# *ETHNICITY AND RISK: THE CHARACTERISTICS OF POPULATIONS IN CENSUS WARDS CONTAINING MAJOR ACCIDENT HAZARDS IN ENGLAND AND WALES*

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Occasional Papers, Series A: Geographical Research

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2001

ISSN 0266-9943

**Abstract:**

Recent geographical and sociological research has focused on analysing the environmental equity and justice dimensions of the distribution of pollution and risk. In the US, where most of this research has taken place, studies have shown that ethnic minority and poor communities bear a disproportionate burden of environmental risk, leading to accusations of environmental racism and deliberate targeting of marginal communities in siting decisions. Little attention has been given to these issues in the UK. This paper reports on a preliminary study examining the ethnic characteristics of census wards containing a particular category of technological risk known as 'major accident hazards'. The ethnic characteristics of wards with and without major accident hazard sites are analysed at national and regional scales. This reveals some evidence of a disproportionate siting of major accident hazard sites in wards with higher Asian populations. However it is stressed that these results provide no more than a preliminary indication of a pattern of distribution to be investigated further and that there are a number of significant limitations with the analysis undertaken including the size of spatial unit utilised, the lack of differentiation between major accident hazard sites and the need to examine the relationship between ethnicity and other socio-economic variables. No definitive conclusions can be drawn at this stage as to the validity, significance or cause of the apparent bias in site locations.

**Contents:**

## Introduction

Whilst recent years have seen increased political and academic attention being given in the UK to questions of social justice and exclusion, this agenda has largely bypassed environmental concerns (Jacobs 1999, Dobson 1998). There are, however, important questions to be asked about the social distribution of environmental degradation and the dimensions of distributive justice embodied within patterns of environmental risk. The basis, severity, distribution, causes and potential resolution of 'environmental exclusion', remain largely unexplored in a UK or wider European context (Ageyman 2001). This situation contrasts markedly with the US where research into the patterns and causes of environmental (in)justice has been one of the most important contributions made by the social sciences to the environmental literature, for example, providing compelling evidence of disproportionate exposure to environmental risks amongst low income and ethnic minority communities (Bullard 1999).

This paper reports on a preliminary study examining the ethnic characteristics of census wards containing a particular category of technological risk known as 'major accident hazards'. Major accident hazards can be broadly defined as the storage or use of hazardous substances, where in the event of a major accident and release of toxic, explosive or flammable materials local people and the nearby environment could be seriously affected. The use and storage of large quantities of hazardous substances is predominantly found in the chemical and petrochemical industries, but can also be associated with a diversity of other activities including those of the gas and water supply utilities (Walker and Draycott 1996). The potential hazard or threat has been demonstrated in a number of major well known disasters, for example at Flixborough,

Seveso (Italy) and Bhopal (India). Most recently accidents in Enschede (Netherlands) in 2000 and Toulouse (France) in 2001 have shown that the potential for disaster can be realised in heavily urbanised areas and in societies where risk management measures are well advanced - 20 people were killed in Enschede and 29 in Toulouse, along with many hundreds seriously injured and property damaged over a wide area at both incidents (Walker 2001).

We report on an analysis of distribution of major accident hazard sites in relation to the ethnic make-up of the census wards within which they are found. This study builds on that produced by Friends of the Earth in 1999 which was the first in the UK to examine the environmental equity dimensions of polluting site locations. The FOE study analysed the location of sites coming within the Integrated Pollution Control (IPC) Regulations (FOE 1999). Some of the key findings of this study include that 662 of the sites coming within the Integrated Pollution Control (IPC) system in England and Wales are located in areas with household income of less that £15,000, whilst only 5 are in areas where average household income is above £30,000. In London over 90% of IPC factories are located in areas with below average household income; and the average household income of £17,640 in areas with no sites, steadily falls as the number of sites per area increases. Whilst such statistics are striking, the strength of this research is to an extent limited by the failure to examine the statistical significance of the differences found (Walker and Bickerstaff 2000).

FOE has recently followed up this study with an analysis of the location and level of emissions from IPC sites in England in relation to levels of deprivation in census wards (FOE 2001). This reveals that IPC sites are predominantly found in the most

deprived wards and that of the 11,400 tonnes of carcinogenic chemicals emitted to the air in England in 1999, 66% of total emissions took place in the 10% most deprived wards and only 8% in the least deprived 50% of wards. Both of the FOE studies therefore identify a bias towards IPC sites being located in areas of low income, a finding which, whilst maybe not surprising, for the first time provides hard data on the extent of social differentiation in potential exposure to site based risks in the UK.

