



## Nexus Shocks project Working Paper: Summary of findings



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### Background to the project

The Nexus Shocks project explored how to improve decision-making and resilience related to nexus shocks. The work consisted of two phases and was funded in 2015 by the UK's Economic and Social Research Council's (ESRC) [Nexus Network](#), which brings together researchers, policy makers, business leaders and civil society to develop collaborative projects and improve decision making on food, energy, water and the environment. Phase 1 ran from 2015 to 2016 set up the Nexus Shocks Network and involved a series of workshops to explore key opportunities and challenges to nexus shocks. Phase 2, the Nexus Shocks Fellowship, ran from October 2016 until September 2017 led by Dr Candice Howarth with Research Fellows Dr Sian Morse Jones and Dr Katya Brooks, and comprised a desk-based review of the literature (Howarth and Brooks, 2017) and a qualitative study to collect primary data using semi-structured interviews. It took forward the work started in 2015 (Howarth and Monasterolo, 2016 & 2017; Howarth 2016 a & b) by exploring insights from existing evidence and practise on the current picture of decision-making and resilience to nexus shocks in the UK and how this could be improved.

The food-energy-water-environment (FEWE) nexus is an increasing area of interest for decision makers (Wentworth, 2016). The term 'nexus' has become a new buzzword for referring to, looking at and thinking about FEWE resources as a whole. It emphasises the interdependencies, linkages and tensions across sectors that have historically been managed in isolation from one another, uncertainty and security of natural resources.

Nexus shocks refer to low probability, high impact events which have significant implications for the energy-food-water-environment resource 'nexus' and related stakeholders (Howarth and Monasterolo, 2016). They are often the result of extreme weather and climate related events, for example, extreme flooding, heatwaves, drought, coastal erosion, sea-level rise and storm surges. At the time of such shocks, different sectors are required to coordinate to resolve urgent issues and to jointly make the most appropriate decisions for society.

To improve effectiveness of those working at the science/policy interface – including academic, policy makers and practitioners – this work explored some of the practical challenges associated with the integrated and transdisciplinary approach required to effectively manage and respond to nexus shocks. With the likelihood of such shocks predicted to increase in the future due to a changing climate, the need for effective, integrated decision-making across sectors, and including a number of stakeholders, will become increasingly important. Reframing the nature of decision-making as a transdisciplinary process involving multiple people, organisations, sectors and strategies, opens opportunities to examine issues within these decision-making processes and to identify ways to improve resilience to shocks.

Building on the UK's Climate Change Risk Assessment (CCRA) 2017, this project focused in particular on heatwaves and flooding, as examples of the two highest risks facing UK. Drawing on findings from Phase 1 of the Nexus Shocks project key areas identified as requiring further investigation included: evidence, communication and co-production, and collaboration.

### Aims and Method

The fellowship aimed to **better understand how decision making processes are informed in response to climate and weather related nexus shocks, and to identify pathways to deliver resilience; with a focus on evidence, collaboration and communication.** This was investigated through the following research questions:

1. How is evidence used in decision-making in relation to nexus shocks, and can this be improved?
2. How can evidence be better communicated to more effectively inform nexus shocks decision-making?
3. How can collaboration be harnessed to improve decision-making and resilience to nexus shocks?
4. What pathways exist to better inform and deliver resilience to climate and weather related nexus shocks?

Data was collected from key stakeholders through 27 semi-structured interviews. Key stakeholders were sampled from 3 pre-defined categories (see Howarth & Monasterolo, 2016):

- (i) Policy communities (involved in formulating policies and decisions on climate change and nexus related issues),
- (ii) Practitioners (involved in implementing climate solutions or decision making on the ground),
- (iii) Academia/Science

Recognising the breadth of work that can contribute to delivering resilience in respect to managing and responding to heatwaves and flooding shocks, efforts were made to include individuals that are directly, as well as indirectly, involved in decision-making processes. Individuals were approached based on their knowledge, expertise and experience of decision-making in relation to climate change and/or nexus related issues. This was assessed based on a literature review of UK organisations and institutions, attendance lists to recent nexus events and project and network contacts. The final interview schedule was structured around 5 themes:

- Roles organisations and individuals play in decision-making processes;
- Evidence used or useful in decision-making processes;
- How evidence is communicated, and what makes effective communication;
- Role of collaboration in decision-making;
- Lessons learnt in managing and responding to heatwaves and flooding.

