REF2021

Institution: Staffordshire University
Unit of Assessment: UOA17 - Business and Management Studies
Title of case study: Tackling environmental inequality: reducing risk in deprived areas
Period when the underpinning research was undertaken: 2003 to 2019
Details of staff conducting the underpinning research from the submitting unit:

Names:	Roles:	Period employed by HEI:
Jon Fairburn	Professor of Sustainable Development	2000 - ongoing
Gordon Walker	Professor	2000 – 2006
Graham Smith	Researcher	2000 – 2016

Period when the claimed impact occurred: 01/08/2013 – 31/12/2020
Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact

Staffordshire University research into environmental inequalities demonstrated that people living in deprived areas disproportionately experience poor air quality and are at greater risk of their homes being flooded. The research has been used to create an air quality index which forms part of the Index of Multiple Deprivation and has been used to target support for deprived populations during the 2013-2020 REF period. In particular, the research has informed targeted funding decisions by the Environment Agency to incentivise flood defence projects that benefit deprived areas, resulting in 53,940 deprived households being moved out of the highest categories of flood risk between 2013 and 2019. Collaborative work with the World Health Organisation Regional Office for Europe has addressed environmental inequalities internationally (53 countries) through the development of tools and resources to raise awareness, support policy makers and inform practice.

2. Underpinning research

Research on the situation in the UK

Since 2003, Staffordshire University has worked with a range of government agencies, including the Environment Agency in England and Wales (EA), Scottish Natural Heritage and government departments, Office of the Deputy Prime Minister, Department for Communities and Local Government (DCLG), to provide research and outputs on environmental inequalities (i.e., the unequal distribution of environmental quality amongst different social groups) and sustainability. This interdisciplinary research links economic indicators with a range of indicators from other fields such as social, environmental and health. In particular, the researchers made use of newly available spatial digital datasets to develop the most detailed understanding of the distribution of environmental quality as measured against socio-economic groups in the UK. Geographic Information Systems (GIS) were used to accurately assess the location of populations with regards to environmental factors, such as risk of flooding, ambient air pollution or living near industrial sites. This determined the number of people affected by these factors and the level of risk that they were exposed to [**3.1, 3.3**].

The research methodology used analysis [**3.1, 3.3**] of very small spatial units which improved accuracy and understanding. It applied this analysis to gain complete coverage of the population at the national level, first using wards [**3.1**] and then achieved through dividing England using Super Output Areas (covering approximately 1,500 people each) [**3.3**]. Integration and manipulation of these data with other environmental and socio-economic datasets via GIS has allowed the creation of new datasets showing patterns of social inequality for environmental exposures, such as siting of industrial plants [**3.2**]. The country-wide coverage at this level of granularity, especially at boundaries and within cities, enables precise targeting of geographic areas.

The 2003 work for the EA [**3.1**] was significant in alerting authorities to the existence of a very strong social gradient in ambient air pollution, with the poorest areas disproportionately experiencing air pollution above the recommended limit as set down in legislation. For all pollutants studied, air quality was poorest for the most deprived 10% of the population. The work also created environmental indicators to be included in the first English Index of Multiple Deprivation (IMD) in 2004, addressing a need identified in a Department of Environment, Transport and the Regions (2000) report. Fairburn has also been responsible for undertaking

further research to create updated environmental indicators for each subsequent IMD (2007, 2010, 2015, 2019).

A similar social inequality was found for flood risk when analysing the 2005 EA Flood Map in combination with the 2004 IMD to obtain data at a fine resolution of spatial units [**3.3**]. The analysis revealed that people in deciles 1 and 2 (the most deprived areas) were 62% more likely to be living at risk of flooding than the rest of the population for flood zone 3 (a flood risk of 1% or greater annual probability from rivers or 0.5% or greater from the sea) [**3.3** p.55]. This research paved the way for showing how more targeted, and therefore more equitable, action can be enabled by a high granularity of data achieved through combining datasets.