Our research differs from that of FOE in:

(1) examining the distribution of a different category of site. IPC sites produce ongoing emissions on a daily basis. Major accident hazards are sites where there is the potential for a major sudden accidental release of hazardous materials.
(2) analysing the distribution of sites in relation to ethnicity rather than income or deprivation.

We begin our discussion by reviewing some of the US environmental justice literature. We then discuss the definition of major accident hazards, how they are identified and the regulatory measures that apply to them. The methods used in analysing the ethnic distribution of risk exposure are then explained and the results of the analysis presented. In the conclusion to the paper we particularly emphasise the preliminary nature of the work undertaken and the need for caution in interpreting the analysis and identify a range of directions for future work.

**Environmental justice in the US**

The evolution of the environmental justice agenda in the US has been widely reported (e.g Bullard 1993, Gottlieb 1993). It emerged from political protest surrounding particular controversies - such as in 1982 in Warren County, North Carolina, when a mostly African-American community was selected as the site of soil contaminated with PCBs. The vigour of the protest and the involvement of a wide range of organisations focused attention on what came to be known as 'environmental racism' (Harvey 1996). Soon afterwards the US General Accounting Office (1983) initiated a study that found three out of four commercial toxic waste landfills in the South-eastern United States were located in poor, black communities. Another early study of Houston found that six of the city's eight municipal incinerators and all five of its landfills were in predominantly black areas (Bullard 1983).

In 1987 the United Church of Christ Commission for Racial Justice (UCC/CRJ) commissioned the first national study of 'environmental racism'. They found race was a more significant predictor of where commercial toxic waste facilities were located in the United States than were a variety of measures of income, property values and proximity to markets. The UCC/CRJ study is usually considered the benchmark study of the literature. A flurry of follow up studies of hazardous facilities confirmed their findings (e.g Bryant and Mohai, 1992; Szasz et al 1993; Goldman and Fitton 1994; Adeola 1994). The National Wildlife Federation reviewed 64 studies of environmental disparities; in all but one, disparities were found by either race or income, and disparities by race were more numerous than were income (Goldman and Fitton 1994).

The findings of empirical investigation, reinforced by persistent political pressure from environmental justice groups, led policymakers to give new consideration to the distribution of environmental risks and benefits across population subgroups and to initiate a series of policy actions (Higgins 1993; Bullard 1994). Members of Congress introduced bills to promote environmental justice and the United States Environmental Protection Agency established an Office of Environmental Justice to focus and co-ordinate agency activities and provide technical assistance. In February 1994 President Clinton issued Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. The order requires federal regulatory agencies to 'make environmental justice a part of all they do.' Under the order every agency would have to consider the impact of its policies on minority communities. Environmental impact statements prepared under the National Environmental Policy Act now have to address environmental justice concerns.

While environmental justice has been recognised, both in political and public life, as a major policy issue in the US, the empirical basis of the movement's claims has come under close scrutiny (Szasz and Meuser 1997). The majority of studies to document environmental inequalities have focused on two kinds of facilities - waste sites and operating plants emitting pollutants. There are many other forms of environmental inequity; to include the distributive impacts of public policy, the transport of hazardous and radioactive materials and air quality and health risks. Researchers have begun to explore some of these other dimensions. Related studies found race biases when analysing other types of toxic hazards including industrial emissions

(Bryant and Mohai 1992; Szasz et al 1993, Pollock 1995) pesticide related illnesses (Perfecto 1992) and government responses to superfund sites (Lavelle and Coyle 1992). Ambient air pollution has been found to be regressively distributed by race (Gelobter, 1993; Wernette and Nieves 1992) and income (Gelobter 1993). In 1988 the Agency for Toxic Substances and Disease Registry (ATSDR) estimated that 3-4 million children in the US are at increased risk of lead poisoning. They also found that black communities have far higher percentages of children with high blood lead levels and this inequity increases the poorer the families are.

