Empowering citizen and community adaptation to systemic risks from climate change

Natural Environment Research Council

EMPOWER UK

Case Study Report

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EMPOWER: Empowering citizen and community adaptation to systemic risks from climate change - UK Report

The EMPOWER project was funded by the NERC COP26 Adaptation and Resilience call under the project title 'EMPOWER: Empowering citizen and community adaptation to systemic risks from climate change'. The project involved a consortium of partners from the University of Reading, the University of Surrey, the Indian Institute of Management Nagpur, and the Council for Scientific and Industrial Research - Water Research Institute, Ghana.

Suggested report citation:

Da Costa, J*., Dornelles, A.D*., Greenwell, M.P.*, Gilbert, N., Narasimhan, K., Oliver, T.H., (2022). EMPOWER UK: Empowering citizen and community adaptation to systemic risks from climate change in Reading, Wallingford, and Oxford. EMPOWER project, UK case study report, March 2022.

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Introduction

The shift in academic/policy focus from mitigation to adaptation

Over the past two decades there has been a shift in policy focus from climate change mitigation towards climate change adaptation. Key differences in these policy types include the timeframe over which the benefits are seen, with mitigations tending to be long term and adaptation short term, and scale, with mitigation being global and adaptation being local (Klein et al. 2005). In the 1990s, mitigation was seen as the main policy focus, in spite of calls for adaptation to become a larger part of climate policy (Pielke Jr 1998). It was argued that a mix of both mitigation and adaptation policy should be adopted, however these two policy types were often seen as conflicting, with calls to determine the optimal mix of strategies. (Klein et al. 2005). By the end of the decade, mitigation was still the major form of climate policy, with a lack of adaptation policies in place to support mitigation (Hamin & Gurran 2009). In 2017 the Paris Agreement called for stronger adaptation commitments from States, effectively giving adaptation the same level of priority as mitigation (Lesnikowski et al. 2017). Climate Science research focus has also recently shifted from assessing climate impacts to climate adaptation strategies (Bormann et al.,2012).

Co-benefits of adaptation actions

Climate change mitigation and adaptation policies are typically targeted towards individual outcomes (Spencer et al. 2016). However, many measures have additional benefits across a range of social factors including health, economics and ecosystem functioning, often referred to as co-benefits (Urge-Vorsatz et al. 2014). Co-benefits are now a key part of reporting by the The Intergovernmental Panel on Climate Change, in spite of the fact that there is no universal definition of 'co-benefits' and evidence to suggest that definitions have been adapted to suit political needs (Mayrhofer & Gupta 2016). An example of this is when policies are determined as win-win scenarios e.g. policies for reducing emissions from deforestation and degradation, without addressing necessary trade-offs (Phelps et al. 2012). In a recent review of climate policy literature Karlsson et al. (2020) identified that the most established co-benefits relate to air quality, with reductions in greenhouse gas emissions also decreasing the release of air

pollutants (Nemet et al. 2010). Aside from air quality and associated health benefits, empirical evidence is limited for other co-benefits, leading to limitations in policy decisions (Karlsson et al. 2020).

The policy landscape for implementing climate change adaptation

Policy regarding climate change adaptation has traditionally been focused on institutional levels or at national scales using top down approaches, using global climate model outputs as guidance for adaptation needs (Bhave et al., 2013). However this does not take into account the scale and context of exposed and vulnerable populations on a more refined scale. 'Bottom-up' approaches can therefore account for some of the gaps left by top-down institutionalised adaptation frameworks. Participatory consultation is essential on a local scale and stakeholders and regional players must be included to adequately assess the local context adaptation requirements and priorities. This approach has led to the emergence and importance of including social sciences, i.e. qualitative approaches to the already established and limited quantitative approaches that climate model projections can offer. Top-down approaches offer a quantitative assessment of climate model outputs based on how climate related changes could impact the model itself.

While global climate policy has been focused on climate change related mitigation and reduction of greenhouse gas emissions, it has become evidently clear that under current climate change populations are already increasingly exposed and vulnerable to changing weather patterns. A great deal of effort is now invested in developing the most sensible adaptation strategies (Amaru & Chhetri, 2013). The threats posed by climate change are heavily influenced by cultural, institutional and socioeconomic contexts in which these risks occur. Adaptation strategies must also be supported by local governance by transcribing them into laws and regulations (Rodima-Taylor et al.,2012).

Bottom-up approaches can account for some of the gaps left by top-down approaches by contextualising and prioritising the performance of locally relevant adaptation measures relevant to the local community (Bhave et al., 2013). Improvements in climate modelling contribute to a better understanding of the physical scenarios to be considered, and therefore feed into the quantitative approach and vice versa. Bottom-up approaches can highlight areas of increased exposure and vulnerability to institutions and policy makers (Amaru & Chhetri, 2013).

Uncertainty in climate impact predictions

Climate projections rely heavily on initial conditions, and projected impacts are modelled with varying degrees of uncertainty and sometimes significant variability, depending on the model type and/or warming scenario (Conway et al., 2019). Top-down climate change adaptation methods often make use of global climate projections. This approach does not necessarily take into account regional warming rates and variation in the magnitude of impacts within regions. In addition, impacts are often not directly related to warming alone (Conway et al., 2019) (e.g. indirect impacts from food and energy supply disruption) and hence impact analysis needs to move beyond biophysical modelling.

The various spatial scales that adaptation strategies fall under poses an additional challenge. Global scale policies have long been limited to climate change mitigation agreements and pledges, under the premise that remaining under a target of 1.5 degrees of warming will equate to a reduction in the cost of future adaptation mechanisms (Coreau et al.,2009). However, literature suggests that many exposed and vulnerable communities are already suffering from a lack of adaptation strategies and options. The inertia in greenhouse gas emissions also suggests that the warming curve will be transient even in the

lowest percentile (Bormann et al.,2012), this highlights the need for context appropriate and long lasting adaptation measures. This has led to an increased decentralisation of the global climate change debate and the emergence of other actors such as non-governmental organisations, local community groups, experts, and individuals (Rodima-Taylor et al.,2012). Participatory approaches give individuals the opportunity to manage their livelihoods, thus empowering them to take appropriate, context specific adaptation measures. Berkhout et al. (2011) define adaptation as the ability of social actors to perceive and evaluate a threat and their capacity to enact a response when needed. The resurgence of local adaptation responses to climate change related threats is starting to change the way in which global responses are designed (Bhave et al., 2013). However, how governments and national stakeholders can enable and encourage local initiatives is still being debated, and an understanding of the relationships between local and global processes in tackling climate change related threats with adaptation methods is still in its infancy. Institutions can both facilitate and hinder local climate action. For example, national and global actors may inadvertently impose policies that inhibit local contextual action strategies (Amaru & Chhetri, 2013).

Inclusion of socioeconomic factors in bottom-up adaptation planning

Bottom up approaches to climate change adaptation take into account past and future vulnerabilities and have the capacity to measure exposure on finer scales (Warren et al., 2018). They have the ability to take into account physical, ecological and societal processes in addition to exposure to severe weather events under climate change. These approaches are of growing necessity for policy makers and stakeholders as they incorporate user-relevant and contextual information. A major challenge of bottom-up approaches is to take into account the complexity of the human-environment system within broader climate change threats, i.e. the approach is inherently people-centred. Some of the threats posed by climate change have a direct and straightforward impact on vulnerable populations, such as heatwaves, however it remains a challenge to account for the indirect effects of climate change, such as the disruption to livelihoods, water, energy, infrastructure, etc. It is therefore essential to assess the vulnerabilities of climate change related threats and their significance on a contextualised, people-oriented scale. Bottom-up approaches can also lead to an understanding of why/how some people/communities take adaptation measures while others do not (Conway et al., 2019). Eventually, the outcomes of bottom-up approach related studies could feed into top-down approaches and vice-versa.

One of the main advantages of the quantitative approach to climate impact assessment is that it takes into account uncertainties in initial conditions of the projection models, however it fails to include the human context. More qualitative approaches can allow for characterisation of societal-vulnerabilities and identify the most appropriate adaptive measures to be taken (Conway et al., 2019). Prioritisation of adaptation options by citizens enables a contextualised and community-oriented implementation.

National and local adaptation policy in the UK

Policy surrounding climate change adaptation in the United Kingdom is framed around the Climate Change Act 2008 (https://www.legislation.gov.uk), which aims to ensure the reduction of national emissions and allow the UK to adapt to climate change. This includes the production of the UK Climate Change Risk Assessment (CCRA) which has been tasked with identifying the risks posed by climate change. The National Adaptation Programme aims to address the identified risks every five years. The

CCRA informs the constituent nations of the United Kingdom of their respective risks. The government is advised by the Adaptation committee of the Climate change Committee (CCC; https://www.theccc.org.uk/) on the findings of the CCRA, through the production of an independent assessment which then is taken into account for the publishing of the next CCRA (https://www.gov.uk). The CCC is an independent body established out of the 2008 Climate Change Act and comprises experts in the fields of climate change, science and economics, and reports to parliament via progress reports.

The Department for Environment Food and Rural Affairs (Defra) is the leading department for climate change *adaptation*, but adaptation policies and actions are not exclusive to this department (https://www.ukclimaterisk.org/). Defra collaborates across government departments and with other stakeholders, such as local governments, businesses and communities.

The current National Adaptation Programme (Climate Change Act 2008) runs from 2018-2023 and sets out the actions to be taken by the government and other stakeholders in England.

At the local level, there is the adaptation advisory panel (LAAP; https://www.gov.uk), intended to link adaptation measures between local and central governments. Many local government adaptation measures are guided by the joint publications of DEFRA and LAAP, which are evidenced by the UK Climate Projections 2018. In terms of identifiable risks the UCRA report highlights areas identified by the independent CCC, namely flooding, health and well being related to high temperatures, water security, and food security.

Case study area

This UK case study focuses on the counties of Berkshire and Oxfordshire, with participants from the greater Oxford and Reading areas, as well as south Oxfordshire (the town of Wallingford). In terms of representativity of climate change impact projections, the spatial scale of the assessment is on a regional scale, focusing on the Thames Valley and, in a broader sense, to South East England. Three workshops were held in Oxford (Oxford City Council), Wallingford (South Oxfordshire Council; https://www.oxfordshire.gov.uk), and Reading (Reading Borough Council).

Reading has experienced substantial recent economic growth, due to strategic investments in hi-tech services and aided by its location, serving as a major transport hub (https://www.reading.gov.uk). Cost of living is high and the town accounts for one of the countries highest number of most deprived wards (3rd most unequal town/city). A little more than half of households are owner occupied, with median house prices laying well above the national average (https://geoportal.statistics.gov.uk/).

Oxford is a historic city, covering around 46 square kilometers. 27% of Oxford is within the Green Belt (largely flood plains) and less than 50% of households are owned, with average house prices well above the national average (https://www.oxford.gov.uk).

South Oxfordshire (Wallingford) is mainly rural and surrounded by agricultural land. 70% of the area is within the green belt and 74% of the households are owned, with house prices well above the national average. It is the least deprived council of the three case study locations (https://www.oxford.gov.uk/).

Methods

Overview

The EMPOWER project used a novel process to investigate the feasibility of climate change adaptation measures from a bottom up, community approach. Climate change risks and potential interventions

were framed from the perspectives of individuals, households and communities, and collaborative, participatory workshops were carried out in order to empower citizens throughout the process. Overall, the EMPOWER project had the following objectives:

1. Pilot a novel participatory approach to develop adaptation strategies with citizens and local communities, empowering them to protect themselves from direct and indirect effects of climate change;

2. Draw on multiple perspectives to analyse climate change adaptation options in light of their feasibility, along with complementarity across interventions, ethical considerations, and who to engage with and when;

3. Reconcile adaptation options with multiple desired outcomes over the longer term (e.g. biodiversity protection, livelihoods and community development, air quality, public health, recreation and cultural values etc.);

4. Draw lessons from the protocol development carried out in different regional contexts to improve the safety of communities and help set direction for the broader uptake of citizen and community adaptation planning.

All procedures, evaluations, and surveys described in this report have been submitted and approved by the Ethics Committee of the University of Reading.

