

PERSPECTIVE • OPEN ACCESS

Exploring the interactions between climate change, chemical exposures and public health

To cite this article: Tom Gaulton *et al* 2026 *Environ. Res.: Health* **4** 013001

View the [article online](#) for updates and enhancements.







You may also like

- [Classifying energy insecurity among households with medical devices through latent class analysis](#)
Matthew D Dean and Katherine E Asmussen
- [Moving toward a more human-oriented analysis of urban heat: examining differences of heat exposure intensity at busy commuting locations](#)
Peter C Ibsen, Melissa R Mchale, Priyanka Desouza et al.
- [Public perceptions and expert opinions about microplastic and nanoplastic contamination in water](#)
Dima Balaa, Fatih Sekercioglu, Roxana Suehring et al.

ENVIRONMENTAL RESEARCH HEALTH

PERSPECTIVE

Exploring the interactions between climate change, chemical exposures and public health

Tom Gaulton^{1,*} , Mari Langreiter¹ , Lydia Izon-Cooper¹ , Haydn Cole¹ , Sari Kovats² , Hanna-Andrea Rother³ , Kerry A Broom^{1,4} , Sarah Dack¹ , Ariana Zeka¹ , Sibylle Ermler⁵ , Chris Collins⁶ , Iain Lake⁷ , Jo Wybrow⁸ , Hannah R Littler⁸  and Raquel Duarte-Davidson¹ 

¹ Radiation, Chemical, Climate and Environment Hazards Directorate, UK Health Security Agency, Didcot, United Kingdom

² London School of Hygiene and Tropical Medicine, London, United Kingdom

³ University of Cape Town, Cape Town, South Africa

⁴ NIHR Health Protection Research Unit in Environmental Change and Health, United Kingdom

⁵ Department of Life Sciences, College of Health, Medicine and Life Sciences, Brunel University London, London, United Kingdom

⁶ School of Biological and Marine Sciences, University of Plymouth, Plymouth, United Kingdom

⁷ School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom

⁸ Environment Agency, Bristol, United Kingdom

* Author to whom any correspondence should be addressed.

E-mail: tom.gaulton@ukhsa.gov.uk

Keywords: climate change, climate policy, chemicals, exposure risks, public health, one health, environment and health



OPEN ACCESS

RECEIVED

27 June 2025

REVISED

24 September 2025

ACCEPTED FOR PUBLICATION

8 January 2026

PUBLISHED

27 January 2026

Original content from this work may be used under the terms of the [Creative Commons Attribution 4.0 licence](https://creativecommons.org/licenses/by/4.0/).

Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.



Abstract

Climate change impacts human exposure to chemicals through multiple pathways. This article discusses the interaction between chemicals, climate change and public health, presenting the outcomes of discussions on gaps and opportunities for progressing scientific knowledge to support positive action in this area. These discussions were held at a workshop hosted by the National Institute of Health Research (NIHR) Health Protection Research Unit in Environmental Change and Health (HPRU ECH) and organised in collaboration between the London School of Hygiene and Tropical Medicine (LSHTM) and the UK Health Security Agency (UKHSA). The workshop focused on the UK, but future work would benefit from broadening the analysis to other countries.

1. Introduction

The interactions between chemical exposures, public health, and climate change are complex, requiring input from various disciplines, policy, and research areas to identify needs, gaps, and opportunities [1, 2]. The recent UK Health Effects of Climate Change (HECC) report covers many aspects of how climate change will affect human health, including increased temperatures, flooding, drought, land stability, air pollution, infectious diseases, wildfires and chemicals [3]. This includes exposure to chemicals involved in, and associated with, agricultural and chemical industrial processes, which can have impacts on water quality, food safety and soil contamination. Several important pathways regarding human health effects from the environment and climate change have also been collated by the World Health Organisation [4].

