Written evidence submission by RAND Europe

Climate Change and Security

Preface

This document provides RAND Europe's submission of evidence in relation to the UK House of Commons Environmental Audit Committee's Call for Evidence on Climate Change and Security.

Part of the global RAND Corporation, RAND Europe is a not-for-profit research institute with a mission to improve policymaking through robust research and analysis. RAND combines academic rigour with a targeted consultancy approach and is committed to the public interest and to making our work accessible. RAND has 75 years of experience helping governments and militaries navigate complex choices and prepare robust strategic approaches in a range of sector and policy areas.

This document draws upon the body of previous RAND research on Climate Change, societal resilience and future challenges and opportunities for UK security and defence. RAND Europe's studies supporting this evidence are mostly publicly available, namely the reports on *Climate Change Dilemmas for UK Defence and Security: Exploring implications, challenges, opportunities and threats through future scenarios* (2023)[1] and *Crisis Response in a Changing Climate: Implications of Climate Change for UK Defence Logistics in Humanitarian Assistance and Disaster Relief (HADR) and Military Aid to the Civil Authorities (MACA) Operations* (2021).[2]

Each section of this document corresponds to a question posed by the Select Committee. This evidence submission covers Questions 1.3, 2.3 and 2.4 as these correspond most directly to RAND's research in this area.

[1] Bellasio et al. (2023).
[2] Retter et al. (2021).

Summary

Understanding the complex interactions between climate change and security is essential for developing effective policies and strategies to mitigate risks and build resilience against climate-related impacts.

This document provides RAND Europe's submission of evidence in relation to the UK House of Commons Environmental Audit Committee's Call for Evidence on Climate Change and Security. Building on previous work from both RAND Europe and RAND US on climate change, resilience, and crisis response, this written evidence presents first on UK infrastructure and land use vulnerability to climate change [Question 1.3]. It then explores how the mitigation of security risks, such as infrastructure vulnerability and resources shortage, can be fully embedded in UK strategy and targets on climate change [Question 2.3]. Finally, it discusses technological innovations that could be integrated into the UK government's approach to respond to climate change while recognising their security implications [Question 2.4].

Introduction to RAND

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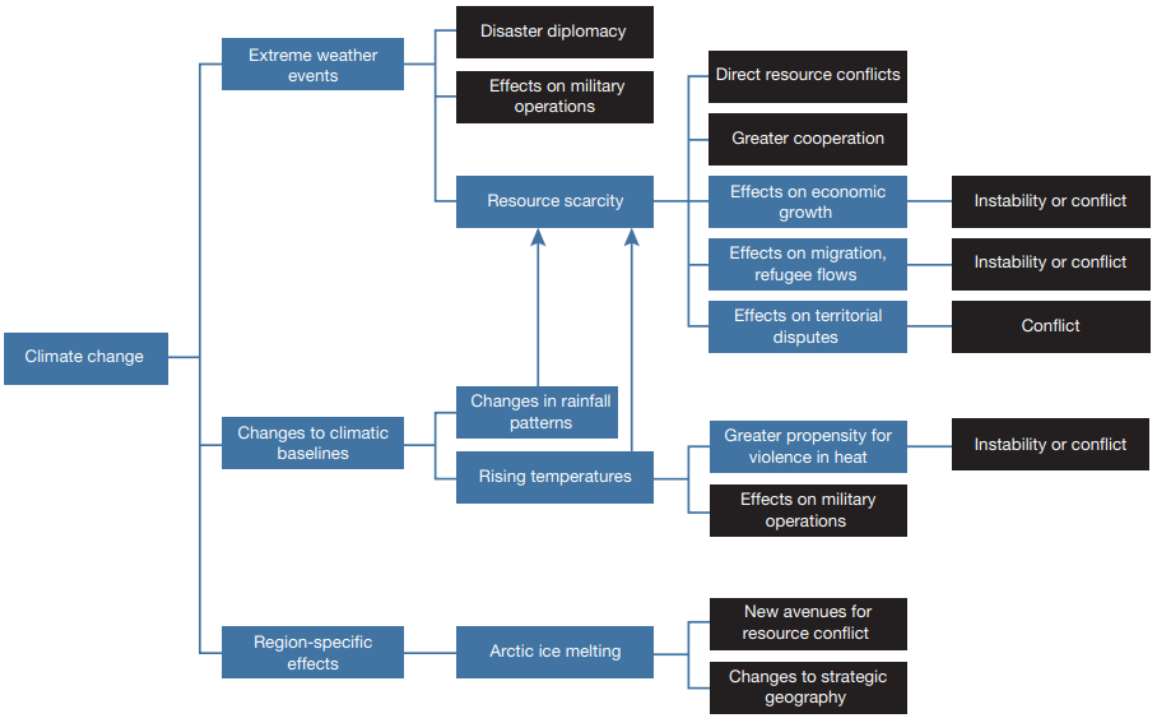
1.3. How does climate change affect UK infrastructure and land use, including military assets, in ways that create and exacerbate insecurities?