Selection of participants

Participants were recruited from the city/towns of Oxford, Reading and Wallingford. These regions were chosen as all three face direct climate based threats, particularly in the form of flooding due to increased/extreme rainfall. In order to recruit participants to the project, a one page advertisement for the Empower project, with background information and a link to express an interest was circulated through academic networks, local civil society groups involved in climate/environment action and local government contacts. Across the three locations, 50 participants expressed an interest in taking part (Oxford n = 10, Reading n = 21, Wallingford n =19). A total of 12 participants per location (ten for Oxford) were selected, to produce an even distribution of male/female and ages, although a perfect balance of ages was not possible. Priority was given to participants who were able to attend both workshop dates.

Pre-workshops

Evaluation form 1

An online evaluation form was used to assess participants' baseline awareness of and preparedness to climate change risks. To capture their individual perception before all EMPOWER events, we used a Likert scale of five possible answers to a statement or question: 'strongly disagree', 'disagree', 'neutral', 'agree', and 'strongly agree'. Participants responded to two statements:

1. I am aware of the ways in which climate change will impact me and my household.
2. I am prepared for climate change impacts in terms of an action plan to reduce risks.

All responses to the evaluation form were collated online.

Briefing pack

Participants received a briefing pack three days before the first workshop, outlining various climate change threats (both direct and indirect pathways) tailored to the regions of Oxford, Wallingford, and Reading. This document aimed to provide participants with a non-exhaustive, easily accessible

summary of systemic risks from climate change and support them in the upcoming participatory activities of the EMPOWER project. Hydrometeorological hazards projected to increase in frequency and intensity in the Thames Valley included severe flooding events, increased risk of heatwaves, storms (cyclones, snow, rain, hail), soil erosion and degradation, and combined severe weather events. Indirect climate change impacts with diverse effects across social, economic and environmental systems are relevant to aspects such as agriculture, food security, transport, logistics, etc. The briefing pack also summarised some information about workshops to come (i.e. overall aims). The complete briefing pack is displayed in the Appendix 1 of this report.

Workshop 1

In the first online workshop, participants worked in a participatory manner to explore how the impacts of climate change might play out in their respective local areas. The workshop started with a general introduction of the aims of the project, expected outputs, and relevant information about the three case studies in the UK, Ghana, and India. Participants were then invited into virtual breakout rooms by their region of the UK: Reading, Wallingford, and Oxford. In the breakout rooms, two facilitators from the EMPOWER team introduced themselves and invited introductions from participants. An initial PRSM map was shared with the group, containing only the primary factor (health, wellbeing and livelihood of me, my household and my community) and supporting factors (housing conditions, working conditions, stable financial income, energy supply, mobility, food and water access, and mental health).

After a brief tutorial on how to use the PRSM software, participants were asked to add to the map by considering how climate change threats (e.g., heatwaves) would impact the health, wellbeing, and livelihood of themselves, their households, and their community (Figure 1) and how this was mediated by supporting factors (e.g., how housing conditions are affected by extreme temperatures). Further supporting factors were added during the workshops after discussion. In addition to the identification of climate change threats, participants were encouraged to design interventions they could pursue as actions to reduce the impacts of climate change from an individual and local perspective. Participants discussed climate change threats and interventions with each other using the briefing pack provided as reference and also shared experiences of previous climate based threats and how they mitigated the effects of these threats. Lastly, participants joined the full group plenary in which the EMPOWER team described the next steps of the project (i.e., interim work by team to flesh out intervention and the focus of next workshop on refining interventions and developing personal adaptation plans).

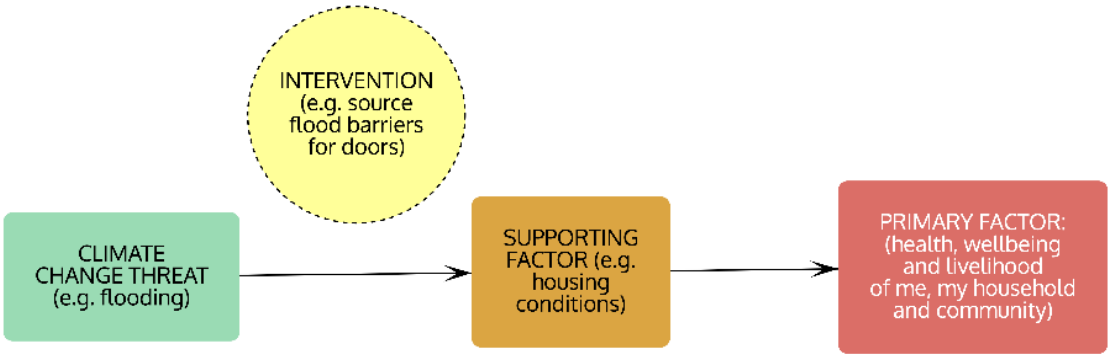


Figure 1 - Generic outline of the proposed key elements for PRSM mapping in the EMPOWER project.

Participatory System Mapping (PRSM) software

The PRSM software provides a platform to easily draw networks (or 'maps') of systems whilst simultaneously interacting with other individuals. Using PRSM, groups of people, each from their own computer (or tablet), can collaborate in the drawing of a map. They may be sitting around a table, discussing the map as it is created face to face, or working remotely, using video conferencing or the chat feature that is built into the app. Groups of people can participate live because every edit (creating nodes and links, arranging them, annotating them, and so on) is broadcast to all the other participants as the changes are made. PRSM is continually developed and is freely available and open source (see: https://prsm.uk).

PRSM can help users to identify key factors that affect some focal factor(s) that users care about, and the causal links between these factors. It can be used in slightly different ways depending on the focus of a study: it can focus on the dynamics of a system (e.g., the direction of flows of material/information/energy and feedback loops between factors) or it can emphasise interventions to disrupt flows to the links in the map. As the EMPOWER project primarily focused on the perception of direct climate change effects to citizens and not on indirect effects of climate change (such as how climate change can affect the national economy and then affect livelihoods in this way), we did not emphasise capturing complex feedback loops. Nonetheless, compounding effects of primary threat vectors were explored (e.g., how widespread local flooding and wider transport system disruption might interact to impact housing, food and energy supply). The PRSM software enabled the objectives of the project to be achieved in more practical terms by:

1. Ensuring the inclusions of important climate change threat pathways from evidence review (e.g., climate change models and historic impacts described in the briefing pack).
2. Including local knowledge of participants (e.g., lived experiences of climate change impacts in the studied areas).
3. Allowing participants to develop ownership in terms of the threats identified and interventions selected in order to increase saliency and motivation.
4. Helping citizens to identify the most important interventions for them, allowing for context dependency in their own situation (e.g., where they work/live, and allowing plurality of values and perspectives).
5. Guiding citizens to develop their own personal adaptation plan, allowing both agency and specificity to potentially increase the likelihood that actions are completed.

Workshop 2

In the second workshop, interventions drawn during Workshop 1 were reviewed with an aim to:

1. Clarify the scope and wording of interventions
2. Share thoughts and experiences on implementation of interventions
3. Discuss how additional benefits from the implementation of interventions might be gained, and how trade-offs might be avoided
4. Detail which interventions participants intend to pursue and why.

Following a general introduction of the planned activities for the workshop, participants were again invited into breakout rooms by their region. In the breakout rooms, four sessions of approximately 30 minutes each were conducted, organised by climate change supporting factors (general interventions, housing and workplace conditions, food and water access, energy supply). These sessions included a brief presentation by the EMPOWER team members, a plenary discussion (to share, for instance, if participants had experience with implementation of interventions), and the completion of structured

online surveys organised by supporting factors. There was a separate survey link for each supporting factor:

- General interventions
- Housing and workplace conditions
- Food & water access
- Energy supply

The surveys were used to assess participants' intentions to implement interventions based on three main options: 'I already have this intervention in place', 'I plan to do it in the future', and 'I do not plan to do this'. A total of 20 interventions (Appendix 2) were investigated via this process, four for 'general interventions', seven for 'housing and workplace conditions', six for 'food & water access', and three for 'energy supply'. Depending on the answers given, a series of conditional questions were asked to better understand how, when, and why participants intend or do not intend to pursue interventions. If participants already had interventions in place, we gathered information on agency: 'it was something I actively organised myself' or 'it was already existent'. For plans to carry out interventions in the future, further details on 'how' and 'when' were asked: 'within next three months', 'within next six months', 'by this time next year', or 'other'. Answers to the question 'how' and the option 'other' were collated as open-ended text. Finally, if participants indicated that they did not intend to implement interventions, they were asked to select from a series of options as to why not: 'It is too expensive', 'I don't have ownership / rights to do this', 'I don't consider it to be relevant or important', 'I don't have time to do this', and/or 'other reason'. Participants could select multiple options and were encouraged to provide open-ended text answers in case they selected 'other reason'. All responses to the surveys were collated online.

Post-workshops

Evaluation form 2

A second evaluation form was sent to all participants to assess the influence of the EMPOWER project on participants' awareness of and preparedness to climate change risks in comparison to the baseline (gathered in evaluation form 1). All responses to the evaluation form were collated online. We maintained the same Likert scale assessment of the statements initially asked to participants before the workshops:

1. I am aware of the ways in which climate change will impact me and my household.
2. I am prepared for climate change impacts in terms of an action plan to reduce risks.

Additionally, participants were specifically asked about the impact of the EMPOWER project from their engagement with activities, using the same Likert scale:

3. The EMPOWER workshops improved my understanding of the way climate change will impact me and my household.
4. The EMPOWER workshops helped me to make clearer plans for improving my adaptation to climate change impacts.

Finally, two open-ended questions with the intention to further improve the protocol used were put to participants:

5. Do you feel that the workshops were valuable? If yes, in what way(s)?
6. Do you have suggestions for improvement or extensions of the EMPOWER project?

Results

Pre-workshops

Evaluation Form 1

Prior to the first workshop, twenty participants submitted responses to Evaluation Form 1, assessing their awareness of climate change threats and their preparedness to deal with the subsequent impacts. The majority of participants agreed with statement 1; I am aware of the ways in which climate change will impact me and my household (Agree, n=13; Strongly agree, n=1). In contrast, none expressed confidence in having an action plan to reduce such risks (Figure 2), with most participants disagreeing with Statement 2: I am prepared for climate change impacts in terms of an action plan to reduce risks (Disagree, n=10; and Strongly disagree, n=2). The remaining respondents (n=8) felt neutral about their preparedness.

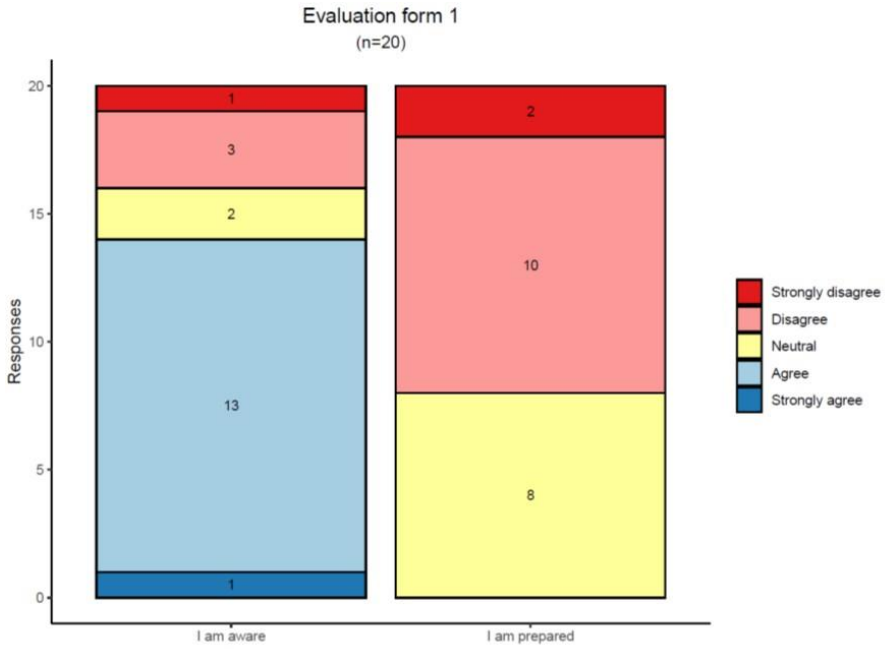


Figure 2. Responses from Evaluation form 1, submitted by participants before the first workshop, assessing the degree to which they feel aware and prepared for the impacts of climate change.