The evidence for environmental inequity is, however, far from conclusive. If we focus on intent, evidence for overt targeting by race is largely circumstantial. The actual data supporting the conclusion that race itself is the central determining factor with waste facility location have been challenged as less significant than age, income and other demographic variables as siting predictors (Perlin et al 1995; Zimmerman 1994; Greenberg 1993) with the research portrayed as relying on inappropriate units for analysis (Cutter and Solecki 1996; Anderton et al 1994; Bowen et al 1995). Gould (1986) and Krieg (1998) both argue that toxic releases (the most commonly used parameter) may be an inappropriate indicator of toxic hazards in de-industrialised urban areas. Poor areas have lost industry and thus their measured releases might decrease, even though they faced risks from prior hazardous waste generators. In a study by Anderton et al (1994) revisiting the 1987 UCC/CRJ study, it is argued that the finding of the original research was an artefact of geographic scale, that ZIP codes are too large and the Census Tract is the more appropriate spatial unit of analysis. Comparing tracts with TSDFs to tracts without, Anderton et al (1994) found no significant racial differences. In addition, studies suggesting race as the key siting

determinant have been questioned for using inappropriate statistical tests to evaluate differences among population subgroups (Greenberg 1993) and for ignoring the racial composition of the community at the time of the initial decision to site a facility (Been and Gupta 1997, Yandle and Burton 1996). Others have questioned the implication of racist intent with any disproportionate burden (Been 1994)

**Major accident hazard sites and their spatial distribution**

In contrast to the increasingly developed and sophisticated profile of empirical environmental justice research in the US, in the UK even the most basic of analyses remains to the undertaken. In this light the research we present in this paper is simplistic, providing only an initial view of how the distribution of one form of risk may be differentiated along ethnic lines.

In the UK there are two main categories of major accident hazards currently identified through legislation:

*1. Consent sites* - installations are designated as 'consent sites' through the Hazardous Substances Consents Regulations (1992). These regulations require that consent be obtained from the local planning authority to store specified levels of hazardous substances at a particular location (Department of the Environment 1992, Walker 1994). Land use planning controls are also applied around consent sites, and the Health and Safety Executive (HSE) identify them as a separate category of installation for safety inspection purposes.

*2. COMAH 'top-tier' sites* - a smaller subset of consent sites are also defined as so called 'top-tier' sites through the COMAH Regulations which implement the Seveso II Directive. For these sites significant additional requirements come into force including the production of safety reports, emergency planning and information provision to the public.

For the purposes of this paper we examine the distribution of consent sites, as this provides a more inclusive definition of major accident hazard. The information on site locations we utilised dates from 1997, which is before changes were made to the consent regulations to reflect the coming into force of the Seveso II Directive[1].

The list of sites obtained from an HSE database was problematic in that there were omission and accuracy problems, in particular relating to grid references. In a surprising number of cases grid references were missing or had been entered incorrectly, with sites appearing in the North Sea or the other end of the country to where they should have been. As far as possible corrections were made. In a few cases where corrections could not be made sites were omitted from the data set. There were also sites included in the data set that were identified as hazardous under European legislation but not under the consent regulations - these were also excluded from the analysis. Following these steps a total of 1235 consent sites were included in the dataset for England and Wales. Maps showing the spatial distribution of these sites across England and Wales can be found in Walker, Pratts and Mooney (2000).

[1] The Seveso II Directive made a range of changes to the inventory lists which define when any one site comes within the remit of the legislation. These changes have fed through to the inventory lists used in the consent regulations leading to a greater number of sites being identified.

In order to examine the ethnic patterns of site distributions it was necessary to define a spatial unit for which population characteristics would be examined. As discussed earlier the choice of spatial units is crucial for environmental justice studies. For the purposes of making an initial analysis census wards were chosen with a simple distinction made between wards with major accident hazard sites and those without. The use of census spatial units, alongside a simple 'includes/excludes' criterion is typical of many of the earlier US studies. Whilst providing a starting point we recognise that this choice of spatial unit can be criticised on a number of grounds:

- **it takes no account of the number of hazardous sites within a ward, or the amount of hazardous material that is held** (which can vary considerably between sites)

- **it takes no account of the distribution and distance decay of potential risk around hazardous sites.** Just because a site falls within a ward does not mean that all of the ward is equally at risk, or indeed that other adjoining wards are not at risk. In other words there is no direct correlation between the spatial definition of wards and the spatial extent of potential risk.

However addressing either of these limitations raises many difficulties (such as needing site specific risk assessments) and we would argue that there is still value in providing a preliminary analysis of the broad characteristics of site locations. Further studies can refine the analysis we have undertaken and provide a more differentiated account of site characteristics and areas at risk.