This article aims to synthesise the outcomes of a multi-sectoral workshop exploring the intersection of climate change, chemical exposure, and public health, and to propose actionable recommendations for research and policy. The focus of the workshop was on identifying issues and knowledge gaps, as well as levers and barriers to address interactions between climate change and public health. The workshop focused on how climate change may change the risk of exposure to chemicals, though it is recognised that changes in chemical use might in turn impact climate, such as increased use of agricultural chemicals requiring an increase in energy use to produce them, or the expected increase in use of alternative fuels. The workshop, which took place in London from 30 September to 1 October 2024, featured expert presentations, interactive exercises, and plenary discussions. It should be noted that a full breadth of relevant stakeholders was not represented and therefore any views expressed are solely those collated

through the workshop and not a comprehensive representation of expert opinion on the subject. Further details of the workshop can be found in the workshop report.⁹

2. Background

Human exposure to chemicals released into the environment through natural and anthropogenic activities directly and indirectly affect human health [5]. In 2019, pollution was estimated to cause around 9 million premature deaths globally, with air pollution accounting for 6.7 million, water pollution at 1.4 million, lead pollution at 900 000 and toxic occupational hazards at 870 000 [6]. In addition, it was estimated that 2 million deaths were attributable to specific chemicals. These deaths had a range of causes including: poisoning, heart disease, chronic respiratory disease and cancer [2]. As well as pollution from routine industrial emissions, from 2000 to 2020, over 1.85 million people were affected by more than 1000 industrial incidents involving chemicals [7].

Weather and climate factors affect the fate, behaviour and toxicity of chemicals in the environment by altering physical, chemical and biological drivers of partitioning between the atmosphere, water, soil, sediment, and biota, through transformation and degradation [8]. For example, reduced summer precipitation can lead to higher concentrations of chemicals (such as pesticides) in rivers; and extreme weather events can increase run-off and flushing from land-deposited waste. Higher temperatures and reduced precipitation can volatilise persistent organic pollutants (POPs), mercury and agricultural chemicals to the environment [9].

Extreme weather is known to increase the risk of human exposure to various chemicals of concern through mobilisation in air, soil, water and food chain, or damage to infrastructure including chemical bunds and remediation containment, such as agricultural chemicals (such as pesticides, herbicides and fertilisers) [10, 11], pharmaceuticals [12], POPs [8, 13, 14], heavy metals, particulate matter [15], polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds [9]. Exposure to these chemicals can cause a range of health effects, such as asthma attacks, immunosuppression, cardiovascular disease, cancer, metabolic disorders, and effects on neurobehavioral, endocrine and reproductive systems [5, 9, 16, 17].

Other scenarios where human health may be affected by chemical exposure as a result of changing climate include flooding and coastal erosion causing chemical releases such as the erosion of landfill; the development of novel technologies which may pose new chemical risks; increased pharmaceutical use, including antimicrobials [18, 19]; and potential for increased sensitivity of humans to chemical exposure due to interactions with other stressors, such as rising temperatures [12].

There is increasing awareness of the importance of predicting potential chemical exposures and effects within a changing environment and mitigating potential negative health effects, particularly in the most vulnerable populations [8]. This growing awareness is reflected in approaches such as the UN Global Framework on Chemicals [18], which aims to strengthen collaboration and coordination among stakeholders to address for our common environment of climate change, biodiversity loss and pollution, among other challenges (the triple crisis¹⁰). One health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems. It recognises the interconnectedness of environmental, animal, and human health, and highlights how climate change is making these links increasingly important [19, 20].

Although focussing on England, to understand the international approach further a policy brief from the University of Cape town (UCT) was presented and discussed during the workshop. Chemicals and Climate Change Nexus: Interventions to reduce interdependencies and their impacts, summarises the problem; highlights relevant climate change policy and calls for action to reduce the health impacts of climate change-mediated chemical exposure.¹¹

However, despite these initiatives, there are significant gaps in understanding of the relationship between climate change and exposure to chemicals [9].

⁹ www.lshtm.ac.uk/media/87061

¹⁰ <https://unfccc.int/news/what-is-the-triple-planetary-crisis>

¹¹ Chemicals and Climate Change Nexus: Interventions to reduce interdependencies and their impacts: https://health.uct.ac.za/sites/default/files/media/documents/health_uct_ac_za/2608/26-09-24-chemicals-and-climate-change-policy-brief-final.pdf

Table 1. Summary of gaps highlighted through the process of producing the chemicals chapter of the HECC report.