Findings from these interviews are presented according to the four Research Questions in this Working Paper. Interviewees and organisations represented undertook a range of roles: (i) Policy and advisory services; (ii) Partnering, coordinating, supporting and advocacy; (iii) Operational responses; (iv) Research and science; and (v) Funding and insuring. Interviewees were involved, directly and indirectly, in a range of decision-making processes in relation to managing and responding to flooding and heatwaves. Five main types of processes were identified: (i) forecasting, warning and communicating; (ii) preparation and planning; (iii) responding; (iv) recovery; and (v) building capacity and supporting stakeholders and communities. It became evidence that a range of roles and processes that interviewees engaged in when it comes to responses to flooding and drought, tend to overlap.

## **How is evidence used in decision-making in relation to nexus shocks, and how can this be improved?**

### **Type and quality of evidence**

- A range of evidence types and sources are used and produced to support decision-making processes and/or research/work around managing and responding to heatwaves and flooding, at a variety of scales.: science/forecasting; adaptation and resilience; operational decision-making, evaluation of policy or processes, and communication
- Due to the collaborative nature of managing and responding to nexus shocks, much information is shared with partner organisations, other agencies or bodies.
- Perceptions towards the adequacy of the evidence base vary. A significant amount of information available is seen to be improving in terms of adequacy, and interviewee attitudes were fairly positive towards adequacy of weather forecasts where accuracy is felt to have improved over the last few years

### **Use of evidence**

- A number of barriers are seen to be limiting the usefulness of existing evidence to decision-making: data sharing and accessibility issues; lack of technical capacity to utilise existing data; disconnect between evidence producers and end-users; difficulties in operationalising evidence in decision-making
- Building the evidence base is compounded by a number of challenges such as inherent difficulties with trying to forecast or predict the future which is uncertain, or in producing evidence on impacts due to missing information, impacts changing over time
- Efforts to address gaps should focus on 6 key areas: (i) social and economic – vulnerable people data, behavioural aspects and socio-economic impact assessments; (ii) assessment or quantification of policy mechanism and other interventions; (iii) scientific and modelling; (iv) geographic or spatial; (v) local and real time, and (vi) communication. There is burgeoning interest in understanding the social and economic aspect.

### **Producing evidence**

- Views varied on who is responsible for producing evidence from nobody to everybody. For some areas, government and specific departments, as well as local government, were considered to be responsible, and for weather and flooding data, scientific organisations (Met Office and EA) were seen to be chiefly responsible.

- The inter- and multi-disciplinary nature of nexus shocks – means that the more pivotal question is “who has the responsibility to bring the different disciplines together?”

### **Informing decision making**

- Hindrances to decision-making occur due to: accuracy or bias in evidence, problems with conflicting information, timing or the lack of dynamism, and evidence mis- or un-used
- Judgement-based decisions seen to be more likely in certain circumstances, can be inevitable, can be beneficial, but also that politics can be a driving factor; issues surrounding reluctance to act or to apply lessons.
- Not all interviewees share the view that judgement-based decisions were appropriate for some evidence-based decisions
- Benefits of evidence-based approaches: lack of ambiguity, shared agreed decision, clear expectations regarding processes, removal of argument and debate – leading to more streamlined, replicable, efficient decision-making process
- CCRA. Just under half of the interviewees had contributed to the CCRA in some way; and two-thirds used it. CCRA used in 3 key ways: (i) to demonstrate business case for action; (ii) to shape direction of policy or work; and (iii) in practical applications. Reasons for not using CCRA: not relevant to specific business function, different timescales, or because other research was used. CCRA viewed as a useful piece of work, but also some questions around quality and value for money. CCRA could be improved in 3 areas: methodological improvements, more operational and better communication

## **How can evidence be better communicated to more effectively inform nexus shocks decision-making?**

### **Communication**

- Clear and effective communication of evidence, and impacts, to specific audiences can raise resilience, but is not always adequately achieved as this assumes a linear process of information dissemination.
- Adequacy of communication to inform decisions depends on evidence produced or available, for whom and what purpose (e.g. preparation, pre-event, response)
- Generally communication of evidence from experts and scientists is considered good and joined up, particularly for operational responses as opposed to preparation and resilience. However information to public and decision-makers is not good, especially when communicating risk, and is more focused on avoiding panic
- Positives examples of communications include the use of good, compelling stories and case studies and evidence for heatwaves impacts and flood impact.