Research with WHO on the situation across Europe
In a joint briefing paper with the technical officer for the World Health Organisation (WHO) for the *Fifth Ministerial Conference on Environment and Health* held at Parma, Italy (later published as peer-reviewed paper 2010 [**3.4**]), Fairburn reviewed studies of the exposure to multiple environmental risks in the home and residential context. The paper identified the poor and less affluent population groups as most exposed to environmental risks. The declaration from the Parma conference (2010) pledged to reduce the adverse health impact of environmental threats and was endorsed by 53 member states. It explicitly stated a need for research on established and emerging environment and health risks to support evidence-based policy-making and preventative action. Fairburn's on-going research with the WHO focuses on addressing this need and therefore helping governments to meet the requirements of the Parma Declaration (and later the Ostrava Declaration (2017, *Sixth Ministerial Conference*)). Fairburn chaired the expert group for the first WHO (2012) *Environmental Health Inequalities in Europe Assessment Report*. This report highlighted the paucity of datasets for international comparison: due to Fairburn's research, the UK was much further advanced in the data and methodologies to assess the issue of the distribution of environmental health inequalities. In [**3.5**], Fairburn and the WHO technical officer summarised the development of environmental indicators and reviewed the incorporation of environmental data into indices (especially into the English IMD), as well as progress across Europe in this area. The research confirmed the evidence gap across Europe. It highlighted the importance of creating such datasets for the use of national and other policy makers, which the WHO subsequently worked towards in response to first the Parma and Ostrava Declarations [**5.9**]. Fairburn also led a formal systematic review [**3.6**] on air quality and social inequalities in the WHO region which used PRISMA reporting standards (**Preferred Reporting Items for Systematic Reviews and Meta-Analyses)**. This work found that across Western Europe, deprived areas are more likely to experience poor ambient air quality, and that certain ethnic groups are more likely to be exposed to poorer air quality. Therefore, this review shows that the burden of higher pollutants falls disproportionally on different social groups.

3. References to the research

Four of the references are peer review papers. The other two reports are for the EA which have been highly cited (over 90 citations each according to google scholar).

3.1 WALKER, G, Mitchell, G, FAIRBURN, J and SMITH, G (2003) Environmental Quality & Social Deprivation Phase II: National Analysis of Flood Hazard, IPC Industries & Air Quality. Project Report. Environment Agency. http://eprints.staffs.ac.uk/1834

3.2 WALKER, G, Michell, G, FAIRBURN, J and SMITH, G (2007) Industrial pollution and social deprivation: evidence and complexity in evaluating and responding to environmental inequality. *Local Environment*, 10. pp. 361-377. http://eprints.staffs.ac.uk/1831

3.3 WALKER, G, Burningham, K, Fielding, J, SMITH, G, Thrush, D and Fay, H (2006) *Addressing Environmental Inequalities: Flood Risk*. Science Report: SC020061/SR1. Environment Agency https://eprints.staffs.ac.uk/6783

3.4 Braubach, M and FAIRBURN, J (2010) Social inequities in environmental risks associated with housing and residential location--a review of evidence. *The European Journal of Public Health*, 20 (1). pp. 36-42. http://eprints.staffs.ac.uk/394

3.5 FAIRBURN, J, Maier, W and Braubach, M (2016) Incorporating Environmental Justice into Second Generation Indices of Multiple Deprivation: Lessons from the UK and Progress

Internationally. *International Journal of Environmental Research and Public Health*, 13 (8). http://eprints.staffs.ac.uk/2377

3.6 FAIRBURN, J, Schüle, S, Dreger, S, Hilz, LK and Bolte, G (2019) Social Inequalities in Exposure to Ambient Air Pollution: A Systematic Review in the WHO European Region. *International Journal of Environmental Research and Public Health*, 16 (17). http://eprints.staffs.ac.uk/5843

Total funding GBP109,000. Including GBP54,000 from the EA (2003 and 2006) and GBP20,000 from Department for Communities and Local Government (and their predecessors) (2004).

4. Details of the impact

4.1 Air pollution and equity

Fairburn's air quality index (based on research findings reported in [**3.1**], with additional research informing subsequent updated versions) has been incorporated into the Living Environment domain of the 2015 and 2019 IMD releases [**5.1a** p. 6; **5.1b** p. 6]. The index widens the definition and conceptualisation of deprivation in the UK, which had previously been focused on economic characteristics. The IMD is extensively used by UK government departments, charities and research funders in the allocation of resources and development of policy, especially to target deprived populations [**3.5**]. The following two regional strategies specifically reference how the Staffordshire team's work (within the IMD) is being used to determine where to target support:

The **Clean air for Cornwall Strategy 2017** [**5.2a**], uses the 2015 update of the IMD and makes specific reference to the Staffordshire air quality research [**3.1**] on [**5.2a** p. 15]. The Strategy makes a clear commitment to equity principles (*e.g.* **5.2a** pp. 16, 18, 34). The 2019 strategy update shows continued awareness of air pollution as an equity issue and recommits to improving the situation for vulnerable groups: 'The most vulnerable in our society are often the ones whose health is most at risk from the impacts of poor air quality. Communities characterised by high levels of deprivation often experience higher than average pollution, or pollution levels that are relatively higher than those in less deprived communities.' [**5.2b** p. 7]

Similarly, in 2019 the **West Midlands Combined Authority** issued a Regional Air Quality Review and Action Plan [**5.3**] which uses the IMD and states that 'Conversely, the most significant health benefits may be attained by targeting interventions in areas where existing poor air quality coincides with low IMD and health index scores. Key priority areas will be identified with this in mind.' [**5.3** p.52 paragraph 6.26].