Gaps highlighted through the HECC report, with reference to peer reviewed literature	
Knowledge and understanding	<ul style="list-style-type: none"> - A requirement for novel methods to assess the direct effects of climate change on chemical exposure to human health [9]. - The identification of emerging priority contaminants and their risks to health [16]. - A requirement for a detailed analysis of the drivers of human vulnerability to chemical exposures and how they are affected by changes in climate [8].
Needs and capacities	<ul style="list-style-type: none"> - Standards and guidelines to limit emerging contaminant concentrations in soil and water [21, 22]. - A need for increased international collaborations, to facilitate collection and sharing of scientific data and experimental evidence of the potential direct impacts of climate change on the movement and fate of chemicals at specific sites (such as contaminated land) and their remediation methods [9]. - A need to develop effective monitoring and evaluation of future uncertainties in relation to extreme events (e.g., droughts and flood events) [23].
Solutions (surveillance, monitoring, collaborations, cross-disciplinary/cross-sector, translation to adaptive strategies and responses)	<ul style="list-style-type: none"> - Adaptation strategies must be regularly evaluated and adjusted to remain within an acceptable level of risk [23]. - Processes put in place to develop targeted surveillance schemes for monitoring chemicals and their health effects (e.g. agricultural chemicals) [9].

3. Methods

To explore these complex interactions further, a workshop was convened to gather expert insights and identify key gaps. 30 participants attended the workshop of the 39 invited. Participants were from academic, governmental and non-governmental sectors to seek representation from a breadth of subject matter experts, with an interest in chemicals and health, climate change or both. The workshop comprised presentations, group and plenary discussions, interactive activities using flip charts and props, and an online survey tool. The workshop was funded by the National Institute for Health and Care Research (NIHR) Health Protection Research Unit in Environmental Change and Health (NIHR 200 909). It focused on England, whilst recognising the importance and relevance of considering wider geographies.

3.1. Defining the gaps

A scoping literature review [9] identified key concerns and knowledge gaps regarding climate and chemical exposure risks in the UK. In addition to the gaps identified in the HECC report (such as the need for UK-based research on the effects of climate change on chemicals and public health, table 1), emerging risks were also identified through workshop discussions, summarised in figure 1. Current chemical and climate change conventions remain siloed, often overlooking the impact of climate change on chemical pollution and chemical exposure.

The first group activity required participants to collectively identify key threats to public health and information/evidence gaps on the interaction between chemical exposures, climate change and public health (summarised at figure 1). Gaps in knowledge and understanding relating to the interaction between chemical exposures and climate change were discussed at the workshop under five themes, pre-defined by the workshop project group (UK Health Security Agency (UKHSA) and London School of Hygiene and Tropical Medicine (LSHTM)) to cover as many gaps as possible: Health Systems; Future Technologies; Agriculture; Incidents, Conflicts and Disasters; and Industry and Regulation. These were selected to prompt discussion, but participants were not limited to discussing issues under these areas.

Considering scientific rather than policy aspects, and with a focus on England, the groups then collectively identified, discussed and summarised four key gaps per theme (figure 1). Key gaps included

Health System	Future technology	Incident, Disaster and Conflict	Agriculture	Industry and Regulation
<ul style="list-style-type: none"> • Current chemical exposures: if and how these are changing with time, across different population groups. • How infectious diseases change risk of chemical exposures. • Use of pharmaceuticals, their disposal, storage, changes in medical practices and functioning of health system. • Changing harms including new exposures to chemicals (e.g. relating to our ability to respond to extreme events). 	<ul style="list-style-type: none"> • The impact of new technologies e.g. nanomaterials, on health (e.g. fate and behaviour). • Risk assessment knowledge for new technology or new applications of existing technology e.g. maritime fuels, hydrogen in cars. • Risk associated with geo-engineering applications to manipulate weather e.g. cloud seeding. • All elements of lifecycles e.g. dealing with novel waste streams. 	<ul style="list-style-type: none"> • Pathways to exposure from chemicals (are exposure routes realistic). • Connectivity between environment and health – One Health. • Risks in domestic settings (homes and gardens) following floods. • Contamination of food following floods and links to food industry. 	<ul style="list-style-type: none"> • Risk to receptors due to use of pesticides and agrochemicals due to changes in growth seasons and pest dynamics. • Presence of chemicals in the human environment and other receptors / pathways e.g. biomonitoring. • Impact of pesticide use on soil carbon sequestration and soil health. • Post-authorisation monitoring of pesticides (e.g. health and effect on various species and environments). 	<ul style="list-style-type: none"> • Knowledge of combined effects and stressors (improvement in sharing of lessons learnt required). • Available resources e.g. for regulation, monitoring, attribution, independent research, research translation. • Impact of industry on regulation e.g. lack of independent data, misinformation, dilution of health effects, accountability. • Information on chemicals e.g. where they are, what they are, monitoring data/info, industry guidance.

