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Workers and Climate Adaptation at Work

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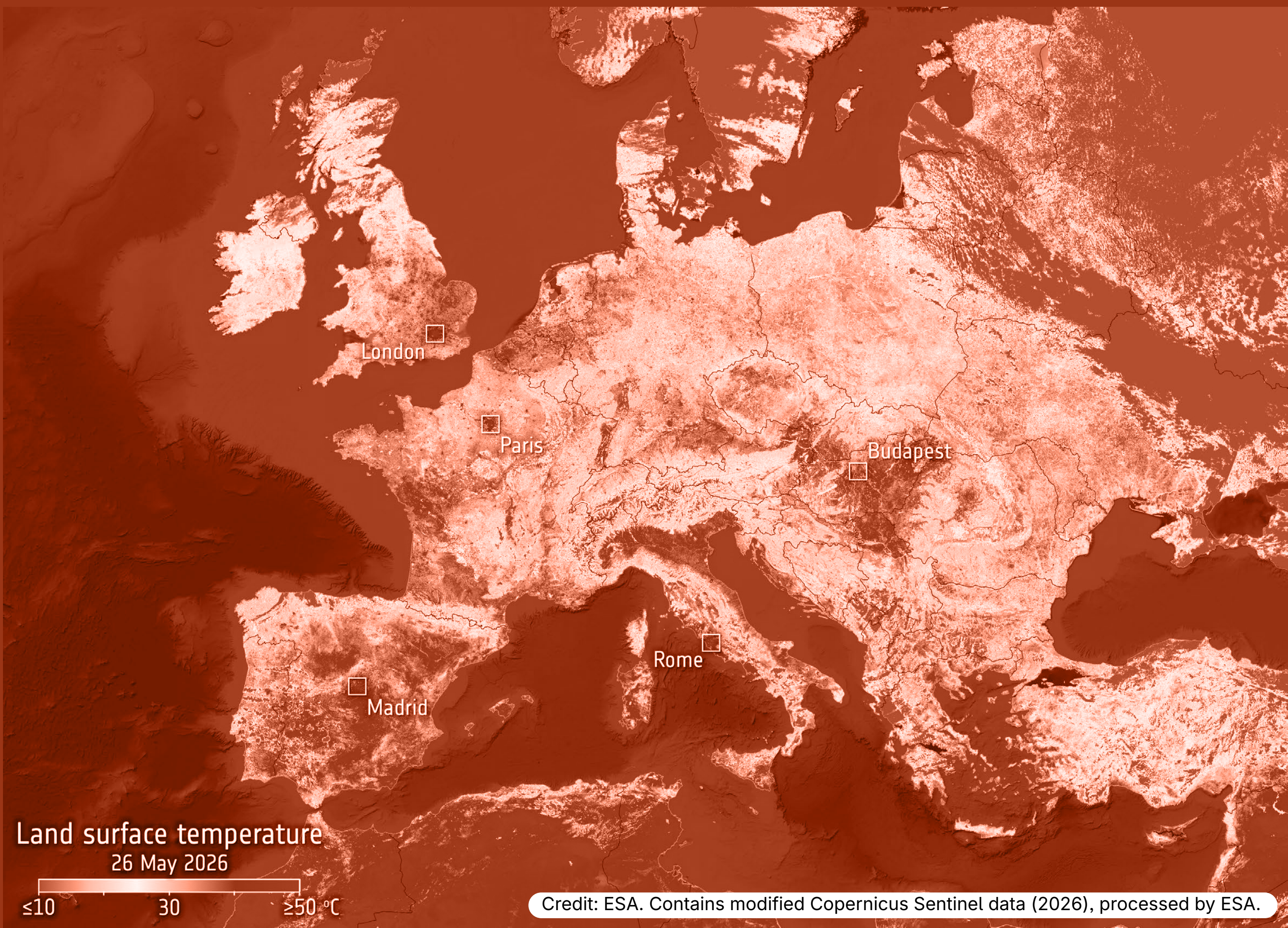

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Executive summary

This report examines **workers' exposure to extreme weather events in seven sectors** where workers are most vulnerable to changing climate and weather: agriculture, construction, emergency services, transport and logistics, education, entertainment, and health care. It is based on a survey with 1,288 workers.

56%

Of workers are affected in their work by extreme weather events. Hot temperature is the most frequently reported exposure.

40%

Of workers who reported sick leave did so due to heat stress.

39% - 82%

Of workers amongst those affected, report that their productivity decreases due to extreme weather events, depending on the weather hazard.

Exposure and negative effects

Vary according to worker characteristics, with those working outside, with higher physical exertion, being male and younger, more likely to be exposed.

4 in 10 (44%)

Of workers amongst those affected, report that their wellbeing is negatively affected (in the case of droughts), and nearly three-quarters (72%) of workers state that their wellbeing is negatively affected by extreme heat events.

These results are important for several reasons.
First, the health and safety of workers is a fundamental right that is becoming increasingly compromised in many sectors due to climate change and needs urgent addressing. Second, the costs of non-adaptation are substantial. The costs of inactivity and postponed non-action are higher than those of investing in adaptation planning and implementation.

Recommendations.
Effects of the climate crisis and weather hazards on work need to be further examined and monitored, and regulations need to be introduced to protect workers, particularly with regard to heat.

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1. Introduction

The current heatwave, as well as the heatwaves in the UK in 2022, **dramatically show the impact of the climate crisis.**

In the heatwaves of 2022, alone, 3000 people died in the UK because of the heat. Fatalities from weather hazards mostly stem from cold weather and heatwaves; other weather hazards have mostly economic costs. Nearly one in three heatwave deaths can be attributed to climate change (Vicedo-Cabrera et al 2021). The Climate Change Committee warns that the UK might see at least 2 degrees of warming above pre-industrial levels, which will cause more heatwaves, droughts, flooding, storms and wildfires (CCC 2025a, CCC 2026). New modelling shows that extreme global climate outcomes may occur even under moderate 2°C warming for several sectors (Bevacqua et al 2026). The UK's climate is already changing rapidly in a number of ways: the last decade (2015-2024) has been 10 per cent wetter and 1.24C° warmer than the 1961-1990 period; the past three years have been in the warmest top-five on record, with the 40°C threshold exceeded for the first time in July 2022 (Kendon et al 2025); and UK sea-levels have risen (Lowe, Harrison and Perks 2026). Recent estimations assume that the loss in GDP due to decreased productivity during heatwaves in recent years amounted to £5.3 billion for the UK (Dietz et al 2021).

Climate and weather pose risks to workers that affect productivity but also occupational health and safety, significantly impacting worker health, safety, and well-being (globally: ETUC 2020; Delgado and Wilkinson, 2024), directly impacting people and communities across the UK (Alvis and Jenkinson 2026). In June 2026, the Health and Safety Executive (HSE), the UK's workplace regulator, issued a heat health alert that urged employers to act to make sure their workers are protected from heat (HSE 2026); albeit without giving any guidance on what too hot would mean. There's currently no law for the maximum working temperature in the UK. Nor has there been a comprehensive analysis of the short- or long-term impacts on how workers' health was affected by the 2022 heatwaves (Robinson et al 2024).

Climate change and extreme weather events pose a 'systemic threat to the UK economy' (Lowe, Harrison & Perks 2026); insurance prices are already going up or becoming impossible to obtain in certain locations hit hard by extreme weather events. Home insurers' payments for claims have already been higher than the premiums they received for the period of 2019-2024, and the overall protection gap for the country was at 29% in 2024 (CCC 2026).

It is estimated that productivity decreased due to heat. Particularly for hot areas of the world, it is estimated that 30–40 per cent of work capacity (or labour productivity) during daylight working hours could be lost by 2085 (Kjellstrom, Briggs, et al 2016: 108). This will result in a loss of 20 per cent in global GDP by 2100 or US$2 trillion per year by 2030, and another loss of 23 per cent of global GDP by 2100 if global temperatures are not maintained (Kjellstrom, Briggs, et al 2016: 108). For the UK, the direct economic costs from climate-induced weather hazards more broadly – from flood damage, failed infrastructure and falling productivity – could reach 3–7 per cent of GDP by 2050 (Rising et al 2022). Productivity losses, absenteeism, reduced work pace, and performance efficiency will be further exacerbated by the projected rise in temperature and climate change (Nunfam et al 2018). But total costs have not yet been estimated for the UK.

> **Climate adaptation** is 'the process of adjustment to actual or expected climate and its effects. [...] Adaptation seeks to moderate or avoid harm or exploit beneficial opportunities'
>
> IPCC 2023

Given the substantial economic and social costs of climate-induced extreme weather events, it is surprising how little empirical research exists on how these events affect work and workers in the UK, and on how workers are experiencing adaptation measures. The most recent work carried out at the same time as this study is by Robinson et al. (2025a, b 2026) and examines the health effects of heat on workers finding that a third of workers suffered from the heat with health effects such as heat stroke, heat exhaustion, headaches or dizziness.

Most research focuses on countries that are much hotter than the UK, where effects are already very severe, tropical or hot desert countries, with a few examples from the US and some Southern/ Mediterranean countries in Europe, mainly Spain (Ioannou et al 2021; Vielma et al 2024). Only a few studies examine the implications for adaptation in Europe (Szewczyk et al 2025, 2021). The study at hand is thus only the second study about workers and climate adaptation in the UK.

This report contributes to understanding workers' experiences of extreme weather events in the UK, like heatwaves, but also cold spells or flooding, by surveying workers in sectors that are among the most vulnerable to extreme weather events due to their current as well as projected future exposure: agriculture, construction, emergency services, transport and logistics, education, entertainment, and health care. As such it is the first study that looks at work and workers' climate adaptation beyond heat.

We wanted to know what extreme weather events are already affecting workers in which sectors and in what ways. We were interested in health effects as much as in material conditions at work. To that end, we surveyed 1288 workers employed across these seven sectors and analysed differences across sectors and the characteristics of workers most vulnerable to climate effects.

The rest of the report is as follows.

Chapter 2 provides a brief overview of existing research on work and climate adaptation, as well as the economic costs of extreme weather events. While there is a larger number of studies on countries with hot temperatures, studies on the UK are rare.

Chapter 3 introduces the methods of this study,

Chapter 4 presents the findings.

Chapter 5 discusses the results and makes some recommendations.

The Annex provides the tables of the analysis.

2.
Overview of the literature

Sectoral variation of extreme weather impact on workers

Impacts will be felt across all sectors, but each sector is sensitive to different climatic impact drivers; as such, what constitutes an extreme climate outcome is therefore strongly sector dependent. For instance, a very dry climate can be detrimental to crop production but less impactful to flood-risk management (Bevacqua et al 2026). Natural disasters induced by global warming will likely disrupt further sectors such as energy and water providers, or tourism, and put additional pressure on emergency and rescue services, the health care sector and other public services (ETUC 2020 p.20; Malik and Berg 2024).

The expected impacts are heterogeneous depending on warming levels, regions, and sectors, with construction and agriculture showing the highest exposure to warming, with likely the greatest losses and impacts (Dasgupta 2024).

In **health care**, one in five hospitals in the UK cancelled operations during the 2022 heatwave (Glasbey et al 2023), at the same time as there was an increase in hospitalisations due to extreme heat (Glasbey et al 2023; Hajat et al 2024). Also, absenteeism of nurses increased due to heat (Davey et al 2024).

In **agriculture**, extreme drought and flooding in consecutive seasons have reduced yields. The largest drop in output was in 2023–24 (Defra 2025), and 2025, putting farmers' livelihoods at risk (Ruban 2025). There is also a severe risk from air pollution decreasing productivity in agriculture. High concentrations of air pollution have a negative impact on labour productivity, where a one standard deviation increase in ozone and PM2.5 reduce productivity by, respectively, 2% and 1.1% (Hill et al 2024).

In **construction and infrastructure**, railways, roads and waterworks are far from prepared for more storms, floods or extreme heat (Ferranti et al 2026)

Emergency services will also need to advance capabilities to respond to new extreme weather events (ETUC 2020). Indoor occupations will also be affected, especially during heatwaves and in spaces without air conditioning, such as in schools (Dawkins et al 2024). In education, children collectively lost 400,000 days of schooling to floods in 2007, and summer heatwaves have been found to hit pupils' concentration more than any other factor (DfE 2025). With a 2-degree increase in heat, most at-risk schools could experience up to 15 days per year with classroom temperatures at 35 °C in an average year (Dawkins et al 2024).

Various extreme weather hazards are impacting work

Heat is the most well-studied weather-related impact on work, studying the exposure of workers to hot environments, labour-intensive tasks, and lack of access to cooling resources (Gibb et al 2024). People work best in temperatures between 16C° and 24C°. Higher temperatures reduce worker productivity but also increase fatigue and the risk of injury (ETUC 2020). High body temperatures and dehydration can affect physiological and behavioural responses in workers, causing heat stroke, heat exhaustion, cardiovascular diseases, respiratory conditions, kidney disease or failure, cancer, and impacts on psychosocial health (e.g. Delgado and Wilkinson 2024; Butler-Dawson et al 2025; Karthick et al 2023). Common factors influencing the magnitude of heat exposure include PPE, heavy equipment, access to shade and cold water, the type of work being completed, and the relative humidity (Gibb et al 2024). In the US, 36% of all occupational deaths are heat-related (Dong et al 2019); in Thailand, heat-related mortality has also increased (Amnuaylojaroen et al 2022). Heat stress is likely to increase and requires urgent adaptation efforts (Dasgupta 2024).

In the UK, the only study on the effects of heat on work (Robinson et al. 2025b) shows that labour supply, productivity, and worker health are harmed by heat. But also, where employers have introduced adaptations, they have been able to reduce losses in labour supply and productivity. Workers were not only negatively affected by heatwaves but also by heat anomalies, with 1°C above the long-term average. A 1°C positive temperature anomaly from the long-term average temperature increased the likelihood of a worker reducing their working hours and working efforts by almost 10 per cent (Robinson et al 2025b).

Previous research suggests that heat stress is primarily experienced by low-income, low-education workers, males, and labourers (Nunfam et al 2018). Apart from health impacts, heat stress among workers can also result in reduced time for family care and household chores and could lead to family disagreements (Nunfam et al 2018).