1. Climate change, as a significant threat multiplier, is foreseen to have significant impacts on the environment through sea level rise, shifts in average climatic baselines, and increased frequency and intensity of extreme weather events such as heat waves, droughts, floods, and windstorms.[3] Recent RAND research has connected these trends to insecurity in multiple ways (Figure 1).

Figure 1: Pathways connecting climate change to insecurity



Source: Frederick & McCulloch (2024).

2. Highlighted in Figure 1, climate change is likely to affect military operations, trigger greater competition over resources, alter strategic geography, exacerbate instability, and conflict, and generate the kind of extreme weather events that will require larger and more frequent disaster response. This is likely to increase the pressure on the military to mount concurrent responses to crises at the very same time that the military itself is impacted by climate change[4], as well as the wider UK economy, likely putting at risk the resources and funding available for UK Defence. If this future comes to pass, it will require difficult trade-offs from decision-makers about how and when to use finite military capabilities, at a time of increasing instability. Given that the security implications are multifaceted, military assets will become stretched, placing demands on infrastructure and land use.

3. **The UK's military assets both at home and overseas are set to become increasingly vulnerable to climate-related impacts.** Military infrastructure could become increasingly exposed to climate change and climatic events including flooding, droughts, sea level rise and extreme

[3] IPCC (2022).
[4] Cox et al. (2020).

temperatures.[5] This vulnerability is likely to threaten the operational readiness of the Defence estate, including bases, manufacturing facilities and training ranges.[6] The potential degradation of infrastructure could complicate logistics delivery, limiting the military's ability to deploy, resupply, and maintain operations, for example if transport aircraft is unable to take off or land due to flooding on runways.[7] Higher average and peak temperatures pose additional risks to military assets and personnel, and likely increase demand for air-conditioning, increasing electricity demand and operational costs.[8] Where air conditioning is not a viable option, buildings and vehicles may be at risk of overheating, requiring personnel to operate in extreme or unsafe conditions.[9] It is also not always clear how complex military equipment will be affected by future higher operating temperatures and more extreme conditions. For example, in Afghanistan, helicopters' performance was affected by the extreme high temperatures. The rising heat levels led to a decrease in the helicopters' ability to carry loads, transport essential supplies and operate effectively. There have also been anecdotal reports of higher ambient temperatures affecting sensor and cooling system performance on naval vessels. As high temperatures become more frequent in various areas of the world, the incidence of equipment failure may increase, and in more regions.[10]

4. **The effects of climate change on military infrastructure will exhibit significant geographical variation.** Coastal infrastructure, especially overseas Permanent Joint Operating Bases, such as Diego Garcia, a low-lying island in the Indian Ocean, are particularly at risk from sea level rise.[11] Domestically, lack of investment in infrastructure and reducing the number of military bases could make this issue worse, possibly resulting in certain bases becoming points of failure.[12] For example, the strategic positioning of the UK's only Aerial Port of Embarkation (APOE), RAF Brize Norton, places it at risk of flooding and drought.[13] Moreover, Humanitarian Assistance and Disaster Relief (HADR) and Military Aid to Civil Authorities (MACA) operations, which rely on Aerial Ports of Debarkation (APODs) and Seaports of Debarkation (SPODs), may face challenges operating in remote or hard-to-reach areas. This situation could be exacerbated if local resources and infrastructure have been depleted due to past disasters or previous damage from climatic events.[14]