Figure 1. Gaps identified from workshop activities, grouped into five main themes.

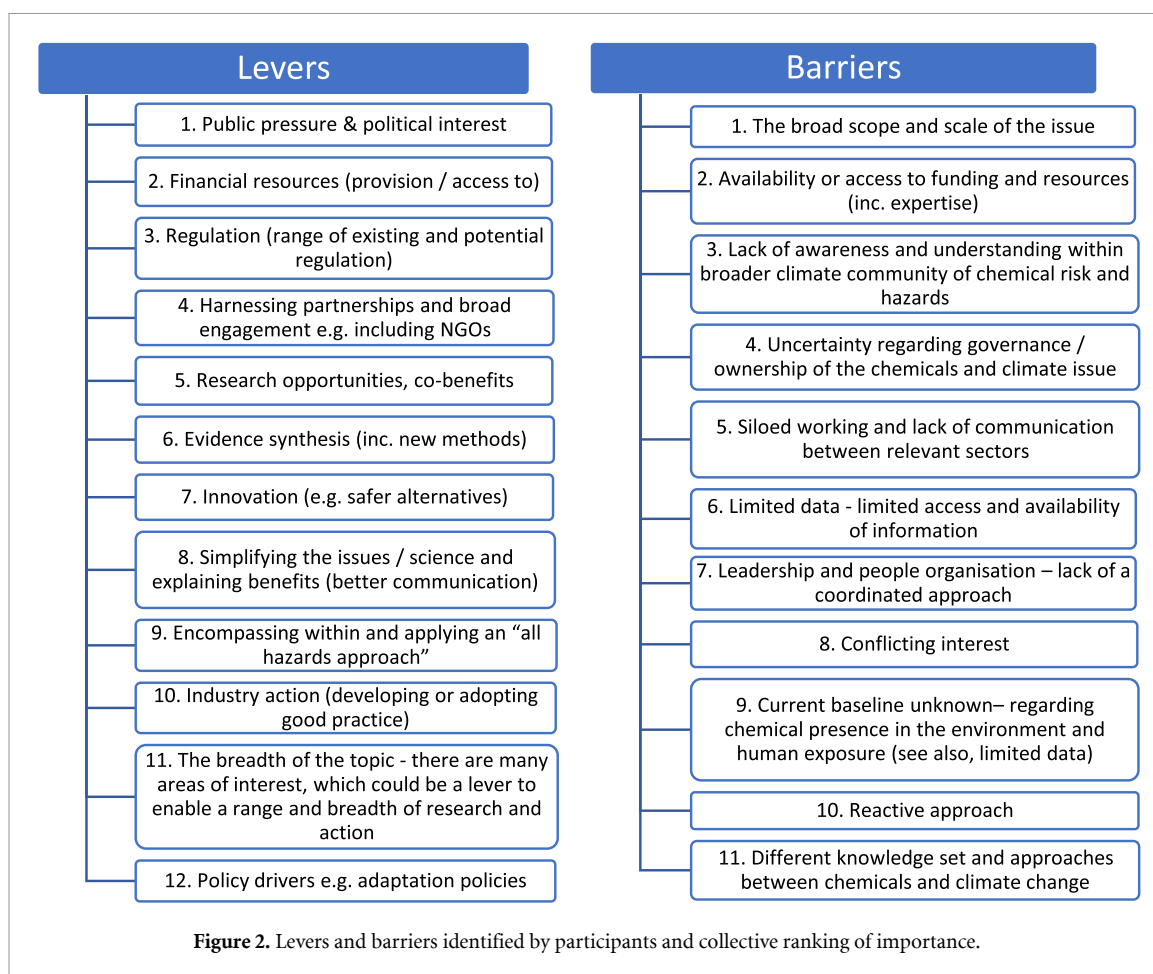
challenges in understanding emerging chemical exposure source-pathway-receptor linkages and their health effects, particularly those driven by new technologies, waste lifecycles, extreme events, and changing environmental conditions and behaviours. Other gaps involved the interdependence of environmental, human, and animal health; cumulative stressors; industry impacts on regulation; pharmaceutical lifecycles in evolving health systems; and resource limitations.