4.2 Impact on reducing flood risk in deprived areas

The research undertaken for the EA [**3.1, 3.2**] informed spending on flood investment, leading to impact in the current REF period, as confirmed by testimonial evidence from the EA: '*Staffordshire University research provided a major part of the evidence base that informed the Environment Agency's corporate targets for flood management schemes in deprived areas. The research made a major contribution to the development of government Flood Risk Management policy and delivery e.g., the targeting of investment in flood protection for those at higher risk. This has contributed to the reduced flood risk of those living in deprived areas in the period 2013-2020.'* [**5.7**]

The research [**3.1, 3.2**] underpinned this impact through the following developments:

1) It raised awareness that deprived households are disproportionately affected by flood risk. This resulted in the introduction (in 2010) of funding criteria for flood defences that incentivised investment in areas with high levels of deprivation.

2) To help address the social inequalities in flood protection, a Department for Environment, Food and Rural Affairs (DEFRA) policy statement [**5.5**] included a new set of corporate targets for flood management schemes for the EA. These new targets (Flood and Coastal Erosion Risk Management Outcome Measures) [**5.4**] took social deprivation into account and were directly informed by the fine-grained analysis in the 2006 EA report [**3.3**]. Under this approach, the government pays 2.25 times more in the top 20% of deprived areas than in the 60% least

deprived areas, therefore providing a clear incentive for schemes that fund improvements for deprived households (see table below).

The policy (with associated Outcome Measures) was introduced in the Spending Review 2010 period, covering delivery between April 2011 and March 2015. Therefore, both the implementation of the policy (part of the targeted investment) and its on-going impact of this can be seen within the current REF period. This financial incentive is still in place to support deprived households.

Present value of direct damages to residential properties and their contents avoided, in the:	Government funding for flood protection measures	Based on moving a single household from very significant risk to low risk for a duration of 50 years, this equates to:
20% most deprived areas	45p per £1	£15,399 per household protected
21-40% most deprived areas	30p per £1	£10,266
60% least deprived areas	20p per £1	£6,844

Source: DEFRA Policy Statement for Flood and Coastal Resilience

Partnership Funding [**5.5** p.11]

Outcome Measure 2c measures the number of households in the 20% most deprived communities, as measured by the IMD, that moved from a 'significant' or 'very significant' flood risk to a moderate or low risk [**5.4**]. A 2020 EA report [**5.6**] was 'based upon and re-used the approach and methodology developed by the Staffordshire University team' [**5.7** p. 2] and assessed the progress towards addressing inequality in flood risk since the 2006 report [**3.3**]. It found that 'recent investment has been relatively successful in addressing social deprivation and flood risk exposure inequality for the 20% most deprived areas in England' [**5.6** p. iv]. The number of households better protected by being moved into a lower risk category in more deprived areas (Outcome Measure 2c) between 2013 and 2019 is recorded as decreased risk to 53,940 households [**5.6** Fig 1 p.1]**.** While in 2006 the two most deprived deciles accounted for 26% of households at High or Medium Risk of flooding from river/sea, this decreased to 17% of the households at that level of risk in 2020 [**5.6** p. 8]

4.3 International – Work with WHO
The reach of the impact of Staffordshire University's research on environmental inequalities is further extended through Fairburn's collaborative work with the World Health Organisation's Regional Office for Europe, which he has undertaken throughout this REF period. The impact of this work is confirmed by testimonial evidence:

'Prof. Jon Fairburn's research experience and knowledge, together with his leadership efforts and collaborative work within and across the expert group have made a valuable contribution to the objectives and overall impact of the WHO work on environmental health inequalities and helped to provide evidence for action to the 53 WHO European Member States.' [**5.8**].