5. **Environmental changes are expected to expose new operating environments, placing new demands on land use, military infrastructure, and assets.** As the environment is set to change, current military assets will have to adapt to new conditions and new areas of operation. For example, historically, the nature of the Arctic environment has limited military and civilian presence, but thawing sea-ice and permafrost could cause this to change; new access routes are likely to create new shipping routes.[15] In turn, new security challenges can emerge, such as new opportunities for criminality such as smuggling and trafficking. The UK, though not an Arctic nation, has significant strategic interest in the region through its NATO membership, leadership

[5] Cox, et al (2020).
[6] Retter, et al., (2021).
[7] Retter, et al., (2021).
[8] Cox, et al., (2020).
[9] Cox, et al., (2020).
[10] Cox, et al (2020).
[11] Bellasio et al. (2022); Cox et al. (2020).
[12] Retter et al. (2021).
[13] Retter et al. (2021).
[14] Retter et al. (2021).
[15] Jouan et al. (2022); Sacks et al. (2021).

on Arctic issues, and dependence on Arctic sea lines for energy, underscoring the importance of this strategic geography.[16] As actors compete for power in the region, diverging geopolitical strategic interests and possible military build-up in the region could trigger conflict.[17] In turn, the UK may have to adapt its current infrastructure, and/or invest in new infrastructure, to support the UK and its allies to deploy in new regions.

6. **Extreme weather events and shifts in climatic baselines are expected to affect food and water supplies, potentially altering land use requirements.** Deployed military personnel may be significantly hindered in accessing essentials such as potable water, communication networks, heating, and food due to extreme weather conditions.[18] Global food insecurity could affect the UK, given our heavy dependence on other countries, leading to considerations around how UK land-use is prioritised and at a time when renewable energy provision may be driving additional land-use constraints.[19] Global resource scarcity, particularly for food and water, could lead to societal discontent, radicalisation, and state repression of civil unrest.[20] UK Defence may need to provide security or provide humanitarian relief in affected areas.

7. **There is growing consensus that climate change will trigger a mass movement of people, placing new strains on military capabilities.** According to the World Bank, climate change is estimated to compel 216 million individuals in six global regions to relocate within their nations by 2050.[21] Existing military deployments that tackle illegal trafficking and migration, such as NATO forces in the Aegean Sea, could experience an uptick in demand and require more personnel.[22] If military operations that manage the movement of people increase, then UK Defence, and NATO may become less able to respond to other insecurities or events.[23]

8. **Correlated and simultaneous insecurities will strain UK military availability and capabilities.** Degrading infrastructure and challenging logistics delivery will limit the military's ability to respond to crises. If concurrent crises occur, UK Defence resources will become even further stretched.[24] The ability of the UK and its allies to respond effectively to these challenges is important but their respective militaries may not have sufficient availability and/or capabilities to respond, especially if there are operations that may involve warfighting for which no other organisations are equally suited. Inadequate responses could exacerbate existing insecurities, whether they manifest as humanitarian disasters, conflicts, migration crises, or state competition. A comprehensive and adaptive response strategy to safeguard national security and maintain operational readiness is urgently needed which also includes identifying which organisations may be best placed to respond to which crises and how.[25]

[16] Jouan et al. (2022).
[17] Jouan et al. (2022).
[18] Caves et al. (2021).
[19] Retter et al. (2021).
[20] Frederick & McCulloch (2024).
[21] The World Bank (2021).
[22] Frederick & McCulloch (2024).
[23] Frederick & McCulloch (2024).
[24] Cox et al. (2020).
[25] Cox, et al. (2020).

2.3. How can the UK Government fully embed mitigation of security risks in its plans to achieve its targets for climate and the environment?

