A preliminary investigation of local air quality management and environmental justice in England and Wales

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Abstract

This paper is concerned with the relationship of air quality and population exposure within the context provided by environmental justice and social equity. It will explore the extent to which different social groups in England and Wales are exposed to adverse concentrations of air pollution as specified in the Air Quality Strategy (AQS) 2000 and subsequent regulations. In England and Wales Local Authorities (LAs) have a duty to review and assess air quality and to identify areas where objectives specified in the AQS are not met. In such areas where public exposure is present the LAs must declare Air Quality Management Areas (AQMAs). The characteristics of the population in these pollution hotspots are not well defined. Furthermore the AQMAs vary in size and pollutant sources and are often, but not exclusively, found in city areas. The paper describes the characteristics of the population resident in AQMAs in terms of their social status as computed by deprivation indicators. The methodological approach employed involves an initial investigation on the availability and suitability of deprivation indicators, and followed by the use of a GIS environment to visualise the deprivation scores in AQMAs areas throughout England and Wales. The paper considers social equity issues in respect of the exposed populations and raises the issue of considering equity in the definition of an AQMA.

Keywords: Air Quality Management Areas (AQMAs), local air quality management, environmental justice, social equity.
1 Introduction

Local Air Quality Management (LAQM) is the UK’s statutory process by which local government tackles air pollution; it is concerned primarily with pollution hotspots where national objectives, set by the Air Quality Strategy (AQS) 2000 and subsequent regulations, are not likely to be met. These hotspots are referred to as Air Quality Management Areas (AQMAs). Local Authorities (LAs) under LAQM have an obligation to designate AQMAs and produce Air Quality Action Plans, detailing the measures to be taken to combat the exceedences and their timetable [4]. LAQM is a phased approach of review and assessment of air pollution, and is currently at the end of the second round. There has been extensive research on the different stages of the process and its possible drawbacks [1,12,13]; however there has been no investigation on the social implications of the strategies that stem from LAQM. The paper is dealing with the issues of social equity and environmental justice and presents initial results on the social status of the populations living within AQMAs.

The term environmental justice refers the equitable treatment of all people, regardless of race, culture, income, or social class, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies [2]. In the UK the literature on air quality and environmental justice is limited. But a number of studies have been conducted on air quality and social equity. They use a range of social indicators, and employ different geographical classification such as wards and LAs districts. It is therefore difficult to draw conclusion on environmental justice and social equity with such fragmented work [9]. On the other hand the literature in the USA is more extensive; the concept of environmental justice was born there as a response to concerns of an increased risk to exposure to pollution by disadvantaged groups of black and Latino origin [3]. There has been a significant amount of empirical research on the subject in the USA spanning three decades, and environmental justice has become a considered element of federal and state government decisions; however there does not appear to be a consensus on the definition or scope of environmental justice nor how it should be incorporated in policy and management decisions [2].

In the UK the issues coming under the auspices of environmental justice are not concerned largely with racial inequality as in the USA, but the disproportionate environmental pollution load placed upon populations that are poor or socially deprived. In this context incorporating environmental justice in policy decisions is a complex issue due to the different ways of assessing the level of poverty. Measuring poverty has been an ongoing task in the UK that was initiated in the nineteenth century; in recent years poverty measures are used for comparative studies, for setting poverty lines and subsequent welfare benefit entitlements and in a more conceptual level to understand how poor people perceive their environment and what they consider as necessities [7]. There is a plethora of approaches with which one can attend to address poverty issues. The majority of social research investigating poverty employs some sort of indicator or measure. Deprivation indices are used regularly to measure poverty; however
the nature and the content of such measures will quite often dictate and influence the outcomes of the research [11].

2 Social indicators

To assess the population within AQMAs, a measure of poverty is employed by overlaying it on the AQMA maps. The process by which poverty is measured is determined by the indicator type, that being objective, subjective, monetary or non-monetary. Objective indicators investigates the environment within which people live and work, and deals with aspects of life like health care provision, crime, education, leisure facilities and housing. On the other hand subjective indicators examine the ways people perceive and evaluate conditions around them. It becomes apparent that divergence between perceived and measured condition is not surprising [11]. Most social research is focusing on either objective or subjective measures; however there are no conclusive evidence, in terms of validity and reliability, of the superiority of one type of indicator over the other [11]. The specificity of an indicator however is ascertained by the scale of analysis and what elements are used to define the indicators such as unemployment, crime and health. Indicators related to education and labour market can be considered as determinants rather than indicators of poverty [5]. Research shows that available indicators on social relations are weakly related to poverty and are subject to cross-national variation [6]. A number of indicators could be used in this study which are based on different variables; these include the Townsend material score, the Jarman Underprivileged Area Score and the Index of Multiple Deprivation [7].