Fairburn has a leading role (including chairing the meetings) in a WHO expert group that was established to meet the stated need for research to support evidence-based policy making that addresses the requirements of the Parma and the Ostrava Declarations. His experience of working with environmental regulators in the UK and his detailed knowledge of evidence gaps, data sources, and digital manipulation through use of GIS are aspects of his contributions that are especially valued [**5.8**]. In addition, his research led to a greater understanding of the need for a targeted approach to reducing air pollution in areas where it is worse for multiple complex reasons [**5.8**]. The following are two detailed examples in which this case study's underpinning research has led to impact via collaborative work with the WHO:

Expanding environmental indicators to inform policymakers
One of the challenges in understanding and addressing environmental inequalities across Europe is finding comparable data, with many studies being carried out at city or regional level (as demonstrated in **3.6**). Following on from the *Sixth Ministerial Conference on Environment and Health* (Ostrava, 2017), a stakeholder group addressed this challenge by expanding the number of environmental indicators used to assess the relationship between environmental

quality and social inequalities. This was achieved through a series of expert group meetings, chaired by Fairburn. The meetings drew on Fairburn's experience with the novel UK dataset [**3.1**], and he presented further, up-to-date research to inform the work. This culminated in the expansion of the number of environmental indicators from 2 (out of 15 overall indicators used previously) to 6 (out of 18). Examples of new indicators included are exposure to air pollution, and inequalities to chemical exposure. They were included in a new WHO report co-authored by Fairburn: WHO (2019) **Environmental Health Inequalities. Second Assessment Report** [**5.9**].

Fairburn was also asked by the WHO to present the results of the systematic review on air quality [**3.6**] and to raise the issue of environmental equity at the **22nd meeting of the Joint Task Force of UN Economic Commission for Europe** (May 2019). This forum is part of the discussion and decision-making process for the new WHO guidelines on air quality that are expected to be published in 2022.

Improving knowledge and skills through professional development
Fairburn is the lead author of a WHO policy toolkit (2019), 'Environmental health inequalities resource package' [**5.10a**]. To address the needs identified in the Ostrava Declaration, it sets out the various dimensions of environmental health inequality; presents relevant methods and approaches for monitoring and assessment; and suggests ways to use this evidence for action to assist policy makers in tackling disparities in exposure to environmental risk at the national and subnational level. The target audience includes urban planners, environmental authorities, and health authorities, and the WHO has received requests from Ireland, Sweden, and Germany to present at events [**5.8**]. Throughout 2020, Fairburn presented at events to promote use of the toolkit and the systematic review. The online meeting format used for the first time has enabled greater attendance (e.g., WHO Environmental Health Inequalities: Evidence for Action webinar on 19/10/2020 with 138 people as participants from around the world; Public Health England's Annual Air Quality Review webinar on 14/10/2020 with 300 people as participants [**5.10b**]). As a result of contributing to the Public Health England event, Fairburn accepted an invitation to join (and later to Chair) the Advisory Committee of TRANSITION Clean Air Network–part of the £3 million UKRI funding for 6 interdisciplinary networks (bridging academia/commercial/public/civic sector) to address emerging air quality challenges at the indoor/outdoor interface. In addition, he accepted an invitation to join the Air Quality Inequalities project led by EA and including DEFRA and Public Health England, which is looking to reduce inequalities through targeted interventions and behavioural changes.

5. Sources to corroborate the impact
5.1a The English Indices of Deprivation Research Report 2015 (p.6 - acknowledgements)
5.1b The English Indices of Deprivation Research Report 2019 (p.6 - acknowledgements)
5.2a Clean Air for Cornwall Strategy (March 2017)
5.2b Clean Air for Cornwall Strategy (2019 update)
5.3 West Midlands Combined Authority Regional Air Quality Review and Action Plan (July 2019)
5.4 Flood and Coastal Erosion Outcome Measures: progress report (2014)
5.5 DEFRA policy on funding (includes incentive for projects in deprived areas) (2011, covering delivery period April 2011-March 2015)
5.6 Report on flooding by Environment Agency (2020): Social deprivation and the likelihood of flooding
5.7 Testimonial from Environment Agency Social Science Manager
5.8 Testimonial from WHO Euro Technical Officer
5.9 WHO (2019) Environmental Health Inequalities in Europe. Second Assessment Report
Regional Office for Europe Chapter 4.2 Fairburn: sole author, Chapter 9. Fairburn: co-author
5.10a WHO (2019) Environmental health inequalities resource package: A tool for understanding and reducing inequalities in environmental risk. Fairburn: lead author.
5.10b Report on dissemination and reach of WHO research outputs 2020