9. Given the additional strains and stretching of military capabilities, the UK Government should consider how to tackle emerging security risks. Based on recent research that investigated how climate change will impact national security and military capabilities, RAND Europe would make a number of recommendations.

10. **One of the first requirements is for good and readily accessible information.** Developing resilient national and security infrastructure, strengthening climate-resilient food and energy supplies, and hardening military capabilities to be able to operate in extreme climates but also to be prepared for more concurrent operations, requires detailed information. The information required should contain the range of climactic effects that could impact future security and national capability in the UK, as well as in the global regions that the UK's interests are most prominently located. This includes, but is not limited to, future ambient temperature extremes, wet bulb temperature, rainfall, wind speed, sea level rise, sea state, and so on. Where modelling is not yet able to predict this with confidence, estimations of the range of extremes for planners to consider when developing national and security capability is the next best thing. This information should be made available to all levels of government and widely across society, in a way that planners can easily absorb and include in existing investment, capability design, and force planning decisions.[26]

11. **Design a roadmap for strengthening the resilience of defence infrastructure.**[27] The UK government should conduct thorough assessments to pinpoint weaknesses in defence infrastructure and the estate that may be exacerbated by climate change impacts, particularly flooding, wildfires, droughts, and storms. Previous RAND research highlights that implementing measures to enhance resilience, including technical upgrades, process improvements, and organisational changes, can help fortify defence infrastructure against security risks associated with climate change.[28] Some of these investments can achieve multiple worthwhile outcomes with a single investment. For example, some US military bases at risk from sea level rise have invested in restoration of mangrove forests and oyster beds. [29] Not only does this make them more resilient to climate impacts, but it also restores natural habitat and biodiversity.

12. **Learn from other countries' approach to resilience planning.** The UK Government could gain valuable insights from examining how other nations have implemented integrated civil-defence strategies to address the challenges posed by climate change[30]:

Table 1: International approaches to resilience.

Country	Approach	Details
Singapore	Whole-of-nation	Climate change adaptation measures serve dual purposes. A prime illustration of this is seen in the coastal defence dike systems on

[26] Bellasio et al. (2023).
[27] Retter et al. (2021).
[28] Cox, et al. (2020); Retter et al. (2021).
[29] Cunningham and Greenberg (2020).
[30] Nicholson et al. (2021).

		Pulau Tekong, which have a dual function. These systems not only function as a network of pumps to protect the land from the sea but also serve as training grounds for the Singaporean Army. The Ministry of Defence (MINDEF) and the Singapore Armed Forces (SAF) in Singapore actively communicate their initiatives to the broader public to garner support and engagement.
Finland	Total defence & community psychological resilience	In Finland, resilience is viewed as a form of psychological protection. Local communities undergo training and readiness measures to manage emergencies. Alongside reserves of food, fuel, and essential supplies, the government upholds 45,000 civil defence shelters capable of accommodating 3.6 million individuals. This approach embodies the concept of total defence in Finland, where collaborative efforts from various sectors of society, encompassing both defence and the public sector, are coordinated to enhance resilience.
Switzerland	Mobilisation	In Switzerland, the Development Programme of the Armed Forces (DEVA) system was implemented by the Suisse Armed Forces, with the objective of mobilising up to 35,000 personnel within ten days. Various categories of personnel would be activated based on a four-tier prioritisation system, with the intention of escalating to the next level of mobilisation if the current level proves inadequate. This modular strategy is designed to guarantee that the armed forces are prepared to address a diverse range of threats.

Source: Nicholson, et al., (2021).

13. **Clarify roles and responsibilities between civil and military entities and enhance coordination to ensure readiness in detection and response.** Increasing the deployment of military liaison officers across various government departments can facilitate communication and collaboration between different sectors, such as industry, government departments, allies, partners, and local authorities, ultimately enhancing overall coordination efforts.[31] Initiating a review of processes for generating and coordinating Defence crisis response plans and involving the necessary government units can help identify areas for improvement and ensure readiness for climate-related security risks. Engaging with local civil emergency planning bodies is essential to increase awareness of Defence capabilities and foster collaboration between different stakeholders.

