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Addressing Environmental Inequalities: Flood Risk

Science Report: SC020061/SR1

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Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

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- **Delivering information, advice, tools and techniques**, by making appropriate products available to our policy and operations staff.



Steve Killeen

Head of Science

Executive Summary

Addressing environmental inequalities is a major theme of the UK Sustainable Development Strategy and one of the three principles of the Environment Agency's social policy. Understanding more about the inequalities which arise in exposure to flood risk and in the experience of flood events, and developing ways of addressing these inequalities, are important in managing the risk of flooding to people and communities.

Aims of the project

The main aims of this Environment Agency science project were to:

- help the Environment Agency understand the social impacts of flooding and the policy context for addressing them;
- examine how flood risk is distributed in relation to patterns of social deprivation in England;
- recommend the most effective ways of addressing inequalities in relation to flooding.

Methodology

A review of the literature on the social impacts of flooding and policy measures relevant to flood risk and environmental inequalities was undertaken. This was supported by a two-day interactive workshop held with stakeholders from within and outside the Environment Agency to discuss the social impacts of flooding. Finally, a GIS-based data analysis using the Environment Agency's Flood Map 2004 was carried out to examine the deprivation characteristics of populations living within and outside the delineated risk areas in England and the English regions.

Social impacts of flooding and their social differentiation

Flooding has a wide range of social impacts on:

- people's physical and psychological health;
- people's possessions and other economic assets;
- households and communities.

The social impacts of flooding vary with the nature and magnitude of the flood event. They may be difficult to delineate as they are interconnected, cumulative and often not quantifiable.

There is, as yet, no body of research that considers the social impacts of flooding on deprived communities in the UK. Existing research focuses on whether particular types of individuals and households are especially vulnerable. Though not all

vulnerable individuals and households are deprived, deprived neighbourhoods do contain concentrations of vulnerable individuals.

Levels of awareness of flood risk are low among those in the lower socio-economic groups. Residents in deprived neighbourhoods are therefore likely to be less well prepared to cope in the event of a flood and with its aftermath.

Health impacts of flooding will be more extensive in neighbourhoods already characterised by poor health. Those who suffer the greatest losses – often those on lower incomes and without insurance – may be most susceptible to psychological health effects and, by extension, physical health effects.

There is UK research which indicates that more deprived communities tend to have lower levels of social capital. Social capital refers to networks or connections among individuals, and the norms of reciprocity and trustworthiness that arise from them. International research concludes that places with low levels of social capital cope less well in the aftermath of flooding.

Overall, deprived neighbourhoods are likely to be particularly hard hit by the impacts of flooding. However, such neighbourhoods are not all the same and a number of factors will influence the degree of impact. Such factors include:

- local social relations
- ethnic and cultural make-up
- housing type
- age profile.

Some deprived neighbourhoods have developed local strategies to prepare for and cope with flooding.

Flood risk and deprivation: data analysis

As a whole, the results of the data analysis for England display broadly similar patterns to previous studies. For both forms of flooding combined and when sea flooding is considered separately, more deprived populations are more likely than less deprived populations to be living within zones at risk from flooding.

For river flooding and when considering England as a whole, the proportions of population at risk are approximately equal across the different deprivation bands. However, this masks considerable variability at a regional level.

Analysis of river flooding within the English Government Office regions shows different patterns between them. There are concentrations of the most deprived populations living at risk of river flooding in some regions and concentrations of the least deprived in others (reflecting the underlying highly uneven geography of deprivation). The proportional patterns within each region are also highly variable. For some regions, the most deprived populations are disproportionately found within

river flood risk zones while, in other regions, the least deprived populations are disproportionately found in river flood risk zones.

Analysis of sea flooding within the English regions shows that there are disproportionate concentrations of deprived populations in zones at risk from sea flooding across nearly all of the affected regions. This suggests that a common factor (or set of factors) may have influenced the development of areas near to the coast and along estuaries which has, over time, led to them being occupied predominantly by deprived populations.

The Environment Agency Flood Map does not yet consistently indicate the areas protected by flood defences. No account has therefore been taken of these areas in the data analysis.

Policy implications and recommendations

There are real and substantial challenges for flood risk management in the future in relation to:

- the social profile of those most vulnerable to flooding;
- the likely consequences of climate change on the frequency and nature of flooding and its impact on different social groups.

People already experiencing social and economic deprivation are a significant proportion of the total numbers currently at risk from flooding and, for sea flooding, they constitute the majority of those at risk in England. This alone indicates that flood risk management will need to be increasingly responsive to the social distribution and social impacts of flood risk.

The project has found evidence of inequality in the proportions of people living at different levels of deprivation within flood risk zones, but this does not necessarily imply an unjust or unfair situation. Stakeholders and policy-makers need to decide whether this inequality is unjust and respond accordingly.

Flood risk policy and management already seeks to take account of the social consequences of flooding through:

- differentiated approaches to communication;
- changes to risk assessment methodologies and flood defence appraisal criteria;
- aspects of flood resilience measures and land use planning.

Most are relatively recent developments and it is thus difficult to evaluate their significance.

This project makes the following recommendations:

1. Flood policy and management at all levels should continue to develop in ways that recognise the social impacts of flooding on different social groups. In

particular, significant attention needs to be given to understanding the implications of sea flooding in areas with large numbers of people experiencing multiple deprivation. In addition, the implications of climate change on flooding and its impacts on different social groups need to be considered carefully.

2. Interactions between processes of environmental, social and economic change and how these may increase vulnerabilities for particular parts of society in the future should be identified and policy implications considered.
3. The impact and significance of flood risk management policy measures and their effectiveness in taking account of social impacts and vulnerability should be monitored carefully.
4. Opportunities should be identified for tackling environmental and social issues together – building local capacity and tackling flood risk problems and social exclusion simultaneously.
5. As the Environment Agency Flood Map is refined, further analysis of the impacts of flooding on different social groups in areas protected by flood defences should be undertaken.
6. Targeted information and advice to vulnerable groups on flooding should be developed in collaboration with national/local agencies and organisations that work with particular social groups and have local knowledge.
7. Further research should be undertaken to understand:
 - how neighbourhoods are affected by flooding;
 - the experience of Flood Action Groups in different kinds of neighbourhoods;
 - the age and ethnicity dimensions of vulnerability;
 - differences in profiles of vulnerability between urban and rural areas;
 - case studies comparing different policy interventions to manage flood risk and their equity implications.

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1. Introduction

This is one of five reports produced as part of a research project commissioned by the Environment Agency on environmental inequalities in relation to flood risk, waste management, water quality and cumulative impacts. This report deals with environmental inequalities in flood risk.

There is, therefore, a general context for the project in addition to particular aspects of the policy and research context for environmental inequalities in relation to flood risk. This section outlines both the general and specific context for the project, sets out its overall objectives and indicates the methods used to achieve those objectives related to flood risk.

1.1 Context for the research project

The Environment Agency has a wide-ranging role in protecting and improving the environment in the context of achieving sustainable development. It is developing a strong social dimension to its work, recognising that social exclusion can have important environmental dimensions and that all people should have a right of access to a decent environment and to essential environmental resources.

The Environment Agency's social policy is defined through three principles:

- understanding and communicating the social impacts of its work, including opportunities to delivery combined environmental and social benefits;
- addressing environmental inequalities;
- transparency, participation and access to information.

It has also developed a social appraisal framework (Chalmers and Colvin, 2005), which subdivides its social policy into six themes:

- promoting health, safety and well-being;
- improving local communities;
- promoting social justice and social inclusion;
- demonstrating the Environment Agency's corporate social responsibility;
- increasing access to information and participation;
- capacity building and learning.

This project focuses on addressing environmental inequalities. This is one of the Environment Agency's three social policy principles and figures centrally in the promoting 'social justice and social inclusion' theme of its appraisal framework.

In a recent position statement, the Environment Agency makes it clear that tackling environmental inequalities and ensuring access for all people to a good quality environment is critical to sustainable development (Environment Agency 2004). The position statement sets out the role for the Environment Agency in this respect and calls for a series of policy solutions which include developing 'a better understanding of environmental inequalities and the most effective ways of addressing them'. This position statement builds on a programme of sustained attention to questions of environmental inequality and social justice within the Environment Agency over the past five years. This has involved working with and responding to the allied agendas of other organisations within and outside government.

Examples of the ways in which the wider political and policy context has evolved over this period include:

- the work of non-governmental organisations (NGOs) such as Friends of the Earth (FoE), which has identified environmental justice as a campaign and research theme, with FoE Scotland in particular making environmental justice an important part of its advocacy work (Dunion 2003);
- a series of pamphlets and publications produced by NGOs, consultancies and political groups highlighting the linkages between the current Labour Government's priorities on social exclusion and the social dimensions of environmental concerns (e.g. Boardman *et al.* 1999, Jacobs 1999, Foley 2004);
- speeches by major political figures such as Jack McConnell, Scotland's first Minister, who in 2002 stated 'For quality of life, closing the gap demands environmental justice too. That is why I said...that environment and social justice would be the themes driving our policies and priorities...' (McConnell 2002) and Tony Blair who argued in 2003 that 'by raising the standards of our local environments overall, we have the greatest impact on the poorest areas' (Blair 2003);
- programmes of work and reports by government departments and agencies exploring the connections between economic, social and environmental policy areas, e.g.
 - the Social Exclusion Unit work on transport and social exclusion (ODPM 2003a);
 - the Sustainable Development Commission (2002) vision focusing on the connections between regeneration, poverty and environment;
 - the Neighbourhood Renewal Unit (NRU) reports on environmental exclusion (Brook Lyndhurst 2004) and achieving environmental equity through neighbourhood renewal (ODPM 2003b);
- the 1998 Aarhus Convention (UNECE 1999), a pan-European treaty that aims to give substantive rights to all EU citizens on public access to environmental information, public participation in environmental decision-making and access to justice in environmental matters;

- the new national sustainable development strategy, *Securing the Future* (Defra 2005a), which aims to 'ensure a decent environment for all' has clear commitments to address and research environmental inequalities and to 'fairness' in the development of sustainable communities.

Within the Environment Agency, important indicators of policy evolution have included the debate on environmental equality at the 2000 Annual General Meeting and the reports, *Our Urban Future* (Environment Agency 2002a) and *The Urban Environment in England and Wales* (Environment Agency 2002b), which provided some initial analysis of relationships between environmental quality and social deprivation.

A research project undertaken by Staffordshire and Leeds universities for the Environment Agency (Walker *et al.* 2003) explored evidence of inequalities and acted as a stimulus for debate (Chalmers and Colvin 2005) in three major areas of its work – flooding, industrial pollution and air quality. The research provided a literature review, scoping and gap analysis of potential topics for investigation, drawing on the expertise of a range of stakeholders. It provided an empirical analysis of environmental data sets against the Index of Multiple Deprivation (IMD) at ward level (separately for England and Wales) (NAW 2000, ODPM 2004) identifying varied patterns of inequality. In developing policy and research recommendations for this work, the research team emphasised:

- the need for careful consideration of methodological issues;
- the limits on what the analysis could reasonably conclude;
- the need for further research, including in the area of cumulative impacts.

There is a growing body of related UK-based research examining questions of social distribution and environmental inequality. This was recently reviewed in a Sustainable Development Research Network (SDRN) rapid research and evidence review for the Department for Environment, Food and Rural Affairs (Defra) (Lucas *et al.* 2004). This review found that the research base is interdisciplinary in nature, drawing on a diverse range of quantitative and qualitative research methods and approaches. The available evidence suggests that patterns of environmental injustice are varied and complex and that there is, therefore, a need for some caution in making claims of inequality and to be wary of over-generalisation.

However, there is mounting evidence that:

- environmental injustice is a real and substantive problem within the UK;
- problems of environmental injustice afflict many of our most deprived communities and socially excluded groups;
- both poor local environmental quality and differential access to environmental goods and services have a detrimental effect on the quality of life experienced by members of those communities and groups;

- in some cases not only are deprived and excluded communities disproportionately exposed to an environmental risk, they are also disproportionately vulnerable to its effects;
- though more needs to be known about both the causes and impacts of environmental injustice, research is also needed to support the development and effective implementation of policy measures to address and ameliorate the impacts of environmental injustice.

This project will add to the research and evidence base that already exists in important areas of responsibility for the Environment Agency. It will build directly on previous research and contribute to the commitment to further research made in the Government's sustainable development strategy.

1.2 Overall objectives of the research project

The project aims to gain a better understanding of environmental inequalities and the most effective ways of addressing them. The project is divided into two parts.

Part 1 will:

- help the Environment Agency to understand the social impacts of waste management, flooding and water quality on deprived communities, and the policy context for addressing these;
- examine the social distribution of waste sites, areas at risk from flooding and river water quality, undertaking where possible analysis for both England as a whole and for each of the English regions;¹
- make recommendations for the most effective ways of addressing inequalities in relation to waste management, flooding and water quality, e.g. by identifying the policy interventions designed to address them with a range of stakeholders and evaluating their relative costs and benefits.

Part 2 will:

- help the Environment Agency to develop an initial understanding of the cumulative impacts of environmental issues in combination on deprived communities;
- identify ways of assessing the cumulative impacts of environmental inequalities, comparing their effectiveness;

¹ Wales is excluded from the analysis in this report as currently available deprivation data are structured differently. A separate report on environmental inequalities in Wales has been produced. (Walker et al 2006)

- scope and propose an approach to undertaking local case studies that will bring together understanding of cumulative environmental inequalities and ways of addressing them.

1.3 Context and objectives of the flood risk component

This report focuses on flood risk and is one dimension of Part 1 of the overall research project.

The assessment and management of flood risk is an important part of the Environment Agency's remit and operational function. Understanding more about the inequalities which arise in exposure to flood risk and in the experience of flood event impacts, and developing ways of addressing these inequalities, is thus particularly relevant to its evolving social policy.

As discussed in Section 6, there are various ways in which flood policy is, in general, becoming more sensitive to social issues and incorporating these into flood management priorities and activities. The evolving Defra *Making Space for Water* strategy (Defra 2004a, 2005b) aims to:

- take more account of environmental and social factors;
- develop a more holistic sustainable approach to flood management;
- focus attention on the most vulnerable communities.

The Foresight report, *Future Flooding* (DTI 2004), highlights the vulnerability of the socially disadvantaged, while procedures for assessing priorities for grant aid for flood protection and for assessing flood risk within Catchment Flood Management Plans now take account of population vulnerabilities. The Environment Agency Corporate Strategy states that it will develop a multi-criteria framework for assessing standards of flood defences that takes into account social and environmental issues. This project will inform such developments in policy and their further evolution.

The specific objectives of the flood risk work within the project are to:

- help the Environment Agency to understand the social impacts of flooding and the policy context for addressing these;
- examine the how flood risk is distributed in relation to patterns of social deprivation in England;
- make recommendations for the most effective ways of addressing inequalities in relation to flooding, e.g. by identifying the policy interventions designed to address them with a range of stakeholders and evaluating their relative costs and benefits.

1.4 Summary of methods

Three research methods have been applied to achieve the objectives related to flood risk. Each has produced different types of evidence and data of both a quantitative and qualitative form.

Review of the academic and policy literature

The review of the literature focused on the social impacts of flooding, and existing and potential future policy measures relevant to shaping and addressing environmental inequalities. Evidence from the literature is used throughout the report, which also highlights gaps in research.

Stakeholder workshop

A two-day interactive workshop was held in February 2005 with two sessions focusing on flooding issues.² The session outcomes are summarised together with presentation materials in Appendix 1.

Participants consisted of members of the project team, the project board, and other academics and stakeholders from within and outside of the Agency at national and regional levels. External stakeholders included representatives from:

- Defra
- FoE
- The National Flood Forum
- Office of Water Services (Ofwat)
- Collingwood Environmental Planning
- Health Protection Agency
- Flood Hazard Research Centre (FHRC), Middlesex University.

The purpose of the workshop was to draw on expertise from a range of stakeholders to help ensure that the review work was as complete as possible and to explore perspectives on and ideas for the future development of policy. The workshop was particularly important in discussing how the experience of flood impacts was differentiated in many varied ways at individual, household and community levels. The main themes and outcomes of the sessions were noted during the workshop and checked against recordings of discussion.

The workshop took place at an early stage in the project in order to shape and inform subsequent work, before the empirical data analysis had been carried out (see below). The participants did not therefore have an opportunity to review or respond to the empirical results. The outcomes of the workshop contributed particularly to

² The workshop was facilitated and documented by Malcolm Eames of the Policy Studies Institute and Karen Lucas of the University of Westminster.

informing the review and discussion in section 4 of the literature on the social impacts of flooding, to ensuring that section 6 on policy interventions captured the various ways in which policy related to inequalities and social factors, and to shaping aspects of the recommendations in section 7.

Data analysis

A geographical information system (GIS) based analysis was undertaken using the Environment Agency Flood Map 2005. The analysis examined the deprivation characteristics of populations living within and outside of the delineated risk areas.

The analysis was undertaken for England as a whole differentiating between river and sea flooding, and then separately for each of the English standard Government Office regions. The analysis did not include sewer flooding, which is a serious potential problem in some areas and is not covered by the Flood Map.

Section 5.2 contains a detailed discussion of the methodology used in this data analysis.

2 Definitions and concepts

This section defines and discusses a number of terms and concepts central to the research undertaken in this project. The need to be explicit about meanings and to distinguish between different but related concepts is particularly important in this relatively new and undeveloped area of policy and research.

2.1 Environmental justice

Like many others, environmental justice is a term open to varying definition and interpretation. Agyeman and Evans (2004) described it as a 'vocabulary for political opportunity', providing a means of highlighting questions of distribution and procedural fairness across a wide range of environmental policy domains (Stephens *et al.* 2001, Lucas *et al.* 2004).

Environmental justice has evolved over a 20-year period. It originated in protests against the siting of toxic facilities in minority communities in the USA, becoming part of the 'vocabulary' of environmental debate in the UK only over the past four or five years.

Environmental justice is generally defined in normative terms, specifying a set of conditions or expectations which should be aspired to, sought after or demanded. Two definitions provide examples.

The US Environmental Protection Agency (USEPA 1998) 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. Fair treatment means that no group of people, including a racial, ethnic, or a socio-economic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that: (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in the decision making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected.'

The Scottish Executive (2005) defines environmental justice through two statements:

'The first is that deprived communities, which may be more vulnerable to the pressures of poor environmental conditions, should not bear a disproportionate burden of negative environmental impacts.

The second is that all communities should have access to the information and to the means to participate in decisions which affect the quality of their local environment.'

Environmental justice has also been conceived in terms of rights and responsibilities. For example, Stephens *et al.* (2001) identify two key assertions of environmental justice as:

'that everyone should have the right and be able to live in a healthy environment, with access to enough environmental resources for a healthy life'

'that responsibilities are on this current generation to ensure a healthy environment exists for future generations, and on countries, organisations and individuals in this generation to ensure that development does not create environmental problems or distribute environmental resources in ways which damage other peoples health'

A number of different elements or interrelated component parts of environmental justice can be identified from the range of definitions that exist.

- **Distributive justice** is concerned with how environmental 'goods' (e.g. access to green space) and environmental 'bads' (e.g. pollution and risk) are distributed among different groups and the fairness or equity of this distribution (see discussion below).
- **Procedural justice** is concerned with the fairness or equity of access to environmental decision-making processes and to rights and recourse in environmental law.
- **Policy justice** is concerned with the principles and outcomes of environmental policy decisions and how these affect different social groups.
- **Intranational justice** is concerned with how these distributions and processes are experienced and operate within a country.
- **International justice** extends the breadth of concerns to include international and global issues such as climate change.
- **Intergenerational justice** encompasses issues of fairness and responsibility between generations, such as emerge in debates over the protection of biodiversity.

Though some people may recognise all of these component parts within their working definition or framing of environmental justice, others may take a more restricted or focused view. For example, much of the US literature on environmental justice has been concerned primarily with intranational distributive justice, while a recently formed NGO, the Coalition on Access to Justice for the Environment (CAJE) (CAJE 2004) in the UK is focusing primarily on issues of procedural justice.

There are also differences in the extent to which environmental justice is seen as only encompassing core environmental issues or extends – within a broader sustainability perspective – to include quality of life and social issues which have environmental dimensions to them (e.g. fuel poverty or access to transport) (Lucas *et al.* 2004).

While this project focuses on three core environmental topics (waste, water quality and flooding), the case for taking a broader perspective within the work on cumulative environmental impacts is also considered. Although the report primarily examines questions of intranational distribution (within the review work on social impacts and the data analysis), questions of procedure are also raised at various points and connections with wider international issues are identified.

2.2 Environmental inequality

Environmental inequality – the key term used in this project – is in effect a step back from, or component part of, environmental justice.

Inequality is a descriptive term. To observe or claim an environmental inequality is to point out that an aspect of the environment is distributed unevenly amongst different social groups (differentiated by social class, ethnicity, gender, age, location, etc.).

There can be different degrees of inequality depending upon how skewed an environmental parameter is towards or away from the social groups of concern. In addition, this can encompass:

- negative aspects of the environment such as exposure to pollution;
- positive aspects such as access to green space;
- procedural aspects such as access to information or decision-making processes.

However, the crucial point is that an inequality is different to an injustice or inequity. It does not necessarily follow that, because a distribution of an environmental good or bad is unequal, it is also unjust or inequitable. An evaluation or judgement has to be made to progress from inequality to injustice and, as theories of justice make clear, substantially different perspectives can be taken (Young 1994, Liu 2001).

Factors that may be relevant in considering the case for an environmental injustice include:

- the degree of inequality that exists;
- the degree to which individuals have been able to exercise choice in their exposure to an environmental good or bad;
- whether or not an inequality has been created through the exercising of power by a public or private body (e.g. in taking facility siting or flood protection decisions);
- whether or not a pattern of inequality is combined with other patterns of inequality (an accumulation of unequal impacts), or with a greater degree of vulnerability or need amongst a social group, when compared to others;
- the degree to which those exposed to an impact or risk also have a role (direct or indirect) in, or benefit from, its creation.

2.3 Social impact

This project uses the term 'social impact' to consider the nature of the relationship between particular aspects of the environment and associated environmental management activities and the impacts these have on humans.

Current definitions of social impact suggest that the concept should be understood in the broadest terms. For example, the International Association for Impact Assessment (IAIA) takes the term to cover:

'all impacts on humans and on all the ways in which people and communities interact with their socio-cultural, economic and biophysical surroundings' (IAIA 2003, p.2).

US guidelines for social impact assessment provide a similarly broad definition:

'By social impacts we mean the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values and beliefs that guide and rationalize their cognition of themselves and their society' (The Interorganizational Committee on Principles and Guidelines for Social Impact Assessment 2003, p.231)

These definitions highlight the need to go beyond narrow understandings of social impacts as measurable effects upon individuals. Data about social impacts may not be available in a quantifiable form (e.g. information about changes to patterns of social interaction or culture) and consideration should be given to effects upon

households and communities as well as individuals. Social impacts may also be direct or indirect, immediate or long term, and both positive and negative in character.

The Environment Agency's policy appraisal framework (Warburton *et al.* 2005) adopts a broad view of the types of social impacts which need to be included in policy appraisal and is in line with the approach taken in this report.

3 Environmental justice and flood risk: review of literature

This section reviews environmental justice literature that has particularly focused on flood risk. Attention is given to research concerned explicitly with analysing the social distribution of exposure to flood risk.

As emphasised in Section 4, there is a substantial body of research on the social dimensions of vulnerability (a term and framing widely used in work on natural hazards) which indicates that poor people tend to be disproportionately affected by 'natural' disasters (Benson, *et al.* 2001). In addition, experience and qualitative studies suggest that in poor countries the poorest groups tend to be those who are disproportionately exposed to the whole range of natural hazards, as they have least choice about where to live and often eke out a living in hazardous areas (Heijmans 2001). This literature has, however, been almost entirely separate from the literature concerned with environmental justice.

This is particularly the case in the USA where environmental justice research and campaigning have been concerned predominantly with the social distribution of risks of technological origins (air quality, hazardous wastes, industrial pollution) rather than those related to 'natural' processes. Part of the explanation for this may be the very politicised drivers for environmental justice campaigning in the USA, which seeks to attribute fault in decision-making processes for the siting of sources of technological risk such as waste facilities and in the priorities given to clean-up activities. There is clearly a more purposeful creation of risk involved when this is of a technological rather than 'natural' origin, in which the responsibilities and motives of developers, operators, planners and regulators may be questioned and critiqued. Whilst there are still important institutional dimensions to the spatial patterning and severity of flood risk and vulnerability (for example related to decisions about flood protection investment or preparedness and emergency planning) the processes through which this source of risk may be seen as institutionally imposed on some people rather than others, are less explicit and substantial in their effect.

It is at the international level that claims that flooding may be an example of environmental injustice are most familiar. Adopting a global perspective on environmental inequality draws attention to the fact that the populations of poor countries are those who often bear the brunt of climate related issues which are the consequence of the burning of fossil fuels in industrial societies (Boyle and Anderson, 1996; Christian Aid 2006). Discussion of intranational justice, in terms of who is exposed to floods and how different social groups are affected, has recently increased following media coverage of Hurricane Katrina which provided dramatic illustrations of the ways in which the poorest and most vulnerable in society are often hardest hit by the impacts of flooding.

In the UK, which has taken a broader and more inclusive approach to environmental justice than the US, the social distribution of flood risk has been analysed in two recent pieces of research funded by the Environment Agency. Both studies were concerned with examining the socio-spatial distribution of flood hazard in relation to deprivation and/or social class.

Walker *et al.* (2003) found different relationships for tidal and fluvial flooding when they used the Indicative Floodplain Map to define areas at risk in England and Wales and Census ward level data to define patterns of deprivation. When both types of floodplains were combined, a general relationship with deprivation was observed. Of the population living in a floodplain, 13.5 per cent were in the most deprived decile compared with 6.1 per cent in the least deprived decile.

However, when tidal and fluvial flooding were examined separately, this overall relationship was dominated by the tidal floodplain populations. Of the population living within the tidal floodplain for England, 18.4 per cent were in the most deprived decile compared with only 2.2 per cent in the least deprived; the proportion of the population in the floodplain in the most deprived decile was eight times that of the least deprived decile. In contrast, for the fluvial floodplain, there was an inverse relationship with deprivation, although of much lesser strength, with a higher proportion of the floodplain population in the more affluent compared with the more deprived deciles. For Wales, this research found that the pattern of social distribution was less distinct but showed some similarities to England.

The research team surmised that the results for the fluvial floodplain populations probably reflected the fact that much of the floodplain area is rural rather than urban in character and that rural wards are generally more affluent than urban wards. In addition, riverside locations often have a premium value in terms of property prices – although this local social patterning is unlikely to be picked up in ward level data – and may serve, on the ground, to further accentuate the proportion of the better-off population living within fluvial floodplains. The strong relationship between deprivation and location in tidal floodplains for England (weaker for Wales) was less expected and an explanation harder to hypothesise. However, a brief regional analysis highlighted the size of the population at risk in London and the Thames Estuary. Of the 747,000 estimated people living within the tidal floodplain in the most deprived 20 per cent of wards, 438,000 (59 per cent) were found to be in the Environment Agency's Thames Region, followed by the North East Region at 134,000 (18 per cent) and the Anglian Region at 117,000 (16 per cent).