3 Methodology

The method of assessing social deprivation in pollution hotspots involves acquiring, manipulating and analysing AQMA maps. A Geographical Information System (GIS) is used to visualise social deprivation data within the boundaries of the AQMAs. The AQMAs maps are accessible electronically on the LAQM website (http://www.airquality.co.uk/archive/laqm/laqm.php) and also in LAs websites; paper copies are available at the Air Quality Management Resource Centre at the University of the West of England. The format of the maps does not allow their use in a GIS environment as they are photographs. In order to conduct the study the maps need to be in a GIS format like shapefile, DXF or MapInfo. These formats were requested directly by LAs declaring AQMAs. However not all LAs have GIS capabilities and only one third of LAs responded. The AQMAs that could not be obtained were digitised manually from paper copies, occasionally AQMA boundaries were hand drawn and hence difficult to digitise. The manual digitations are likely to introduce uncertainty due to the different scales of the maps. The procedure of digitisation involves downloading raster data (www.edina.ac.uk) at the same scale as the AQMAs maps and using Arcview 3.2 to digitise them. The use of specific scales ensures a more accurate reflection of the actual boundaries. This procedure is under way
and from approximately 125 AQMAs, declared on the first round of LAQM strategy, 30 AQMAs have been digitised and provide the results presented in section 4. However many LAs have declared more that one AQMA and are considered as one unit. In other words LAs have designated a number of areas within their geographical boundaries and are considered one as they are found in the same LA.

In terms of the social indicator employed, the IMD 2004 has proved a sufficiently detailed indicator that is available for the entirety of England and Wales. This index is based on a new geographical term called Super Output Areas (SOAs). These are built from groups of the 2001 Census Output Areas (OAs). The SOAs are chosen as an alternative standard unit to the electoral ward division that local statistical information is delivered. Specifically for England and Wales three layers of SOA have been created. The lower layer comprise a minimum population of 1000 with a mean 1500 and it is constructed from groups of OAs and constrained by the boundaries of the Standard Table wards used for 2001 Census outputs. This layer provides the smallest scale and hence more detailed information and is employed for the study. The middle layer comprise a minimum population of 5000 with a mean 7500, and the upper layer has yet to be determined but will comprise a minimum population size of 25,000 [10].

These lower layer SOAs however do not correspond to the boundaries of AQMAs unless LAs have declared the entire borough as an AQMA. The process of visualising these areas, is by aggregating SOAs that are included in the AQMAs. The SOAs falling under AQMAs areas were identified and their overall deprivation index was computed using Excel. Small AQMAs that are part of a single SOA are attributed the SOA score. In the case of small AQMAs covered by a small number of SOAs, they will be aggregated regardless if the cover a small part of an AQMA. The method of aggregating SOAs will be finalised when all AQMA are digitised and classified according to their shape, size and pollutant.

4 Results

The digitisation of AQMAs is ongoing; this process entails classifying AQMAs according to their shape, the pollutant and the areas they encompass; those being the entire borough, a road network, individual houses or a combination of different shapes (Table 1). A total of 30 LAs AQMAs have been examined, containing a total of 53 AQMAs. The classification shown in table 1 enables us to distinguish the shape of the AQMAs and subsequently the method of analysis. The AQMA that encompass the whole boroughs are the least complex as their boundaries are the administrative boundaries and hence are covered by a discrete number of SOAs. On the other hand “Road Network” AQMAs includes strips of motorways or road and no apparent residential areas. The lack of obvious residential areas is attributed to the scale of the available maps. It needs to be noted that AQMAs are declared when there is human exposure and the lack of residential areas is a GIS outcome. The AQMAs that are classified under
“Houses” are very small areas that include only residential buildings. The last two types create difficulties in measuring poverty. The classifications of “Roads & Houses” combine part of motorway and adjacent residential areas and “Other” refers to special areas such as railways and docks.

![Deprivation in SOAs and AQMAs in Derby](image)

Figure 1: Deprivation in SOAs and AQMAs in Derby; Areas 1, 2, 3 indicate the different AQMAs overlaid on map of SOAs.

Table 1: Current classification of AQMAs.

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<td>Houses</td>
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<tr>
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A total of 53 AQMAs have been examined.