Excessive cold can cause physical fatigue, hypothermia, vasoconstriction of blood vessels, respiratory issues, inflammation, frostbite, necrosis, asthma, musculoskeletal disorders, and can increase the number of accidents caused by slips and falls. Mentally, cold temperatures can lead to disorientation, hallucination, aggression, psychological stress, lack of mental coordination, and reduced neuromuscular function (Karthick et al 2023). Whilst climate models project generally milder winters in the UK which would decrease these impacts, the models used to calculate the high-resolution for the UK do not include detailed components on ice sheets and therefore are not able to simulate tipping points such as the collapse of the Atlantic Meridional Overturning Circulation (AMOC) (Lowe, Harrison & Perks 2026). However, some research suggests that such collapse could indeed lead to colder winters in the UK (van Westen et al 2025).

Effects of other extreme weather hazards have not yet been studied.

Economic costs of extreme weather events

The economic impact of extreme weather events is huge. There are direct economic costs – for example, from flood damage, failed infrastructure and falling productivity. For the UK, estimates assume costs could reach 3–7 per cent of GDP by 2050 (Rising et al 2022), posing a threat to the UK's living standards. The Climate Change Committee assumes that without additional adaptation measures, the cost of climate change could rise to £60–£260 billion per year, an equivalent of 2 or 5 per cent of GDP per year (CCC 2026).

The costs on labour productivity for the UK are assumed to rise to a loss of 106.6 million hours per 1°C increase in temperature anomaly; however, with adaptation measures in place, this could potentially be reduced by 66.7 million hours (Robinson et al 2025b).

The higher the global warming, the higher the economic costs due to loss in productivity. Orlov et al. (2019: 1) even assume that "a large fraction of global mitigation costs of achieving the 2°C global warming target could be offset by the avoided adverse impacts of heat stress on worker productivity at higher warming levels." For Europe, Orlov et al. (2019: 191) estimate that the cost of heat-induced reductions in outdoor worker productivity in Europe caused by the heatwaves in August of 2003, July of 2010, and July of 2015 resulted in $41 to $90 per worker.

But also, in sectors where work takes place indoors, like in manufacturing and services, when there are no well-functioning air-conditioners, heat waves could result in economic losses (Orlov et al 2019).

Climate adaptation

Climate adaptation can stem from government regulation, companies implementing adaptative measures or workers responding autonomously. In the UK, most climate adaptation seems to be autonomous action from workers (Robinson et al 2025a). In many countries, climate adaptation at work is already regulated, typically including setting maximum temperature thresholds and limiting tasks that can be performed during extreme heat. In some countries, such as Kuwait, during summertime, there is already a midday work ban enacted to protect workers from extreme heat (Alahmad et al 2023).

Company strategies could, for example, include mechanising heavy labour (although this is dependent on access to resources, both technological and financial) or using and implementing air conditioning technology. Many adaptation options, such as these, typically take time to implement and are expensive. As such, it is critical that companies begin to implement them. Easy steps and simple measures can be a good start, like the provision of shade, adequate water, and frequent rest breaks" (Gibb et al 2024). However, surprisingly, little is known about how businesses are preparing for extreme weather events (Dookie et al 2024).

Workers' autonomous adaptation to protect themselves from heat is better documented. Examples from Spain, Greece or Portugal show how workers are rescheduling their work to avoid intense heat (Cefaliello 2023). Other examples include (Dasgupta 2024; Day et al 2019; Nunfam et al 2018):

- Shifting working schedules away from the highest points of the day
- Task-shifting (where workers move more labour-intensive tasks to the cooler points of the day)
- Working less (worktime reduction), extra breaks, reducing the pace of labour
- Drinking water
- Wearing different and often thinner clothes, wearing a hat with a wide-brim
- Using a fan and adequate ventilation,
- Wearing sunblock, hydrating more
- Reallocating labour to a different place that has reduced heat exposure/ working at less exposed sites.

Some workers might be able to work in cooler hours of the day, whereas others cannot. Some workers might want to work at night during the summer (ETUC 2020). Workers' social and human capital (e.g. networks of relationships, and knowledge, abilities, and skills respectively) will play a significant role in increasing adaptive capacity and reducing climate change and occupational heat-stress vulnerability (Nunfam, Adusei-Asante et al 2019). Gender and migration status are considered to influence adaptation measures taken by individual workers. However, Cefaliello (2023) highlights that workers will not prioritise their health if doing so puts their jobs at risk, so the state's role in regulating it is crucial.

Shifting working hours could potentially have the largest systemic impact if deployed nationally (Day et al., 2019). And additional measures such as work rotations, physiological monitoring, and ergonomic solutions are considered to potentially reduce the heat stress for workers (Dong et al 2019).

For the UK, Robinson et al (2025b) have shown that workers who received weather warnings in advance of the heat period in 2024 had a 2.1–3.8% higher probability of adopting at least one adaptation strategy than those who did not receive an alert.

The Climate Change Committee has called for action from government at various levels, like improvements in the built environment, better water management, investment in more resilient climate-ready service provision and more integrated climate risk management (CCC 2026). The Chair of the Adaptation Committee of the CCC has urged the government to prepare the UK for weather extremes that are predicted with global warming of 2° and even 4°above pre-industrial levels with a likelihood of 80 per cent for heatwaves occurring each year and a higher risk for wildfires (CCC 2026).

Without effective adaptation, the costs and effects for workers potentially affecting their health, and income risking poverty, and rising inequality will worsen over time (Robinson et al 2025b).

3.
Methods

We designed a questionnaire to understand how workers in the UK are **already affected by extreme weather events** in their working lives. We asked about the extreme weather events affecting them at work, how they are affecting them, and what **measures their organisations are taking to protect them**.

The survey was administered by the market research firm Norstat in August/September 2025. Participants were drawn from Norstat's and partner institutions' consumer panels, with workers selected from the seven sectors. Participants had to be at least 18 years old and in work. They had to provide consent for the use of their anonymised data in publications. We surveyed 1288 workers in total, with the following split across sectors:

Table 1: Sample size

Sector	Respondents
Agriculture	114
Construction	229
Education	216
Emergency services	71
Entertainment/sports	220
Health and social care	219
Transport and logistics	219

Our research questions were:

1. To what extent are workers in what sectors already affected by a variety of extreme weather events;
2. What workers are most vulnerable;
3. To what extent are workers already adapting their work patterns to the new climate conditions, and;
4. To what extent do employers already offer training on the topic or even organisational responses with a Heat plan.

We investigated the relationship between the specific contextual situations of individual workers and their exposure to extreme weather asking questions on the following issues:

Individual characteristics: gender, age, sector, place of birth, citizenship, migration status and visa sponsorship status, qualifications, income, trade union membership.

Employment characteristics: location of employer, tenure, seniority, occupational group, employment status and type, size of employer, length of working day, personal flexibility within employment, hours worked outside, physical exertion.

Exposure to severe weather: e.g. hot or cold temperatures, wet/dry conditions, wind, snow and ice, wildfires and other as well as effect on productivity and health & wellbeing (completely positive to completely negative).

Consequences of severe weather: e.g. on working patterns, working hours, pay, sick leave and specific health impacts).

Personal preparedness and organisational adaptation measures: use of weather forecasts, organisational weather warnings, employer response to severe weather, individual response to extreme weather, workplace safety, established processes for responses to extreme weather, employee involvement in organisational adaptation planning, awareness of organisation climate risk management/ adaptation strategy, training.

Personal perceptions: e.g. of personal exposure to extreme weather, climate change, timeliness of impacts of climate change on the UK, level of urgency for response in the UK, level of awareness.

Information on union membership and migration status was relevant as the literature states that workers' ability to adapt are impacted by information asymmetries, (lack of) unionization and employment rules (Dasgupta et al 2024; ETUI 2020), members of trade unions are more likely to be concerned about climate change (Schulz and Trappmann 2023), and migrants are more likely to be affected by extreme weather impacts, given their often informal employment status and lack of social protection (Delgado and Wilkinson 2024).

Please see the appendix for the complete questionnaire.

For each question analysed below, we calculated the percentage of respondents selecting each choice option. For some questions, we further examined differences across sectors by presenting the percentage within each sector. The significance of sectoral differences was assessed using chi-square tests for categorical variables and Kruskal–Wallis tests for continuous variables.

Pearson correlation tests and binary logit regression models were used to assess the statistical significance of associations between items. Pearson correlation tests were used to examine associations between worker characteristics and reported workplace exposure to each weather category, or the number of weather-related work impacts. The results are presented in the format of a heatmap, where the values shown indicate statistically significant correlation coefficients at the 90 per cent confidence level. Binary logit regression models were used to examine associations between sector, worker characteristics, and reported workplace exposure to each weather category. Binary logit models were used instead of other choice models or linear regression models because the dependent variables in these questions are binary and therefore cannot be treated as continuous. These dependent variables include whether respondents were exposed to a specific extreme weather event, whether their productivity or health and well-being were negatively affected, and whether they reported a specific disruption caused by extreme weather events. Details of the model specifications can be found in the Annex.

4.
Findings

4.1 Overall exposure of workers to extreme weather events

Over half (56%) of respondents reported workplace exposure to at least one type of extreme weather event. Just over four in ten (44%) workers claimed to have never been exposed to extreme weather events. Hot and / or cold temperatures extreme wet and / or dry conditions, snow and ice and high winds were most commonly reported. Wildfires were the least commonly reported. Respondents most frequently reported that their workplace was impacted by extreme weather for 1-2 days in the last year (mode), and a median of half a week.

4.1.1 Who is affected by extreme weather events?
Significant sectoral differences were observed across weather hazards. Agriculture, Emergency Services, and Transport and Logistics were the top three sectors reporting the highest exposure across all weather categories. In contrast, the Health and Social Care, Entertainment/Events/Sports, and Education sectors were the least affected by extreme weather events. We thus see that workers who worked outside were more likely to be affected by extreme weather events than workers who worked inside.

Figure 1: Workers' exposure to extreme weather types in the workplace.
Multiple responses were allowed. Note that, for this question, hot and/or cold temperatures are treated together as a single category. Thus, we are unable to separate the percentages for these two types of extreme weather.

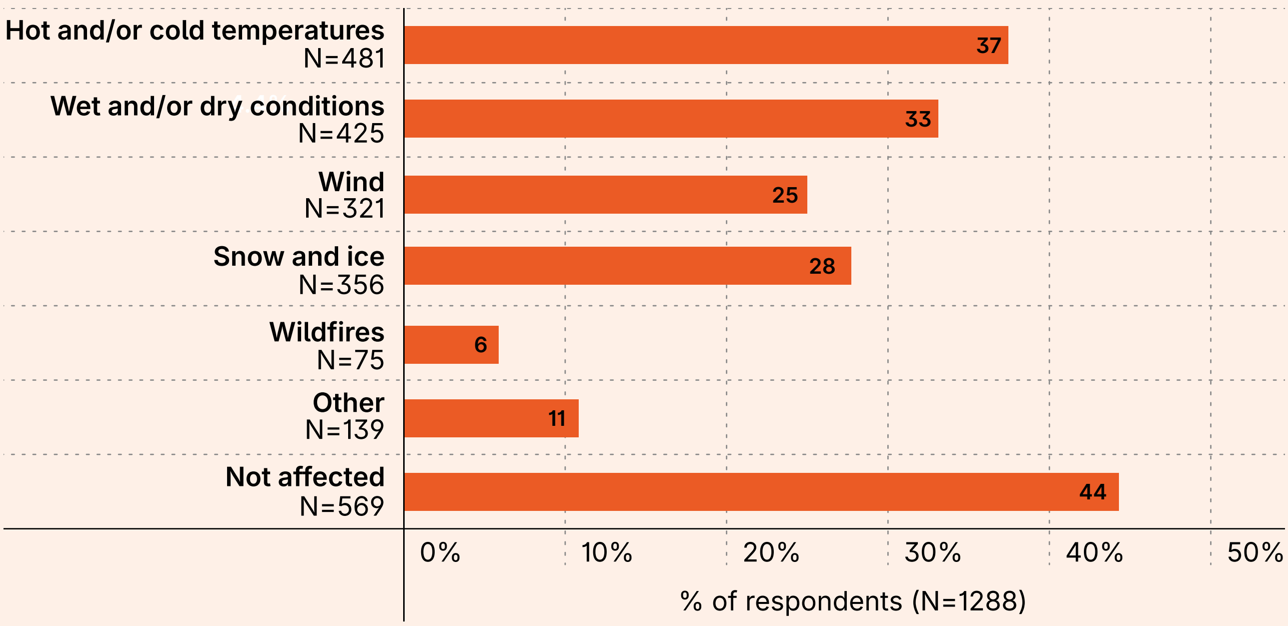


Figure 2: Exposure to extreme weather types across sectors.
Each panel reports the percentage of respondents within each sector who indicate exposure to a specific type of extreme weather or report not being affected by any of these weather types. Respondents can select multiple extreme weather types.

