</th>
<th>Polluted (n=32)</th>
<th>Not Polluted (n=232)</th>
<th>Eigenvalue</th>
<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of residents with less than a 9th grade education</td>
<td>6.46</td>
<td>3.61</td>
<td>0.101</td>
<td>0.303</td>
<td>0.908</td>
<td>25.145</td>
<td>0.000</td>
</tr>
<tr>
<td>Percent of residents with a high school diploma or equivalent</td>
<td>26.73</td>
<td>28.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.6. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Franklin County 2000 (n=264). The variables number of different SIC codes, number of different polluters, and number of new polluters between 1999 and 2000 were removed.
When the variables the number of different SIC codes, the number of different polluters and the number of new polluters between 1999 and 2000 are removed from the model it shows that education is again an important variable in explaining the pollution disparities in Franklin County in 2000 (Table 5.6). The percent of residents with less than a ninth grade education and the percent of residents who received a high school diploma are two factors that now account for 9.2 percent of the explained variance, according to the Canonical correlation, when the other afore mentioned variables are not included.

In the census tracts with pollution present there is a higher percent of residents who have only received less than a ninth grade education. In these polluted tracts the mean percent is 6.5 percent compared with an average 3.6 percent of residents receiving less than a ninth grade education in non-polluted census tracts.

The average percent of residents with a high school education is 28.1 percent in the census tracts with no pollution, which is a higher percentage than in those census tracts with pollution. These polluted census tracts have an average of 26.7 percent of residents with a high school diploma or equivalent.

5.4 POLLUTED CENSUS TRACT REGRESSION ANALYSIS

Data from polluted census tracts were examined using multivariate linear regression analysis to determine the utility of the independent variables in understanding the variance in the dependent variable. A model was calculated once for 1990 and once
for 2000. In both cases none of the independent variables entered the model at the 0.05 level of significant. This means that none of the independent variables were useful for predicting the variability in the dependent variable.

Environmental justice theory would predict that high levels of pollution would also be accompanied by high levels of minority or low income residents (Hofichter, 2002). In Franklin County this is simply not the case. While several of the most polluted census tracts exhibited higher percentages of minority populations and lower annual income, this seems to be the exception rather than the rule. However, a disproportionate amount of pollution in conjunction with a high population of disadvantaged residents is a precarious situation. Steps should be taken, both from a policy and administrative stance to ensure that in the future the environmental health and quality of the residents is only improved and not further degraded.
CHAPTER 6

CUYAHOGA COUNTY, OHIO

This chapter describes the environmental justice situation of Cuyahoga County, Ohio. First, the descriptive statistics for both 1990 and 2000 will be discussed and compared. Then this chapter will highlight the five most polluted census tracts in 1990 and the five most polluted census tracts in 2000. Five census tracts were chosen for each year as an arbitrary number to provide a snapshot in time of the industrial and demographic descriptive characteristics of Cuyahoga County.

Cuyahoga County contains the urban area of Cleveland, Ohio. Currently the population of Cuyahoga County is 1,393,978 and the average age of the population is 37.3 years. Also, the population is 52.8 percent female and 31.5 percent non-white (American Fact Finder, 2005). By examining US Census data from 1990 and 2000 it is possible to observe changes in population demographics, education levels, and housing characteristics (Table 6.1 and Table 6.2).

In 1990 there were 499 census tracts in Cuyahoga County. This number increased to 501 census tracts in 2000. This may be an indicator that little population growth took place over the ten-year period of this study and the population remained relatively constant.
The percent of non-white residents in Cuyahoga County was widely distributed in both 1990 and 2000. The minimum percentage of non-white residents per census tract was zero percent and the highest was 100.0 both years. In 1990 the mean percent of non-white residents was 32.5 percent with a standard deviation of 38.3 percent. The situation in 2000 was similar. The mean percent of non-white residents was 39.4 percent, which was a 6.9 percent increase from 1990. The standard deviation for 2000 was 37.1 percent.

In 1990 the percent of elderly residents ranged from zero percent to 80.3 percent, with a mean of 15.2 percent. The standard deviation was 8.4 percent. In 2000 the percent of elderly residents ranged from zero percent to 59.2 percent. This was an overall decrease in the maximum amount of elderly residents. In 2000 the mean percent of elderly residents was 15.0 percent with a standard deviation of 7.92 percent. This was similar to the 1990 statistics.

The mean percent of vacant dwellings in 1990 was 6.7 percent. The range was from zero percent to 80.1 percent. The standard deviation was 8.6 percent. In 2000 the mean percent of vacant dwellings increased to 8.6 percent. The range in values in 2000 narrowed, spanning from zero percent to 60.5 percent. The standard deviation decreased to 7.6 percent.

The percent of rented residences in 1990 ranged from census tracts with zero percent rented to 100.0 percent rented. The mean percent of rented dwellings was 40.5 percent with a 27.0 percent standard deviation. In 2000 a similar trend was identified. The percent of rented residences ranged from zero percent rented to 100.0 percent rented. The mean percent of rented dwellings was 40.4 percent with a standard deviation of 26.5 percent.
The mean percentage of single mother households in 1990 was 9.8 percent and ranged from zero percent to 79.0 percent. The standard deviation for this variable in 1990 was 9.5 percent. In 2000 the mean percentage of single mother household was 12.4 percent, a 2.9 percent increase since 1990. The data in 2000 ranged from zero percent to 64.9 percent, with a standard deviation of 10.8 percent.

The median household income in 1990 was $27,934. These data ranged from $0 to $126,786. The standard deviation was $17,366. In 2000 the median household income was $39,236. The distribution of income ranged from zero to $200,000, with a standard deviation of $23,959.

In 1990 the percent of residents with less than a 9th grade education averaged 6.1 percent in Cuyahoga County. The data ranged from zero percent to 52.2 percent with a standard deviation of 5.6 percent. In 2000 the percent of residents with less than a 9th grade education increased to 7.4 percent. These data ranged from zero percent to 100.0 percent of residents with less than a 9th grade education. The standard deviation for the 2000 data was 7.9 percent.

The average percent of residents with some high school education in 1990 was 13.4 percent. This ranged from zero percent to 100.0 percent. The standard deviation was 8.2 percent. In 2000 the mean percent of residents with some high school education decreased to 4.8 percent. The minimum mean percent of residents with some high school education was zero and the maximum was 20.1 percent. The standard deviation in 2000 was 3.4 percent.

In 1990 the mean percent of residents with a high school diploma or equivalent degree was 19.7 percent. These data ranged from zero to 100.0 percent. The standard
deviation was 8.0 percent. In 2000, a larger average percent of residents received a high school diploma or equivalent. The average percent of residents receiving this degree was 29.5 percent, a 9.8 percent increase from 1990. The data ranged from zero percent to 50.9 percent of residents receiving a high school degree or equivalent. The standard deviation in 2000 was 10.0 percent.

Next, there was an average of 11.3 percent of residents in 1990 that had some college coursework. The data ranged from zero percent to 55.3 percent. The standard deviation was 4.8 percent. In 2000 the average percent of residents with some college education increased 44.3 percent to 20.2 percent. The minimum was zero percent and the maximum was 38.2 percent, with a standard deviation of 5.8 percent.

The percent of residents that completed an associate's degree in 1990 was 3.1 percent. The data ranged from zero percent to 8.6 percent. The standard deviation was 1.6 percent. In 2000 the average percent of residents receiving an associate's degree increased to 4.8 percent. The data ranged from zero percent to 12.5 percent, with a standard deviation of 2.3 percent.

In 1990 the mean percent of residents with a college degree was 7.6 percent, with a standard deviation of 6.8 percent. The data ranged from zero percent to 44.7 percent of residents having achieved a college degree. In 2000 the average percent of residents with a college degree increased to 13.5 percent. These data ranged from zero percent to 52.5 percent, with a standard deviation of 9.9 percent.

The percent of residents receiving a graduate or professional degree in 1990 was 4.6 percent. The minimum percentage was zero percent and the maximum was 100.0 percent. The standard deviation in 1990 was 7.1 percent. In 2000 the mean percent of
residents who received a graduate or professional degree increased to 8.4 percent. These data ranged from zero percent to 50.1 percent. The standard deviation for 2000 was 9.5 percent.

In 1990 the mean percent of foreign born residents was 5.4 percent. These data ranged from zero percent to 77.9 percent. The standard deviation was 5.6 percent. The mean percent of foreign born residents in 2000 was 5.8 percent, and the standard deviation was 5.4 percent. The data ranged from zero percent to 48.3 percent.

In 1990 the average percent of residents who do not speak English well or at all, as defined by the US Census was 1.5 percent. These data ranged from zero percent to 19.4 percent, with a standard deviation of 2.3 percent. This variable increased in 2000 to 10.9 percent. These data ranged from zero to 63.8 percent. The standard deviation was 8.9 percent.

The mean number of different Standard Industry Classifications (SIC) in 1990 was 0.3 classifications per census tract. The minimum number was zero and the maximum number was four, with a standard deviation of 0.8 different SIC numbers. In 2000 this number decreased to an average of 0.2 classifications per census tract. The variety in classifications ranged from zero to three, with a standard deviation of 0.5.

Next, average number of polluters per census tract in 1990 was 0.3. These data ranged from zero polluters to seven, with a standard deviation of 1.0. In 2000, again there was a decrease. The average number of polluters in each census tract was 0.2, which ranged from zero to six. The standard deviation in 2000 was 0.7.

In 1990 the mean number of new polluters per census tract, as compared with 1989 was 0.04. These data ranged from zero to one new polluter, with a standard
deviation of 0.2. In 2000 the average number of new polluters per census tract, as compared with 1999, was 0.01. The minimum number of new polluters was zero and the maximum was two. The standard deviation in the 2000 data was 0.1.