**Analysis for England and Wales**

An analysis for the whole of England and Wales was first undertaken utilising data from the 1991 census on ethnicity. Data was obtained for five categories of ethnicity – Black, Asian, Irish, Chinese, and White. Table 1 provides the results of the analysis showing average percentage figures for all wards in the England and Wales, and then averages for wards *with* hazardous sites and for those *without*.

**Table 1: Ethnicity of wards with and without consent sites in England and Wales**

| | Average for all wards | Average for wards with consent sites (total 951) | Average for wards without consent sites (total 8556) |
|---|---|---|---|
| % White | **96.5** | **95.56** | **96.6** |
| % Black | **1** | **1.19** | **1.0** |
| % Asian | **1.6** | **2.37** | **1.5** |
| % Chinese | **0.9** | **0.87** | **0.9** |
| % Irish | **1.3** | **1.26** | **1.3** |

It can be seen that for most of the ethnicity variables there is little or no difference between the national averages and the averages for wards with and without consent sites. The ethnic category for which the most significant difference can be seen is Asian. Here the national average of 1.6%, compares to the 2.4% in wards with consent sites and 1.5% in wards without consent sites. This is a significant difference between wards with and without consent sites at the 99.99% level (t test with unequal variance). The only other ethnic group for which a statistically significant difference is apparent is white (t test with unequal variance, significant at the 99.9% level).

One problem with producing averages for wards is that wards have different population sizes, therefore averaging percentages can produce distortions in the summary variables. An alternative approach is to sum the total population in all wards

with and without sites and to produce a percentage figure from this totalled data. The results produced using this method are shown in Table 2.

**Table 2: Ethnic breakdown of total populations in wards with and without consent sites for England and Wales**

| | Percentage of total population in wards with consent sites (total wards = 951) (total popn = 5,886,816) | Percentage of total population in wards without consent sites (total wards = 8556) (total popn = 43,317,655 |
|---|---|---|
| White | **93.1** | **94.3** |
| Black | **1.9** | **1.7** |
| Asian | **3.9** | **2.7** |
| Chinese | **1.2** | **1.2** |
| Irish | **1.5** | **1.6** |

This method of comparison again indicates the strongest difference for the Asian ethnic group with a bias towards a higher percentage in wards with consent sites. A much smaller and insignificant bias in the same direction is evident for the Black ethnic group.

A third approach to examining differences along ethnic grounds is to calculate the percentage of the total England and Wales population in an ethnic category that lives in wards with and without consent sites. Table 3 shows a comparison between Asian and White ethnic groups using this method:

**Table 3: Proportion of Asian and White population in wards with and without consent sites in England and Wales**

| | Total Population | Percentage |
|---|---|---|
| **Asian** | | |
| Asian population in wards with consent sites | **230950** | **16.3%** |
| Asian population in wards without consent sites | **1187307** | **83.7%** |
| Total asian population | **1418257** | **100%** |
| **White** | | |
| White population in wards with consent sites | **5478748** | **11.8%** |
| White population in wards without consent sites | **40935553** | **88.2%** |
| Total white population | **46414301** | **100%** |

Again this Table indicates that there is a greater likelihood of a person of Asian ethnicity living in a ward with a consent site than a white person. In total 16.3% of the Asian population of England and Wales lives in wards with consent sites compared to only 11.8% of the total white population.

**Regional Analysis**

To begin to explore the regional differentiation of patterns of distribution of hazardous sites data was examined for the standard regions of England and Wales. A simple analysis of average percentages (as in Table 1) for White, Asian and Black ethnicity is shown in Table 4.

The regional pattern again shows differentiation along ethnic lines. In most regions a bias towards a higher proportion of people of Asian ethnicity living in wards with consent sites is evident. The strongest bias is apparent in the West Midlands, where a 2% average Asian population in wards without sites, rises to 5% in wards with sites. Differentiation in some regions also emerges for the Black ethnic group – for example in the East Midlands, where there is no bias towards Asian populations, in Wales and the West Midlands.