Workshop 1

Participatory mapping activity outputs

The initial PRSM outputs from Workshop 1 were split by region (Oxford, Reading Wallingford) and can be seen in Figures X-Y. The EMPOWER team reviewed the supporting factors initially included, as well as those added by participants, with the aim of simplification. After discussion it was decided that mental health should be included as part of the primary factor. Housing conditions and workplace conditions were merged to form a single factor. Stable financial income, mobility, education, social cohesion, access to culture, and overall ecosystem health were removed in order to focus on more basic societal needs such as food and shelter. The region specific PRSM outputs were collated by the EMPOWER team and grouped by the four remaining supporting factors; housing and workplace conditions (Figure 6), food and water access (Figure 7), energy supply (Figure 8), and general interventions (Figure 9). As well as climate threats, secondary drivers were also included in these factor specific maps. For example, low winter temperatures are a climate threat that could result in housing conditions becoming unsafe (too cold). However, a secondary driver (poor housing insulation) influences the impact of this threat.

Part 1) PRSM maps by town/city:

Reading

Two additional supporting factors were added by the Reading participants: *Health of the overall ecosystem* and *Education*. A total of 23 climate threats were added, with 18 interventions (Figure 3). The interventions *Evidence communication/Scientific outreach* were noted to be general, multi-functioning interventions that were relevant to all supporting factors.

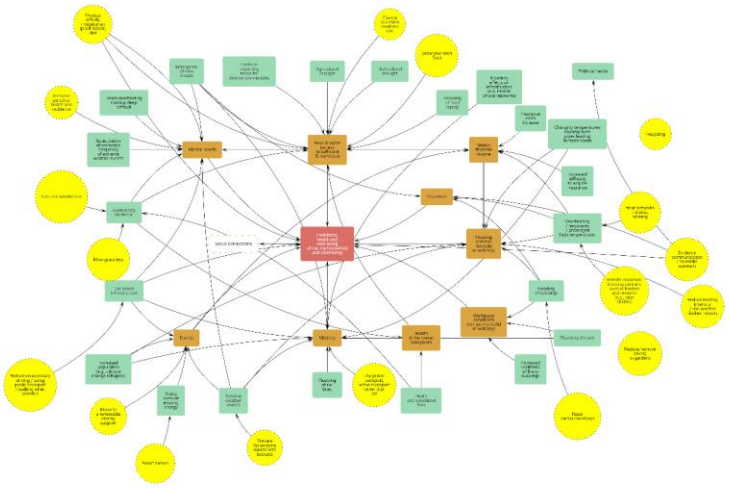


Figure 3. Climate change threats, supporting factors and interventions developed by Reading citizens in workshop 1 of the EMPOWER project. Climate change threats are shown in green boxes, supporting factors are shown in orange boxes, and interventions are displayed in yellow circles. Impacts to health, wellbeing, and livelihood of individuals are represented by red boxes (i.e., primary factor). This map was drawn collectively by participants using the PRSM software. An interactive version of the map in Figure X can be accessed here: [https://www.prsm.uk/prsm.html?room=NTL-POM-ZOS-ENU]

Wallingford

No additional supporting factors were added by the Wallingford participants. A total of 30 climate threats were added, with 32 interventions (Figure 4). A number of 'threats 'were reclassified by the EMPOWER team as 'interventions' e.g. "*Less wastage of food at retailer and personal levels is required to ensure best use of food resources*" and "*Can we purchase land communally to grow food*". Additionally, although impacting on the primary and supporting factors, some threats were not explicitly linked to climate change and could be considered out of scope e.g. "*Collapse of the economy*".

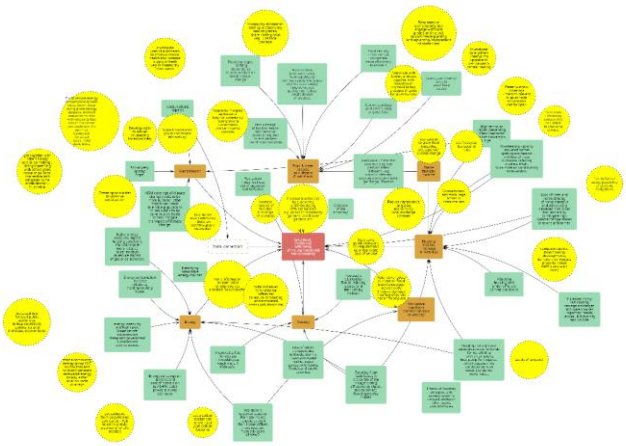


Figure 4. Climate change threats, supporting factors and interventions developed by Wallingford citizens in workshop 1 of the EMPOWER project. Climate change threats are shown in green boxes, supporting factors are shown in orange boxes, and interventions are displayed in yellow circles. Impacts to health, wellbeing, and livelihood of individuals are represented by red boxes (i.e., primary factor). This map was drawn collectively by participants using the PRSM software. An interactive version of the map can be accessed here: [https://prsm.uk/prsm.html?room=SZG-NDJ-KKY-XBB]

Oxford

Two additional supporting factors were added by the Oxford participants; *social cohesion* and *Access to other services - cultural, social*. A total of 23 climate threats were added, with 30 interventions (Figure 5). The discussion covered all factors, but focused predominantly on "food / farming/ social cohesion / community liaison".

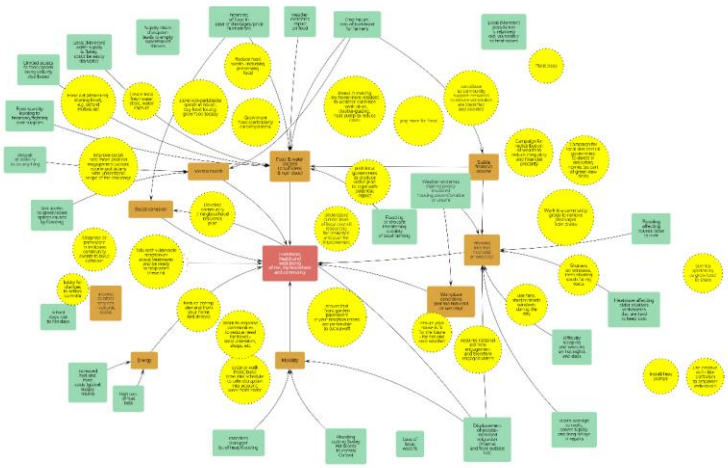


Figure 5. Climate change threats, supporting factors and interventions developed by Oxford citizens in workshop 1 of the EMPOWER project. Climate change threats are shown in green boxes, supporting factors are shown in orange boxes, and interventions are displayed in yellow circles. Impacts to health, wellbeing, and livelihood of individuals are represented by red boxes (i.e., primary factor). This map was drawn collectively by participants using the PRSM software. An interactive version of the map can be accessed here: [https://www.prsm.uk/prsm.html?room=PMH-HGU-HRK-JDX]

Part 2) PRSM maps by supporting factors: climate change threats, drivers, and interventions

Housing and workplace

Six climate based threats were identified for the housing and workplace conditions map: *high temperatures, low temperatures, changing seasonality, storms, climate migratio*n, and *flooding* (as a result of increased or extreme rainfall events). A total of sixteen interventions were identified (some repeated across multiple threats e.g. *Add loft insulation to reduce heat loss in winter and cooling in the summer*). The majority of interventions focused on controlling housing temperatures (Figure 6).

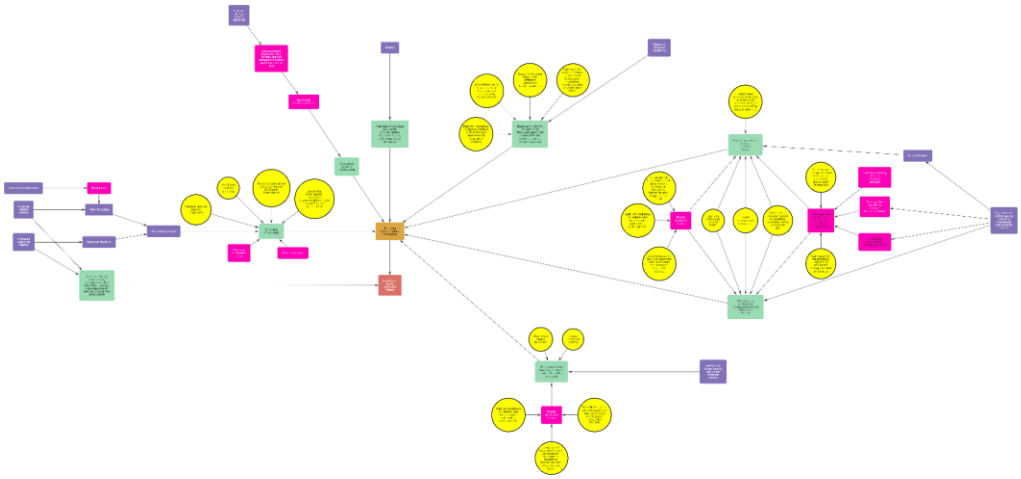


Figure 6. Overview of climate change threats, drivers and interventions related to the housing and workplace supporting factor across Reading, Wallingford, and Oxford. Specific threats to housing conditions are shown in green boxes, climate threats are shown in purple boxes, with secondary drivers in pink. Interventions are displayed in yellow circles. This map was summarised by members of the EMPOWER team using the PRSM software. An interactive version of the map can be found here: [https://prsm.uk/prsm.html?room=GVJ-LSG-RWZ-AOL]

Food & water access

Four climate based threats were identified for the food and water access map: *periods of high rainfall, flooding, changing seasonality*, and *high temperatures/droughts.* Seven interventions were identified, with the most focus on mitigating food shortages in shops (Figure 7).

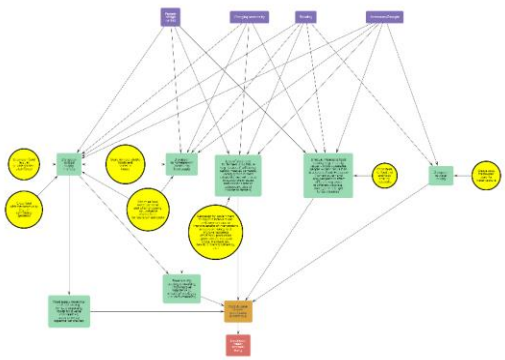


Figure 7. Overview of climate change threats, drivers and interventions related to the food & water access supporting factor across Reading, Wallingford, and Oxford. Specific threats to food and water

access are shown in green boxes, climate threats are shown in purple boxes, with interventions displayed in yellow circles. This map was summarised by members of the EMPOWER team using the PRSM software. An interactive version of the map can be found here: [https://prsm.uk/prsm.html?room=HTK-QRZ-ZRJ-PGY]

Energy supply

Three climate based threats were identified for the energy map: *high temperatures*, *low temperatures*, and *extreme weather events.* A total of four interventions were identified, three of which focused on mitigating losses to mains power (Figure 8).

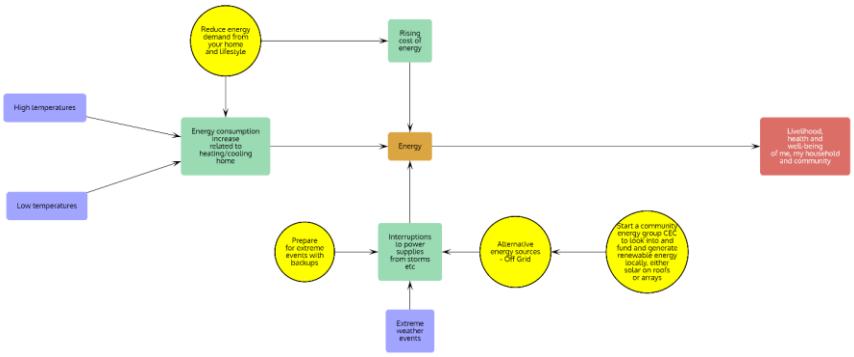


Figure 8. Overview of climate change threats, drivers and interventions related to the energy supporting factor across Reading, Wallingford, and Oxford. Specific threats to energy supply are shown in green boxes, climate threats are shown in purple boxes, with interventions displayed in yellow circles. This map was summarised by members of the EMPOWER team using the PRSM software. An interactive version of the map can be found here: [https://prsm.uk/prsm.html?room=KZB-IMR-ZBN-VCF]

General interventions

General interventions were relevant to the three other supporting factors. As such no climate drivers or specific threats have been shown. For example, campaigning could be applied to improve housing insulation, reduce flood risk, create community gardens etc. The general interventions can be summarised as *Communicating*, *Campaigning*, *Working with local government* and *Organising events* (Figure 9).