The mean of the dependent variable, the natural log of the total pounds of toxins released or transferred per census tract, was 1.6, and ranged from zero pounds to 15.6 pounds. The standard deviation in the 1990 data was 3.9 pounds. In 2000 the average of the natural log of pounds of toxic substances created decreased to 1.2, and ranged from zero pounds to 15.2 pounds. The standard deviation was 3.4 pounds.
<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent non-white residents</td>
<td>499</td>
<td>.00</td>
<td>100.0</td>
<td>32.5</td>
<td>38.3</td>
</tr>
<tr>
<td>Percent elderly</td>
<td>499</td>
<td>.00</td>
<td>80.3</td>
<td>15.2</td>
<td>8.4</td>
</tr>
<tr>
<td>Percent vacant dwellings</td>
<td>499</td>
<td>.00</td>
<td>80.1</td>
<td>6.7</td>
<td>8.6</td>
</tr>
<tr>
<td>Percent rented</td>
<td>499</td>
<td>.00</td>
<td>100.0</td>
<td>40.5</td>
<td>27.0</td>
</tr>
<tr>
<td>Percent households with female head and children under 18</td>
<td>499</td>
<td>.00</td>
<td>79.0</td>
<td>9.8</td>
<td>9.5</td>
</tr>
<tr>
<td>Median household income</td>
<td>499</td>
<td>.00</td>
<td>126786.0</td>
<td>27934.0</td>
<td>17365.9</td>
</tr>
<tr>
<td>Percent residents with less than 9th education</td>
<td>499</td>
<td>.00</td>
<td>52.2</td>
<td>6.1</td>
<td>5.6</td>
</tr>
<tr>
<td>Percent residents with some high school education</td>
<td>499</td>
<td>.00</td>
<td>100.0</td>
<td>13.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Percent residents with a high school diploma or equivalent</td>
<td>499</td>
<td>.00</td>
<td>100.0</td>
<td>19.7</td>
<td>8.0</td>
</tr>
<tr>
<td>Percent residents with some college education</td>
<td>499</td>
<td>.00</td>
<td>55.3</td>
<td>11.3</td>
<td>4.8</td>
</tr>
<tr>
<td>Percent residents with an associates degree</td>
<td>499</td>
<td>.00</td>
<td>8.6</td>
<td>3.1</td>
<td>1.6</td>
</tr>
<tr>
<td>Percent residents with a college degree</td>
<td>499</td>
<td>.00</td>
<td>44.7</td>
<td>7.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Percent residents with a graduate or professional degree</td>
<td>499</td>
<td>.00</td>
<td>100.0</td>
<td>4.6</td>
<td>7.1</td>
</tr>
<tr>
<td>Percent of foreign born residents</td>
<td>499</td>
<td>.00</td>
<td>77.9</td>
<td>5.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Percent of residents who do not speak English well or at all</td>
<td>499</td>
<td>.00</td>
<td>19.4</td>
<td>1.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Median household income</td>
<td>499</td>
<td>.00</td>
<td>126.8</td>
<td>27.9</td>
<td>17.4</td>
</tr>
<tr>
<td>Number of different sic</td>
<td>499</td>
<td>.00</td>
<td>4.0</td>
<td>.3</td>
<td>.7</td>
</tr>
<tr>
<td>Number of different polluters</td>
<td>499</td>
<td>.00</td>
<td>7.0</td>
<td>.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Total toxins released and transferred</td>
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<tr>
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<td>1.0</td>
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Table 6.1. Descriptive statistics for Cuyahoga County, Ohio as reported by the 1990 US Census
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<td>Number of different polluters</td>
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Table 6.2. Descriptive statistics for Cuyahoga County, Ohio as reported by the 2000 US Census
6.1 POLLUTION TRENDS

From 1986 to 2003 a weak trend emerged in the amount of pollution produced in Cuyahoga County, Ohio (Figure 6.1). Between 1986 and 1997 pollution levels were generally between 20 million and 35 million pounds released and transferred each year. These levels were approximately double the amount of those in Franklin Country, Ohio for the same time period. The largest decrease during this eleven-year period was in 1990, when the amount reported pollution was 21,384,290 pounds. This decrease in both Cuyahoga County and Franklin County was probably due to the Pollution Prevention Act of 1990.

![Cleveland total pollution trends overtime](image)

Figure 6.1. Total amount of pounds of pollution released and transferred, in Cuyahoga County, over time.
Pollution levels in Franklin County also showed a significant decrease in this year as well. Then in 1998 pollution levels reached an all time high of 48,733,245 pounds of toxic substances released and transferred. Franklin County sustained the greatest increase in pollution during this year as well. Cuyahoga County decreased by more than 50 percent one year later, to 21,223,680 pounds.

The quantity of toxic substances continued to decrease. In 2000 the amount of pollutants released and transferred was 13,215,753 pounds. The following year the total pollution was 12,309,110 pounds. Finally in 2002, Cuyahoga County industries produced 9,187,626 pounds of toxins. This amount was the lowest reported since the Toxic Release Inventory was implemented in 1986.

6.2 MOST POLLUTED AREAS

In 1990 in Cuyahoga County, Ohio, the five most polluted census tracts occurred at locations across the county and ranged in characteristics. These census tracts included: 1106.00, 1922.00, 1525.02, 1148.00, and 1175.00. Each of these five census tracts had a high number of different standard industry classification and a variety of different polluters. None had any new polluters between 1989 and 1990. There are a variety of socioeconomic variables of which each census tract has a high percentage, including race, income, and education variables. In 1990, these five census tracts contained 12,435,186 pounds of pollution, which was 58.2 percent of the total pollution in Cuyahoga County during that year.
The most polluted census tract was 1106.00, which contained 6,176,623 pounds of toxic substances (Figure 6.2). There was only one company responsible for the entire amount of pollution in this area: LTV Steel Co. Inc. Cleveland Works. In 1990 it was owned by LTV Steel Co Inc., and had a Standard Industry Classification (SIC) code of 3312. This meant that it was a producer of “steel works, [using] blast furnaces, including coke” (Toxic Release Inventory, 1990).

This census tract has several interesting demographic characteristics. First, out of 499 census tracts, it had the 60th highest percent of vacant buildings, which was 13.4 percent. Next, this census tract had many statistics that show low educational achievement. For example, it had the 18th highest percent of residents with less than a ninth grade education. In other words, 17.7 percent of the residents in this census tract had no education past the junior high school level. Also, this area had the 55th highest amount of residents with only some high school coursework (22.2 percent) and had the 31st lowest amount of residents with some college coursework (3.7 percent). No residents in 1990 reported having an associate degree, a college diploma, or a graduate or professional degree. Finally, in census tract 1106.00, 5.4 percent of the residents did not speak English well or at all. In relation to the other census tracts, this neighborhood ranked as the 22nd highest for this variable.
The second most polluted census tract was 1922.00 (Figure 6.3). This area had six polluting companies with four different SIC codes, which produced 2,206,801 pounds of pollution released and transported in 1990 year. Three companies were classified as Division D according to SIC codes which meant these businesses manufactured chemicals and allied products. The first company was Benjamin and Moore Co. Cleveland. It had a SIC code of 2851 and produced “paints, varnishes, lacquers, enamels, and allied products” (Toxic Release Inventory, 1990). Next, the Engelhard Corporation had a SIC code of 2819 and created “industrial inorganic chemicals, not elsewhere classified” (Toxic Release Inventory, 1990). The third business was classified as manufacturing chemical products and was named Research Organics Incorporated. This
company was responsible for the largest amount of toxic substances in census tract 1922.00. It had a SIC code of 2869 and generated mostly "industrial organic chemicals, not elsewhere defined" (Toxic Release Inventory, 1990).

Figure 6.3. Census tract 1922.00

This census tract also had three other polluters in 1990, each with a different SIC code. First, the Aluminum Company of America (ALCOA) created "nonferrous forgings" (Toxic Release Inventory, 1990). Its SIC code was 3463. Next, Sunar Hauserman had a SIC code of 2542 and according to the Toxic Release Inventory (1990) it generated "office and store fixtures, partitions, shelving, and lockers. The last polluter
in census tract 1922.00 was Garland Floor Co., which produced the least amount of pounds of pollution in 1990 for this area. It did not report a SIC code or classification division.

Census tract 1922.00 had several notable demographic characteristics as well. For instance, this census tract had the 79th highest elderly population in Cuyahoga County. 21.6 percent of the residents in this neighborhood were 65 years of age or older. 30.7 percent of the residents had received a high school diploma as their highest education level. That was the 21st highest in all of Cuyahoga County. Also, no resident reported having an associate or two-year college degree. Finally, this census tract had the 49th lowest minority resident population; only 0.9 percent.

The third most polluted census tract in Cuyahoga County in 1990 was census tract 1525.02 (Figure 6.4). There were three polluters and two different SIC codes in this area. There were no new polluters between 1989 and 1990. The total amount of pollution was 1,561,090 pounds. The first polluter was Lincoln Electric Co. It had a SIC code of 2899, which denoted a producer of "chemicals and chemical preparations, not elsewhere classified" (Toxic Release Inventory, 1990). The next polluter, Man-Gill Chemical Co., had the same industrial classification. Precision Metallurgy Co. was the last polluter. The SIC code was 3324, which classified Precision Metallurgy Co. as a producer of "steel investment foundries" (Toxic Release Inventory, 1990).
Figure 6.4. Census tract 1525.02

There are two variables of interest in this census tract. First, this area contained the 74th highest percent of elderly residents in Cuyahoga County. About 21.9 percent of the people in this community were over the age of sixty-five. Next, the area had the 89th highest percent of residents with some high school education but no degree. It also had the 16th highest percent of residents who completed an associate degree as their highest level of education, 5.8 percent.

Census tract 1148.00 was the fourth most polluted area in Cuyahoga County (Figure 6.5), with 1,263,738 pounds of pollution released or transferred in 1990. This census tract had four different polluters, each with a different industrial classification.
First was Rexam Performance Products, which was owned by Rexham Incorporated. The SIC code for this business was 2672, which indicated that "coated and laminated paper, not elsewhere classified" was created by Rexam Performance Products (Toxic Release Inventory, 1990). Next, Weldon Tool Co. was classified by SIC code 3545. This denoted "cutting tools, machine tool accessories, and machinists' precision" were made by this company (Toxic Release Inventory, 1990). The third contributor to the pollution in census tract 1148.00 was Tremco Incorporated. This company was owned by BF Goodrich Co. and created "asphalt, felts, and coatings" (Toxic Release Inventory, 1990). The SIC code for Tremco Inc. was 2952. Finally, Chemical Solvents Inc. was located in census tract 1148.00. This company had another location in Cuyahoga County as well, however in a different census tract. The classification for Chemical Solvents Inc. was 2869, which meant it created "industrial organic chemicals, not elsewhere classified" (Toxic Release Inventory, 1990).
Figure 6.5. Census tract 1148.00

There were a variety of demographic characteristics for census tract 1148.00. First, it had a population that was 97.5 percent non-white. It had the 68th highest percentage of minority residents. This was the only census tract out of the five most polluted to have a high minority population. In this census tract there were zero percent foreign born residents, as well as zero percent of residents that claim to speak English poorly or not at all.

Next, there was evidence that many residents in this area had not achieved high levels of education. This census tract had the 48th highest percent of residents with less than a ninth grade education (12.0 percent), the 36th highest percent of residents with
some high school education but no degree (23.8 percent), and it had zero percent of residents that had earned a university bachelor, graduate, or professional degree. It also had the 34th lowest income in Cuyahoga County; an average resident earned $6,142.00 in 1990.

Finally, the fifth most polluted census tract in Cuyahoga County in 1990 was census tract 1175.00 (Figure 6.6). This area had 1,226,936 pounds of pollution, produced by three companies with two SIC codes. The first was Chemical Products Plant. It was owned by General Electric Co. This business was classified as manufacturing chemicals and allied products, specifically inorganic pigments. The other polluter who shares this classification was Synthetic Products Co. It was owned by Ferro Corp. and specifically produced “industrial organic chemicals. Not elsewhere classified” (Toxic Release Inventory, 1990). The third polluting company that was located in this census tract was Hupp Co., owned by Hupp Industries Incorporated. It created commercial air conditioning and heating units and had a SIC code of 3585 (Toxic Release Inventory, 1990).
Figure 6.6. Census tract 1175.00

This census tract had several variables that, like the other four most polluted census tracts, indicated that many residents had only achieved the most basic levels of education. For instance, this community had the 93rd lowest percent of residents with some college coursework. This meant that 7.2 percent of residents in this area had taken college classes. Also, this census tract had the 85th highest percent of residents with only a ninth grade education, which was 9.3 percent. Also, census tract 1175.00 had the 69th highest percent of residents who do not speak English well or at all. This was about 2.7 percent of residents living in this area.
The most polluted census tracts in 2000 were different than those in 1990. Only the most polluted census tract, 1106.00, was the same. The other most polluted census tracts included 1081.00, 1246.00, 1178.00, and 1242.01. The total amount of pollution in 2000 was 8,013,770 pounds. This was about four million pounds less than in 1990.