The study of poverty in these areas is in progress and areas are analysed using the IMD 2004. An example is shown in figure 1. It is displaying the AQMAs overlaid on a map of Derby showing the IMD score in different SOAs within the LA. The deprivation score in the SOAs are classified in four bands: very high,
high, moderate, low and very low. This banding is arbitrary and was computed using the GIS software. The AQMA comprises three areas identified on the map. Area 1 has very low deprivation whereas area 2 and 3 are more difficult to distinguish as they go through several SOAs. Aggregating the values of the SOAs shows that area 2 is moderately deprived and area 3 is characterised by low deprivation.

5 Discussion

The investigation of the population status in AQMAs is still continuing. Several issues have been raised at this stage of the study. The first point is the diversity of the AQMAs; the classification presented in this paper only reflects the AQMAs that have been analysed. It is expected that it will change and a new classification will be created. The way the different AQMAs are analysed will depend on their classification. The problems of AQMAs that fall under the roads classification are, as illustrated in figure 1 (Area 2), that they cross several SOAs with different deprivation levels. At the same time the AQMAs that are classed as houses face similar drawbacks as LAs have identified in some cases individual residences and disclosing results for such AQMAs could present difficulties, as it will be identifying individuals. Other issues that need to be addressed is the aggregation of SOAs and whether the aggregation can be performed automatically in GIS and not manually as it was done for this paper. Another point to note is the need to establish the actual population within AQMAs as it is often not known.

Furthermore one needs to take into consideration the effects of aggregating deprivation data. There is a risk that the choice of scale can conceal the local situation as data are aggregated to represent national conditions. Regardless though of the scale, correlating social and environmental data will not necessarily reflect the life concerns of all individuals within the area. “The larger the unit of enquiry though the greater the potential ignorance of internal variations from the mean positions” [11]. An element affecting the scale of analysis is the existence of different social groups within a city and their potential grouping according to common interest such as estate residents [11]. An essential constituent of indicators is establishing a fault line, in other words a critical point that indicates when an individual can be considered poor or deprived [5]. The choice of that line is what will establish a particular group as socially deprived or not [11]. The arbitrary values chosen for the different bands of deprivation dictate whether AQMAs can be classified as deprived or not. This is an illustration of the issue of neutrality of GIS and the possibility of results being influenced by the methodology and possibly becoming politicised. There is always a risk that a chosen methodology will identify a community as being deprived or not deprived in order to influence subsequent decisions.

The IMD 2004 chosen as a poverty measure influences which are the deprived areas. The way that different indicators are aggregated to produce a measure of multidimensional poverty vary from simple addition of scores of indicators or domains to the calculation of weights for each domain/indicator [5].
IMD 2004 is a measure of multiple deprivation that consists of domains which contribute at different degrees in the overall score used in this paper. Regardless of how straightforward these methods are, they are still plagued with conceptual and methodological problems [5] and encompass several assumptions such as that indicators are perfect measures ignoring the presence of measurement error [5]. The indicator used in this paper is the most straightforward; however, there is also the possibility of creating indicators from census data specific to the artificial areas such as AQMA. This bottom-up approach will be explored in the future.

The necessity to incorporate social considerations in environmental policy stems from a need to safeguard sensitive communities that may lack the skills or political power to articulate the issues effectively. It becomes apparent that environmental justice is an ethical issue. In terms of air quality, a sophisticated management system exists that does not involve any mechanisms to ensure social equity in environmental decisions. In order to consider equity issues in the definition of AQMA, the underlying problems of environmental justice and air quality need to be addressed; primarily, we need to adopt an integrated transdisciplinary and intersectorial strategy that will involve several government departments in policy formulation, and central and local government departments on implementation. It will require improved communication with and between central and local government [1].

6 Conclusion

This paper introduced issues regarding the measurement of poverty in pollution hotspots. The methodological concerns when studying the relationship of social deprivation and the environment is scale discordance. This scale discordance refers to the available datasets and their corresponding geographical boundaries. Other methodological problems relate to the use of specific indicators, the choice of aggregated measures or specific domains. The lack of uniform methodology and empirical research stands out as an underlying problem where policy makers are unable to use the current research due to the absence of a conceptual model [11]. Also, there are gaps in our understanding of the relationship of people and the environment; scientists and professionals adopt a compartmentalized disciplinary focus and do not share definitions and interpretations but take on exclusive interpretations [8].

One of the challenges of the project is to be able to assess the social impacts of the LAQM process. The work presented forms the initial part of the overall project plan. The study is aiming to examine the mitigation strategies suggested through LAQM; compare air quality before and after implementation, identify the social attributes of the population and quantify distributional impacts of the strategies in a social context. The outcomes of the research will be to produce guidelines and recommendation for the Environment Agency and other government bodies on the minimisation of such impacts, and to contribute to the debate on the relationship between social deprivation and exposure to environmental pollution.
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References