The second activity required participants to attempt a subjective prioritisation activity for the twenty gaps identified across the 5 topics. Using an online survey tool, participants were asked to rank each gap (using a numerical scale) based on a combination of ‘public health impact’ and ‘urgency’. The activity highlighted that such simple subjective ranking is not a useful approach to understanding priorities for these gaps (due to wide range and variability of answers from individual participants), though it did provide valuable opportunity for discussion.

4. Levers and barriers to address the interaction between chemicals, climate change and public health

Discussions explored and ranked key levers and barriers influencing the interaction between chemicals, climate change and public health, along with potential mechanisms to overcome challenges or leverage opportunities, as summarised in figure 2. The complexity and broad scope of the issue, spanning multiple agencies/stakeholders and disciplines, makes it difficult to coordinate a holistic response and was collectively considered the most significant barrier. Limited resources, including financial, institutional and expert knowledge, were highlighted as major constraints on efforts to mitigate and adapt to chemical-related health risks exacerbated by climate change. It was also emphasised that there is a lack of awareness and understanding within the broader climate change community of chemical exposure risks and hazards, and that, in general, existing efforts to manage chemical exposure and climate risks remain fragmented, with limited coordination between governmental and non-governmental agencies, industry, research institutions and the public.

Conversely, public pressure and political interest were identified as the strongest levers that could drive action, highlighting the increasing recognition of potential health impacts associated with climate-driven chemical exposures as an important public health issue. Growing awareness about climate and chemical exposure risks creates opportunities for policy change, which in turn could provide the financial resources (identified as a key enabler) needed to fund research, strengthen surveillance systems, and



support mitigation efforts. Regulation, including both existing and potential measures, was also highlighted as one of the top levers, with the scope to shape industry practices, enhance monitoring, and drive compliance with public health and environmental standards.

To translate these views into practical outcomes, participants were tasked with prioritising the most critical barriers and levers for action (figure 2). Prioritisation was achieved by the workshop participants ranking each lever or barrier in order of importance (in terms of addressing the interactions between climate change, chemicals and public health) via an online survey. These results were consolidated to identify the top action areas, which reflect the most strategic opportunities for intervention. Three key action areas emerged from this process, all focussing on enhancing communication and collaboration across sectors:

- **Leadership and people organisation:** coordination—improved coordination among key stakeholders, including government agencies, academia, private sector, and non-governmental organisations, is essential for developing a holistic strategy to manage chemical exposure health risks in the context of climate change.
- **Communication and information sharing:** collaboration—strengthening communication between scientific communities, government agencies, policymakers, and the public could facilitate better decision-making and increase public awareness of chemical-climate health risks.
- **Awareness and understanding of chemical exposure-associated risks:** communication—expanding knowledge and understanding of chemical-associated risks among those involved in climate change research and response efforts is crucial for integrating chemical exposure risk considerations into broader climate adaptation strategies. Developing and strengthening communication networks is important for addressing the identified barriers and leveraging the existing momentum to develop integrated, actionable solutions. The promotion of collaborative working will allow for sharing of intelligence and collective understanding of new and emerging risks, which require collaborative solutions.

5. Potential actions from the workshop

Potential actions to address the gaps and challenges discussed in the workshop are summarised in table 2 and described in more detail below.

Multi-hazard risk assessment and multi-criteria decision analysis to identify holistic solutions. Climate-related hazards are multifaceted and the relationships between climate, chemicals and risks to health are complex. Focusing on a single hazard may result in the incomplete assessment of risk, so employing multi-hazard risk assessment (the assessment of the interactions between single hazards, as opposed to assessing them independently from one another) and multi-criteria decision analysis (a method for evaluating and comparing multiple options based on diverse criteria to assist in making informed decisions e.g. on climate adaptation measures) strategies allows for the combined effects of multiple hazards to be considered. This offers a more complete perspective on the potential risks of climate-mediated chemical exposure that is essential for developing effective adaptation strategies, whilst avoiding unintended consequences. For example, the one health approach encompasses multiple hazards and their interconnectedness and impact on human, animal and environmental health, with the role of climate change becoming increasingly important [20].