### **Communication on heatwaves and flooding**

- Communication on heatwaves is better than on flooding partly due to management of public responses to heatwaves in UK being relatively straightforward (i.e. keep cool, drink enough etc.), however with flooding need longer term preparations which is better communicated to professionals than public
- Professionals in the flood community are aware and understand evidence and risks barriers however there is no clear useful way of explaining flood risk to the public
- Challenges with how to communicate flood risk with public, but frequencies, probabilities, flood return periods and statistics do not work
- Concerns raised over culture in UK of having positive attitudes towards hot weather, meaning that the public fail to adequately recognise the serious risk associated with heatwaves, especially for vulnerable people

### **Areas for improvement**

- Scientists and academics are not always packaging their findings in ways to successfully reach practitioners; efforts are underway to improve this, but there is insufficient focus on the language
- Communication on climate change risks needs to be improved so that people understand why it is relevant. Moving away from probabilities
- General sense of failure of existing communication to raise awareness and engender a sense of ownership and responsibility towards appropriate management of risks, particularly among the public
- There has been difficulty in maintaining interest and engagement levels in between flood or heatwave which has manifested in reactive (instead of proactive) responses
- ‘Champions’ who take responsibility in an organisation and look beyond the immediate operational concerns to the longer term issues can have long term benefit
- Communication could be improved by including end-users earlier in the production process. Co-production plays an important role in building on this and addressing any potential gaps.

### **Communication of risk and uncertainty**

- Communication of risk and uncertainty considered poor, with UK seen to be lagging behind other countries due to combination of factors including lack understanding of flood risk, inappropriate use of technical terminology in public communications.
- Lack of public understanding of flooding risks is not just an issue of communication, rather an intentional choice made by the public.
- Concerns that insufficient information is given to public, and that is not provided using appropriate language
- Flood return period terminology has not worked, incorrectly interpreted by public as no explanation to go with the terminology - need to move into talking about probability and likelihood and potential impact
- Incident management systems not advanced enough to support decision-makers by providing local information
- Flooding and heatwave risks are not truly understood, misperceptions towards heatwaves in UK
- Return periods are known to be a problem as they don't explain impact or size.
- Heat risks are more difficult to communicate as people enjoy the sunshine and there is no physical disruption
- Anecdotes can be useful and easily understood language such as likely or probably

### **Co-production & end-user involvement in production of evidence**

- Co-production not necessarily understood in same way by all interviewees, the majority consider it to be a loose way, to simply capture whether or not end-users had been involved in evidence production.
- Co-production implementation varies depending on nature of project in question and/or stakeholders involved.
- Mixed views about involving end-users with overall view this is positive and useful with its challenges
- Co-production involving end users enables access to valuable knowledge that would otherwise be untapped, this might include community knowledge on location of vulnerable people
- Co-production also enables collaboration to bring funding and funders together to develop innovative, agile and responsive modes of funding.

### **Barriers to involving end-users**

- Capacity, resources and misaligned timescales. Co-production considered to be time and resource intensive, particularly as it takes time and investment to engage in and maintain relationships with sustained trust and willingness on end-users to engage, whilst this can lead to very positive experiences
- There can be apathy to engage with a co-production process
- Individuals may not recall own experiences of impacts felt as a result of a climate event such as floods
- Often cultural barriers to overcome across different stakeholder groups participating in process, such as who owns evidence and whose role is it to act upon it
- Not having adequate know-how to engage in co-production
- It can be practically challenging to identify and define who the end users are.