Fielding *et al.* (2005a) examined the distribution of flood hazard (fluvial and tidal combined) against social class for England. Using a grid method to distribute the population within a Census enumeration district area, they found that:

- those people at significantly increased risk are the lower social classes (Class 3 and 4 at 9 per cent increased risk) and the unemployed (3.4 per cent increased risk);

- those in Class 1 and 2 have a significantly lower risk of flooding (8.5 per cent decreased risk).

This research thus produced similar results to Walker *et al.* (2003) for the combined fluvial and tidal floodplain. The results of further data analysis discussed in Section 5 provide a further development that combines inputs from those involved in both previous pieces of research.

Whilst the extent of literature explicitly concerned with environmental justice and flooding is limited, some of the wider preoccupations of the environmental justice field and the issues it has had to contend with can be usefully discussed in the context of flood risk.

First, there have been significant methodological difficulties for environmental justice studies in establishing the nature and extent of impacts, or cause-effect relationships between environmental features (such as an industrial site producing pollution) and people (Liu 2001, Mitchell and Walker 2006). Simplistic studies which for example take populations that live within the wards, district or zip codes that a source of pollution is located in, and assume that these people experience impacts from the emitted pollution, have been robustly criticised for their lack of concern about the spatial geography of pollution impacts compared to population zone size and shape (Bowen 2002). Other research has adopted alternative methodologies – for example drawing buffers of different sizes around pollution sources to identify potentially affected populations – but there are still significant limitations related to site and pollution variability, pathways and dose-response relationships which need to be recognised when considering claims of bias in population exposure.

In the case of flooding the availability of flood maps which identify areas at risk from flooding (in the UK related to estimated flood return periods) do to some degree provide a much better quality of spatial delimitation of area of potential impact, than is typically available in environmental justice studies. The difference between the detailed mapping used in the studies for the Environment Agency discussed above (and in this report) and the methodological alternative of assuming that all people living within a certain distance from a river or coastline could be flooded, brings home the need for and advantage of having good quality flood risk maps. However, even so there are limitations to these maps in that flood zones are based on estimates using modelling and historical data, their resolution means that very localised topographical variations may not be recognised and they do not deal well with flood defences (see later discussion). In addition the maps only show tidal and main river flood areas and do not include areas potentially at-risk from secondary river sources or from storm drains. As with all spatial studies relating environmental and social data, it is therefore necessary to be fully aware of methodological limitations and evaluate results with this in mind.

Second, there have been a range of questions revolving around the basis on which claims of injustice may be made and evidence used to substantiate such claims. As emphasised in the last section there is a difference between the descriptive sense of inequality and the normative sense of injustice. The types of issues which become

relevant in considering questions of justice, as identified, for example, by Walker *et al.* (2003) include:

- the extent and nature of the social distribution of benefits that may compensate for potential adverse effects;
- the relationship between environmental impacts and continuing and inherent patterns of residential segregation;
- the extent to which informed choice has been exercised by people in choosing where to live;
- the extent to which discriminatory decision processes can be identified which have resulted in some social groups experiencing more impacts than others

For flood risk each of these questions is relevant to evaluating evidence of inequality. If people can be said to have exercised 'free choice' in the housing market fully informed of flood risk implications, then arguably there is no injustice in any bias towards particular social groups in the profile of who is and is not living at risk. However, if there is evidence that there have been biases in the decision making processes which lead to well-off areas being better protected by flood defences than deprived areas, then an injustice may be claimed. These questions are returned to in section 7 when policy implications and recommendations are discussed.

As outlined in section 2, environmental justice has been conceived in terms of both rights and responsibilities. The preceding discussion focuses on the rights dimension in relation to flooding, but issues of responsibility are also relevant. The Environment Agency's use of the slogan 'Flooding: You can't prevent it. You can prepare for it' (Environment Agency 2006) draws attention to the ways in which members of the population living in areas at flood risk can take action to prepare for flooding and to mitigate its impacts. Responsibilities (from the individual to the international level) are also clear in terms of adopting practices and policies which aim to minimise climate change.

4 The social impacts of flooding and their social differentiation

4.1 Conceptualising the social impacts of flooding

As discussed earlier, social impact needs to be cast in the broadest terms for the purposes of this project. In the case of flooding, the notion of a 'social impact' can be misleading as it suggests that social effects follow automatically from environmental change. Flood events have both direct and indirect impacts (e.g. damage to property from flood water and the effects on psychological health of losses sustained), while the impacts experienced vary over time (flood event, aftermath, living with flood risk).

The impacts associated with flooding vary with the nature of the flood event. As pointed out by Handmer *et al.* (1999, p.126), the term flooding covers events from 'barely noticeable to catastrophes of diluvian proportions'.

Research by the Flood Hazard Research Centre at Middlesex University (Tapsell *et al.* 1999) established that the impacts of any flood event vary depending on:

- the rarity of the event;
- the presence or lack of warnings;
- speed of flood;
- when the flood occurs (night /holiday period);
- duration of flood;
- depth and temperature of water;
- the presence of contaminants in the water.

How individuals experience the impact will also vary depending on their levels of awareness of the risk of flooding and preparedness for a flood event, and the existence or lack of coping strategies.

Few (2003, p.44) notes that:

'Flooding is something of a catch-all term, referring to events of varying magnitude with different causes. A typology of flooding can comprise overflow of rivers produced by prolonged seasonal rainfall, rainstorms, snowmelt, and dam-breaks, accumulation of rainwater in low-lying areas with high water tables or inadequate storm drainage, and intrusion of seawater on to land during cyclonic/tidal surges (Handmer *et al.* 1999).'

The Environment Agency categorises floods in terms of whether they are fluvial or tidal, or the result of sewer flooding (this is not its responsibility). For those experiencing flooding, it is not yet clear whether the source of the flooding has any effect upon the impact experienced.

For this reason, no distinction will be made between these different sources of flooding in the following consideration of the particular social impacts associated with flooding.

Although tidal flooding is uncommon in the UK and therefore relatively low in the risk-awareness of coastal residents, however, the potential impacts of a serious tidal flood are both considerable and life-threatening (Baxter *et al.* 2002).

4.2 Differential experiences of the social impacts of flooding

There are three ways in which it is possible to consider whether groups within the population are differentially affected by flood risk and the experience of flooding.

1. The **social distribution of flood risk**: are certain groups disproportionately exposed to the risk of flooding? This issue was discussed in Section 3 and is addressed further in Section 5.
2. The **social distribution of awareness of flood risk**: awareness of flood risk has been shown to be a major factor informing preparedness and likelihood of taking effective action in the event of a flood (Fielding *et al.* 2005b). If lack of awareness of flood risk is treated as an indicator of vulnerability to flooding, then the following groups are particularly vulnerable:
 - those who have recently moved into a floodplain;
 - people renting;
 - people in socio-economic groups C2, D and E;
 - people aged below 35 and over 55.
3. The **social distribution of ability to cope** in the event of flooding and during its aftermath. This final way of thinking about possible social differentiation on the distribution of flood risk is the focus of this section.

The issue of whether the impacts of floods are experienced differentially depending upon individual and household characteristics is relatively well researched.

There is a body of literature that examines variance in vulnerability to flooding (see Thrush *et al.* 2005a for a review). In their account of natural hazards and disaster in the third world, Blaikie *et al.* (1994, p.9) offer a relatively simple working definition of vulnerability:

'By vulnerability we mean the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society'.

Certain of these factors are demographic, e.g. age, gender, race and ethnicity, class and caste (see Perry and Lindell 1991, O'Brien and Mileti 1992, Blaikie *et al.* 1994, Enarson and Morrow 1998, Wisner *et al.* 2003). Other factors (also fundamental in understanding the causes of human vulnerability) include insufficient access to resources, information and knowledge, and a lack of political power and representation – all of which will, in their turn, be influenced by the factors mentioned above (Blaikie *et al.* 1994, Cutter *et al.* 2003, Wisner *et al.* 2003).

For many years, researchers (e.g. White and Haas 1975; Cova and Church 1997, Cutter *et al.* 2000, Enarson and Fordham 2001, Cutter *et al.* 2003) noted that vulnerability to natural hazard is affected by social and political decisions concerning housing:

- population density;
- urban development;
- racial or ethnic bias reflected in 'redlining neighbourhoods';
- economic barriers to safe housing.

In a paper setting out new approaches in the area of emergency planning, Buckle *et al.* (2000) remind us that vulnerability is also dynamic – varying not only within categories but over time and according to the characteristics and circumstances of the individual.

It is, of course, a truism to say that these populations do not represent homogeneous groups. Each one, though unified by its principal descriptor (gender, race, etc.), will contain a wide and disparate range of other characteristics. Minority ethnic groups within the UK alone will include Indians, Pakistanis, Bangladeshis, Africans, Afro-Caribbeans, Chinese and Vietnamese with attendant differences in culture, religion and language (Petts and Leach, 2000). The disaster research literature applies the 'older people' category to people aged 55 and over, yet not all will fit the stereotypical picture of the frail and impoverished older person. Chronological age does not, in itself, engender vulnerability but interacts with many other factors, e.g. pre-existing health and fitness, mobility, income and family support. Levels of disability and impairment will vary considerably, as will the amount of social and financial support available to a sick or disabled person. All these and other variations will impact differentially on levels of vulnerability, and many of them are likely to change with time.

The unit of analysis in assessments of vulnerability also needs to be considered. Just as groups are heterogeneous, so too are households. Most people will experience and respond to a hazard event as a member of households (Morrow 1999), yet not

all members of the household will experience it in the same way, e.g. women and children will often bear the brunt of the hazard experience. The findings below should therefore be interpreted in the light of these comments.

Buckle *et al.* (2000) are critical of 'simple typologies' of vulnerability that ignore these temporal, spatial and socio-economic factors. They favour instead 'a framework which includes multiple levels of social life'. They also stress the need to consider the wider community and environment since damage to infrastructure, services or economy is likely to increase the vulnerability of its members.

Vulnerability to hazard is embedded within the resistance and resilience of at-risk populations. It is a compound phenomenon in which multiple factors coexist, intensifying the hazard experience by impacting negatively on the capacity of the community (and the individual) for recovery and ability to resist its negative effects (Brown and Damery 2002).

Community networks and relationships, if disrupted, will adversely affect coping and support systems on both a community and a personal level (Buckle *et al.* 2000). In turn, the community's vulnerability or resilience to hazard will be affected by the attitudes and values of its members (King and MacGregor 2000). Post-disaster changes (damage to homes, livelihoods, social networks) as well as changes in the economic, environmental or social climate may therefore generate new conditions of vulnerability.

It becomes clear that vulnerability is a multi-faceted, complex and dynamic concept, not determined simply by personal and demographic characteristics but also by social, political, cultural and economic conditions. However, it is difficult to find research evidence of the ways in which these kinds of variables actually influence the experience of the impacts of flooding in England and Wales. The majority of research has focused upon how floods affect individuals and households, and has not considered how different kinds of places may be differentially affected.

An important point here is that vulnerability **may**, but does not necessarily, equate with social deprivation. The IMD 2004 (ODPM 2004) includes indicators of household income, health and housing quality. Thus, deprived communities can be expected to contain concentrations of vulnerable households; however, not all vulnerable individuals are located within deprived neighbourhoods.

The particular economic, social, cultural and political characteristics of places might be expected to influence how flooding is experienced there and what happens as a result. Research in developing countries concludes that poorer communities and those with lower levels of social capital are hit harder by flooding than their more affluent and better-integrated counterparts.

For instance, Pelling (1997) found that the neighbourhoods most vulnerable to flooding in Georgetown, Guyana, were those where household incomes were low, housing quality was poor and levels of community organisation low. Similarly, Maskrey (1999) concludes that a community's capacity to recover is partly

determined by the resistance of their infrastructures, economic capacity and levels of social cohesion. A number of commentators note that social capital is critical among these factors in fostering coping strategies at various phases of the hazard cycle (Pelling 1998, Cannon 2000, Sanderson 2000, Wong and Zhao 2001).

However, there is little research from which to draw firm conclusions about the effect of these factors in England and Wales. It is known that there is a relationship between levels of deprivation and social capital, though this is not entirely straightforward. Recent research by the Office for National Statistics (ONS) has revealed that people in the most deprived wards are considerably less likely to be trusting of their neighbours than those in the least deprived wards (40 per cent trusted most or many of their neighbours in the most deprived wards compared with 73 per cent in the least deprived) (Coulthard *et al.* 2002). They are also less likely to feel that neighbours looked out for each other or to have done or received a favour from a neighbour. However, people in the most deprived wards were more likely to speak to their neighbours daily (33 per cent compared with 19 per cent in the least deprived wards) and there was little variation with respect to deprivation in the likelihood of people knowing their neighbours. Thus while more deprived communities might be expected to also lack the characteristics of social organisation and integration that increase resilience to flooding and ability to cope in the aftermath, one should be wary of assuming that levels of deprivation map simply onto levels of social capital.

The following sections deal with the various social impacts of floods. They describe the impact and consider ways in which groups within the population and different kinds of neighbourhood may be differentially affected by flood risk and the experience of flooding.

Although the impact of flooding has been broken down into discrete categories (economic impacts, health impacts, etc.), it is important to note the extent to which the impacts are interconnected and cumulative. For example, the experience of the loss of valued possessions and disruption to the household may have effects on psychological health. Health impacts in turn may have economic consequences if they render an individual unable to work. A study of the 1998 Easter floods in the Thames region concluded that the cumulative effects affected people's physical, mental and social well-being (Tapsell *et al.* 1999). These intangible effects of flooding – including stress, anxiety and ill health – are complex and result from a combination of interdependent factors.

4.2.1 Economic impacts

For individuals, the most obvious financial impact relates to damage and loss to property and its contents sustained by the flood event. All or some of these losses may be covered by insurance.

Following a flood, there is a variety of expenditure associated with living in temporary accommodation and/or making the home habitable again. This again may, or may not, be covered by insurance and can include:

- the cost of temporary accommodation;
- meals out;
- increased electricity bills for drying out homes;
- prescription charges (should ill-health follow the flood).

Potential effects on house prices and the ability to sell property form a longer-term economic impact for home owners.

The financial impact of flooding will vary depending upon whether people have adequate insurance to cover their losses. Whyley *et al.* (1998) found that one in five households do not have home contents insurance. Uninsured households were disproportionately likely to have low incomes, few savings and to be facing financial difficulties. Most were tenants living in disadvantaged urban neighbourhoods. One in seven had lost possessions through theft, fire or flood, and either been unable to replace them or else compelled to borrow within their families or from the Social Fund.

Research by the Association of British Insurers (ABI) found that 50 per cent of households in the lowest income decile do not have contents insurance – often because other household costs leave no margin for ‘voluntary’ charges such as insurance premiums. (ABI 2002) Under-insurance can pose particular problems where households lack adequate cover yet are judged ineligible for hardship funds by virtue of the fact that they have some insurance (Ketteridge and Fordham 1998).

Members of some minority ethnic groups may be particularly likely to lack adequate insurance. For instance, Tapsell *et al.* (1999) found that the Asian community in Banbury had lower incomes and less insurance cover than their white neighbours and found it hard to understand the insurance system. Areas with high crime rates (which are likely to correlate with areas classified as deprived) will have high insurance premiums, making insurance even more likely to be unaffordable for residents (Ketteridge and Fordham 1998).

Those on low incomes are likely to find it hard to cover the incidental expenses associated with evacuation and temporary accommodation (restaurant meals, accommodation costs, etc.). Green (1993) describes financial resources acting as a ‘buffer’ to flood impacts, and suggest that those without such a buffer will be hit harder by the various impacts of flooding.

Business owners are affected economically if their premises are flooded (loss of stock, damage to property and furnishings, lost days trading). Employees may suffer if they lose days at work, either because business premises are flooded or because they are unable to attend work if their home has been flooded. People employed in unstable, low income jobs are those most likely to lose their jobs should businesses close or move. Low paid ‘home work’ is particularly severely affected if the worker’s home is flooded (Morrow 1999).

The effect on small businesses

'In Carlisle, there is an industrial area called the Willowholme Estate where approximately 50 small businesses are situated. It was totally devastated by the floods with water up to 3 metres deep. Many businesses lost everything. Some businesses have now moved out permanently and there is a fear that the number of businesses left will not be sustainable, i.e. for Carlisle City Council to service the infrastructure, insurance problems, dereliction and vandalism, etc. Carlisle City Council is working hard to assure businesses that this won't be the case.'

Environment Agency representative – Project Workshop

Products are now available which can be installed in advance of flooding and, dependent upon the type of flood, may help protect the home (Environment Agency 2005) These include:

- 'flood boards'
- air brick covers
- pump systems and back-flow return valves
- plastic skirts to surround the property
- temporary free-standing barriers that can help protect a group of properties.

Although the use of such products may offer some protection to both the property and its contents for floods of up to 900 mm, the cost is expensive in the short term.

It is difficult to generalise about the cost of protecting properties from flood water as this will vary considerably according to the source of flooding and its severity in terms of depth, flow and duration as well as type of property and local topography. Prevention measures start at around £12 for two airbrick covers but costs quickly mount. One company offering flood protection products estimated that the DIY solution would cost approximately £1,000 to protect two doors and several airbricks. Others suggested that costs may at least double should non-return valves, sumps and pumps, and isolation membranes be installed. Such an outlay is prohibitive for those on lower incomes (Morrow 1999). The Association of British Insurers suggests that the use of 'accredited products, flood resilient materials and temporary defences to defend the property in locations where the risk of flooding is unacceptably high ... might make the property insurable in some form' (<http://www.abi.org.uk/>).

If poorer people are unable to afford any protective measures, they are thus not only more vulnerable to future flood events but are unlikely to be able to obtain insurance cover even if they could afford it.

Mitigation measures

'There is anecdotal evidence from water companies that homeowners are reluctant to accept mitigation measures for sewer flooding because it advertises that the property floods.'

Workshop participants – Project Workshop

Households living in basement flats, single storey dwellings and caravans suffer greater economic losses as a result of flooding (Green and Penning-Rowse 1989). Older people are particularly likely to live in bungalows, ground floor flats and mobile homes. A number of studies (reviewed by Ngo 2001) suggest that older people perceive their losses to be greater than those of the population around them, whether or not they are.

There is little available research on how neighbourhoods in England and Wales are affected economically by flood events and the risk of flooding. Possible impacts include effects on the local economy when businesses move out of the area and the possibility that a locality may become poorer after a flood event. Anecdotal evidence suggests that this may be the case. People who are able to move away have the choice of doing so, resulting in a potential decline in house prices – all of which may lead to a less affluent population moving in to the neighbourhood. Those who are unable to move (e.g. older people or those who cannot afford to absorb a loss in property value) are left behind, resulting in a less affluent population with concomitant impacts on local shops and businesses. In addition, more affluent neighbourhoods tend to be better resourced to campaign for flood defences which both protect their homes from flooding and protect their insurance status, thereby protecting property prices.

4.2.2 Non-economic losses

Qualitative research with flood victims recurrently documents the significance of losing items of sentimental value:

'Loss of treasured items in floods can be 'heartbreaking', and much more significant than financial losses, which are now commonly recovered through household insurance policies' (Penning-Rowse and Green 2000 cited in Tapsell *et al.* 2002, p.1511).

'... possessions within the home can assume considerable significance to people as attachment objects, helping to mark important events and experiences in people's lives, define who they are and who they care the most about' (Csikszentmihalyi and Rochberg-Halton 1981 cited in Tapsell *et al.* 1999, p.50).

While the flood protection products described above offer one way of protecting household contents, there are other strategies available to some households. For

example, the Environment Agency recommends moving possessions upstairs. But this is not a measure available to all (e.g. those living in bungalows, basement flats or caravans) and may also prove difficult for those who are frail or disabled.

Qualitative research suggests that older people may be the most affected by the loss of memorabilia collected over a lifetime (Tapsell *et al.* 1999, Thrush *et al.* 2005b); simply in terms of the extent of loss – as they are likely to have accumulated more, they also stand to lose more. They are also over-represented among residents of bungalows, ground floor flats and mobile homes – all property types that tend to involve a greater degree of damage to possessions due to a shortage of dry storage space (Ketteridge and Fordham 1998, Tapsell *et al.* 1999).

4.2.3 Impacts on physical health

Included among the main health consequences of flood are deaths by drowning (Hajat *et al.* 2003); flood disasters worldwide since 1900 have resulted in at least 6.8 million reported deaths (Few *et al.* 2004). In addition people may be killed by ‘hypothermia, electrocution, burns, carbon monoxide poisoning (associated with the use of petrol powered electric generators and pressure washers in poorly ventilated areas indoors)’ (Ohl and Tapsell 2000, p.1167).

US research indicates that those aged over 60 have the highest death rates of any age group during disasters (Ngo 2001). Of the four deaths attributed to the storms in northern England in January 2005, two were elderly women who died in flooded properties in Carlisle and another was a 63-year-old man crushed after a barn collapsed on his caravan in Cumbria (the fourth death is subject to an inquest to determine cause and may yet prove not to have been associated with flooding). Families of deceased older people sometimes feel that deaths have been hastened by flood experience, whether or not these deaths are directly attributable to flooding (Tapsell *et al.* 1999, Thrush *et al.* 2005b).

Flooding can have both short- and longer-term impacts on physical health. In the short-term, individuals may be injured during the flood event and:

‘... are more likely to present to acute medical care facilities for skin rashes and exacerbation of asthma and for outpatient medical needs, such as dialysis or refills of prescriptions or oxygen. Although some clusters of cases of gastroenteritis and respiratory infection have been attributed to flooding in the developed world, they are usually minor, seen in low numbers and often ascribed to increased crowding among people who have been displaced. Epidemics are not expected, but people are often still extremely concerned about the possibility of contracting an infectious disease from flood waters or from property damaged by floods, and false rumours of outbreaks often circulate within communities’ (Ohl and Tapsell 2000, p.1167).

Research in Banbury and Kidlington following flooding in 1998 found that a major health concern was the effect of possible contaminants in flood water and the concomitant risks to health from sewage particularly for young children (Tapsell *et al.* 1999). A recent survey conducted for Ofwat also found that the majority of

respondents affected by sewer flooding were very concerned about the health implications associated with effluent entering their homes (Ofwat 2004). There is epidemiological evidence that chemical material may contaminate homes after flooding, but less evidence that this has a clear causal effect on the patterns of morbidity and mortality following a flood (Euripidou and Murray 2004).

Research by the FHRC on the health effects associated with flooding in north east England in 2000 found that, three to four months after the flood, flood-affected residents reported a range of health effects associated with the trauma of flooding and with living for long periods in damp and dirty conditions. Many were concerned about health risks from 'streets not being cleaned following the flooding (particularly where children were playing in these environments) ... associated with these concerns was the fear of rats, and the danger to health and diseases that they may carry' (Tapsell *et al.* 2002, p.1517).

It would be interesting to know whether the speed and efficiency of street cleaning following a flood varies with indicators of neighbourhood affluence. It is possible that well-resourced local authorities in relatively affluent areas might be able to offer a swifter and more thorough service than those serving poorer neighbourhoods. Indeed, an earlier study in this same area by Tapsell and Tunstall (2001) found that a lack of available resources was highlighted by the Chief Executive of a small district council as hindering an effective response. Residents also expressed concerns about contaminated buildings and possessions, and the lateness of advice on how to deal with contaminated possessions.

The effect of flooding on health varies by pre-existing health status as well as by age (Tapsell *et al.* 2002, RPA 2004). Older people, for example, are more adversely affected by the cold, damp conditions caused by flooding (Tapsell *et al.* 2002); those most likely to be affected are infirm older people and people aged 75 years or more (Tapsell *et al.* 1999, Tapsell and Tunstall 2001).

There is also a gender dimension to the health impact of floods as women tend to carry the physical and emotional burden of caring for sick household members (Tapsell *et al.* 1999), as well as experiencing particular physical and psychological flood-related health problems themselves (Tapsell and Tunstall 2001, Tapsell *et al.* 2003, RPA 2004). Women are also over-represented in the 75+ age group, which is often those hardest hit by health impacts (see Tapsell and Tunstall 2001).

Research also suggests that levels of social support are important in mediating health effects (Green *et al.* 1985, Tapsell *et al.* 1999). If social capital is taken to be a good indicator of levels of social support, then negative health impacts would be expected to be more apparent in more deprived neighbourhoods. As outlined above, however, it is necessary to be cautious about assuming that there is straightforward relationship between levels of social capital and deprivation. Family ties may be particularly strong in deprived neighbourhoods and these may well provide the most direct means of social support after a flood event.

There are relatively few data on the longer-term impacts of flooding on physical health (Baxter *et al.* 2002, Few *et al.* 2004). Two early studies of health effects following flood events found medium-term increases in hospital and clinic visits. In the first, a study of the health impacts of the Bristol floods of 1968, Bennet (1970) found that 'the number of clinic visits, hospital admissions, and deaths from all causes was greater in the year after the flood among those who had been affected by flooding than among those who had not'. Heightened psychological stress was thought to have played a part in the increase in visits (Ohl and Tapsell 2000, p.1167). In the second, an Australian study following Brisbane floods in 1974, increased rates of hospital and primary care attendance were apparent approximately one year later amongst flooded individuals (Abrahams *et al.* 1976); here again it was suggested that psychological distress may be implicated.

A recent survey of Lewes residents following the floods of October 2000 found that flooded individuals were more likely than non-flooded individuals to report incidences of earache, gastroenteritis and skin rash during the nine months after the event (Reacher *et al.* 2004). This study also supports the view that physical illness following flooding may be partly explained by psychological distress. Although findings suggest that adverse physical health effects generally recede within weeks or months after a flood event (Tapsell *et al.* 2003, RPA 2004), a four-year follow-up study examining the longer term health effects of flooding in Banbury and Kidlington showed that significant psychological health effects can persist over many years (Tapsell *et al.* 2003). These and other findings lend support to the body of existing literature on the links between the stress of exposure to natural hazard and negative health impacts, psychological as well as physical.

4.2.4 Impacts on psychological health

Victims of flooding often describe the event as traumatic, resulting in a range of psychological health effects that include panic attacks, agoraphobia, depression, tiredness, stresses and anxiety (Tapsell *et al.* 1999, Hajat *et al.* 2003, Few *et al.* 2004, Thrush *et al.* 2005b). In addition, both doctors and patients emphasise interactions between the psychological and physical health impacts of floods, with stress being blamed for a range of physical symptoms (Tapsell *et al.* 2002, p.1517). In their study of Lewes residents, Reacher *et al.* (2004) state that 'the most striking result ... was the scale of psychological distress experienced by flooded adults' (p.6).

Emotional trauma is associated not only with the flood event but with the process of evacuation and recovery. Making repairs, cleaning up, and dealing with builders and insurance claims have all been reported as being stressful (Ohl and Tapsell 2000, Thrush *et al.* 2005b). Where sewage effluent has been a factor in the flood event, people tend to find the recovery process particularly difficult emotionally (Ofwat 2004, Thrush *et al.* 2005). Research with people affected by floods in 2000 found that three to four months after the event:

'Many people in the focus groups were displaying symptoms of impaired mental health such as those related to adjustment disorder (Rick *et al.* 1998). These symptoms included avoidance of talking or thinking about the flooding, flashbacks, sleep disorders and depression. Only a few people in the north-

eastern England focus groups felt that they were now 'over' the flood, and these tended to be the men rather than women' (Tapsell *et al.* 2002, p.1518).