14. **Develop effective long-term relationships with civil services and strengthen communication channels between national, regional, and local levels.** Establishing relationships between contacts at national, regional, and local levels is essential for facilitating communication and coordination during emergencies.[32] Effectively managing the narrative during crises and clearly conveying Defence capabilities and constraints can align public perceptions with reality, improving coordination and response efforts.[33] Enhancing transparency and understanding among stakeholders through widespread information dissemination about crisis roles and responsibilities, coupled with the integration of crisis roles into normal daytime positions, can significantly improve coordination.[34] Lastly, sharing good practices across various regions of the

[31] Retter et al. (2021).
[32] Caves et al. (2021).
[33] Bellasio et al. (2023).
[34] Caves et al. (2021).

country can help standardise resilience planning and ensure a consistent approach to building and strengthening national resilience.[35]

15. **Conduct regular exercises to improve readiness and effectiveness, involving different partners at local, national, and multinational levels.** Regular exercises with civil authorities would help establish familiarity and coordination among various entities involved in emergency response. Secondly, using exercises to enhance understanding of interrelationships and cascade effects that may occur during crises is important.[36] By simulating complex scenarios, organisations can better understand the interconnected nature of emergencies and improve their ability to respond effectively. Lastly, efforts should be made to boost interoperability and share best practices with international partners through joint exercises. This can facilitate learning from different approaches and strengthen collaborative capabilities across borders for more effective crisis management.[37]

16. **Prepare HADR and MACA capabilities for a higher operational tempo.** In preparation for increased demands and frequency of HADR and MACA operations, the UK Government should ensure operational planning is adaptable to different crises. While each HADR and MACA operation presents unique challenges and uncertainties, UK Defence could consider expanding the scope of existing plans for such operations.[38] For instance, insights gained from Operation RUMAN in 2017, which provided hurricane relief in the Caribbean, highlighted the importance of maintaining a rapid-response force during the Caribbean hurricane season. These lessons can be extrapolated to anticipate and address extreme climate events in other vulnerable regions across the UK and worldwide. Continuing to develop template plans for new operations, will help to ensure a coordinated, timely response in periods of an increased operational tempo. The UK government should work to coordinate military HADR and MACA preparations alongside civil response teams to further prepare for a time when the UK Government may be responding to multiple crises in the UK and overseas. Increased HADR and MACA operations and higher concurrency demands alongside traditional security operations should also be actively anticipated in force design decisions in UK Defence, to explore all opportunities to increase force availability and reduce regeneration time beyond shorter-term preparedness planning.

2.4. What technological innovations could strengthen the UK Government's approach to addressing the security implications of climate change?

17. As extreme weather events, resource scarcity, and population displacement, continue to manifest, the UK Government needs to be positioned to explore and adopt innovative technological approaches to address these security implications effectively:

18. **Enhance rapid mass and cross-sector mobilisation in the UK.** To enhance mobilisation without resorting to conscription, the UK could explore partnerships with non-governmental organisations to attract different demographics and utilise existing networks.[39] By utilising new and emerging technologies like mobile applications, volunteers with specific skills such as first aid could be reached swiftly. Additionally, consideration should also be given to ways of alerting

[35] Caves et al. (2021).
[36] Caves et al. (2021).
[37] Bellasio et al. (2023).
[38] Caves et al. (2021).
[39] Caves et al. (2021).

civilians with certain skills in times of need. Defence collaborations with established volunteer databases like the British Red Cross could be pivotal in emergency situations, facilitating a coordinated and effective response.[40]

19. **Leverage AI and ML technologies to enhance sustainable food provisioning services.**[41] AI can play a significant role in monitoring crops for pests and administering targeted pesticides only, when necessary, thereby minimising the use of chemicals. Furthermore, AI's capability to analyse vast amounts of data enables the identification of patterns and the streamlining of agricultural management practices.[42] While the increased adoption of AI in agriculture offers numerous benefits, such as improved efficiency and sustainability, it is essential to consider potential drawbacks, including the widening of the digital divide and the potential displacement of traditional employment within the industry. By employing AI to monitor crops for pests and apply precise pesticide treatments, the UK government can not only reduce the use of harmful chemicals but also mitigate water pollution, contributing to a more sustainable and environmentally friendly approach to food provisioning services.[43]