Evidence syntheses and knowledge mobilisation needs to be conducted to foster a greater understanding on the interaction between climate change, related chemical exposure hazards likely to impact on health, and the change in risk of exposure due to climate. Targeted reviews of known gaps would also be beneficial to help in finding solutions. A more diverse group of national and international stakeholders is required to do this, to better prioritise identified gaps and provide sufficient detail to develop realistic, actionable recommendations and solutions. These should be updated regularly to stay abreast of ongoing and emerging developments/insights into the interaction between climate change and chemicals and allow adaptation strategies to be reviewed and adjusted. Knowledge mobilisation is a collaborative, two-way process supporting the transfer of evidence between researchers and stakeholders (such as collaborators, end users, the public and policymakers) that can help to close the gap between research and effective changes in health policy and practice. Adoption of knowledge mobilisation principles, including dissemination of these reviews through climate change networks, publication in journals and sharing across government can optimise uptake of results.

Networking. There was support and interest amongst the workshop participants for establishing a sustainable, health-focused climate change and chemicals network(s)/community of practice, with clear objectives as a means to collaborate, share research opportunities and interests, generate evidence or identify evidence gaps (that might be used to inform policy), foster ongoing communication and collaboration, raise awareness and address some of the gaps, levers and barriers identified during the workshop. Whether national or global, such a network should have clear governance to enable priorities to be set, actions to be taken, and the flexibility to evolve with the topic area. Workshop discussions highlighted that a committee or steering group to lead the network would be beneficial. It will also require diverse and representative membership to reflect the full spectrum of health, climate change and chemical exposure challenges. For example, a network that adopts a one health approach, including the integration of environmental and animal expertise, will strengthen the evidence base for regulatory and policy decisions, ensuring a more system-wide approach to mitigating climate-driven chemical exposure risks.

Existing UK and global networks could be used as examples of good practice in how networks are managed and could also provide opportunities for collaboration. Examples of such networks include the clean air networks, a collection of six networks with specific areas of focus¹² or the UCT networks for chemicals and pesticides.¹³

Horizon scanning activities will need to be established to identify the impact of climate change on emerging trends of chemicals likely to impact on human health, as well as monitoring levels of existing chemicals of concern i.e. monitor both the known and unknown chemicals of concern. There are existing UKHSA surveillance systems for chemical incidents which could be adapted/leveraged and utilised for this purpose (e.g. the Chemical Incident Response and Information System, Environmental public health surveillance system and event-based surveillance), however, more resources and suitable methodologies need to be directed to the development of a dedicated surveillance system for climate-mediated chemical

¹² www.saqn.org/about/clean-air-networks/

¹³ <https://health.uct.ac.za/environmental-health-projects/chemical-network>

Table 2. Potential actions to address the gaps discussed in the workshop (see figure 1 for full list of gaps).

Potential action	Description
Multi-hazard risk assessments	To holistically understand risk scenarios, multiple risk and exposure assessments need to be conducted as part of multi-hazard risk assessments. This is necessary to avoid solutions which address one issue without full consideration of impacts and consequences.
Multi-criteria decision analysis	Due to the complexity of determining appropriate adaptation measures, multi-criteria decision analysis may be necessary to avoid unintended consequences.
Comprehensive evidence syntheses and knowledge mobilisation	There is a need for both general reviews to identify gaps in knowledge and targeted reviews of known and potential risks and scenarios to find solutions. Examples may include risks associated with alternative fuels and novel technologies; lifecycle assessments of novel waste streams; and assessments of risks associated with increased pharmaceuticals (such as antimicrobials) in the environment.
Networking	The establishment of networks and networking activities will improve connectivity between disciplines with a stake in chemicals management, climate change and health interactions. Such as those working on one health, industry, regulators, policymakers, and academics.
Horizon scanning	Establish/incorporate horizon scanning activities to identify the impact of climate change on emerging chemicals likely to impact health, as well as known chemicals of concern.

exposure. Collaborating with other government departments, agencies and organisations which also conduct regular surveillance e.g. for food, the environment, would be beneficial for access to additional data, which could identify signals to be detected by horizon-scanning activities. It may also be useful to connect with non-chemical experts and key contacts connected to climate change for further access to data and other surveillance resources.

The signals identified from horizon scanning could be used to help prioritise risks and actions. Such as, changes in current chemical exposures, use of pharmaceuticals, changing harms (including new exposures to chemicals), risks in domestic settings, contamination of food and information on chemicals (e.g. which chemicals and where they are present) from figure 1.