Furthermore, being evacuated from home and losing personal possessions may undermine people's sense of place as well as their sense of attachment and self-identity (Fullilove 1996). In the longer term, recognising the risk of recurring flood and the realisation of the potential financial impacts of the situation may also affect mental health.

The stress associated with the experience of flooding may have an impact on personal relationships. In their research following the 2000 floods, Tapsell *et al.* (2002) found that participants in focus groups mentioned relationship problems in their households and in the community due to the stress of the flood and the recovery process. Ketteridge and Fordham (1998, p127) also point to the fact that 'flood events can put a significant strain on personal relationships and can even trigger separations'. Research conducted after the 1997 Grand Forks flood in the USA found that community professionals observed an increase in domestic violence during the aftermath of the flood (Clemens and Hietala 1999).

Focus group research with flood victims has found that participants express concern and anxiety during heavy rainfall following the experience of being flooded (Tapsell *et al.* 2002, Thrush *et al.* 2005b). Although anxiety is clearly a negative impact, changes in flood awareness that result in better preparation against possible future flood events may be viewed positively. Indeed analysis of survey data collected for the Environment Agency reveals that experience of flooding was the most significant factor affecting levels of awareness and preparedness to take action on receiving a flood warning (Fielding *et al.* 2005b).

The stresses associated with losses sustained during the flood event and the disruption of the recovery process might be expected to affect people differently depending upon individual characteristics and household circumstances. It is reasonable to expect that those who suffer the greatest losses and inconvenience – often those on lower incomes and without insurance – may be most susceptible to adverse psychological health effects. It has been suggested that women take longer to 'get over' flooding than men and that lone mothers face particular pressures having to cope single-handedly with children and the trauma of flooding (Green *et al.* 1987). Although older people have many of the characteristics that might increase psychological vulnerability (fewer resources, living alone, reduced social networks, etc.), their life experiences can also act as mechanisms to reduce rather than exacerbate psychological distress after a disaster (e.g. Ngo 2001).

4.2.5 Impacts associated with evacuation and temporary accommodation

This somewhat broad category of impact covers the variety of ways in which people may be affected differentially by having to leave their home and live in temporary accommodation.

Level of preparedness for a flood event will have some bearing upon the experience of evacuation. Those who are prepared for an evacuation and have collected the necessary personal effects will have an easier time than those who have not made such contingency plans. People who have recently moved into a floodplain, people in rented accommodation and people in socio-economic groups C2, D and E are known to have low levels of awareness of flood risk and preparedness for flood event (Fielding et al 2005b).

There is much research to demonstrate that many older people have a disproportionate vulnerability to the effect of disasters, with those who are frail or disabled being particularly at risk (see Tapsell *et al.* 1999, Tapsell *et al.* 2002). As already noted, however, some older people display a greater psychological resilience than their younger counterparts (Tunstall and Parker 1999, Ngo 2001, Tapsell *et al.* 2003, Thrush *et al.* 2005b). Many older people may find evacuation by boat difficult and experience problems in emergency rest centres, especially if they are reliant on specific medication (Ketteridge and Fordham 1998) or have disabilities. People with disabilities (not just older people) may not be able to find suitably adapted temporary accommodation, and so face particular inconvenience and hardship. For those living in bungalows, ground floor flats or mobile homes, the period in temporary accommodation may be extended owing to the degree of property damage and, as noted above, older people are over-represented among residents of these types of property.

Members of minority ethnic groups may face difficulties in understanding warnings and receiving advice or support. In addition, their particular cultural needs are sometimes not catered for in evacuation centres. A study of the impacts of flood on an Asian community in Banbury (Tapsell *et al.* 1999) found that adverse effects were exacerbated by several factors including language and economic difficulties, and a lack of knowledge of the system for protection and recovery. On the other hand, some minority ethnic communities appear to have stronger and more highly organised networks for the dissemination of information.

Once again, women have been identified as bearing the brunt of this impact of flooding. They are most likely to be the adult who stays in the temporary accommodation during the day while men go back to work. Responsibility falls on them to cope with the stress of the flood and with their children's anxieties and distress (Ketteridge and Fordham 1998). These authors also suggest that parents are often so involved with managing the crisis that they can sometimes overlook how their children are being affected. The impacts of evacuation and temporary accommodation on children deserve further research.

As noted above, financial resources buffer the impacts of floods. This is particularly true if there is a need to move into temporary accommodation. People with insurance cover are able to go to good hotels, whereas those with none have sometimes been sent to low standard hotels used for housing homeless families (Ketteridge and Fordham 1998). People on low incomes and without insurance also find the incidental expenses associated with temporary accommodation (travel, subsistence, etc.) hard to meet.

Community characteristics may inform how residents of a particular area are affected by evacuation. Ketteridge and Fordham (1998) point to the ways in which relations between local people and the emergency services and local authorities can affect the way in which people respond to an order to evacuate and how smoothly the evacuation proceeds.

International research has concluded that wealthier, organised communities are better placed to cope with natural hazards than those that are poor or less well-organised. However, 'intense social capital can be a double-edged sword for disaster management: It can foster greater co-operation through exploitation of pre-existing networks, but it can also lead to greater conflict in decision-making as a result of flatter social structure' (Buckland and Rahman 1999, pp.186–187).

Evacuation

'Some councils have evacuation databases on who to evacuate first.'

'Tracking the location of evacuees can be problematic as local authorities have varied methods for this, e.g. Bewdley keeps a list of vulnerable residents.'

'Can be difficulties in people getting to work and school if evacuated at a distance.'

'It's an isolating experience if few other households are affected – there's a lack of understanding and support.'

'Moving people into temporary accommodation can disrupt social networks – cohesive communities recover more quickly.'

Participants at Project Workshop

4.2.6 Household disruption

Various studies show that the general disruption of the home and household caused by flooding is ranked by flood victims as the most important impact (Tapsell *et al.* 1999, Tapsell and Tunstall 2001, McCarthy 2004). Such disruption includes:

- the practical inconveniences and stresses associated with living away from home should temporary accommodation be necessary after flooding;
- the tasks of moving heavy furniture, cleaning, repairing and replacing property;
- living in a damp and dirty environment;
- dealing with insurers and builders.

In a recent quantitative study of the health impacts of flooding (RPA 2004), problems associated with settling flood damage claims emerged as the most significant factor

in increasing negative health effects. Difficulties in dealing with builders also had a significant effect, as did the length of time taken in 'getting back to normal'.

Flood victims often report that their homes will never feel the same again (Tapsell *et al.* 1999, Tapsell and Tunstall 2001, McCarthy 2004). This relates to losing a sense of security and identity as much as to the loss of specific items. As already noted, losing personal possessions, particularly those of sentimental value, has been shown to be one of the most devastating aspects of flooding for many people (e.g. Tapsell and Tunstall 2001, Thrush *et al.* 2005b).

It is women who bear the major responsibility for getting the home 'back to normal' and who have less chance to 'escape' the post-event disruption by going to work. Those who do work, however, often face the double burden of managing both a job and the task of putting their home to rights. As women also tend to have more investment in the sense of 'home', they are likely to suffer more when it is disrupted. Women are more involved in the work of recovery, obtaining relief and 'rebuilding' the home, yet have to deal with male-dominated authorities and institutions that are not always sympathetic to their needs (Enarson 2000); single women were found to be particularly disadvantaged in this regard (Tapsell and Tunstall 2001, Tapsell *et al.* 2002). Even UK emergency services (again male-dominated) have not always been found to have treated women flood victims with sympathy and understanding (Fordham and Ketteridge 1998; Tapsell *et al.* 1999).

Though all of this can be hard and stressful, research indicates that for some women there are positive impacts associated with tackling the challenge of putting their home back together. They may become more assertive and develop new skills as they learn to fight the 'system' and gain the results they want from insurers and builders. (Ketteridge and Fordham 1998). Conversely, men may feel inadequate and 'helpless' in the face of disruption at home (Tapsell *et al.* 1999; Thrush *et al.* 2005b).

The level of disruption faced varies with type of property and type of tenure. Those in single storey properties suffer more disruption, longer periods of evacuation and a greater loss of sentimental items (Tapsell *et al.* 1999). It has also been suggested that the impact of disruption is worse for people who own their home and furnishings than for renters who have less investment (both material and emotional) in their home (Tapsell *et al.* 1999). Those without a home face particular problems as they may lose all their possessions and face greater competition after flooding for available housing.

Characteristics of flood event

'Speed of the event is so important – slow rising catchments allow for more community active response/preparedness. With fast rising catchments, a far more limited community response is possible.'

Participants at Project Workshop

4.2.7 Community and neighbourhood changes

There are, as yet, little empirical data on community and neighbourhood changes after flooding. Experience, as well as recent research findings (Tapsell and Tunstall 2001) indicate, however, that impacts might include:

- population change
- closure of businesses
- alterations in levels and perceptions of social capital.

It is difficult to find any data that provide concrete evidence of population changes within England and Wales, but it seems likely that areas affected by flooding may experience population change. In the short term, changes occur as people are evacuated from flooded homes and may not return for weeks or months. In the longer term, more lasting population changes may involve those who have the wherewithal to move (this may include absorbing a possible drop in property value as well as the associated costs of moving home) leaving behind those who are unable to do so, e.g. older or poorer residents and local authority or housing association tenants.

In cases where people have left a flood-affected area, remaining residents sometimes express a fear of 'undesirable' people moving in, particularly where council or housing association properties are concerned (Tapsell and Tunstall 2001).

Such changes may have an impact on both social capital and community stability as indicated in a study of two communities in north east England (Tapsell and Tunstall 2001). It is also possible that population change may affect the local economy where those moving into the area less affluent than those who had left it. While it is not possible to find research that provides evidence of these effects, discussion with stakeholders at the Environmental Inequalities workshop in February 2005 revealed that their experience strongly supported these ideas.

Population change

'Older people who are frail tend to stay out of the area after a flood. Is this the same for disabled people and those with long-term illnesses? Does this impact on the social mix in these areas?'

'Closure of shops within areas may have an impact on non-car owners who tend to be concentrated in lower income groups.'

'Social capital as measured by some indices of deprivation suggest that this is lower in deprived areas. But are those indicators really useful for understanding "neighbourliness" in a crisis?'

Participants at Project Workshop

It is clear that, in the short term, floods disrupt local businesses, services and infrastructure. However, the longer-term effects are less clear. Anecdotal evidence suggests that some businesses close after flooding and this may then have wider impacts on the character of the neighbourhood. Small businesses are likely to be hit harder than their larger counterparts as they are less likely to have adequate insurance, business continuity plans and computer protection. However, it should be acknowledged that some local, small businesses profit from a flood event, e.g. those providing building, decorating or furnishing services.

The experience of flooding may have both positive and negative impacts upon social relationships within a locality. Several studies report an initial sense of community spirit, cohesiveness and solidarity after flooding (Ketteridge and Fordham 1998, Tapsell *et al.* 1999, Tapsell *et al.* 2002, Thrush *et al.* 2005). These same studies, however, also note the emergence of new divisions and conflicts which often revolve around the issue of perceived differences in the treatment of flood victims.

The provision of flood relief assistance poses particular problems (Tapsell and Tunstall 2001). For example, those who have paid for insurance cover may be angered by charitable payouts to those who did not finance their own insurance (Tapsell and Tunstall 2001) and home owners and private tenants sometimes feel that council tenants and people on social security receive more assistance from the local authority than they do themselves. Ketteridge and Fordham (1998) suggest that:

‘The greatest obstacles to community recovery from flood and evacuation are the divisions they produce. These divisions occur when householders become aware of the differential treatment received, often as a result of the very systems set up with the intention of helping the community’ (Ketteridge and Fordham 1998, p.136).

Trust in the Environment Agency, emergency services and local authorities may be affected positively or negatively depending on local perceptions of the adequacy of warnings, evacuation procedures and support during the recovery process. In Banbury and Kidlington, Tapsell *et al.* (1999) found that ‘since the flood, virtually all of the flood victims interviewed stated that they now had no confidence in their local authorities’ (p.38). This finding is echoed in the study of communities in the north east of England by Tapsell and Tunstall (2001).

However, the Stockbridge Pathfinder project illustrates how, through the process of bringing together key stakeholders to co-ordinate flood response and recovery: ‘high level of trust started to be built between the residents themselves, between agencies solving problems together and between agencies and residents ... It also enabled a productive relationship between the Environment Agency ... and residents to start planning for improved flood defences’ (Wilkinson *et al.* 2004, p.15).

The shared sense of anger and strong desire not to be flooded again, which often follow a flood event, provide the basic conditions for the formation of local flood action groups (National Flood Forum representative at workshop). The development

of a strong Flood Action Group (FAG) may play a major role in community recovery after a flood and in ensuring that residents are well informed and prepared for future flood events, as well as in campaigning for flood protection measures. In addition, participation in action groups, although resource intensive, can be personally rewarding and contribute to a sense of social solidarity.

As with other kinds of voluntary participation, however, it may well be that middle and upper class adults are more likely to participate in FAGs than those in lower classes and are those most likely to mount effective campaigns (Finsterbusch 1980, Freudenberg and Olsen 1983). Deprived communities are more likely to lack the time, money, contacts and experience which participation demands and which aid successful group activity. This suggests another way in which deprived communities may be harder hit by flood events; they may be less well equipped than more affluent neighbourhoods to campaign for flood protection measures. This might constitute procedural injustice.

Recent research for the Environment Agency that aimed to provide a better understanding of Special Interest Groups (SIGs) (non-governmental, non profit-making interest groups with a special interest in areas or issues in which the Environment Agency is involved) noted the importance of not equating a lack of local activity with a lack of local concern. Barnett *et al.* (2004) found that:

'SIGs themselves tended not to equate lack of public involvement with lack of public concern. They noted that often people affected by various environmental 'bads' are poorer people who have more immediate day-to-day concerns and do not have the time or the energy to devote to campaigning ... SIGs also noted that people often do not express concern as they feel they are powerless to affect decisions and outcomes. This is a position well supported in the literature on political participation' (Barnett *et al.* 2004, p.40).

Further research is needed in order to explore the experience of FAGs in different kinds of neighbourhoods and to examine issues such as:

- the conditions under which successful groups are formed;
- what constitutes success;
- who participates in these groups;
- the personal and wider social costs and benefits of participation.

Who is active in Flood Action Groups?

'FAGs are more or less invisible unless they have the energy and resources to put together a website. This restricts the groups that even we can find. It doesn't mean that more informal, and possibly working class groups don't spring up in response to local flooding.

Yes, the running of a campaigning flood group is mostly an educated middle-class occupation. Presumably this is at least partly because owner-occupiers have the most at stake in these circumstances. (Does being an owner-occupier necessarily

make you middle-class?). There are two or three groups that I would represent as being in working class areas.

Leaders are normally in their 40s or 50s and in work. They include journalists, teachers and lecturers, a designer, the owner of a horticultural nursery, a personal assistant, a self-employed floor tiler, an aerial archaeologist, a Baptist minister, a restaurant owner, a caterer, a publisher, a dentist, a transport manager and the director of an IT business.'

National Flood Forum Representative – Project Workshop

4.3 Conclusions

Any discussion of the ways in which the social impacts of flooding may be experienced differentially must begin with acknowledgement of the fact that impacts vary with the nature and magnitude of the flood event. In addition, impacts may be difficult to delineate as they are interconnected, cumulative and often not quantifiable. However, past research allows some conclusions to be drawn about the differential experience of flood impacts. Table 4.1 below summarises the evidence presented above.

There is not, as yet, a body of research that specifically considers the impacts of flooding on deprived communities in England and Wales. Existing research on the experience of flooding has focused on the issue of whether particular kinds of individuals and households are especially vulnerable in the face of a flood event and its aftermath. While it is important to emphasise that not all vulnerable individuals and households are deprived, it is nonetheless true that deprived neighbourhoods contain concentrations of vulnerable individuals. Thus, the findings of existing work on vulnerable groups can be used to piece together an understanding of the ways in which deprived neighbourhoods are likely to be affected by flooding.

Recent research for the Environment Agency (Fielding *et al.* 2005b) has demonstrated that levels of awareness of flood risk are low among those in the lower socio-economic groups. Levels of awareness of flood risk would therefore be expected to be lower in deprived neighbourhoods than in their more affluent counterparts and thus residents would be less well prepared to cope in the event of a flood and its aftermath.

Should floods occur in neighbourhoods where household incomes are low and levels of unemployment are high, a high proportion of the flooded population would be expected to be particularly hard hit. To some extent, the impact of flooding is buffered by financial resources, and an insufficiency or lack of insurance has been found to heighten the adverse effects of flooding (Fordham and Ketteridge 1995). Those on low incomes are likely to find it hard to cover the incidental expense associated with evacuation and temporary accommodation, and people employed in unstable, low income jobs are those most likely to lose their jobs if businesses close or move.

Table 4.1 Differential experience of the social impacts of floods

Social impacts	Evidence of differential effect depending on individual, household or neighbourhood characteristics
Economic impacts	Ethnicity, age, income and property type all have a bearing on the experience of economic impacts.
Non-economic losses	Age and property type inform the perception of, and extent of, this impact.
Physical health	Pre-existing health status, age and gender all have a bearing on the experience of health impacts.
Psychological health	Gender, age, social class and household composition all have a bearing on the experience of psychological health impacts.
Evacuation and temporary accommodation	Age, gender and income are relevant to understanding how this phase affects people. Levels of social capital are likely to be important in understanding community response and resilience.
Household disruption	Gender, ethnicity, age, property type and tenure type all influence how individuals and households are affected.
Community and neighbourhood changes	No research evidence, but suggestion that deprived neighbourhoods and those with low levels of social capital will be particularly hard hit.

The IMD 2004 (ODPM 2004) includes consideration of health data. Extensive research on inequalities in health has established that deprivation and high levels of morbidity and mortality go hand in hand. Research shows that the impact of flooding on health varies with pre-existing health status; it might thus be expected that the health impacts associated with flooding will be more extensive in neighbourhoods characterised by poor health.

There are important interactions between the psychological and physical health impacts of floods, with stress being blamed for a range of physical symptoms. It is reasonable to expect that those who suffer the greatest losses and inconvenience (often those on lower incomes and without insurance) may be most susceptible to psychological health effects and, by extension, physical health effects.

Social relations within localities are likely to have an important bearing on neighbourhood resilience to natural hazards. There is UK research which indicates that more deprived communities tend to have lower levels of social capital, and international research that concludes that places with low levels of social capital cope less well in the aftermath of flooding. There has not, however, been any research specifically on the relationship between levels of deprivation, levels of social capital and community resilience to flood event in England and Wales, and this remains an important area for future research. Possible demographic and community changes following flood events are another area where research is needed. It seems likely that neighbourhoods will be differentially affected depending on their economic characteristics, but there is no firm evidence of this.

In conclusion, there is evidence to suggest that deprived neighbourhoods are likely to be particularly hard hit by the social impacts associated with flooding. It is important, however, to emphasise that deprived neighbourhoods are not all the same. Some of the dimensions of difference that may influence how they are impacted by flooding include:

- local social relations
- relationships with emergency services
- ethnic and cultural make up
- type of housing
- age profile of residents.

Some neighbourhoods which would be classified as deprived have developed local strategies and organisations to cope with the aftermath of flooding and preparation for future flood events. One example is Skinningrove, a small coastal village in north east England. In collaboration with the Environment Agency, residents there have been proactive in successfully developing a flood plan and flood warden scheme. Their experiences have now been recorded in a video, which is used by the Environment Agency to raise awareness in other flood risk areas.

It is also crucial not to forget that vulnerable people do not all live in deprived communities. Not all poor people will live in poor neighbourhoods, and research indicates that the experience of rural poverty is particularly isolating (Cloke *et al.* 1995). In addition.

vulnerable people are not necessarily poor; vulnerabilities associated with age, gender and disability do not simply map onto measures of socio-economic status.

5 Flood risk and deprivation

5.1 Introduction

This section discusses the methodology and results of a quantitative GIS-based analysis of the relationship between flood risk and multiple deprivation in England. This analysis seeks to reveal whether or not some parts of the population living at different levels of deprivation are more exposed to flood risk than others.

As discussed in Section 3, two previous studies have examined the relationship between exposure to flood risk and deprivation. These both made use of the Indicative Floodplain Map (IFM) produced by the Environment Agency to identify areas in England and Wales at risk from river and sea floods. In 2004, the Environment Agency produced a new Flood Map, which improved upon the IFM by providing more accurate and consistent information on flood risk and defining flood zones at different levels of risk.

The analysis discussed below makes use of the new Flood Map, along with an analytical methodology which identifies patterns of deprivation and household location with a better spatial resolution than available in previous research. It also provides a breakdown of results by Government Office regions of England so that patterns of relationship across and within regions can be considered.

In the sections presenting results, the question being addressed in each part of the analysis is first specified to add clarity and to distinguish, in particular, between different ways of considering regional data.

5.2 Methodology

General methodological issues for environmental justice research were reviewed by Mitchell and Walker (2003) as part of a previous project for the Environment Agency. This section discusses the datasets and analytical methods used to relate flood risk zones to deprivation data in this project.

5.2.1 Population and deprivation datasets

The spatial unit of analysis used for population and deprivation is the Super Output Area (SOA) (Lower Level), of which there are 32,482 in England. SOAs are aggregations of 2001 Census Output Areas and are designed to be the core geography for small area statistics. Because SOAs are designed to contain roughly equal populations (approximately 1,500 people), their physical size is density dependent – with small SOAs in urban centres and large SOAs in rural areas.

Deprivation was represented using the English IMD 2004 (OPDM 2004), which is based on seven separate domains:

- income deprivation
- employment deprivation

- health deprivation and disability
- education, skills and training deprivation
- barriers to housing and services
- living environment deprivation
- crime.

Each domain score is produced from a total of 37 indicators, with the majority relating to 2001 data. For each SOA, a score is produced for each indicator and then each domain. Individual domain scores are then weighted and summed to create the overall IMD score for the SOA. This IMD score forms the basis for a final ranking of SOAs.

The living environment domain of the IMD required further investigation because there could be potential for auto-correlation within the environmental equity analysis. This domain is made up of two sub-domains – the ‘indoors’ living environment and the ‘outdoors’ living environment. The ‘outdoors’ living environment sub-domain accounts for one-third of the overall domain score and is made up of an air quality score and a road traffic accidents score. For the purpose of this study, there is no expected link between air quality and flooding or between road traffic accidents and flooding. Thus, there is no expected danger of auto-correlation in the analysis.

In some cases the use of the overall IMD can lead to a slightly confusing picture of deprivation. For example the ‘barriers to housing and services’ domain, tends to vary inversely with the other 6 domains of the IMD (these 6 are on the whole strongly positively correlated with each other). The barriers domain is important, in that it particularly tends to pick out more rural areas, where deprivation may not be well represented by other domains. Given this, and the extent to which flood risk and impacts might differ between urban and rural areas, the analysis could be slightly clouded by the nature of the overall IMD measure.

Given the nature of the IMD, deprivation data in this project are consistently presented in the form of deprivation deciles, which maintain the ranked ordinal form of the data. A detailed explanation of the construction of these deciles is given in Section 5.2.3.

To improve the spatial resolution of the analysis, the study used Ordnance Survey’s Address-Point®, a spatial dataset which records every residence (postal delivery address) in England (<http://www.ordnancesurvey.co.uk/oswebsite/products/addresspoint/>). This point dataset gives approximately 98 per cent of locations to 1-metre accuracy (estimated by an interrogation of the dataset’s positional quality indicator). These data were used to locate residential address locations within a SOA that contained population. Locations were deemed residential if they were ‘non PO Box and did not have an organisation name’ and, in addition, if they were not classified as demolished.

5.2.2 Flooding data

The Flood Map produced by the Environment Agency and released in October 2004 was used to relate flood hazard risk to SOA deprivation data. The Flood Map contains flood zones developed primarily for use in land use planning (DTLR 2001). These flood zones are based on the annual probabilities of flooding (Table 5.1).

This study used flood zones 2 and 3 to differentiate between different levels of risk (note that in the data provided and the analysis undertaken all of the population in zone 3 is also in included zone 2).

Table 5.1 Flood zones

Zone	Level of risk	Annual probability of flooding
1	Little or none	<0.1 per cent (1 in 1000 year floods) from rivers and the sea
2	Low to medium	>0.1 (1 in 1000 year floods) from rivers >0.1 (1 in 1000 year floods) from the sea
3	High	≥1.0 per cent from rivers ≥0.5 per cent from the sea

The main limitation of the Flood Map is that no account is taken of flood defences or man-made structures such as bridges, culverts and rail and motorway embankments. Thus, it gives a worst-case view of the potential risk from flooding. Although there is an additional dataset that shows flood zones which benefit from flood defences, this currently accounts only for defences built in the last five years plus a few selected others. It has therefore not been used in this study.

The methods used in this study combine SOA populations with residential address location to ensure that only the population in an SOA that is also within a flood zone is counted within the analysis. Many SOAs have rivers running through their area but no people resident within flood zone itself, particularly in rural SOAs. The results reported show the percentage of population for each deprivation decile that lives within flood zones. The method is described in detail in Section 5.2.3.

A further generic limitation of the Flood Map is that it treats the risk within each of the zones as homogenous whereas, in reality, it will be differentiated and much higher in some parts of the zone than others. This is an intrinsic feature of any mapping of risk zones and can only be addressed through more differentiated and precise mapping, which is unavailable at a national scale.

It is also important to note that the Flood Map does not provide an indicator of risk to health or mortality, or of levels of damage to property. Rather, it provides an indicator of the likelihood of a flood event taking place regardless of its level of impact.

5.2.3 Creation of SOA deprivation deciles

For the purpose of this study, the population of England was divided into ten groups containing equal populations; these are known as deciles.

In order to create SOA deciles, the overall IMD 2004 rank was used to place each SOA into a decile of equal population (see Table 5.2). Deciles of equal population are preferred to those of equal data zone count as the analysis then gives a population-based distribution, which is more meaningful for equity-based studies.

In all cases, decile 1 is the most deprived and decile 10 is the least deprived. Essentially, decile 1 has the largest concentration of deprived people and decile 10 the smallest concentration.

Shorthand terminology is often used to refer to population-weighted deprivation deciles of this form, but it is important to remember their precise definition. This definition means that decile 1 is not ‘the poorest 10 per cent of the population’, as some of the poorest people will live in pockets within less deprived SOAs. Nor is it ‘the 10 per cent most deprived SOAs’, as a population weighting has been applied.

The population within a SOA and within a decile will vary in their characteristics. The IMD provides a statistical measure for a group of people rather than a precise measure for every individual. This is a well-known limitation of area-based studies. It is referred to as the ‘ecological fallacy’ and requires a caveat to be placed on any area-based analysis. However, the smaller population of SOAs will have helped to lessen this problem compared with a ward level analysis.