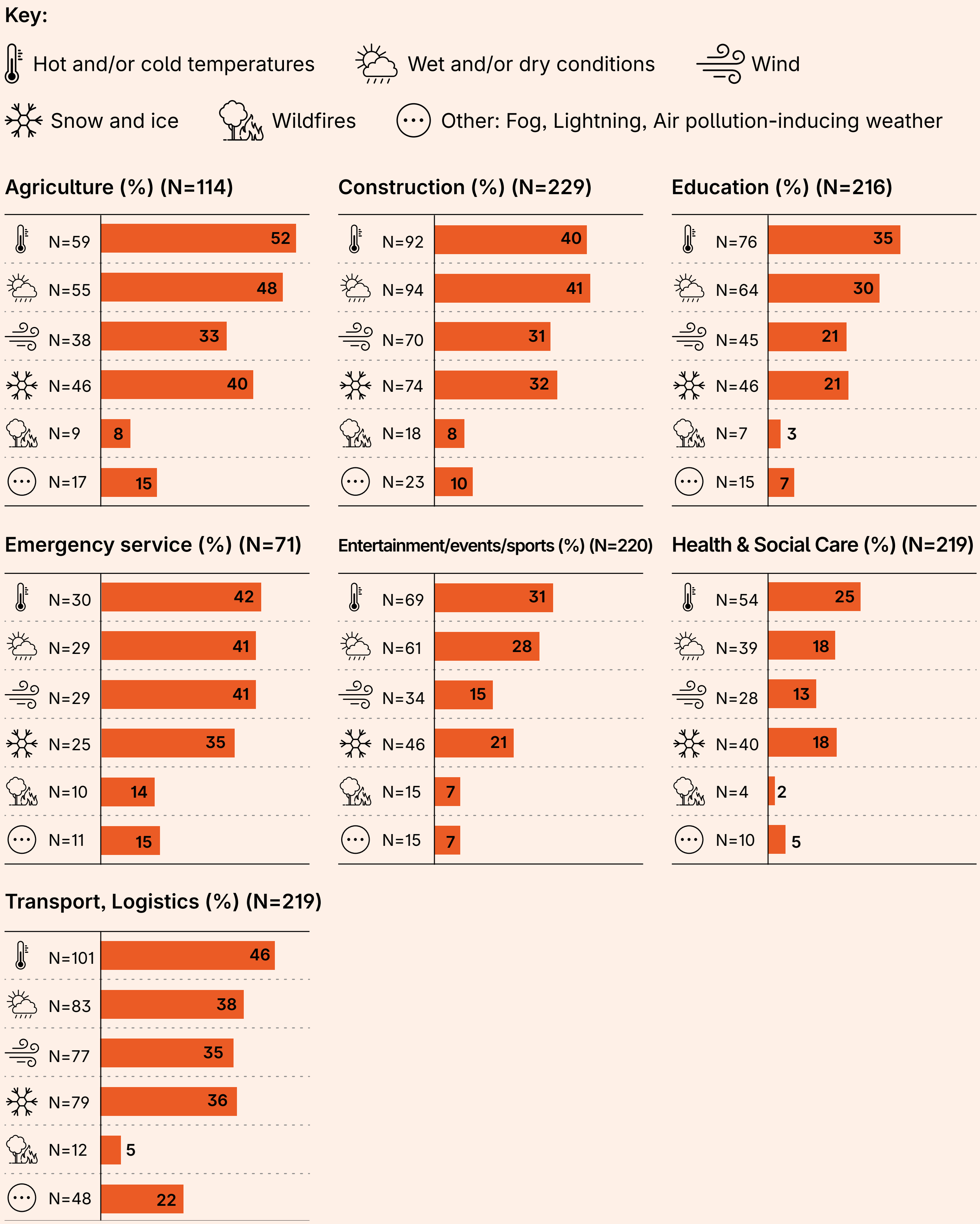


Figure 3: Correlation between extreme weather type exposure and worker characteristics.
The heatmap displays pairwise correlations between extreme weather exposure and key worker characteristics. Colour intensity reflects the direction and strength of the correlation, ranging from negative (turquoise) to positive (orange). Only correlation coefficients that are statistically significant at the 90 per cent confidence level are shown. Worker characteristics are treated as dummy variables. Gender: male equals 1; Age: >=40 equals 1; Income: >=40K equals 1, Education: degree level equals 1, Member of Trade Union: yes equals 1. Hours worked outside: ranging from 0 to 7; Physical exertion: ranging from 1 to 5. See Annex for robustness checks.

Correlation Coefficient (ρ)

- (0.4, 0.6) Moderate positive
- (0.2, 0.4) Weak positive
- (0, 0.2) Very weak positive
- (-0.2, 0) Very weak negative
- (-0.4, -0.2) Weak negative
- (-0.6, -0.4) Moderate negative
- Blank cells: not significant at the 90% confidence level

	Gender	Age	Work Seniority	Income	Education	Migrant	Trade union member	Hours worked outside	Physical exertion
Hot and/or cold temperatures	0.11						0.12	0.25	0.23
Wet and/or dry conditions	0.10	-0.07	0.06			-0.07	0.12	0.33	0.26
Wind	0.12				-0.05	-0.06	0.11	0.32	0.20
Snow and ice	0.11	-0.08				-0.07	0.11	0.31	0.21
Wildfires	0.07	-0.12		0.06			0.08	0.16	0.11
Other	0.07						0.14	0.23	0.11
Not affected	-0.14	0.19		-0.08		0.08	-0.17	-0.41	-0.38

Individual worker characteristics play a huge role, revealing varying levels of exposure. Workers with longer hours worked outside and higher physical exertion, were more likely to report workplace exposure to any weather category. Male workers and trade union members also show a slightly positive correlation with workplace exposure, i.e., they were more likely to report workplace exposure. Age, however, shows a negative correlation with workplace exposure, which implies that older people were less likely to report workplace exposure to any weather category. Age has a significant correlation with working outside. Income and education were not very strongly or significantly associated with workplace exposure. Although higher income was negatively associated with workplace exposure, this relationship was not statistically significant. The income effect shown here may reflect the influence of gender and trade union membership, both of which were positively correlated with income.

Further analysis of those workers who reported negative experiences of extreme weather events reveals clear class differences. Workers in elementary occupations, process, plant and machine operatives, skilled trades occupations were more likely to report negative effects. Less productivity affected were workers with full-time employment contracts and older workers. They were also less likely to earn less due to weather events. Participants with degree-level education or above were more likely to earn less as an effect of weather-related events. This effect was driven mainly by workers with both higher education and higher income levels, who may be more capable of identifying and attributing earnings losses to weather hazards. Detailed results can be found in Tables 7 and 8 in the annex.

Workers born in the UK were more likely to have higher earnings than those born outside of the UK. However, workers who have UK citizenship were less likely to have higher earnings due to weather hazards than those with non-UK citizenship. We then tested the interaction between UK citizenship and being born outside the UK, and found that these workers were less likely to have higher earnings. This may imply that immigrants were less likely to have higher earnings given the effects of extreme weather events, even though they may have already obtained UK citizenship. The regression results can be found in Table 9 in the Annex.

Older participants were less likely to report that they had to take sick leave. Table 10 in the Annex shows the detailed results.

Workers in elementary occupations, process, plant and machine operatives, skilled trades occupations were more likely to report negative effects. Less productivity affected were workers with full-time employment contracts and older workers.

Key:

- Completely negative
- More negative than positive
- Neither positively nor negatively affected
- More positive than negative
- Completely positive
- Don't know / Not applicable

Figure 4: Impacts of different extreme weather events on productivity.

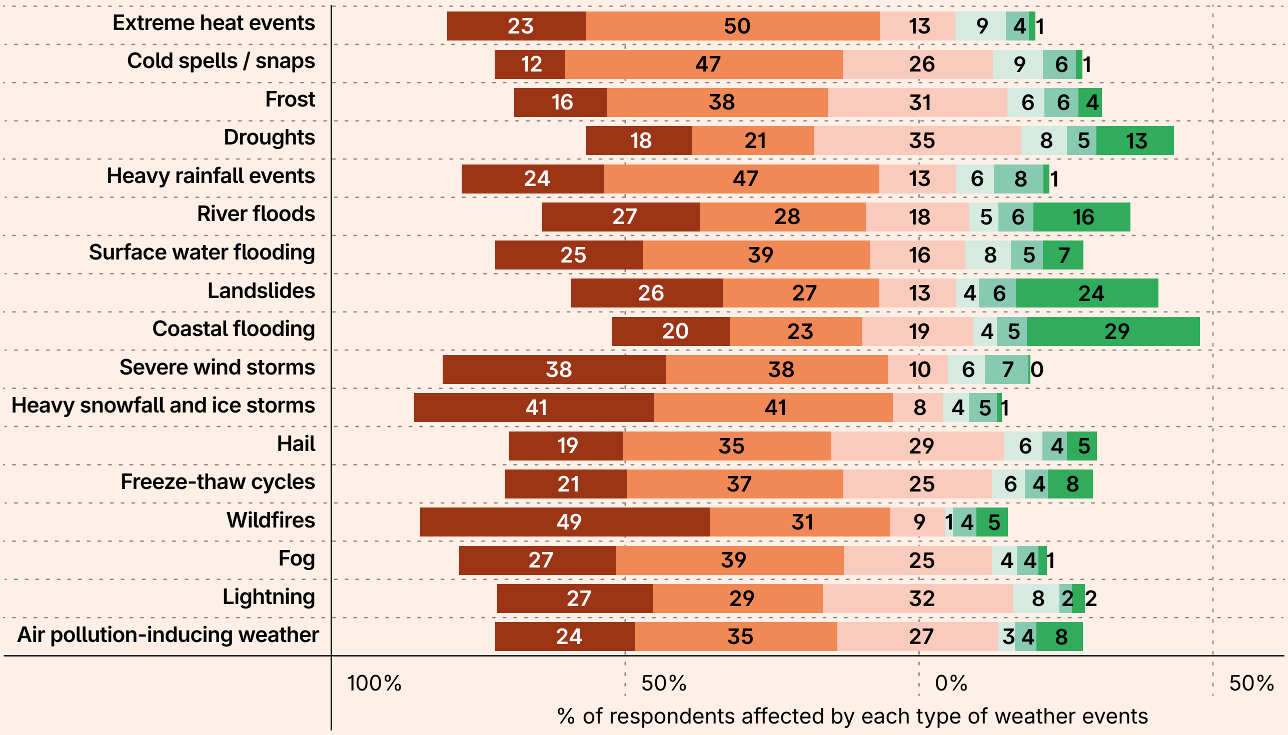
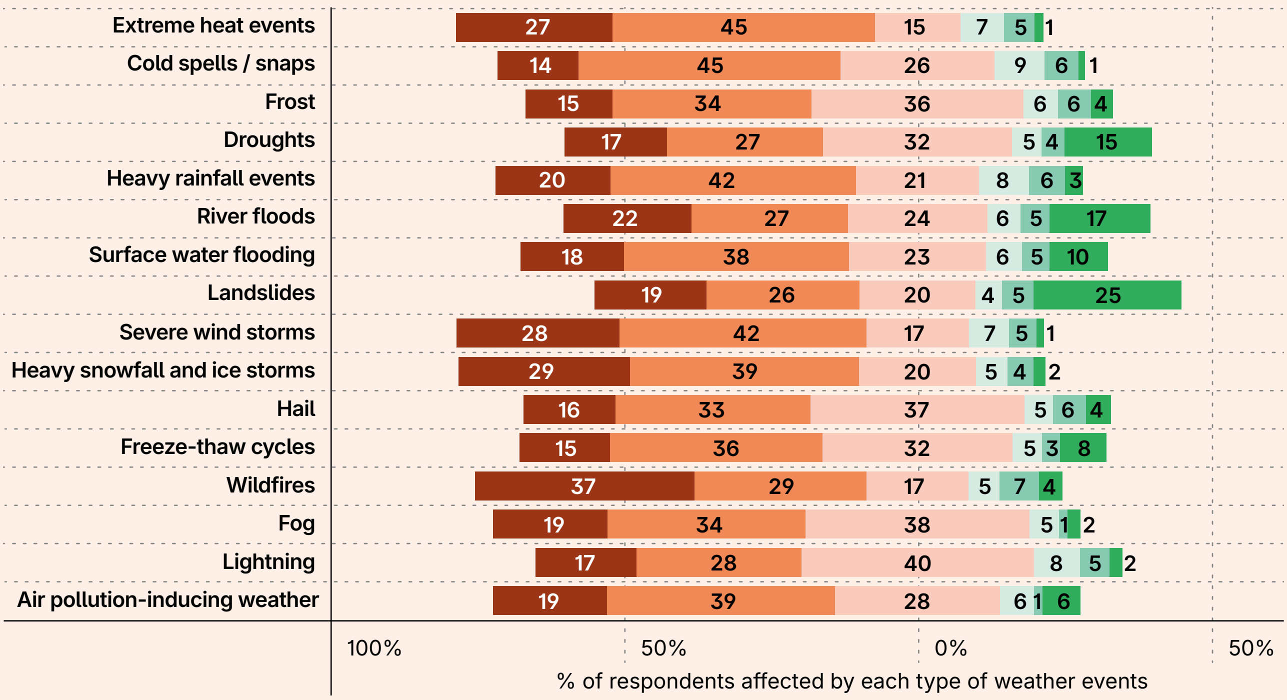


Figure 5: Impacts of different extreme weather events on health and wellbeing.



4.2 Productivity and health implications of extreme weather events for workers

The effects of extreme weather events on work were mainly felt in decreased productivity and reduced health and well-being.

Most workers in this survey report that they were negatively affected (presented in turquoise, Figure 4) by extreme weather events in terms of productivity, with the proportion ranging from 39 per cent (in case of droughts) to 82 per cent (in case of heavy snowfall and ice storms). The high number of those who feel negatively affected is significant, with an average of 61 per cent across the weather events. Similarly, most respondents were negatively affected in terms of health and well-being, with an average of 56 per cent, the proportion ranging from 44 per cent (in the case of droughts) to 72 per cent (in the case of extreme heat events, presented in Figure 5).

We tested for differences across sectors (Table 5 in Annex) and found that the general negative impact of these weather events on productivity, health, and well-being held across sectors, with only a few exceptions. Productivity in agriculture was most affected by drought, while fog and air pollution caused greater productivity losses in construction than in other sectors. The impact on health and well-being, was strongest for cold spells/snaps and air pollution-inducing weather for workers in the Health & Social Care (Mean = 2.2) and Entertainment/events/sport sectors (Mean = 2.2).

4.3 Changing work patterns, sick leave and income loss

We see three further effects on workers from weather events: disruptions related to working patterns, to pay, and sick leave. These effects were explored for those workers who had been affected by at least one extreme weather event (n = 719). Of this group, 44 per cent (around a quarter of all workers) reported having to change their working patterns because of such weather events. Workers were more likely to reduce (50%) rather than increase their hours. Just under one in five workers (18%) had to take leave from work because their employer suspended operations. One in four (40%) affected workers reported that their travel to work had been affected by extreme weather events. 14 per cent of affected workers had to take time off work on sick leave.

We further present disruptions reported by workers for each weather type. The percentages shown in Figure 6 were calculated among respondents who were again affected by at least one extreme weather event. Snow and ice, storms, extreme heat, extreme wet and wind, and extreme cold all caused the stoppage of certain activities for about 19-22 per cent of workers; these extreme weather events directly impacted work activities. Travel to and from work was mostly disrupted by snow and ice. Sick leave was reported slightly more often for extreme heat or cold, and forced leave was reported more often for wind and snow and ice.

