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Not in Whose Backyard? Minority Population Concentrations and Noxious Facility Sites

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ABSTRACT

The NIMBY syndrome has become the nemesis of facility siting efforts in the U.S.A. Given people's reluctance to live near noxious facilities, in whose backyard are such facilities located? This study employs U.S. county-level data to examine relative concentrations of minorities living near noxious facilities. Facility types analyzed include electric generating plants, manufacturing plants, Superfund sites, and radioactive waste disposal sites. While this study does not address which came first, the minority population concentration or the noxious facilities, it documents their current degree of association.

DISCLAIMER

Many types of municipal and industrial facilities make poor neighbors. These include facilities such as sewage treatment plants, airports, toxic waste disposal sites, and petrochemical refineries, that create unpleasant noises or odors or potential risks to life and health. While the value of having these facilities is widely recognized, most people prefer to live far enough from them to minimize personal impacts. Few communities actively seek the location of a noxious facility nearby. Indeed organized and highly visible opposition to the siting of new facilities is generally the rule.

Who, then, does live near noxious facilities? The least desirable occupations and locations are usually occupied by the poorest and the least powerful members of society. The idea that noxious facilities may be located near or in minority neighborhoods is not new but it has been raised again recently by the United Church of Christ Commission for Racial Justice study of toxic waste sites[1]. A large number of minority organizations are beginning to address environmental issues[2], to the extent that the First National People of Color Environmental Leadership Summit was held in October, 1991.

To the degree that equitable treatment of population subgroups is a goal, there are reasons for concern about the proximity of minority populations to noxious facilities. If these facilities present health and safety risks to the surrounding residents, they may contribute to differences in health status and life expectancy among demographic groups. There are many gaps in our knowledge of the linkages between environmental pollutants, population exposures, and health effects[3]. However, differences in health status between minority and majority populations in the U.S. are relatively well documented. For example, asthma, lead poisoning and some types of cancer occur at a higher rate among African-Americans than in the rest of the population. While this may be partially due to poverty and inadequate medical care, it may also be caused by greater exposure to environmental hazards.

This study only looks at the whether minorities may have greater potential exposure to whatever risks are associated with noxious facilities. It does not assess the risks or evaluate the

evidence related to health effects but uses county-level data to examine the degree of association between the location of noxious facilities and the percentage of the population that is nonwhite. The types of facilities included in this analysis are listed in Table 1. These range from manufacturing plants to toxic waste sites to electricity generating plants, which are divided into four categories depending on the primary type of environmental hazard associated with each type of facility. The

TABLE 1 Number of U.S. Facilities by Hazard Type

Facility and Hazard Type	Number
Air emissions hazard:	
Chemical manufacturing plants	591
Coal-fired generating plants	458
Gas-fired generating plants	241
Incinerators	53
Petroleum-fired generating plants	170
Petroleum refining	302
Petroleum production	281
Plastics and rubber manufacturing	131
Pulp mills	253
Smelters	375
Groundwater hazard:	
Commercial hazardous waste disposal	27
National Priorities List/Superfund sites	1129
Radiation hazard:	
Formerly utilized radioactively contaminated sites (FUSRAP)	29
Nuclear generating plants	119
Radiation-related research facilities	26
Radioactive waste disposal	7
Uranium mill tailings sites	21
Other hazards:	
Military chemical weapons storage sites (CHMDMIL)	7
Geothermal generating plants	4
Liquefied natural gas storage sites	78
Other generating plants	13
TOTAL:	4315

facilities listed as air emissions hazards produce contaminants that reduce ambient air quality, contributing both to acid precipitation and airborne toxics. Of the 4,315 facilities included in this study, more than half are in the air emissions hazard category. The next largest category is composed of toxic waste sites that mainly threaten groundwater resources.

The distribution of these categories of facilities across major regions of the U.S. is shown in Table 2. While the number of facilities in the radiation and other hazard categories are roughly equal across regions, the numbers of groundwater hazards and especially, of air emissions hazards varies substantially. The South has more than three times as many air emissions hazards as the East and the East has nearly twice as many identified groundwater hazards as the West.