Census tract 1106.00 was still the most polluted census tract in Cuyahoga County. In 2000 it contained 4,060,252 pounds of toxic substances, which was about 2 million pounds less than it did in 1990. LTV Steel Co. Cleveland Works was still the only polluter.

This census tract had the 91st highest percent of single-mother households. In 2000, 23.0 percent of all households had no male household head present and had children under the age of 18 years. It also had the 70th highest percent of residents with less than a ninth grade education as the highest level of achievement. This meant that 14.1 percent of the population did not attend high school. Ten years earlier this variable was 17.7 percent, which was the 18th highest in Cuyahoga County. Next, the percent of residents with some high school coursework decreased from 22.2 percent in 1990 to zero percent in 2000. This meant that residents were either finishing their degrees, dropping out of school before high school, or not reporting accurate information. In 2000, 15.4 percent of the population of this census tract received some college education. This was an increase from the 3.7 percent reported in 1990. This census tract had the 31st lowest percent of residents with college degrees with 1.3 percent. It also experienced an increase from zero percent reported in 1990. Also, zero percent of the residents were foreign born.
The second most polluted census tract in 2000 was 1081.00 (Figure 6.7). This census tract had 1,529,480 pounds of pollution. This was created by one company with one SIC code. The Day-Glo Color Corp. owned by RPM Inc. was responsible for all of the pollution. It was characterized as a producer of "plastic materials, synthetic resins, and nonvulcanizable elastomers" (Toxic Release Inventory, 2000). It had a SIC code of 2821.

Figure 6.7. Census tract 1081.00
This census tract also had a variety of interesting characteristics. First, it had a 100.0 percent renter population. That meant that no one was a homeowner. There was only one other census tract in Cuyahoga County that reported no homeownership. Next, the median household income, and education variables reported were all zero percent. This indicated that an unusual living situation might have been present, such as a nursing home, jail, or a juvenile group home.

Census tract 1246.00 was the third most polluted census tract in Cuyahoga County (Figure 6.8). This census tract had four different polluters with three different SIC codes. There were 1,091,368 pounds of toxins released and transferred in 2000. The first polluter was Kirkwood Industries Incorporated. It was classified as SIC code 3299, which according to the Toxic Release Inventory (2000) was a generator of “nonmetallic mineral products, not elsewhere classified.” The other company that shares the same classification was Von Roll Isola USA Inc. Midwest Mica. This corporation was owned by Von Roll Isola USA Incorporated. The third polluting company was Sterling Dies Operations, which was the subsidiary of Coltec Industries Incorporated. This corporation made “cutting tools, machine tool accessories, and machinists’ precision tools” with a SIC code of 3545 (Toxic Release Inventory, 2000). The fourth TRI reporting business in this census tract was Clorox Products Manufacturing Co. It was owned by Clorox Co. and had a SIC code of 2842, which described “specialty cleaning, polishing, and sanitation preparations” (Toxic Release Inventory, 2000).
This census tract also had the 81st lowest percent of residents with college degrees, 3.6 percent. The average annual income for this community was $34,517.00, which was above the poverty line but below the general average for Cuyahoga County. Also, the percent of non-white residents was 14.4 percent, which was far below the average amount for Cuyahoga County. Low education levels and income seemed to be the trend in Cuyahoga County in both 1990 and 2000. This census tract was no different.

The fourth most polluted census tract in 2000 in Cuyahoga County was census tract 1178.00 (Figure 6.9). It had 705,979 pounds of pollution, contributed by three different polluters with two SIC numbers. The first was Cleveland Range, a
manufacturing company that made industrial machinery and equipment. More specifically Cleveland Range made “service industry machinery, not elsewhere classified” (Toxic Release Inventory, 2000) and had a SIC code of 3589. It was owned by Enodis Corporation. The next company with the same industrial classification was TRW Inc. Valve Division. This business was owned by TRW Inc. and had a SIC code of 3592. This meant it made “carburetors, pistons, piston rings, and valves” (Toxic Release Inventory, 2000). The final polluter in census tract 1178.00 was Euclid Chemical Company. It was owned by RPM Inc. and generated “chemicals and chemical preparations, not elsewhere classified” (Toxic Release Inventory, 2000). It had a SIC code of 2899.

Figure 6.9. Census tract 1178.00
This area also had a higher percentage of non-white residents than the average for
Cuyahoga County, but it did not rank within the top one hundred census tracts. The
percent of minority residents was 55.8 percent. Also, the percent of single-mother
households was 16.3 percent. Again, this was above the average, but not an extremely
high ranking. Finally, the average annual household income for this community was
$24,306. This meant that this was a lower income area, with a higher than average
percent of non-white residents.

Finally, the most polluted census tract in 2000 in Cuyahoga County, Ohio was
1242.01 (Figure 6.10). This area had 626,691 pounds of toxins released and transported.
One polluter, with one industrial classification was responsible for engendering this
pollution. PPG Industries, Ohio Inc. was the only polluter located in this area. It had a
SIC code of 2851 and created “paints, varnishes, lacquers, enamels, and allied products”
(Toxic Release Inventory, 2000).
Figure 6.10. Census tract 1242.01

This area had average characteristics and ranked between the top 100 and 400 of each census tract. For instance, the average annual income was $34,351, which was slightly lower than the mean annual income for Cuyahoga County. It had only a 13.9 percent population of non-white residents and only 5.5 percent of all households were a single-mother family unit.

6.3 DISCRIMINANT ANALYSIS

In Cuyahoga County in 1990 there were four variables that were significantly related to whether a census tract was polluted or not. These four variables included the
percent of residents with a college degree, the number of different SIC codes, the number of different polluters, and the number of new polluters between 1989 and 1990. According to the Canonical correlation, these variables accounted for 74.0 percent of the variance (Table 6.3).

The average percent of residents with a college degree was greater in areas that were not polluted. In these areas the average percent of residents with a college degree was 8.4 percent, whereas only 3.0 percent of residents had a university degree in polluted census tracts. This may indicate that these areas with higher levels of residents with a college degree also have a higher average household income.

Next, the number of different SIC codes were greater in those areas with pollution present. The mean number of classifications in polluted census tracts was 1.8, compared to zero classifications in areas without pollution present. This is intuitive; those areas without pollution will not have polluting facilities to classify.

The number of different polluters was also greater in polluted census tracts. The average number of different polluters was 2.2 for polluted census tracts and zero for the non-polluted census tracts. Again, it is reasonable that there will be more polluters present in polluted areas and zero polluters present in non-polluted areas.

Finally, the number of new polluters between 1989 and 1990 in Cuyahoga County was also higher in the polluted areas. There were an average of 0.3 new polluters in the polluted census tracts and no new polluters in the non-polluted census tracts.
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Table 6.3. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Cuyahoga County 1990 (n=499). This includes all variables.
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<td>Percent of residents that are non-white</td>
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<td>8.36</td>
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Table 6.4. Discriminant analysis findings of the in of the total amount of pollution released and transferred for all census tracts in Cuyahoga County 1990 (n=499). The variables number of different SIC codes, number of different polluters, and number of new polluters between 1989 and 1990 were excluded.
When the above pollution variables were removed several new variables enter the model, explaining 16.2 percent of the variance. These five variables were the percent of residents that are non-white, percent of dwellings that are rented, percent of single mother households with children under 18 years of age, percent of residents with less than a ninth grade education, and percent of residents with a college degree. These variables encompass race, education, and income levels.

First, the percent of non-white residents was higher in those areas that are not polluted. The percent in non-polluted areas was 32.6 percent, whereas the percent of non-white residents was 31.7 percent in polluted areas. It seems that in Cuyahoga County in 1990 Caucasian residents were more likely to be located in a census tract with pollution than their non-white counterparts.

Next, the percent of rented dwellings was higher in areas that were polluted. In the polluted census tracts the average percent of rented dwellings was 45.7 percent. The non-polluted census tracts had 39.6 percent rented dwellings.

The mean the percent of households with a single female householder and children under 18 years of age was higher in polluted census tracts, 12.8 percent. In those non-polluted areas the average percent of single mother households was 9.3 percent. Again, this variable is an indicator of income.

Next, those census tracts with pollution present had, on average, 9.8 percent of residents with less than a ninth grade education. This was higher than those areas with no
pollution. Non-polluted census tracts had an average of 5.4 percent of residents with less than a ninth grade education.

The average percent of residents with a college degree was higher in polluted areas. In the polluted census tracts the average percent was 8.3 percent, whereas the average percent in non-polluted areas was 8.4 percent. Again, a variety of higher income jobs area available to those with a college degree. In Cuyahoga County in 1990 it was the lower income areas that generally face higher pollution levels.

In 2000 in Cuyahoga County there were seven variables that were significantly related to whether a census tract was polluted or not. These seven variables included the percent of residents with some high school education, the percent of residents with some college education, the percent of residents with a college degree, the percent of residents who do no speak English well or at all, the number of different SIC codes, the number of different polluters, and the number of new polluters between 1999 and 2000. According to the Canonical correlation, these variables accounted for 76.6 percent of the variance (Table 6.5).
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<th>Eigenvalue</th>
<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
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<td>3.280</td>
<td>0.675</td>
<td>0.234</td>
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Table 6.5. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Cuyahoga County 2000 (n=561). This includes all variables. This includes all variables.
The average percent of residents with some high school education was higher in census tracts with pollution present. In those census tracts that were polluted, the average percent was 5.8, whereas in non-polluted tracts the average percent of residents with some high school education was 4.7 percent. This may be an indicator that those in non-polluted census tracts have higher levels of education. Usually those with a higher level of education, such as a high school diploma, or college degree make a significantly higher annual income than those that do not (Carr, 1999).

The average percent of residents with some college education was 20.6 percent in areas with no pollution. This was greater than the 17.4 percent of residents with some college found in polluted areas.

Next, the percent of residents with a college degree was much higher in non-polluted areas. In these census tracts the average percent of residents with a college degree was 14.5 percent, as compared with the 5.4 percent of residents with a university degree in the polluted census tracts. This may indicate that these areas with higher levels of residents with a college degree also have a higher average household income. Thus, it seems Cuyahoga County may have a bias in citing noxious facilities nearer to residents with a lower average yearly income.

The percent of resident with limited English abilities was higher in non-polluted census tracts. In polluted census tracts the average percent of residents who do not speak English well or at all, as defined by the US Census, was 9.9 percent. In non-polluted communities this number was 11.0 percent.

Next, the number of different SIC codes were greater in those areas with pollution present. The mean number of classifications in polluted census tracts was 1.5, compared
to 0.02 classifications in areas without pollution present. This is intuitive; those areas without pollution will likely not have many polluting facilities to classify. In this instance it is likely that there are very few polluting facilities that, while present, did not produce any toxic substances in 2000, and therefore did not report any pounds of pollutants to the Toxic Release Inventory.

