ISF Women, Peace and Security Helpdesk

GEDSI & Biosecurity

Submitted: 21/10/25

Assignment Code: 2007

Author: Nicole Haegeman

WPS Women, Peace & Security Helpdesk

The Women Peace and Security Helpdesk, managed by Saferworld in partnership with Conciliation Resources, GAPS UK, University of Durham, DCAF and Researchers Without Borders was established in December 2021 to increase capability across the UK Government on WPS policy and programming in order to make its work on conflict and instability more effective. If you have an enquiry about the WPS Helpdesk or work for the UK government and would like to send us a task request please email us at wpshelpdesk@saferworld.org.uk.

Direct Audience: Chemical Biological & Radiological Security Team, COBR, Cabinet Office

Suggested Internal Distribution:X-HMG departments and teams acting as implementors for the biosecurity portfolio and teams with responsibility for Biosecurity policy areas, ISFU

Confidentiality Status: Official

Task Overview

Title of Task:

GEDSI and Biosecurity

Requesting Officer:

James Lovell

Keely Robinson

Date request submitted:

8/07/2025

Submission date:

20/10/25

Terms of Reference:

The Cabinet Office-led Biosecurity Portfolio is a new domestic portfolio, with input from across HMG departments that have an interest in Biosecurity. This programme will draw on existing activity in several HMG Departments for the first year of operation (FY 25/26). It will then seek to stand up further, new projects from this first year to ensure continual innovation and trial and testing of new ideas. The Portfolio has aligned with the Biosecurity Strategy in its structure and outcomes.

The task intention is to build a comprehensive evidence base on the relationship between gender and biosecurity to inform future programming. This will be undertaken through a literature review of Biosecurity policy area investigating existing and potential future inequalities. This will draw together insights from existing literature, policy frameworks and practice to establish why biosecurity needs a gendered approach, exploring the interaction of gender with the development of biosecurity management and the gendered implications of biosecurity threats and interventions.

Abstract

This literature review explores how gender equality, disability, and social inclusion (GEDSI) considerations shape the UK's biosecurity landscape. Drawing on UK and global evidence, it analyses five thematic areas - health inequalities, food insecurity, animal and plant health, digital technology, and STEM workforce and innovation.

Executive summary

This literature review explores how gender equality, disability, and social inclusion (GEDSI) considerations shape the UK's biosecurity landscape. Drawing on UK and global evidence, it analyses five thematic areas - health inequalities, food insecurity, animal and plant health, digital technology, and STEM workforce and innovation.

The UK's biosecurity system is strong on technical innovation but gives limited attention to social inclusion. While national strategies emphasise surveillance, early detection, and system architecture, they pay little systematic attention to who participates in these systems, who bears the risks, and whose needs are overlooked. Exclusion of marginalised groups not only reinforces inequalities but also undermines effectiveness, and resilience.

Key findings

- **Health inequalities** drive vulnerability and recovery. Income, gender, ethnicity, and disability shape exposure to infectious disease and access to healthcare, PPE, vaccination, and screening (Public Health England, 2019; ONS, 2020). Evidence from COVID-19, Mpox, TB, and antimicrobial resistance shows that inequities weaken national preparedness and slow outbreak control. (Health Foundation, 2021; Wenham & Davies, 2022; UKHSA, 2023).

- **Food insecurity and supply chains** are critical but disruptions from COVID-19, climate shocks, and local access barriers (such as disability, poverty, or lack of transport) reveal how vulnerable groups are disproportionately excluded from secure food systems (Davis et al., 2020; Parnham et al., 2020; Wolfson & Leung, 2020). Inclusive design in emergency food support and local resilience measures improves outcomes (Daley et al., 2022; Food Foundation, 2023; Keyes et al., 2025).

- **Animal and plant health systems** often under-recognise the role of women, migrant workers, and smallholder farmers in surveillance and risk management (FAO, 2023; Kempster et al., 2023). The UK experience with avian influenza and historical outbreaks like foot and mouth disease demonstrates the economic and social costs of overlooking diverse knowledge and frontline conditions (Thompson et al., 2002; Adlhoch et al., 2021; Everett et al., 2021).

- **Technology, surveillance, and trust** highlight digital divides and legitimacy gaps. While innovation in surveillance (apps, drones, diagnostic tools) strengthens detection, uptake depends on fairness, accessibility, and trust. Evidence from the NHS COVID-19 app and UK biosecurity accreditation schemes shows the risks of excluding digitally marginalised or low-trust communities (Wymant et al., 2021; Marzano et al., 2021; Ofcom, 2023).

- **STEM workforce and innovation** could be more inclusive. Women, people with disabilities, and under-represented groups face persistent barriers in UK STEM fields, limiting diversity in decision-making and innovation pipelines (Royal Society, 2021; UK Parliament, 2023; UKRI, 2023). Responsible innovation frameworks exist but are weakly connected to inclusive practice in biosecurity.

- **Cross-cutting issues emerge** across the five areas. Inequalities intersect to heighten risks across health, food, agriculture, and technology systems. Evidence also shows that when systems are designed inclusively and engage communities, resilience improves. Disaggregated data, intersectional

perspectives, and long-term approaches remain underdeveloped. Climate change is intensifying threats, but its distributional and equity impacts are still poorly integrated into biosecurity governance.

Implications

Biosecurity outcomes are shaped not only by laboratories, surveillance tools, and border checks, but by who designs, implements, and benefits from them. Addressing persistent gaps requires:

- Building **inclusive systems** that reflect the needs of diverse users, from equitable PPE standards to accessible health services.
- Strengthening **community partnerships** so that local knowledge, trust, and lived experience inform surveillance and response.
- Embedding **equity in innovation**, ensuring that new technologies, data systems, and workforce strategies do not reproduce or deepen existing inequalities.

The UK has an opportunity to strengthen its biosecurity approach by aligning technical strengths with a deliberate focus on equity and inclusion. Next steps could include reviewing existing programmes for inclusion gaps, developing practical tools for teams, piloting inclusive approaches in the UK context, and scoping a standalone GEDSI and biosecurity initiative with an innovation fund to surface and test new ideas.

Contents

1. Introduction & Method

1.1

Introduction

The UK Government has recently established a new domestic Biosecurity Portfolio, led by the Cabinet Office with input from across HMG. In its first year, the Portfolio has brought together existing activity across departments and will over time design and deliver new projects to ensure continued innovation and resilience. Aligned with the UK's Biosecurity Strategy, (BSS) it is intended to strengthen national capability to understand, detect, prevent and respond to biological risks.

The BSS acknowledges the importance of a *One Health* approach, recognising the interconnections between human, animal, plant, and environmental health. While the strategy commits to embedding this approach, however, its focus to date has been largely technical: emphasising surveillance, diagnostics, and Border controls. Less attention has been given to the social and behavioural dimensions of resilience, including how inequalities shape exposure, participation, and trust. This is where Gender Equality, Disability and Social Inclusion (GEDSI) perspectives add value.

GEDSI is an approach that examines and addresses unequal power relations between different social groups. It is not only about women and men, but about ensuring equal rights, opportunities and respect for all individuals, regardless of their gender, disability, ethnicity, age, income or other aspects of social identity. For the purpose of this review, it means asking how these factors shape people's exposure to risks, their ability to respond, and their inclusion in decision-making. Intersectionality further highlights that vulnerabilities overlap, for example, the experience of a young woman with a disability from a minority ethnic background cannot be understood by considering age, gender or ethnicity in isolation.

For biosecurity, this framing could, in part, be applied through the following questions:

- Who is most affected when biological risks emerge?
- Who has access to prevention, treatment, or support?
- Whose perspectives shape decisions and preparedness plans?

By looking at existing research, this literature review explores these questions, examining where inequalities matter for biosecurity, how they have been addressed in related fields, and what lessons may be relevant to the UK.

1.2

Method

The review is structured around five key themes where social inequalities intersect with biosecurity:

- health inequalities in pandemics

- food insecurity and supply chains
- animal and plant health
- technology, surveillance and trust
- STEM workforce and responsible innovation.