**Table 4: Ethnicity of wards with and without consent sites in the standard regions of England and Wales**

| | | Regional Average for All Wards | Average for Wards with Consent Sites | Average for Wards without Consent Sites |
|---|---|---|---|---|
| North | White | 99.1 | 99 | 99.1 |
| | Black | 0.1 | 0.2 | 0.1 |
| | Asian | 0.5 | 0.4 | 0.5 |
| Yorkshire and Humberside | White | 97.5 | 96.3 | 97.8 |
| | Black | 0.4 | 0.6 | 0.4 |
| | Asian | **1.5** | **2.5** | **1.4** |
| North West | White | 96.8 | 95.6 | 97 |
| | Black | 0.5 | 0.5 | 0.5 |
| | Asian | **2** | **3.3** | **1.8** |
| Wales | White | 99 | 97.6 | 99.1 |
| | Black | **0.2** | **0.8** | **0.2** |
| | Asian | **0.3** | **0.8** | **0.3** |
| West Midlands | White | 96.3 | 92.5 | 96.7 |
| | Black | **0.9** | **1.8** | **0.8** |
| | Asian | **2.3** | **5** | **2** |
| East Midlands | White | 97.3 | 96.8 | 97.3 |
| | Black | **0.6** | **1.1** | **0.5** |
| | Asian | 1.6 | 1.5 | 1.6 |
| East Anglia | White | 98.6 | 98.3 | 98.6 |
| | Black | 0.5 | 0.7 | 0.5 |
| | Asian | 0.4 | 0.3 | 0.4 |
| South West | White | 99.1 | 98.4 | 99.2 |
| | Black | **0.3** | **0.6** | **0.3** |
| | Asian | **0.2** | **0.5** | **0.2** |
| South East | White | 93.2 | 92.5 | 93.3 |
| | Black | 2.4 | 2.3 | 2.4 |
| | Asian | **2.7** | **3.6** | **2.6** |

## Conclusions, 'health warnings' and implications

Our preliminary analysis has shown that there is an **apparent** bias in the location of major accident hazard sites on ethnic grounds which merits further investigation. For England and Wales as a whole we have identified a statistically significant difference in average Asian ethnicity levels between census wards with and without major accident hazard sites. A bias towards sites being located in census wards of higher

Asian ethnicity consistently emerges from a number of different approaches to manipulating the data-set. Analysing the data for individual standard regions within England and Wales reveals that the difference for the Asian ethnic group emerges more strongly in some regions than in others, reflecting, in part, patterns in the distribution of the Asian population across the country. Some regions also show differences by black ethnicity, which do not emerge as significant across the whole of England and Wales.

Whilst these findings suggest a commonality with the many environmental justice studies in the US, which have also found statistically significant inequities on ethnic grounds, **such comparisons need to be made very carefully**. The absolute scale of difference we have found is much smaller than in many of the US studies. Differences of 1 or 2% in our analysis, which are high in relative terms, compare in absolute terms to differences of 10 or 15% in US research (Brown 1994) – in part reflecting the much greater degree of spatial differentiation along ethnic lines in US urban morphologies. The biases we have found also appear to be a general feature of the spatial distribution of consent sites, rather than one caused by sites being located predominantly in wards with a particularly high minority population.

**Caution in utilising the results of this research also needs to be exercised due to the preliminary nature of the analysis undertaken.** As discussed earlier there are a range of grounds on which, in particular, the use of census wards can be legitimately criticised. In this light, our study provides a guide to future research that could usefully include:

- using a finer spatial scale at enumeration district or postcode unit level
- testing the consistency of findings at different spatial scales below the region
- using a site-specific assessment of the scale and extent of potential harm around each sites
- undertaking similar research for other categories of hazardous or polluting site
- examining the relationship between patterns of ethnicity and other social variables
- undertaking the analysis with a current list of hazardous sites (post Seveso II changes) and using 2001 census data

**We also need to be wary of too hastily drawing any implications as to the cause of the apparent bias we have found towards Asian populations**. There are multiple possible explanations which need to be explored – for example, it could well be that the patterns we have identified are largely to do with the correlation between Asian ethnicity and deprivation, rather than a specific bias towards Asian ethnicity independent of deprivation. It could then be the case that it is the functioning of housing markets which mean that people of lower income (including Asians disproportionately) end up living near to industrial sites. We also in the UK need to take account of the long history of many of the 'hazardous' industries and the way in which site locations and population distributions have evolved over time (mirroring the 'what came first' the people or the hazard debate which has emerged in the US; Pulido 1996). All of these possibilities need to be carefully examined before any accusation of 'environmental racism' in siting, the deliberate location of hazardous facilities in areas of higher Asian ethnicity, can even begin to be entertained or substantiated.

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