The number of different polluters was also greater in polluted census tracts. The average number of different polluters was 1.8 for polluted census tracts and zero for the non-polluted census tracts. Again, it is reasonable that there will be more polluters present in polluted areas and few polluters present in non-polluted areas.

Finally, the number of new polluters between 1989 and 1990 in Cuyahoga County was also higher in the polluted areas. There were an average of 0.1 new polluters in the polluted census tracts and no new polluters in the non-polluted census tracts.

When the above pollution variables were removed several new variables entered the model, which explained 12.7 percent of the variance. These five variables were the percent of residents that are non-white, the percent of residents with some college education, the percent of residents with a college degree, and the percent of residents that are foreign born. These variables encompass race, education, and income levels.

First, the percent of non-white residents was higher in areas that were polluted. In those polluted census tracts the average percent of non-white residents was 43.6 percent, whereas in non-polluted census tracts the average percent of non-white residents was 38.9 percent. While this is compatible with environmental justice theory, this model only explains 12.7 percent of the variance, and thus concluding that the pollution distribution in Cuyahoga County in 2000 may be an exaggeration and incorrect.
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<th>Not Polluted (n=446)</th>
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<th>Canonical correlation</th>
<th>Wilk's lambda</th>
<th>Chi-squared</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
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<td>38.91</td>
<td>0.145</td>
<td>0.356</td>
<td>0.873</td>
<td>67.327</td>
<td>.000</td>
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<tr>
<td>Percent of residents with some college education</td>
<td>17.42</td>
<td>20.58</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Percent of residents with a college degree</td>
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<td>14.46</td>
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<tr>
<td>Percent of residents that are foreign born</td>
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<td>6.11</td>
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</table>

Table 6.6. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Cuyahoga County 2000 (n=501). The variables number of different SIC codes, number of different polluters, and number of new polluters between 1999 and 2000 were excluded.
Next, the percent of residents with some college education again entered the model. As before, those census tracts with no pollution had a greater average percent of residents with some college education, 20.6 percent. In polluted census tracts the average percent of residents with some college education was 17.4 percent.

The percent of residents with a college degree also was significant again, in the model without the pollution variables. As concluded above, the percent of residents with a college degree was 14.5 percent, which was greater than in polluted census tracts. In those polluted communities the average percent of residents with a college degree was 3.9 percent.

Finally, the percent of residents that were foreign born was higher in non-polluted census tracts. In these census tracts with no pollution the average percent of foreign born residents was 6.1 percent, where as in polluted census tracts the average percent was 3.7 percent.

6.4 POLLUTED CENSUS TRACT REGRESSION ANALYSIS

The polluted census tracts for each year where examined using multivariate regression analysis. In 1990 only one variable entered the model: the number of different polluters.

\[ y = 0.502x \]

Where:
\[ y = \text{total pollution} \]
\[ x = \text{the number of different polluters} \]
The standardized Beta coefficient was 0.502. The Adjusted $R^2$ value was 0.376, which meant that 37.6 percent of the variance was explained by the regression model. The above equation indicated that as the amount of pollution increased only the number of different polluters increased significantly. One unit change in the independent variable (the number of different polluters) will result in a 0.502 change in the dependent variable (the ln of the total amount of pollution released and transferred). This is also evident by examining the amount of polluters in the most polluted census tracts. Many of these areas have three or four degrading industries. The directionality is determined by the positive value of the standardized beta coefficient.

The polluter variables were removed and the model was recalculated. No variables entered the model as significant.

In 2000, one additional variable, the percent of vacant dwellings, enters the regression model. This, along with the number of different polluters, gives rise to the equation:

$$y = -0.392x_1 + 0.270x_2$$

Where:
- $y$ = the total amount of pollution
- $x_1$ = the percent of vacant dwellings
- $x_2$ = the number of different polluters

The standardized Beta coefficient for the percent of vacant dwellings was -0.392, while the standardized Beta coefficient for the number of different polluters was 0.270. The Adjusted $R^2$ value for this model was 0.455, which meant that 45.5 percent of the variance was explained.
Again, we see as the number of different polluters per census tract increased, so did the amount of pollution. Also, it was evident that as the percent of vacant dwellings decreased the amount of pollution increased, due to the negative beta coefficient.

The polluter variables were removed and the model was again calculated. This time two variables entered as significant. The regression equation is as follows:

\[ y = -0.540x_1 + 0.293x_2 \]

Where:
- \( y \) = the total amount of pollution
- \( x_1 \) = the percent of vacant dwellings
- \( x_2 \) = the percent of households with a female head and children under 18 years of age

The standardized Beta coefficient for the percent of vacant dwellings was -0.540, while the standardized Beta coefficient for the percent of households with a female household head with children under 18 years of age was 0.293. The Adjusted R\(^2\) value for this model was 0.189, which meant that 18.9 percent of the variance was explained.

Overall, in Cuyahoga County in both 1990 and 2000 pollution creating facilities seemed to be located in areas with low education levels. Also, there was a weak connection between polluted census tract and percent of non-white residents. It seemed that in some cases there might be a higher amount of non-Caucasian residents in areas with pollution. Cuyahoga County had a different situation than Franklin County. In Franklin County the majority of the most polluted census tracts in 2000 were also polluted in 1990. Cuyahoga County had approximately one million more pounds of total pollution in 2000 than Franklin County. However, of the five most polluted areas, Cuyahoga County had about 1.5 million pounds less than the most degraded areas in
Franklin County. The total amount of pollution in Cuyahoga County in 2000 was 13,215,753 pounds.
CHAPTER 7

HAMILTON COUNTY, OHIO

This chapter describes the environmental justice situation of Hamilton County, Ohio. Descriptive statistics for both 1990 and 2000 will be discussed and compared. Then this chapter will highlight the five most polluted census tracts in 1990 and the five most polluted census tracts in 2000. Five census tracts were chosen for each year as an arbitrary number to provide a snapshot in time of the industrial and demographic descriptive characteristics of Hamilton County. This was done to understand the environmental justice climate in 1990 and 2000 in Hamilton County and compare the two years.

Hamilton County is the third urban county of study and is home to Ohio’s third largest city, Cincinnati. It has a population of 845,303 residents, of which 52.3 percent are female. The average age is 35.5 years, and the city-wide percent of non-white residents is 31.8 percent (American Fact Finder, 2005). By examining US Census data from 1990 and 2000 it is possible to observe changes in the population demographics, educational levels, and housing characteristics (Table 7.1 and Table 7.2). These changes, when compared with polluter data, may provide insight about the environmental justice
characteristics of Hamilton County, Ohio. In 1990 there were 217 census tracts in Hamilton County. This number increased to 230 census tracts in 2000.

In 1990 the percent of non-white residents within the specific census tracts ranged from zero percent to 99.2 percent, with a mean of 26.5 percent. The standard deviation was 32.2 percent. In 2000 the mean percent of non-white residents increased to 31.8 percent. The data in 1990 were similar to the data for 2000 and ranged from 0.8 percent to 99.4 percent, with a standard deviation of 31.7 percent. While there was an increase in overall percent of minority residents, the minimum and maximum per census tract remained relatively constant.

The average percent of elderly residents in 1990 was 13.4 percent. This ranged from zero percent to 34.6 percent, with a standard deviation of 6.1 percent. The data for 2000 was similar. The mean percentage of elderly residents was 12.9 percent, which ranged from 0.2 percent to 34.0 percent. The standard deviation was 5.4 percent.

The percent of vacant dwellings in 1990 ranged from zero percent to 38.0 percent, with a standard deviation of 5.5 percent. The average percentage of vacant buildings was 6.9 percent. This percentage increased substantially in 2000 to an average of 8.2 percent. The range also increased from zero percent to 43.9 percent. The standard deviation was 7.1 percent.

In 1990 the percent of rented residences ranged from zero percent to 100.0 percent. The mean was 44.8 percent, and the standard deviation was 27.2 percent. In 2000 a similar situation was observed. The average percent of rented dwellings was 43.7 percent, with a standard deviation of 26.6 percent. The range varied from zero percent to 99.3 percent.
The average percent of residents with a female household head and children under 18 years of age, in 1990, was 0.1 percent. This variable ranged from zero to 1.4 percent with a standard deviation of 0.2 percent. In 2000 this variable increased considerably. The mean percentage of single-mother households in 2000 was 11.4 percent and ranged from zero percent to 66.4 percent with a standard deviation of 9.3 percent.

The median household income per census tract reported in 1989 was $29,405 for Hamilton County. The lowest reported median income per census tract was zero dollars and the highest during 1990 was $109,242. The standard deviation was $15,894. The median annual household income in 2000 increased to $41,306. The range also broadened, with the lowest median income per census tract of zero dollars, and the highest median income per census tract increased to $125,737. The standard deviation was $20,992.

The mean percent of residents with less than a ninth grade education in 1990 was 6.0 percent. This ranged from zero percent to 21.7 percent with a standard deviation of 4.1 percent. In 2000 the average percent of residents with less than a ninth grade education decreased to 5.3 percent. The data ranged from zero percent to 25.6 percent. The standard deviation was 4.4 percent.

The average percent of residents with some high school education in 1990 was 11.4 percent. This ranged from zero percent to 32.2 percent across Hamilton County census tracts. The standard deviation was 5.6 percent. In 2000 the mean percent of residents with some high school education decreased to 4.2 percent. The minimum mean percentage of residents with some high school education in a census tract was zero.
percent and the maximum is 15.1 percent. The standard deviation in 2000 was 3.0 percent.

The percent of residents with a high school diploma or other equivalent per census tract in 1990 was 17.2 percent. This ranged from a minimum of zero percent to a maximum value of 35.4 percent. The standard deviation was 6.1 percent. This variable increased in 2000 to 27.7 percent, with a range of 3.3 percent to 47.4 percent. The standard deviation in 2000 was 9.5 percent.

There was an average of 11.1 percent of residents per census tract in 1990 that had some college coursework. These data ranged from zero percent to 23.4 percent. The standard deviation was 3.6 percent. In 2000 the average percent of residents with some college education increased to 19.1 percent. The minimum was 6.9 percent and the maximum was 37.6 percent, with a standard deviation of 4.8 percent.

The mean percent of residents in Hamilton County in 1990 with an associate degree was 3.6 percent, and ranged from zero percent to 7.0 percent. The standard deviation was 1.5 percent. In 2000 the average percent of residents with an associate degree was 5.7 percent. This ranged from zero percent to 11.9 percent, with a standard deviation of 2.3 percent.

In 1990 the mean percent of residents with a college degree was 9.0 percent, with a standard deviation of 6.9 percent. The data ranged from zero percent to 40.1 percent of residents having achieved a college degree. In 2000 the average percent of residents with a college degree increased to 16.7 percent. These data ranged from zero percent to 54.9 percent, with a standard deviation of 10.7 percent.
In 1990 the mean percent of residents with a graduate or professional degree per census tract was 5.3 percent. This ranged from zero percent to 25.4 percent, with a standard deviation of 5.3 percent. In 2000 the average percent of residents with a graduate or professional degree was 9.8 percent, which ranged from zero percent to 36.4 percent. The standard deviation was 8.6 percent.