Figure 6: Weather-related impacts on work activities across extreme weather events.
% of respondents (N=719).
Note that this was a multiple-response question, and respondents were not required to select one option within each domain. Therefore, the total percentage for each effect do not necessarily sum to 100%. Non-selection may indicate that respondents considered the domain to be not applicable or unaffected.

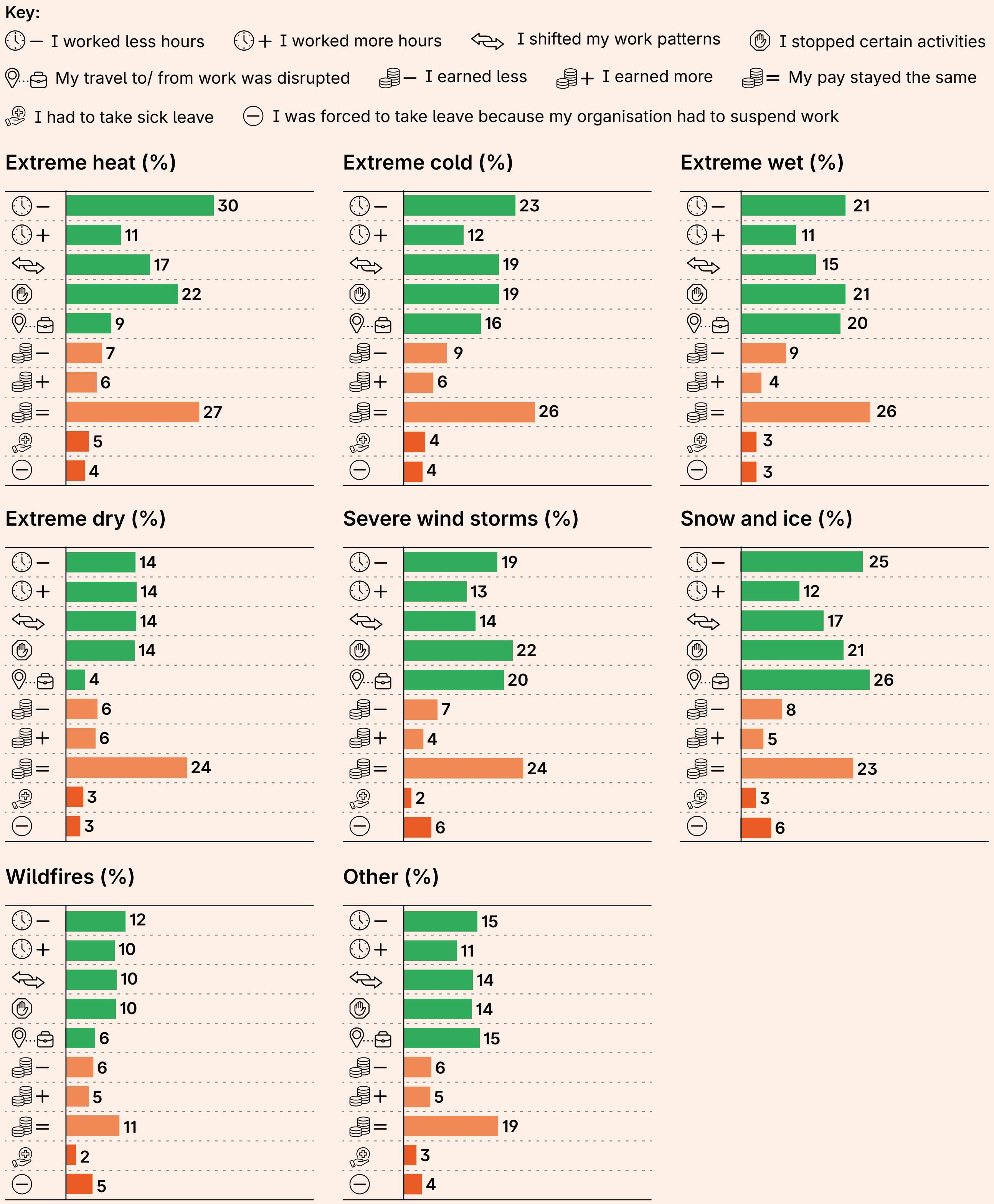
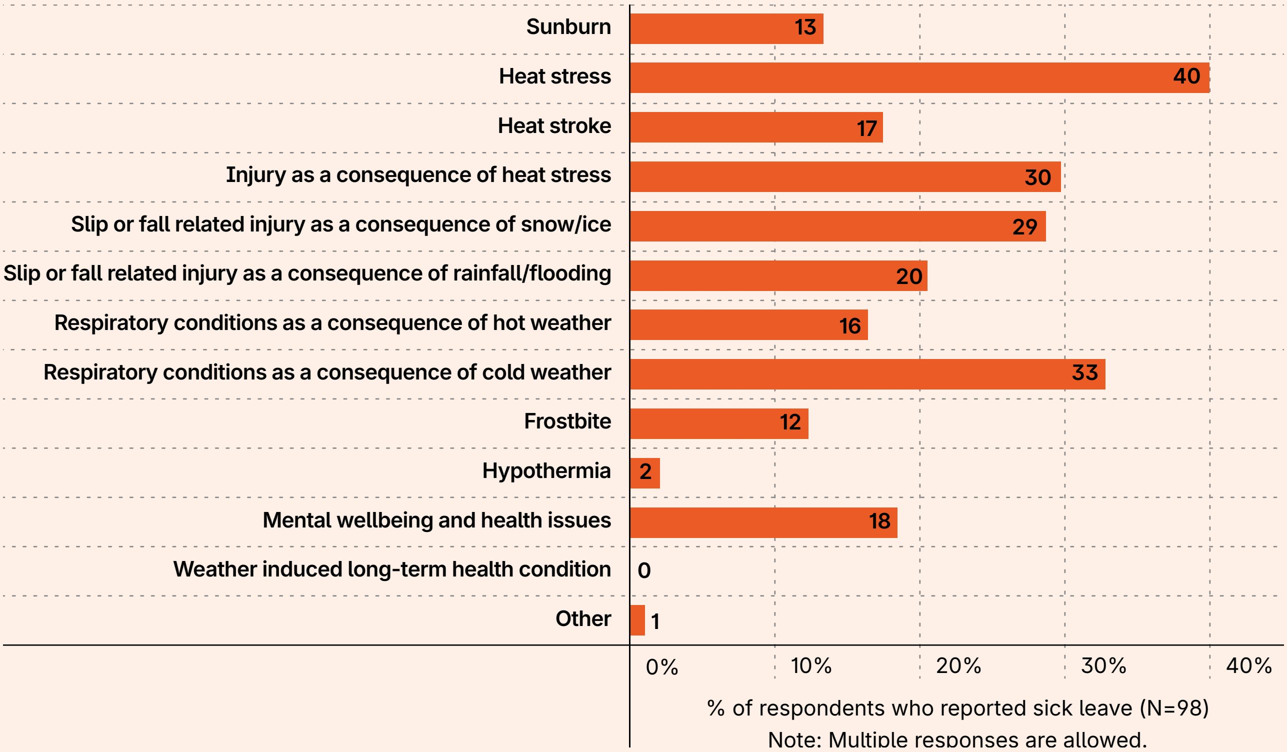


Figure 7: Weather-related sick leave.



We then asked for details about sick leave. Workers who had been affected by at least one extreme weather event were asked to select, from a list, the weather-related illnesses they had experienced due to a weather hazard. The results for workers who reported taking sick leave at least once in response to the questions shown in Figure 6 (N = 98, 8% of the total surveyed workers) are presented in Figure 7. Among these workers, 40% reported taking sick leave due to heat stress.

4.4 Responses of organisations to extreme weather events to protect workers

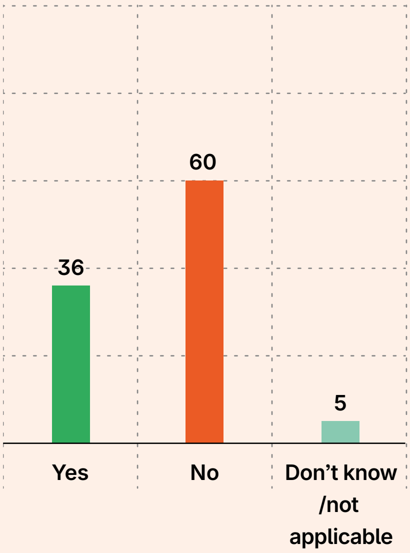
A little over one third (36%) of workers received weather warnings from their employer, and a similar number agreed that their employer was actively managing weather/climate-related risks (35%). Fewer workers said their employers had developed an extreme weather preparedness and/or climate adaptation plan or strategy (26%) (see Figure 8).

Furthermore, fewer than half of employees (46%) agreed or strongly agreed that their employer did enough to address extreme weather and climate impacts, and in fact 12 per cent disagreed or strongly disagreed (see Figure 1 in the Annex).

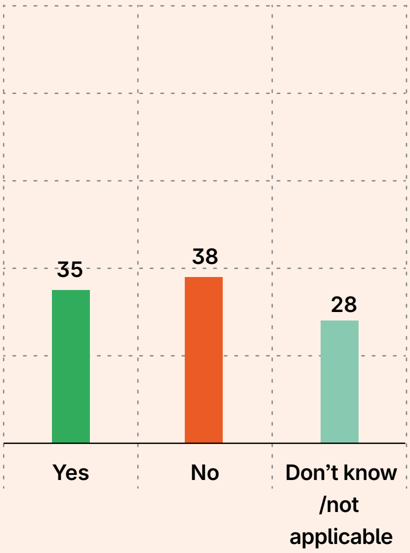
Only 30 per cent of workers have received training on how to cope with and manage the impacts of extreme weather in their workplace, which is, however, more workers than those who received training on climate crisis (24%) or climate mitigation and decarbonisation (26%) (Figure 8 and Table 2).

Figure 8: Employers' response to extreme weather events
% of respondents (N=1,228)

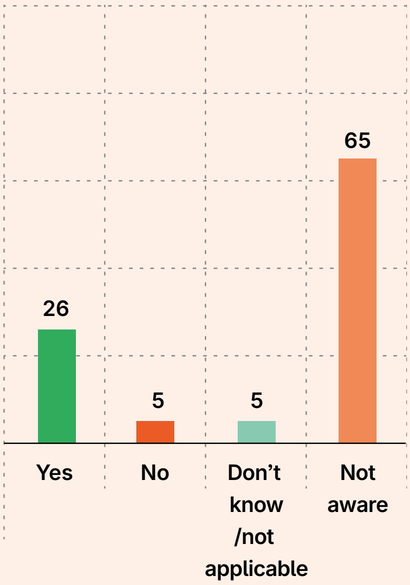
Does your employer send weather warnings to you?



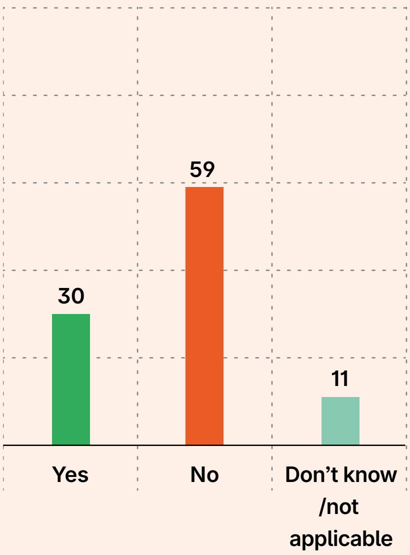
Are you aware as to whether your organisation is actively trying to manage weather/ climate risk?



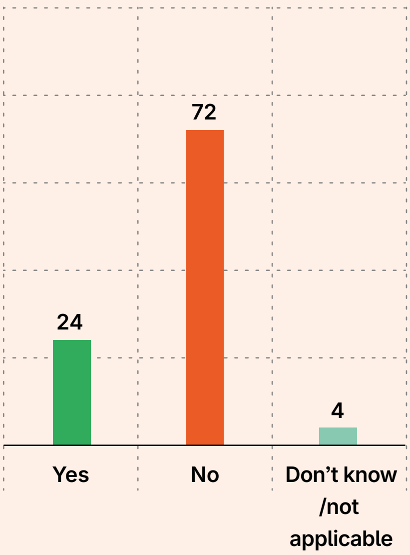
Does your employer have an extreme weather preparedness and/or climate adaptation plan or strategy?



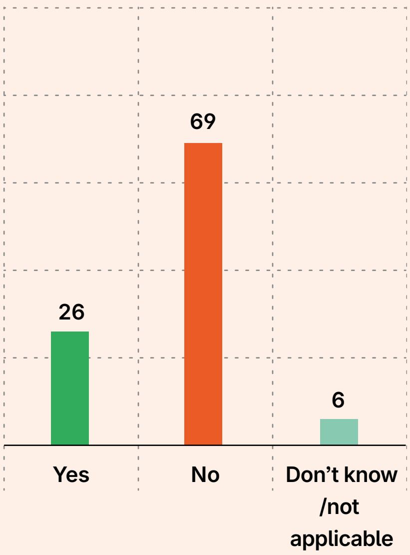
Have you received any training on how to cope with and manage the impacts of extreme weather in your workplace (e.g. how to handle heat stress)?



Have you taken part in any education or training courses at work that have developed your knowledge the causes or consequences of climate change?



Have you received any training that is relevant to achieve plans to decarbonize your workplace?



Most weather warnings were given out in sectors of agriculture, construction and emergency services. Around half (49%) of workers in agriculture stated they received weather warnings by their employers, and 45 per cent of workers in construction and emergency services. Equally, awareness of organisations' active management of weather/climate risk across sectors was highest in agriculture and construction.

In half the cases where workers responded to extreme weather events, they did follow a pre-designed procedure; in 21 per cent, they were not aware of a pre-designed procedure but took ad-hoc measures to manage it. The percentage of workers following pre-designed procedures was again highest in agriculture and construction.

Sectoral differences were also visible in terms of training provision. It was again mainly in agriculture (54%) compared to entertainment, transport, and education, where only 22, 23 and 22 per cent of the workers respectively received training. This trend was similar when more general training on climate change or decarbonising measures was concerned. It was more widespread in agriculture and construction than in the other sectors.

The sector where workers felt the employer was not doing enough to address extreme weather impacts was highest in emergency services, on average 12 per cent of workers felt the employer is not doing enough. Only 41 per cent in emergency services thought the employer was doing enough, 16 felt strongly that they were not doing enough.