TABLE 2 Types and Numbers of Noxious Facilities by Region

	Region				
Facility Type	West	Central	East	South	Total
Air Emissions Hazard	455	786	366	1248	2855
Groundwater Hazard	211	318	359	268	1156
Radiation Hazard	47	49	49	57	202
Other Hazard	16	21	34	31	102
All Combined	729	1174	808	1604	4315

Some types of facilities tend to be located near population centers or transportation hubs, others tend to be relatively isolated. This tendency is measured in Table 3 by the correlation between the density of all types of noxious facilities in counties that have facilities and the density of each individual facility type. These are presented in rank order to show the progression from most

concentration to most isolated facility types. In general the manufacturing facilities tend to be located in areas with many other facilities and the Superfund sites tend to be located with them. Radiation-related and chemical weapons storage sites, in contrast, tend to be isolated from other activities.

TABLE 3 Association of Concentration of All Facilities Combined with Facility Density by Facility Type (N = 1323)

Facility Type	Correlation (R)
Chemical Manufacturing Plants	0.658
Petroleum-Fired Generating Plants	0.630
Pulp Mills	0.615
Petroleum Refining	0.601
National Priorities List/Superfund Sites	0.568
Incinerators	0.541
Plastics and Rubber Manufacturing	0.526
Liquefied Natural Gas Storage Sites	0.452
Gas-Fired Generating Plants	0.399
Smelters	0.389
Formerly Utilized Radioactively Contaminated Sites	0.365
Coal-Fired Generating Plants	0.244
Commercial Hazardous Waste Disposal	0.074
Petroleum Production	0.063
Nuclear Generating Plants	0.054
Radiation-Related Research Facilities	0.052
Other Generating Plants	0.038
Military Chemical Weapons Storage Sites	0.004
Radioactive Waste Disposal	-0.009
Geothermal Generating Plants	-0.011
Uranium Mill Tailings Sites	-0.017

Table 4 shows the distribution of facilities in each hazard category across counties (and independent cities). For each hazard category, the first column indicates the percentage of counties that do not have any facilities. Thus, over 57% of counties do not have any facilities of the types included in this study. This means that all of the noxious facilities are located in fewer than 43% of U.S. counties. The majority of counties with facilities have just one or two. Only 3.8% of counties

have more than eight facilities, considering all types combined.

TABLE 4 Percentage Distribution of Counties by Type and Number of Facilities[a] (N = 3109)

	Number of Facilities					
Facility Type	0	1	2	3-7	8-19	≥20
Air Emissions Hazard	64.97	17.27	7.49	8.36	1.75	0.15
Groundwater Hazard	82.47	10.52	3.28	3.03	0.68	0.03
Radiation Hazard	95.75	2.61	1.19	0.45	0.00	0.00
Other Hazard	97.36	2.19	0.26	0.19	0.00	0.00
All Combined	57.45	18.01	8.81	11.91	3.43	0.37

[a] Some "county" data units are independent cities.

Table 5 shows the distribution of counties and facilities by categories of percentage minority population concentration and per capita income for each region. (Per capita income provides a crude measure of income levels in each county and does not account for possible income differences between minority and majority populations.) There are three categories of nonwhite population concentration: low, mid and high, based on the standard deviation of percentage nonwhite across counties. Per capita income is similarly divided into four categories. The last column gives the percentage difference between the distribution of facilities and counties (% facilities less % counties). In effect this considers an equal distribution of facilities across counties to be the standard and records the percentage of facilities that are lacking, or excess, in each minority population or per capita income category. Looking at the West, 69% of counties have a low percentage of minorities, but these counties have only 39% of the region's noxious facilities, needing an additional 30% of the facilities to equalize the distribution across counties. The relationship between the distribution of

minorities and facilities is similar for all regions and for the U.S. as a whole. Counties with higher concentrations of minorities have higher percentages of the region's facilities.

TABLE 5 Percentage of Counties and Facilities by Percentage Minority and Per Capita Income Category by Region (N = 3109)

Variable	% Counties	% Facilities	% Difference[a]
WEST			
Percentage Minority			
Low (0-14%)	69.17	38.96	-30.21
Mid (14-31.4%)	15.53	33.74	+18.21
High (>31.4%)	15.29	27.30	+12.01
Per Capita Income			
Low (<$6529.2)	12.38	3.02	-9.36
Low-Mid ($6529.2-$8546.74)	38.35	16.87	-21.48
High-Mid ($8546.74-$10564.2)	34.71	36.21	+1.50
High (>$10564.2)	14.56	43.90	+29.34
CENTRAL			
Percentage Minority			
Low (0-14%)	94.60	79.73	-14.87
Mid (14-31.4%)	3.60	13.71	+10.11
High (>31.4%)	1.80	6.56	+4.76
Per Capita Income			
Low (<$6529.2)	9.95	0.77	-9.18
Low-Mid ($6529.2-$8546.74)	38.01	12.10	-25.91
High-Mid ($8546.74-$10564.2)	41.99	47.87	+5.88
High (>$10564.2)	10.05	39.27	+29.22
EAST			
Percentage Minority			
Low (0-14%)	89.86	77.72	-12.14
Mid (14-31.4%)	6.91	15.84	+8.93
High (>31.4%)	3.23	6.44	+3.21
Per Capita Income			
Low (<$6529.2)	0.0	0.0	0.0
Low-Mid ($6529.2-$8546.74)	26.27	5.20	-21.07
High-Mid ($8546.74-$10564.2)	40.55	34.90	-5.65
High (>$10564.2)	33.18	59.90	+26.72