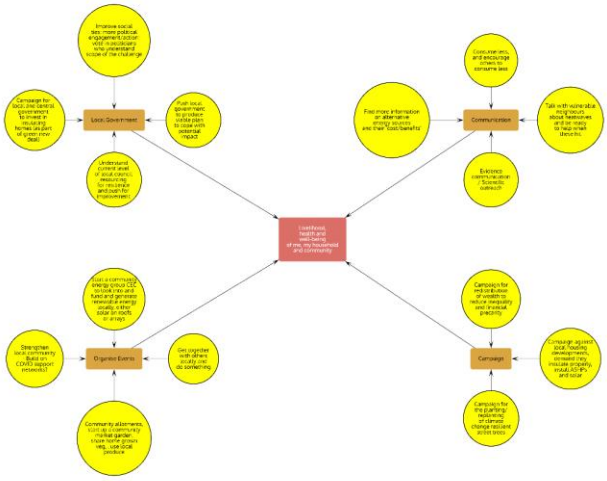


Figure 9. Overview of climate change threats, drivers and interventions related to the general supporting factor across Reading, Wallingford, and Oxford. Supporting factors are shown in brown, and interventions are displayed in yellow circles. This map was summarised by members of the EMPOWER team using the PRSM software. An interactive version of the map can be found here: [https://prsm.uk/prsm.html?room=OHS-JNC-DQS-JVO]

Workshop 2

Implementation across all interventions

The results below summarise the degree of implementation of interventions and respective conditions across all interventions (Part 1) and organised by climate change supporting factors (Part 2).

Part 1) Summary of the extent of implementation across all interventions (Figure 10)

The majority of interventions have been implemented by at least one participant (19 out of 20 interventions). Across all interventions, 139 responses (43% of total) indicated *I already have this intervention in place*. The remaining responses were split similarly between *I plan to do it in the future* (n=96, 29%) and *I do not plan to do this* (n=91, 28%). Of the 139 already implemented responses, 93 (67%) indicated that *It was something I actively organised myself*.

Where participants selected *I do not plan to do this,* the most frequent response to the question "Why not?" was the free text category *Other* (n=39, 43%). Other common impediments for implementation were *I don't have ownership / rights to do this* (n=16, 18%), *I don't consider it to be relevant or important* (n=12, 13%), or a combination of multiple factors (n=18, 20%). *I don't have time to do this* (n=5) and *It is too expensive* (n=1), were the least prevalent individual reasons behind the lack of motivation to implement interventions, although they were included in some combinations of factors.

Of the follow-up responses to *I plan to do it in the future*, most indicated a long term or yet to be determined timescale (*By this time next year*, n=23, 24%; *Other*, n=38, 40%). Less than half of the responses indicated that interventions were planned to be implemented *Within the next three months* (n=15, 16%) or *Within the next six months* (n=20, 21%).

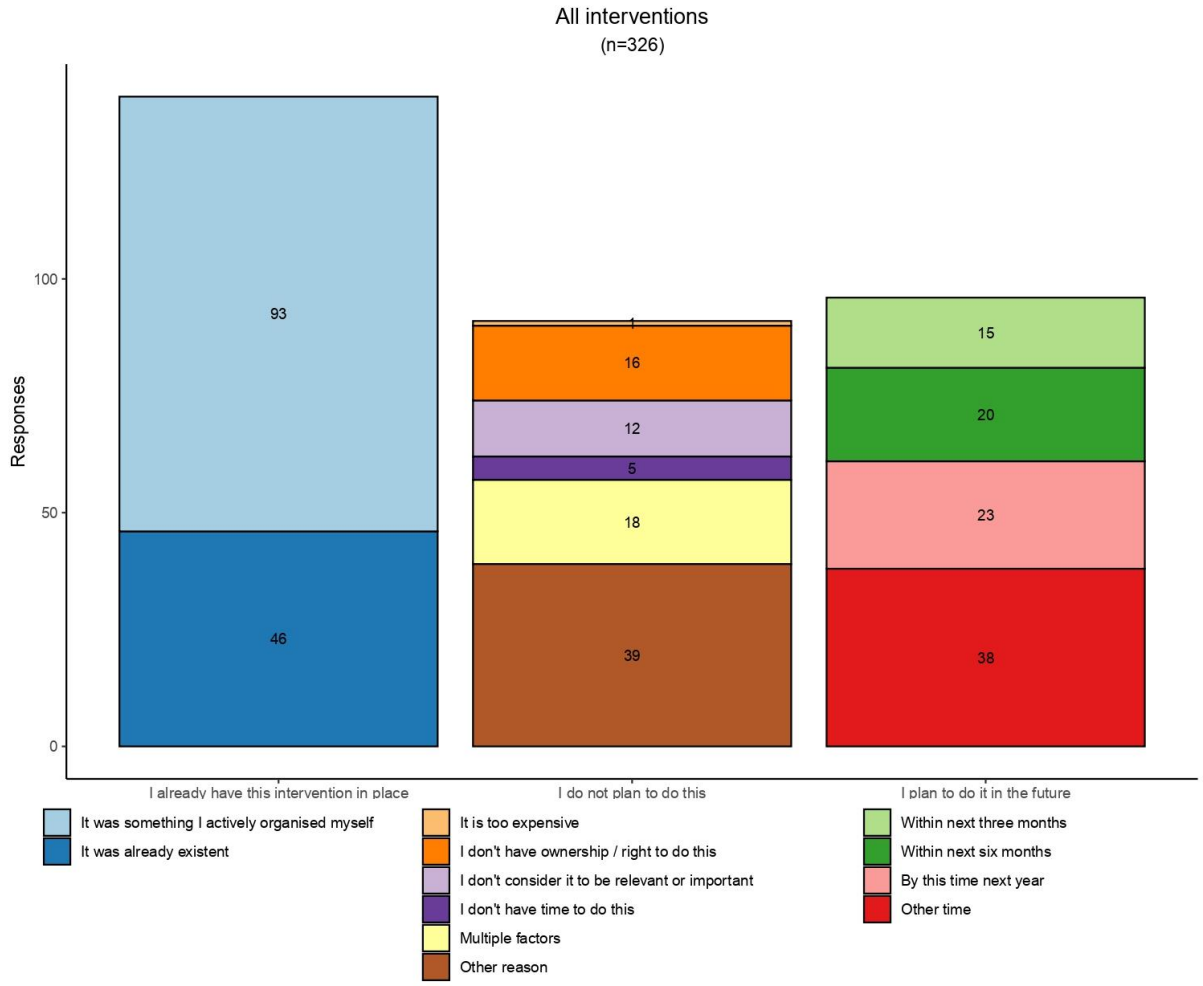


Figure 10. Overall summary of degree of implementation of interventions, reasons for progressing/not progressing them, and planned time frames

Part 2) Summary of the degree of implementation of interventions by climate change supporting factors: 'general interventions', 'housing and workplace conditions', 'food & water access', and 'energy supply' (Figure 11)

For the 'food & water access' supporting factor interventions, the majority of responses indicated that participants *already have this intervention in place* (n=64, 63%) with most indicating that *It was something I actively organised myself* (n=51, 80% of implemented food interventions).

For the 'general' supporting factor interventions, less than half of responses indicated that participants *already have this intervention in place* (n=31, 48%). However an additional 29 responses (45%) selected that they *plan to do it in the future*. Many of the participants with interventions already in place indicated that these interventions were *already existent* and not actively organised by the participants themselves (n=17, 55%). Importantly, the majority of the responses indicate participants plan to implement the general interventions in the short-term future (*Within next three month*s, n=8, 28%; and *Within next six months*, n=11, 38%).

A considerable number of participant responses indicated that they do not plan to implement interventions from the 'housing and workplace' supporting factor (n=58, 52%). Additionally, out of the

participants that do plan to implement interventions of this group in the future, the vast majority intend to do so in the long-term (*By this time next year*, n=2, 7%; and *Other*, n=25, 89%).

Responses were balanced for the degree of implementation of interventions related to the 'energy supply' supporting factor. A total of 18 responses (37%) indicated that interventions were already implemented, 16 (33%) that interventions are planned to be implemented, and 14 (29%) that participants do not plan to implement interventions. The vast majority of responses show that implemented interventions were organised by participants (n=17, 95%), whilst the minority of responses suggest that interventions within this supporting factor are planned to be implemented in the near future (*Within next three months*, n=1, 6%; and *Within next six months*, n=3, 18%).

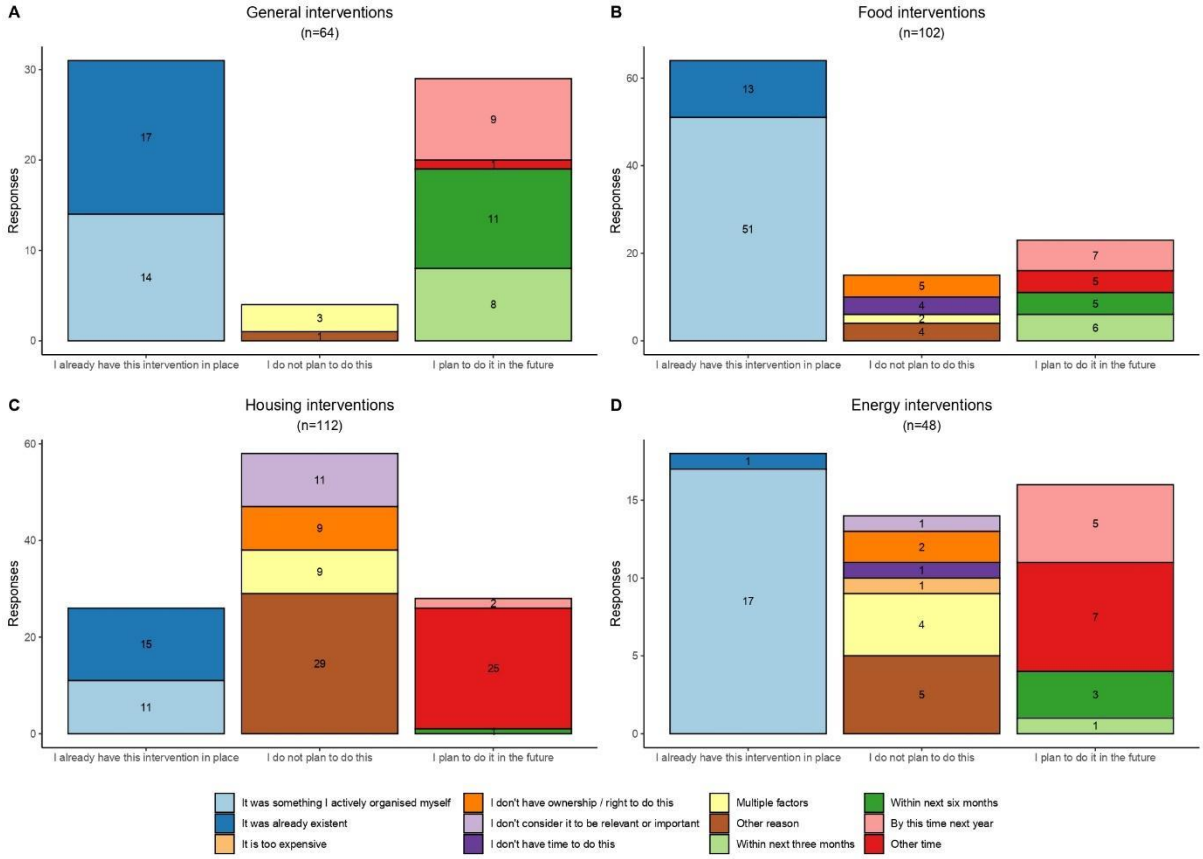


Figure 11. Degree of implementation of interventions and respective conditions stratified by climate change supporting factors.