Figure 9: Statement on whether organisations are doing enough to address extreme weather and climate impacts across sectors.

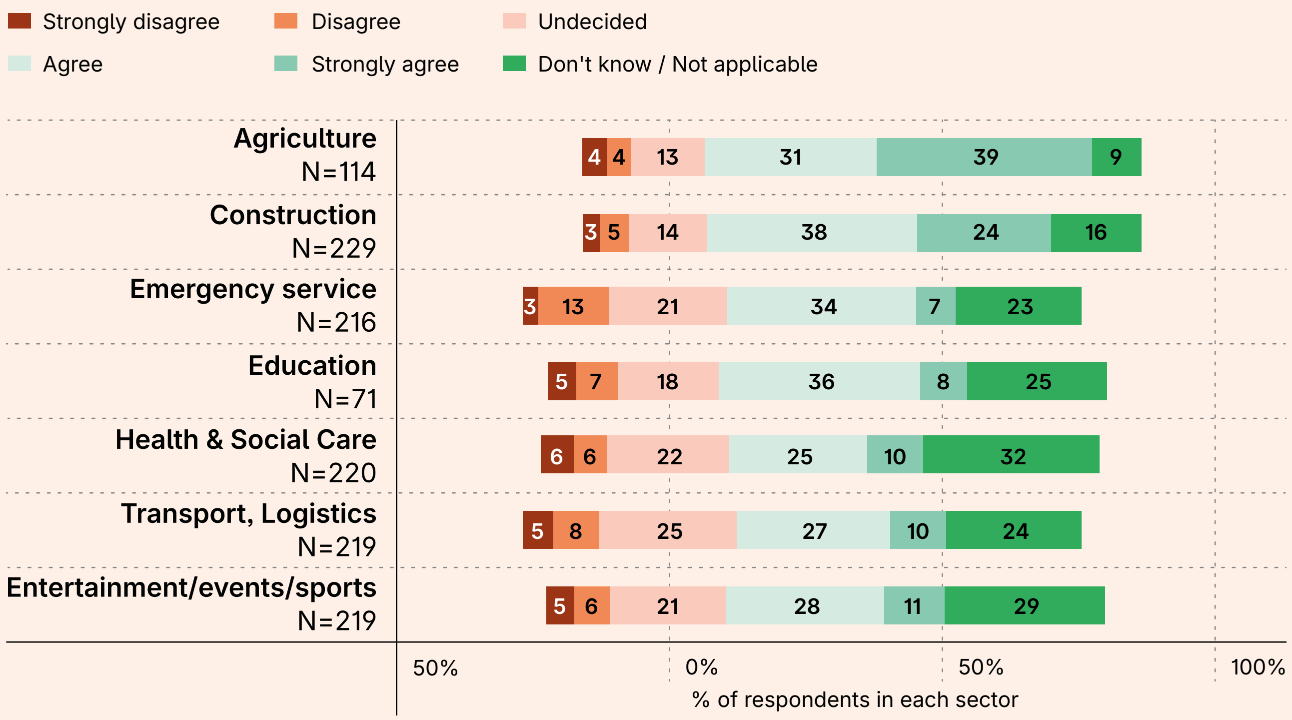


Table 2: Training received across sectors on climate related topics

Training received in:	Causes or consequences of climate change	Decarbonisation	Managing the impacts of extreme weather in your workplace
Agriculture (N=114)	49%	47%	53%
Construction (N=229)	39%	39%	45%
Emergency services (N=71)	17%	13%	31%
Education (N=216)	24%	23%	22%
Health and social care (N=219)	18%	21%	26%
Transport and logistics (N=219)	11%	21%	21%
Entertainment/events/sports (N=220)	19%	19%	22%

5.
Discussion and conclusion

Our results show that more than half (56%) of sampled respondents say that their work activities **are affected by at least one type of extreme weather**, with hot and/or cold temperatures being the most frequently reported.

These results complement a UK survey of workers into heat–health impacts in summer 2024 (Robinson et al 2025a), global studies (Orlov et al 2020) and evidence-based guidance (WHO & WMO 2025). We found that workers who work in sectors that predominantly operate outside and have more physical exertion (e.g., Agriculture, Emergency Services, and Transport and Logistics) are more affected by extreme weather than workers who work in sectors that predominately operate indoors (e.g., Health and Social Care, Entertainment/Events/ Sports, and Education).

Most respondents say that they are negatively affected by all extreme weather events in terms of productivity (ranging from 40% for droughts to 82% for heavy snowfall and ice storms) and in terms of health and well-being (ranging from 44% for droughts to 72% for extreme heat events). We found that heat stress is amongst the biggest causes of weather-related sick leave. This confirms the earlier result of the negative effect of heat on workers' health (Robinson et al 2025a) and the calculation of the loss of GDP resulting from hot days (Dietz et al 2026)

We found that few employers (26%) have an extreme weather preparedness and/or climate adaptation plan or strategy. This again confirms earlier findings by Robinson et al. (2025b) on the 2024 heatwave: only 20 per cent of employers had implemented workplace changes to tackle heat. We further found that few employees (30% of workers) have received any training on how to cope with and manage the impacts of extreme weather at the workplace (e.g. how to handle heat stress).

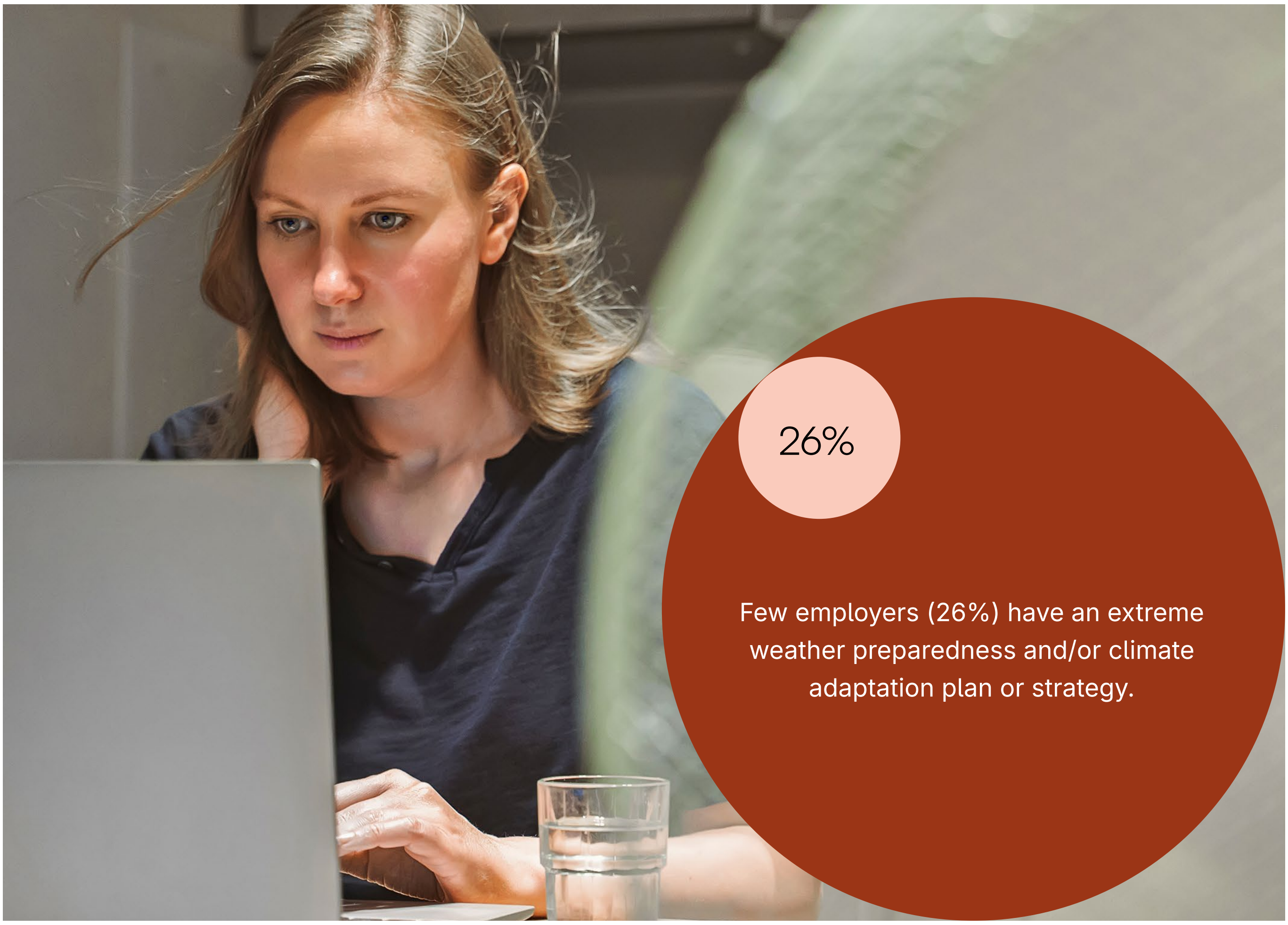
Workers felt employers are not doing enough to address extreme weather impact, especially in emergency services.

The fallouts of retarded action on climate adaptation will have huge impacts on workers. Gibb et al. (2024: 328) reckon that occupational heat illness is a significant public health concern that "will require a multifaceted, collaborative approach involving policy makers, regulatory agencies, public health agencies, employers, and workers."

We have shown in which sectors workers are already most affected and where action is most urgent. We have further shown that the risks are not limited to heat and flooding but also include other extreme weather hazards affecting workers' productivity and well-being.

Adaptation responses need a wide range of responses, amongst others, regulatory, institutional, behavioural and technological responses.

Politically, climate adaptation is not only necessary to protect workers' health and safety, but also to ensure a just transition, which has the potential to create more jobs while experiencing job loss due to mitigation measures (ETUI 2020). Part of justice in adaptation means requiring income protection, e.g. compensation for lost working time (Kjellstrom, Otto, et al 2016; Benavides and Delclos 2024). It is essential to establish adequate labour and social security measures to mitigate the potential impacts of extreme weather events (Laabbas-el-Guennouni 2024).



Positive examples are already found elsewhere. The Spanish government, in accordance with union demands, has been implementing several labour and social security measures to protect workers during extreme weather events (Laabbas-el-Guennouni 2024). They introduced a "labour shield", which included temporary and permanent measures and provisions for labour and social security including employers' duty to inform about weather warnings, adoption of climate adaptation action play, as well as paid climate leave for up to four days with the possibility of extending this, which can be applied when workers cannot reach their workplace as a consequence of serious weather risks or due to public authority orders (Laabbas-el-Guennouni and Arabadjieva 2024).

In the UK, the Worker-Climate Project has called upon a heat strike in June 2026 (to amplify the demand of the Trade Union Congress of 2008 to introduce a heat maximum temperature of indoor working temperature of 30 degrees (TUC). Currently, the TUC is campaigning for the Health and Safety Executive to introduce a maximum heat-working temperature, in line with international guidance, requiring employers to take steps to reduce temperatures when they exceed 24°C and workers feel uncomfortable. The Approved Code of Practice to the Workplace Regulations already gives guidance on what to do when temperatures rise, but the voluntary character of the code has proven insufficient.

The link between extreme weather events and support for climate policies is also noteworthy. Interestingly, support for climate policies increases when extreme weather events and their costs are explicitly linked to climate change (Cologna et al 2025). The current hot weather spells seem to be the perfect moment for bolder demands and rapid action.

6. Recommendations

Currently, there is **no protection or insurance against risks for workers from extreme weather events like heatwaves.** Some risks can be dealt with at the individual level, but a systemic risk response is needed.

The costs of addressing risks shouldn't be borne by individuals, who, as workers, are in most cases not accountable for the increased risks and impacts. We know that the drivers of global warming are fossil fuel companies and luxury consumption of the top 1 per cent of the population.

Rather, costs should be borne by the central and local governments and, ideally, funded by the fossil fuel companies, as they have caused global warming. Local responses at workplaces are helping workers to adapt, often in autonomous worker action, but it needs regulation at the national level to ensure that all workers are enabled to take adaptive measures and that companies are investing in adaptation.

For government

- **Design and enforce clear regulatory standards** and frameworks that mandate organisational actions to increase workers' adaptive capacity.
- **Set maximum heat temperatures at workplaces,** indoors, particularly in health and care and education, to protect nurses, doctors, teachers, children and patients, and outdoors. The World Health Organisation recommends a maximum heat temperature of 24 degrees for work inside.
- **Commission a study on successful heat adaptation** at work labour laws in countries which are already exposed and how this can be adopted in the UK.
- **Commission a study that calculates the costs** of missing climate adaptation at work beyond heat from global warning.
- **Develop guidance** on climate adaptation for other extreme weather events than heat stress.

For companies

- **Ensure that when extreme weather warnings are sent** to workers clear advice on how to respond to such warnings is communicated alongside.
- **Effectively engage workers** in the design and implementation of organisational extreme weather protocols as well as longer-term climate adaptation plans.
- **Effectively collaborate with Trade Unions** to enable cross-organisational knowledge-sharing and learning on good practice examples for responding to and preparing for extreme weather events.
- **To integrate risk mitigation for climate-related risks** with established organisational health and safety protocols for workers.

For workers

- **Address companies** for more proactive climate adaptation to keep workplaces safe
- **Campaign to government** for a better regulatory framework

References

Alahmad, B., Al-Hemoud, A., Al-Bouwarthan, M., Khraishah, H., Kamel, M., Akrouf, Q., Wegman, D.H., Bernstein, A.S. and Koutrakis, P. 2023. Extreme heat and work injuries in Kuwait's hot summers. Occupational and Environmental Medicine. 80(6), pp.347–352.

Alvis, S. and Jenkinson, S. 2026. Adapt or die: Why progressives need to deal with extreme weather [Online]. [Accessed 31 March 2026]. Available from: https://www.ippr.org/articles/adapt-or-die.

Amnuaylojaroen, T., Limsakul, A., Kirtsaeng, S., Parasin, N. and Surapipith, V. 2022. Effect of the Near-Future Climate Change under RCP8.5 on the Heat Stress and Associated Work Performance in Thailand. Atmosphere. 13(2), p.325.

Benavides, F.G. and Delclos, G.L. 2024. Climate emergency and decent work. Scandinavian Journal of Work, Environment & Health. 50(4), pp.229–232.