Table 5.2 Population-weighted deprivation deciles for SOAs in England

Decile	Population	SOA count	Rank	
			From	To
1	4,934,430	3,247	1	3,247
2	4,934,780	3,253	3,248	6,500
3	4,934,250	3,261	6,501	9,761
4	4,934,910	3,262	9,762	13,023
5	4,935,060	3,259	13,024	16,282
6	4,933,820	3,255	16,283	19,537
7	4,935,180	3,237	19,538	22,774
8	4,933,430	3,234	22,775	26,008
9	4,935,160	3,229	26,009	29,237
10	4,934,500	3,245	29,238	32,482
England	49,345,520	32,482		

5.2.4 Estimating the population within the floodplain

When calculating the population living within a flood zone, it is not sufficient to simply use the overall SOA population that the flood zone falls within. For example, the part of the SOA that falls within the flood zone may in fact contain no population (a particular issue in the larger rural SOAs where floodplains cover only agricultural land). Therefore, to use the social characteristics of this SOA within any analysis would be nonsensical because flood risk would be being assigned to people that did not exist.

To improve the spatial resolution of the analysis, use has been made of residential address locations derived from Address-Point. Each residential address location was assigned to the SOA that it fell within. Each SOA population was then divided evenly across all the addresses within it. This is important because the total population of the

addresses must match the population reported in the IMD. By assigning a SOA to each address, the deprivation decile of each address is also known.

Flood zone maps can be used to determine which residential addresses within a SOA are located inside a flood zone (see Figure 5.1). Using the populations assigned to the addresses, the population of the SOA within a flood zone can be estimated and summary data produced.

Figure 5.1 Residential address locations within and outside flood zones



This method is a better alternative to other methods often used in equity studies such as calculating the proportion of the SOA area occupied by the flood zone and using this to estimate the proportion of the population.

Using Address-Point data does not provide a perfect distribution of the population in each SOA because, in reality, the number of people at each address location will vary slightly (though average household size does not tend to vary by a large amount within the same locality). In addition, some addresses may be wrongly classified as residential or commercial. For the purposes of this study, however, it provides a very good estimation of the proportion of the population within a SOA (and therefore each deprivation decile) that is within and outside a flood zone.

With this method, large sites such as blocks of flats or apartments will be represented by single points sitting on top of each other. The limitation of these locations is that they will experience edge effects in any analysis because they are representing a large site with a large population as a single point location. Thus, a point could fall outside a flood zone resulting in the population being missed out while in reality part of the site and associated population is actually within the zone. In contrast, a point could fall within a flood zone resulting in all of the population being included while in reality part of the site is outside the zone. It is important to be aware of these limitations when looking at the results, even though the population involved is only a very small percentage of the total population.

Although the use of Address-Point data improves the spatial distribution of population, it **cannot** provide a more detailed picture of the deprivation characteristics of that population. All addresses within a SOA are still necessarily assumed to have the same deprivation characteristics.

5.2.5 Indicators of inequality

Two statistical measures have been used in the analysis to provide indicators of degree of inequality:

- the Concentration Index (CI)
- the Comparative Environmental Risk Indicator (CERI).

These have been selected to aid communication of results as well as to be appropriate to the ranked ordinal form of the IMD data.

Concentration Index

The CI is closely related to the simpler Gini coefficient, which has been widely adopted as a measure of income and health inequalities (Wagstaff *et al.* 1991) and also recently applied to environmental equity research (Lejano *et al.* 2002, Walker *et al.* 2003).

Whereas a Gini coefficient is used to calculate the distribution of a variable across a constant unit (e.g. income by population), Gini CI values are used to investigate the distribution of a variable with respect to a second, usually socio-economic, variable (e.g. disease by socio-economic status). A modified form of the Gini calculation method is used in which CI values range from 1 to –1. A value of zero indicates complete equality (e.g. in this study's application, the proportion of the population within the flood zone would be identical for all deprivation deciles), while values of 1 and –1 indicate extreme inequality in positive or negative relationships with deprivation.

The CI does not provide an indicator of the **significance** of inequality, which will always be an ethical and/or political judgement and is best used in a comparative setting. However, values for income inequality in the UK between 1979 and 2001 ranged from 0.25 to 0.35. Gini values for income inequality in the USA, by comparison, are currently around 0.45 (Shephard 2003).

Comparative Environmental Risk Index

This measure involves the calculation of a ratio of the population 'at-risk' as a proportion of the total population for any particular group over the ratio of the rest of the population 'at-risk' as a proportion of the total rest of the population.

The index produced is a quotient (a ratio of ratios) (Harner *et al.* 2002). In terms of the deciles used in this study, the index can be represented by the following equation, where X is any particular decile:

$$\frac{\text{DecileX}^{at-risk} / \text{DecileX}}{\text{Not-in-DecileX}^{at-risk} / \text{Not-in-DecileX}}$$

When looking at the results of this study, the group of people in question (decile X) can refer to a group of deciles.

For example, if the group reported in the results is 'decile 1 and 2' and the CERI value is 1.653 (the CERI value for the population within flood zone 2 for all types of flooding), then this means that people living in decile 1 and 2 (as a group) are 65.3 per cent more likely to be at risk in flood zone 2 compared with people living in Deciles 3–10 (as a

group). A figure of 0.8 would mean that they are 20 per cent less likely and a figure of 1 equally likely. In presenting the results of analysis, three CERI values are provided:

- deciles 1 and 2 compared with all others
- deciles 1–5 compared with all others
- deciles 6–10 compared with all others.

5.3 Flood risk in England

5.3.1 Total numbers of people at risk

How many people live within flood risk zones in England?

A total of 4.1 million people (8.3 per cent of the population) in England live within a flood risk zone of greater than 0.1 per cent annual probability of flooding (the zone 2 area) (Table 5.3). Nearly 3.3 million of these people also live within zone 3, which has the higher risk of flooding – a 1 per cent or greater annual probability from rivers or 0.5 per cent or greater from the sea.

The estimated zone 3 population of 3,299,132 from Table 5.3 is approximately 250,000 lower than that derived from previous research using the Indicative Floodplain Map, which defined the same probability boundary. Walker *et al.* (2003) estimated a total population of 3,546,154 using the IFM. This lower figure may suggest that the new Flood Map has reduced the population covered by the flood area by more precisely defining areas at risk. However, there are differences in the way that population figures have been derived which could also contribute to this difference.

For zone 2, the total number of people at risk from river flooding is remarkably similar to the number at risk from sea flooding – both approximately 2.1 million people. For zone 3, however, the number of people at risk from sea flooding is higher than for river flooding – approximately 2 million people compared with 1.4 million. For sea flooding, 98 per cent of those at risk are living in the higher of the two risk zones, whereas for river flooding the equivalent figure is 66 per cent.

Table 5.3 Total populations living in flood risk zones in England

Zone	Total Population	Percentage of English population	River flooding	Percentage of English population	Sea flooding	Percentage of English population
Zone 2	4,117,087	8.34	2,121,940	4.30	2,168,386	4.39
Zone 3	3,299,132	6.69	1,391,245	2.82	2,032,304	4.12

Note: The total population living in flood risk zones does not equal river plus sea populations because some people live in both river and sea flood risk zones.

5.3.2 Flood risk and deprivation

Are deprived populations more likely to be living within flood risk zones than others?

There is a general association between overall flood risk and deprivation, with deprived populations disproportionately concentrated in both zone 2 and zone 3 flood risk areas (Table 5.4 and Figure 5.2).

In the most deprived deciles, there is a substantially higher proportion of the population within the risk zones than in the least deprived. The CERI values indicate that:

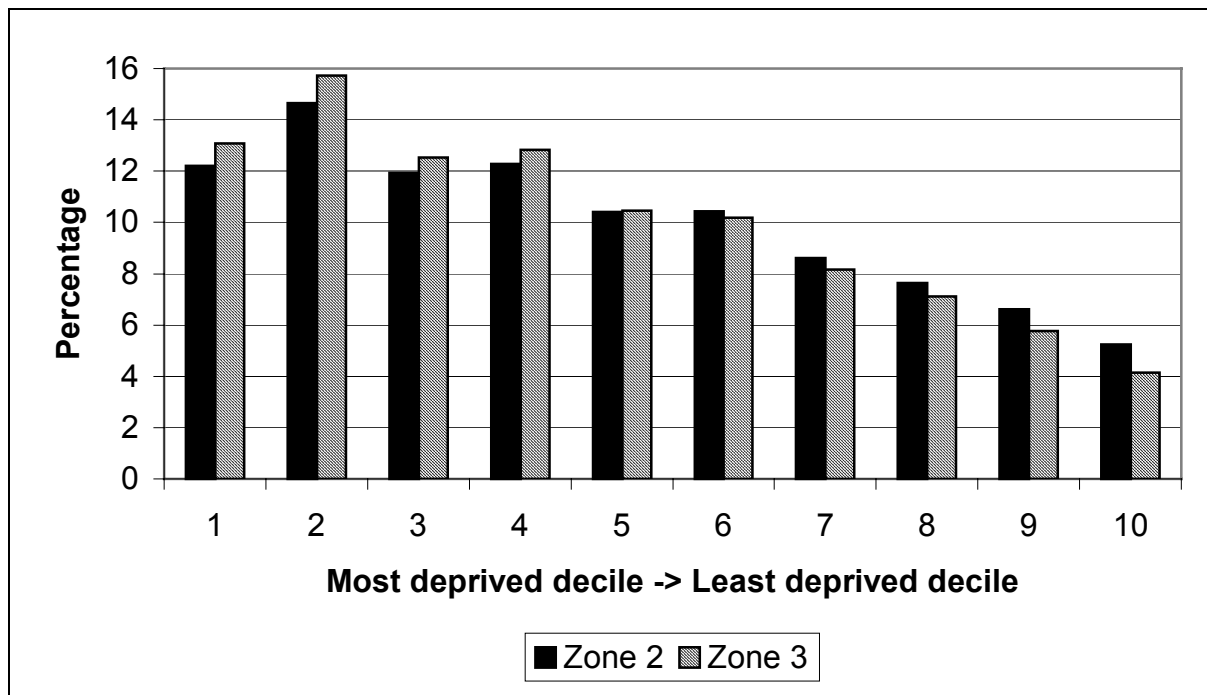
- people in deciles 1 and 2 are 47 per cent more likely to be living at risk of flooding than the rest of the population for zone 2;
- 62 per cent more likely for zone 3.

For both zones, the highest proportion is in decile 2, which is about three times higher than the lowest, in decile 10. The strength of inequality is more acute for zone 3 than for zone 2, as indicated by the higher CI and CERI values.

Table 5.4 Population within zone 2 and 3 for all types of flooding by deprivation decile

Decile	Zone 2 population	Percentage	Zone 3 population	Percentage
1	502,280	12.20	431,612	13.08
2	602,768	14.64	518,491	15.72
3	491,138	11.93	413,068	12.52
4	505,356	12.27	423,389	12.83
5	428,298	10.40	345,262	10.47
6	429,937	10.44	336,156	10.19
7	354,949	8.62	269,500	8.17
8	314,451	7.64	234,658	7.11
9	272,418	6.62	190,364	5.77
10	215,491	5.23	136,633	4.14
England	4,117,087	100.00	3,299,132	100.00
CI value		0.15		0.19
CERI deciles 1 and 2		1.47		1.62
CERI deciles 1–5		1.59		1.83
CERI deciles 6–10		0.63		0.55

Figure 5.2 Percentage of total population within zones 2 and 3 for all types of flooding by deprivation decile



Is there a difference between river and sea flooding in the likelihood of deprived populations living within flood risk zones?

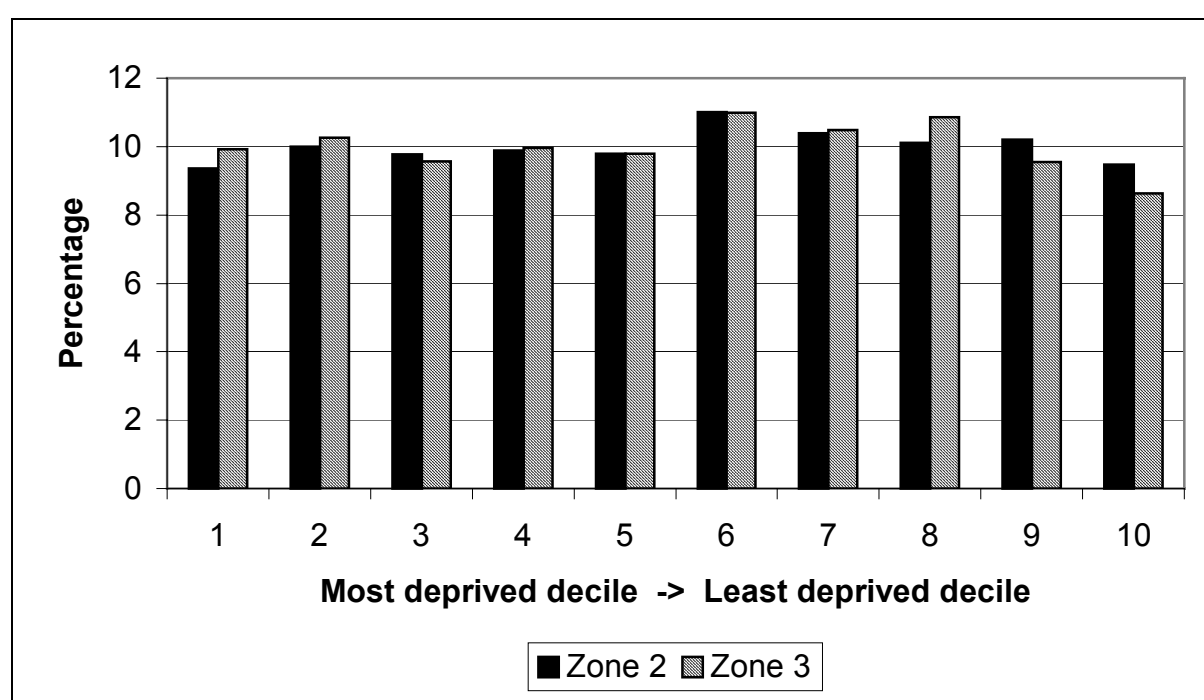
When the data are disaggregated into river and sea flooding zones, it becomes clear that the overall profile of the association with deprivation observed in the aggregated data is entirely created by the pattern within the sea flooding zones.

The profile across the deciles for river flooding is very flat, with little variation from most to least deprived (Table 5.5 and Figure 5.3). The most deprived in deciles 1 and 2 are no more likely than others to be living within flood risk zones (the CERl values are very close to 1). The highest proportion is found in decile 6 for both zones 2 and 3, but this is only marginally higher than for other deciles.

Table 5.5 Population within zones 2 and 3 for river flooding by deprivation decile

Decile	Zone 2 population	Percentage	Zone 3 population	Percentage
1	198,716	9.36	138,143	9.93
2	212,273	10.00	142,798	10.26
3	207,342	9.77	133,154	9.57
4	209,918	9.89	138,473	9.95
5	207,841	9.79	136,175	9.79
6	233,637	11.01	152,764	10.98
7	220,354	10.38	145,968	10.49
8	214,466	10.11	150,949	10.85
9	216,362	10.20	132,873	9.55
10	201,029	9.47	119,947	8.62
England	2,121,940	100.00	1,391,245	100.00
CI values		-0.01		0.01
CERI deciles 1 and 2		0.961		1.012
CERI deciles 1–5		0.954		0.980
CERI deciles 6–10		1.048		1.020

Figure 5.3 Percentage of total population within zones 2 and 3 for river flooding by deprivation decile

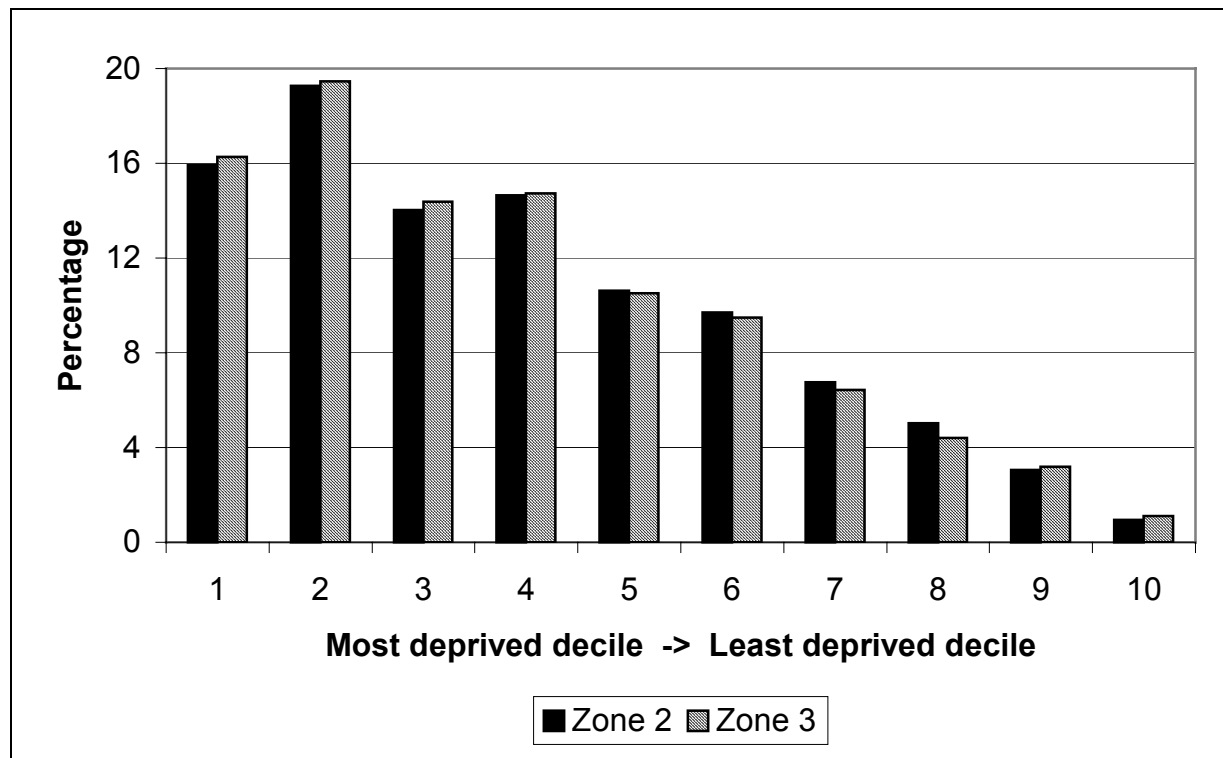


For sea flooding, there is a strong concentration towards the most deprived deciles, which is more accentuated than for both types of flooding combined (Table 5.6). There is a strong linear relationship such that people in deciles 1 and 2 are 122 per cent more likely than others to be living within sea flood zone 3 than the rest of the population; those living at greater than median level of deprivation (deciles 1–5) are 206 per cent more likely to be within this zone. The CI values of 0.32 and 0.33 also indicate a high degree of inequality.

Table 5.6 Population within zones 2 and 3 for sea flooding by deprivation decile

Decile	Zone 2 population	Percentage	Zone 3 population	Percentage
1	345,250	15.92	330,868	16.28
2	417,691	19.26	395,354	19.45
3	304,333	14.03	292,309	14.38
4	317,376	14.64	299,282	14.73
5	230,322	10.62	213,927	10.53
6	210,636	9.71	193,055	9.50
7	146,728	6.77	130,625	6.43
8	108,961	5.02	89,631	4.41
9	66,419	3.06	64,932	3.19
10	20,670	0.95	22,321	1.10
England	2,168,386	100.00	2,032,304	100.00
CI values		0.32		0.33
CERI deciles 1 and 2		2.17		2.22
CERI deciles 1–5		2.92		3.06
CERI deciles 6–10		0.34		0.33

Figure 5.4 Percentage of total population within zones 2 and 3 for sea flooding by deprivation decile



5.4 Flood risk in the English regions

5.4.1 Undertaking regional analysis

A regional analysis of the distribution of flood risk in relation to deprivation can consider the data in two ways:

- across the regions as a whole, considering how each region contributes to the national pattern;
- within each region considering the profile of relationship with deprivation within that region.

Both analyses need to take account of the background differences in distribution of population and deprivation within each Government Office region (Table 5.7). For example, the South East contains a much greater number of people in total (16 per cent of population in England) than the North East (only 5 per cent). It also has 40 per cent of all the people in England in the least deprived decile 10 compared with only 1 per cent in the North East.

The decision was made to continue to use the national ranked scores for the IMD and the associated population weighted population deciles within the regional analysis in this study rather than re-rank and score within each region and create new sets of deciles. This means that comparisons between regions can be more easily made, but also that

care needs to be taken in interpreting results so that misleading conclusions are not reached.

Data are presented separately for each of the regions in Appendix 2.

Table 5.7 Percentage of the population in each deprivation decile falling within the standard regions of England

Decile	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West	Total (per cent)
1	10.91	28.40	17.44	6.74	14.66	2.20	14.38	2.36	2.90	100
2	8.38	16.66	12.30	7.99	13.76	4.55	24.81	5.92	5.62	100
3	6.62	15.82	10.81	8.41	10.72	6.98	23.69	9.45	7.49	100
4	5.84	13.23	10.36	9.29	10.01	9.52	18.72	11.73	11.30	100
5	4.51	12.57	9.37	8.16	11.10	11.59	15.27	14.07	13.36	100
6	4.33	12.43	10.70	7.77	10.76	12.41	13.92	14.66	13.02	100
7	3.82	11.77	9.37	8.95	10.53	13.63	11.57	16.81	13.55	100
8	3.16	9.99	9.14	9.48	9.72	14.76	9.86	21.92	11.97	100
9	2.30	9.71	6.46	10.07	8.57	16.36	9.88	25.21	11.45	100
10	1.11	6.42	4.68	7.77	7.13	17.36	5.96	40.27	9.30	100
Total	5.10	13.70	10.06	8.46	10.70	10.94	14.81	16.24	10.00	100

Given the differences between river and sea flooding identified above for England as a whole, the following discussion disaggregates flood risk between river and sea flooding. The main analysis also focuses on the larger zone 2 of the flood map. Any significant differences in the patterns for zone 3 are highlighted.

5.4.2 Distribution of flood risk across the English regions

How is the population in England living within river flood zones distributed across the regions?

For zone 2 river flood risk, most of the regions have roughly similar proportion of the total national population at risk with figures of 8–13 per cent (Table 5.8), which equates to approximately 170,000–265,000 people per region. Two regions, the South East and London, have higher proportions with approximately 18 per cent (380,000) and 15 per cent (320,000) of the total at risk population, respectively. The North East stands out with a much lower proportion of people at risk at only 2.7 per cent (58,000).

How is the population in England living within river flood zones in the different deprivation deciles distributed across the regions?

Focusing on the **most** deprived population in deciles 1 and 2, the majority of those at risk from river flooding are found in London and the North West. In decile 1, over half of the total population at risk is in these two regions alone. In contrast, the South East dominates when the **least** deprived in deciles 9 and 10 are considered; for decile 10, the South East by itself contains over half of the population at risk from river flooding, 104,000 people, with the next highest the East of England at 26,000. Results for zone 3 are not detailed but show broadly similar patterns.

Table 5.8 Populations within zone 2 for river flooding by deprivation decile and standard region

Decile	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
1	198,716	14,997	54,843	25,160	14,558	17,669	7,182	52,894	339	11,075
2	212,273	9,581	36,101	26,574	29,468	27,383	8,462	52,969	8,957	12,779
3	207,342	4,018	35,982	23,238	33,733	18,458	15,690	39,238	14,044	22,942
4	209,918	5,286	30,768	25,468	36,224	19,710	14,170	33,984	19,222	25,085
5	207,841	5,628	22,060	23,042	21,440	16,099	22,446	31,266	35,314	30,546
6	233,637	7,480	29,085	23,960	36,262	22,688	21,771	23,223	38,360	30,808
7	220,354	3,576	22,603	20,438	33,633	19,718	25,422	22,472	42,270	30,222
8	214,466	2,834	17,168	24,473	30,519	15,229	25,522	18,414	58,532	21,775
9	216,362	2,735	14,184	18,461	31,101	13,168	30,382	26,558	59,775	19,999
10	201,029	1,961	3,164	13,982	15,126	6,661	26,483	20,114	104,053	9,485
England	2,121,940	58,095	265,958	224,794	282,063	176,784	197,532	321,133	380,866	214,714
Decile	Percentages									
1	100	7.55	27.60	12.66	7.33	8.89	3.61	26.62	0.17	5.57
2	100	4.51	17.01	12.52	13.88	12.90	3.99	24.95	4.22	6.02
3	100	1.94	17.35	11.21	16.27	8.90	7.57	18.92	6.77	11.06
4	100	2.52	14.66	12.13	17.26	9.39	6.75	16.19	9.16	11.95
5	100	2.71	10.61	11.09	10.32	7.75	10.80	15.04	16.99	14.70
6	100	3.20	12.45	10.26	15.52	9.71	9.32	9.94	16.42	13.19
7	100	1.62	10.26	9.27	15.26	8.95	11.54	10.20	19.18	13.72
8	100	1.32	8.01	11.41	14.23	7.10	11.90	8.59	27.29	10.15
9	100	1.26	6.56	8.53	14.37	6.09	14.04	12.27	27.63	9.24
10	100	0.98	1.57	6.96	7.52	3.31	13.17	10.01	51.76	4.72
England	100	2.74	12.53	10.59	13.29	8.33	9.31	15.13	17.95	10.12

How is the population in England living within sea flood zones distributed across the regions?

For sea flooding (Table 5.9), the overall population at risk within zone 2 is strongly concentrated within two regions – London, which is most dominant with over 895,644 people or 41 per cent of the total, followed by Yorkshire and Humberside with 417,588 or 19 per cent. The West Midlands has no population at risk, while the North East again has a very low proportion at only 0.61 per cent.

How is the population living within sea flood zones in the different deprivation deciles distributed across the regions?

The strong inequality and concentration of deprived populations within the zone 2 sea flood area identified for England as a whole is also dominated by the two regions of London, and Yorkshire and Humberside (Table 5.9). In the most deprived decile, Yorkshire and Humberside has just the higher proportion of population (40 per cent) but, when combined with London at 38 per cent, over three-quarters of the population at risk in this decile is found just within these two regions. As detailed below, the concentration of the most deprived population within these regions is, in proportional terms, greater than the concentration of the total population at risk. People in these regions are more likely to be both deprived and at risk of flooding than would be expected. Results for zone 3 are not detailed but show similar patterns.