These themes were identified through an initial scoping of the literature, guided by both the UK Biosecurity Strategy and areas where evidence on social inequalities is strongest. Health inequalities, food insecurity, and animal and plant health emerged as priority areas where biosecurity threats clearly interact with social factors. Technology, surveillance and trust, and the diversity of the STEM workforce were included because they are rapidly developing fields with significant implications for how biosecurity is designed and delivered in the UK.

The review draws on:

- **UK literature where available**, supplemented with **global evidence** that is relevant and transferable.
- **Insights from related fields** (e.g. public health, food security, agriculture, technology and innovation studies) where evidence on inclusion is stronger.

The evidence base was identified through a structured desk-based search of academic, policy, and grey literature. Sources were screened for relevance and quality, then synthesised thematically to identify patterns, gaps, and implications for integrating GESI into UK biosecurity.

1.3

Limitations

This is not a comprehensive evaluation of the UK's biosecurity approach or its individual programmes. Nor is it an exhaustive review of "what works" in inclusion. Instead, it is a thematic evidence scan designed to identify where inequalities matter for biosecurity, highlight lessons from related domains, and point to areas where further research and policy development are needed.

2. Health Inequalities and Biosecurity

Health inequalities are closely linked to biosecurity outcomes because they shape who faces the greatest risks, who can access protection, and who is most affected when threats emerge. These patterns reflect structural inequalities that influence both everyday health and crisis response capacity.

2.1

Unequal Risk and Exposure

The COVID-19 pandemic demonstrated how structural inequalities shape patterns of risk and exposure during health emergencies. Public Health England's disparities review found mortality rates were disproportionately high among minority ethnic groups, people living in deprived areas, and those with disabilities (Public Health England, 2020). ONS analysis confirmed significantly higher COVID-related death rates among Black and Asian groups compared to White populations (ONS, 2020). These UK patterns reflect wider global evidence which shows strong associations between infectious disease outcomes and intersecting factors such as poverty, gender, race, disability, and geography (Ayorinde et al., 2023). These disparities influence not only infection and mortality rates, but also access to prevention, quality of care, and recovery, highlighting the need for preparedness efforts to identify and address these issues, to build resilience (Health Foundation, 2021).

2.2

Gendered and Structural Impacts

The impacts of the pandemic were not gender neutral. Women were over-represented in frontline roles such as nursing, social care, and cleaning services, all carrying heightened risk of exposure to infection (ONS, 2020; WHO, 2020). At the same time, school closures and reduced social care provision dramatically increased unpaid care work, which disproportionately fell to women. Surveys in the UK and globally, also recorded increases in domestic violence, especially during lockdowns (ONS, 2021; UN Women, 2020). For minority ethnic women, these pressures were compounded, as occupational exposure intersected with structural racism, creating particularly acute risks (Health Foundation, 2021). These examples show how outbreaks can affect women differently, through higher risk of infection, and through the social and economic consequences of control measures (Wenham & Davies, 2022). Pandemic responses, however, focused primarily on biomedical risks, with little consideration of how policies impacted care responsibilities, access to services, or exposure to violence. This weakened the overall response by overburdening the care workforce, and reducing public health compliance (Wenham & Davies, 2022).

Workplace conditions reinforced underlying inequalities. The UK's health and social care workforce (disproportionately composed of women and minority ethnic workers) also faced heightened risks due to limited and inadequate personal protective equipment (PPE). Respirators, for example, were often designed around male

facial features, with UK studies finding significantly poorer fit-test outcomes for women (Ascott et al., 2021; Regli et al., 2021), leaving them much less protected (TUC, 2021). This reflects a wider problem in health system design, in that many tools, and protocols are still based on an assumed 'default' user, typically a white, able-bodied man, which fails to account for the needs and experiences of the actual workforce (Ascott, 2021; TUC, 2021). These design gaps undermine safety among workers who already face disproportionate risks and shows that inclusive design is both a basic right and a practical necessity for managing future health risks.

2.3

Access to Healthcare and Disrupted Services

Structural inequalities shaped who could access timely healthcare during the pandemic. As resources were diverted to COVID-19, many people experienced delays in diagnosis, screening, and treatment, particularly for chronic conditions like cancer or diabetes. These delays were not experienced equally. People in more deprived areas, older adults, and those with disabilities or limited digital access faced longer waits and greater difficulty navigating increasingly 'digital-first' systems (Doctors of the World UK, 2020). For some, language barriers and low trust in remote consultations further reduced engagement with services. These disruptions did not just affect individual outcomes but reduced the flexibility and responsiveness of the wider health system. Barriers and delays meant that many conditions became more severe before patients accessed care, driving demand for emergency and specialist services. They also reduced trust in the institutions managing the crisis, prompting some groups to disengage. Together, these dynamics made the system less able to adapt during the pandemic and, over the longer term, risk weakening capacity to detect and respond to new infectious disease threats. Resilient public health infrastructure depends not only on surge capacity, but on ensuring that routine care systems are inclusive, trusted, and accessible to all (Thomas et al., 2020).

2.4

Prevention, Participation and Public Trust

Preventative health measures show similar divides, with clear consequences for outbreak preparedness. Data on influenza and COVID-19 vaccination uptake reveal consistently lower coverage among minority ethnic groups and people in deprived areas (ONS, 2022; UKHSA, 2023a). Barriers such as digital exclusion, language, and mistrust in institutions reduce coverage rates and slow outbreak response, particularly in communities already at higher risk. Similar inequalities affect other preventative services, for example, only 37% of homeless women in one UK study had attended breast screening in the past three years, compared with around 62% of the general population, while people with disabilities face persistent obstacles accessing routine care (NCL Cancer Alliance, 2024; Healthwatch & NHS England, 2022). In this case, exclusion is not only a rights issue but also weakens surveillance systems and delays early detection of emerging threats, undermining preparedness for future infectious diseases (Frieden et al., 2023; Meena et al., 2023).

Recent outbreaks highlight the practical value of inclusive approaches. During the UK's 2022 Mpox outbreak, targeted vaccination and community-led messaging among gay and bisexual men contributed to high uptake and rapid behavioural change, helping to limit the spread of the virus (Ogaz et al., 2024). Similar lessons emerged during the COVID-19 response, where local authorities in Greater Manchester developed targeted vaccination

efforts with community partners to improve uptake among disadvantaged and minority groups, demonstrating the impact of context specific, participatory models (Bradley et al., 2025). In contrast, during the Ebola and Zika outbreaks, the exclusion of women community health workers, who often held deep local knowledge and trust, undermined early warning systems and reduced the legitimacy of public health interventions (Davies & Bennett, 2016). These examples show that inclusive strategies are not only more equitable but also more effective in managing biosecurity threats. When communities are treated as partners, interventions are more responsive to real-world needs and less likely to reinforce stigma or resistance. Evidence from global disaster preparedness approaches, similarly, suggests that social inclusion can improve compliance, trust in public messaging, and the overall speed of emergency response (Yumarni et al., 2021).

2.5

Antimicrobial Resistance and Tuberculosis

Antimicrobial resistance (AMR) and tuberculosis (TB) further demonstrate how health inequalities shape risk. In the UK, TB remains concentrated in deprived urban areas and among migrant communities, reflecting the effects of overcrowded housing, limited healthcare access, and structural racism (Public Health England, 2019). AMR shows similar patterns; resistance is more common where poverty, caring responsibilities, or chronic illness drive reliance on antibiotics as a ‘quick fix’ (Collignon et al., 2018; Willis & Chandler, 2019). Policy responses have often focused on prescribing guidelines or awareness campaigns, but without tackling the underlying drivers, poor housing, inaccessible healthcare, and exclusion from public health messaging, resistance will continue to rise. The UK’s *Confronting AMR 2024–2029* strategy acknowledges social determinants but still lacks concrete measures to address them (HM Government, 2024; WHO, 2018; WHO, 2019). This gap leaves AMR and TB as persistent weak points in national preparedness.

Key Takeaways

Health inequalities make the UK’s biosecurity system weaker. Outbreaks fall hardest on already disadvantaged groups. Evidence shows that health systems become more resilient when they adapt to social differences in workforce roles, access to care, and community engagement. Failing to do so leaves preventable gaps in protection

3. Food Insecurity & Supply Chains

Food systems and supply chains are a key part of the UK's capacity to manage crises. When they function well, they help limit the spread of biological risks and ensure people have access to safe, nutritious food. Beyond food production, effective biosecurity depends on whether food reaches people consistently, especially during emergencies. Disruptions to supply chains, whether caused by pandemics, conflict, climate shocks or rising costs, tend to hit disadvantaged groups hardest. These shocks exacerbate and intensify existing inequalities in food access, making it more challenging for the UK to respond to future threats (Davis et al., 2020).