Bevacqua, E., Fischer, E., Sillmann, J. and Zscheischler, J. 2026. Moderate global warming does not rule out extreme global climate outcomes. Nature. 651(8107), pp.946–953.

Butler-Dawson, J., Jaramillo, D., Krisher, L., Hernandez, K.V., Calvimontes, L., Dally, M., Li, Y., James, K.A., Johnson, R.J., Pilloni, D., Cruz, A., Schaeffer, J., Adgate, J. and Newman, L.S. 2025. A work and off-work evaluation of female workers' heat and particulate matter exposures and kidney health in Guatemala. The Journal of Climate Change and Health. 22, p.100408.

Brooks, K. et al. 2023. 'Heatwaves, hospitals and health system resilience in England: a qualitative assessment of frontline perspectives from the hot summer of 2019', BMJ Open, 13(3), pp. e068298–e068298. Available at: https://doi.org/10.1136/BMJOPEN-2022-068298.

Butler-Dawson, J., Johnson, R.J., Krisher, L., Jaramillo, D., Cruz, A., Pilloni, D., Brindley, S., Rodriguez-Iturbe, B., Sanchez-Lozada, L.G., Dally, M. and Newman, L.S. 2024. A longitudinal assessment of heat exposure and biomarkers of kidney function on heat shock protein 70 and antibodies among agricultural workers. BMC Nephrology. 25(1), p.277.

Cefaliello, A. 2023. Heat stress at work: not just a hot topic but a political emergency. HesaMag. 28(Winter 2023), pp.14–17.

Climate Change Committee 2025a. Letter: CCC letter to Minister Hardy - advice on the UK's adaptation objectives. [Accessed 31 March 2026]. Available from: https://www.theccc.org.uk/publication/letter-ccc-letter-to-minister-hardy-advice-on-the-uks-adaptation-objectives/.

Climate Change Committee 2025b. Progress in adapting to climate change: 2025 report to Parliament. [Accessed 31 March 2026]. Available from: https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2025/.

Climate Change Committee 2026. A Well-Adapted UK – the Fourth Independent Assessment of UK Climate Risk (CCRA4-IA). Available online: https://www.theccc.org.uk/wp-content/uploads/2026/05/A-Well-Adapted-UK-CCRA4-IA-784y9813-3094039i85t59yhfufoub24f2bipdj1.pdf, Accessed on: 27/.05/2026

Cologna, V., Mede, N.G., Berger, S., et al. 2025. Trust in scientists and their role in society across 68 countries. Nature Human Behaviour. 9(4), pp.713–730.

Dasgupta, S., Van Maanen, N., Gosling, S.N., Piontek, F., Otto, C. and Schleussner, C.-F. 2021. Effects of climate change on combined labour productivity and supply: an empirical, multi-model study. The Lancet Planetary Health. 5(7), pp.e455–e465.

Davey, S.L. et al. 2024. Prevalence of occupational heat stress across the seasons and its management amongst healthcare professionals in the UK. Applied Ergonomics. 118, pp. 104281–104281. Available at: https://doi.org/10.1016/J.APERGO.2024.104281.

Dawkins, L.C., Brown, K., Bernie, D.J., Lowe, J.A., Economou, T., Grassie, D., Schwartz, Y., Godoy-Shimizu, D., Korolija, I., Mumovic, D., Wingate, D. and Dyer, E. 2024. Quantifying overheating risk in English schools: A spatially coherent climate risk assessment. Climate Risk Management. 44, p.100602.

Day, E., Fankhauser, S., Kingsmill, N., Costa, H. and Mavrogianni, A. 2019. Upholding labour productivity under climate change: an assessment of adaptation options. Climate Policy. 19(3), pp.367–385.

Delgado, B. and Wilkinson, R. 2024. Protecting workers from the impacts of climate change. IOSH [Institution of Occupational Safety and Health]. [Online]. [Accessed 10 March 2025]. Available from: https://iosh.com/news-and-opinion/protecting-workers-from-the-impacts-of-climate-change.

Department for Education [DfE]. 2025. 'Summary of findings in relation to 3 climate risks: overheating, flooding and water scarcity', GOV.UK website, 19 June 2025. https://www.gov.uk/government/publications/impact-of-uk-climate-change-riskon- the-delivery-of-education/summary-of-findings-in-relation-to-3-climate-risksoverheating- flooding-and-water-scarcity

Department for Environment, Food & Rural Affairs [Defra]. 2025. Agriculture in the United Kingdom 2024. https://assets.publishing.service.gov.uk/ media/6881de3ff47abf78ca1d35b0/agriculture-in-the-uk-2024.pdf

Dietz, S., Rising, J., Stoerk, T. and Wagner, G. 2021. Economic impacts of tipping points in the climate system. Proceedings of the National Academy of Sciences. 118(34), p.e2103081118.

Dong, X.S., West, G.H., Holloway-Beth, A., Wang, X. and Sokas, R.K. 2019. Heat-related deaths among construction workers in the United States. American Journal of Industrial Medicine. 62(12), pp.1047–1057.

Dookie, D. S., Conway, D., Dessai, S., & Oliner, E. 2024. Organisational perceptions of adapting to a changing climate. Climate Risk Management, 45, 100637.

El-Shafei, D.A., Bolbol, S.A., Awad Allah, M.B. et al. Exertional heat illness: knowledge and behavior among construction workers. Environ Sci Pollut Res 25, 32269–32276 (2018). https://doi.org/10.1007/s11356-018-3211-8

European Trade Union Confederation 2020. Adaptation to Climate Change and the world of work: a guide for trade unions [Online]. Brussels: ETUC. [Accessed 10 March 2025]. Available from: https://www.etuc.org/sites/default/files/publication/file/2020-08/ETUC-adaptation-climate-guide_EN.pdf.

Ferranti, E., Donaldson, D., Greenham, S., Xia, X., Quinn, A. and Fisher, R. 2026. Chapter 6: Infrastructure In: J. A. Lowe, M. Harrison and R. J. Perks, eds. Fourth climate change risk assessment – independent assessment (CCRA4-IA) technical report [Online]. London, UK: Climate Change Committee. Available from: https://www.ukclimaterisk.org/wp-content/uploads/2026/05/C6-CCRA4-IA-TR-Infrastructure-vQzHPCOLyYjT.pdf.

Flouris, A.D., Dinas, P.C., Ioannou, L.G., Nybo, L., Havenith, G., Kenny, G.P. and Kjellstrom, T. 2018. Workers' health and productivity under occupational heat strain: a systematic review and meta-analysis. The Lancet Planetary Health. 2(12), pp.e521–e531.

Friedrich, J., Schick, T.S., Mess, F. et al. Wearable device-based interventions in heat-exposed outdoor workers — a scoping review and an explanatory intervention model. BMC Public Health 25, 2893 (2025). https://doi.org/10.1186/s12889-025-24262-2

Gibb, K., Beckman, S., Vergara, X.P., Heinzerling, A. and Harrison, R. 2024. Extreme Heat and Occupational Health Risks. Annual Review of Public Health. 45(1), pp.315–335.

Glasbey J, Beggs A, Nankivell P and Li E. 2023. Elective surgical services need to start planning for summer pressures. British Journal of Surgery. 110(4): 508–510. https://doi.org/10.1093/bjs/znad033

Hajat, S. et al. 2024. Ambient heat and acute kidney injury: case-crossover analysis of 1 354 675 automated ealert episodes linked to high-resolution climate data. The Lancet Planetary Health. 8(3). pp. e156–e162. Available at: https://doi.org/10.1016/S2542-5196(24)00008-1.

Hill, A.E., Burkhardt, J., Bayham, J., O'Dell, K., Ford, B., Fischer, E.V. and Pierce, J.R. 2024. Air pollution, weather, and agricultural worker productivity. American Journal of Agricultural Economics. 106(4), pp.1329–1353.

HSE 2026. Temperature in the workplace: Heat stress. [Accessed 1 July 2026]. Available from: https://www.hse.gov.uk/temperature/employer/heat-stress.htm.

Ioannou, L.G., Mantzios, K., Tsoutsoubi, L., Nintou, E., Vliora, M., Gkiata, P., Dallas, C.N., Gkikas, G., Agaliotis, G., Sfakianakis, K., Kapnia, A.K., Testa, D.J., Amorim, T., Dinas, P.C., Mayor, T.S., Gao, C., Nybo, L. and Flouris, A.D. 2021. Occupational Heat Stress: Multi-Country Observations and Interventions. International Journal of Environmental Research and Public Health. 18(12), p.6303.

IPCC, 2023: Annex I: Glossary [Reisinger, A., D. Cammarano, A. Fischlin, J.S. Fuglestvedt, G. Hansen, Y. Jung, C. Ludden, V. Masson-Delmotte, R. Matthews, J.B.K Mintenbeck, D.J. Orendain, A. Pirani, E. Poloczanskaa, and J. Romero (eds.)]. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 119-130, doi: 10.59327/IPCC/AR6-9789291691647.002.

Kakamu, T., Endo, S., Hidaka, T., Masuishi, Y., Kasuga, H. and Fukushima, T. 2021. Heat-related illness risk and associated personal and environmental factors of construction workers during work in summer. Scientific Reports. 11(1), p.1119.

Karthick, S., Kermanshachi, S., Pamidimukkala, A. and Namian, M. 2023. A review of construction workforce health challenges and strategies in extreme weather conditions. International Journal of Occupational Safety and Ergonomics. 29(2), pp.773–784.

Kendon, M., A. Doherty, D. Hollis, et al. 2025. State of the UK Climate in 2024. International Journal of Climatology . 45, no. S1: e70010. https://doi.org/10.1002/joc.70010

Kjellstrom, T., Briggs, D., Freyberg, C., Lemke, B., Otto, M. and Hyatt, O. 2016. Heat, Human Performance, and Occupational Health: A Key Issue for the Assessment of Global Climate Change Impacts. Annual Review of Public Health. 37(Volume 37, 2016), pp.97–112.

Kjellstrom, T., Otto, M., Lemke, B., Hyatt, O., Briggs, D., Freyberg, C. and Lines, L. 2016. Climate Change and Labour: Impacts of Heat in the Workplace [Online] (M. McKinnon, E. Buckle, K. Gueye, I. Toroitich, D. Ionesco, E. Mach, & M. Maiero, eds). UNDP. [Accessed 17 March 2025]. Available from: https://www.undp.org/sites/g/files/zskgke326/files/publications/Climate%20and%20Labour%20Issue%20Paper_28%20April%202016_v1_lowres.pdf.

Laabbas-el-Guennouni, M. 2024. Workers' protection facing extreme weather events | etui. ETUI. [Online]. [Accessed 11 March 2025]. Available from: https://www.etui.org/news/workers-protection-facing-extreme-weather-events.

Laabbas-el-Guennouni, M. and Arabadjieva, K. 2024. Climate change adaptation means rights for workers. [Accessed 10 March 2025]. Available from: https://www.socialeurope.eu/climate-change-adaptation-means-rights-for-workers.

Lowe, J. A., Harrison, M. and Perks, R. J. 2026. Executive Summary. In: CCRA4-IA Technical Report [Lowe, J. A., Harrison, M. and Perks, R. J.]. Available Online: https://www.ukclimaterisk.org/publications/technical-report-ccra4-ia/; Accessed on 27/05/2026

Malik, A. and Berg, J. 2024. Polycentric governance, epistocracy and the limits of policing knowledge in preparing for the climate crisis. Policing and Society. 0(0), pp.1–15.

Marquez, D., Krenz, J.E., Chavez Santos, É., Torres, E., Palmández, P., Sampson, P.D., Blancas, M., Carmona, J. and Spector, J.T. 2023. The Effect of Participatory Heat Education on Agricultural Worker Knowledge. Journal of Agromedicine. 28(2), pp.187–198.

Masuda, Y.J., Castro, B., Aggraeni, I., Wolff, N.H., Ebi, K., Garg, T., Game, E.T., Krenz, J. and Spector, J. 2019. How are healthy, working populations affected by increasing temperatures in the tropics? Implications for climate change adaptation policies. Global Environmental Change. 56, pp.29–40.

Nunfam, V.F., Adusei-Asante, K., Van Etten, E.J., Oosthuizen, J., Adams, S. and Frimpong, K. 2019. The nexus between social impacts and adaptation strategies of workers to occupational heat stress: a conceptual framework. International Journal of Biometeorology. 63(12), pp.1693–1706.

Nunfam, V.F., Adusei-Asante, K., Van Etten, E.J., Oosthuizen, J. and Frimpong, K. 2018. Social impacts of occupational heat stress and adaptation strategies of workers: A narrative synthesis of the literature. Science of The Total Environment. 643, pp.1542–1552.

Orlov, A., Sillmann, J., Aaheim, A., Aunan, K. and De Bruin, K. 2019. Economic Losses of Heat-Induced Reductions in Outdoor Worker Productivity: a Case Study of Europe. Economics of Disasters and Climate Change. 3(3), pp.191–211.

Orlov, A., Sillmann, J., Aunan, K., Kjellstrom, T. and Aaheim, A. 2020. Economic costs of heat-induced reductions in worker productivity due to global warming. Global Environmental Change. 63, p.102087.

Rising, J., Dietz, S., Dumas, M., Khurana, R., Kikstra, J., Lenton, T., Linsenmeier, M., Smith, C., Taylor, C. and Ward, B. 2022. What will climate change cost the UK? Risks, impacts and mitigation for the net-zero transition [Online]. London, UK: Grantham Research Institute on Climate Change and the Environment. [Accessed 31 March 2026]. Available from: https://www.lse.ac.uk/granthaminstitute/publication/what-will-climate-change-cost-the-uk/.

Rising, James, Tedesco, M., Piontek, F. and Stainforth, D.A. 2022. The missing risks of climate change. Nature. 610(7933), pp.643–651.

Robinson, E., Howarth, C. and Dasgupta, S. 2024. How can the UK better adapt to heat in the workplace. Science in Parliament. 80(1).