Table 5.9 Populations within zone 2 for sea flooding by deprivation decile and standard region

Decile	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
1	345,250	6,372	21,036	139,132	10,393		20,109	131,420	7,352	9,437
2	417,691	1,727	27,617	53,971	22,933		10,823	266,136	22,210	12,274
3	304,333	1,360	7,356	47,831	19,741		22,391	165,489	27,870	12,295
4	317,376	2,337	16,708	56,491	33,526		24,524	123,249	41,508	19,032
5	230,322	1,010	27,748	37,845	23,355		33,160	57,401	39,962	9,841
6	210,636	255	24,586	27,046	16,898		23,905	65,473	34,336	18,137
7	146,728	58	14,003	31,462	12,337		13,077	34,087	21,997	19,707
8	108,961	134	8,150	14,074	6,552		7,387	23,607	23,288	25,769
9	66,419	2	7,593	8,132	1,988		8,374	17,759	9,651	12,920
10	20,670	39	2,435	1,604	15		1,914	11,023	1,047	2,592
England	2,168,386	13,295	157,232	417,588	147,737	0	165,666	895,644	229,221	142,004
Decile	Percentages									
1	100	1.85	6.09	40.30	3.01	0.00	5.82	38.07	2.13	2.73
2	100	0.41	6.61	12.92	5.49	0.00	2.59	63.72	5.32	2.94
3	100	0.45	2.42	15.72	6.49	0.00	7.36	54.38	9.16	4.04
4	100	0.74	5.26	17.80	10.56	0.00	7.73	38.83	13.08	6.00
5	100	0.44	12.05	16.43	10.14	0.00	14.40	24.92	17.35	4.27
6	100	0.12	11.67	12.84	8.02	0.00	11.35	31.08	16.30	8.61
7	100	0.04	9.54	21.44	8.41	0.00	8.91	23.23	14.99	13.43
8	100	0.12	7.48	12.92	6.01	0.00	6.78	21.67	21.37	23.65
9	100	0.00	11.43	12.24	2.99	0.00	12.61	26.74	14.53	19.45
10	100	0.19	11.78	7.76	0.07	0.00	9.26	53.33	5.06	12.54
England	2,168,386	0.61	7.25	19.26	6.81	0.00	7.64	41.30	10.57	6.55

5.4.3 The distribution of flood risk within each English region

As noted above, looking for evidence of any disproportionate distribution of flood risk within each region involves taking account of the underlying pattern of deprivation within that region. Two indicators are provided below to enable this.

- Tables and figures are provided which show, for each deprivation decile in each region, the percentage of the population in that decile and region that is within the flood zone. So, if there are 100,000 people within decile 1 of region X and 10,000 of those people live within the floodplain, then the percentage figure in this table will be 10 per cent. If there are 5,000 people within decile 1 of region Y and 500 people live within the floodplain, then the percentage figure in this table will also be 10 per cent.
- CERI values are provided for each of the regions, which in their derivation also take account of the underlying population distribution across the deciles.

Within each of the English regions, are the deprived populations in that region more likely to be living within river flood risk zones than others?

The flat distribution across the deciles for river flooding at a national level is not maintained in the regions (Tables 5.10 and 5.11; Figure 5.5). In proportional terms, the South West, East of England, London and North East all have deprived populations which are more likely than others to be living in the river floodplain. The CERI values indicate that, for these four regions, populations in deciles 1 and 2 are 34 per cent, 31

per cent, 37 per cent and 21 per cent, respectively, more likely to be in the river floodplain than others.

This does not mean that, in absolute terms, there is a concentration of deprived people at risk. In the East of England, for example, deciles 1 and 2 provide the smallest number of people at risk (see Table 5.8). However, because of the small total number of deprived people in the East of England, someone in the most deprived decile (as measured nationally) is more likely, in relative terms, to be in the floodplain than someone who is less deprived.

For the South West and East of England, the relationship is relatively constant with proportions decreasing from most to least deprived. In London and the North East, the median CERI values indicate that there is a more complex relationship – London has an unusual U-shaped, bimodal distribution such that both the most and least deprived are more likely to be in the river flood zone than others.

For the South East and Yorkshire and Humberside, there is an inverse relationship such that populations in deciles 1 and 2 are 53 per cent and 29 per cent **less** likely to be at risk than others. The likelihood of being in the river floodplain is instead biased towards the least deprived deciles.

Table 5.10 Percentage population within zone 2 for river flooding by deprivation decile for each standard region

Decile	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
1	4.03	2.79	3.91	2.92	4.38	2.44	6.61	7.45	0.29	7.74
2	4.30	2.32	4.39	4.38	7.47	4.03	3.77	4.33	3.07	4.61
3	4.20	1.23	4.61	4.36	8.13	3.49	4.55	3.36	3.01	6.21
4	4.25	1.84	4.71	4.98	7.90	3.99	3.02	3.68	3.32	4.50
5	4.21	2.53	3.56	4.98	5.32	2.94	3.92	4.15	5.09	4.63
6	4.74	3.51	4.74	4.54	9.46	4.27	3.56	3.38	5.30	4.79
7	4.46	1.90	3.89	4.42	7.62	3.79	3.78	3.94	5.10	4.52
8	4.35	1.82	3.48	5.43	6.53	3.17	3.50	3.79	5.41	3.69
9	4.38	2.41	2.96	5.79	6.26	3.11	3.76	5.45	4.80	3.54
10	4.07	3.59	1.00	6.06	3.94	1.89	3.09	6.84	5.24	2.07
England	4.30	2.31	3.93	4.53	6.75	3.35	3.66	4.40	4.75	4.35

Table 5.11 CERI values for population within zone 2 for river flooding for each standard region

CERI values	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
CERI deciles 1 and 2	0.961	1.205	1.060	0.713	0.877	0.945	1.308	1.366	0.466	1.341
CERI deciles 1–5	0.954	0.863	1.210	0.816	1.002	0.994	1.121	1.003	0.702	1.330
CERI deciles 6–10	1.048	1.159	0.826	1.226	0.998	1.006	0.892	0.997	1.425	0.752

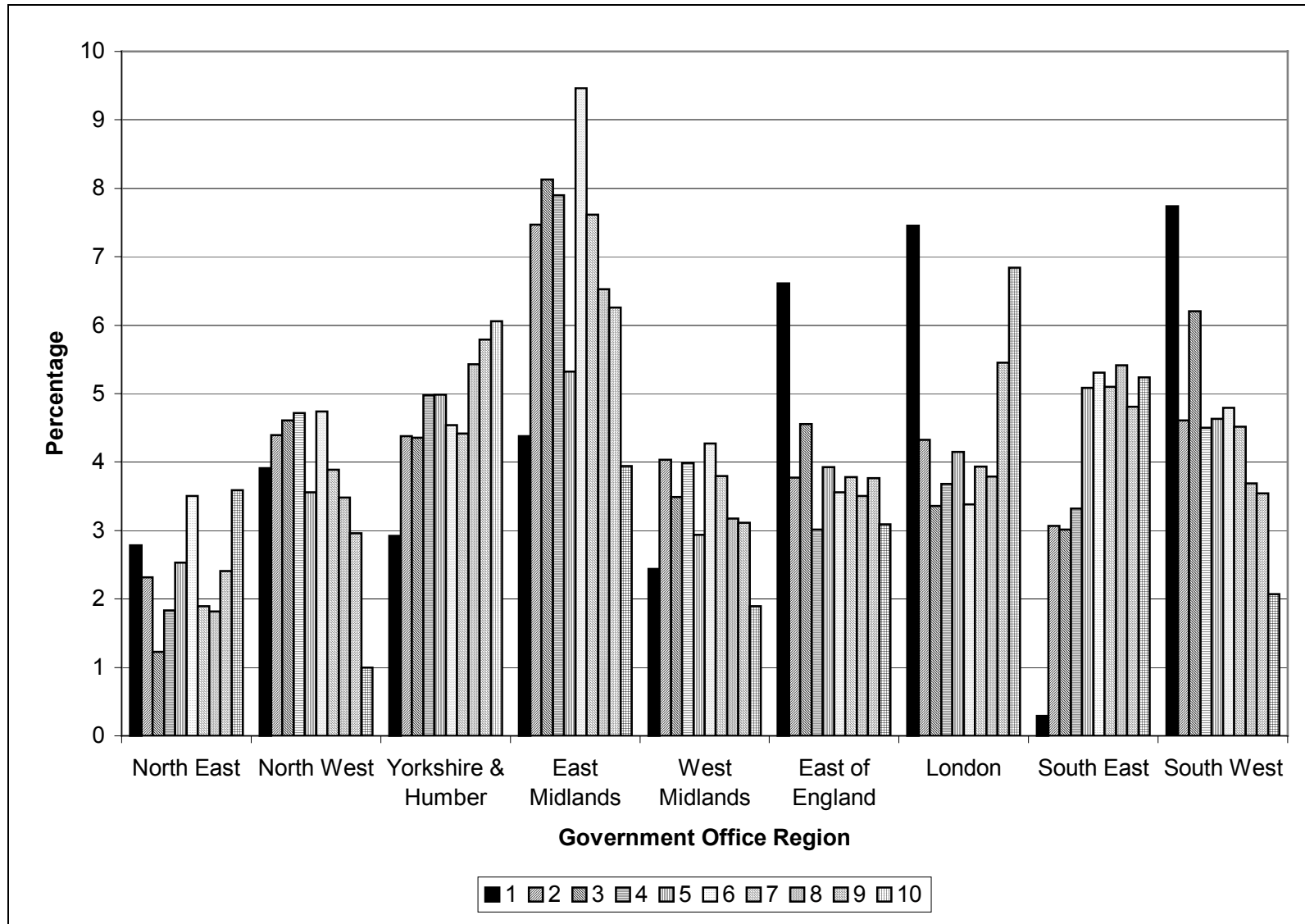


Figure 5.5 Population within zone 2 for river flooding by deprivation decile for each standard Government Office region

Within each of the English regions, are the deprived populations in that region more likely to be living within sea flood risk zones than others?

For sea in contrast to river flooding, the national picture of a disproportionate concentration of deprived populations in flood risk zones is maintained fairly consistently across the regions. Table 5.12 shows that, in every region, the lowest proportion of people at risk is found in either decile 9 or 10, the least deprived. Conversely, the highest proportion of people at risk is found in decile 1, the most deprived, for the North East, the East of England, the South West, and Yorkshire and Humberside.

The decile 1 and 2 CERI value for the East of England is very high; these people are 249 per cent more likely to be living in sea flood zone 2 than the rest of the population (Table 5.13). For all other regions apart from the North West and East Midlands, the increased likelihood of being at risk for deciles 1 and 2 is over 100 per cent. In the North West and East Midlands, there is a bell shape curve (Figure 5.7) such that the highest proportions at risk are found in the middle deciles. For all other regions, the shape of the relationship is, with some variation, similar to that for England as whole.

Table 5.12 Percentage population within zone 2 for sea flooding by deprivation decile for each standard region

Decile	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	East of England	London	South East	South West
1	7.00	1.18	1.50	16.17	3.12	18.51	18.52	6.31	6.59
2	8.46	0.42	3.36	8.89	5.81	4.82	21.74	7.61	4.42
3	6.17	0.42	0.94	8.97	4.76	6.50	14.16	5.98	3.33
4	6.43	0.81	2.56	11.05	7.31	5.22	13.34	7.17	3.41
5	4.67	0.45	4.47	8.18	5.80	5.80	7.62	5.76	1.49
6	4.27	0.12	4.01	5.12	4.41	3.90	9.53	4.75	2.82
7	2.97	0.03	2.41	6.80	2.79	1.94	5.97	2.65	2.95
8	2.21	0.09	1.65	3.12	1.40	1.01	4.86	2.15	4.36
9	1.35	0.00	1.58	2.55	0.40	1.04	3.64	0.78	2.29
10	0.42	0.07	0.77	0.70	0.00	0.22	3.75	0.05	0.57
England	4.39	0.53	2.33	8.41	3.54	3.07	12.26	2.86	2.88

Table 5.13 CERI values for population within zone 2 for sea flooding for each standard region

CERI values	All Regions	North East	North West	Yorkshire and Humberside	East Midlands	East of England	London	South East	South West
CERI deciles 1 and 2	2.171	2.561	0.914	2.050	1.382	3.490	2.217	2.756	1.937
CERI deciles 1–5	2.918	10.634	1.027	2.725	3.156	4.343	2.586	4.200	1.158
CERI deciles 6–10	0.343	0.094	0.973	0.367	0.317	0.230	0.387	0.238	0.863

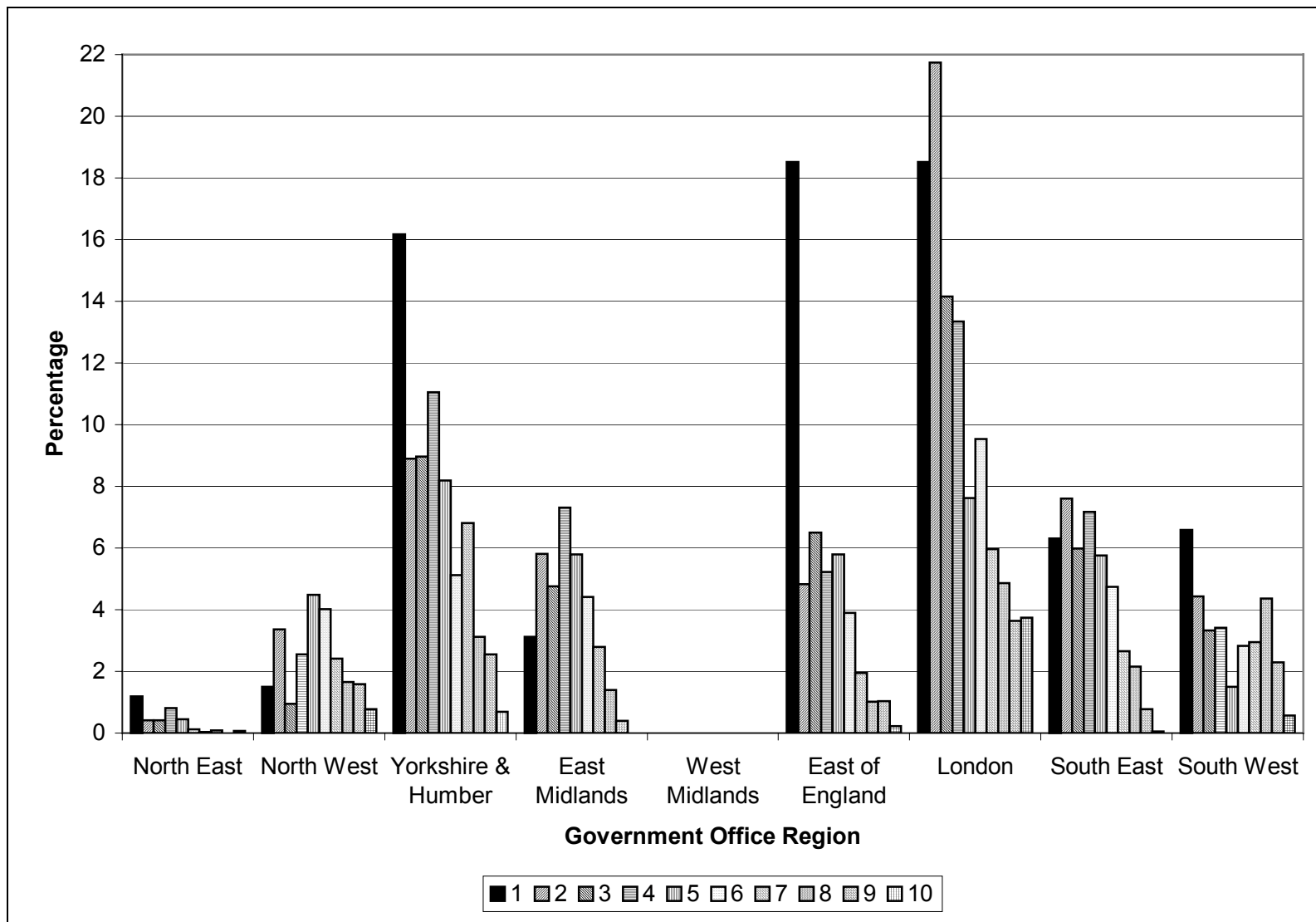


Figure 5.6 Percentage population in zone 2 for sea flooding by deprivation decile for each standard Government Office region

5.5 Conclusion

The results of the deprivation and flooding analysis were produced using a methodology that improves upon previous studies in terms of the resolution of deprivation and household location data and the quality of the flood risk map.

The results obtained for England as a whole display broadly similar patterns to previous studies.

When analysis is undertaken for all types of flooding combined and separately just for sea flooding, more deprived populations are more likely than less deprived populations to be living within flood risk zones. Thus, there are clear inequalities in living at risk of flooding.

When analysis is undertaken just for river flooding, there is no such relationship evident – with approximately equal proportions of more deprived and less deprived populations living within flood risk zones. However this overall pattern masks significant differences between the regions.

The regional scale analysis has not been undertaken before and provides information on which regions have the most deprived populations at risk and the degree of inequality in relation to deprivation found within each region.

For river flooding, all regions have populations at risk but there are concentrations of the most deprived at risk populations in some regions (North East, North West, East of England and South West) and concentrations of the least deprived in others (South East, Yorkshire and Humberside) reflecting to some degree the underlying highly uneven geography of deprivation. The proportional patterns within each region are also highly variable; in some regions, the most deprived are disproportionately found within flood risk zones while, in others, it is the least deprived. In London there is an unusual bimodal distribution with both the most and least deprived more likely to be living with flood risk zones – this may be because areas near to the Thames are either historically deprived or more recently regenerated.

For sea flooding, the population at risk is dominated by two regions, which also contain in absolute and relative terms, a disproportionate number of deprived people at risk. In fact, the national picture of a disproportionate concentration of deprived populations in flood risk zones is maintained fairly consistently across the regions. In every region, the lowest proportion of people at risk is found in the two least deprived deciles.

This suggests, but by no means proves, that a common factor (or set of factors) may have been influencing the development of areas near to the coast and along estuaries which, has over time, led to them being occupied predominantly by deprived populations. What this factor(s) might be remains a question for further research.

Although the results of the analysis stand in their own right and are strengthened by their broad accord with other research, it is still important to take into account the various methodological limitations of this form of analysis and of the datasets used.

6 Policy interventions

This section identifies aspects of current flood policy and management that take account of distributional social factors. A broad view has been taken which seeks to identify any aspect of policy or management which either:

- recognises the particular circumstances of different social groups when exposed to or experiencing the consequences of flood risk;
- recognises the differential vulnerabilities of different social groups;
- seeks to ensure that policy or decision making is equitable and/or inclusive.

The aspects of policy and management reviewed below were identified through brainstorming and discussion during the workshop session on flood policy (see Appendix 1) and a review of policy documentation. Where policy is devolved this discussion largely focuses on the English situation.

6.1 Land use planning

Planning was identified during the workshop discussion as an area of policy which had clear potential relevance to the vulnerability of different social groups – given that it could potentially determine what types of development and, to some degree, what types of people are occupying areas at risk of flooding. However, there was some uncertainty at the workshop as to whether the need to take account of vulnerability was currently recognised in planning guidance and practice (and the current review of land use planning policy for England).

In general, local planning authorities are expected to be sensitive to issues of social differentiation, inequality and inclusion. For example, Planning Policy Guidance 12 (PPG12) guides English local planning authorities on how to prepare development plans. It directs local authorities to consider the relationship of planning policies and proposals to social needs and problems, including 'their likely impact on different groups in the population, such as ethnic minorities, religious groups, elderly and disabled people, women, single parent families, students, and disadvantaged people living in deprived areas' (ODPM 1999).

The most important current document on land use planning and flooding in England is *Planning Policy Guidance 25: Development and Flood Risk* (PPG25) (DTLR 2001). This includes the following points of policy guidance which, in some way, address issues of vulnerability:

- The sequential test, which guides development away from areas of flood risk if other more suitable sites are available, specifies that all flood risk zones are unsuitable for essential civil infrastructure, e.g. hospitals and fire stations (DTLR 2001, p.13). In addition, higher risk undeveloped and sparsely developed risk areas, are, according to the sequential test not suitable for certain development

including general purpose housing or other development comprising residential or institutional accommodation and caravan and camping sites.

- Additional guidance on applying the sequential test developed by Defra and the Environment Agency identifies hospitals, homes for the elderly and schools as unsuitable for development in any identified flood risk area (low, medium or high risk) (Ramsbottom 2003, p.21).
- Sites vulnerable to rapid inundation should defences be overtopped or breached are identified as unlikely to be suitable for those of restricted mobility, whether in conventional, adapted or sheltered housing or in institutional accommodation (Ramsbottom 2003, p.15).
- Caravan and camping sites and other temporary occupancy sites – which may, in some situations, predominantly include people on a low income or specific ethnic groups – are identified as particularly vulnerable. The instability of caravans places their occupants at special risk and it may be difficult to operate an effective flood warning system. Guidance therefore states that sites in high risk of flooding should erect warning notices and prepare effective warning and evacuation plans (Ramsbottom 2003, p.26).
- Owners of hotels, hostels or guesthouses in areas at risk of flooding (which may contain marginal and vulnerable groups) are also advised to establish emergency procedures to be followed in the event of a flood. This also applies to sites designed to attract the public, especially young children and old people (health centres, leisure centres, theme parks. etc.) or where large numbers of people are expected to be present (e.g. shopping and recreational areas) (Ramsbottom 2003, p.49).

Scottish Planning Policy on Planning and Flooding (SPP7) is the Scottish equivalent of the English PPG25 (Scottish Executive 2003). This contains a more explicit reference to issues of inequality and environmental justice. Paragraph 3 states that

‘in achieving social, economic and environmental goals in support of sustainable development, and delivering environmental justice, a long-term view of flood risk has to be taken’

and notes that:

‘those who are already socially and economically disadvantaged may be particularly vulnerable to the hardship caused by flood damage to their homes and possessions. The identification of land and property for development and redevelopment, including economic development, should therefore have regard to the potential harmful effects of flooding.’

6.2 Communication and awareness

Communication and awareness feature in the Government response to *Making Space for Water* (Defra 2005b) as one way in which the 'social justice' implications of decisions on capital schemes may be addressed. In a section on social justice and community well-being, it is stated that even within the risk management framework to be introduced under the strategy, there will be cases where investment in capital schemes to manage flooding will not be justified. It is then stated that:

'in such cases and in line with its policies on social justice, the Government recognises that there is a need to consider extending the risk management tools available, in particular to take account of the needs of smaller rural or dispersed communities. Subject to further work on the legislative and funding implications, consideration will be given to the expansion of available risk management tools to include: the expansion of flood warning and flood awareness ...' (Defra 2005b, p.20).

A later chapter refers to promoting awareness and education through:

- community partnerships
- the use of new techniques for visualising alternative futures
- information packs
- DVDs
- website resources.

It also calls, in general, for support for more active community involvement (Defra 2005b, chapter 9).

The need to differentiate and target communication and awareness raising programmes for different social groups has been recognised by the Environment Agency and implemented in different ways. For example, it produces fact sheets in several languages and for people with learning disabilities.

6.2.1 Environment Agency's older people campaign

Recent flood awareness initiatives have particularly focused on older people. The older people campaign, launched in October 2004, is an initiative by the Environment Agency in partnership with Help the Aged.

The campaign consists of the launch of a leaflet, *Flooding: be prepared, a guide for older people*, which contains valuable advice on what preparations older people can make before, what they should do during, and how they can clean up after, a flood situation. It also includes a list of useful numbers and details of what should be put in a flood preparation pack.

The leaflet will be advertised by posters in GP surgeries, libraries, buses, magazines and various community outlets located within floodplains. Where possible, the Environment Agency is distributing the leaflet through organisations able to take it into the homes of

older people and explain it to them. These organisations include Help the Aged's HandyVan scheme, which helps older people maintain their homes, and Crossroads (a charity that supports carers).

As part of this campaign, the Environment Agency's Thames Region will target older people with a range of initiatives to improve awareness of flooding. These activities will be evaluated in order to determine the success of the older people campaign within Thames Region. The results will be used to develop any future campaigns targeted at older people.

The campaign provides a good example of how the Environment Agency can work with other organisations to deliver appropriate materials to specific vulnerable groups. Help the Aged is expert at communicating with older people and the Environment Agency has followed its advice in developing the materials and organising the distribution channels.

The decision to focus on older people was informed by the Flood Warnings for Vulnerable Groups project (Fielding *et al.* 2005a), which found that older people may be particularly vulnerable (along with single parents, new homeowners and those in lower socio-economic groups) because of low levels of awareness of flood risk.

The Environment Agency plans to target other social groups in future flood awareness activities.

6.3 Flood resilience

The Defra consultation document, *Making Space for Water*, (Defra 2004a) notes that the ability of householders to make their homes more resilient to flooding is dependent on income. It states that:

'The Government is of the view that, in general, individual building owners should be responsible for improving the flood resilience of their buildings. The benefits for the owner are substantial: lower repair costs following an event, fewer health implications and continued insurance. However, the Government recognises that low income, vulnerable households in high-risk areas may not be able to afford the flood protection products/resilience measures ... They may also be the least likely to be able to cope with a major flooding event' (Defra 2004a, paragraph 12.20, p.95).

The document goes on to point out the availability of a mechanism for providing financial assistance for vulnerable households. In July 2002, The Regulatory Reform (Housing Assistance) (England and Wales) Order 53 gave local authorities more flexibility to decide how they would provide home improvement grants, loans, help and advice to low income households within their areas. It then states that:

'In light of this provision and in view of the chronic health problems caused by flooding and long-term damage done to properties, the Government would encourage local authorities in high-risk areas to consider requests for assistance with flood protection/resilience products as a matter of course alongside other more traditional requests' (Defra 2004a, paragraph 12.21, p.95).

The Government response to *Making Space for Water* (DEFRA 2005b) refers to a project to assess the feasibility of the Government providing financial support for making particularly vulnerable properties on the floodplain more flood resilient/resistant additional. This is justified through reference to the principles of 'sustainable development and social justice' to be potentially applied where the provision of a flood alleviation scheme is very difficult. This feasibility study will consider:

- the scope of any scheme
- effectiveness
- eligibility
- legal basis
- degree of incentivisation
- cost.

There is a commitment to then develop a pilot grant scheme.

6.4 Flood risk assessment and Catchment Flood Management Plans

The assessment of flood risk is an important part of flood risk management – identifying where flood risks are high and low, and potentially directing where intervention of various forms is to be implemented.

Traditionally flood risk assessment has not taken account of social factors in the methodologies followed, being focused largely on the assessment of flood probability and economic damage. This was identified in the workshop session as a negative feature of past and current policy (Appendix 1), although recent developments were recognised.

Making Space for Water (Defra 2004a) asks whether the assessment of risk at all levels should take account not just of economic damage but of environmental and social factors as well. It notes that, at the national level, the Environment Agency is working to assess and map flood probabilities on a consistent national basis and that the maps will be 'used for the derivation of estimates of risk through a project on risk assessment for strategic planning' (Defra 2004, p.38). The estimation of risk that is currently used is one of damages to economic assets measured in monetary terms, whereas the strategy notes that 'this will need to be broadened over the lifetime of the Defra strategy to take better account of environmental and social aspects' (Defra 2004a, p.39).

The consultation document also suggests that more comprehensive, consistent and reliable assessments of risk will provide the driver for improved prioritisation of risk management factors. Areas of potential action could be prioritised by reference to the contribution that could be made to risk reduction using a consistent national methodology for measuring risk. This would, over time, replace Defra's scheme-based prioritisation system, which is the current mechanism used to determine the relative priority to be

given to a range of potential schemes, in order to make best use of available funding (see below).

Defra is currently sponsoring research into the development of multi-criteria approaches. The consultation document notes that more formal adoption of these approaches 'will allow greater and more consistent account to be taken of non-quantifiable aspects of an environmental or social nature' (Defra 2004a, p.42). In the Government response to the consultation document, these proposals are supported as part of developing 'a more holistic assessment of risk' (Defra 2005b, p.19).