3.1

Structural inequalities in food access

Food insecurity in the UK stems from unequal access rather than food scarcity. Lower-income households, people with disabilities, single parents, and some ethnic minority communities face systemic barriers, including high prices and poor public transport links. These pressures intensify during disruptions, as seen when COVID-19 supply chain issues intersected with job losses and isolation requirements (Wolfson & Leung, 2020). Gender adds another layer of vulnerability. Women, particularly single mothers, experience higher rates of food insecurity in the UK, reflecting global trends in which female-headed households are often among the first to reduce food quality or intake during emergencies (Food Foundation, 2023). Even in more stable periods, persistent food bank use among people with long-term health conditions and caring responsibilities highlights structural gaps that become more acute in times of strain (Brucker & Coleman-Jensen, 2017; Sonik et al., 2016). In some cases, food insecurity can also heighten the risk of gender-based violence, particularly where women's access to food depends on others and is shaped by financial insecurity or caregiving pressures (Hatcher et al., 2022).

Physical and systemic access failures become critical during emergencies. During COVID-19, families without cars could not stockpile food or reach supermarkets when local shops closed (Keyes et al., 2025; The Health Foundation, 2023), while those reliant on school meals or home care saw essential services paused (Parnham et al., 2020). Similar challenges were seen during the 2001 UK foot-and-mouth outbreak where movement restrictions disrupted local food access in rural areas, and after Hurricane Maria in Puerto Rico, households without vehicles or savings were cut off from supplies for weeks (Davis et al., 2020; Kishore et al., 2018). Emergency food aid schemes also frequently exclude those most in need through language barriers, complex application processes, or digital-only access (Lalli et al., 2021). Such failures in food access and supply not only deepen existing inequalities, but also slow crisis response, undermine the perceived legitimacy of food security measures, and limit the effectiveness of national preparedness (Food Foundation, 2023; McClelland et al., 2024; Humanitarian Outcomes, 2018)

Disability creates specific barriers to food access that are often overlooked in emergency planning. People with disabilities may face limited mobility, inaccessible shops, and poorly tailored support schemes. These barriers intensify during crises, while adaptive services often disappear. As discussed in Section 2, broader systemic exclusion compounds these challenges, but their impact on food access remains under-addressed. Families who have children with disabilities, for example, report difficulties sourcing affordable, suitable food when caring responsibilities already stretch income and flexibility (Brucker & Coleman-Jensen, 2017; Sonik et al., 2016). Food system planning rarely reflects these realities, creating blind spots in preparedness and response.

3.2

Trust and compliance in food systems

Trust in food systems directly affects biosecurity outcomes. For some groups, confidence in food safety institutions is weakened by histories of neglect or discrimination. When safety alerts are poorly translated or labels are inaccessible, people can miss crucial information. Without local and trusted channels of engagement, communities may also feel unable to raise concerns or act on public health guidance (Williams & Phuong, 2022; Lalli et al., 2021). Where confidence breaks down, compliance with safety measures falls, creating vulnerabilities that can quickly spread across interconnected food systems. For households under financial strain, already struggling to secure adequate food, restrictions that further limit choice are often impossible to follow.

3.3

Learning from inclusive approaches

Targeted interventions demonstrate the potential of inclusive design. The US Supplemental Nutrition Assistance Program (SNAP), for example, shows how large-scale safety nets can reduce food insecurity and improve health outcomes (Wang et al., 2021). By stabilising access for low-income households, such schemes can strengthen resilience during crises and reduce reliance on ad hoc emergency aid. In the UK, local councils, schools, and community organisations helped buffer the worst impacts of COVID-19 through food parcel distribution and expanded meal access. However, many of these measures were short-lived, and failed to reach the most marginalised populations (Daley et al., 2022; Djurle et al., 2022). To achieve lasting progress, food security measures must be designed and delivered with affected communities. Local institutions, schools, and faith networks can act as trusted intermediaries, ensuring that food aid is not only culturally appropriate but also consistently accessible in times of crisis. Without this involvement, food system responses risk remaining reactive rather than building lasting preparedness.

Key takeaways

A biosecurity strategy that overlooks food equity is incomplete. Food insecurity is a predictable vulnerability that intensifies during every disruption. While individual behaviours play a role, structural factors ultimately determine who can access adequate nutrition when supply chains are strained. Food systems designed collaboratively with those most at risk are more resilient, more legitimate, and better prepared for future biosecurity threats.

4. Animal and Plant Health

Protecting animal and plant health is central to the UK's resilience against biological risks. As with other areas, outcomes are shaped by social as well as technical factors. Surveillance and control systems often focus on laboratory diagnostics, Border checks, and veterinary expertise, yet real-world outcomes depend on who notices and reports disease, and who complies with restrictions. Global, and UK focused research, shows that overlooking gender roles, labour conditions, and access to decision-making weakens early detection and compliance, and leaves critical risks unaddressed.

4.1

Detection and Early Warning

Early detection relies on those closest to animals and crops. In UK farming households, women contribute substantially to daily observation and informal management but are often excluded from advisory services (Kempster et al., 2023). Surveillance systems commonly assume that the farmer is male and formally registered, which sidelines women and other household members who may be the first to notice unusual symptoms (Kempster et al., 2023). This pattern is widely noted in One Health literature, where women farmers and household members contribute substantially to disease recognition but are often excluded from formal reporting channels (Cataldo et al., 2021; FAO, 2023). This exclusion creates gaps in early warning that technical systems cannot fully replace.

The 2001 Foot and Mouth Disease (FMD) outbreak demonstrated the costs of this exclusion. More than six million animals were culled at an estimated cost of £3.1 billion to agriculture and a further £2.7–3.2 billion to tourism (Thompson et al., 2002). Farmers and vets were central to the immediate response, but testimonies collected after the crisis highlight that households and smallholders also noticed symptoms but without clear ways to report them (Middlemiss, 2021). This meant that surveillance planning missed opportunities for earlier intervention.

Plant health systems also miss opportunities by failing to value diverse agroecological knowledge. Global studies show that people engaged in seed saving, biodiversity monitoring and daily cultivation are often the first to notice changes in pests or crop health (Ramirez-Santos et al., 2023; Dittmer et al., 2023; FAO, 2023). In the UK, these contributions are not recognised in formal systems, yet allotments, community gardens, and seed-saving networks demonstrate similar practices, with women and other small-scale growers often leading observation and exchange (Garden Organic, 2011; Westaway, 2020). Evidence from ecological studies also highlights how local practices such as these, strengthen resilience across whole landscapes, not just individual farms (Altieri, et al. 2024). When these roles are excluded, valuable perspectives are lost. International initiatives such as Plantwise a global programme supporting farmers with plant health advice, show that when advisory systems are designed to include different groups, especially women and smallholders, problems are reported more quickly and uptake of protective measures is stronger (CABI, 2024).

Citizen reporting has potential to expand surveillance, but only if systems are inclusive. Wildlife disease monitoring in the UK has increasingly relied on public contributions, such as reporting cases of Usutu virus in wild birds (Lawson et al., 2022). Yet access to these channels depends on awareness, digital literacy, and confidence in engaging with institutions. Groups excluded from training or technology are less likely to contribute, limiting the reach of public surveillance.

4.2

Compliance and Working Conditions

Compliance with protective measures is harder to sustain when agricultural workers face poor conditions. Insecure contracts, limited housing, lack of sick pay, and risk of exploitation all discourage seasonal and migrant workers in the UK from raising concerns about livestock health, crop pests, or unsafe practices (FLEX, 2025; Home Office, 2024). Overcrowded or inadequate accommodation can also make it difficult to follow on-farm hygiene rules, such as avoiding contamination between sites. These vulnerabilities are recognised in UK debates on labour governance, with oversight by the Gangmasters and Labour Abuse Authority and Defra's seasonal worker schemes highlighting the precarious conditions of agricultural labour. While rarely framed in terms of animal and plant health, international evidence shows that insecure conditions on the frontline reduce reporting and weaken protective practices (FAO, 2023).