Robinson EJZ, Dasgupta S, Howarth, C, et al. (2025a) Protecting UK workers' health and incomes in a warming world. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. https://www.lse.ac.uk/granthaminstitute/publication/protecting-uk-workers-health-and-incomes-in-a-warming-world/

Robinson EJZ, Howarth C, Zhou Y and Dasgupta S (2025b) Improving the resilience of the UK labour force in a 1.5°C world. Grantham Research Institute on Climate Change and the Environment Working Paper 423. London: London School of Economics and Political Science

Roca J, Sanromà-Ortiz M, Cemeli T, Tort-Nasarre G, Santamaría AL, Espart A, Cantos-Puig C, Campoy C. Health Interventions for the Prevention of Dehydration in Agricultural Workers Exposed to Heat Stress: A Systematic Review. Healthcare. 2025; 13(11):1232. https://doi.org/10.3390/healthcare13111232

Ruban Y. 2025. Analyst insight: provisional UK crop production estimates for 2025. Agriculture and Horticulture Development Board website, 16 October 2025. https://ahdb.org.uk/news/provisional-uk-crop-production-estimates-for-2025- analyst-insight#:~:text=This%20is%20provisionally%20the%20smallest,the%2029 %25%20increase%20in%20yield

Schulz, F., Trappmann, V. 2023. Erwartungen von Beschäftigten an die sozial-ökologische Transformation - Ergebnisse einer repräsentativen Umfrage zu Klimawandel und Arbeitswelt Forschungsförderung Working Paper Nr. 308, Düsseldorf, 77 Seiten

Szewczyk, W., Mongelli, I. and Ciscar, J.-C. 2021. Heat stress, labour productivity and adaptation in Europe—a regional and occupational analysis. Environmental Research Letters. 16(10), p.105002.

Szewczyk, W., Mongelli, I. and Ciscar Martinez, J.C., Climate change, heat stress and labour productivity. A regional European assessment, Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/7164850, JRC144137.

van Westen, R. M., Vanderborght, E., Kliphuis, M., & Dijkstra, H. A. 2025. Physics-based indicators for the onset of an AMOC collapse under climate change. Journal of Geophysical Research: Oceans, 130, e2025JC022651. https://doi.org/10.1029/2025JC022651

Vicedo-Cabrera AM, Scovronick N, Sera F, Royé D, Schneider R, Tobias A et al. 2021. The burden of heat-related mortality attributable to recent human-induced climate change. Nat Clim Change. 11:6(6). pp. 492–500. https://doi.org/10.1038/s41558-021-01058-x. 11

Vielma, C., Achebak, H., Quijal-Zamorano, M., Lloyd, S.J., Chevance, G. and Ballester, J. 2024. Association between temperature and occupational injuries in Spain: The role of contextual factors in workers' adaptation. Environment International. 192, p.109006.

World Health Organization (WHO) and World Meteorological Organization (WMO). 2025 Climate change and workplace heat stress: technical report and guidance. https://library.wmo.int/records/item/69616-climate-change-and-workplace-heat-stress

Annex

Factors associated with workers' weather exposure

Binary logit models are then used to assess whether sector differences exist in workplace exposure reported to each weather category, and whether sector effects are mediated by worker characteristics.

$$y_i=\beta_0+\boldsymbol{\beta_1} \mathbf{X_i}+\boldsymbol{\beta_2} \mathbf{S_i}+\boldsymbol{\beta_3} \mathbf{S_i} \cdot HWO_i+\boldsymbol{\beta_4} \mathbf{S_i} \cdot PE_i+\varepsilon_i$$

where y denotes the dependent variable, including 1) whether worker i is affected by any weather category; or i reports workplace exposure to 2) hot and/or cold temperatures; 3) wet and/or dry conditions; 4) wind; 5) snow and ice; 6) wildfires; or 7) other. Since these dependent variables are all dummy variables with binary values (i.e., 0 or 1), binary logit models are used in this case. X_i is the vector of characteristics of worker i. S_i is the vector of sectors, including construction, emergency services, education, health and social care, transport and logistics, and entertainment / events/sports, representing whether worker i is from sector $s, s \in S$. The agriculture sector is set as the base category among these sectors, which implies that the coefficient β_2 should be interpreted as the relative association effect of sector s on y compared to the agriculture sector. For those sectors that have a significant correlation with y, interactions $S_i \cdot HWO_i$ and $S_i \cdot PE_i$ are then added in an extended model to test whether the association effects of Hours Worked Outside (HWO) and Physical Exertion (PE) can be partly explained by sector effects. ε_i is the error term which follows the logistic distribution.

Results of the above regressions are shown in Tables 1-4, where Odds Ratios (OR) are reported instead of coefficients. In logit models, coefficients cannot be interpreted intuitively, so odds ratios are usually used to directly explain the change in the likelihood that the dependent variable occurs when an explanatory variable increases by one unit. The value of odds ratios should be compared with 1, with odds ratios larger than 1 indicating that is more likely to occur, and values below 1 indicating the opposite.

Table 1 provides general insights into the explanatory factors for being affected by any weather categories. Model 1 is the basic model. Models 2 to 5 build on model 1 and are expanded step by step.

Regression analysis shows that male workers are 89 per cent (OR=1.89) more likely to be affected (than female workers), trade union members are 94 per cent (OR=1.94) more likely to be affected (than non-trade union members), while people older than 40 and those with a degree-level qualification are 57 per cent (OR=0.43) and 23 per cent (OR=0.77) less likely to be affected (than people younger than 40 and those without a degree-level qualification), respectively. The effects of gender, age, and trade union membership are robust, while the effects of education can be explained by the number of hours worked outside (HWO) and the degree of physical exertion (PE). The effects of hours worked outside and physical exertion are robust over different weather categories. Longer hours worked outside and greater physical exertion, are associated with a higher likelihood of being affected by all types of weather events.

Model 3 further includes sectoral factors. Compared to the agriculture sector, Health & Social Care (HSC) and Entertainment/events/sports (EES) are 63 per cent (OR=0.37) and 49 per cent (OR=0.51) less likely to be affected. Models 4 and 5 then assess the mediation of HWO and PE on the sectoral effects. Although the interactions are not significant in any model, we find that the main effects of the HSC and EES sectors are no longer significant when adding the interactions between these sectors and PE. This implies that the sector difference from HSC and EES can be somewhat explained by the difference in physical exertion across sectors.

Table 1: Binary logit models of "Being affected"

	Being affected by any type of extreme weather				
Models	**1**	**2**	**3**	**4**	**5**
Gender = Male	1.89***	1.60***	1.49***	1.52***	1.54***
	(0.23)	(0.22)	(0.21)	(0.21)	(0.22)
Age >= 40	0.43***	0.56***	0.55***	0.55***	0.55***
	(0.05)	(0.08)	(0.08)	(0.08)	(0.08)
Income >= 40K	1.14	1.16	1.13	1.15	1.14
	(0.14)	(0.16)	(0.17)	(0.16)	(0.16)
Education = Degree level	0.77*	0.88	0.92	0.9	0.89
	(0.10)	(0.13)	(0.15)	(0.14)	(0.14)
Member of Trade Union	1.94***	1.41**	1.42**	1.39**	1.41**
	(0.24)	(0.20)	(0.20)	(0.20)	(0.20)
Hours worked outside (0 ~ 7)		1.54***	1.46***	1.48***	1.48***
		(0.09)	(0.08)	(0.10)	(0.08)
Physical exertion (1 ~ 5)		1.77***	1.80***	1.79***	1.87***
		(0.11)	(0.12)	(0.11)	(0.15)
Sector					
Construction			0.66		
			(0.21)		
Emergency service			0.65		
			(0.26)		
Education			0.63		
			(0.21)		
Health & Social Care			0.37***	0.54***	0.99
			(0.12)	(0.12)	(0.51)
Transport, Logistics			0.84		
			(0.27)		
Entertainment/events/sports			0.51**	0.63**	0.64
			(0.17)	(0.15)	(0.32)
Sector × Hours worked outside					
Health & Social Care ×				0.94	
				(0.14)	
Entertainment/events/sports ×				1.17	
				(0.19)	
Sector × Physical exertion					
Health & Social Care ×					0.8
					(0.13)
Entertainment/events/sports ×					1.04
					(0.17)
Constant	1.28	0.13***	0.23***	0.17***	0.15***
	(0.20)	(0.03)	(0.09)	(0.04)	(0.04)
Observations	1,262	1,250	1,250	1,250	1,250

Note. Robust standard errors are shown in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. odds ratios are shown in the table, with larger than 1 reflects positive association and smaller than 1 reflect negative association. Agriculture is the reference category for sectors.

Table 2: Binary logit models of “Hot/Cold” and “Wet/Dry”

	Hot and/or cold temperatures					Wet and/or dry conditions				
Models	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Gender = Male	1.57***	1.39**	1.32**	1.36**	1.36**	1.55***	1.23	1.18	1.19	1.19
	(0.19)	(0.18)	(0.18)	(0.18)	(0.18)	(0.20)	(0.17)	(0.16)	(0.16)	(0.16)
Age >= 40	0.95	1.22	1.18	1.22	1.22	0.69***	0.94	0.93	0.94	0.94
	(0.12)	(0.17)	(0.16)	(0.17)	(0.17)	(0.09)	(0.13)	(0.13)	(0.13)	(0.13)
Income >= 40K	1	0.98	0.99	0.98	0.99	1.04	0.99	1	0.99	0.99
	(0.12)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)
Education = Degree level	0.95	1.04	1.11	1.05	1.05	0.78*	0.87	0.9	0.88	0.87
	(0.13)	(0.15)	(0.16)	(0.15)	(0.15)	(0.11)	(0.13)	(0.14)	(0.13)	(0.13)
Member of Trade Union	1.64***	1.35**	1.34**	1.35**	1.35**	1.67***	1.31**	1.30*	1.33**	1.33**
	(0.20)	(0.18)	(0.18)	(0.18)	(0.18)	(0.21)	(0.18)	(0.19)	(0.19)	(0.19)
Hours worked outside (0 ~ 7)		1.25***	1.22***	1.23***	1.23***		1.40***	1.36***	1.36***	1.37***
		(0.05)	(0.05)	(0.05)	(0.05)		(0.06)	(0.06)	(0.06)	(0.06)
Physical exertion (1 ~ 5)		1.41***	1.44***	1.42***	1.39***		1.43***	1.45***	1.44***	1.47***
		(0.08)	(0.08)	(0.08)	(0.09)		(0.09)	(0.09)	(0.09)	(0.10)
Sector										
Construction			0.72					0.84		
			(0.17)					(0.22)		
Emergency service			1					1.18		
			(0.33)					(0.41)		
Education			0.8					0.91		
			(0.21)					(0.25)		
Health & Social Care			0.52**	0.61**	0.37**			0.46***	0.47***	0.75
			(0.14)	(0.13)	(0.19)			(0.14)	(0.11)	(0.40)
Transport, Logistics			1.11					0.95		
			(0.28)					(0.26)		
Entertainment/ events/sports			0.79					0.84		
Sector × Hours worked outside										
Health & Social Care ×				0.99					1.06	
				(0.11)					(0.13)	
Sector × Physical exertion										
Health & Social Care ×					1.17					0.88
					(0.18)					(0.14)
Constant	0.40***	0.09***	0.12***	0.10***	0.11***	0.45***	0.09***	0.11***	0.10***	0.09***
	(0.06)	(0.02)	(0.04)	(0.03)	(0.03)	(0.07)	(0.02)	(0.04)	(0.03)	(0.03)
Observations	1,262	1,250	1,250	1,250	1,250	1,262	1,250	1,250	1,250	1,250

Note. Robust standard errors are shown in parentheses, *** p<0.01, ** p<0.05, * p<0.1. odds ratios are shown in the table, with larger than 1 reflects positive association and smaller than 1 reflect negative association. Agriculture is the reference category for sectors.

Table 3: Binary logit models of “Wind”/”Snow and ice”/”Wildfires”

	Wind					Snow and ice			Wildfires				
Models	1	2	3	4	5	1	2	3	1	2	3	4	5
Gender = Male	1.91***	1.52***	1.40**	1.48***	1.48**	1.71***	1.37**	1.28*	2.11***	1.83**	1.77**	1.83**	1.83**
	(0.27)	(0.23)	(0.22)	(0.23)	(0.22)	(0.23)	(0.20)	(0.18)	(0.58)	(0.52)	(0.51)	(0.53)	(0.53)
Age >= 40	0.76**	1.01	0.94	1	0.99	0.67***	0.89	0.85	0.38***	0.47***	0.45***	0.45***	0.45***
	(0.11)	(0.15)	(0.15)	(0.15)	(0.15)	(0.09)	(0.13)	(0.12)	(0.10)	(0.13)	(0.13)	(0.12)	(0.12)
Income >= 40K	0.91	0.83	0.81	0.82	0.84	0.94	0.86	0.84	1.19	1.09	1.17	1.12	1.12
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.12)	(0.12)	(0.31)	(0.30)	(0.32)	(0.31)	(0.30)
Education = Degree level	0.74**	0.84	0.94	0.87	0.89	0.93	1.1	1.21	1.05	1.17	1.33	1.28	1.28
	(0.11)	(0.13)	(0.15)	(0.14)	(0.14)	(0.13)	(0.17)	(0.19)	(0.31)	(0.38)	(0.43)	(0.43)	(0.43)
Member of Trade Union	1.70***	1.40**	1.34*	1.37**	1.38**	1.55***	1.24	1.22	1.73**	1.43	1.4	1.37	1.37
	(0.24)	(0.21)	(0.20)	(0.21)	(0.21)	(0.20)	(0.18)	(0.18)	(0.43)	(0.38)	(0.38)	(0.36)	(0.36)
Hours worked outside (0 ~ 7)		1.40***	1.35***	1.38***	1.38***		1.40***	1.36***		1.25***	1.23***	1.24***	1.25***
		(0.06)	(0.06)	(0.06)	(0.06)		(0.06)	(0.06)		(0.09)	(0.10)	(0.09)	(0.09)
Physical exertion (1 ~ 5)		1.29***	1.33***	1.31***	1.23***		1.31***	1.33***		1.26**	1.32**	1.30**	1.31**
		(0.08)	(0.09)	(0.08)	(0.09)		(0.08)	(0.08)		(0.14)	(0.15)	(0.14)	(0.15)
Sector													
Construction			0.94					0.78			0.98		
			(0.25)					(0.20)			(0.43)		
Emergency service			2.02**	2.87***	0.59			1.21			3.46**	2.92	3.88
			(0.71)	(1.02)	(0.52)			(0.43)			(1.94)	(2.01)	(3.45)
Education			1.03					0.76			0.82		
			(0.30)					(0.21)			(0.45)		
Health & Social Care			0.59*	0.55**	0.24**			0.67			0.43		
			(0.18)	(0.15)	(0.14)			(0.19)			(0.28)		
Transport, Logistics			1.52					1.3			1.2		
			(0.42)					(0.34)			(0.60)		
Entertainment/ events/ sports			0.68					0.69			1.47		
			(0.20)					(0.19)			(0.73)		
Sector × Hours worked outside													
Health & Social Care ×				1.05									
				(0.12)									
Emergency service ×				0.8								1.07	
				(0.12)								(0.24)	

	Wind					Snow and ice			Wildfires				
Models	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**
Sector × Physical exertion													
Health & Social Care ×					1.31*								
					(0.22)								
Emergency service ×					1.5								0.96
					(0.43)								(0.26)
Constant	0.27***	0.07***	0.07***	0.07***	0.08***	0.32***	0.08***	0.09***	0.04***	0.01***	0.01***	0.01***	0.01***
	(0.05)	(0.02)	(0.03)	(0.02)	(0.02)	(0.05)	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	1,262	1,250	1,250	1,250	1,250	1,262	1,250	1,250	1,262	1,250	1,250	1,250	1,250

Note. Robust standard errors are shown in parentheses, *** p<0.01, ** p<0.05, * p<0.1. odds ratios are shown in the table, with larger than 1 reflects positive association and smaller than 1 reflect negative association. Agriculture is the reference category for sectors.