6. Conclusions

There are considerable gaps in our knowledge and collaboration around the interaction between chemical exposure hazards, climate change and public health. The fourth HECC report identified several gaps, research priorities and implications for public health and provided a basis for discussions at the workshop and the themes under which gaps were grouped. The climate change and chemicals workshop itself gathered multi-sectoral stakeholders to collectively identify key areas of concern, gaps, barriers and levers related to the interaction between climate change, chemicals and risk to health.

Gaps identified in the workshop include a lack of connectivity between environmental and health research within and across sectors, as well as gaps in our understanding of current chemical exposures, the pathways/routes they take and how they will change over time. Barriers to progress include the broad scope and scale of the interaction between chemicals and climate change and the lack of awareness and understanding within the broader climate community of chemical exposure hazards and risks. In contrast, public pressure, political interest and financial resources were identified as key levers for action. Priority areas for action include improving leadership and coordination, collaboration, communication and raising awareness of chemical-associated risks.

There are opportunities to build knowledge and partnerships in this area. For example, there was strong agreement among participants of the workshop on the importance of establishment a health-focused interdisciplinary and cross-sectoral climate change and chemicals network. This network could

raise awareness, foster ongoing collaboration and maintain momentum for tackling the challenges posed by the interaction of climate change and exposure to chemicals. Initial discussions around a network found that having national and global arms of the same network would be beneficial to allow the direct action on country-specific issues while also considering issues that affect all countries. While this workshop was focused on the UK, future work would benefit from broadening the scope to other countries.

To facilitate these next steps (including formation of a network, arranging future meetings/workshops, horizon scanning of emerging contaminants), available funding opportunities and resources need to be identified and communicated to colleagues with an interest in research into climate change and chemical exposure. Strengthening networks and incorporating multisectoral and multidisciplinary stakeholder perspectives into planning and implementation can help deliver better research outcomes and increased utility.

This work is intended to highlight areas for progression in relation to the topics covered above and grow the sphere of collaboration amongst those with an interest in climate change and chemical exposure research.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary information files).

Acknowledgment

The authors thank all the experts who attended the Workshop on Climate Change, Chemical Hazards and Public Health, on the 30th September to the 1st October, as well as those who reviewed this manuscript.

Funding

This work is funded by the National Institute for Health and Care Research (NIHR) Health Protection Research Unit in Environmental Change and Health (NIHR 200909), a partnership between UK Health Security Agency (UKHSA) and the London School of Hygiene and Tropical Medicine (LSHTM), in collaboration with University College London and the Met Office.

Conflict of interest

The authors are not aware of any conflicts of interest. The views expressed are those of the author(s) and not necessarily those of the NIHR, UK Health Security Agency, London School of Hygiene and Tropical Medicine, University College London, the Met Office or the Department of Health and Social Care.

Author contributions

Tom Gaulton  0000-0002-8797-2771

Writing – original draft (equal)

Mari Langreiter  0009-0005-5047-8023

Writing – original draft (equal)

Lydia Izon-Cooper  0009-0003-2718-1454

Writing – original draft (equal)

Haydn Cole  0009-0002-0250-9903

Writing – original draft (equal)

Sari Kovats  0000-0002-4823-8099

Writing – review & editing (equal)

Hanna-Andrea Rother  0000-0001-5292-8909

Supervision (equal), Writing – review & editing (equal)

Kerry A Broom  0000-0003-2421-5076

Writing – review & editing (equal)

Sarah Dack  0009-0004-7776-2705

Writing – review & editing (equal)

Ariana Zeka  0000-0002-9570-8831

Writing – review & editing (equal)

Sibylle Ermler  0000-0002-2626-9548

Writing – review & editing (equal)

Chris Collins  0000-0002-8282-2803

Writing – review & editing (equal)

Iain Lake  0000-0003-4407-5357

Writing – review & editing (equal)

Jo Wybrow  0009-0005-7724-1691

Writing – review & editing (equal)

Hannah R Littler  0000-0001-7764-3790

Writing – review & editing (equal)

Raquel Duarte-Davidson  0000-0002-4409-2088

Supervision (equal), Writing – review & editing (equal)