In 1990 the mean percent of foreign born residents in Hamilton County was 2.5 percent. These data ranged from zero percent to 15.7 percent. The standard deviation was 2.4 percent. The mean percent of foreign born residents in 2000 was 3.2 percent, with a standard deviation of 3.2 percent. The data ranged from zero percent to 19.9 percent.

In 1990 the percent of residents who do not speak English well or at all, as defined by the US Census was 0.5 percent. This ranged from zero percent to 3.8 percent, with a standard deviation of 0.6 percent. The percent of residents with limited English ability increased in the 2000 data to 5.6 percent. This ranged from zero percent to 22.9 percent and had a standard deviation of 3.6 percent.

The mean number of different Standard Industry Classifications (SIC) in 1990 was 0.4 classifications per census tract. The minimum number was zero and the maximum number was five, with a standard deviation of 1.0 different SIC numbers. In 2000 this number decreased to an average of 0.3 classifications per census tract. The variety in classifications ranged from zero to eight, with a standard deviation of 0.9.

Next, average number of different polluters per census tract in 1990 was 0.5. These data ranged from zero polluters to nine, with a standard deviation of 1.4. In 2000,
again there was a decrease. The average number of polluters in each census tract was 0.4, ranged from zero to eight. The standard deviation in 2000 was 1.2.

In 1990 the mean number of new polluters per census tract, as compared with 1989 was 0.1. These data ranged from zero to five new polluters, with a standard deviation of 0.4. In 2000 the average number of new polluters per census tract, as compared with 1999, was zero. The minimum number of new polluters was zero and the maximum was one. The standard deviation in the 2000 data was 0.2.

The mean of the natural log of the total pounds of toxins released or transferred per census tract that was treated as the dependent variable in this study was 2.01, and ranged from zero pounds to 15.5 pounds. The standard deviation in the 1990 data was 4.4 pounds. In 2000 the average of the natural log of pounds of toxic substances created increased to 1.4, ranging from zero pounds to 15.6 pounds. The standard deviation was 3.9 pounds.
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<th>Maximum</th>
<th>Mean</th>
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<td>.6</td>
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Table 7.1. Descriptive statistics for Hamilton County, Ohio per census tract as reported by the 1990 US Census.
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<td>31.7</td>
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<td>34.0</td>
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<td>Percent households with female head and children under 18</td>
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<td>5.7</td>
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<td>Percent of foreign born residents</td>
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<td>Percent of residents who do not speak English well or at all</td>
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<td>3.6</td>
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<tr>
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<td>73704.9</td>
<td>446923.8</td>
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<tr>
<td>ln of total toxin released and transferred</td>
<td>230</td>
<td>.00</td>
<td>15.6</td>
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<tr>
<td>number of new polluters</td>
<td>230</td>
<td>.00</td>
<td>1.0</td>
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</table>

Table 7.2. Descriptive statistics for Hamilton County, Ohio per census tract as reported by the 2000 US Census
7.1 POLLUTION TRENDS

Overtime the magnitude of pollution engendered in Hamilton County, Ohio decreased (Figure 7.1). The first year of toxic substances released and transferred were recorded in Ohio was 1987. The average pounds of pollution in Hamilton County between 1987 and 2003 were 23,889,748 pounds per year. This was greater than the average total pollution in Franklin County, which was 12,393,403 pounds per year, but lower than the average total pounds in Cuyahoga County, which had a mean of 25,1197,22 pounds per year.

The greatest quantity of toxin was identified in 1987. There were 102,359,180 pounds of toxic substances created and reported to the Toxic Release Inventory. The rapid and continual decline in pounds of toxins released over time indicates that many polluters complied with the requirements of the Toxic Release Inventory and that they did not resist disclosing the amount of pollution engendered.
Figure 7.1. Total amount of pounds of pollution released and transferred, in Hamilton County, over time.

Figure 7.1 shows that pollution levels decreased to 29,282,053 pounds in 1988. The drastic reduction was likely caused by the lucidity of the reporting mechanism. Also, the Superfund Amendments and Reauthorization Act (SARA) were passed in 1986. Many large polluters may have been “grandfathered” with regard to compliance. These grandfathered companies may not have reported their pollution outputs immediately, which may have caused the overall amount of pollution to seem less than it truly was. By 1988 all polluters reduced their amount of pollution to abide by SARA.

Pollution levels continued to decrease steadily until 1994 to 12,015,524 pounds. Pollution slightly increased, but remained below 20 million pounds. The lowest pollution levels reported were in 2002 and were 11,420,341 pounds. The lowest levels for
Cuyahoga County were reported in 2002 as well. This may be an indication that a combination of increased community awareness and better pollution laws are working to curb pollution in the urban centers in Ohio.

7.2 MOST POLLUTED AREAS

In 1990 the three most polluted census tracts in Hamilton County, Ohio created and released a total of 17,739,562 pounds of pollution. These census tracts were: 258.00, 73.00, 59.00, 249.01, and 80.00. Each of these five census tracts had a high number of different standard industry classifications and a number of different polluters. Only one census tract, 258.00, had any new polluters between 1989 and 1990. There was high variability among the socioeconomic variables included in the study including race, income, and education. All five of these census tracts had a zero percentage of female-headed households with children less than 18 years of age present.

The most polluted area in 1990 in Hamilton County was census tract 258.00 (Figure 7.2), which had industries that produced 5,347,931 pounds of pollution. The total pounds of toxins were created by five different polluters with three Standard Industry Classifications. First, the largest polluter was PMC Specialties Group. It was owned by PMC Inc. and produced 5,148,922 pounds of pollutants in 1990. It had a SIC code of 2869, which indicated this company produced “industrial organic chemicals, not elsewhere classified” (Toxic Release Inventory, 1990). Next, the Proctor and Gamble, Ivorydale Plant produced the second highest amount of pollution in this census tract. This manufacturer engendered 196,550 pounds of toxic substances and was in the same SIC code division as PMC Specialties Group. The specific SIC code for Proctor and
Gamble, Ivorydale Plant was 2841, which meant it produces “soaps and other detergents, except specialty cleaners” (Toxic Release Inventory, 1990). The third polluter sharing this SIC code division was Orchem Inc, which created “specialty cleaning, polishing, and sanitation preparations,” and had a SIC code of 2842 (Toxic Release Inventory, 1990). The fourth polluter in census tract 258.00 was Cincinnati Vulcan Co. In 1990 it produced 1,645 pounds of “lubricating oils and greases” (Toxic Release Inventory, 1990). It had a SIC code of 2992. Finally, Seven-Up RC Bottling Co., which was owned by Brooks Beverage Management, and was located in this census tract. They produced “bottled and canned soft drinks and carbonated waters” classified by SIC code 2086 (Toxic Release Inventory, 1990).

Census tract 258.00 had several variables of interest relating to education and community composition. First, it had the 45th highest percent of elderly residents in Hamilton County, with 18.1 percent.

Next, this area had the 85th highest percent of residents with less than a ninth grade education, with 6.0 percent. There were also 14.7 percent of residents with some high school coursework but no degree, which was the 62nd highest amount in Hamilton County. Finally, 19.9 percent of residents had a high school diploma, which was the 78th highest percent.

There were some surprising characteristics about this census tract as well. First, it had 5.1 percent nonwhite residents, which was the 85th lowest. Also, it had the 70th highest percent of residents with an associate degree, at 4.5 percent. Finally, zero percent of the residents reported not speaking English well or at all.
The next most polluted census tract in 1990 in Hamilton County was census tract 73.00 (Figure 7.3). It had five different polluters with three different SIC codes. There was a total of 4,359,591 pounds of pollution released and transferred in 1990. The largest polluter was Phthal Chem, which was responsible for 4,296,250 pounds of toxins. It was owned by PCL Group Inc. and had a SIC code of 2865. This meant that Phthal Chem produced “cyclic organic crude and intermediates and organic dyes” (Toxic Release Inventory, 1990). Next, Sun Chemical Corp had the same SIC code and was the second largest producer of pollution in census tract 73.00. It was owned by DIC Americas Inc. and produced 57,910 pounds of pollution in 1990. The third polluter is Intercontinental
Chemicals Corp. It produced 2,250 pounds of toxins and was owned by UCI Inc. It had the same SIC code division as the above two polluters, however its specific SIC code was 2842, which indicates that it produced “specialty cleaning, polishing, and sanitation preparations” (Toxic Release Inventory, 1990). Next highest polluting industry was GA Avril Co., Brass and Bronze Ingot Division. The SIC code for this business was 3341, which means it was responsible for “secondary smelting and refining of nonferrous metals” (Toxic Release Inventory, 1990). The final polluter in census tract 73.00 in 1990 was EnerFab Corp. It created “fabricated plate work (boiler shops)” and released and transferred 174 pounds of pollutants (Toxic Release Inventory, 1990).

Census tract 73.00 also had a wide range of socioeconomic and educational characteristics. First, 28.4 percent of its residents were nonwhite, which is the 71st highest. It also had an above average percentage of vacant buildings, with 7.2 percent. The average annual income was $22,475, which was the 75th lowest. Also, it had the 53rd highest percent of residents with less than a ninth grade education (8.2 percent), the 39th highest with some high school education (16.7 percent) and the 28th lowest percent of residents with some college coursework (7.0 percent). Finally, 1.1 percent of residents in this area did not speak English well or at all, which was the 19th highest percent in Hamilton County.

This census tract had one unanticipated characteristic. The percent of elderly residents was 8.9 percent, which is the 52nd lowest in Hamilton County.
Figure 7.3. Census tract 73.00

Census tract 59.00 (Figure 7.4) was the third most polluted census tract in Hamilton County. It had a total of 3,690,417 pounds of pollution, created by three polluters, each of which had a different SIC code. The first polluter was Hilton Davis Co. Cincinnati, which produced 3,357,389 pounds of pollution. It was classified as developing “cyclic organic crude and intermediates and organic dyes” (Toxic Release Inventory, 1990). This business had a SIC code of 2865. The next largest polluter in this community was Emerson Electric Co. Fusite Division. It engendered 317,771 pounds of toxins and made “current carrying wire devices” (Toxic Release Inventory, 1990).
Finally, Smith Electrochemical Co. produced 15,257 pounds of pollution. It had a SIC code of 3471 and made "electroplating, plating, polishing, anodizing and coloring" devices (Toxic Release Inventory, 1990).

This census tract had the 79th highest percent of elderly residents at 15.1 percent. It also had the 87th highest percent of rented dwellings, which was 52.7 percent. Also there were 10.2 percent of residents have had any college-level coursework, which was the 75th lowest amount in Hamilton County. This area had the 62nd highest percent of residents with a high school diploma, which was 21.2 percent. This meant that many residents could have been dependant on the industries for a variety of employment positions. Finally, this census tract had the 35th highest amount of foreign born residents (4.1 percent).