### **Recommendation: Contextualisation**

- Contextualisation of weather and climate warnings in relation to recent events is useful to help people understand the scale of what they are experiencing, and to trigger action to reduce impacts
- Local knowledge can play a role in contextualising broader warnings to fine-tune information and understand implications of risks locally
- Recommendation to move away from abstraction of warnings to situational warnings, which provide a clear message on the situation and required response
- Mechanism for communicating messages (e.g. narratives, visual, colours, language) needs to be relatable. E.g., a tiered warning system can be highly useful where people can easily relate to the scale used, however use of colours such as red, amber and green, may not be helpful to segments of society not familiar with these systems
- Contextualising by talking about first hand experiences, and using stories and narratives, can really resonate with policymakers in terms of helping them to understand why support is needed and the tangible impacts

### **Recommendation: Focus on Impacts and behaviour**

- Clarity needed on what the expected impact and action required. It is important to convey how events are expected to impact people, to make it relevant
- Increase engagement and behaviour responses by ensuring timely warnings
- Translate risk into action by using local trusted word of mouth, and trusted individuals

### **Recommendation: Good structures and Access**

- Importance of having structures in place to share and disseminate effectively through a range of communication channels ensuring correct information is feeding through planning, preparation, response
- Working with growth in technology for communication during emergency events
- Build on strong relationships with partners who have access to evidence and experts who can talk convincingly

**Recommendation: Targeted, Digestible advice**

- Digestible and targeted information to audience is needed, ensuring requirements are being met through effective communication with clear purpose of message, and effective messaging.
- To gain traction with the public, it can be helpful to convey personal opinions, and go beyond strict formal constraints of traditional ways of presenting science
- Reduction in detail of information has not been welcomed by all. For some, in depth information provides a clear set of warnings and alerts, better signposting, and enables more efficient filtering of alerts
- Value placed on one voice, one message coordinated through collaboration to deliver a clear, consistent message aligned with others, which is more effective, more trusted
- Visualising with maps can help as these are familiar tool

**Recommendation: Consistency, Language and format**

- Language is very important in communication and framing, however terms such as 'climate change' have been found to hold little salience with public, yet talking in terms of 'hot weather' is something people can immediately relate to
- Challenges of using different languages in different organisations

**Recommendation: Credible, Robust, Trusted and Accurate**

- Important to be clear about caveats that accompany evidence, about the provenance of the data, update cycle, which can add to trust, credibility, authority of the data
- Credibility and trust essential. Lack of trust in organisation can undermine messaging

**Recommendation: monitoring and managing information quantity**

- Mixed views on the volume of information to provide
- Not about using different information, but about packaging it differently and providing information so communities can make informed decisions
- Preference to avoid information overload and difficulties in knowing whether to issue warnings and avoid crying wolf where too many warnings can lead to increased uncertainty of need for action

**How can collaboration be harnessed to greater effect to improve decision-making and resilience to nexus shocks?**

**Contextualising Collaboration**

- Collaboration is seen as vital to ensure the most robust evidence informs decision-making; and to design and implement appropriate responses to ensure resilience to nexus shocks.
- The type of collaboration following a shock event will depend on the event itself, its nature, the stakeholders involved and nexus sector(s) affected
- The length of collaboration will depend on the shock event and can bring stakeholders together for specific projects of a pre-determined duration or on a specific ongoing issue

**Benefits of Collaboration: Comprehensive or coordinated response**

- Collaboration enables a comprehensive picture or response to be consistently constructed and coordinated
- Collaboration can lead to a more comprehensive view of the shock at hand and enable a faster assessment of potential impacts to infrastructure, human lives, economy, culture and the environment.
- Collaboration facilitates exchange of information and better access to data, evidence or expertise providing a rich picture of what is happening on the ground, enabling a hands-on view of how a system works. Bringing together practical expertise and theoretical knowledge, enhancing quality of data, relationships and responses

**Benefits of Collaboration: Effectiveness**

- Collaboration can increase effectiveness in managing and responding to flooding or heatwaves particularly where communities are more resilient and better able to support the vulnerable in their communities.
- Collaboration with government, utility companies, NGOs, community social enterprises or community groups can lead to more impact and be more meaningful
- Leveraging different resources available becomes increasingly important whether financial or intellectual, to enable responses to be implemented and giving credibility to work
- Collaboration helps to identify where more research should be done, helping to create and maintain focus on what is most useful and needed