Recent avian influenza outbreaks underline how working conditions affect compliance. Since 2021 HPAI control measures have required strict cleaning, protective equipment, and culling protocols (Ahmed et al., 2021; Adlhoch et al., 2021). Migrant workers in the poultry sector are crucial to implementing these measures, but they often face barriers that hinder compliance. These include a lack of training in languages they understand, leading to gaps in awareness of biosecurity protocols, which increases risks of disease spread (Subedi et al., 2022). Precarious job security and limited trust in employers can lead to inconsistent compliance with rules, as workers may avoid raising concerns that could threaten their employment (Sarıipek et al., 2023; Everett et al., 2021). When poor conditions force workers to prioritise income over rules, safety measures don't hold and farms become more at risk (Adlhoch et al., 2021). Trust in employers and health authorities is a prerequisite for sustained compliance, highlighting how socio-economic factors shape the effectiveness of biosecurity controls (Everett et al., 2021; Enkirch et al., 2025).

Inclusive communication is essential for effective pest management. When women and smallholder farmers are excluded from advice, uptake is lower and practices less sustainable (Zimu-Biyela et al., 2020; Belmain et al., 2022). Reviews of integrated pest management similarly find higher adoption rates when communication strategies engage all stakeholders, including marginalised groups (Deguine et al., 2021; Rambauli et al., 2021). Yet in the UK, women and small-scale growers are often underrepresented in consultations on pest management strategies, despite evidence that inclusive approaches strengthen long-term outcomes. Recognising different information needs and perspectives is therefore key to building plant health resilience.

4.3

Policy Blind Spots

UK biosecurity strategies often prioritise technical capacity over inclusion. DEFRA's Plant Biosecurity Strategy 2023–28, for example, focuses on surveillance and diagnostics with little attention to who participates in these systems or who bears the costs of restrictions (DEFRA, 2023). Similarly, the House of Lords briefing on Infectious Disease Threats (2024) highlights risks from climate change and global trade yet overlooks which groups are most exposed to animal and plant health threats and who may be least able to meet new requirements.

Policy responses to animal and plant health threats often overlook how burdens are unevenly shared. During the 2001 Foot and Mouth Disease outbreak, compensation centred on livestock losses for commercial farms, while income from farm tourism, often managed by women, was less protected, and households absorbed significant psychological strain (Thompson et al., 2002; Middlemiss, 2021). Recent avian influenza measures reveal similar gaps: housing orders and movement restrictions place heavier costs on smallholders and backyard keepers, who also have less access to compensation, making compliance harder. Plant health policy likewise prioritises border checks and diagnostics, with little consideration of whether small traders can absorb new costs or whether women's ecological knowledge is included in risk assessment.

Key Takeaways

Animal and plant health outcomes depend as much on social and economic factors as on technical controls. Like in Sections 2 and 3, excluding women, smallholders, and frontline workers from surveillance and decision-making creates gaps in early detection, and weakens compliance, shifting costs onto those with limited capacity to absorb them. When policies focus narrowly on diagnostics and border checks, they miss the practical realities of early warning and the ability of different groups to comply with restrictions. More inclusive approaches would strengthen resilience, improve trust, and make protective measures more effective in practice.

5. Technology, Surveillance & Trust

Digital technologies are transforming biosecurity surveillance, offering new opportunities to detect and respond to threats more rapidly and at greater scale. Their effectiveness depends not only on technical sophistication but on whether communities can access and trust these systems. If digital tools remain out of reach for certain populations or are perceived as unfair, they risk creating surveillance gaps and deepening existing inequalities rather than strengthening collective biosecurity.

5.1

Digital Exclusion and Surveillance Inequities

Digital divides limit who can participate in surveillance. Around one in five UK adults lack access to a smartphone, and broadband coverage remains uneven across income and ethnic groups (Ofcom, 2023). During the COVID-19 pandemic, uptake of the NHS contact-tracing app was lowest among marginalised communities, with socio-economic status, age, and ethnicity all shaping participation (Wymant et al., 2021). Similar challenges affect agricultural surveillance: community reporting on livestock or crop pests depends on digital literacy and connectivity, leaving smallholders and lower-income groups underrepresented. Exclusion of these groups weakens the reach and accuracy of monitoring systems across animal, plant, and human health. Effective early warning of zoonotic and transboundary risks depends on inclusive systems that capture information from all sectors.

Uptake falters when technologies are seen as imposed rather than relevant. Evidence from the UK shows that groups facing socioeconomic disadvantage were less likely to adopt digital surveillance tools when they could not see how their contributions were used or receive useful feedback in return (Shannon et al., 2018). In Cambodia, mobile-based poultry reporting platforms saw little sustained use because farmers were not involved in design and the tools did not align with local practices (Conan et al., 2012). Even the NHS COVID-19 app, despite technical sophistication, had limited uptake because mistrust and poor communication undermined confidence (Wymant et al., 2021). These cases highlight that the effectiveness of biosecurity technologies depends as much on legitimacy and user confidence as on technical design.

5.2

Algorithmic Bias and Perceptions of Fairness

New surveillance technologies risk reproducing inequities. AI systems are only as reliable as the datasets that train them, and when those datasets do not represent the target population, results are skewed. In human health, genomic databases that underrepresent minority ethnic groups reduce diagnostic accuracy, while in agriculture, the focus on commercially valuable crops and livestock leaves smallholder varieties and local breeds overlooked (Muellner et al., 2018). Outbreak models built on smartphone mobility data exclude communities with limited digital access, missing potential hot spots, while risk tools trained only on commercial farms may fail to detect problems in smallholder systems. These gaps can misdirect resources, unfairly label some groups as “high risk,” and reduce

confidence in protective measures. Evidence from other sectors shows that biased algorithms replicate existing discrimination (Buolamwini & Gebru, 2018); biosecurity systems face the same risk unless equity is built in from the start.

Concerns about fairness strongly influence whether people adopt surveillance tools. Research shows uptake drops when systems are seen to target particular groups unfairly (Sutcliffe et al., 2017). In UK agriculture, farmers' willingness to use digital reporting depends on trust in the institutions running them and confidence that data will not be misused (Brennan & Christley, 2013). Studies of poultry farms likewise show higher compliance when monitoring technologies are introduced with clear communication and adequate support, how technologies are governed matters as much as their technical capacity (Royden et al., 2021)..

5.3

Community Engagement and Legitimacy

Digital surveillance tools are most effective when communities help shape them. In Australia, smartphone apps and drones used for forest biosecurity succeeded because Indigenous Ranger networks were engaged as co-designers, embedding local knowledge and strengthening legitimacy (Grant et al., 2019). UK evidence points the same way, digital accreditation systems in the plant trade gained traction only once growers were consulted on how reporting would work (Marzano et al., 2021). These cases show that technologies work best when people see them as relevant and fair, not imposed from outside.

Uptake also depends on addressing inequality. Research shows women and small-scale farmers are more likely to use mobile plant health tools when information reflects their roles in seed selection and cultivation (FAO, 2023; Marzano et al., 2021). Broader digital health studies confirm that closing gender gaps increases participation and outcomes (Taukobong et al., 2016). Participatory ICT projects in New Zealand forests likewise demonstrate that trust in drones and sensor networks grows when communities influence how data are collected and shared (Ogilvie et al., 2019).

Case Study: Community Co-Design of Surveillance Technologies

Forestry biosecurity strategies increasingly rely on remote sensing tools like unmanned aerial vehicles (UAVs), but these can raise public concerns around privacy and control. In New Zealand, **researchers trialled a participatory design approach, involving local communities** in shaping how UAVs were used for early pest and disease detection.

This included working with marginalised rural communities, including Māori landowners, older smallholders, and those with limited digital access, to build shared understanding and co-create operational guidelines.

Why it worked:

- Community engagement from the outset
- Attention to cultural values, land rights, and data concerns
- Shared governance over how tools were deployed

Outcome:

- Increased legitimacy and trust in surveillance
- Higher uptake and local support for pest monitoring
- Practical model for balancing innovation and equity

Shows how inclusive design and shared governance build trust in biosecurity, by including community expertise and strengthening systems.