There were several variables that were contradictory to assertions often made about environmental justice in the context of toxin industry location. First, only 4.4 percent of the buildings were vacant, which was the 85th lowest percent. Next, this area had the 71st highest percent of residents with a college degree at 11.0 percent and the 45th highest percentage of residents with a graduate or professional degree, at 8.3 percent. Even though census tract 59.00 had a high foreign born population zero percent of the residents reported not speaking English well or at all.
The fourth most polluted census tract in Hamilton County was census tract 249.01 (Figure 7.5). There were three different polluters, which were categorized into two SIC code classifications. Together these polluters released and transferred 2,217,633 pounds of toxic substances in 1990. Senco Products Inc., owned by Sen Corp., produced 1,494,604 pounds of toxins. This business was classified as SIC code 3496, which meant they produced “miscellaneous fabricated wire products” (Toxic Release Inventory, 1990). The next largest polluter had a similar SIC code of 3411. Heekin Can Inc. created metal cans and engendered 116,460 pounds of pollution in 1990. Finally, Didier Taylor Refractories Corp. produced 6,569 pounds of pollution, stemming from their “clay
Refractories" operations (Toxic Release Inventory, 1990). This business had a SIC code of 3255.

Census tract 249.01 had the eighth highest percent of vacant buildings, with 18.6 percent. It also had the 83rd lowest average annual income at $24,306 per year. There were several education variables that lead to the conclusion that this area had a large number of residents with low educational obtainment. For instance, 11.6 percent of residents had less than a ninth grade education, which was the 27th highest. Also, this area had the 22nd lowest percent of residents with some high school education, which was 18.6 percent. Only 3.6 percent of the population had a college degree and only 1.7 percent of the residents had a graduate or professional degree, which was the 57th lowest ranked census tract.
Figure 7.5. Census tract 249.01

This area also had some unexpected characteristics for having the fourth highest amount of pollution in Hamilton County in 1990. First, only 0.5 percent of the population was nonwhite. This was the 17th lowest amount of minority residents. Next, it had the 69th lowest percent of rented homes, which was 27.4 percent. Finally, there were no foreign born or non-English speaking residents in this census tract.

Census tract 80.00 (Figure 7.6) was the fifth most polluted neighborhood in Hamilton County in 1990. It had 2,123,990 pounds of pollution released and transferred. There were three polluters present with two different Standard Industry Classifications. The first polluter was Color Intermediates Inc., which was owned by PCL Group Inc.
The SIC code for this corporation was 2865, which indicated that they created “cyclic organic crude and intermediates and organic dyes” (Toxic Release Inventory, 1990). Next, Henkel Corp. Chemicals Group Cincinnati was the largest polluter, and it had the same SIC code division as Color Intermediates Inc. This business created 2,086,158 pounds of “chemicals and chemical preparations, not elsewhere classified” pollution (Toxic Release Inventory, 1990). The SIC number was 2899. Finally, REH Co. was the third polluter and had a SIC code of 3369. It created “nonferrous foundries, except aluminum and copper” according to the Toxic Release Inventory (1990).

This census tract had the 22nd highest percent of nonwhite residents with 80.00 percent. It also had the 15th highest amount of vacant buildings (16.1 percent) and the 11th highest amount of rented dwellings (93.8 percent). The average annual household income for this census tract was $7,360, which was the 15th lowest in Hamilton County. There were also several variables that revealed that many residents did not have advanced degrees. For instance, only 1.4 percent of residents had a graduate or professional degree. This was the 43rd lowest amount. Also, only 1.8 percent of residents had a college diploma, which was the 24th lowest percent. About 1.5 percent of residents had an associate degree and 6.5 percent had taken some college courses.

This area also had the 19th lowest percent of elderly residents at 5.5 percent and only 1.0 percent of the population was foreign born. These are two variables that are also usually associated with environmental inequality. However, when comparing this with the other most polluted census tracts, it is observed that the amount of elderly and foreign born residents do not always coincide with polluted areas.
Figure 7.6. Census tract 80.00

Overall, in the five most polluted areas in Hamilton County there were a few commonalities. First, it was apparent that many residents do not have high levels of education. It also seemed that these census tracts had a high percent of rented homes and vacant dwellings. Finally, the percent of non-white residents in these areas were not high. Thus, in 1990 Hamilton County shows some signs of being unjust, from an environmental justice point of view in the context of socioeconomic status. However the county does not appear to be environmentally unjust in the context of race and gender.

The most polluted census tracts in 2000 differed somewhat than those in 1990. These most polluted census tracts in 2000 were 253.00, 80.00, 59.00, 258.00, and 64.00. The new census tracts in the top five most polluted were 253.00 and 64.00. The total
amount of pollution in these areas in 2000 was 12,535,599 pounds, which was over five million pounds less than a decade earlier. These census tracts had no more than three polluters each and none had any new polluters between 1999 and 2000. Census tract 73.00, which was the second most polluted census tract in 1990 dropped to the ninth most polluted census tract. Census tract 249.01, which was the fourth most polluted area in 1990 decreased to the 10th most polluted census tract in 2000. Overall, the amount of pollution and the number of polluters had decreased over this ten year period.

Census tract 253.00 (Figure 7.7) was the most polluted area in Hamilton County in 2000, with 5,667,358 pounds of pollutants released and transferred. There were three different polluters, all of which had the same SIC code. Shepard Chemical Co. was the major polluter in this area, and it produced 5,629,395 pounds of pollutants. It had a SIC code of 2819, which indicated that it made “industrial inorganic chemicals, not elsewhere classified” (Toxic Release Inventory, 2000). Next, Perry and Derrick Co. released and transferred 35,686 pounds of toxins. They had a SIC code of 2851, and made “paints, varnishes, lacquers, enamels, and allied products” (Toxic Release Inventory, 2000). The final polluter in this neighborhood was Texo Corp., which was owned by Ondeo Nalco Co. This business produced 2,277 pounds of pollution and specialized in “soaps and other detergents, except specialty cleaners” (Toxic Release Inventory, 2000).

This census tract had the 70th lowest average annual household income at $30,605. It also had the 41st highest percentage of residents with less than a ninth grade education. The percentage was 8.3 percent. The percent of residents with some high school education, but no degree was 4.7 percent, which was the 71st highest. Also, 33.4 percent of residents had a high school diploma, which was the 67th highest. Next, this
area had the 59th lowest population of residents with a college diploma; only 16.0 percent. Finally, only 2.8 percent of residents had a graduate or professional degree, which was the 41st lowest.

Census tract 253.00 also had some unanticipated variables. For instance, only 5.9 percent of the population was nonwhite. Environmental justice theory would argue that the most polluted areas also are home to high minority populations (Bullard, 1993, 2000). This was not the case in census tract 253.00. Also, only 1.3 percent of residents were foreign born, which was the 73rd lowest percent. Finally, this area had the 58th lowest percent of residents who did not speak English well or at all, which was 3.2 percent.

Figure 7.7. Census tract 253.00
The next most polluted census tract in 2000 was census tract 80.00, with 2,179,493 pounds of pollution released and transferred. In 1990 this census tract was the fifth most polluted. In 1990 there were three polluters; however, in 2000 only one was present. Cognis Corp. Cincinnati Plant was the sole polluter in 2000 and had a SIC code of 2899. This business created "chemicals and chemical preparations, not elsewhere classified" (Toxic Release Inventory, 2000).

In 2000 census tract 80.00 had the 22\textsuperscript{nd} highest percent of nonwhite residents, which was 86.6 percent. This was a 6.6 percent increase from 1990. Also, 93.4 percent of all homes were rented, which was the 10\textsuperscript{th} highest. This was a decrease of 0.4 percent since 1990. The percent of single mother households was 47.2 percent, which was the 3\textsuperscript{rd} highest. Next, this area had the 14\textsuperscript{th} lowest median annual household income, at $12,215. In 1990 it had the 15\textsuperscript{th} lowest median annual household income.

The overall amount of educational achievement had also remained stagnant. For instance, only 3.2 percent of residents had a graduate or professional degree. Also, this census tract had the 53\textsuperscript{rd} lowest percent of residents with a college degree, with 8.0 percent. It had the 53\textsuperscript{rd} lowest percent of residents with some college coursework at 15.4 percent.

Census tract 59.00 was the third most polluted census tract in 2000, with 2,041,782 pounds of pollution. This census tract was also the third most polluted area in 1990, however pollution levels had decreased by over 1.6 million pounds. There were three polluters in this area with two different SIC numbers. In 1990 there were also three polluters, with three SIC codes. One polluter has since left and a new one has entered the census tract. The first polluter was Novoen Hilton Davis Inc. In 2000 it produced
2,010,060 pounds of pollution, and was present in 1990 as well. It had a SIC code of 2865 and produced “cyclic organic crude and intermediates and organic dyes” (Toxic Release Inventory, 2000). The next polluter was Cintech Industrial Coatings Inc. It produced 23,500 pounds of pollution and was not present in 1990. It shared a SIC division with Novoen Hilton Davis Inc. Specifically, the SIC code for this company was 2851, which meant it makes “paints, varnishes, lacquers, enamels, and allied products” (Toxic Release Inventory, 2000). The last polluter in this census tract was Emerson Electric Co., which produced 8,222 pounds of pollution in 2000. It was also present in 1990. It has a SIC code of 3643, which meant it created “current carrying wire devices” (Toxic Release Inventory, 2000).

This census tract had the 75th highest percent of nonwhite residents, with 42.2 percent. In 1990 12.5 percent of the residents were nonwhite. Next, the percent of residents with some high school education, but no degree, was 6.5 percent. This was the 39th highest amount in Hamilton County in 2000. Also, the percent of residents with some college coursework, but no degree, was 14.4 percent, which was the 45th lowest amount. This number has increased since 1990, when only 10.2 percent of all residents had some college courses. Next, the percent of foreign born residents was 5.0 percent, which was the 45th highest. In 1990 4.1 percent of the population in this census tract was foreign born. Finally, the percent of residents who did not speak English well or at all was 6.1 percent. This was the 69th highest amount for this community. In 1990 zero percent of the population reported that they did not speak English well or at all. Though changes in several variables had occurred, the composition of the census tract was similar over time. The largest change was that the percent of nonwhite residents had increased.
Census tract 258.00 was the fourth most polluted area in Hamilton County in 2000, with 1,423,200 pounds of pollution. In 1990 it was the most polluted census tract in Hamilton County and contained about four million more pounds of pollution. It had three different polluters with three different SIC codes. In 1990 there were five different polluters with three SIC codes. Two of the current polluters were also present in 1990. The first was Cincinnati Specialties LLC, which was called PMC Specialties Group in 1990. This business created 1,256,388 pound of pollution in 2000 and had a SIC code of 2869. The parent company was PMC Inc., and this company created “industrial organic chemicals, not elsewhere classified” (Toxic Release Inventory, 2000). The next polluting industry was Cincinnati Vulcan Co., which was also present in 1990. It had a SIC code of 2992 and produced “lubricating oils and grease” (Toxic Release Inventory, 2000). Finally, Proctor and Gamble was also located in this census tract. They produced 166,812 pounds of “shortening, table oils, margarine, and other edible fats and oils” pollution and byproducts in 2000 (Toxic Release Inventory, 2000).

The census tract had the 72nd highest elderly population at 15.5 percent. In 1990 it had 2.7 percent more elderly residents and had the 45th highest elderly population in Hamilton County. It also had the 32nd lowest amount of residents with a high school diploma. Only 37.4 percent of the population in this census tract had a high school degree or equivalent. This was an increase from 19.9 percent in 1990. Finally, in census tract 258.00, 9.1 percent of residents had a college degree. This was the 62nd lowest amount.