- Collaboration enables a pooling of resources and sharing of work, providing access to expertise that isn't necessarily available in-house
- Collaboration enables a better and clearer understanding of issues and research needs enabling a better framing of research, ensuring that all aspects are understood and explored from all angles. Questions are thereby framed by the needs of those collaborating, ensuring they are central to the design of the research thereby maximising the potential for responses to be more adequately formulated

#### **Good Practise & Recommendations: Build relationships and Trust**

- Good collaboration depends on relationships enabling processes to work more effectively if these are built on sound and trusted relationships as the communication channels are already likely to be established
- Trust is key where partners know each other, their roles and capabilities and how this relates to others
- Having a system in place to facilitate communication with the public and different communities; collaborating with NGOs can be particularly fruitful, enabling engagement, enthusiasm and curiosity to be sustained.
- Individuals who take it upon themselves to take on a leadership role can act as a conduit between stakeholders, community groups and members of the public

#### **Good Practise & Recommendations: Coordination and Creating Networks**

- Establishing networks enables inclusive cross-stakeholder collaboration facilitating knowledge exchange on key responses to weather and climate extremes whilst building capacity and knowledge of public and networks
- Networks established enable a deeper on the ground approach to formulated and implementing responses, this can bypasses many delays faced at policy or leadership levels where decision making processes are far removed from the realities of a nexus shock on the ground.

#### **Good Practise & Recommendations: Challenges in Collaboration**

- Top down engagement often fails to work in the long term due to a lack of incorporation of a wider set of knowledge and expertise of those operationalising responses on the ground.
- In operationalising responses, bad practise can stem from when a collaborator is still having to do the work post-emergency as other collaborators are too under-resourced to take back responsibility/work
- Challenges in collaboration can be linked to different interests and objectives or positions of groups involved, including concerns relating to possible top-down/imposition of views
- Nature of collaborations means that at times organisations may not be able to speak directly to end-users
- Difficulties knowing whether people representing organisations in collaborations have traction at Board or decision making levels, nevertheless useful to have section of an organisation alert to a particular shock
- Different organisations and individuals involved may have fundamentally different methods of working, where some may be more inclined to collaborate, sharing as they go along, whereas others have a different culture
- Collaboration can be hard to carry out and sustain, and at times not appropriate when involving a wide group
- Challenging to facilitate collaboration between stakeholders and policy makers who are time poor
- Collaboration takes time, particularly when adopting a co-production approach. This is further exacerbated by funding cuts or the lack of funding or structure to deliver processes at the level a country needs.
- Apathy and unwillingness to engage needs expectations management where communities expect councils to respond to shock events rather than take ownership and discuss practical issues of leadership

#### **Recommendations for Future Collaborations**

- More active collaboration between policy/practitioners and academic where they are viewed as partners rather than stakeholders and therefore would have more ability to influence
- Flexibility and agile processes where contributors are open to doing things differently and sharing, innovatively and in a way that aligns with the needs of communities affected by nexus shocks
- More joined up approaches where stakeholders are better informed of overall processes.
- Pro-active and pre-emptive approaches for shock events with bigger picture in mind
- Strategic approaches working backwards from the desired outcome
- Strengthened capacity through more professional support and better resourcing where more funds are available alongside technical and professional support to community groups

#### **Improving collaborations: Engagement**

- Improved constructive conversations where people talk to each other to stimulate better frameworks for collaboration and accounting for benefits of collaborative projects
- Maintain historical and institutional memory so that when shock re-occurs, knowledge and expertise on responses is not lost
- Better mechanisms to align with decision making occurring within different organisations

### **Improving collaborations: Funding**

- Increased funding to deliver solutions and plan responses
- Provide funding mechanisms whereby policy and practitioners actors are eligible for funding and have more leverage over how Research Councils may spend their money so that it can be more applied

## **Insights into nexus challenges**

### **Lack of integration**

- Considerable work has been carried out on responses to flooding, more of a shift is needed to focus on heatwaves which will require more integration and more investigation across stakeholders
- Adopting more joined up approaches enables nexus resources to be better understood as a part of a joined up life cycle, from abstraction, pollution, biodiversity and flooding water scarcity.