Key Takeaways

New technologies expand biosecurity's toolkit, but their value depends on inclusion. Digital reporting platforms and AI systems can strengthen early detection, yet they risk repeating old problems if digital divides, biased datasets, and weak engagement are ignored. Systems that exclude those without access, rely on skewed data, or are introduced without consultation will be less reliable and harder to sustain. Resilience is strongest when technologies are designed and governed in ways that are transparent, participatory, and equitable.

6. STEM Workforce & Responsible Innovation

Biosecurity depends on who builds, designs, and governs it. From laboratories developing diagnostics, to engineers creating surveillance systems, and staff implementing outbreak controls, the UK's ability to anticipate and respond to biological threats rests on its STEM workforce. If this workforce is narrow and exclusionary, bias and gaps can emerge, risks are poorly understood, and community needs are overlooked. A more diverse workforce brings broader perspectives, making approaches to biological risks both fairer and more effective

6.1

Persistent Gaps and Operational Consequences

Women, people with disabilities, and minority ethnic groups remain underrepresented in UK science and innovation. The Royal Society's diversity report shows that women, people with disabilities, and minority ethnic groups are still underrepresented in senior academic positions and fellowships (Royal Society, 2021). Although the proportion of female fellows has increased slowly, men dominate most disciplines. UKRI data reveal ongoing disparities in award rates, with Black and disabled applicants facing particular disadvantages (UKRI, 2023). Socio-economic barriers also mean students from disadvantaged backgrounds are less likely to enter or progress in STEM careers (UK Parliament, 2023). These structural gaps matter for biosecurity because they narrow who contributes to design, governance, and decision-making. A workforce that does not reflect society risks overlooking the needs of those most affected by biological threats.

Exclusion narrows the scope of innovation and creates systemic oversights in biosecurity design. The COVID-19 PPE failures (see Section 2) illustrate this; respirators designed around White male facial dimensions left women and non-White healthcare workers less protected (Caggiari et al., 2023). The same pattern appears elsewhere. Surveillance systems assuming universal smartphone access overlook rural areas with poor connectivity (Ofcom, 2023). Diagnostic tools validated in specialist clinics often fail in community health centres or informal care settings (WHO, 2021). Teams tend to design for people like themselves; if they lack diversity, they often reproduce assumptions that overlook the realities of people with disabilities, migrant workers, or those in low-resource contexts. This results in weaker detection, and gaps in compliance. As biosecurity relies more on AI and machine learning, the background of those who design these systems influences how they work and who they serve.

6.2

Embedding Responsible Innovation

Responsible Innovation (RI) offers a framework to promote inclusion. Current approaches, including UKRI's Responsible Innovation Hub and the UK Government's 2024 Model for Responsible Innovation, emphasise anticipation, inclusion, and responsiveness as active responsibilities rather than optional extras (UKRI, 2024; DSIT, 2024). Gender and inclusion responsiveness needs to be mainstreamed across One Health research and innovation, rather than treated as an afterthought (Garnier et al., 2020). This would mean embedding GEDSI principles systematically in UKRI frameworks and biosecurity institutions. Such approaches can build on established frameworks like the AREA model (Anticipate, Reflect, Engage, Act) to provide practical guidance for technology development (Stilgoe et al., 2013).

Case Study: Integrating Diverse Knowledge in Biosecurity Governance

Adaptive governance models trialled in Australia show how diversity improves system resilience. Rather than relying solely on centralised expertise, these models brought together Indigenous knowledge holders, scientists, farmers, and community representatives to co-develop strategies for invasive species, antimicrobial resistance, and zoonotic threats. This shifted governance from top-down control to shared decision-making.

Why it worked:

- Recognised the value of non-institutional knowledge
- Shared risk identification and mitigation planning
- Focus on relationships alongside regulations

Outcomes:

- More flexible, locally responsive policies
- Improved trust and uptake
- Showed how inclusive governance enhances adaptability

(Source: Rawluk et al., 2021)

There are concrete examples of frameworks making a difference when they are implemented. UKRI's move to require RI and Equality Diversity and Inclusion (EDI) plans in funding calls signals that inclusion is part of research governance rather than optional. Involving diverse staff in PPE fit-testing led some organisations to review procurement, improving safety and confidence. By contrast, evaluations of *Horizon 2020*, the EU's flagship research funding programme (2014–2020), suggest that responsible research and innovation was often implemented superficially or inconsistently, limiting its influence on design decisions (Tabarés et al., 2022). However, project-level cases show it can work when embedded with resources and authority, for example, Horizon 2020's *In Silico World* explicitly brokered RRI activities to shape engagement and governance within a health-tech programme (Elhadj et al., 2024). Equity and responsibility frameworks can deliver tangible improvements, but only when they are built into projects with clear incentives, accountability, and room to adjust designs.

International and national frameworks now provide opportunities for change. WHO's 2024 guidance on gender and antimicrobial resistance outlines practical steps for incorporating gender analysis into One Health strategies, from data disaggregation to workforce training. While not UK-specific, it reflects a growing international consensus that equity enhances effectiveness. Domestically, the UK Biological Security Strategy Implementation Report (2023–25) commits to new capacity, including a National Biosecurity Centre. These institutions could entrench inequalities if recruitment and governance mirror existing STEM gaps. However, they also have the power

to set new standards, embedding inclusive hiring practices, publishing diversity data, ensuring accessible workplaces, and requiring Responsible Innovation plans for projects.

Key Takeaways

The challenge is to scale effective measures and close remaining gaps. Disability and intersectionality remain under-researched in UK STEM datasets, and comprehensive examples of RI being systematically applied to biosecurity surveillance and detection systems are rare. Evidence on design–user feedback loops is limited, and long-term impacts of interventions are not well evaluated. Still, signs of progress are evident: UKRI's diversity reporting, the inclusion of RI plans in funding calls, and changes to PPE standards show inequities can be identified and addressed. Diverse teams frame problems differently and spot risks others may miss. Technologies and policies are more effective when they are visibly inclusive, and resilience is greater when institutions draw on a wide range of knowledge and networks. These are not abstract benefits but essential conditions for robust and legitimate biosecurity.

7. Cross-Cutting Themes & Gaps

Biosecurity and inequality are closely linked. Gaps in health, food, or technology interact and reduce resilience throughout the system. Evidence across the five thematic areas highlights three recurring, cross-cutting issues: i) **inequalities increase exposure and vulnerability**; ii) s**ystems are more effective when designed around the realities of people's lives**; and iii) **persistent policy and evidence gaps leave weaknesses unaddressed**.

7.1

Inequalities Increase Vulnerability

Systemic inequalities weaken the UK's ability to detect, respond to, and recover from biological threats. Across health, food, surveillance, and animal and plant systems, disadvantaged groups face higher risks and encounter more barriers to protection and response. During COVID-19 for example, delays in care, digital exclusion, and lower vaccine uptake were most common among people in deprived areas, people with disabilities, and ethnic minorities. Similar patterns are evident in antimicrobial resistance and tuberculosis, where prescribing guidance often falls short in the context of poverty, overcrowding, or care responsibilities.

Crises also generate secondary impacts that deepen inequality. Lockdowns, for example, contributed to rises in gender-based violence, loss of support services, and unpaid care burdens. These harms shape how people engage with systems designed to support them; however, they remain largely absent from preparedness planning. Building resilience means understanding how unequal experiences of safety, trust, and access influence people's ability to act in the face of risk.

7.2

Making Systems Work for People

Inclusion improves effectiveness. Inclusive approaches that engage directly with affected groups and communities, tend to achieve higher uptake and greater legitimacy. The UK's 2022 Mpox response benefited from early engagement with gay and bisexual men, while Ebola and Zika responses faltered where women health workers were excluded.

Design shapes access and outcomes. Tools and policies often reflect assumptions about a default user, typically able-bodied, digitally connected, and economically secure. This was evident, for example, in PPE designed around male facial dimensions, which left many women and minority ethnic healthcare workers less protected. Similarly, digital platforms that assume smartphone access or digital literacy have excluded some older people and low-income groups from timely information and support.

