

Pluvial (rain-related) flooding in urban areas: the invisible hazard

Findings
Informing change

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This study assesses how many people in urban areas now and in the future are at risk from 'pluvial' flooding – surface water accumulating from the result of intense rainfall. It also examines the exposure of vulnerable social groups to pluvial flood risk.

Key points

- Pluvial flood risk accounts for approximately one-third of flood risk in the UK. Approximately 2 million people in UK urban areas are exposed to an annual pluvial flood risk of 0.5 per cent or greater ('1-in-200 year' event).
- An additional 1.2 million people in urban areas could be put at risk by 2050 due to a combination of climate change and population growth.
- From a social justice perspective, it is important to know the characteristics of the population at risk, not just the number of properties in an affected area.
- Settlements across the UK with higher rainfall tend to have greater levels of social deprivation, although the differences are small.
- Changes to the cost and availability of insurance in the future have the potential to alter the socio-economic composition of flood risk areas and/or blight certain areas.
- Pluvial flood risk can be heavily mitigated in new developments through a combination of avoiding the highest risk locations, investment in drainage systems, flood proof building design and innovative surface water management schemes.
- A key challenge remains for existing built-up areas at high risk, although surface water management can ameliorate risk when opportunities for redevelopment arise.
- While recent flood management legislation around the UK has improved the priority given to pluvial flood risk, concerns still exist about partnership working, uncertainty about levels of risk (which can hinder planning), competing demands and capacity to respond.
- An interdisciplinary approach incorporating engineering, natural sciences and social sciences is required to better understand social vulnerability to flood risk.

The research

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Background

The most common source of flooding is when water levels in rivers rise and overtop their banks ('fluvial' flooding). Another familiar source of flooding along coasts results from a combination of high tides and stormy conditions. Less well known and understood are 'pluvial' (rain-related) floods. These floods occur after short, intense downpours which cannot be quickly enough evacuated by the drainage system or infiltrated to the ground. Pluvial floods often occur with little warning in areas not prone to flooding – hence the 'invisible hazard' tag.

How many people are at risk from pluvial flooding?

The study estimates that almost 2 million people in urban areas (settlements with a population over 10,000) face an annual 0.5 per cent probability ('1-in-200 year') of pluvial flooding. This represents around 5 per cent of the urban population, and around one-third of flood risk from all sources.

How many people could be at risk by 2050?

By 2050, 3.2 million people in urban areas could be at risk from pluvial flooding, an increase of 1.2 million. This increase is composed of an additional 300,000 due to climate change and 900,000 due to population growth.

Key findings

This research has revealed that socially deprived areas are at slightly higher risk of pluvial flooding. This is particularly the case in cities on a sizeable river, where deprived inner city neighbourhoods tend to be located in low-lying areas – a situation found in many British cities. Some of these neighbourhoods are also at risk from river or coastal flooding.

National population growth by 2050 has the potential to put around three times more people at risk from pluvial flooding than climate change.

It is possible that the impact of population growth on numbers at risk will be mitigated by effective planning policy and enhanced drainage capacity and Sustainable Urban Drainage Systems (SUDS, designed to slow the flow of water) on new developments. Whether and to what extent population growth can be accommodated in low-risk contexts remains to be seen.

Climate change is only part of the story of vulnerability to flooding. Economic, demographic and social forces may have greater impacts in the short and medium term. An interdisciplinary approach incorporating engineering, natural sciences and social sciences is required to better understand social vulnerability to flood risk and to promote effective research, policy development and implementation.

Uncertainty

There is significant uncertainty about projected changes to rainfall and therefore flood hazard. This is particularly the case for pluvial flooding, which is often caused by short but very intense downpours which are difficult to capture in climate models. Nevertheless, it seems likely that short, high intensity rainfall events will increase in force and frequency due to climate change.

In order to reduce this uncertainty the authors recommend that further research be undertaken:

- to refine existing estimates of sub-daily pulses of intense short-duration rainfall on a 1km (or better) grid;
- to improve understanding of place- and time-related variations in rainfall within extreme events; and
- to improve real time forecasting of extreme rainfall events in order to give longer lead-times in flood warnings.

Social justice and vulnerability

Using data from the Census of Population, the authors have developed a methodology to estimate the population of small areas affected by pluvial flooding.

Analysis in Belfast, Glasgow and Luton revealed that areas in towns and cities at risk from pluvial flooding have slightly higher levels of potentially vulnerable groups, although the differences are small. Households with no car and social and private renters were particularly over-represented in areas at risk from pluvial flooding.

Current methods for assessing social vulnerability to flooding assume that social deprivation is a good proxy of vulnerability to a flood. While clearly some aspects of social deprivation increase susceptibility to the impacts of a flood, contrary to usual expectations other groups with specific vulnerabilities to flooding have also been identified. For example, home owners with a mortgage report high impacts of being flooded. Measures of vulnerability to flooding could be improved by including factors relating to resilience and adaptive capacity, for example social support networks.

The scale of a flood appears to magnify impacts on some groups more than others. For example, many private renters are less affected by small-scale localised floods because they can find permanent alternative accommodation with relative ease. However, private renters (and social renters) can be badly affected by a large-scale widespread flood if they cannot find suitable accommodation in the same town.

