THE ROYAL SOCIETY

Royal Society response to the House of Commons Environment, Food and Rural Affairs Committee inquiry into future flood prevention

Summary

- The UK's climate and weather modelling capability is world leading and significant progress has been made over the past few decades in improving the ability to forecast and predict weather relevant for flooding, though areas for improvement remain.
- Within a national strategy, the UK should consider a portfolio of flood defences, including ecosystem-based approaches, and should monitor and evaluate their effectiveness in order to improve future decision-making.
- Defra and Environment Agency policies include elements that aim to encourage the use of innovative approaches to managing flood risk. However, more evidence of their cost-effectiveness is needed to support those who plan and implement flood management strategies locally.
- Long-term planning and investment in resilience-building strategies is essential. While immediate flood risk is important, wider factors such as future climate change may need to be emphasised more strongly in local decision-making to ensure the resilience of communities and infrastructure in the face of increasing extreme weather. One way to dis-incentivise development in areas of high risk would be to place a *value* on flood resilience. Another step might be to require public and private sector organisations to report their financial exposure to extreme weather, in a standardised form.

1. The Royal Society is the national academy of science in the UK. It is a self-governing Fellowship of many of the world's most distinguished scientists. The Royal Society draws on the expertise of the Fellowship to provide independent and authoritative scientific advice to decision-makers in the UK and overseas.

2. This response is based on the Society's 'Resilience to extreme weather' report[1] and wider consultation with Fellows.

Predicting the future: Are the Environment Agency and Met Office models that predict rainfall patterns and the likelihood of future floods fit for purpose - and do they correctly calculate the costs of future flooding to communities?

3. Though there remain areas for improvement, the UK's modelling capability is world leading. It is encouraging to see the Environment Agency and Met Office working closely together on flood risk. The Met Office's most recent predictions of future rainfall[2] are very good, with a climate model being run for the first time at weather prediction scales (~1.5km) and realistic extreme rainfall being simulated. The Met Office 24 hour in advance rainfall forecasts have also improved considerably over the last 20 years.

The specific question of whether Environment Agency and Met Office models correctly calculate the costs of future flooding to communities is not dealt with here. The National Flood Resilience Review terms of reference indicate that they will be considering the assumptions in current models. More generally, it is important to ensure that the information produced by models is useful to decision-makers for risk assessments and risk management. This can be done by involving those who make and

[1] https://royalsociety.org/resilience

[2] http://www.nature.com/nclimate/journal/v4/n7/full/nclimate2258.html

implement policy in research and ensuring an ongoing dialogue between the producers and users of knowledge[3].

Protecting communities and infrastructure: How adequately do defences protect communities and agricultural land from floods and do current funding arrangements target spending in the right way?

4. There is more evidence regarding the effectiveness of engineered flood defences – such as dams, dykes and dredging – than there is for ecosystem-based approaches which use natural structures and processes. Using the evidence available, we compared a range of engineered, hybrid and ecosystem-based flood defences[4]. We found that engineered options are generally effective at providing protection against flooding, but can be expensive and have the potential to fail catastrophically. Ecosystem-based approaches tend to be the most affordable, and can offer additional benefits such as protection against multiple hazards, biodiversity protection and climate change mitigation (which are available all of the time, not just when the risk of flooding is high). Hybrid approaches generally combine the advantages of engineered and ecosystem-based approaches.

5. We concluded that a portfolio of defences, beyond traditional engineered options, should be used to protect communities and infrastructure from multiple hazards, including flooding. Given the limited evidence regarding ecosystem-based approaches, we also recommended improved monitoring and evaluation of the full range of approaches in order that more accurate comparisons and better decisions can be made in future.

Managing water flows: How effectively do Defra and the Environment Agency's policies encourage innovative approaches to managing risk such as slowing the flow of water in urban and rural river catchment areas and promoting water storage?

6. Defra and Environment Agency policies include elements that aim to encourage innovative approaches to managing flood risks. The 2008 Future Water strategy promotes measures such as sustainable urban drainage systems (SUDS) and increased above-ground storage. The subsequent 2010 Flood and Water Management Act also lists 'maintaining or restoring natural processes' as an effective measure for reducing flood risks. In addition, it is encouraging that Environment Agency project appraisal guidance for catchment flood management plans and river basin management plans recommends that 'working with natural processes' should be considered when evaluating alternative flood management projects.

7. However, it is unclear how widely these policies are actually implemented, and how easy it is for local bodies to do so given the complex nature of environmental governance in the UK. There is also currently only limited evidence regarding the effectiveness of innovative ecosystem-based approaches[5].