Implementation grouped by interventions

The results below detail the survey responses for each intervention, organised by supporting factors. Responses are displayed by the uptake of interventions (Part 1), whether participants actively organised interventions (Part 2), what the timeframe for future implementation plans is (Part 3), and reasons behind not implementing interventions (Part 4). A detailed breakdown of the degree of implementation and categories of individual interventions are collated in the Appendix 2.

Part 1) Uptake of interventions (Figure 12):

Many of the interventions across all four supporting factors ('General', 'Housing & Workplace', 'Food & Water', and 'Energy Supply') have already been implemented by a high number of participants (Figure X). The intervention with the highest current implementation is "Minimise food waste", with

all participants stating that they already have this intervention in place. The intervention "Install flood barriers" was the only intervention not currently implemented by any participants.

Across the four general interventions 31/64 responses indicated that interventions were already in place, 29/64 indicated plans to implement them in the future and 4/64 responses indicated no intention to implement interventions.

Across the seven housing and workplace interventions 29/112 responses indicated that interventions were already in place, 27/112 indicated plans to implement them in the future and 56/112 responses indicated no intention to implement interventions.

Across the six food and water access interventions 64/102 responses indicated that interventions were already in place, 23/102 indicated plans to implement them in the future and 15/102 responses indicated no intention to implement interventions.

Across the three energy supply interventions 18/48 responses indicated that interventions were already in place, 16/48 indicated plans to implement them in the future and 14/48 responses indicated no intention to implement interventions.

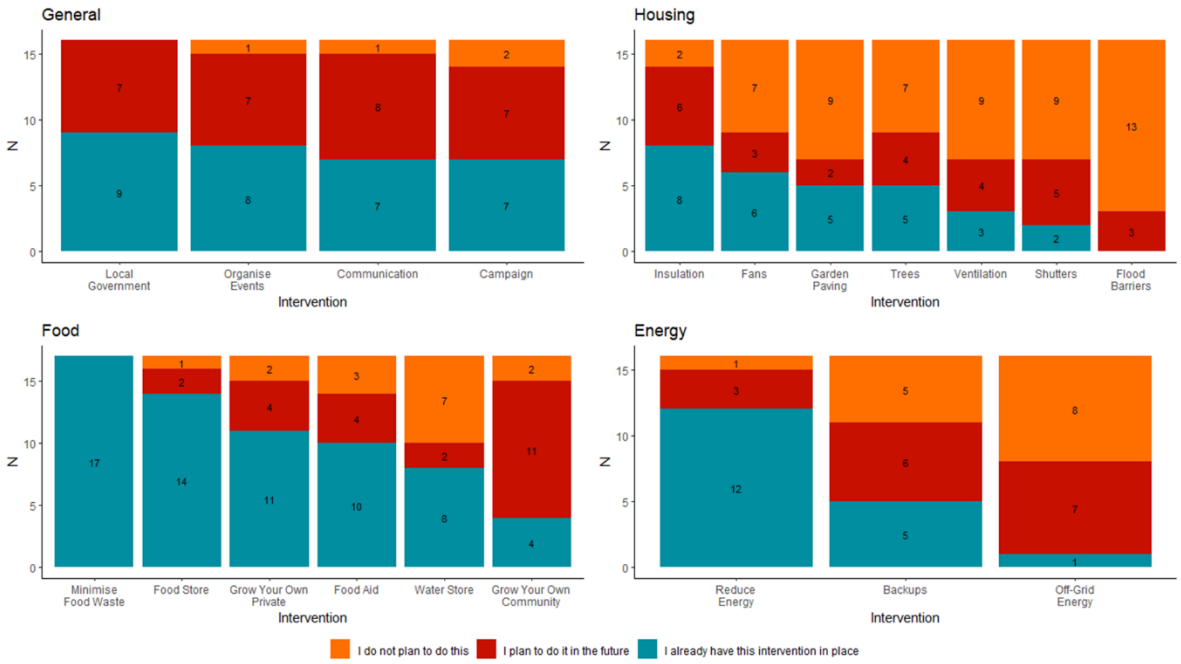


Figure 12. Breakdown of interventions split by uptake.

Part 2) Interventions already in place (Figure 13):
All interventions other than "install flood barriers" received at least one response indicating that they were already in place. The majority of responses for "Minimising food waste" indicated that it had been actively organised by participants, whilst the intervention "installing housing insulation" was already in place for the majority of those that had it.

Across the four general interventions, 17/31 responses indicated that interventions were already existent and 14/31 indicated that participants had actively organised them themselves.

Across the six housing and workplace interventions, 14/29 responses indicated that interventions were already existent and 15/29 indicated that participants had actively organised them themselves.

Across the six food and water access interventions, 13/64 responses indicated that interventions were already existent and 51/64 indicated that participants had actively organised them themselves.

Across the three energy supply interventions, 1/18 responses indicated that interventions were already existent and 17/18 indicated that participants had actively organised them themselves.

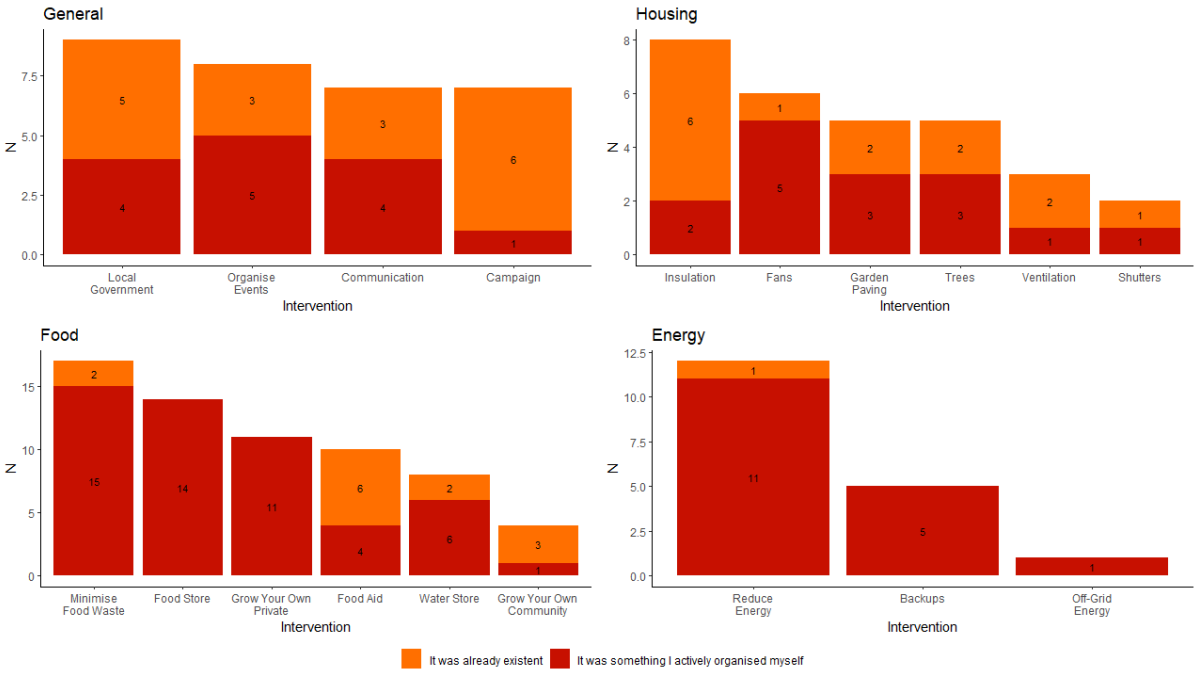


Figure 13. Breakdown of interventions that participants already have in place, split by whether they were actively organised by the participants or not.

Part 3) Intended intervention implementation timeframe (Figure 14):
With the exception of "reduce food waste", all interventions had at least one response stating that participants intend to implement them in the future. All responses for "reduce food waste" indicated that it was already in place. Across all interventions the most common time period selected was 'Other', this included general points such as "*When necessary*" or "*When costs allow*" to more participant specific timeframes such as "*When carry out a major property renovation*".

Across the four general interventions, 8/29 responses indicated this would be within the next three months, 11/29 within the next six months, 9/29 by this time next year, and 1/29 other.

Across the seven housing and workplace interventions, 2/27 responses indicated this would be within the next six months, 2/27 by this time next year, 3/27 more than one year, 5/27 when they own their property, and 15/27 other.

Across the five food and water access interventions, 6/23 responses indicated this would be within the next three months, 5/23 within the next six months, 7/23 by this time next year, 1/23 more than one year, and 4/23 other.

Across the three energy supply interventions, 1/16 responses indicated this would be within the next three months, 3/16 within the next six months, 5/16 by this time next year, and 7/16 other.

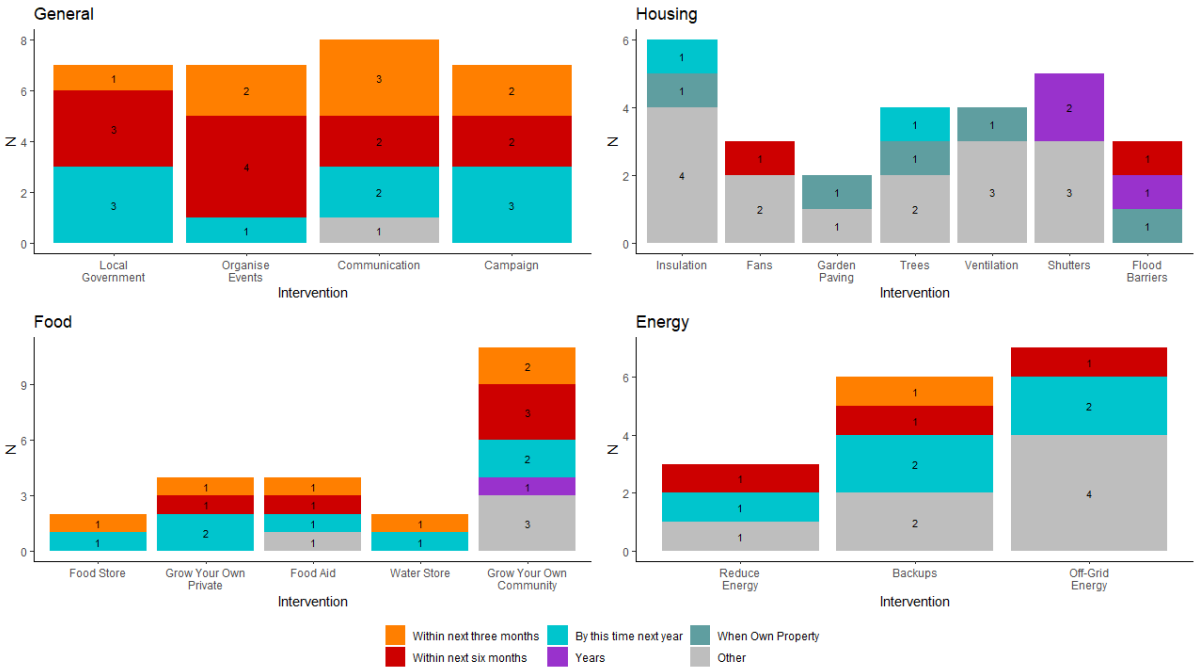


Figure 14. Breakdown of interventions that participants intend to implement, split by the timeframes in which implementation may occur. Other includes a number of alternative options such as "*When necessary*" and "*During larger housing refurbishment projects*".

Part 4) Reasons for not implementing interventions (Figure 15):
With the exception of "Engage with local government" and "Minimise food waste", all interventions had at least one response stating that participants did not intend to implement them in the future (Figure X). The most common response was that interventions were irrelevant, occurring for 36/89 responses. 'Other' includes a number of alternative options such as "*Don't know how to do this*", "*Would increase my carbon footprint*" and "*Don't have space*". The category 'Irrelevant' includes responses indicating that the threat is deemed negligible e.g., flood risk at the top of a hill, and responses indicating that implementation is unnecessary as other interventions effectively mitigate the risk.

Across the three general interventions, 2/4 responses indicated that time was the reason they could not be implemented, and 2/4 indicated other.

Across the seven housing and workplace interventions, 1/56 responses indicated that time was the reason they could not be implemented, 12/56 did not have ownership/rights to implement, 33/56 were irrelevant, and 10/56 indicated other.