### **Reluctance to act**

- A proactive approach is needed as opposed to a reactive one but there appears to be general reluctance to act
- Partly driven by institutional (un)willingness to act due to conservative approaches with slow rates of change, funding limitations, budget cuts
- Progress in managing and responding to flooding when government partner with utilities enabling them to become better equipped to respond
- Climate change is an abstract, long-term issue in contrast to short term political timescales where people consistently underestimate how big a challenge there is and defer responding to the evidence.

### **Funding limitations**

- Budget cuts leave government department with no capacity, high staff turnover, loss of institutional memory leading to a lack of capacity and resource,
- Shrinking audience for evidence as funding cuts and the lack of statutory requirements means there is nobody to direct evidence to who has a statutory responsibility to respond to it

### **Managing uncertainty**

- Managing and communicate uncertainty is increasingly challenging in the context of nexus issues yet is managed well in other sectors such as the business community
- May take considerable time for research to answer some of the issues around climate science, so rather than solely relying on new science to be produced, a framework must be produced to support better decisions now

### **Different nature and focus of heatwaves and flooding**

- Heatwaves and flooding are two distinct and different meteorological phenomena with different impacts and heatwaves being clearly less visible than flooding.
- Heatwave risks are often overlooked in comparison to flooding due to larger evidence base on flooding
- More work is needed to explore these phenomena, societal impacts and implications for the nexus
- Impacts of shocks are different and therefore management is different and can impose more or less challenges in responding to them
- Growing need for the housing sector in the UK to consider the sustainability of new developments where innovation such as sustainable draining systems and processes for future management are considered

## **Pathways to better inform and deliver resilience to climate and weather related nexus shocks**

The research provided insights into developing pathways to better inform decision-making and deliver resilience to climate and weather related nexus shocks, examining perspectives on the lessons learnt about decision-making in response to nexus shocks. Many of these reflected on how the policy, practitioner and academic communities could evolve to better meet the needs of decision-makers; how research funders can help with this, if at all; and the 'silver bullets' that would make the biggest difference in improving decision making and resilience, and what is needed to put these into action.

### **Lesson Learnt**

- Evidence must inform decision making whilst being focused on and reflecting the needs of different end users. This will enable a stronger evidence base to be constructed based on strong science, accurate modelling, and data and will, as a result, facilitate a stronger focus on end-users, working backwards from decisions made by these users and to understand what is needed to inform choices and decision making process
- Proactive, integrated approaches are needed to adopt a preventative approach, with good preparation and planning, adopting a systems approach which looks at the big picture not just operational responses

### **Limitations, challenges and gaps**

- Stakeholders working in different ways, to different timescales and funded differently requires more time to invest in developing relationships
- Building collaborative relationships can be challenging to address if there is a lack of transparency at the policy end which is felt to still heavily rely upon personal relationships
- Academics need to get better at turning their research into useable practical tools.

### **Better, Targeted Communication**

- Communication that is more focused, succinct, dynamic, and with a focus on end users will better facilitate linkages and connections to different audiences
- Language used in science communication (such as prediction and forecasting) must help to clarify the characteristics of science, levels of uncertainty and how to make better decisions under uncertainty is required.

### **Identifying windows of opportunity for collaboration**

- Collaboration should entail a process of working together, communicating, finding out about each other's drivers and challenges, differences between stakeholders and to provide support to ensure delivery of mutually beneficial solutions ensuring widespread win-wins
- Taking advantage of windows of opportunity, through engagement with a process that enables participants to be up to date with funding mechanisms that can support these collaborations

### **People Focus**

- In the face of nexus shocks, a social dimension emerges with people at the centre, and a focus on the protection of people and livelihoods
- A focus on people and society, one of which aims to improve society and focuses on saving lives and infrastructure can further maximise impacts of collaborating for solution-driven decision making.