8. Across the UK, it is important that appropriate and accessible information, including scientific evidence, is available to those who plan and implement flood management policies. The Flood and Water Management Act places responsibilities on local land owners and third parties to maintain flood defences. To support them in doing so, greater public awareness of flood risk and its management, including innovative approaches, is required. This should build on pilot schemes already being run by the Environment Agency to help landowners understand what their responsibilities are in relation to

[3] http://Royalsociety.org/resilience
[4] https://royalsociety.org/topics-policy/projects/resilience-extreme-weather/
[5] http://environmentalevidencejournal.biomedcentral.com/articles/10.1186/2047-2382-1-13

flood defences on their property or land. The devolved agencies in Scotland, Wales and Northern Ireland have shown leadership in encouraging dialogue between communities and local authorities when developing and implementing innovative flood policies[6].

Planning for floods: How well do planning policies ensure new buildings are not put in areas of high flood risk nor where they would increase risk to others – and how well do new developments incorporate sustainable drainage and flood-resilient buildings?

Planning for floods

9. In many instances, early planning and pre-emptive investment in resilience-building is more cost-effective than reacting following a disaster. We recommend that national governments develop resilience strategies[7]. These will be most effective when they:
    - focus on minimising the consequences of infrastructure failure rather than avoiding failure completely – for example by prioritising the resilience of critical infrastructure and having plans to minimise impacts when noncritical infrastructure fails;
    - incorporate resilience-building into other relevant policies such as land-use and urban planning (given the direct impact of these policies on people's exposure to flooding);
    - consider all the factors – the whole system – likely to be impacted by flooding, including geographical areas beyond those directly affected, and effects over decades;
    - use a range of expertise from disciplines such as environmental management, climate change adaptation, disaster risk reduction and sustainable development, and from sources including the private sector, non-governmental organisations and local communities; and
    - support and enable local action that is consistent with national strategies.

Infrastructure and 'building back better'

10. Flooding presents a major challenge to infrastructure and can cause significant disruption. Decisions taken about rebuilding after a flood will influence the impact of future extreme weather. Impacts will get worse if decisions are purely reactive and short-term, and if co-ordinated action is not taken to reduce the exposure and vulnerability of people and property.

11. However, flooding can also generate political and public willingness to change the way things are done, to take a long-term view, and to build back better. Systems thinking is central to the planning, design and maintenance of resilient infrastructure. It involves taking a holistic approach and recognising that vulnerabilities or failure in one sector can affect the whole system, potentially leading to a cascade of failures.

12. We welcome the formation of the National Infrastructure Commission, which will help the UK to make long-term, strategic plans for its infrastructure. Given its long-term focus, the Commission would be well placed to consider how to incorporate resilience to flooding and the broader impacts of climate change into the UK's infrastructure system.

Dis-incentivising building on the flood plain

13. The pressure for new homes in the UK means that there is still development on land that has a significant risk of flooding[8]. The National Planning Policy Framework (NPPF) states that inappropriate

[6] See for example http://gov.wales/docs/desh/publications/111114floodingstrategyen.pdf and http://www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf

[7] https://royalsociety.org/topics-policy/projects/resilience-extreme-weather/

[8] http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7517#fullreport

development in areas at risk of flooding should be avoided by directing development away from areas at highest risk; and where development is necessary, making it safe without increasing flood risk elsewhere. It also highlights that Local Plans should safeguard land from development that is required for current and future flood management, and accepts the potential need to relocate development to areas that are less likely to be affected by future climate change. While immediate flood risk is important, wider factors such as future climate change may need to be emphasised more strongly in local decision making to ensure the resilience of infrastructure in the face of increasing extreme weather.

14. One way to dis-incentivise development in areas of high risk would be to place a *value* on flood resilience. The re/insurance sector has made considerable progress in evaluating the risks posed by extreme weather. These risks now need to be better accounted for in the wider financial system, in order to inform valuations and investment decisions and to incentivise all capital owners to reduce their exposure to risks such as flooding. This could be done through a requirement for public and private sector organisations to report their financial exposure to extreme weather at a minimum of 1 in 100 (1%) per year risk levels[9].

15. Until these risks are accurately evaluated and reported, organisations and individuals will have limited incentives to reduce them. Implementing this reform could mean that in the short-term flood insurance becomes less accessible and affordable for some, which in turn could dis-incentivise development in areas of high risk.

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[9] http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/09/RESILIENCE-1-in-100-initiative.pdf