One way in which this broadening of approach to risk assessment is already taking shape is in the framework being developed for the production of Catchment Flood Management Plans (CFMPs). CFMPs are a 'strategic planning tool through which the Environment Agency will work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood management' (Environment Agency, Defra and Welsh Assembly 2004). The overall objective is to achieve the sustainable management of flood risk. Sustainable is defined in guidelines for the production of CFMP as indicating that 'social economic and environmental issues have been taken into full account and balanced to optimise the benefits to them in the long term' (Environment Agency, Defra and Welsh Assembly 2004, p.9). This guidance also states that 'through effective stakeholder dialogue and consideration of the wider social agenda, the CFMP can make a significant contribution to achieving the broader objectives of sustainable development: equity, social inclusion and engagement in decision making (e.g. regeneration, sustainable communities, partnerships' (Environment Agency, Defra and Welsh Assembly 2004, p.18).

Section 5.4.2 of the guidance document (*ibid*) deals with developing a strategic assessment of flood risk and stresses the need to take account of the full range of the impacts of flooding. Under 'impacts on people', a broad perspective is taken with reference to loss of life, injury and distress and to groups particularly vulnerable to flood risk.

6.4.1 Modelling and Decision Support Framework

A Modelling and Decision Support Framework (MSDF) (<http://www.mdsf.co.uk/about.shtml>) has been developed to be used by Environment Agency and consultants in the development of CFMPs, Shoreline Management Plans (SMPs) and other flood studies.

The MDSF consists of a set of procedures and a GIS-based software front end which provide tools and guidance for a range of tasks, including one focused on social impacts. These tasks include:

- facilities for managing and viewing catchment data;
- advice on catchment hydrological and hydraulic modelling using external modelling software;
- advice on future land use and climate change scenarios;
- import of river flood level data from external models;
- calculation of flood extent and depth;

- calculation of economic damages for commercial, industrial, residential and agricultural assets;
- **calculation of social impacts**, including population affected and social vulnerability;
- presentation of results for a range of cases for assistance with preferred policy selection;
- a framework for policy evaluation;
- procedures for estimating uncertainty in the results for each policy.

To calculate social impacts, the MSDF uses the Social Vulnerability Flood Index developed by the Flood Hazard Research Centre for the Environment Agency. Social impacts can be assessed in terms of estimates of:

- the number of people flooded;
- the percentage of specified areas flooded;
- the relative vulnerability of people living in those areas.

6.5 Flood defences

The methodology historically used for appraising where to invest public money in flood defences has been recognised as potentially leading to socially inequitable outcomes.

Under a conventional cost-benefit analysis approach, the benefits to be achieved have been assessed by estimating the economic cost of flood damage that is avoided if the flood defences are in place. These savings are then set against the cost of the flood defences to indicate whether the investment is economically efficient. However, the focus on economic impacts means that a high income area with high cost property and other assets may be assessed as a higher priority for flood defence investment than a low income area.

Two methods for addressing this position and for taking some account of the vulnerability of populations to a wider range of 'intangible' impacts have recently been put into place.

First, Defra guidance to operating authorities (Defra 2004b) on the economic appraisal of flood and coastal defences has been supplemented in two ways:

- **How to reflect socio-economic equity in appraisal.** This is guidance on how to assess 'distributional impacts' within the overall framework provided by the Treasury Green Book where considered 'necessary and practicable'. In addition to using information on property type and age, information on social class is also to be obtained and used to apply weighted factors in the derivation of 'damages avoided'. This will have the effect of increasing the estimated damages for lower social class populations.

- **How to appraise the human-related intangible impacts of flooding.** Drawing on a research project on the economic valuation of impacts such as stress, health effects and loss of memorabilia, this guidance indicates how an additional monetary cost can be added to the appraisal methodology in order to take intangible impacts into account. A value of £200 per household per year is recommended to be applied through a matrix which adjusts for the standards of protection before and after an option is implemented, with some account taken of distributional differences within this matrix.

Secondly, the methodology used for assessing the priority to be given to applications for Grant in Aid (GIA) for flood management projects has been developed to supplement just economic criteria with others related to people and environment (Defra 2004c). Defra funds most of the Environment Agency's flood management activities in England and provides GIA on a project-by-project basis to the other flood and coastal defence operating authorities (local authorities and internal drainage boards) to assist them with the cost of capital flood and coastal defence projects. GIA is available when the flood and coastal defence solutions are shown to be 'technically, economically and environmentally sound and sustainable, subject to the availability of funds' (Defra 2004c, Annex B, Section 1).

The prioritisation system for GIA attempts to ensure the equitable distribution of funding supporting the provision of flood and coastal defence solutions. In addition to economics, it provides a simplified approach to weighting projects to take account of the intangible impacts on people and the natural environment. The system is based on three criteria:

- economics
- people
- environment.

The 'people' score recognises that there are often impacts on those living in risk areas that are not reflected in the economic assessment. The focus is on impacts on people as a result of flood or erosion risk at their places of residence rather than at their places of work.

The adjustment undertaken for population is a combination of the number of residents affected (adjusted to reflect those effectively outside the risk area such as properties in the upper levels of blocks of flats) and a further adjustment to reflect the degree of vulnerability within the population at risk. Though it is recognised that a number of critical population characteristics have been identified as indicating particular vulnerability to events (e.g. age, single parent, etc.), the data for including each of these factors are not considered readily available. Therefore, the Index of Multiple Deprivation is used as follows:

- 'The score is related to the ranked scale of deprivation by ward that is provided on the ODPM website. Recognising that the distribution is not even, the greatest adjustment is applied only to the top or bottom 300 wards with no adjustment to approximately 50 per cent of wards in the middle range. The scale of +2 to -2 is applied so that the overall effect is, theoretically, neutral. Thus, wards with a less vulnerable ranking will have their priority reduced whereas those assumed to be

more vulnerable will have increased priority' (Defra 2004c, Annex B, Section 2.1.4).

- It is noted that the IMD is 'not fully researched for the proposed use ... it is considered to provide a reasonable indication of the likely location of the above groups for whom higher funding priority is justified on the basis of increased vulnerability exacerbated by lower economic resources' (Defra 2004c, Annex B, Section 2.1.4).

In the Government response to *Making Space for Water* (Defra 2005b), a commitment is made to produce better guidance on social costs and benefits so as better to identify gains and losses to individuals and different sectors.

7 Recommendations

Any attempt to tackle inequalities in the social distribution and impacts of flood risk needs to consider the implications of climate change for future flooding. The Foresight report, *Future Flooding*, considered the economic, social and environmental consequences of future patterns of flooding. It concluded that impacts will not be felt equally:

‘the socially disadvantaged will be hardest hit. The poor are less able to afford flooding insurance and less able to pay for expensive repairs. People who are ill or who have disabilities will be more vulnerable to the immediate hazard of a flood and to health risks due to polluted flood waters’ ((DTI 2004, p.20).

The report also notes, that whilst social impacts are hard to quantify, the analysis showed a large increase in social risks in all of the scenarios considered, commenting that ‘unless these risks are managed, significant sections of the population could be blighted’ (DTI 2004, p.24).

Taking into account the results of the data analysis undertaken in this project, this suggests that there are real and substantial challenges for future flood risk management and the way it manages the risks to those most vulnerable to flooding.

People already experiencing social and economic deprivation are a significant proportion of the total numbers currently at risk from flooding – and, for sea flooding, they constitute the majority of those at risk in England, particularly in regions where at risk populations are greatest in number. This alone indicates that flood policy will need to be increasingly responsive to the social distribution of flood risk – a conclusion supported by stakeholders who attended the project workshop.

However, a number of factors need to be borne in mind when considering the scope for and nature of policy interventions, and in developing policy and research recommendations.

- 1) In Section 3, it was concluded that there is evidence to suggest that deprived neighbourhoods are likely to be particularly hard hit by the social impacts associated with flooding. However, it was also emphasised that deprived neighbourhoods are not all the same. Some of the dimensions of difference, which may influence how they are impacted by flooding, include:
 - local social relations
 - relationships with emergency services
 - ethnic and cultural make-up
 - type of housing
 - age profile of residents.

It is also the case that vulnerable people do not all live in deprived communities. Not all poor people will live in poor neighbourhoods and vulnerable people are not necessarily poor; vulnerabilities associated with age, gender and disability do not map simply onto measures of socio-economic status. In a number of respects, not

enough is known about how different types of neighbourhoods are affected by flooding.

- 2) The analysis undertaken largely confirms the relationships between flood risk and deprivation found in previous studies. It used a more sophisticated methodology than previous work and enhanced datasets. However, this study was not able to take account of the level of flood protection provided for communities in the risk zones used, which may change the patterns of distribution identified.
- 3) Although policy interventions to protect particular people and social groups may be justified if they can be shown to be more vulnerable to flood impacts than others, questions of justice or fairness should also be considered. As emphasised in Section 2, there is a difference between inequality and injustice. Evidence of inequality was found in the proportions of people in different deprivation categories that are living within flood risk zones (or the likelihood that a person within each category will be living in a flood risk zone). However, this does not necessarily imply an unjust or unfair situation in need of addressing to reduce the extent or scale of inequality.
- 4) Section 6 outlines a number of ways in which flood policy and management is already seeking to take account of social issues. Most of these interventions are relatively recent and it is difficult therefore to evaluate their significance. It was not possible to undertake a systematic assessment of the ways in which past and current policy measures may be producing outcomes which either positively or negatively impact on patterns of inequality – raising questions of procedural and policy justice (see Section 2). The workshop sessions attempted to do this in a qualitative manner, as outlined in Appendix 1. In particular, participants questioned:
 - the degree to which decisions about past flood protection investments have marginalised areas for flood protection which contain poor communities and only low value economic activity;
 - the extent to which changes in the appraisal of investments are now affecting change in the distribution of flood protection measures.

These questions merit further investigation.

- 5) The Flood Map used in the data analysis defines areas and the people within them as 'at-risk' or 'zoned as risky'. Though necessary for flood management purposes and land use planning, this potentially affects the cost of insurance and, possibly, people's ability to move house. This 'label' may also have a differential impact on different populations and may create a polarisation of communities. The accuracy of these maps is of vital importance to those who get labelled as 'at-risk'.

A number of recommendations follow from the above and earlier discussions.

Recommendation 1

Flood risk policy and management at national, regional and local levels should continue to develop in directions which recognise that the impacts of flooding are socially differentiated in a range of sometimes complex ways. However, vulnerability wherever it arises should be factored into:

- flood management planning
- priority setting
- option analysis
- work before, during and after flood events.

Particular attention needs to be paid to differences between urban and rural areas.

Recommendation 2

Flood risk policy and management at national and regional levels should consider the implications of sea flood risk zones containing larger numbers of people who are already socially and economically deprived than would be expected if there was an equality of exposure to flood risk.

The potential implications arise from two considerations:

- The high absolute numbers of people involved and the scale of deprivation-related vulnerability that therefore exists, which suggests that flood protection, preparedness and responses measures may need to be both more intensive and sensitive to vulnerability in sea flood zones than would otherwise be the case.
- The relative numbers of deprived compared to the less deprived that live in flood risk areas, potentially introducing issues of fairness and distributional injustice as additional drivers for the prioritisation of risk reduction and protection in deprived communities.

Recommendation 3

Flood risk policy at a strategic level should take account of likely future change in climatic, economic and social variables following the approach adopted in the Foresight report. In particular, interactions between processes of environmental, social and economic change, and how these may increase vulnerabilities for certain parts of society should be identified.

Recommendation 4

Defra and the Environment Agency should monitor the effectiveness of policy measures designed to take account of:

- the social impacts of flooding
- the vulnerability of different social groups.

As a priority, monitoring of the impact of changes made to the appraisal methodology for flood protection investment should be put in place in order to evaluate equity implications and the sufficiency of the changes that have been made.

Recommendation 5

Opportunities should be identified for tackling environmental and social issues together – building local capacity and tackling flood risk problems and social exclusion simultaneously.

As Few (2003, p.54) comments: 'Action to counter vulnerability to flood hazards needs to work hand in hand with action to reduce poverty and promote sustainability. Indeed, sustainable development in the context of a flood prone area arguably implies supporting people's capacity to 'live with' floods rather than attempting to engineer away the problem.'

This recommendation is particularly relevant to local authorities and agencies involved in local flood hazard management and catchment flood management planning.

Recommendation 6

As the Environment Agency's Flood Map is refined, further data analysis of the relationship between deprivation and flooding should be undertaken which takes account of flood defences. This should consider:

- the impact that flood defences have on the social distribution of flood risk;
- the extent to which past flood investment decisions have afforded a greater degree of protection to the 'better off' due to the primacy of economic losses in investment appraisal.

Recommendation 7

Targeted information and advice to vulnerable groups on flooding should be developed in collaboration with:

- national and local agencies
- organisations that work with particular social groups and have relevant local knowledge.

Recommendation 8

The Environment Agency should consider encouraging and co-ordinating research into the distribution and impacts of flooding from sewers and ground water.

Recommendation 9

Further research is needed to understand:

- how neighbourhoods as a whole are affected by flooding. Research is needed which seeks to understand:
 - the role of social capital in building resilience to flooding and enabling community recovery;
 - the conditions under which social capital is increased – rather than dented – by a flood event;
 - how businesses are affected;
 - and how populations change.

The findings could help inform approaches to developing preparedness and managing the complex impacts of flood events. This is likely to involve longitudinal studies of specific places to trace changes over time, covering both urban and rural contexts.

- the experience of formal and informal Flood Action Groups in different kinds of neighbourhoods. Such research could explore issues such as:
 - the conditions under which successful groups are formed;
 - what constitutes success;
 - who participates, barriers to participation;
 - the personal and wider social costs and benefits of participation.

This research could assess the extent to which Flood Action Groups may contribute to producing and/or addressing inequalities in flood risk.

- the age and ethnicity dimensions of vulnerability. The understandings and responses of minority ethnic groups at risk of flooding deserve further investigation, as they may be inadequately taken into account in current flood management policy and practice. There are also gaps in our understanding of the needs and experiences of children, particularly regarding the impacts of evacuation and temporary accommodation. Further data analysis could also consider patterns of exposure to risk amongst different age groups and ethnicities.
- the historical development of areas at risk from sea flooding to identify possible factors and processes that have led to deprived populations occupying areas at risk of sea flooding to a greater degree than others. Such understanding could inform future policy on land use planning in coastal areas.
- differences in profiles of vulnerability between urban and rural areas, and the ways in which policy measures should be developed to take account of these differences.
- case studies comparing different policy interventions to manage flood risk and the equity implications of these.

In exercise 2 of the workshop, participants were asked to think through potential future policy scenarios that gave a far greater priority to social impacts and issues of inequality and social vulnerability. Whilst deliberately freeing those involved from the realities of current policy positions and constraints and encouraging 'blue skies' thinking, the suggestions made in the groups can provide a potentially useful stimulus to the policy deliberations advocated in recommendations 1–3 above.

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List of acronyms

ABI	Association of British Insurers
CI	Concentration Index
CERI	Comparative Environmental Risk Indicator
CFMP	Catchment Management Flood Plan
Defra	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions (no longer exists; environment responsibilities moved to Defra)
DTI	Department of Trade and Industry
DTLR	Department for Transport, Local Government and the Regions (no longer exists; responsibilities split between Department for Transport and ODPM)
EIA	Environmental Impact Assessment
FAG	Flood Action Group
FHRC	Flood Hazard Research Centre
FoE	Friends of the Earth
GIA	grant-in-aid
GIS	geographical information system
IAIA	International Association for Impact Assessment
IFM	Indicative Floodplain Map
IMD	Index of Multiple Deprivation
MSDF	Modelling and Decision Support Framework
NGO	non-governmental organisation
NRU	Neighbourhood Renewal Unit
ODPM	Office of the Deputy Prime Minister
Ofwat	Office of Water Services
ONS	Office for National Statistics
PPG	Planning Policy Guidance
RPA	Risk and Policy Analysts Ltd
SDRN	Sustainable Development Research Network
SEA	Strategic Environmental Assessment
SIG	Special Interest Group
SMP	Shoreline Management Plan
SOA	Super Output Area

SPP	Scottish Planning Policy
UNECE	United Nations Economic Commission for Europe
USEPA	United States Environmental Protection Agency

Appendix 1: Workshop summary

Aims of the workshop

A project workshop was held from 2–3 February 2005 at West Hills House Conference Centre in Birmingham. It was facilitated by Malcolm Eames of the Policy Studies Institute and Karen Lucas of the University of Westminster as well as the authors of this report. A range of stakeholders both internal and external to the Environment Agency was invited in order to draw on a breadth of expertise and experience. One day of the workshop was devoted to understanding environmental inequalities in relation to waste sites and flooding, with participants splitting into two groups to discuss each issue in depth.

Participants with experience relevant to understanding the distribution of the social impacts of flooding included senior Environment Agency staff and representatives of: Ofwat, the National Flood Forum, Friends of the Earth, Collingwood Environmental Planning, the Health Protection Agency and the Flood Hazard Research Centre (Middlesex University).

Two sessions were held which focused on flooding.

The first aimed to review, validate and extend the project's preliminary research on the social impacts of flooding and how these may be experienced in different ways by different social groups (as characterised by deprivation, age, gender, disability, etc.).

The second session aimed to identify ways in which existing policy interventions for flooding may be positively or negatively influencing patterns of impact on different social groups and to explore the potential for and possible direction of further policy development

Session 1 – Social impacts and inequalities: flooding.

Facilitated by Kate Burningham, University of Surrey.

The first session focused on eliciting participants' ideas about:

- What are the social impacts of flooding?
- How might the impacts of flooding be differentially experienced?

The project objectives were introduced, along with definitions of social impact and considerations of how to conceptualise the impacts of flooding given that:

- individuals, households, organisations, businesses, communities are all affected;
- impacts overlap
- flood events vary in important ways.

The following categorisation of the social impacts of floods was presented:

- economic
- health
- evacuation
- household disruption
- changes in perception of risk and behaviour
- population change
- community changes
- political impacts
- changes to local services/infrastructure.

And participants asked to work in pairs and comment on:

- Is this a reasonable and comprehensive way of categorising the impacts of flooding?
- Is anything missing?
- Any better (simple!) ways of doing it?

Suggested changes to and comments on the list were:

- make sure include both positive and negative impacts;
- impact on both insider and outsider communities;
- is evacuation part of household disruption?
- linkages between impacts;
- non-economic losses;
- access to legal services;
- wider access to services and disruption to life chance, e.g. education;
- nature of flood;
- environmental quality, e.g. tree loss, erosion, landscape.

The session then moved on to address the question of whether or not the impacts of flooding are experienced equally. It focused particularly on:

- the social distribution of ability to cope in event of flood and the aftermath;
- the question of whether different kinds of places are differentially impacted by flooding.

Participants worked in groups and were given two categories of impact (e.g. economic, health). They were asked to consider:

- Does the impact vary by:
 - individual characteristics?
 - sex, age, ethnicity, disability?
 - household characteristics?
 - social class/income, household composition – presence of children, older or disabled dependents; tenure type, property type, length of residence?
 - neighbourhood characteristics?
 - level of deprivation, social capital, ethnic/cultural composition?
- For each level at which the impact might be experienced (individual, household, neighbourhood) to provide:
 - any research evidence of inequalities/differences in the experience of this impact;
 - any anecdotal/experiential evidence of inequalities/differences in the experience of this impact;
 - any knowledge of data available which might help us understand ways in which this impact is differentially experienced;
 - ideas about what would it be useful/interesting to know about the distribution of this impact.

Health

- Information on social clusters but not related to flooding and much of the data are classified as confidential below the neighbourhood level. There are also issues with data quality.
- Reported incidents of drowning in Carlisle of elderly and frail residents.
- Many health impacts on individuals are removed in the immediate term because of evacuation.
- Longer-term psychological health risks not researched but worries about economic factors, etc. must contribute.

Community cohesion

- No research evidence noted but is there research on social capital and resistance to disasters? General household survey.
- Anecdotal evidence from FoE in Teesside that there is a very low level of participation in deprived communities and few opportunities to engage in general change to the area.
- At the community level, there is still development in floodplains despite Environment Agency policy to the contrary. Is there any evidence that this is poorer development, e.g. social housing?

Household disruption

- There may be some benefit from looking at related research base on household disruption, e.g. the effects of war, family break-up, enforced re-housing on individuals, households and communities.
- Issues of tenure are important.

- Insurance, income, tenure type and scale of impact are related.
- Are there stronger family ties for some ethnic groups which help to counteract disruption? (Slough experience)
- Are there issues around the spiritual significance of water and connections with perceptions of risk and impacts?
- Are there differences based on the proximity of the threat and histories of threat and ability to cope, e.g. between people in Tower Hamlets and a coastal community?
- The data on age is not consistent – some research suggests age and fragility means people are less likely to return, other research identifies elderly residents as more able to cope.
- Are there sensitivities around splitting up families where they are second language speakers, i.e. Muslim women, family members as translators, etc.

Changes to local service

- Evidence suggests small and medium enterprises (SMEs) are more vulnerable – less insurance, but some local businesses do very well from flooding (repairs, etc.).
- Some times local emergency services are also flooded (e.g. Carlisle) and therefore the response infrastructure is poor.
- Sewage systems can be out of order for some time and there are related mid-term impacts, which often go unrecognised.

Evacuation

For individuals:

- EU research on individual impacts with some reference to different social groups, e.g. women, age (Middlesex University)
- USA research base on the effects of disasters on groups
- Evidence that ethnic groups are not properly catered for culturally in temporary accommodation
- Some insurance pays for accommodation in hotels but probably doesn't extend to low cost policies
- Social networks are important as a source of places to stay – less psychologically disruptive and more support staying with family and friends
- Issues with disability and the suitability of temporary accommodation
- Issues with the distance of temporary accommodation and the level of disruption
- Tracking the location of evacuees can be problematic as local authorities have varied methods for this, e.g. Bewdley keeps a list of vulnerable residents
- There may be issues with legal aspects of evacuation – orders to evacuate, agencies involved and compliance

For households:

- Ford and Ketteridge – Scottish research on flooding and impact on single households and women.
- Insurers and claimant relations amongst different household types.
- Employment and educational access can be problematic with displacement.
- Worries about looting, scrutiny of builders and clean-up operations when not in close proximity of home.
- Isolation can lead to psychological stress

For communities:

- Re-housing social tenants and sufficiency of temporary accommodation within areas for this, particularly for housing associations.
- Disruption of social networks and levels of cohesion – communities with stronger social networks find it easier to rebuild.

Political impacts

- Suggestion that, at the level of individuals and households, this is more about political responses to flooding.
- Often there is mobilisation within poorer communities but a lack of understanding about where to direct energies and how the system works – confusion between agencies that warn and those that respond – leads to loss of faith in the system (National Flooding Forum data).
- At the community level of analysis, there is research in parallel areas, e.g. cliff erosion and the effect on households without insurance, caravan dwellers and responses to floods.
- Are the political responses different for isolated rural households?
- There is Environment Agency evidence to suggest that farming communities in floodplains are moving away and there is a need to manage the decline of these areas rather than protect them from flooding in the longer term – an exit strategy.
- Groups generally have greater political credibility than individuals in mobilising activity and political response.
- What is the voluntary sector response?
- How does de-prioritisation of intervention in areas impact on political action within affected communities and on local authorities representing in these areas?
- Different expectation within groups and who can do what.
- A need for greater transparency within political decisions made on flooding.

Economic impacts

For individuals:

- Middlesex University research that Asian families are less likely to be insured against flooding.
- Women are more likely to be involved in clean-up exercises and this can disrupt their employment activities.
- Anecdotal evidence that builders are discriminatory towards older people – leaving their properties until last.

Population change

For individuals:

- Older people who are frail tend to stay out of the area after a flood. Is this the same for disabled people and those with long-term illnesses? Does this impact on the social mix in these areas?

For households:

- Closure of shops within areas may have an impact on non-car owners who tend to be concentrated in lower income groups.
- Short-term tenants move out of the area.

For communities:

- Social capital as measured by some indices of deprivation suggest that this is lower in deprived areas but some flood research (University of Surrey) suggests may be high if based on informal neighbourly responses to flood clean-up and support.

Session 2 – Policy Interventions

Facilitated by Gordon Walker, Staffordshire University.

This session had three main aims:

- addressing issues
- contributing factors
- more sensitive policy scenarios.

Exercise 1: Existing policy

Participants were invited in small groups to make a bullet point list of current policy measures that influence the different exposure to flood risk or the experience of flood events for different social groups. This influence could be either positive (addressing vulnerabilities reducing inequalities) or negative (creating or exacerbating inequalities and vulnerabilities).

These areas of policy were identified and allocated to one of the three categories (Table A1.1).

Table A1.1 Results of exercise 1

Negative	Both	Positive
Economic drivers for flood protection (use of cost benefit analysis)		Scoring system for flood protection investment now includes allowance for deprivation.
Green Book rules		
Lack of effective flood management policy for social issues		New Catchment Flood Management Plans should incorporate more social issues.
Insufficient differentiation and sensitivity in communication programmes for needs of different social groups		Environment Agency flood warnings direct customisation of messages for different languages
Insufficient differentiation and sensitivity to needs of		Environment Agency/ABI

Negative	Both	Positive
<p>different social groups in recovery phase</p> <p>Is social housing pushed into vulnerable areas (cheaper land?)</p> <p>Complexity or responsibilities between institutions</p> <p>Lack of consistency between local authorities in how ready they are to assess different vulnerabilities and respond to these</p> <p>Complexities of participation for disadvantaged groups – issues of representation of action groups</p>	<p>Regeneration and sustainable communities</p> <p>Policy not to build on floodplains. Do planning decisions take account of vulnerability?</p>	<p>policy on positive design in relation to insurance problem</p> <p>Review of PPG25</p> <p>Civil Contingencies Act</p>

Exercise 2: Future policy scenarios

Four small groups were asked to consider how policy could develop in the future (10 or 20 years time) if issues of inequality and differential vulnerability were given a high profile within flood management policy.

- What would such a scenario look like?
- What would it include?
- How would it be different from current policy?

Each group was asked to put forward one main suggestion. These were:

- establish a flood fund at national level ‘flood relief’, social insurance fund;
- link local inequality to global inequality – through climate change and domestic tradeable carbon dioxide (CO₂);
- rebalance economic and social concerns in decision making – regional funds (levies) which are accessible;

- consider relocation where most severe vulnerabilities exist.
- Other suggestions from the four groups are summarised in Table A1.2.

Group	Suggestions
1	<ul style="list-style-type: none"> • ‘Bottom up’ consultation to build capacity • Mobilise communities to help themselves • Massive education on sustainable development, flood risk and climate change • Start with the most vulnerable communities • Relocating most vulnerable • Building on stilts, other design measures • Public fund for flood proofing (similar to grants for energy saving) • Socially funded insurance • Include flood within a TV soap opera (e.g. Eastenders and Thames Barrier failure!)
2	<ul style="list-style-type: none"> • See Foresight report which includes inequalities within the scenarios produced
3	<ul style="list-style-type: none"> • Join local and global issues • More tailored responses for preparedness, response and recovery • Use of Environment Agency database to identify social groups at risk • Layered approaches to risk communication • Shift from cost-benefit analysis to multi-criteria analysis • Develop participation through community development skills, good practice responses, flood wardens • Social insurance fund
4	<p>Spider diagram produced – some aspects of this:</p> <ul style="list-style-type: none"> • Rebalance the green book re investment decisions • Higher local levies • More integration within river basin planning • Focus on adaptive, resilient communities • Layered communication, sensitive to language/culture • Vulnerability within land use planning decisions

Final discussion: Flooding

Two main points emerged:

- Environmental justice solutions and problems run across a number of issues. An ability for communities to actively participate in solutions is a key driver of change.
- Environmental justice is a new area of policy in the UK. At present, its framing largely omits intergenerational aspects of the problem as well as the global dimensions. This is missing a trick in the context of making the links between environmental justice in the UK and the problems in Africa and climate change.