There were several unexpected findings in this census tract. First, 22.0 percent of residents have had some college coursework, which was the 65th highest. Next, this area
was ranked 39th highest for percent of residents with an associate degree, with 7.7 percent. In 1990 this census tract had the 70th highest percent of associate degree holders. Finally, this area had 3.1 percent of its population which did not speak English well or at all, which was the 56th lowest amount. In 1990 this variable was zero percent.

In 2000 in Hamilton County, census tract 64.00 (Figure 7.8) was the fifth most polluted area. It had 1,223,766 pounds of pollutants released and transferred. There were two different polluting industries, each with a different SIC code. The first was Grace Davison Cincinnati Plant, which was owned by WR Grace Co. In 2000 it produced 1,173,601 pounds of toxins. The SIC code was 2819, which meant this company created “industrial inorganic chemical, not elsewhere classified” (Toxic Release Inventory, 2000). The second polluter was BP Exploration and Oil Inc. Cincinnati Terminal, which produced 50,165 pounds of pollution in 2000. It was owned by BP America Inc. The SIC code was 5171 and indicated “petroleum bulk stations and terminals” (Toxic Release Inventory, 2000).
Census tract 64.00 had the 15\textsuperscript{th} highest nonwhite population. In this area 94.3 percent of the residents were nonwhite. Also, 15.7 percent of the residents were over 65 years of age. This was the 69\textsuperscript{th} highest percent of elderly residents in Hamilton County. Next, the amount of single-mother households with children less than 18 years of age present was 16.9 percent, which was the 46\textsuperscript{th} highest amount. This area had the 28\textsuperscript{th} highest percent of residents with some high school, but no degree, which was 8.1 percent. The percent of residents with a high school diploma was 37.8 percent (the 29\textsuperscript{th} highest) and the percent of residents with a college degree was only 7.4 percent (the 49\textsuperscript{th} lowest).
The situations in 2000 and 1990 in Hamilton County were similar. In the most polluted census tracts there were usually several polluters with a diversity of Standard Industry Classifications. Many of the most highly polluted census tracts had a high percentage of residents with low educational obtainment. Several of the areas had a high percent of nonwhite, high percent of foreign born or high percent of non-English speaking residents. Overall, the pollution is concentrated within about 25.0 percent of all census tracts.

7.3 DISCRIMINANT ANALYSIS

The Canonical correlation shows that two variables, the number of different Standard Industry Classifications (SIC) and the number of different polluters, were significant in accounting for 66.1 percent of the variance. These are both pollution factors and therefore it makes sense that these two variables would be significant. This is reassurance that the classification and reporting system for toxic substances is accurate and reliable (Table 7.3).

The mean number of different SIC codes in polluted census tracts is 2.0 polluters. This is greater than the number of classifications found in non-polluted census tracts. For these non-polluted areas the average number of SIC codes is zero. Prior to rounding this number appears to not be zero because there may be a polluter in one of these census tracts, but did not report any amount of toxic substances release or transfer during 1990.

The average number of different polluters between 1989 and 1990 is higher in polluted census tracts. In these areas the average number is 2.6, whereas in non-polluted areas the average number of new polluters is zero.
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Table 7.3. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Hamilton County 1990 (n=217). This includes all variables.
When the polluter variables, including the number of different SIC codes, the number of different polluters, and the number of new polluters between 1989 and 1990 were excluded no variables entered the model as significant.

The percent of residents with a college degree and the number of different polluters explains about 58.8 percent of the variability in this model (Table 7.4). In those census tracts that are polluted the percent of residents who obtained a college degree was 12.5 percent in contrast to those where no pollution was present, the number of residents acquiring a college degree increased to 17.4 percent.

Also the mean number of polluters in areas with pollution was 2.6 polluters. In areas where no pollution was reported there were on average zero polluters per census tract. Since the percent of residents with a college degree may influence other factors, such as income, the polluter variables were removed and the model was run again. This indicated that other socioeconomic variables may account for the rest of the variability in the model.

When the polluter variables, including the number of different SIC codes, the number of different polluters, and then number of new polluters between 1999 and 2000 were removed there was one variable that accounted for 9.2 percent of the variance (Table 7.5).
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Table 7.4. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Hamilton County 2000 (n=230). This includes all variables.
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</tbody>
</table>

Table 7.5. Discriminant analysis findings of the ln of the total amount of pollution released and transferred for all census tracts in Hamilton County 2000 (n=230). The variables the number of different SIC codes, the number of different polluters and the number of new polluters between 1999 and 2000 were excluded.
The percent of residents with less than a 9th grade education was significant in explaining some of the variance in the dependent variable. In the polluted census tracts in 2000 there was an average of 7.5 percent of residents with less than a 9th grade education. This number was lower in the non-polluted census tracts, where an average of 4.9 percent of residents had less than a 9th grade education.

7.4 POLLUTED CENSUS TRACT REGRESSION ANALYSIS

The polluted census tracts for each year where examined using multivariate regression analysis. In 1990 only one variable entered the model: the number of different Standard Industry Classifications (SIC).

\[ y = 0.497x \]

Where:
\[ y = \text{total pollution} \]
\[ x = \text{the number of different Standard Industry Classifications} \]

The standardized Beta coefficient for the number of different SIC codes was 0.497. The Adjusted \( R^2 \) value for this model was 0.562, meaning that 56.2 percent of the variance in total pollution was explained. The above equation shows that as number of different Standard Industry Classifications increases one unit the amount of pollution increases by 0.497 units. The directionality is determined by the positive value of the standardized beta coefficient. So in this case the number of different SIC codes is directly proportional to the amount of pollution.
The polluter variables were removed from the data and the regression model was again calculated. This time no socioeconomic variables entered the model.

In 2000 three different variables enter the regression model. These include the number of different polluters, the percent of residents with a high school diploma, and the percent of residents that are foreign born.

\[ y = 0.771x_1 + 0.441x_2 - 0.281x_3 \]

Where:
- \( y \) = total pollution
- \( x_1 \) = the number of different polluters
- \( x_2 \) = the percent of residents with a high school diploma
- \( x_3 \) = the percent of foreign born residents

The standardized Beta coefficient for the number of different polluters was 0.771. The standardized Beta coefficient the percent of residents with a high school diploma was 0.441, while it was -0.281 for the percent of foreign born residents. The Adjusted R\(^2\) value for this model was 0.780, which means that 78.0 percent of the variance is explained by the model.

This means that as the number of different polluters and the percent of residents with a high school education increase, the amount of pollution also increase. Also as the percent of foreign born residents increases, the amount of pollution decreases. When examining the census tracts with the most pollution, it is common to notice that there are several contributing polluters.

The polluter variables were removed from the data and the regression model was again calculated. This time no socioeconomic variables entered the model.
Environmental justice theory suggests that often community residents who are foreign born have less of a grasp of city, state, and federal laws and thus resist new polluting companies less (Bullard, 2000). This is not the scenario in Hamilton County, Ohio. Overall, polluted census tracts seem to be related to income and education levels. Those census tracts with pollution present were more likely to have residents with lower income and education levels.
CHAPTER 8

SUMMARY AND CONCLUSIONS

Overall, the three areas of study, Franklin, Cuyahoga, and Hamilton Counties have a wide range of pollution distribution. This distribution is dependant mostly on socioeconomic factors, such as income and education, as well as the presence of a polluting industry. Contrary to many environmental justice studies, status groups such as race, ethnicity, age, and gender play basically no role in predicting the location of noxious facilities within the census tracts in the areas of study.

Two years of US Census and Toxic Release Inventory data were analyzed. In 1990 only education, income, and pollution variables were significant in the discriminant analysis and regression models (Table 8.1).

In 2000 a similar pattern was observed, however there was some change in the variables that were significantly related to areas associated with TRI pollution (Table 8.2). In 2000 only Hamilton County had one variable, the percent of residents that do not speak English well or at all, that may have ethnicity implications. This was a self-claiming variable as part of the US Census. The findings for 2000 revealed that the percent of residents who did not speak English well or at all was higher in the non-polluted census tracts. This is a phenomenon that does not lead one to conclude that these
residents were taken advantage of in noxious facility citing due to their lack of comprehension of English.

<table>
<thead>
<tr>
<th>County</th>
<th>Type and Number of Significant Variables</th>
<th>Significant variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franklin (Columbus)</td>
<td>Education (3)  Income (1)  Polluter (2)</td>
<td>Percent of dwellings rented  Percent of residents with less than a ninth grade education  Percent of residents with some high school education  Percent of residents with an associate degree  Number of different SIC codes  Number of different polluters</td>
</tr>
<tr>
<td>Cuyahoga (Cleveland)</td>
<td>Education (1)  Polluter (3)</td>
<td>Percent of residents with a college degree  Number of different SIC codes  Number of different polluters  Number of new polluters</td>
</tr>
<tr>
<td>Hamilton (Cincinnati)</td>
<td>Polluter (2)</td>
<td>Number of different SIC codes  Number of different polluter</td>
</tr>
</tbody>
</table>

Table 8.1. Significant variables in the unrefined discriminant analysis for each county using 1990 data. Refined discriminant analysis information was not considered due to low amount of explained variance.

The first county that was examined was Franklin County, which contains Columbus, Ohio. All of the variables that were significant in the discriminant analysis were education, income, or pollution related. No race, ethnicity, gender, or age variables were significant in the statistical analyses. When regression models using the 1990 and 2000 data were calculated no variables entered the model.
<table>
<thead>
<tr>
<th>County</th>
<th>Type and Number of Significant Variables</th>
<th>Significant variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franklin (Columbus)</td>
<td>Education (1) Income (1) Polluter (3)</td>
<td>Percent of dwellings rented Percent of residents with a graduate or professional degree Number of different SIC codes Number of different polluters Number of new polluter</td>
</tr>
<tr>
<td>Cuyahoga (Cleveland)</td>
<td>Education (3) Polluter (3) Ethnicity/Race (1)</td>
<td>Percent of residents with some high school education Percent of residents with some college Percent of residents with a college degree Percent of residents that speak English Number of different SIC codes Number of different polluters Number of new polluters</td>
</tr>
<tr>
<td>Hamilton (Cincinnati)</td>
<td>Education (1) Polluter (1)</td>
<td>Percent of residents with a college degree Number of different polluters Number of different polluter</td>
</tr>
</tbody>
</table>

Table 8.2. Significant variables in the unrefined discriminant analysis for each county using 2000 data. Refined discriminant analysis information was not considered due to low amount of explained variance.

Using the 1990 data there were six significant variables in the discriminant analysis. The percent of explained variance was 84.1 percent. First, the percent of rented dwellings was greater in polluted census tracts than in those with no pollution. This is likely a function of income. Next, the percent of residents achieving only a ninth grade education and the percent of residents with some high school education above ninth grade but receiving no diploma were both higher in the census tracts with some pollution present. Finally the polluter variables, the number of different SIC codes and the number
of different polluters variables were both higher in the polluted census tracts. This is intuitive, since those census tracts with pollution should have higher amounts of polluters.

The 1990 discriminant analysis was refined and the polluter variables were removed. The refined discriminant analysis findings revealed that the model explained about 11.4 percent of the variance and that three variables were significant in predicting whether or not a census tract would be polluted. First, the percent of residents with some college coursework was 9.2 percent in the polluted census tracts and 12.4 percent in the non-polluted census tracts. Also, the average percent of residents with a high school diploma or equivalent was higher in census tracts with no pollution present. In polluted census tracts the average was 18.0 percent, whereas in non-polluted tracts it was 18.7 percent. Finally, the percent of residents who do not speak English well or at all was higher in the non-polluted census tracts.