Across the five food and water access interventions, 4/15 responses indicated that time was the reason they could not be implemented, 1/15 were limited by cost, 6/15 did not have ownership/rights to implement, and 4/15 indicated other.

Across the three energy supply interventions, 1/14 responses indicated that time was the reason they could not be implemented, 3/14 were limited by cost, 5/14 did not have ownership/rights to implement, 3/14 were irrelevant, and 2/14 indicated other.

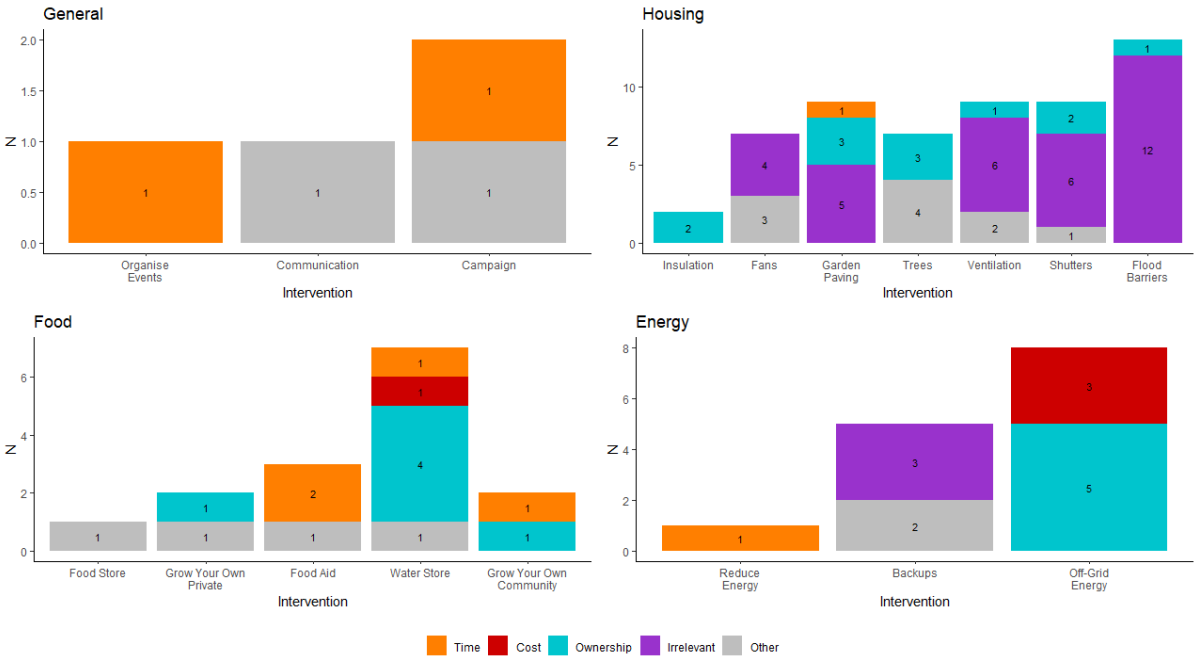


Figure 15. Breakdown of interventions that participants do not intend to implement, split by reasons for not implementing.

Post workshop Evaluation:

Many more participants felt aware of the impacts of climate change after the EMPOWER workshops compared with before. For example, before the workshops 70% of people responded that they were aware of how climate change might impact them, their households and communities (Figure 2; agree or strongly agree). After the EMPOWER workshop, this proportion was 86% (Figure 16). When asked directly whether they felt the workshops had improved their understanding 78% agreed (Figure 17).

In terms of increasing preparedness for the impacts of climate change, before the workshops 0% felt prepared (Figure 2), but after the workshops 43% felt prepared (Figure 16; agree or strongly agree). When asked directly whether they felt the workshops had improved their preparedness 79% agreed (Figure 17).

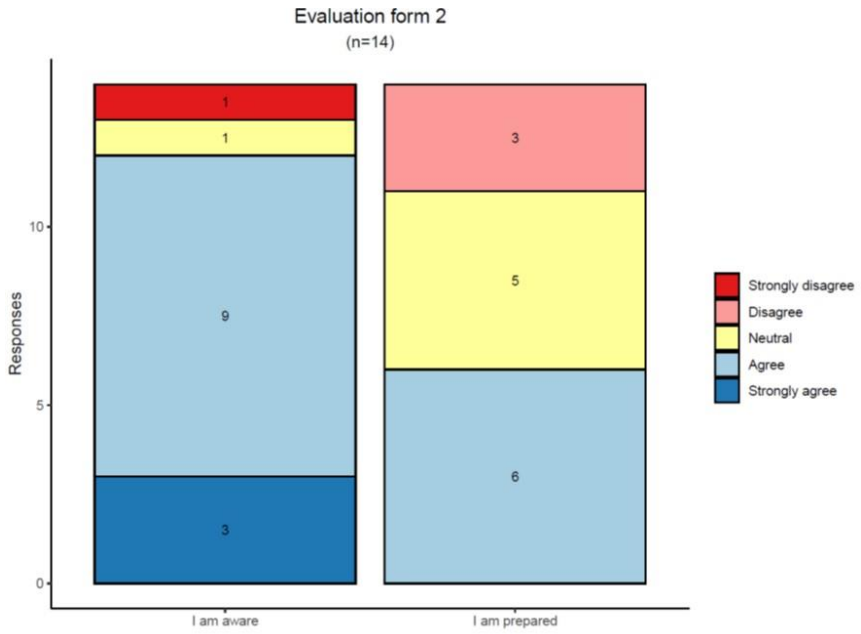


Figure 16. Responses from Evaluation form 2, submitted by participants after the EMPOWER workshops, assessing the degree to which they feel aware and prepared for the impacts of climate change.

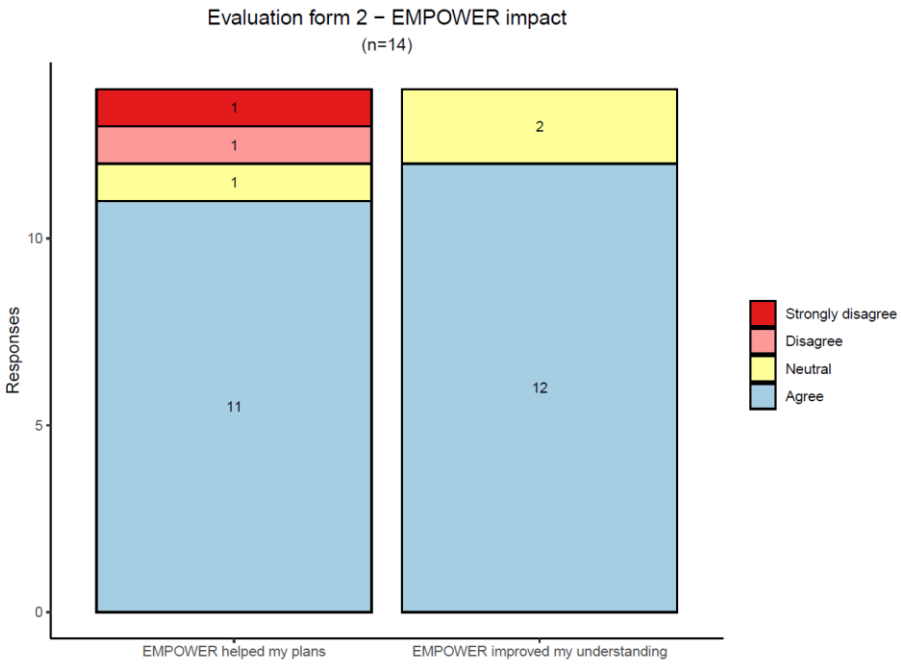


Figure 17. Responses from Evaluation form 2, submitted by participants after the EMPOWER workshops, assessing the degree to which they feel the project helped them make plans and improved their understanding.

Reflections / Lessons learned:

Participants

The recruitment of participants was not random, and therefore did not result in a diverse range of individuals from across society. This was a deliberate choice made during the planning stage owing to the short timescale of the project. By specifically targeting community members with an interest in the impacts of climate change we were able to quickly gather information on people's knowledge and mostivations. An obvious trade off to this approach is that we did not capture the views from those most vulnerable to climate change. This was most apparent when the majority of participants deemed installing flood barriers as irrelevant, despite living in towns/cities with areas of high flood risk. However, as our interventions are not just about households but also communities, it could be that there are 'spillover' benefits to other community members (e.g. helping vulnerable neighbours). Nevertheless, future work could think about directly engaging those most vulnerable (e.g those in flood risk zones, or with homes susceptible to heat shock particularly if elderly or in greater poverty etc.). Additionally, the recruitment of participants who are less aware of/don't 'believe in' climate change should also be considered in future work. In these cases, the protocol might be different, requiring not only the identification of threat vectors and interventions, but an additional prior step to facilitate recognition of climate change as a problem (which is, of course, no small task). Hence the protocols may not be directly transferable to all demographics without refinement.

Interventions

There were multiple reflections from the workshops regarding interventions. The first was that some participants were keen to focus on big picture interventions to *mitigate* the effects of climate change globally, for example suggesting cutting personal carbon emissions or reducing meat consumption. This is unsurprising given the demographic, with many individuals involved in campaigns or activities to limit climate change. However, this acted as a barrier to the workshops as some participants were reluctant to focus on smaller scale *adaptation* measures to specific climate threats. Future projects would benefit from a more explicit explanation in the introduction of the workshop's focus on local threat adaptation, rather than global climate mitigation. This global vs local viewpoint is also relevant to the second intervention reflection. Whilst there were multiple reasons why individuals did not intend to implement interventions, one which repeatedly came up was a reluctance to consume materials or energy. This is a respectable viewpoint, mediated by the morals of participants concerned, and is part of a wider debate around mitigation and adaptation. At the local scale, arguably the most important reason for not implementing interventions was a lack of ownership or rights to implement them. Future work should consider how land owners/rights holders could be involved in the process alongside tennants. A final consideration is that many of the interventions that participants already implemented were not actively organised by participants but were already in place. This was expected for the housing category (e.g. loft insulation already present when a house was bought), but it also occurred for all supporting factors, even the general ones around campaigning and communicating. It seems participants interpreted this question differently to how we expected, therefore future projects should be more explicit in their definitions

Technical and practical

Hosting the workshops online did not cause any major issues, as this way of working is increasingly becoming the norm in the UK due to the Covid-19 pandemic. Participants were briefed in emails beforehand that using a PC or laptop was preferable to a phone or tablet. It is worth considering how to connect with individuals who do not have access to the technology. Could a hybrid of online and in person workshops be carried out? Where issues arose e.g. being unable to access the PRSM maps, they were dealt with by having multiple EMPOWER team members within each breakout room. This allowed one person to lead the discussion whilst another could sort out technical issues. It is likely that with larger numbers of participants more technical issues would arise, so a higher number of team members may be required, all briefed on overcoming common technical issues. Future work would also benefit from numbering all interventions to aid discussion.

Appendices Appendix 1) Briefing pack

EMPOWER

Empowering citizen and community adaptation to systemic risks from climate change

CLIMATE CHANGE IMPACTS

Berkshire – Oxfordshire

UNITED KINGDOM

Climate change is having increasing impacts on individual livelihoods and prosperity, yet plans for adaptation strategies have mostly been limited to government and the private sector. Our international team will undertake three case studies (in the UK, India, and Ghana) to explore the direct and indirect impacts of climate change at a local level, from the citizen perspective.

The project involves an interactive mapping exercise to identify climate change threats and interventions tailored to local context. By the end of the project, participants will have a better understanding of how climate change might affect themselves, their households and local communities.

They will have identified opportunities for adaptation actions, including developing a 'personal adaptation plan' of simple actions to take to reduce the impacts of climate change.

UK Case Study

In our UK case study, we will focus on the counties of Berkshire and Oxfordshire, with participants from the greater Oxford and Reading area. In terms of representativity of climate change impact projections, the spatial scale of the assessment is regional, focusing on the Thames Valley and, in a broader sense, South East England.

Figure 1 EMPOWER Project- UK Case Study Area (Berkshire, Oxfordshire)

Direct Effects of climate change

Impacts of climate change are already affecting all communities across the globe. Whether these are record breaking temperatures, severe flooding events, or heatwaves, these effects are undeniable and multifaceted.