Appendix 2: Flood risk and deprivation in the English Government Office regions

North East

Table A2.1 North East population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	538,120	20,179	14,997	6,372	11,527	7,101	5,079
2	413,640	10,786	9,581	1,727	4,468	3,777	1,026
3	326,620	5,312	4,018	1,360	2,925	1,844	1,080
4	287,980	7,623	5,286	2,337	4,052	2,430	1,622
5	222,730	6,348	5,628	1,010	4,373	3,828	663
6	213,390	7,684	7,480	255	4,318	4,164	156
7	188,600	3,605	3,576	58	2,228	2,199	58
8	156,090	2,834	2,834	134	2,192	2,192	116
9	113,580	2,737	2,735	2	1,408	1,406	2
10	54,670	2,000	1,961	39	1,378	1,353	26
North East	2,515,420	69,110	958,095	13,295	38,869	30,293	9,830
Percentage of decile population							
1	538,120	3.7	2.8	1.2	2.1	1.3	0.9
2	413,640	2.6	2.3	0.4	1.1	0.9	0.2
3	326,620	1.6	1.2	0.4	0.9	0.6	0.3
4	287,980	2.6	1.8	0.8	1.4	0.8	0.6
5	222,730	2.9	2.5	0.5	2.0	1.7	0.3
6	213,390	3.6	3.5	0.1	2.0	2.0	0.1
7	188,600	1.9	1.9	0.0	1.2	1.2	0.0
8	156,090	1.8	1.8	0.1	1.4	1.4	0.1
9	113,580	2.4	2.4	0.0	1.2	1.2	0.0
10	54,670	3.7	3.6	0.1	2.5	2.5	0.0
North East	2,515,420	2.75	2.31	0.53	1.55	1.20	0.39
CERI values							
Decile 1 and 2	951,760	1.334	1.205	2.561	1.149	0.920	2.693
Decile 1–5	1,789,090	1.082	0.863	10.634	0.963	0.681	10.725
Decile 6–10	726,330	0.925	1.159	0.094	1.038	1.468	0.093

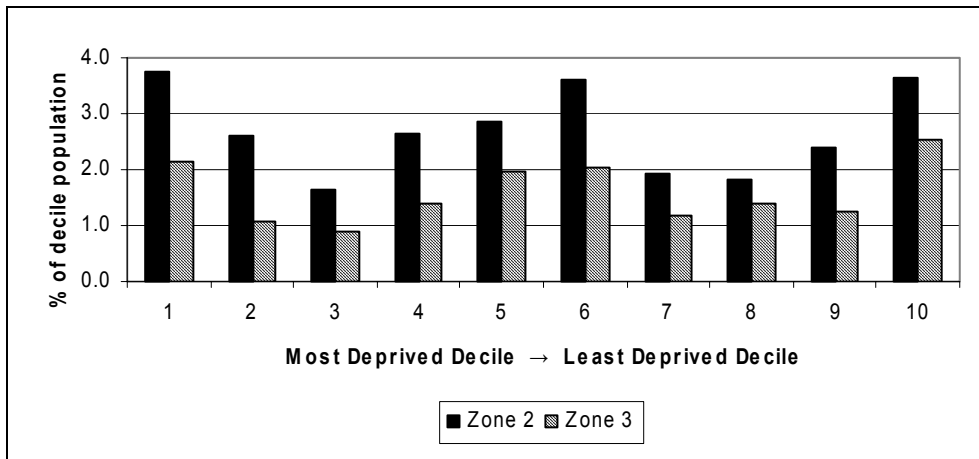


Figure A2.1 Percentage of total population in the North East within zones 2 and 3 for all types of flooding by deprivation decile

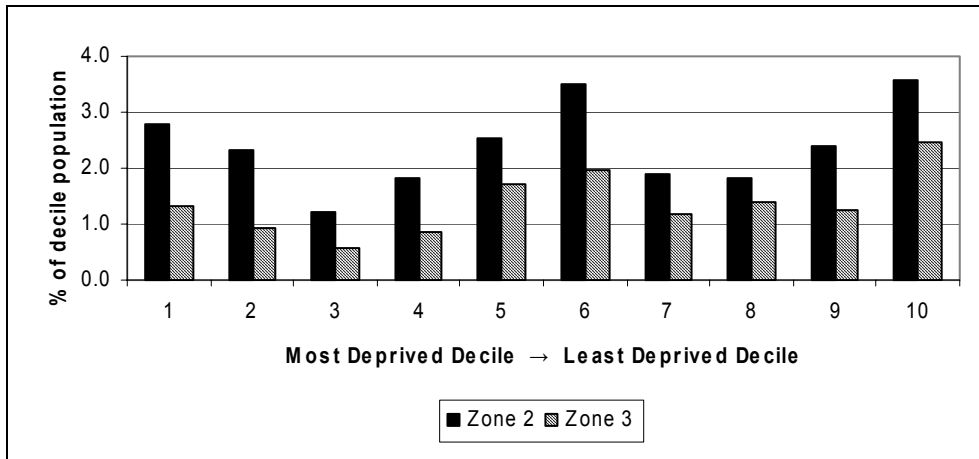


Figure A2.2 Percentage of total population in the North East within zones 2 and 3 for flooding from rivers by deprivation decile

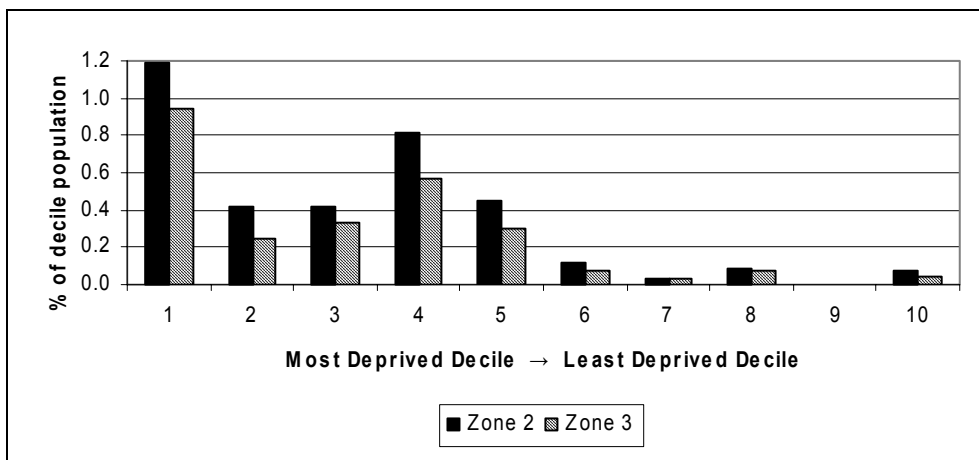


Figure A2.3 Percentage of total population in the North East within zones 2 and 3 for flooding from the sea by deprivation decile

North West

Table A2.2 North West population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	1,401,540	74,867	54,843	21,036	50,924	37,113	14,367
2	822,230	62,698	36,101	27,617	42,315	20,235	22,592
3	780,730	42,887	35,982	7,356	28,564	23,118	5,752
4	652,710	46,404	30,768	16,708	31,010	16,512	15,365
5	620,170	49,426	22,060	27,748	36,603	12,262	24,538
6	613,250	51,993	29,085	24,586	37,530	15,916	22,871
7	580,880	35,677	22,603	14,003	22,629	13,098	9,641
8	492,710	24,495	17,168	8,150	17,357	10,609	7,305
9	479,220	20,379	14,184	7,593	13,138	7,549	6,665
10	316,920	5,213	3,164	2,435	4,204	2,120	2,100
North West	6,760,360	414,040	265,958	157,232	284,274	158,534	131,195
Percentage of decile population							
1	1,401,540	5.3	3.9	1.5	3.6	2.6	1.0
2	822,230	7.6	4.4	3.4	5.1	2.5	2.7
3	780,730	5.5	4.6	0.9	3.7	3.0	0.7
4	652,710	7.1	4.7	2.6	4.8	2.5	2.4
5	620,170	8.0	3.6	4.5	5.9	2.0	4.0
6	613,250	8.5	4.7	4.0	6.1	2.6	3.7
7	580,880	6.1	3.9	2.4	3.9	2.3	1.7
8	492,710	5.0	3.5	1.7	3.5	2.2	1.5
9	479,220	4.3	3.0	1.6	2.7	1.6	1.4
10	316,920	1.6	1.0	0.8	1.3	0.7	0.7
North West	6,760,360	6.12	3.93	2.33	4.21	2.35	1.94
CERI values							
Decile 1 and 2	2,223,770	1.015	1.060	0.914	0.996	1.156	0.800
Decile 1–5	4,277,380	1.164	1.210	1.027	1.159	1.286	0.987
Decile 6–10	2,482,980	0.859	0.826	0.973	0.863	0.777	1.013

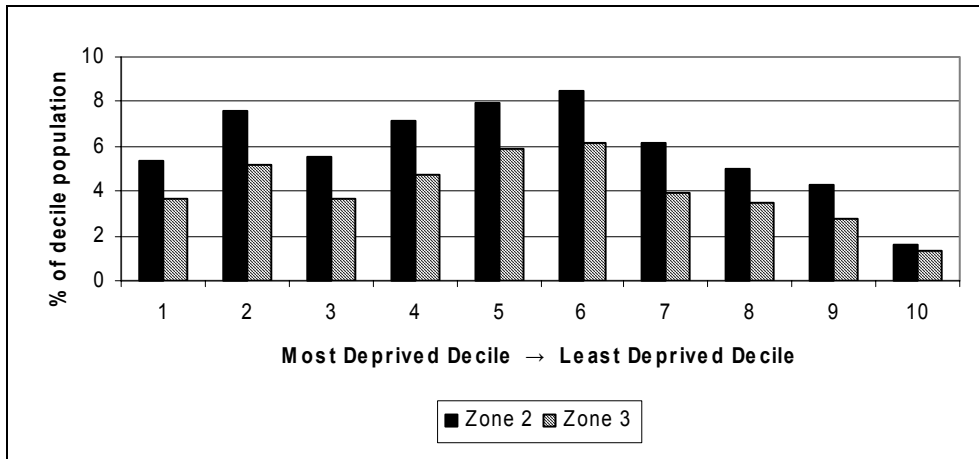


Figure A2.4 Percentage of total population in the North West within zones 2 and 3 for all types of flooding by deprivation decile



Figure A2.5 Percentage of total population in the North West within zones 2 and 3 for flooding from rivers by deprivation decile

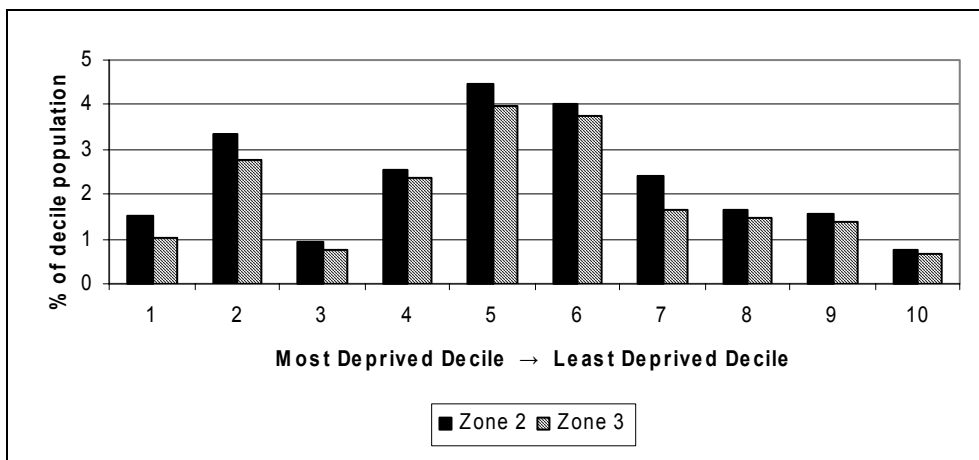


Figure A2.6 Percentage of total population in the North West within zones 2 and 3 for flooding from the sea by deprivation decile

Yorkshire and Humberside

Table A2.3 Yorkshire and Humberside population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	860,490	162,993	25,160	139,132	159,587	18,202	141,466
2	607,000	75,540	26,574	53,971	70,068	17,188	53,728
3	533,410	67,475	23,238	47,831	63,503	16,534	47,612
4	511,450	78,110	25,468	56,491	74,282	19,584	57,178
5	462,400	60,685	23,042	37,845	54,853	17,057	38,086
6	527,830	47,518	23,960	27,045	41,747	17,512	26,800
7	462,490	49,824	20,438	31,462	45,410	13,382	32,318
8	450,810	38,209	24,473	14,074	31,840	16,141	15,738
9	318,670	25,757	18,461	8,132	19,136	8,912	10,739
10	230,700	15,586	13,982	1,604	9,088	6,922	2,166
Yorkshire & Humberside	4,965,250	621,695	224,794	417,588	569,516	151,434	425,831
Percentage of decile population							
1	860,490	18.9	2.9	16.2	18.5	2.1	16.4
2	607,000	12.4	4.4	8.9	11.5	2.8	8.9
3	533,410	12.6	4.4	9.0	11.9	3.1	8.9
4	511,450	15.3	5.0	11.0	14.5	3.8	11.2
5	462,400	13.1	5.0	8.2	11.9	3.7	8.2
6	527,830	9.0	4.5	5.1	7.9	3.3	5.1
7	462,490	10.8	4.4	6.8	9.8	2.9	7.0
8	450,810	8.5	5.4	3.1	7.1	3.6	3.5
9	318,670	8.1	5.8	2.6	6.0	2.8	3.4
10	230,700	6.8	6.1	0.7	3.9	3.0	0.9
Yorkshire & Humberside	4,965,250	12.52	4.53	8.41	11.47	3.05	8.58
CERI values							
Decile 1 and 2	1,467,490	1.484	0.713	2.050	1.611	0.727	2.017
Decile 1–5	2,974,750	1.683	0.816	2.725	1.919	0.943	2.578
Decile 6–10	1,990,500	0.594	1.226	0.367	0.521	1.061	0.388

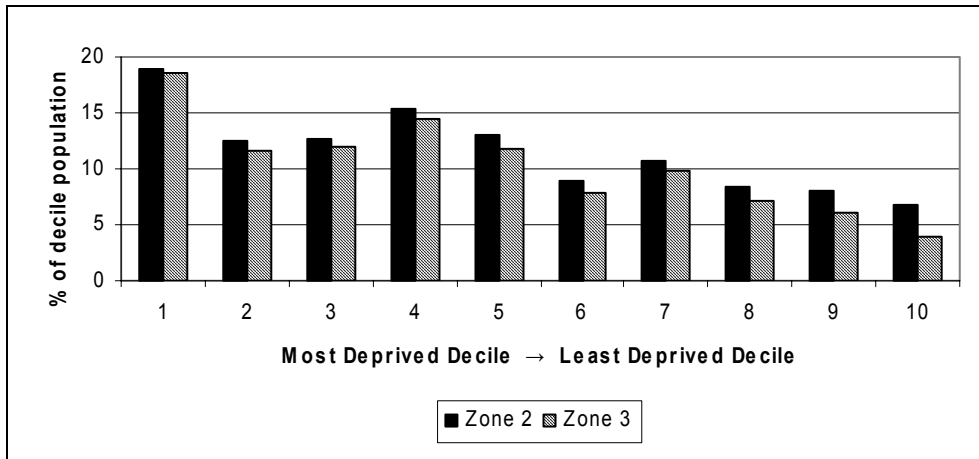


Figure A2.7 Percentage of total population in Yorkshire and Humberside within zones 2 and 3 for all types of flooding by deprivation decile



Figure A2.8 Percentage of total population in Yorkshire and Humberside within zones 2 and 3 for flooding from rivers by deprivation decile

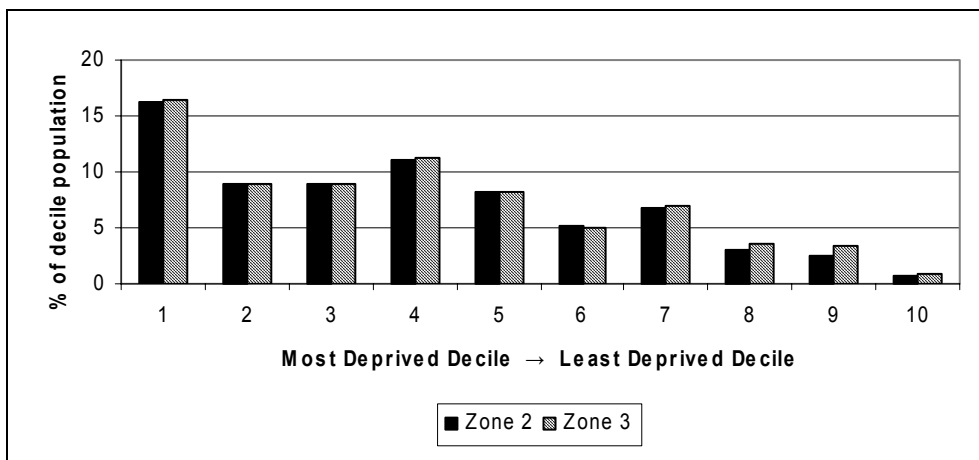


Figure A2.9 Percentage of total population in Yorkshire and Humberside within zones 2 and 3 for flooding from the sea by deprivation decile

East Midlands

Table A2.4 East Midlands population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	332,650	23,457	14,558	10,393	19,285	10,115	10,380
2	394,390	49,217	29,468	22,933	43,563	22,719	23,469
3	414,930	50,009	33,733	19,741	40,143	21,094	22,043
4	458,590	65,368	36,224	33,526	57,283	27,224	33,283
5	402,690	43,220	21,440	23,355	37,304	15,910	22,549
6	383,240	50,613	36,262	16,898	42,027	28,825	14,899
7	441,660	43,802	33,633	12,337	35,661	25,396	12,221
8	467,640	35,146	30,519	6,552	31,405	26,634	6,479
9	496,780	31,851	31,101	1,988	24,398	23,596	1,916
10	383,560	15,140	15,126	15	11,038	11,023	15
East Midlands							
	4,176,130	407,823	282,063	147,737	342,108	212,537	147,254
Percentage of decile population							
1	332,650	7.1	4.4	3.1	5.8	3.0	3.1
2	394,390	12.5	7.5	5.8	11.0	5.8	6.0
3	414,930	12.1	8.1	4.8	9.7	5.1	5.3
4	458,590	14.3	7.9	7.3	12.5	5.9	7.3
5	402,690	10.7	5.3	5.8	9.3	4.0	5.6
6	383,240	13.2	9.5	4.4	11.0	7.5	3.9
7	441,660	9.9	7.6	2.8	8.1	5.8	2.8
8	467,640	7.5	6.5	1.4	6.7	5.7	1.4
9	496,780	6.4	6.3	0.4	4.9	4.7	0.4
10	383,560	3.9	3.9	0.0	2.9	2.9	0.0
East Midlands							
	4,176,130	9.77	6.75	3.54	8.19	5.09	3.53
CERI values							
Decile 1 and 2	727,040	1.029	0.877	1.382	1.068	0.867	1.416
Decile 1–5	2,003,250	1.421	1.002	3.156	1.483	0.912	3.411
Decile 6–10	2,172,880	0.704	0.998	0.317	0.674	1.097	0.293

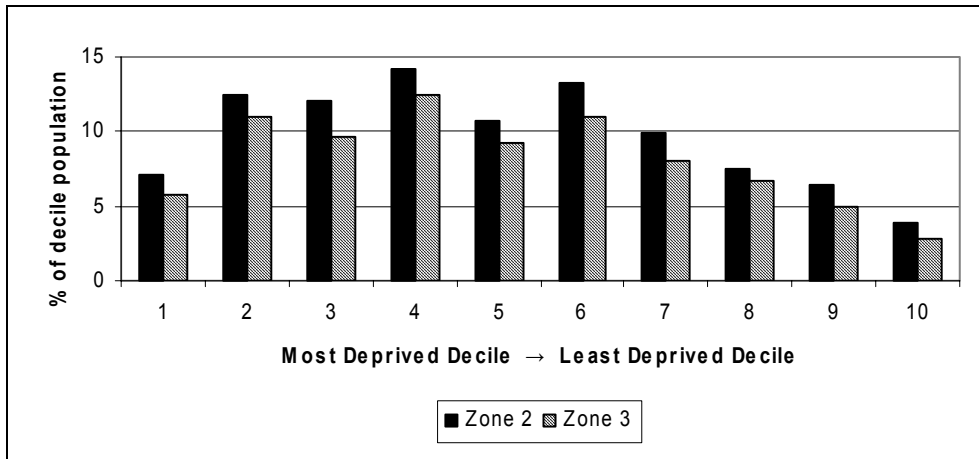


Figure A2.10 Percentage of total population in the East Midlands within zones 2 and 3 for all types of flooding by deprivation decile

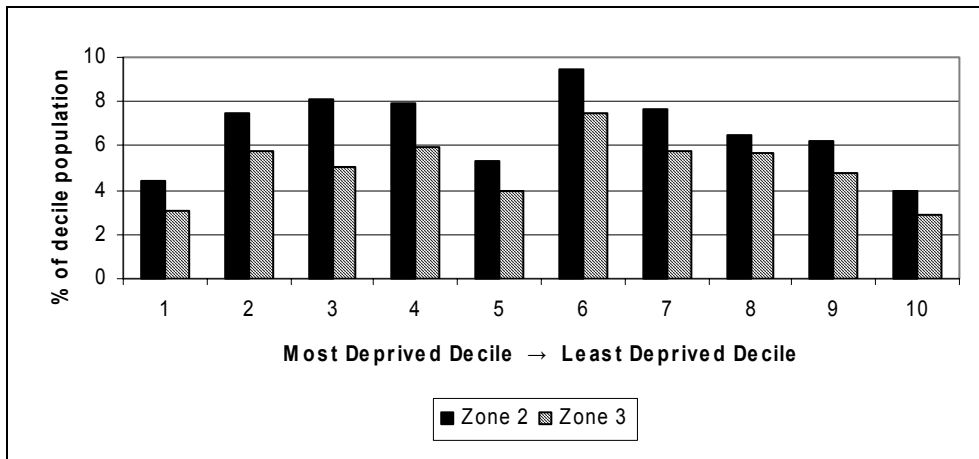


Figure A2.11 Percentage of total population in the East Midlands within zones 2 and 3 for flooding from rivers by deprivation decile

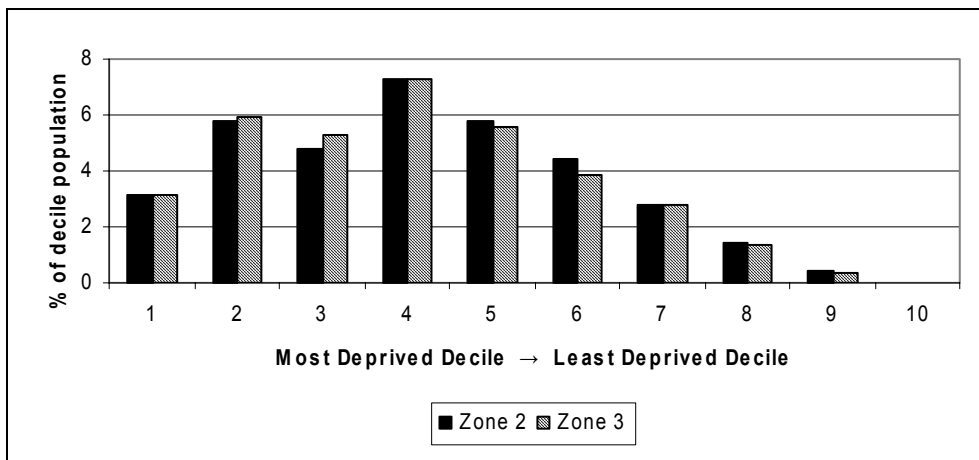


Figure A2.12 Percentage of total population in the East Midlands within zones 2 and 3 for flooding from the sea by deprivation decile

West Midlands

Table A2.5 West Midlands population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	723,580	17,669	17,669		13,490	13,490	
2	679,250	27,383	27,383		20,937	20,937	
3	529,050	18,458	18,458		11,055	11,055	
4	493,930	19,710	19,710		9,209	9,209	
5	548,010	16,099	16,099		10,054	10,054	
6	531,040	22,688	22,688		11,567	11,567	
7	519,820	19,718	19,718		12,107	12,107	
8	479,750	15,229	15,229		10,340	10,340	
9	422,920	13,168	13,168		8,627	8,627	
10	351,800	6,661	6,661		4,457	4,457	
West Midlands		5,279,150	176,784	176,784	111,843	111,843	
Percentage of decile population							
1	723,580	2.4	2.4		1.9	1.9	
2	679,250	4.0	4.0		3.1	3.1	
3	529,050	3.5	3.5		2.1	2.1	
4	493,930	4.0	4.0		1.9	1.9	
5	548,010	2.9	2.9		1.8	1.8	
6	531,040	4.3	4.3		2.2	2.2	
7	519,820	3.8	3.8		2.3	2.3	
8	479,750	3.2	3.2		2.2	2.2	
9	422,920	3.1	3.1		2.0	2.0	
10	351,800	1.9	1.9		1.3	1.3	
West Midlands		5,279,150	3.35	3.35	2.12	2.12	
CERI values							
Decile 1 and 2	1,402,830	0.945	0.945		1.229	1.229	
Decile 1–5	2,973,820	0.994	0.994		1.066	1.066	
Decile 6–10	2,305,330	1.006	1.006		0.938	0.938	

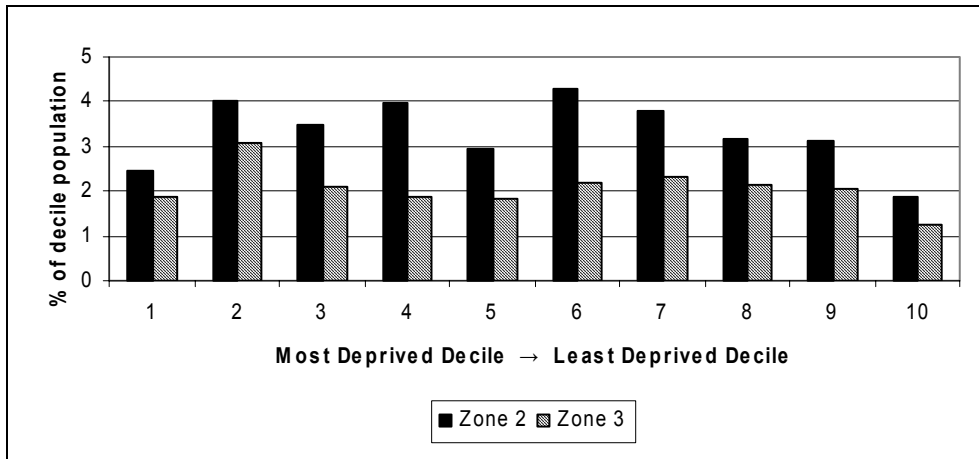


Figure A2.13 Percentage of total population in the West Midlands within zones 2 and 3 for all types of flooding by deprivation decile