In order to better understand the nature of social vulnerability and flood risk, a more sophisticated approach to flood risk assessment could, for example, incorporate information on the number of households with a ground floor – this is particularly important in London and Scotland where significant proportions of the urban population live above street level so are not directly at risk from flooding. Another important step would be for local authorities to collate lists of addresses receiving personal care services available to emergency planners and those responsible for flood-risk assessment.

Insurance and housing markets

Changes to the availability and affordability of insurance cover for flooding, as well as changes to the operation of housing markets in high-risk locations, may affect the social composition of flood-risk areas in the long run. The Association of British Insurers is renegotiating with governments around the UK over a sustainable solution for when the Statement of Principles expires in 2013. This agreement has ensured a certain level of investment in flood defence from the Government in return for guaranteed continuation of cover at no extra premium provided defences are planned. Some insurers are already charging higher premiums or imposing higher excesses for flood damage in high-risk locations, and this trend is likely to increase from 2013 when the current Statement of Principles expires.

It is important that a new agreement provides adequate protection for vulnerable groups in higher risk locations who may not be able to afford cover. In addition, it is important that insurance cover is available in all developed areas in order to prevent the blighting of communities. In return, the Government needs to address insurers' concerns that they are not receiving timely information on levels of risk and the provision of new flood defences.

To date, the housing market has remained unresponsive to flood risk and even actual flood events. However, this has been in a context of widespread affordable insurance availability in high-risk locations, and relatively low levels of information and public awareness of flood risk. Initial evidence indicates that the publication of indicative maps for coastal and fluvial flood risk has not had a big impact on housing markets. There is therefore good justification to publish maps of pluvial flood risk in order to provide existing residents and potential home buyers (and renters) with information about levels of risk.

In order to enhance the availability and take up of insurance, the research emphasises the critical importance of the Governments of the UK and the Association of British Insurers working together to ensure adequate provision for vulnerable groups and to maintain a high level of geographical coverage in developed areas. It also suggests responsible bodies increase the take-up of contents insurance among vulnerable groups through 'pay-with-rent' schemes in the social rented sector, for example through introducing an 'opt-out' rather than an 'opt-in'.

The potential socio-economic and housing market impacts of flood risk need to be better understood. Monitoring the changes in the cost and availability of insurance (building on work underway by the Association of British Insurers) and its implications for social justice, vulnerability and urban development is an important element of this.

Conclusion

Pluvial flooding represents a significant risk to urban areas in the UK with up to 3.2 million people at risk by 2050. Demographic change and climate change will significantly increase the number of people at risk. It is therefore important that population growth in towns and cities is accommodated away from the highest risk locations when possible.

More effective adaptation responses need to be developed at local level through a partnership approach to surface water management. Local authorities have a pivotal role to play in leading the partnership approach to surface water management. However, lack of powers, funding and capacity and skills constraints conspire to make this difficult to achieve.

SUDS, surface water management plans and flood proofing of developments all have the potential to limit the increase, or even decrease, the number of people and properties at risk. Separate storm and foul water systems increase drainage capacity and reduce the likelihood of sewage mixing with pluvial flood water. Recently introduced legal requirements for new developments to include SUDS where possible and the empowerment of flood authorities to withhold permission for developments to connect to the sewerage system (in England and Wales) are important steps forward in mitigating future pluvial flood risk.

A major issue remains, however, with existing properties and poor capacity sewerage systems which will remain part of the urban fabric for many decades to come. The research recommends that local authorities should develop a more strategic approach to surface water management, where possible, integrating it with wider urban regeneration and landscape design plans which incorporate 'green' (non-built up vegetated areas) and 'blue' spaces (urban areas set aside for storing water or conveying storm water to drains). This strategic approach, to include water companies, should make more use of opportunities to de-couple existing combined clean and foul water drainage systems (e.g. when areas are undergoing major redevelopment) and comprise:

- Developed areas – retro-fitting (substituting new or modernised parts or systems for older equipment) when possible, identify and improve 'pinch points' in the drainage system, and manage the local landscape to create safe flow routes.
- Undeveloped areas with development pressure – insist on effective SUDS, flood-proof design and surface water management plans.
- Undeveloped areas with less pressure for development – identify opportunities for landscaping incorporating 'green' and 'blue' spaces, supported through land use planning, (and if necessary, compulsory purchase) to attenuate run-off and direct surface water away from properties.

The research calls for local authorities to fully incorporate surface water issues into their flood risk management schemes by, for example, pooling expertise and knowledge across neighbouring authorities. It also recommends that local authorities, regulators and water companies engage the public about surface water and drainage issues, promoting the preservation of porous surfaces and capture of rainwater at household level.

Some potentially vulnerable groups, for example those on lower incomes, are slightly over-represented in areas at risk from pluvial flooding. It is important that this pattern is not accentuated and vulnerability increased by changes to insurance provision in flood-risk locations. The cost and availability of insurance in flood risk locations is an area of great uncertainty in terms of both existing knowledge and future policy developments.

For further information

This Findings is part of a programme of work on Climate change and social justice. See www.jrf.org.uk/work/workarea/climate-change-and-social-justice

The full report, **Pluvial (rain-related) flooding in urban areas: the invisible hazard** by Donald Houston, Alan Werritty, David Bassett, Alistair Geddes, Andrew Hoolachan and Marion McMillan, is available as a free download at www.jrf.org.uk

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