References

- [1] Romanello M *et al* 2024 The 2024 report of the lancet countdown on health and climate change: facing record-breaking threats from delayed action *Lancet* **404** 1847–96
- [2] WHO 2021 *WHO—The Public Health Impact of Chemicals: Knowns and Unknowns—2021 Update* (World Health Organisation)
- [3] UKHSA 2023 *Health Effects of Climate Change (HECC) in the UK: State of the Evidence 2023* (United Kingdom Health Security Agency)
- [4] Shrikhande S, Wolf J, Vert C, Egorova A, Neira M and Pruss A 2024 World Health Organization repository of systematic reviews on interventions in environment, climate change and health: a new resource for decision makers, intervention implementers, and researchers *Environ. Health* **23** 88
- [5] Balbus J M, Boxall A B, Fenske R A, McKone T E and Zeise L 2013 Implications of global climate change for the assessment and management of human health risks of chemicals in the natural environment *Environ. Toxicol. Chem.* **32** 62–78
- [6] Fuller R *et al* 2022 Pollution and health: a progress update *Lancet Planet. Health* **6** e535–e47
- [7] WHO 2024 *WHO—Compendium of WHO and Other UN Guidance on Health and Environment—2024 Update* (World Health Organisation)
- [8] Noyes P D, McElwee M K, Miller H D, Clark B W, LAv T, Walcott K C, Erwin K N and Levin E D 2009 The toxicology of climate change: environmental contaminants in a warming world *Environ. Int.* **35** 971–86
- [9] UKHSA 2023 Health effects of climate change (HECC) in the UK: 2023 report—chapter 12: impact of climate change on human exposure to chemicals
- [10] Boxall A B *et al* 2009 Impacts of climate change on indirect human exposure to pathogens and chemicals from agriculture *Environ. Health Perspect.* **117** 508–14
- [11] Hader J D, Lane T, Boxall A B A, MacLeod M and Di Guardo A 2022 Enabling forecasts of environmental exposure to chemicals in European agriculture under global change *Sci. Total Environ.* **840** 156478
- [12] Cains M G, Desrousseaux A O S, Boxall A B A, Molander S, Molina-Navarro E, Sussams J, Critto A, Stahl R G and Rother H-A 2024 Environmental management cycles for chemicals and climate change, EMC(4): a new conceptual framework contextualizing climate and chemical risk assessment and management *Integr. Environ. Assess. Manage.* **20** 433–53
- [13] Nadal M, Marques M, Mari M and Domingo J L 2015 Climate change and environmental concentrations of POPs: a review *Environ. Res.* **143** 177–85
- [14] Tudi M, Daniel Ruan H, Wang L, Lyu J, Sadler R, Connell D, Chu C and Phung D T 2021 Agriculture development, pesticide application and its impact on the environment *Int. J. Environ. Res. Public Health* **18** 1112
- [15] UNEP/AMAP 2011 *UNEP/AMAP Expert Group: Climate Change and POPs—Predicting the Impacts* (Jointly published by the Secretariat of the Stockholm Convention and the Arctic Monitoring and Assessment Programme (AMAP))
- [16] Biswas B, Qi F, Biswas J K, Wijayawardena A, Khan M A I and Naidu R 2018 The fate of chemical pollutants with soil properties and processes in the climate change paradigm—a review *Soil Syst.* **2** 51
- [17] Hiatt R A and Beyeler N 2020 Cancer and climate change *Lancet Oncol.* **21** e519–e27
- [18] UNEP 2023 *UNEP—Global Framework on Chemicals—For a Planet Free of Harm from Chemicals and Waste* (United Nations Environment Programme)
- [19] UNEP 2022 *UNEP—One Health Joint Plan of Action (2022–2026)* (United Nations Environment Programme)
- [20] Zhang R *et al* 2022 From concept to action: a united, holistic and one health approach to respond to the climate change crisis *Infect. Dis. Poverty* **11** 17
- [21] Bayabil H K, Teshome F T and Li Y C 2022 Emerging contaminants in soil and water *Front. Environ. Sci.* **10** 873499
- [22] Morton D 2016 *Climate change impacts on contaminated land in the coastal zone* CoastAdapt Impact Sheet 10, National Climate Change Adaptation Research Facility (available at: <https://nccarf.edu.au/wp-content/uploads/2019/05/10.-Climate-change-and-contaminated-land.pdf>)
- [23] DEFRA 2018 The national adaptation programme and the third strategy for climate adaptation reporting