TABLE 5 (Cont'd)

Variable	% Counties	% Facilities	% Difference[a]
SOUTH			
Percentage Minority			
Low (0-14%)	42.04	25.56	-16.48
Mid (14-31.4%)	28.70	39.65	+10.95
High (>31.4%)	29.26	34.79	+5.53
Per Capita Income			
Low (<$6529.2)	15.37	3.37	-12.0
Low-Mid ($6529.2-$8546.74)	48.42	30.74	-17.68
High-Mid ($8546.74-$10564.2)	26.81	43.64	+16.83
High (>$10564.2)	9.40	22.26	+12.86
U.S. TOTAL			
Percentage Minority			
Low (0-14%)	66.82	52.38	-14.44
Mid (14-31.4%)	16.91	27.14	+10.23
High (>31.4%)	16.27	20.53	+4.26
Per Capita Income			
Low (<$6529.2)	12.09	2.02	-10.07
Low-Mid ($6529.2-$8546.74)	41.99	18.54	-23.45
High-Mid ($8546.74-$10564.2)	33.95	41.90	+7.95
High (>$10564.2)	11.96	37.59	+25.63

[a] % Facilities minus % Counties

The possibility that facilities are located in lower income areas, a characteristic often associated with minority status, is also examined in Table 5. In this case the % Difference column shows the percentage of facilities that need to be relocated to equalize the distribution of facilities among counties by income category. Rather than being located in counties with lower per capita incomes, the facility concentration increases with per capita income level. Thus, lower income status does not make a county more likely to contain noxious facilities.

Since many of the facility types are highly concentrated in a small proportion of counties, the degree to which facility location is related to the metropolitan area status of counties is important. Table 6 shows the percentage of facilities of each hazard type that are located in urban counties in each region. For example, the first cell in the table indicates that in the West 62.2% of all facilities classified as air emissions hazards are located in metropolitan counties. The tendency for facilities to be located in urban areas is highest in the East for each type of hazard. Referring back to Table 3, the air emissions hazard facilities tend to be most concentrated, so it might be expected that these facilities would dominate urban counties in the East. Table 2 indicates, however, that the concentration of facilities in the East is composed about equally of air emission hazards and hazardous waste sites. Nearly half of the air emissions hazard facilities in the U.S. are located in the South, where, as Table 6 indicates, they are apparently more dispersed among urban and nonmetropolitan counties than in the other regions. Comparing hazard types, the radiation related facilities are most likely to be located outside of urban areas.

TABLE 6 Percentage of Total Facilities in Urban (MSA) Areas by Region

	Region				
Facility Type	West	Central	East	South	Total
Air Emissions Hazard	62.20	61.32	86.61	58.09	63.29
Groundwater Hazard	73.46	64.15	87.19	67.16	73.70
Radiation Hazard	48.94	55.10	91.84	36.84	57.43
Other Hazard	50.00	71.43	97.06	90.32	82.35
All Combined	64.33	62.01	87.62	59.48	66.26

Having determined that the presence of noxious facilities is primarily an urban phenomenon, the next question is the degree to which minority population concentration is related to metropolitan location. Table 7 shows the number and percentage of counties in urban areas with minority population in each of these categories. Of all urban counties, only 11.84% have high percentages of minorities (greater than 31.4%). This may be compared to the percentage of all urban facilities that are located in counties with high percentages of minorities, 20.92%. Thus, Table 7 shows that noxious facilities are disproportionately concentrated in counties with high minority population percentages. The final column of Table 7 indicates the average number of facilities per county in each category. Among urban counties, those with high minority population concentrations have more than twice as many facilities than those with less than 14% minority population.