The Thames Valley is facing an increased threat of severe weather events which will have a direct impact on the livelihoods of the people living in the area.

Severe weather events posing a threat to human life are known as hydrometeorological hazards.

These hazards encompass a wide range of threats (e.g., thunderstorms, hailstorms, floods, heatwaves, snowstorms, etc.).

Hydrometeorological Hazards

The IPCC's 6th Assessment Report and the wider scientific community agree that based on current projections, some severe weather events are likely to increase in frequency and intensity in the Thames Valley.

What are some of the direct threats to the area?

- Severe flooding events
- Increased risk of heatwaves
- Storms (cyclones, snow, rain, hail)
- Soil erosion and degradation
- Combined severe weather events

Indirect Effects of climate change

Some of the effects of climate change have a direct and measurable impact. However, communities all over the world are also at increasing risk due to vulnerability to *indirect* effects of climate change, which occur through contagion effects across social, economic and environmental systems. These indirect effects impact aspects such as agriculture, food security, transport, logistics, etc.

All of these effects have a massive impact on quality of life. It is therefore imperative to become more resilient to systemic risks of climate change through citizen and community adaptation.

The anticipation of the risks that lie ahead of us are the first step to creating adequate adaptation plans and to encourage policy action on other levels of decision making.

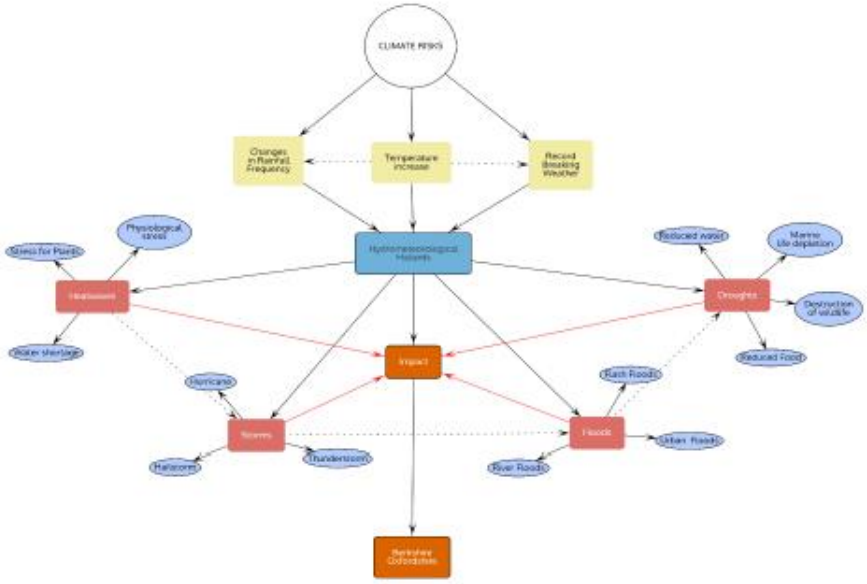
Figure 2- Flood risk projections in the central Reading area (model: UKCP18 Met Office; RCP 6.0)

Natural Environment Research Council

University of Reading

University of Surrey

IIM Nagpur



Examples of direct effects of climate change

Storms

What are the projected changes for this area?

It is difficult to attribute a change in storm patterns to climate change alone. However, the extent of storms will likely increase in coastal settings. Some trends indicate that wind gusts are set to increase with a potential for cyclones in the autumn months. Extreme weather events, including storms, are set to become more frequent in the coming decades.

How could these impact health and livelihoods?

- Increased risk to life from storm damage
- Property damage due to storms/debris
- Transport disruptions, delays, cancellations

Flooding

What are the projected changes for this area?

An increase in projected global temperatures will lead to a warmer and more moist atmosphere, capable of holding more water, resulting in heavier rainfall. The frequency and intensity of rainfall events will increase, leading to a higher risk off flooding events.

How could these impact health and livelihoods?

- Danger to life
- Property damage
- Severe transport disruptions
- Power outages
- Water pollution (e.g. sewage/industrial contamination)

Heatwaves

What are the projected changes for this area?

The area is projected to be warmer in the coming decades. Hotter and drier summers are likely to become more common. Tropical nights with temperatures above 25°C are expected to become more common as well as extreme hot temperature summers.

How could these impact health and livelihoods?

- Severe risk to health (especially among vulnerable groups)
- Aggravation of chronic diseases and death
- Disruption of daily life
- Increased energy costs (air conditioning, etc.)
- Transport disruption (road and rail affected by high temperatures)

Droughts

What are the projected changes for this area?

On average, drier summers are projected especially in the south of the UK. The extent of the droughts depends on greenhouse gas emission scenarios, with a higher emission scenario resulting in a higher likelihood of prolonged droughts, especially in the summer months.

How could these impact health and livelihoods?

- Increased risk of wildfires and dust formation
- Disruption of daily life
- Aggravation of respiratory diseases
- Water supply problems
- Negative effects on wildlife and ecosystems

Compounding effects of multiple events

Floods, droughts, heatwaves and storms can occur as a combination over a short time frame rather than single events spread out over time. This combination of events is known as a "compound" event that usually results in high-impact and much more severe outcomes on the ground. This type of event requires a strong adaptation plan in order to mitigate the damages.

Examples:

- Droughts coupled with a heatwaves
- Floods coupled with environmental/ecological disasters
- Wind storms coupled with flash floods

Examples of Indirect effects of climate change

Food security

What are the potential impacts to this area?

Indirect effects from increasing temperatures and unpredictable extreme weather events can impair the quantity and quality of the food supply to the UK. Climate change can affect local food production (e.g., UK farms and fisheries) or effects can happen overseas, with important consequences to imports and exports of food products.

How could these impact health and livelihoods?

- Reduced food availability (e.g., from shorter growing seasons)
- Limited access to foods (e.g., increased price of food baskets)
- Instability and lower diversity of food supply (e.g., from price shocks affecting the global supply of imported products)
- Decrease in agricultural productivity (Ortiz-Bobea, 2021)
- Change in nutritional quality of crops (e.g., increased concentration of glucose and fructose, and reduced concentration of protein, iron, and zinc of vegetables - Dong, 2018)

Energy supply disruption

What are the potential impacts to this area?

Energy supply is multifaceted and it can be disrupted by many factors, such as from the consequence of storms physically damaging supply lines or from variability in wind patterns. The UK is particularly reliant on wind and natural gas for energy generation and thus is vulnerable to environmental and geopolitical fluctuations related to these energy sources. In addition, increased energy demands to adjust indoor temperatures (e.g., either from extremely high or low temperatures outside) can present more susceptibility to energy disruptions.

How could these impact health and livelihoods?

- Power shortages (e.g., Storm Arwen cutting off 5,100 homes from the power grid)
- Increased price of energy (e.g., all-time high energy prices in November 2021 from a combination of factors such as reduced production from renewable sources in Scotland, increased demand for gas in Asia, and reduced exports from Russia)
- Infrastructure investments may be necessary to achieve energy stability from alternative sources (e.g., instalment of solar panels)

Biological factors

What are the potential impacts to this area?

The survivability, adaptation, and migration of living beings are fundamentally conditioned by environmental factors (e.g., temperature, humidity, altitude, and availability of and competition for resources). With increasing temperatures and more frequent and intense extreme weather events, plants and animals experience substantial changes in their ecosystems (which can be particularly compounded by the degree of international connectedness of the UK with multiple countries globally).

How could these impact health and livelihoods?

- Zoonotic diseases (e.g., expanding ranges of diseases vectored by mosquitoes and ticks)
- Changes to migration patterns of important providers of ecosystems services (e.g., pollinators)
- Invasive species of plants or animals which can disrupt local ecosystems
- Resilient pests and pathogens which can impair agriculture

Mental health & wellbeing

What are the potential impacts to this area?

Impacts to the environment can ultimately modulate how people see and understand themselves, both from an individual and collective perspective. Climate changes can have important implications for the mental health and wellbeing of current and future generations.

How could these impact health and livelihoods?

- Stress from direct impacts of weather extremes (e.g. flooding, drought, heatwaves)
- Chronic stress, pressure and uncertainty about the future
- Limited capacity to control risk factors (e.g. "they are out there, in another place, sector or country; not in my household")
- Loss of sense of place ('solastalgia') and disconnection from nature (e.g., in highly-urbanised settings or in degraded ecosystems)
- Inequity and injustice (e.g., climate change impacts are expected to disproportionally affect communities least responsible for emissions and those that are most vulnerable in society - Klinsky, 2017)

Transport and logistics

What are the potential impacts to this area?

The effects of climate change on transport and logistics vary from physical disruption of roads or railways (e.g., from flooding or snowstorms) to problems in services/buildings of strategic benefit to society (e.g., harbours and airports interruptions or damages from severe storms). They can also be less obvious, such as an increased need for cold storage for food and other perishable goods in the presence of increasing temperatures.

How could these impact health and livelihoods?

- Increased food loss and waste
- Increased demand for storage of perishable goods
- Disruption to supply lines

House and workplace

What are the potential impacts to this area?

People need shelter to protect them from environmental threats. Effects from extreme weather events, however, present a serious change in the scale, frequency, and predictability of these environmental threats. Increases to severe flooding events and to heatwaves, for instance, require adaptation measures in houses and in the workplace.

How could these impact health and livelihoods?

- Increased demand for house insulation and/or ventilation
- More resources needed to build resilient structures (e.g., flood barriers on house doors or house elevation)
- Limited working hours for outdoor professions to avoid exposure to extreme temperatures (e.g., avoiding physically demanding work between 11am and 2pm in the summer)
- Flexible contracts for desk-based work activities (e.g., remote work)

Stability of financial incomes

What are the potential impacts to this area?

Extreme weather events bring instability and unpredictability, which in turn affect financial models of future liabilities. The ability to acquire credit from the perspective of individuals or business is thus influenced by the effects of climate change, in particular for regions susceptible to flooding and storms.

How could these impact health and livelihoods?

- Limited capacity to find insurance (e.g., unpredictability of extreme events)
- Increased budgeting costs to improve resilience
- Reduced credit score, leading to higher interest rates (e.g., more susceptibility to default on loans)
- Inflation caused by global economic disruption and price rises of food and energy through supply chain disruption

This briefing note was developed by the EMPOWER project team. For more information see https://www.empower-project.org/

Appendix 2) List of interventions

Table A2.1 Interventions developed participants in Workshop 1 after being collated and consolidated by the EMPOWER team.

Climate Driver	Supporting Factor	Threat	Intervention
Extreme weather events	Energy	Loss of mains power	Develop off grid energy supply (e.g., solar roofs, micro wind turbine)
Multiple factors including weather e.g. wind/sun for wind and solar energy	Energy	Increased energy costs	Minimise energy demand at home (e.g., energy efficient electronics) to buffer from climate-induced price spikes/rationing
Extreme weather events	Energy	Loss of mains power	Prepare for extreme events with backups (e.g., battery powered torches/devices)
Changing seasonality, increased rainfall, high temperatures	Food and Water Access	Food shortages	Contribute to food aid and food sharing networks
Extreme events	Food and Water Access	Water Shortages	Create local freshwater store for water capture
Changing seasonality, increased rainfall, high temperatures	Food and Water Access	Food shortages	Grow food with the community (e.g., at community gardens)
Changing seasonality, increased rainfall, high temperatures	Food and Water Access	Food shortages	Grow own food (e.g., at private garden, allotments)
Changing seasonality, increased rainfall, high temperatures	Food and Water Access	Food shortages	Minimise food waste (at home and when shopping, incl. preserve excess food for future consumption)
Changing seasonality, increased rainfall, high temperatures	Food and Water Access	Food shortages & Extreme events	Store non-perishable foods and drinks in house
General	General	General	Campaign for government to support interventions and communicate to improve uptake of interventions across community
General	General	General	Communicate interventions within the community, including vulnerable neighbours.
General	General	General	Engage with local and central government to support the development and implementation of neighbourhood resilience plan
General	General	General	Organise / contribute to / attend events and networks to improve general resilience of community (through building social capital).
Increased seasonal / extreme rainfall events	Housing	Flooding	Install flood barriers / sandbags (and alternatives)
High summer temperatures	Housing	Overheating	Install shutters (or alternative) to windows to shade rooms during the day
High summer temperatures	Housing	Overheating	Insulate housing
High summer temperatures	Housing	Overheating	Invest in improved ventilation
High summer temperatures	Housing	Overheating	Plant climate change resilient trees on own property to shade south facing walls
Increased seasonal / extreme rainfall events	Housing	Flooding	Reduce / remove paving in gardens
High summer temperatures	Housing	Overheating	Use fans to cool rooms during high temperatures

Appendix 3) Breakdown of the degree of implementation and categories of individual interventions.