### **Strong Leadership and governance**

- Strong leadership and governance structures enables stakeholders to feel confident to make better decisions.
- Champions, pioneers, individuals who dedicate themselves, can have an enormous impact, where creative and approaches driven by individuals who are determined to make a difference
- Aligning different elements towards a common goal can help focus efforts, even if this is a complicated, messy process where there is a lack of clarity of who does what

### **Collaboration and Relationships**

- The gap between academia and practitioners, often working to different timescales can be bridged through academics further developing the ability to effectively communicate their science and producing more digestible core messages and to harness knowledge and experience of practitioners
- More effective collaboration will strengthen mechanisms to share data and skills to improve evidence and building progress in knowledge and learning exchanges between academic and practitioners

### **Practical Application**

- Practice-oriented research is needed to enable collaborative processes for responses to climate and weather extremes to evolve.
- Engaging end-users early on in the process can further maximise practical application of findings as further down the line it is hard to change
- The impact agenda has been a useful way of improving academia in translating research more
- Developing approaches to implement more ground testing including more rapid evidence assessments could lead to more projects with practical applications from policy and practitioners

### **Better evidence, data needed**

- Academia must continue to play an evidence-generating role on the expected impacts of climate change to facilitate the quantification of these impacts at an operational scale where more evidence is needed to address practical issues
- A better understanding of the effects of heat on different parts of population is needed that can be practically applied and shared across sectors
- Better investment in evaluation of interventions made to the natural environment is needed taking into considerations effects on, implications of and processes of different nexus resources.

### **Proactive approaches**

- Lessons from past events could be better put into practise
- For flooding, more acceptance is needed on the science and evidence around increased flooding to enable action to take place such as adaptation, flood risk activities, changing building regulation to improve infrastructure
- Communities working across nexus shocks issues need to be more receptive and flexible to change and open to cultural change (i.e. in academia to achieve impact)

### **Improving Capacity for Better Communication**

- Scientific evidence needs to align with the needs, priorities, structures of different audience and stakeholders
- Evidence is required at a number of levels with considerations for language varying from plain English, technical engineering, scientific data as opposed to an approach where one size fits all
- Education is required for those actively involved in responses to climate shocks, (e.g. practitioners, LA workers), particularly on flooding and heatwaves where a basic understanding of the science is needed

Responding to nexus shocks, as illustrated in this report, raises numerous challenges and opportunities. Interviewees were asked what the role of research funders should be going forward (Box 1) which demonstrated a need for more calls for interdisciplinary and applied research allowing space for longer, larger projects with a flexible approach to incorporate numerous stakeholder and sectoral perspectives with the aim of filling evidence gaps. And as a final question, interviewees came up with the following bullets on how to better inform decision making in the context of nexus shocks: managing uncertainty; better governance structures; better communication and systems; better evidence; more awareness and ownership of risks; embracing technology; better resourcing.

### **Box 1. Role of Research Funders**

#### **Applied projects**

- Research councils need to fund more applied projects on how to make people aware of the residual risks of nexus shocks
- It can be challenging to get applied research projects funded in this space due to lack of clarity of which RC or government department should be involve/leading
- The impact agenda has been very helpful in encouraging knowledge exchange and collaboration for application of research

#### **Collaboration & Co-production**

- Call for co-produced research projects enabling users and practitioners to be involved in a more balanced way to conduct user need-driven research.
- Need to have end-users engaged at the level of Research Councils to help guide what is needed on the ground or aligns with policy needs

#### **Encouraging more Interdisciplinary Research**

- Interdisciplinary projects appear to be slipping through the gaps between different Research Councils
- More interdisciplinary research is needed where people come together from different sectors and disciplines such as health and meteorology in order to actually exchange data and ideas.
- Challenge of getting interdisciplinary or multidisciplinary research funded where nexus topics fit across. This calls for more joined up funding to engage in problem-focused research and peer reviewers equipped to fairly evaluate cross-disciplinary research
- Investing in trans-disciplinary methodologies can bring different groups together to answer broad questions to help contextualise an issue, before addressing more specific questions.
- Sustainable funding mechanism needed to maximise rigour and impact: open calls, available for longer periods of time, funding bigger, larger and longer projects, with appropriate processes in place to coordinate them

#### **Filling Evidence Gaps**

- Research funders should focus on filling evidence gaps and mobilise academic community to provide better evidence to support decision making and of the consequences of climate change

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