20. **Technological advancements offer promising solutions to tackle water scarcity and pollution challenges.** By utilising methods such as desalination of seawater and fog collectors, the quantity of available water can be increased.[44] Solar-powered filtration systems present a sustainable approach to enhancing drinking water availability in arid regions. Additionally, the integration of AI and ML technologies can optimise the efficient use of freshwater resources and tackle water pollution. Implementing AI, sensors, and nitrogen-fixing techniques in agriculture can help reduce the reliance on chemical products and pesticides, thereby mitigating water pollution and contamination.[45]

21. **The implementation of technological innovations to address security risks should be monitored for unintended consequences.**[46] When considering the implementation of technological innovations to prevent or address climate-change security risks, the UK government should consider that unintended consequences may arise. For example, explorations of geoengineering methods such as atmosphere seeding and stratospheric aerosol injections to offsetting the effects of climate change should be monitored for the security risk they pose.[47] One nation's deployment of geoengineering technology could have negative consequences for neighbouring states; by increasing rainfall in one country, flooding or drought could occur in a neighbouring region. [48] Additionally, technological developments tackling insecurity, such as unmanned or minimally manned vehicles may also generate further security risks. The implementation of such autonomous advancements in the Arctic, should Arctic shipping expand, may bring challenges as well as potential overlaps between civilian research and military operations.[49] Given the potential risks that may arise from technological innovation

[40] Caves et al. (2021).
[41] Bellasio et al. (2022).
[42] Bellasio et al. (2022).
[43] Bellasio et al. (2022).
[44] Bellasio et al. (2022).
[45] Bellasio et al. (2022).
[46] Jouan et a. (2022).
[47] Jouan et al. (2022).
[48] Jouan et al. (2022).
[49] Jouan et al. (2022).

implementation, monitoring practices should be in place to address any potential consequence that may emerge over time. It is crucial for the UK government to carefully consider the national security implications of technological innovations aimed at addressing security risks.

22. **Enhance early warning systems to predict crises**. To limit the impact of the insecurities posed by climate change, the UK Government could enhance its capability to detect and respond to crises. Investing in the adoption of robotics, remote systems, artificial intelligence (AI) and machine learning (ML) into early warning systems could improve the monitoring and forecasting changing environmental conditions and weather systems.[50] By understanding the potential trajectories and critical tipping points of ecosystems, these technologies can support efforts to conserve ecosystems.[51] Developing a robust horizon scanning and early warning capability is crucial for UK Defence to enable the earliest possible response and adopt a proactive approach. This includes enhancing weather forecasting through cutting-edge technology and modelling, refining intelligence gathering processes, and establishing mechanisms for intelligence sharing across government levels.[52] In doing so, changing environments, like the Arctic, can be monitored so that crises can be responded to swiftly. Leveraging and integrating capabilities at the local level, like the Royal Air Force Regional Liaison Officer (RAFRLO) alert system, can further enhance the crisis response readiness of UK Defence.[53] Such a capability would be useful to other government and civil services, and also be something the UK could offer allies and partners – either in the form of information or the technology. Lastly, the establishment of a dedicated agency for early warning monitoring, horizon scanning, and societal resilience could enhance the coordination of efforts that mitigate and respond to the security risks posed by climate change.

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[50] Caves et al. (2021).
[51] Bellasio et al. (2022).
[52] Caves et al. (2021).
[53] Caves et al. (2021).

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Acronyms

AI	Artificial intelligence
APOD	Aerial Port of Debarkation

APOE	Ariel Port of Embarkation
DEVA	Development Programme of the Armed Forces
HADR	Humanitarian Assistance and Disaster Relief
ML	Machine learning
MACA	Military Aid to Civil Authorities
NATO	The North Atlantic Treaty Organization
SPOD	Seaports of Debarkation
UK	United Kingdom

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