A.3.1) General interventions:

A.3.1.1) Engage with local and central government to support the development and implementation of Neighbourhood Resilience Plan

Nine out of 16 responses indicated that participants already had this intervention in place, with the remaining seven indicating that they plan to implement it in the future. Of the nine that already had this implementation in place, four actively organised it themselves, whilst it was already existent/in place for the remaining five. Of the seven that intend to implement this intervention in the future, one intend to do so within the next three months, three within the next six months and three by this time next year.

A.3.1.2) Organise / contribute to / attend events and networks to improve general resilience of community

Eight out of 16 responses indicated that participants already had this intervention in place, seven indicated that they plan to implement it in the future, and one indicated that they did not intend to implement this intervention. Of the eight that already had this implementation in place, five actively organised it themselves, whilst it was already existent/in place for the remaining three. Of the seven that intend to implement this intervention in the future, two intend to do so within the next three months, four within the next six months, and one by this time next year. A lack of time was selected as the reason why one response would not be implementing this intervention

A.3.1.3) Communicate interventions within community, including vulnerable neighbours.

Seven out of 16 responses indicated that participants already had this intervention in place, eight indicated that they plan to implement it in the future, and one indicated that they did not intend to implement this intervention. Of the seven that already had this implementation in place, four actively organised it themselves, whilst it was already existent/in place for the remaining three. Of the eight that intend to implement this intervention in the future, three intend to do so within the next three months, two within the next six months, two by this time next year, and one other ("*As and when interventions are established and we can confidently communicate them*"). The reason why one response would not be implementing this intervention was other ("*I think my energy is better spent on projects that impact larger groups of people*").

A.3.1.4) Campaign for government to support interventions and communicate to improve uptake of interventions across community

Seven out of 16 responses indicated that participants already had this intervention in place, seven indicated that they plan to implement it in the future, and two indicated that they did not intend to implement this intervention. Of the seven that already had this implementation in place, four actively organised it themselves, whilst it was already existent/in place for the remaining three. Of the seven that intend to implement this intervention in the future, three intend to do so within the next three months, two within the next six months, two by this time next year and one other ("*As and when interventions are established and we can confidently communicate them*"). Of the two that did not intend to implement this intervention, a lack of time and other ("*I don't know how to do this*") were selected.

A.3.2) Housing and workplace interventions:
A.3.2.1) Insulate housing (including double glazing)

Eight out of 16 responses indicated that participants already had this intervention in place, six indicated that they plan to implement it in the future, and two indicated that they did not intend to implement this intervention. Of the eight that already had this implementation in place, two actively organised it themselves, whilst it was already existent/in place for the remaining six. Of the six that intend to implement this intervention in the future, one intends to do so by this time next year, one when they own property, and four selected other (with reasons being "*Unsure*" & "*In Planning*"). Of the two that did not intend to implement this intervention, ownership/rights was selected.

A.3.2.2) Use fans to cool rooms during high temperatures

Six out of 16 responses indicated that participants already had this intervention in place, three indicated that they plan to implement it in the future, and seven indicated that they did not intend to implement this intervention. Of the six that already had this implementation in place, five actively organised it themselves, whilst it was already existent/in place for the remaining one. Of the three that intend to implement this intervention in the future, one intends to do so within the next six months and two selected other ("*When necessary*" & "*As part of larger project*"). Of the seven that did not intend to implement this intervention, four selected that it was irrelevant and three selected other (with all three reasons being a reluctance to increase energy/fossil fuel use).

A.3.2.3) Reduce/remove paving in gardens

Five out of 16 responses indicated that participants already had this intervention in place, two indicated that they plan to implement it in the future, and nine indicated that they did not intend to implement this intervention. Of the five that already had this implementation in place, three actively organised it themselves, whilst it was already existent/in place for the remaining two. Of the two that intend to implement this intervention in the future, one intends to do so when they own property, and one selected other (their reason being an inability to carry out this intervention on their property but an "*intention to influence other households*" in the future). Of the nine that did not intend to implement this intervention, one selected that time was the constraint, three selected that they were unable to because they did not have ownership/rights, and five selected that it was irrelevant.

A.3.2.4) Plant climate change resilient trees on own property to shade south facing walls

Five out of 16 responses indicated that participants already had this intervention in place, four indicated that they plan to implement it in the future, and seven indicated that they did not intend to implement this intervention. Of the five that already had this implementation in place, three actively organised it themselves, whilst it was already existent/in place for the remaining two. Of the four that intend to implement this intervention in the future, one intends to do so by this time next year, one when they own property, and two selected other ("*Unsure*"). Of the seven that did not intend to implement this intervention, three selected that they did not have ownership/rights to do so and four selected other (reasoning either that they "*Do not have a garden*" or "*Do not have the space to plant trees*").

A.3.2.5) Invest in improved ventilation

Three out of 16 responses indicated that participants already had this intervention in place, four indicated that they plan to implement it in the future, and nine indicated that they did not intend to implement this intervention. Of the three that already had this implementation in place, one actively organised it themselves, whilst it was already existent/in place for the remaining two. Of the four that intend to implement this intervention in the future, one intends to do so when they own property and three selected other ("*As part of larger project*"). Of the nine that did not intend to implement this intervention, one selected that they did not have ownership/rights to do so, six selected irrelevant and two selected other ("*Not previously considered*" & "*Could take to company management"* i.e., not at home).

A.3.2.6) Add shutters (or alternative) to windows to shade rooms during the day

Two out of 16 responses indicated that participants already had this intervention in place, five indicated that they plan to implement it in the future, and nine indicated that they did not intend to implement this intervention. Of the two that already had this implementation in place, one actively organised it themselves, whilst it was already existent/in place for the remaining one. Of the five that intend to implement this intervention in the future, two intend to do so in more than a year and three selected other ("*When necessary*" & "*As part of larger project*"). Of the nine that did not intend to implement this intervention, two selected that they did not have ownership/rights to do, six selected that it was irrelevant and one selected other ("*Trying to reduce consumption*").

A.3.2.7) Add flood barriers/sandbags

No responses indicated that participants already had this intervention in place, seven indicated that they plan to implement it in the future, and eight indicated that they did not intend to implement this intervention. Of the three that intend to implement this intervention in the future, one intends to do so within the next six months, one in more than a year and one when they own property. Of the 13 that did not intend to implement this intervention, one selected that they did not have ownership/rights to do so. The remaining 12 selected that it was irrelevant.

A.3.3) Food and water access interventions:

A.3.3.1) Minimise food waste (at home and when shopping, incl. preserve excess food for future consumption)

Seventeen out of 17 responses indicated that participants already had this intervention in place. Of these 17, 15 actively organised it themselves, whilst it was already existent/in place for the remaining two.

A.3.3.2) Store non-perishable food and drink in house

Fourteen out of 17 responses indicated that participants already had this intervention in place, two indicated that they plan to implement it in the future, and one indicated that they did not intend to implement this intervention. Of the 14 that already had this implementation in place, all 14 actively organised it themselves. Of the two that intend to implement this intervention in the future, one intends to do so within the next three months, and one intends to do so by this time next year. The one that did not intend to implement this intervention selected other ("*Concerns over food hoarding*").

A.3.3.3) Grow own food (e.g., at private garden, allotments)

Eleven out of 17 responses indicated that participants already had this intervention in place, four indicated that they plan to implement it in the future, and two indicated that they did not intend to implement this intervention. All 11 that already had this implementation in place actively organised it themselves. Of the four that intend to implement this intervention in the future, one intends to do so within the next three months, one within the next six months, and two by this time next year. Of the two that did not intend to implement this intervention, one selected that they did not have ownership/rights to do, and one selected other ("*Not green fingered*").

A.3.3.4) Contribute to food aid and food sharing networks

Ten out of 17 responses indicated that participants already had this intervention in place, four indicated that they plan to implement it in the future, and three indicated that they did not intend to implement this intervention. Of the ten that already had this implementation in place, four actively organised it themselves, whilst it was already existent/in place for the remaining six. Of the four that intend to implement this intervention in the future, one intends to do so within the next three months, one within the next six months, one by this time next year, and one selected other ("*Dependent upon crops*"). Of the three that did not intend to implement this intervention, two selected that time was restricting and one selected other ("*Can only do if have excess food*").

A.3.3.5) Create local freshwater store for water capture

Eight out of 17 responses indicated that participants already had this intervention in place, two indicated that they plan to implement it in the future, and seven indicated that they did not intend to implement this intervention. Of the eight that already had this implementation in place, six actively organised it themselves, whilst it was already existent/in place for the remaining two. Of the two that intend to implement this intervention in the future, one intends to do so within the next three months, and one by this time next year. Of the seven that did not intend to implement this intervention, one selected that

time was restrictive, one selected that costs were restrictive, four selected that they did not have ownership/rights to do, and one selected other ("*Complicated and safety concerns*").

A.3.3.6) Grow food with the community (e.g., at community gardens)

Four out of 17 responses indicated that participants already had this intervention in place, 11 indicated that they plan to implement it in the future, and two indicated that they did not intend to implement this intervention. Of the four that already had this implementation in place, one actively organised it themselves, whilst it was already existent/in place for the remaining three. Of the 11 that intend to implement this intervention in the future, two intend to do so within the next three months, three within the next six months, two by this time next year, one in more than a year, and three selected other ("*When others commit*", "*No plan currently, but it's an ambition"*, and "*Once have explored possibility of community purchase of farmland*"). Of the two that did not intend to implement this intervention, one selected that time was restricting and one selected that they did not have ownership/rights to do.

A.3.4) Energy supply interventions:

A.3.4.1) Minimise energy demand at home (e.g., energy efficient electronics) to buffer from climate-induced price spikes/rationing

Twelve out of 16 responses indicated that participants already had this intervention in place, three indicated that they plan to implement it in the future, and one indicated that they did not intend to implement this intervention. Of the 12 that already had this implementation in place, 11 actively organised it themselves, whilst it was already existent/in place for the remaining one. Of the three that intend to implement this intervention in the future, one intends to do so within the next six months, one by this time next year, and one selected other ("*Intend to improve on existing*"). The response that did not intend to implement this intervention selected that time was restricting.

A.3.4.2) Prepare for extreme events with backups (e.g., battery powered torches/devices)

Five out of 16 responses indicated that participants already had this intervention in place, six indicated that they plan to implement it in the future, and five indicated that they did not intend to implement this intervention. All five of those that already had this implementation in place actively organised it themselves. Of the six that intend to implement this intervention in the future, one intends to do so within the next three months, one within the next six months, two by this time next year, and two selected other ("*When necessary*" & "*Keep open fire*"). Of the five that did not intend to implement this intervention, three selected that it was irrelevant, and two selected other ("*Would leave home*" & "*Impractical*").

A.3.4.3) Develop off grid energy supply (e.g., solar roofs, micro wind turbine)

One out of 16 responses indicated that participants already had this intervention in place, seven indicated that they plan to implement it in the future, and eight indicated that they did not intend to implement this intervention. The individual that already had this implementation in place actively organised it themselves. Of the seven that intend to implement this intervention in the future, one intends to do so within the next six months, two by this time next year, and four selected other ("*Unsure*", "*As part of larger project*" & "*Dependent on how long intending on living in current property*"). Of the eight that did not intend to implement this intervention, three selected that costs were restrictive, and five selected that they did not have ownership/rights to do.

Suggested report Citation:

Da Costa, J*., Dornelles, A.D*., Greenwell, M.P.*, Gilbert, N., Narasimhan, K., Oliver, T.H., (2022). EMPOWER UK: Empowering citizen and community adaptation to systemic risks from climate change in Reading, Wallingford, and Oxford. EMPOWER project, UK case study report, March 2022.

*Joint first authors, equal contribution

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