TABLE 7 Percentage Distribution of Counties and Facilities by Percentage Minority Category and Urban (MSA) Status

Percentage Minority Category	# Counties in MSAs	% Counties in MSAs	# Facilities in MSAs	% Facilities in MSAs	Facilities Per Urban County
Low (0-14%)	454	61.10	1360	47.57	2.95
Mid (14-31.4%)	201	27.05	901	31.51	4.48
High (>31.4%)	88	11.84	598	20.92	6.80
Total	743	100.00	2859	100.00	

A comparison of the two groups of counties, those with noxious facilities and those without, is presented in Table 8. Mean values for percentage of minority population and mean per capita income are shown for each region and the total U.S. The Central and East regions have the highest per capita incomes while the South and West have the highest proportions of minority population. A

t-test on differences in the mean values for counties with and counties without facilities shows that most of the differences are statistically significant. Though the difference is slightly less pronounced in the South, counties with noxious facilities contain significantly higher percentages of minorities. Since these counties also have significantly higher per capita incomes, facility location is clearly not associated with low income status.

TABLE 8 Comparison of Minority Population Percentage and Per Capita Income for Counties With and Without Any Noxious Facilities (N = 3109)

	Mean Value		
Variable	Counties With Facility	Counties Without Facilities	t
U.S.			
Percentage Minority	15.1	13.2	-2.917**
Per Capita Income	9361.46	7943.23	-20.665**
West			
Percentage Minority	17.4	11.8	-3.331**
Per Capita Income	9370.47	8063.79	-6.565**
Central			
Percentage Minority	5.0	3.5	-2.915**
Per Capita Income	9567.74	7965.11	-16.561**
East			
Percentage Minority	7.1	2.8	-3.063**
Per Capita Income	10643.71	8832.73	-5.465**
South			
Percentage Minority	23.8	21.7	-2.082*
Per Capita Income	8846.65	7837.28	-9.620**

* >0.05 level of significance.
** >0.01 level of significance.

Source: 1980 U.S. Population Census.

The data indicate a rather strong relationship between increasing percentages of minority population and concentration of noxious facilities in a county. This effect is not associated with low incomes: in fact, higher incomes in these areas may compensate for the proximity of noxious facilities. The relationship is not primarily due to urban location of minorities and facilities either since the concentration of facilities in urban areas increases with increasing percentages of minorities.

Both the effects of urban location and of income level are controlled in Table 9. Correlation coefficients for facility density (the number of facilities per square mile) and percentage of minority population are presented for each region. Then controls for MSA location and per capita income are applied, first separately and then simultaneously. The first row of coefficients shows a relatively strong association between minority population concentration and facility density in the East and no association at all in the South. Controlling for urban location doesn't change these relationships except in the Central region, where the association increases from weak to moderately strong. This indicates that differences between urban and nonurban counties in the Central region mask the relationship between percentage minority and facility density. Controlling for income levels increases the statistical significance of the relationship between percentage minority and facility density in all regions. Finally, controlling for both effects show the relationship to be highly significant in all regions. It is very small in the South and moderately strong in the Central and East regions. Thus, the correlation between percentage minority and noxious facility density is greater in all regions when the effects of urban location and income level are controlled in the analysis.

While this analysis indicates that minority populations are more likely to be exposed to the hazards of noxious facilities, it leaves a number of important questions unanswered. Which came first, the minorities or the facilities? Are there differences in the patterns of population proximity among regions or among facility types? Are there differences among facility types in whether the

facility was sited in a minority community or whether minorities migrated to the facility site, perhaps seeking higher incomes? These and related questions should be the focus of ongoing research.

TABLE 9 Correlation of Facility Density with Percentage Minority for Counties with Noxious Facilities (N = 1323)

Correlated Variables	Region r value				
	West	Central	East	South	Total
Facility Density with Percentage Minority (first order)	0.150*	0.581**	0.674**	0.039	0.132**
Controlling for MSA Location	0.110	0.520***	0.646***	0.062	0.131***
Controlling for Per Capita Income (second order)	0.272***	0.556***	0.642***	0.121**	0.214***
Controlling for MSA and Per Capita Income	0.237***	0.520***	0.634***	0.099**	0.189***

*** > 0.001 level of significance

** > 0.01 level of significance

* > 0.05 level of significance

ENDNOTES

1. Chavez, B. and C. Lee, *Toxic Wastes and Race in the U.S.*, Prepared for the Commission for Racial Justice of the United Church of Christ, 1987.

2. De La Pena, N., "Fighting for the Environment", *Hispanic*, March, 1991, pp. 19-23.

3. National Research Council, *Environmental Epidemiology: Public Health and Hazardous Wastes*, National Academy Press, Washington, D.C., 1991.

END

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