Trust is shaped not only by system design but by past experience. Where communities have faced discrimination or exclusion, engagement may be lower, even when systems are well intended**.**

7.3

Policy and Evidence Gaps

Across the reviewed literature, inclusion is rarely treated as a core design requirement in biosecurity systems. While UK strategies emphasise surveillance, diagnostics, and innovation, they give limited attention to who participates, who is affected, or how different groups experience preparedness measures. DEFRA's Plant Biosecurity Strategy 2023–28, for example, focuses primarily on technical capacity with little consideration of participation or access. The UK Biological Security Strategy mentions equity only briefly, with no clear mandate for embedding gender, disability, or social inclusion across programmes.

Where inclusion has been addressed, it tends to be ad hoc rather than systemic. It has typically emerged through short-term adaptations, localised initiatives (which often remain isolated and difficult to replicate), or through the efforts of individual champions. While these approaches are often context-specific and demonstrate clear value, they remain fragmented and are not sustainable. Most have not been scaled or embedded within the core architecture of biosecurity systems.

These patterns are reinforced by gaps in data and analysis. Disaggregated data is rarely collected systematically across surveillance, food systems, or innovation pipelines. Intersectional analysis remains limited, and evidence on disability is particularly weak. Without deliberate mechanisms to capture and apply learning on who is reached, who is excluded, and what barriers persist, biosecurity policy risks reproducing the same blind spots.

Climate change is amplifying many of the risks identified across this review. Shifts in disease patterns, ecosystem instability, and environmental stressors, from air pollution to water insecurity, are all increasing pressure on biosecurity systems. UK studies highlight how marginalised groups are disproportionately affected by climate-linked harms. These include exposure to high levels of air pollution and heat stress, alongside limited capacity to adapt (Fenech et al., 2021; Davies et al., 2025). While the UK Biological Security Strategy identifies climate change as a key driver of future threats, it does not address how these risks are distributed across different groups or how inclusion might strengthen adaptation. Initiatives like Place-based Action for Inclusive Climate and Health Equity (PAICE) show how health equity can be embedded in climate policy, but remain siloed from biosecurity, even as climate-related health risks become increasingly central to preparedness. This remains a critical area for further exploration, particularly as climate-driven health risks become more central to the UK’s biosecurity landscape.

8. Implications for UK Practice and Next Steps

Addressing the gaps identified above requires changes in how biosecurity is designed, and delivered in the UK. While the UK Biological Security Strategy (BSS) provides a valuable framework, its implementation has so far placed limited emphasis on equity and inclusion. The evidence reviewed in this report suggests that more deliberate integration of GEDSI principles could make biosecurity systems more inclusive, effective, and sustainable.

This section sets out some areas where GEDSI principles could be better incorporated into the UK's approach to biosecurity. The examples are illustrative, not exhaustive, but show what more inclusive and resilient systems might look like in practice.

8.1

Build Inclusive Systems

Biosecurity systems work best when designed for the full diversity of users from the outset, including those most at risk, and those whose needs are often overlooked. For example, a vaccination programme might combine digital booking with phone and walk-in options to ensure access for people without internet access or digital literacy. PPE standards could reflect a wider range of body types, recognising the diversity of the health and care workforce. Everyday services such as primary care, transport, and social care could be treated as core components of biosecurity infrastructure, since unequal access in these areas quickly creates gaps during a crisis.

8.2

Partner with Communities

Surveillance, monitoring, and early warning systems are more accurate and sustainable when communities are involved. Farmers, care workers, and health volunteers often notice signs of risk early, but their knowledge is frequently excluded from formal systems. Women, over-represented in many of these frontline roles, face particular barriers to participation. Practical models could include training and compensating trusted community actors as local sentinels, co-designing reporting tools that work offline, and ensuring feedback loops are in place so communities see how their input is used. These approaches improve early detection, strengthen trust, and align public health goals with lived realities.

8.3

Ensure Accountable Innovation

New tools and technologies strengthen biosecurity only if they work for the full range of people affected. Innovations developed in narrow contexts, such as diagnostic tests, digital platforms, or surveillance algorithms, often fail when applied more widely. Future projects could include usability testing with diverse users before scale-up, and advisory boards that reflect the populations most affected by biological risks. Greater transparency in design decisions, data governance, and evaluation processes would not only improve accountability, but also build public confidence in biosecurity interventions.

8.4 Looking Ahead

The focus areas outlined above highlight where further reflection and experimentation could strengthen system effectiveness, equity, and resilience. Next steps will depend on HMG priorities and programme design, however, potential actions could include:

- **Review programmes and strategies** to identify gaps or entry points where inclusion can be strengthened.[1]
- **Develop tools and guidance** (e.g. a GEDSI entry points tool aligned to the BSS pillars) to help programme teams and delivery partners assess risks of exclusion, identify opportunities for inclusive design, and track progress.
- **Convene cross-sector partners** through workshops or dialogues to explore how inclusive approaches can be translated into practice.
- **Pilot inclusive approaches** where UK evidence is limited (for example, surveillance systems that work for digitally excluded groups, or reporting tools co-designed with communities to build trust).
- **Design standalone programming on GEDSI and biosecurity**, combining funding for structured pilots with a small innovation fund to surface new ideas from diverse partners and a platform to share learning across sectors.

Delivering these shifts will require coordination across multiple departments and sectors but aligns with existing frameworks such as the *UK Biological Security Strategy Implementation Plan (2023–2025)* and *UKRI's Responsible Innovation* requirements. This review offers an opportunity to build on that momentum, embedding inclusion more fully into how the UK prepares for and responds to biosecurity threats.

[1] This review includes analysis of five ongoing biosecurity projects, which offer immediate opportunities to consider and test GEDSI integration.

References

Health Inequalities and Biosecurity

Ayorinde, A., Ghosh, I., Ali, I., Zahair, I., Olarewaju, O., Singh, M., … & Oyebode, O. (2023). *Health inequalities in infectious diseases: a systematic overview of reviews*. BMJ Open, 13(4), e067429.

Ascott, A., Crowest, M., Gordon, J. & Humphreys, J. (2021) *Respiratory PPE for healthcare workers: impact of sex differences on respirator fit test results*. British Journal of Anaesthesia, 126(1), pp. e48–e49

Bradley, F., Nelson, P.A., & Dumville, J. (2025). *Implementing targeted vaccination activities to address inequalities in vaccination: a qualitative study*. Journal of Public Health.

Caro, D., Nordehn, C. & Betron, M. (2010) *Gender Analysis Toolkit for Health Systems*. Jhpiego/USAID.

Collignon, P., Beggs, J., Walsh, T., Gandra, S. & Laxminarayan, R. (2018). *Anthropological and socioeconomic factors contributing to global antimicrobial resistance: a univariate and multivariable analysis*. The Lancet Planetary Health, 2(9), e398–e405.

Davies, S. E. & Bennett, B. (2016) *A gendered human rights analysis of Ebola and Zika: locating gender in global health emergencies*. International Affairs, 92(5), pp. 1041–1060.

Department of Health and Social Care (DHSC) (2024) *Confronting Antimicrobial Resistance: The UK's 5-Year Action Plan 2024 to 2029*. London: HM Government. Available at: (Accessed: 12 September 2025).

Doctors of the World UK (2020). *An Unsafe Distance: The Impact of the COVID-19 Pandemic on Excluded People in England (Rapid Needs Assessment).* London: Doctors of the World UK.

Frieden, T. R., Cash-Goodman, A., & Lesser, J. (2023). *The road to achieving epidemic-ready primary health care.* The Lancet Public Health, 8(6), e422–e429.

Health Foundation (2021) *Unequal Pandemic, Fairer Recovery: The COVID-19 Impact Inquiry report*. London: The Health Foundation.

Healthwatch & NHS England (2022) *Barriers to cervical screening faced by people with a learning disability*. London: Healthwatch.

Kirby, A. & Herbert, A. (2013). Correlations between income inequality and antimicrobial resistance. *PLoS One*, 8(8)

Meena, J., Kumar, S., Sharma, A., & Shukla, A. (2023). *Health systems preparedness for infectious disease outbreaks: A review*. Travel Medicine and Infectious Disease, 54, 102546.

NCL Cancer Alliance. (2024). *Improving cancer screening for people experiencing homelessness: Final evaluation*. North Central London Cancer Alliance.