Next, the discriminant analysis model was calculated using the 2000 data. This model accounts for 80.3 percent of the variation. Five variables were significant for predicting whether or not census tracts would be polluted. First, the percent of rented dwellings was higher in polluted census tracts. Next, the percent of residents with a graduate or professional degree was 9.5 percent in the polluted census tracts and 10.0 percent in the non-polluted census tracts. All of the polluter variables including the number of different SIC codes, the number of different polluters, and the number of new polluters between 1999 and 2000 were higher in the polluted census tracts.

This model was refined and recalculated without the polluter variables. This time the explained variance was extremely low with about 9.2 percent of the variance
accounted for by the model. Only two variables were shown to be significant as predictor variables. First, the percent of residents with less than a ninth grade education was higher in the polluted census tracts. Next, the percent of residents receiving their high school diplomas was higher in the non-polluted census tracts. These variables suggest that educational obtainment is overall higher in the non-polluted census tracts.

The next county that was examined was Cuyahoga County, which contains Cleveland, Ohio. In Cuyahoga County the variables that entered the discriminant analysis and regression models again basically were associated with education and variables measuring polluter characteristics. Data from the years 1990 and 2000 were analyzed separately.

There were four variables that entered the discriminant analysis model in Cuyahoga County, Ohio in 1990. First, residents living in non-polluted census tracts were more likely to have obtained a college degree. In the polluted census tracts on average 3.0 percent of residents had earned a college diploma, while in the non-polluted census tracts 8.4 percent of residents had a college or university degree. Next, in census tracts with polluters present there was on average 1.8 different SIC codes, compared with zero in the non-polluted census tracts. Also, there were 2.2 different polluters in the polluted census tracts and none present in the non-polluted census tracts. Finally, there were 0.3 new polluters in those census tracts containing polluters between 1989 and 1990 and again, zero present in the non-polluted census tracts. This model explained 74.0 percent of the variance.

When this model was refined by removing the polluter variables, several new variables entered the model; however the explained variance was fairly low with about
16.2 percent the variance accounted for by the model. This strongly suggests that the conclusions drawn from the resulting model should be interpreted with caution. First, the percent of non-white residents was higher in the non-polluted census tracts by about one percent.

The percent of rented dwellings was higher in polluted areas, with 45.7 percent rented in polluted census tracts and 39.6 percent in non-polluted census tracts. Next, the percent of female headed households with children under 18 years of age was higher in census tracts with pollution present. This variable is considered an economic variable and not specifically representative of a gender social status group. Next the percent of residents receiving a ninth grade education was higher in polluted census tracts. There were 9.8 percent of residents living in polluted census tracts receiving up to a ninth grade education and 5.4 percent of residents in non-polluted census tracts receiving a ninth grade education. Finally the percent of residents with a college degree was higher in the non-polluted census tracts.

Using the 2000 data, the discriminant analysis models were again calculated. The results were similar. The model for 2000 data revealed that 76.6 percent of the variance was explained. Seven variables were significant in differentiating polluted and non-polluted census tracts. The percent of residents with some high school above the ninth grade level but not graduating from high school was higher in the census tracts with polluters present. Also the percent of residents who had taken some college course work and the percent of residents who had completed their college degrees were higher in the non-polluted census tracts. The percent of residents who classified themselves on the US Census as not speaking English well or at all was 9.9 percent in the polluted census tracts.
and 11.0 percent in the non-polluted census tracts. This finding is contrary to most social status group theories and may further support the finding that class, not other status groups, is primarily responsible for the citing of noxious facilities. Finally the pollution variables were all higher in the census tracts with polluters present.

When the model was refined by excluding the polluter variables the explained variance was 12.7 percent which is considered low. Four variables entered the model and were consistent with the findings for the other counties. First, the percent of non-white residents was higher in the polluted census tracts than in the non-polluted census tracts. This may be an indication that race or ethnicity is involved with polluting distribution, however since this is the only time this variable was shown to be a significant discriminating variable in any year or any county this conclusion is rejected. Also, the explained variance in the model is extremely low, thus there is a lack of confidence in concluding that race or ethnicity is significant in choosing a location for polluting facility.

Next, two education variables, the percent of residents having some college coursework and the percent of residents obtaining a college degree, were significant. In both cases higher educational achievement was observed in the non-polluted census tracts. Finally, the percent of foreign born residents was higher in the non-polluted areas with 6.1 percent, compared to the 3.7 percent in the polluted census tracts.

In 1990 the regression model explained 37.6 percent of the variance. Only one variable, the number of different polluters, was significant. The regression model was then calculated with the polluter variables removed. No variables entered the model as significant during this calculation.
The regression model calculated for the 2000 data produced two significant variables, the number of different polluters and the percent of vacant dwellings. This model accounted for 49.0 percent of the variance. The model was calculated again with the polluter variables removed. There were two significant variables: the percent of vacant dwellings and the percent of households with a single female as the household head and children under 18 years of age. This model accounted for 18.9 percent of the variance.

The third county examined was Hamilton County, home to the urban center of Cincinnati. In Hamilton County the variables that entered the model during the discriminant analysis all were associated with pollution or socioeconomic class. Few of the variables entering the model were a result of race, ethnicity, or gender. Discriminant analysis models were computed for 1990 and for 2000.

There were two variables that entered the model computed from 1990 data. These were the number of different SIC codes and the number of different polluters. In the polluted census tracts the mean for the number of polluters was 2.6 whereas the non-polluted census tracts had no polluters. This model explained 66.1 percent of the total variance. When the model was refined by removing the polluter variables, no variables entered as significant.

When the regression model was calculated for 1990, 56.2 percent of the variance was explained. In this model, only one variable was significant: the number of different SIC codes. This, combined with the discriminant analysis lead to the conclusion that pollution description variables, such as the number of different SIC codes, number of different polluters, and number of new polluters, along with education variables are more
significant in the citing of pollution than race, ethnicity, gender, or age. The polluter variables were then removed and the regression model was again calculated. This time, no variables entered the model as significant.

A similar conclusion can be drawn from the 2000 models in Hamilton County. The discriminant analysis explained 58.8 percent of the variance and included two variables. First, the percent of residents with a college degree or equivalent in polluted census tracts was 12.5 percent. This number increases in the non-polluted census tracts to 17.4 percent. In other words, more residents in the non-polluted areas had achieved a higher level of educational obtainment. Next the number of different polluters in 2000 in the polluted census tracts was 2.6 polluters compared to none in the non-polluted census tracts.

When this model was refined by removing the polluter variables one education variable entered the model and explained 9.2 percent of the variance. The percent of residents with less than a ninth grade education was significant. The average percent of residents in polluted census tracts with less than a ninth grade education was 7.5 percent. This number decreased in the non-polluted census tracts to 4.9 percent.

When the regression model for the 2000 data was calculated three variables entered the model. These explained 78.0 percent of the variance in the dependent variable. The first two variables were the number of different polluters per census tract and the percent of residents with a high school diploma. The third variable, which may have some relation to ethnicity, was the percent of foreign born residents. This is the only indication that a status group may have some influence on pollution distribution in
Hamilton County, Ohio. The polluter variables were removed and the regression model was again calculated. No variables entered the model as significant.

Overall the majority of variables that were significant in both types of analyses were mostly due to social class and not race, ethnicity, gender, or age. However, it is important to note that many studies have been conducted in other areas of the country that observe these status groups in connection with pollution location (Macey et al., 2001; Bullard, 2000; Williams, 1999; Carr, 1996; Bryant, 1995; Bullard, 1993; Anderton et al., 1994).

Also, this was a broad spectrum analysis of three large counties in Ohio. Sometimes the aggregate data is not always representative of small scale or community-wide environmental injustices (Szasz and Meuser, 1997). For this study it was found that race, ethnicity, gender, age, and other social status group variables are not significant on the whole. However, there may be instances in which certain census tracts may be considered environmentally racist (Bullard, 2000) when just the data from that area are considered. This, however, would produce biased conclusions, since according to this study there were many middle-class, white neighborhoods that also contained pollution. The findings in this study indicate that in the sampling area there was no discrimination based on race, gender, or ethnicity.

It would be beneficial for future research to further examine each census tract on a more in-depth level as well as review the temporal characteristics of large polluting companies in relation to socioeconomic data. Overall, the distribution in the areas of
analysis is wide-spread. Pollution tends to be concentrated in areas that have polluting industries, a variety of Standard Industry Classifications, and characteristics such as low income and education levels.
APPENDIX A

REGRESSION MODELS FOR FRANKLIN, CUYAHOGA, AND HAMILTON COUNTIES COMBINED
\[ y = 0.417x \]

Where:
- \( y \) = total pollution
- \( x \) = the number of different Standard Industry Classifications

The standardized Beta coefficient for the number of different SIC codes was 0.417. The Adjusted \( R^2 \) value for this model was 0.168; meaning that 16.8 percent of the variance in total pollution was explained. The above equation shows that as number of different Standard Industry Classifications increases one unit the amount of pollution increases by 0.417 units. The directionality is determined by the positive value of the standardized beta coefficient. So in this case the number of different SIC codes is positively related to the amount of pollution.

The regression model was calculated again with the polluter variables removed. No variables entered the model as significant.

2000 Regression Analysis for Franklin, Cuyahoga, and Hamilton Counties combined.

\[ y = 0.387x_1 - 0.221x_2 + 0.181x_3 \]

Where:
- \( y \) = total pollution
- \( x_1 \) = the number of different polluters
- \( x_2 \) = the number of new polluters
- \( x_3 \) = the percent of residents with an associate degree

The standardized Beta coefficient for the number of different polluters was 0.387, the standardized Beta coefficient for the number of new polluters was -0.221, and the standardized Beta coefficient for the percent of residents with an associate degree was 0.181. The Adjusted \( R^2 \) value for this model was 0.153; meaning that 15.3 percent of the variance in total pollution was explained. The above equation shows that as number of
different polluters increases one unit the amount of pollution increases by 0.387 units. Also as the number of new polluters increases by one unit the amount of pollution decreases by 0.221 units. Finally, as the percent of residents with an associate degree increases one unit the amount of pollution increases 0.181 unit. The directionality is determined by the value of the standardized beta coefficient. So in this case the number of different polluters and the percent of residents with an associate degree are positively related to the amount of pollution. In contrast, the number of new polluters is inversely related to the amount of pollution.

The polluter variables were removed and the regression model was again calculated. The regression equation is as follows:

\[ y = 0.217x \]

Where:
\[ y = \text{total pollution} \]
\[ x = \text{the percent of residents with an associate degree} \]

The standardized Beta coefficient for the percent of residents with an associate degree was 0.217. The Adjusted R^2 value for this model was 0.039; meaning that 3.9 percent of the variance in total pollution was explained. The above equation shows that as percent of residents with an associate degree increases one unit the amount of pollution increases by 0.217 units. The directionality is determined by the positive value of the standardized beta coefficient. So in this case the percent of residents with an associate degree is positively related to the amount of pollution.
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