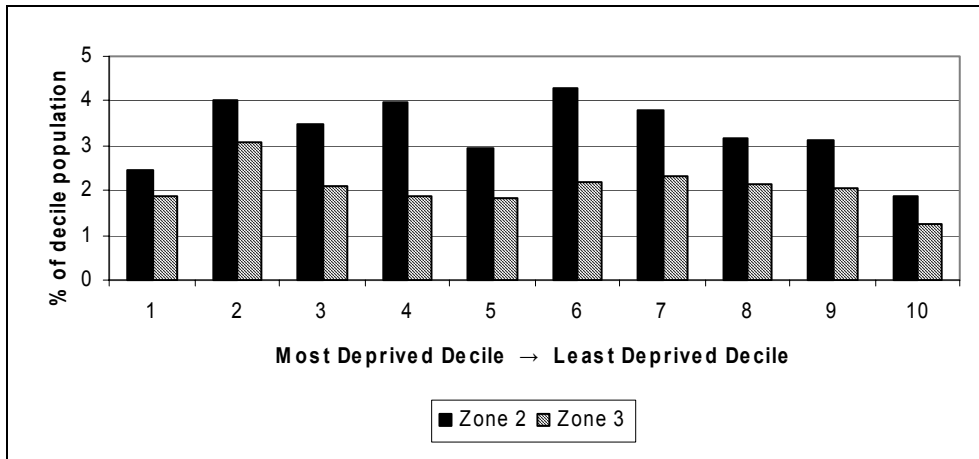


Figure A2.14 Percentage of total population in the West Midlands within zones 2 and 3 for flooding from rivers by deprivation decile

East of England

Table A2.6 East of England population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	108,610	26,862	7,182	20,109	20,823	2,796	18,369
2	224,490	19,056	8,462	10,823	13,822	3,253	10,625
3	344,550	37,402	15,690	22,391	27,409	6,285	21,559
4	469,910	36,970	14,170	24,524	31,039	8,706	23,529
5	572,210	54,106	22,446	33,160	44,730	14,614	31,107
6	612,210	44,717	21,771	23,905	36,332	14,017	23,069
7	672,590	38,109	25,422	13,077	29,682	17,132	12,802
8	728,290	32,689	25,522	7,387	22,916	15,788	7,311
9	807,540	38,599	30,382	8,374	26,544	18,105	8,591
10	856,770	28,398	26,483	1,914	15,116	13,220	1,896
East of England	5,397,170	356,908	197,532	165,666	268,413	113,916	158,857
Percentage of decile population							
1	108,610	24.7	6.6	18.5	19.2	2.6	16.9
2	224,490	8.5	3.8	4.8	6.2	1.4	4.7
3	344,550	10.9	4.6	6.5	8.0	1.8	6.3
4	469,910	7.9	3.0	5.2	6.6	1.9	5.0
5	572,210	9.5	3.9	5.8	7.8	2.6	5.4
6	612,210	7.3	3.6	3.9	5.9	2.3	3.8
7	672,590	5.7	3.8	1.9	4.4	2.5	1.9
8	728,290	4.5	3.5	1.0	3.1	2.2	1.0
9	807,540	4.8	3.8	1.0	3.3	2.2	1.1
10	856,770	3.3	3.1	0.2	1.8	1.5	0.2
East of England	5,397,170	6.61	3.66	3.07	4.97	2.11	2.94
CERI values							
Decile 1 and 2	333,100	2.245	1.308	3.490	2.253	0.852	3.394
Decile 1–5	1,719,770	2.043	1.121	4.343	2.257	0.974	4.191
Decile 6–10	3,677,400	0.489	0.892	0.230	0.443	1.027	0.239

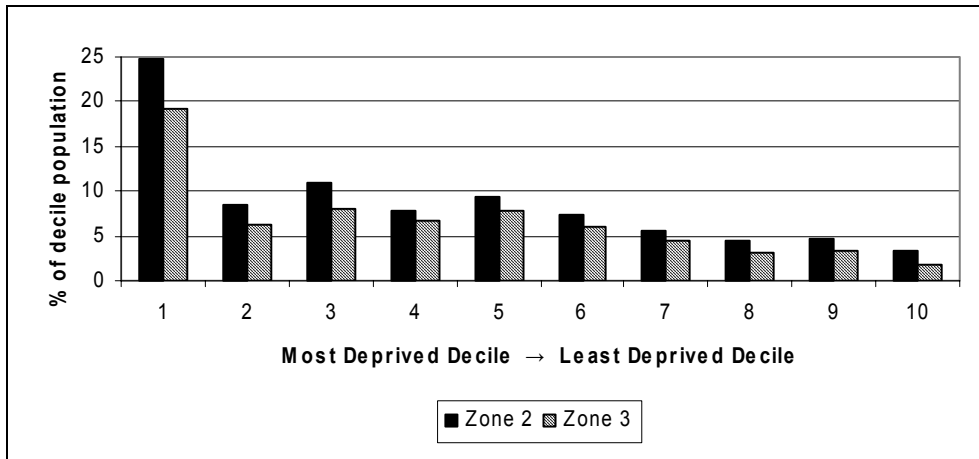


Figure A2.15 Percentage of total population in the East of England within zones 2 and 3 for all types of flooding by deprivation decile



Figure A2.16 Percentage of total population in the East of England within zones 2 and 3 for flooding from rivers by deprivation decile

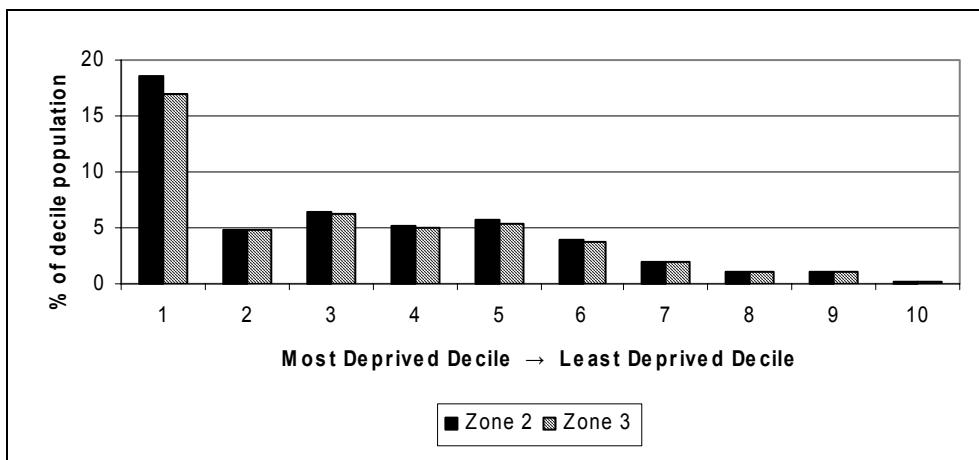


Figure A2.17 Percentage of total population in the East of England within zones 2 and 3 for flooding from the sea by deprivation decile

London

Table A2.7 London population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	709,740	151,161	52,894	131,420	140,802	45,919	126,456
2	1,224,350	304,374	52,969	266,136	283,347	42,698	253,910
3	1,169,000	199,392	39,238	165,489	187,195	31,360	159,730
4	923,960	153,104	33,984	123,249	143,848	26,206	120,401
5	753,370	87,081	31,266	57,401	79,261	25,080	54,954
6	686,970	86,971	23,223	65,473	81,077	17,645	64,862
7	570,830	55,121	22,472	34,087	49,778	16,969	33,768
8	486,200	39,563	18,414	23,607	35,487	14,073	23,179
9	487,390	39,261	26,558	17,759	31,758	15,478	19,503
10	293,980	25,934	20,114	11,023	21,622	13,515	13,370
London	7,305,790	1,141,962	321,133	895,644	1,054,176	248,943	870,132
Percentage of decile population							
1	709,740	21.3	7.5	18.5	19.8	6.5	17.8
2	1,224,350	24.9	4.3	21.7	23.1	3.5	20.7
3	1,169,000	17.1	3.4	14.2	16.0	2.7	13.7
4	923,960	16.6	3.7	13.3	15.6	2.8	13.0
5	753,370	11.6	4.2	7.6	10.5	3.3	7.3
6	686,970	12.7	3.4	9.5	11.8	2.6	9.4
7	570,830	9.7	3.9	6.0	8.7	3.0	5.9
8	486,200	8.1	3.8	4.9	7.3	2.9	4.8
9	487,390	8.1	5.4	3.6	6.5	3.2	4.0
10	293,980	8.8	6.8	3.7	7.4	4.6	4.5
London	7,305,790	15.63	4.40	12.26	14.43	3.41	11.91
CERI values							
Decile 1 and 2	1,934,090	1.843	1.366	2.217	1.870	1.535	2.157
Decile 1–5	4,780,420	1.916	1.003	2.586	2.006	1.165	2.443
Decile 6–10	2,525,370	0.522	0.997	0.387	0.498	0.859	0.409

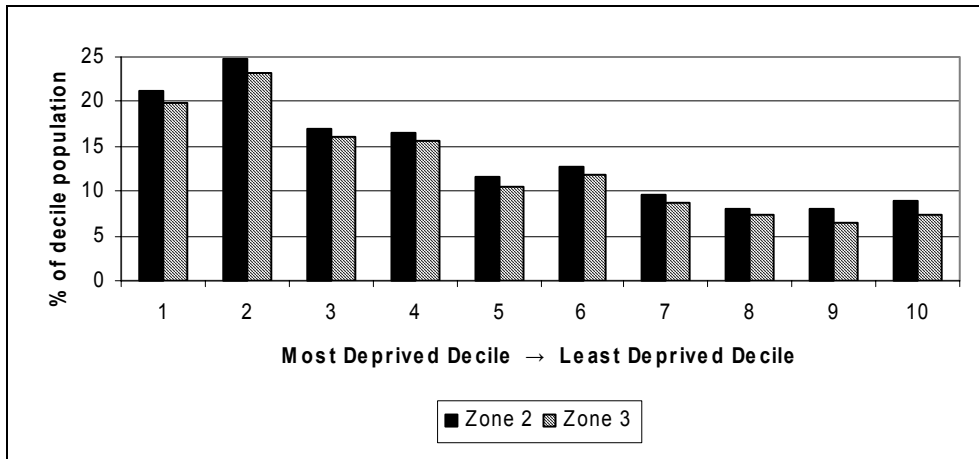


Figure A2.18 Percentage of total population in London within zones 2 and 3 for all types of flooding by deprivation decile

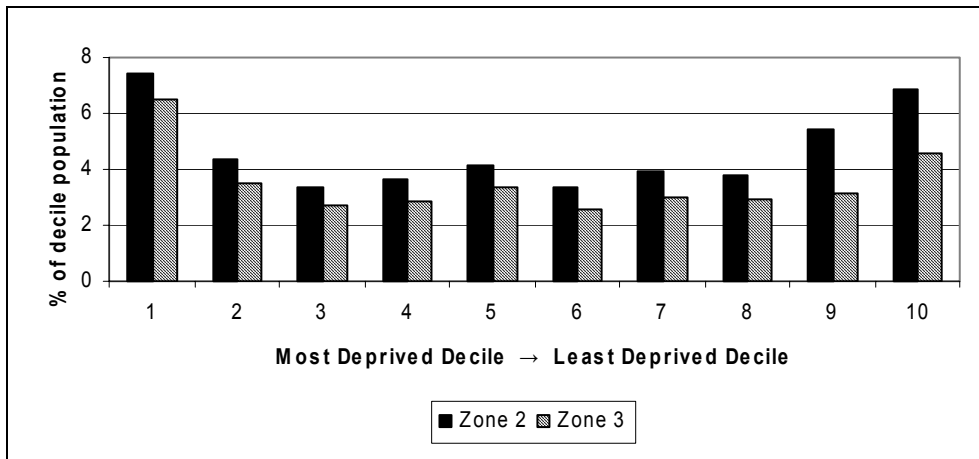


Figure A2.19 Percentage of total population in London within zones 2 and 3 for flooding from rivers by deprivation decile

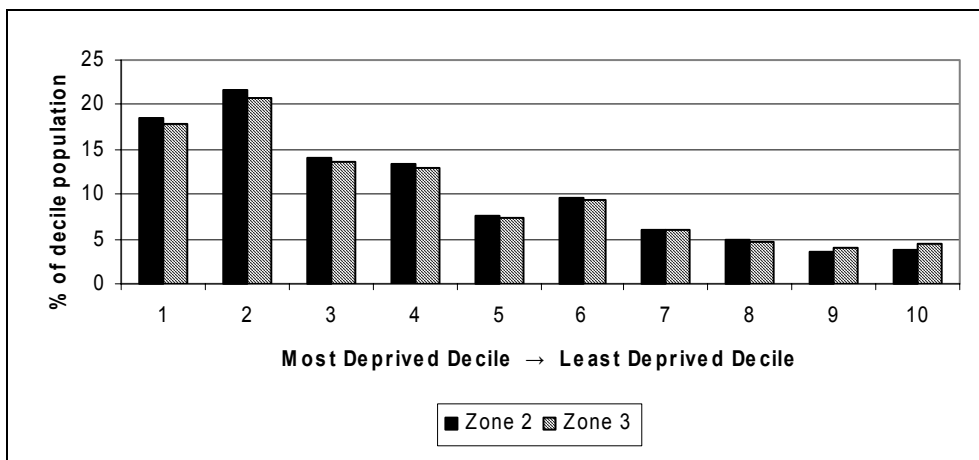


Figure A2.20 Percentage of total population in London within zones 2 and 3 for flooding from the sea by deprivation decile

South East

Table A2.8 South East population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	116,560	7,691	339	7,352	6,653	301	6,352
2	292,020	29,628	8,957	22,210	23,672	7,254	17,663
3	466,230	39,124	14,044	27,870	30,620	10,815	21,667
4	578,700	57,755	19,222	41,508	45,749	13,201	33,405
5	694,300	72,208	35,314	39,962	52,063	21,712	31,121
6	723,300	70,264	38,360	34,336	51,091	26,139	26,168
7	829,470	62,364	42,270	21,997	42,871	28,455	14,951
8	1,081,360	80,716	58,532	23,288	55,013	40,813	14,518
9	1,244,020	68,473	59,775	9,651	43,376	35,854	8,580
10	1,987,300	104,968	104,053	1,047	62,818	62,062	769
South East	8,013,260	593,190	380,866	229,221	413,926	246,607	175,194
Percentage of decile population							
1	116,560	6.6	0.3	6.3	5.7	0.3	5.4
2	292,020	10.1	3.1	7.6	8.1	2.5	6.0
3	466,230	8.4	3.0	6.0	6.6	2.3	4.6
4	578,700	10.0	3.3	7.2	7.9	2.3	5.8
5	694,300	10.4	5.1	5.8	7.5	3.1	4.5
6	723,300	9.7	5.3	4.7	7.1	3.6	3.6
7	829,470	7.5	5.1	2.7	5.2	3.4	1.8
8	1,081,360	7.5	5.4	2.2	5.1	3.8	1.3
9	1,244,020	5.5	4.8	0.8	3.5	2.9	0.7
10	1,987,300	5.3	5.2	0.1	3.2	3.1	0.0
South East	8,013,260	7.40	4.75	2.86	5.17	3.08	2.19
CERI values							
Decile 1 and 2	408,580	1.250	0.466	2.756	1.471	0.588	2.957
Decile 1–5	2,147,810	1.457	0.702	4.200	1.699	0.753	4.631
Decile 6–10	5,865,450	0.686	1.425	0.238	0.589	1.329	0.216

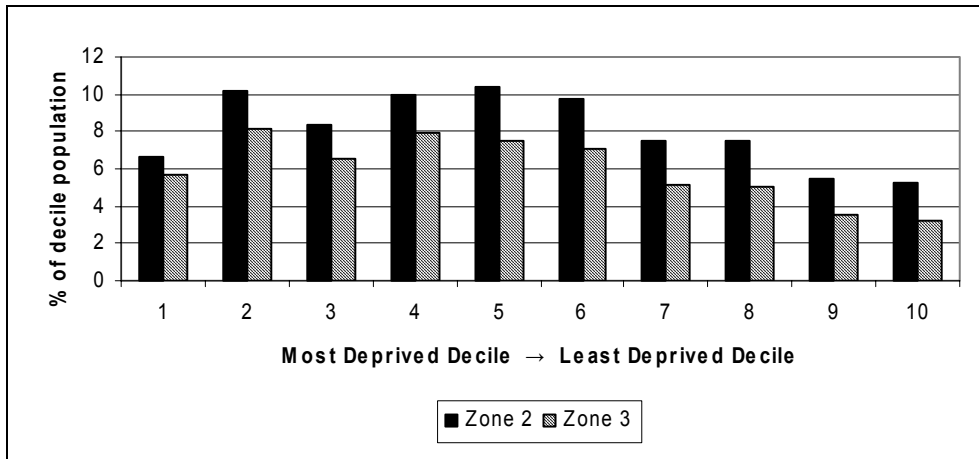


Figure A2.21 Percentage of total population in the South East within zones 2 and 3 for all types of flooding by deprivation decile

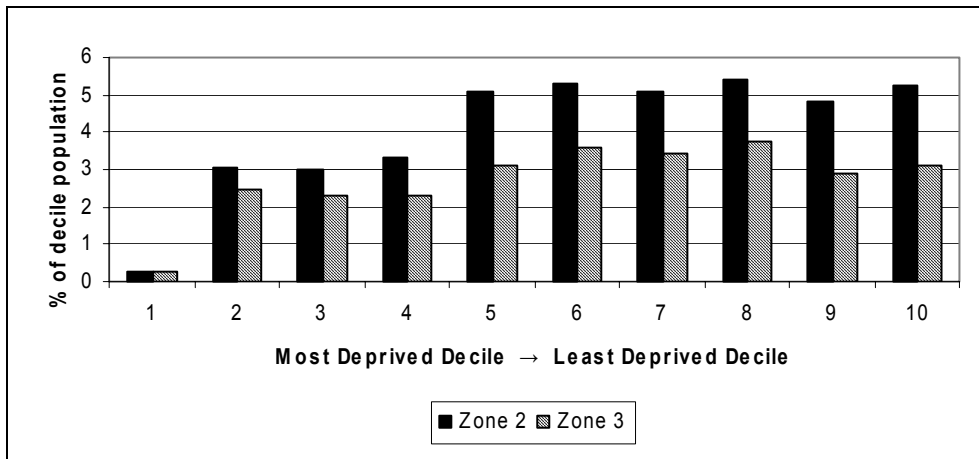


Figure A2.22 Percentage of total population in the South East within zones 2 and 3 for flooding from rivers by deprivation decile

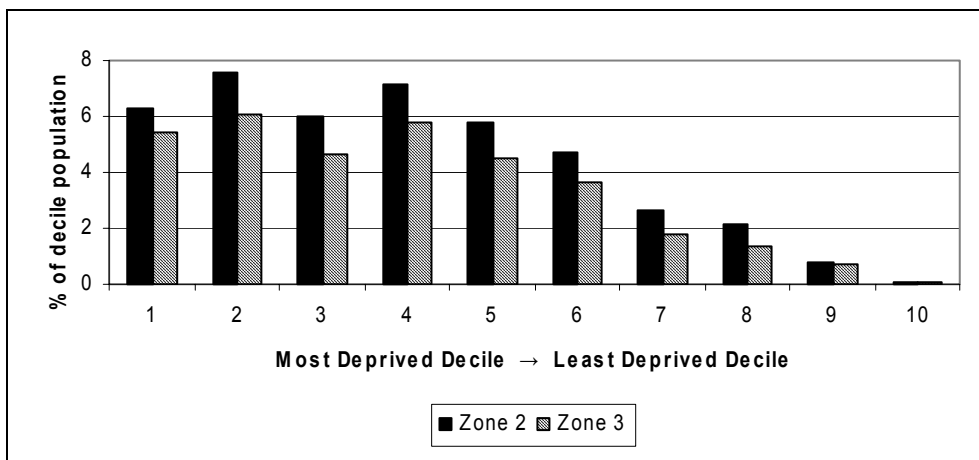


Figure A2.23 Percentage of total population in the South East within zones 2 and 3 for flooding from the sea by deprivation decile

South West

Table A2.9 South West population within zones 2 and 3 for all types of flooding

Total population		Within zone 2			Within zone 3		
Decile	Population	All	From rivers	From the sea	All	From rivers	From the sea
1	143,140	17,401	11,075	9,437	8,520	3,106	8,399
2	277,410	24,087	12,779	12,274	16,300	4,737	12,342
3	369,730	31,078	22,942	12,295	21,654	11,048	12,866
4	557,680	40,312	25,085	19,032	26,916	15,401	14,498
5	659,180	39,125	30,546	9,841	26,020	15,657	10,909
6	642,590	47,489	30,808	18,137	30,466	16,979	14,230
7	668,840	46,729	30,222	19,707	29,133	17,231	14,867
8	590,580	45,570	21,775	25,769	28,108	14,359	14,985
9	565,040	32,193	19,999	12,920	21,979	13,346	8,936
10	458,800	11,590	9,485	2,592	6,912	5,274	1,980
South West	4,932,990	335,574	214,714	142,004	216,007	117,137	114,012
Percentage of decile population							
1	143,140	12.2	7.7	6.6	6.0	2.2	5.9
2	277,410	8.7	4.6	4.4	5.9	1.7	4.4
3	369,730	8.4	6.2	3.3	5.9	3.0	3.5
4	557,680	7.2	4.5	3.4	4.8	2.8	2.6
5	659,180	5.9	4.6	1.5	3.9	2.4	1.7
6	642,590	7.4	4.8	2.8	4.7	2.6	2.2
7	668,840	7.0	4.5	2.9	4.4	2.6	2.2
8	590,580	7.7	3.7	4.4	4.8	2.4	2.5
9	565,040	5.7	3.5	2.3	3.9	2.4	1.6
10	458,800	2.5	2.1	0.6	1.5	1.1	0.4
South West	4,932,990	6.80	4.35	2.88	4.38	2.37	2.31
CERI values							
Decile 1 and 2	420,550	1.514	1.341	1.937	1.393	0.770	2.386
Decile 1–5	2,007,140	1.207	1.330	1.158	1.243	1.084	1.564
Decile 6–10	2,925,850	0.828	0.752	0.863	0.805	0.923	0.639

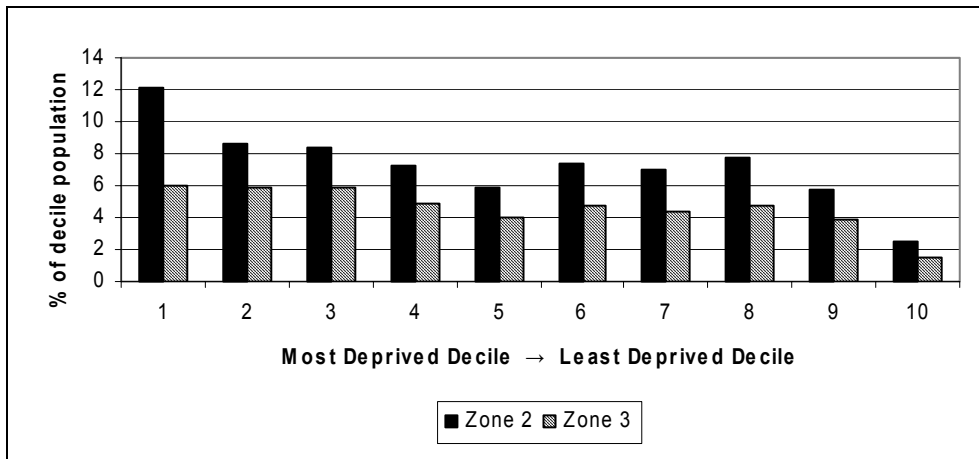


Figure A2.24 Percentage of total population in the South West within zones 2 and 3 for all types of flooding by deprivation decile

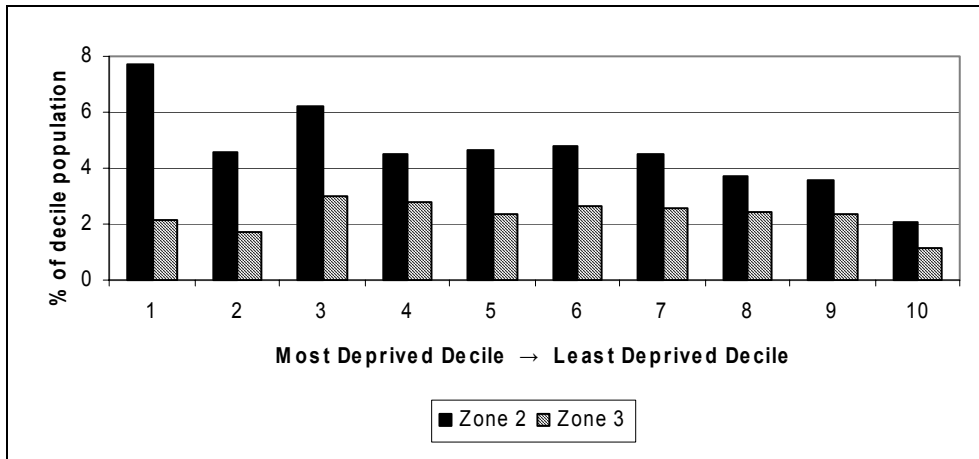


Figure A2.25 Percentage of total population in the South West within zones 2 and 3 for flooding from rivers by deprivation decile

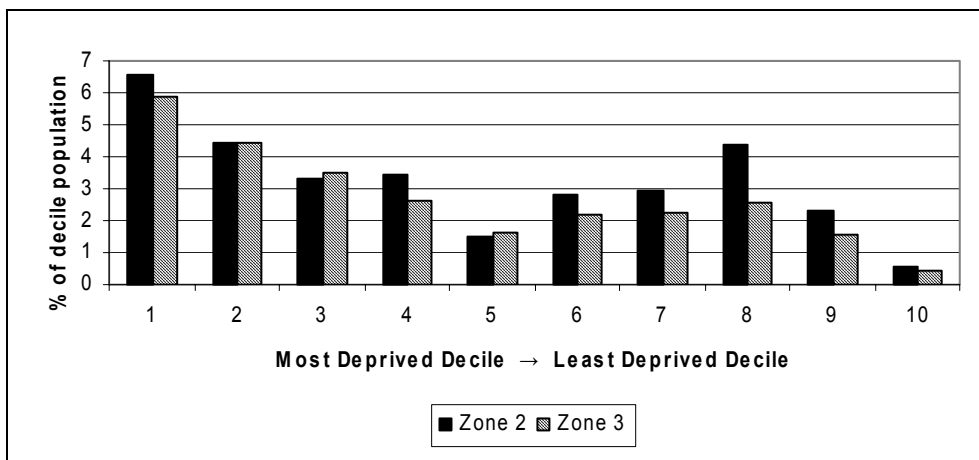


Figure A2.26 Percentage of total population in the South West within zones 2 and 3 for flooding from the sea by deprivation decile

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