Office for National Statistics (ONS) (2020) *Coronavirus (COVID-19) related deaths by ethnic group, England and Wales*. Newport: ONS

Office for National Statistics (ONS) (2021) *Domestic abuse during the coronavirus (COVID-19) pandemic, England and Wales: November 2020*

Office for National Statistics (ONS) (2022) *Coronavirus and vaccination rates in people aged 18 years and over by socio-demographic characteristic, England: 8 December 2020 to 31 December 2021*.

Ogaz, D., et al.., (2022) *Mpox diagnosis, behavioural risk modification, and vaccination uptake among gay, bisexual, and other men who have sex with men.*. Emerging Infectious Diseases, 30(3).

Public Health England (2019) *Tuberculosis in England: 2019 report*. London: PHE.

Public Health England (2020) *Disparities in the risk and outcomes of COVID-19*. London: PHE.

Regli, A., von Ungern-Sternberg, B. S., von Ungern-Sternberg, S. N. & Hall, G. (2021) Fit testing of respiratory protective equipment in UK healthcare workers: a prospective observer study. *Anaesthesia*, 76(4), pp. 473–479

Thomas, S., Sagan, A., Larkin, J., et al. (2020). *Strengthening health systems resilience: Key concepts and strategies.* Policy Brief, No. 36. Copenhagen, Denmark: European Observatory on Health Systems and Policies.

Trades Union Congress (TUC) (2021) *Personal protective equipment and women.*

UK Health Security Agency (UKHSA) (2023) *Mpox clade Ib and clade IIb outbreak: epidemiological overview*. London: UKHSA. First published 21 June 2022; last updated 11 September 2025.

UKHSA. (2023a). *Seasonal influenza vaccine uptake in GP patients: Winter 2022 to 2023*. UK Health Security Agency.

UN Women (2020). The Shadow Pandemic: Violence against women during COVID-19

Wenham, C. & Davies, S.E. (2022) '*WHO runs the world—(not) girls: gender neglect during global health emergencies',* International Feminist Journal of Politics, 24(3), pp. 415–438.

Willis, L. & Chandler, C. (2019). *Quick fix for care, productivity, hygiene and inequality: reframing the entrenched problem of antibiotic overuse.* BMJ Global Health, 4(4), e001590.

World Health Organization (WHO) (2018) *Addressing Gender Inequalities in National Action Plans on Antimicrobial Resistance: Guidance for Policy Makers*. Geneva: WHO.

World Health Organization (WHO) (2019) *No time to wait: securing the future from drug-resistant infections*. Report to the Secretary-General of the United Nations. Geneva: WHO.

World Health Organization (2020) *Gender and COVID-19: Advocacy Brief*. Geneva: WHO.

Yumarni, T., Sulistiani, L., Idanati, R. & Gunarto, G. (2021). Gender equality and social inclusion (GESI) for strengthening disaster resilient village. *Journal of Public Administration Studies*, 6(1), 8–15

Food Insecurity and Supply Chains

Almotairy, H. et al., 2024. *Enhancing agricultural biosecurity: strategies for food safety and environmental sustainability in Saudi Arabia.* IntechOpen.

Blazy, J., Causeret, F. & Guyader, S., (2021). Immediate impacts of COVID-19 crisis on agricultural and food systems in the Caribbean

Brucker, D.L. & Coleman-Jensen, A., 2017. *Food insecurity across the adult lifespan for persons with disabilities.* Disability and Health Journal, 10(2), pp.287–293

Davis, K., Downs, S. & Gephart, J., 2020. *Towards food supply chain resilience to environmental shocks*. Nature Food, 2(1), pp.54–65

Daley, O., Isaac, W., John, A., Roopnarine, R., & Forde, K. (2022). An assessment of the impact of covid-19 on the agri-food system in Caribbean small island developing states. Frontiers in Sustainable Food Systems, 6.

Djurle, A., Ortiz, A., & Ortiz, J. (2022). *Biohazards in primary production: A gender and social inclusion perspective.* Food Security, 14, 1203–1216.

Food Foundation. (2023). *Disability and Food Insecurity in the UK*. The Food Foundation.

Gomez, M.I., Mejía, A., Ruddell, B.L. & Rushforth, R., (2021). *Supply chain diversity buffers cities against food shocks. Nature*, 595(7866), pp.250–254.

Hatcher AM, Page S, Aletta van Eck L, Pearson I, Fielding-Miller R, Mazars C, Stöckl H. *Systematic review of food insecurity and violence against women and girls: Mixed methods findings from low- and middle-income settings*. PLOS Glob Public Health. 2022 Sep

Humanitarian Outcomes. (2018). *The Role of the State in Humanitarian Action.* Humanitarian Outcomes, London. Available at

Keyes, A.M., Wright, B.J., Spencer, J.H. and Corso, L.C., (2025). Missing meals and missed rides: transportation barriers to food access for vulnerable populations. *Urban Science*, 9(6), p.198.

Kishore, N., Marqués, D., Mahmud, A., Kiang, M. V., Rodriguez, I., Fuller, A., Ebner, P., Sorensen, C., Racy, F., Lemery, J., Maas, L., Leaning, J., Irizarry, R. A., Balsari, S., & Buckee, C. O. (2018). *Mortality in Puerto Rico after Hurricane Maria*. New England Journal of Medicine, 379, 162–170.

McClelland, A., Pike, A., & Tomaney, J. (2024). *Legitimacy and place leadership in disrupted institutional settings: Local government responses to COVID-19 in England*. *Regional Studies*.

Parnham, J.C., Laverty, A.A., Majeed, A. and Vamos, E.P., (2020). *Half of children entitled to free school meals did not have access to the scheme during the COVID-19 lockdown in* the UK. Public Health, 187, pp.161–164.

Lalli, G., White, J., Holland, K. and BERA, (2021). *The free school meal voucher scheme: Children's access to food during the COVID-19 crisis*. British Educational Research Association / The Food Foundation.

Lee, J., Lee, J., & Cui, L. (2025). *Association between food insecurity and multiple chronic diseases in elderly people with disabilities in south Korea*. Asian Social Work and Policy Review, 19(2).

Sonik, R., Parish, S., Ghosh, S., & Igdalsky, L. (2016). *Food insecurity in U.S. households that include children with disabilities. Exceptional Children,* 83(1), 42-57.

The Health Foundation, 2023. Trends in households without access to a car. *Health Foundation Evidence Hub*.

Wang, M., Levi, R., & Seligman, H. (2021*). New SNAP eligibility in California associated with improved food security and health.* Preventing Chronic Disease, 18.

Wolfson, J.A. & Leung, C.W., 2020. *Food insecurity and COVID-19: Disparities in early effects for US adults*. Nutrients, 12(6), 1648.

Animal and Plant Health

Adlhoch, C., Fusaro, A., Gonzales, J., Kuiken, T., Marangon, S., Niqueux, É., … & Baldinelli, F. (2021). *Avian influenza overview September – December 2021*. EFSA Journal, 19(12).

Ahmed, H., Mohamed, M., Erfan, A., Abdelkarim, L., & Awadallah, M. (2021). *Investigating the biosecurity measures' applications in poultry farms and its relationship with the occurrence of avian influenza.* Slovenian Veterinary Research.

Altieri, M.A., Nicholls, C.I., Dinelli, G. et al. (2024) Towards an agroecological approach to crop health: reducing pest incidence through synergies between plant diversity and soil microbial ecology" *npj Sustainable Agriculture* 2, 6.

Belmain, S., Tembo, Y., Mkindi, A., Arnold, S., & Stevenson, P. (2022). *Elements of agroecological pest and disease management*. Elementa Science of the Anthropocene, 10(1).

CABI. (2024). *PlantwisePlus Annual Review 2024*. Wallingford: CABI.

Cataldo, C., Bellenghi, M., Masella, R., & Busani, L. (2023). *One Health challenges and actions: Integration of gender considerations to reduce risks at the human-animal-environmental interface*. One Health, 16: 100530.

DEFRA (2023). *Plant Biosecurity Strategy for Great Britain 2023 to 2028*. Department for Environment, Food & Rural Affairs.

Deguine, J., Aubertot, J., Flor, R., Lescourret, F., Wyckhuys, K., & Ratnadass, A. (2021). *Integrated pest management: good intentions, hard realities. A review*. Agronomy for Sustainable Development, 41(3).

Dittmer, K., Rose, S., Snapp, S., Kebede, Y., Brickman, S., Shelton, S., … & Wollenberg, E. (2023). *Agroecology can promote climate change adaptation outcomes without compromising yield in smallholder systems*. Environmental Management, 72(2), 333–342.

Enkirch, T., Gervelmeyer, A., Hallmaier–Wacker, L., Melidou, A., & Willgert, K. (2025). *Coordinated One Health investigation and management of outbreaks in humans and animals caused by zoonotic avian influenza viruses.* EFSA Journal, 23(1).

Everett, J., Colombatto, C., Awad, E., Boggio, P., Bos, B., Brady, W., … & Crockett, M. (2021). *Moral dilemmas and trust in leaders during a global health crisis.* Nature Human Behaviour, 5(8), 1074–1088.

FLEX (2025). *Migrant workers in UK agriculture: Conditions, rights and vulnerabilities*. Focus on Labour Exploitation.

Food and Agriculture Organization (FAO) (2023). *The Status of Women in Agrifood Systems.* Rome: FAO.

Garden Organic (2011). *Sowing New Seeds: A guide to crop diversity and seed saving for community groups*. Coventry: Garden Organic.

Home Office (2024). *Seasonal Worker visa route and agricultural labour supply: Guidance and data.* London: Home Office.

Kempster, V., Bennett, K., & Carter, A. (2023). The role of women in United Kingdom farm businesses. *Journal of Rural Studies*, 96, 55–64.

Lawson, B., Robinson, R. A., Neimanis, A., Handeland, K., Isomursu, M., Ågren, E. O., Hamnes, I. S., Tyler, K. M., van der Kolk, J. H., Cromie, R. L., Durr, P. A., Leighton, F. A., & Cunningham, A. A. (2022). Combining host and vector data informs emergence and potential impact of an Usutu virus outbreak in UK wild birds. *Scientific Reports*, 12, 19715.

Middlemiss, C. (2021). *World Organisation for Animal Health (WOAH). Reflections on the Foot-and-Mouth Disease Epidemic of 2001. WOAH Bulletin*

Ramirez-Santos, A.G., Ravera, F., Rivera-Ferre, M.G. *et al.* Gendered traditional agroecological knowledge in agri-food systems: a systematic review. *J Ethnobiology Ethnomedicine* 19, 11 (2023)

Rambauli, M., Antwi, M., & Mudau, F. (2021). *Review of plant health clinics: A recent phenomenon for effective plant pests and diseases diagnosis*. South African Journal of Agricultural Extension, 49(3), 90–103.

Sarıipek, D., Aybas, M., & Stanikūnienė, B. (2023). *Precarious job and union tendencies among women and young employees: The relationships between economic constraints, job security and trust in employers*. Engineering Economics, 34(3), 335–350.

Subedi, D., Phuyal, P., Bhandari, S., Kandel, M., Shah, S., Rawal, G., … & Dhakal, S. (2022). *Risk factors associated with avian influenza subtype H9 outbreaks in poultry farms of central lowland Nepal.* Infectious Disease Reports, 14(4), 525–536.

Thompson, D.et al. (2002). *Economic costs of the foot and mouth disease outbreak in the United Kingdom in 2001.* Revue Scientifique et Technique (OIE), 21(3), 675–687.

Westaway, J. (2020). *Seeds and stories: An ethnography of seed saving in London.* Journal of Material Culture, 25(4), 478–496.

Zimu-Biyela, A., Walt, T., & Dube, L. (2020). *Information needs of women subsistence farmers in a village in KwaZulu-Natal Province, South Africa*. Mousaion South African Journal of Information Studies, 38(1).

Technology, Surveillance and Trust

Brennan, M. and Christley, R. (2013*). Cattle producers' perceptions of biosecurity*. *B*MC Veterinary Research, 9(1), 71.

Buolamwini, J. and Gebru, T. (2018). *Gender shades: Intersectional accuracy disparities in commercial gender classification*. Proceedings of Machine Learning Research, 81, 77–91.

Conan, A., Goutard, F., Sorn, S. and Vong, S. (2012*). Biosecurity measures for backyard poultry in developing countries: a systematic review*. BMC Veterinary Research, 8(1), 240.

Food and Agriculture Organization (FAO) (2023). *The Status of Women in Agrifood Systems.* Rome: FAO.

Grant, A., Pawson, S. and Marzano, M. (2019). *Emerging stakeholder relations in participatory ICT design: renegotiating the boundaries of sociotechnical innovation in forest biosecurity surveillance*. Forests, 10(10), 836.

Jurdak, R., Elfes, A., Kusý, B., Tews, A., Hu, W., Hernández, E. et al. (2015). *Autonomous surveillance for biosecurity*. Trends in Biotechnology, 33(4), 201–207.

Marzano, M., Dunn, M. and Green, S. (2021). Perceptions of biosecurity-based accreditation in the plant trade: a UK example. *Forests*, 12(12), 1741.

Muellner, P. (2018). Surf: an innovative framework in biosecurity and animal health surveillance evaluation. Transboundary and Emerging Diseases, 65(6), 1545-1552..

Ofcom (2023). *Digital exclusion: A review of Ofcom's research on digital exclusion among adults in the UK.* London: Ofcom.

Ogilvie, S., McCarthy, A., Allen, W., Grant, A., Mark-Shadbolt, M., Pawson, S. et al. (2019). *Unmanned aerial vehicles and biosecurity: enabling participatory-design to help address social licence to operate issues*. *Forests*, 10(8), 695.

Royden, A., Christley, R., Prendiville, A. and Williams, N. (2021). *The role of biosecurity in the control of campylobacter: a qualitative study of the attitudes and perceptions of UK broiler* farm workers. Frontiers in Veterinary Science, 8, 751699.

Shannon, C., Quinn, C., Sutcliffe, C., Stebbing, P., Dally, T., Glover, A. et al. (2018). *Exploring knowledge, perception of risk and biosecurity practices among researchers in the UK: a* quantitative survey. *Biological Invasions*, 21(2), 303–314.

Sutcliffe, C., Quinn, C., Shannon, C., Glover, A. and Dunn, A. (2017). *Exploring the attitudes to and uptake of biosecurity practices for invasive non-native species: views amongst stakeholder organisations working in UK natural environments*. Biological Invasions, 20(2), 399–411.

Taukobong, H. F. G., Kincaid, M. M., Levy, J. K., Bloom, S. S., Platt, J. L., Henry, S. K. and Darmstadt, G. L. (2016). *Does addressing gender inequalities and empowering women and girls improve health and development programme outcomes?* Health Policy and Planning, 31(10), 1492–1514.

Wymant, C., Ferretti, L., Tsallis, D., Charalambides, M., Abeler-Dörner, L., Bonsall, D. et al. (2021). *The epidemiological impact of the NHS COVID-19 app*. Nature, 594, 408–412.

STEM Workforce & Responsible Innovation

Marzano, M., Dunn, M. and Green, S. (2021). *Perceptions of biosecurity-based accreditation in the plant trade: a UK example*. *Forests*, 12(12), 1741.

Ofcom (2023). *Digital exclusion: A review of Ofcom's research on digital exclusion among adults in the UK.* London: Ofcom.

Royal Society (2021). *Diversity Data Report 2021*. London: Royal Society.

Stilgoe, J., Owen, R. and Macnaghten, P. (2013). *Developing a framework for responsible innovation.* Research Policy, 42(9), pp.1568–1580.

UK Parliament, House of Commons Science and Technology Committee (2023). *Diversity and Inclusion in STEM*. Fifth Report of Session 2022–23. London: UK Parliament

UK Research and Innovation (UKRI) (2023). *Diversity Data*. UKRI.

UK Research and Innovation (UKRI) (2024). *Responsible Innovation*. UKRI.

World Health Organization (WHO) (2021). *Ensuring diagnostics access: Strengthening diagnostic capacity to support pandemic response*. Geneva: WHO.

World Health Organization (2024). *Addressing Gender Inequalities in National Action Plans on Antimicrobial Resistance*. Geneva: WHO.

Reporting Requirements and Quality Assurance

Submission date:

21/10/25

Sign off date:

24/10/25