Table 4: Binary logit models of “Other”

	Other: Fog, Lightning, Air pollution-inducing weather				
Models	**1**	**2**	**3**	**4**	**5**
Gender = Male	1.59**	1.26	1.09	1.12	1.12
	(0.31)	(0.26)	(0.23)	(0.24)	(0.24)
Age >= 40	0.71*	0.89	0.76	0.78	0.78
	(0.14)	(0.19)	(0.16)	(0.17)	(0.17)
Income >= 40K	0.93	0.81	0.8	0.79	0.8
	(0.18)	(0.17)	(0.16)	(0.16)	(0.16)
Education = Degree level	0.64**	0.73	0.91	0.87	0.88
	(0.14)	(0.17)	(0.21)	(0.20)	(0.20)
Member of Trade Union	2.62***	2.26***	2.22***	2.25***	2.25***
	(0.49)	(0.45)	(0.45)	(0.46)	(0.45)
Hours worked outside (0 ~ 7)		1.40***	1.34***	1.40***	1.36***
		(0.08)	(0.08)	(0.09)	(0.07)
Physical exertion (1 ~ 5)		1.11	1.17*	1.16*	1.19*
		(0.10)	(0.10)	(0.10)	(0.12)
Sector (Agriculture as base)					
Construction			0.66		
			(0.24)		
Emergency service			1.27		
			(0.62)		
Education			0.68		
			(0.28)		
Health & Social Care			0.5		
			(0.22)		
Transport, Logistics			2.21**	3.48***	3.88**
			(0.76)	(1.13)	(2.34)
Entertainment/events/sports			0.69		
			(0.28)		
Sector × Hours worked outside					
Transport, Logistics ×				0.94	
				(0.10)	
Sector × Physical exertion				1.17	
Transport, Logistics ×					0.92
					(0.17)
Constant	0.10***	0.04***	0.04***	0.03***	0.03***
	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)
Observations	1,262	1,250	1,250	1,250	1,250

Note. Robust standard errors are shown in parentheses, *** p<0.01, ** p<0.05, * p<0.1. odds ratios are shown in the table, with larger than 1 reflects positive association and smaller than 1 reflect negative association. Agriculture is the reference category for sectors.

Sectoral differences in productivity and wellbeing due to extreme weather events for workers

Sector differences in productivity and health impacts reported for each extreme weather event are tested by Kruskal–Wallis tests. As shown in Tables 5 and 6, the mean value represents the average score for each type of weather event in each sector, with completely negative values at 1 and completely positive values at 5. Answers of “don’t know / not applicable” are not included in this analysis and treated as missing values. Mean scores for any weather events and any sectors are all lower than 3, indicating a general negative impact of these weather events on productivity and health and well-being across sectors, consistent with the results from Figures 4 and 5.

The final column shows the p-value from the Kruskal–Wallis tests, indicating the statistical significance of sectoral differences in the impacts of each weather event. Overall, sectors have no differences in most of these weather events. It may reflect large deviations among workers in the same sector, leading to a larger standard deviation for each sector and therefore to insignificant p-values.

For productivity, some sectoral differences are found under dry conditions, including droughts, heavy rainfall events, and landslides, while others, including fog and air-pollution-inducing weather, show no such differences. For example, compared to the other sectors, productivity in agriculture is more negatively affected by droughts (Mean = 2.0), and that of construction is more negatively affected by fog (Mean = 1.7) and air pollution-inducing weather (Mean = 1.7).

For the impact on health and wellbeing, sectoral differences are found for cold spells/snaps and air pollution-inducing weather. Cold spells/snaps’ impact on health and wellbeing is more negatively reported by workers in the Health & Social Care (Mean = 2.2) and Entertainment/events/sport sectors (Mean = 2.2). Air pollution-inducing weather impact is more negatively reported by workers in the construction sector (Mean = 1.7).

Table 5: Sectoral differences in the productivity impact from extreme weather exposure.

Category	Weather events	Variables	Agriculture	Construction	Emergency service
Hot and/or cold temperature	Extreme heat events	N	58	91	30
		Mean	2.2	2.4	2.4
	Cold spells / snaps	N	59	90	30
		Mean	2.8	2.6	2.5
	Frost	N	58	89	28
		Mean	2.6	2.5	2.5
Wet and/or dry conditions	Droughts	N	51	87	23
		Mean	2.0	2.6	2.4
	Heavy rainfall events	N	54	94	28
		Mean	2.5	2.4	2.0
	River floods	N	45	83	24
		Mean	2.2	2.2	2.3
	Surface water	N	50	88	27
		Mean	2.2	2.3	2.3
	Landslides	N	36	81	21
		Mean	2.2	2.2	2.6
	Coastal flooding	N	34	79	20
		Mean	2.4	2.3	2.5
Wind	Severe wind storms	N	38	70	29
		Mean	2.3	2.2	2.1
Snow and ice	Heavy snowfall and ice storms	N	46	74	25
		Mean	1.9	1.9	2.2
	Hail	N	45	69	25
		Mean	2.4	2.3	2.7
	Freeze-thaw cycles	N	44	72	22
		Mean	2.5	2.3	2.7
Wildfires	Wildfires	N	9	17	9
		Mean	2.1	1.6	2.1
Other	Fog	N	16	23	11
		Mean	2.6	1.7	2.2
	Lightning	N	15	23	11
		Mean	2.3	2.0	1.9
	Air pollution-inducing weather	N	17	23	10
		Mean	2.7	1.7	2.2

	Education	Health & Social Care	Transport, Logistics	Entertainment/events/ sport	Kruskal–Wallis p-value
	76	53	99	69	0.330
	1.9	2.2	2.1	2.2	
	76	53	100	68	0.259
	2.3	2.4	2.4	2.3	
	74	51	96	66	0.899
	2.4	2.5	2.5	2.3	
	52	36	69	51	0.005***
	2.5	2.9	2.7	2.6	
	63	39	83	60	0.084*
	2.0	2.5	2.3	2.0	
	47	36	70	50	0.985
	2.1	2.4	2.2	2.2	
	59	38	81	53	0.930
	2.3	2.3	2.2	2.1	
	42	33	66	43	0.099*
	2.1	2.7	1.9	2.0	
	37	35	55	40	0.939
	2.2	2.4	2.3	2.3	
	44	28	77	34	0.619
	2.0	2.4	1.8	1.9	
	45	40	77	46	0.108
	1.8	2.3	1.7	1.8	
	43	36	75	45	0.506
	2.4	2.5	2.3	2.2	
	38	35	75	43	0.244
	2.4	2.2	2.2	2.2	
	6	4	11	15	0.362
	2.0	1.3	1.3	1.7	
	15	10	48	14	0.048**
	2.1	2.3	2.1	2.7	
	15	10	47	15	0.122
	2.1	3.1	2.4	2.3	
	13	9	42	14	0.048**
	2.2	2.4	2.4	2.1	

Note. 1 Completely negative to 5 Completely positive. Answers of “Don’t know / Not applicable” are not included for analysis. * p<0.1, ** p<0.05, *** p<0.01.

Table 6: Sectoral differences in the health and wellbeing impact from extreme weather exposure.

Category	Weather events	Variables	Agriculture	Construction	Emergency service
Hot and/or cold temperature	Extreme heat events	N	58	91	30
		Mean	2.3	2.4	2.2
	Cold spells / snaps	N	58	92	30
		Mean	2.9	2.6	2.5
	Frost	N	58	91	29
		Mean	2.9	2.6	2.6
Wet and/or dry conditions	Droughts	N	50	87	22
		Mean	2.2	2.5	2.4
	Heavy rainfall events	N	54	93	29
		Mean	2.6	2.5	2.2
	River floods	N	42	82	22
		Mean	2.3	2.4	2.5
	Surface water	N	49	87	25
		Mean	2.6	2.4	2.4
	Landslides	N	37	77	19
		Mean	2.4	2.4	2.6
Wind	Severe wind storms	N	38	69	29
		Mean	2.4	2.2	2.0
Snow and ice	Heavy snowfall and ice storms	N	45	73	25
		Mean	2.4	2.2	2.3
	Hail	N	43	72	25
		Mean	2.6	2.5	2.5
	Freeze-thaw cycles	N	44	72	23
		Mean	2.5	2.4	2.6
Wildfires	Wildfires	N	9	18	9
		Mean	2.7	2.2	2.0
Other	Fog	N	16	23	11
		Mean	2.6	2.0	2.3
	Lightning	N	16	23	11
		Mean	2.6	2.1	2.4
	Air pollution-inducing weather	N	17	23	10
		Mean	2.8	1.7	2.3

Education	Health & Social Care	Transport, Logistics	Entertainment/events/ sport	Kruskal–Wallis p-value
75	53	98	69	0.598
2.0	2.2	2.2	2.0	
75	53	101	67	0.068*
2.3	2.2	2.5	2.2	
73	50	97	65	0.137
2.4	2.5	2.4	2.3	
52	36	67	48	0.342
2.3	2.6	2.5	2.4	
61	38	82	55	0.625
2.4	2.3	2.4	2.2	
51	37	71	47	0.981
2.2	2.2	2.4	2.3	
55	39	78	50	0.738
2.2	2.3	2.3	2.3	
42	34	66	43	0.859
2.1	2.4	2.4	2.3	
45	27	77	32	0.638
2.1	2.1	2.1	2.3	
44	40	78	44	0.652
1.9	2.1	2.1	2.1	
45	36	77	43	0.961
2.5	2.6	2.4	2.5	
38	35	74	42	0.735
2.2	2.3	2.3	2.5	
6	4	11	15	0.854
2.0	1.5	1.9	2.1	
15	10	46	15	0.584
2.2	2.3	2.5	2.3	
15	10	46	15	0.196
2.3	3.0	2.7	2.9	
14	9	43	14	0.024**
2.1	2.8	2.3	2.4	

Note. 1 Completely negative to 5 Completely positive. Answers of “Don’t know / Not applicable” are not included for analysis. * p<0.1, ** p<0.05, *** p<0.01.

Factors associated with negative impacts on productivity and wellbeing due to extreme weather events for workers

For each dependent variable, Y=1 if a participant reported at least once "completely negative" or "more negative than positive" affected by any type of extreme weather event and did not report a positive effect for any of the extreme weather events. In each table, three binary logistic regression models with different groups of independent variables are estimated. Model 1 includes the socioeconomic characteristics. Model 2 extends Model 1 by adding the level of physical exertion and outdoor working hours. Model 3 further extends Model 2 by adding sector dummy variables. The logistic regression tables report odds ratios rather than coefficients. An odds ratio greater than 1 indicates a higher possibility of the outcome for participants with the corresponding characteristic, while an odds ratio below 1 indicates a lower possibility.

Table 7: Logistic regression results for negative productivity effects

	Model 1	Model 2	Model 3
Gender = Male	1.23	1.20	1.13
	(0.162)	(0.161)	(0.155)
Age >= 40	0.79*	0.90	0.84
	(0.104)	(0.124)	(0.118)
Born in UK	1.17	1.18	1.12
	(0.325)	(0.333)	(0.326)
Citizenship in UK	1.04	0.99	1.07
	(0.381)	(0.363)	(0.407)
Education >= Degree level	1.10	1.10	1.13
	(0.159)	(0.163)	(0.172)
Income > £40K	1.03	1.01	1.01
	(0.140)	(0.140)	(0.141)
Level of seniority (1 Apprentice - 4 Senior)	1.10	1.09	1.15
	(0.097)	(0.098)	(0.107)
Administrative occupations	0.64*	0.73	0.73
	(0.150)	(0.173)	(0.176)
Associate professional and technical occupations	1.15	1.17	1.24
	(0.311)	(0.331)	(0.350)
Caring, leisure and other service occupations	1.51	1.47	1.71*
	(0.409)	(0.406)	(0.486)
Elementary occupations	3.22***	2.93***	2.76**
	(1.299)	(1.203)	(1.145)
Process, plant and machine operatives	2.76**	2.65**	2.36**
	(1.210)	(1.138)	(1.033)
Professional occupations	1.16	1.25	1.31
	(0.216)	(0.236)	(0.256)

	Model 1	Model 2	Model 3
Sales and customer service occupations	1.66	1.64	1.48
	(0.548)	(0.535)	(0.483)
Skilled trades occupations	1.94***	1.59**	1.58**
	(0.426)	(0.360)	(0.361)
Others	0.61	0.60	0.57
	(0.229)	(0.226)	(0.216)
Permanent contract	0.95	1.03	1.00
	(0.149)	(0.167)	(0.168)
Fulltime job	0.79	0.73**	0.72**
	(0.124)	(0.117)	(0.118)
Trade union in workplace	1.00	1.00	1.00
	(0.002)	(0.002)	(0.002)
Member of Trade Union	1.00	1.00	1.00
	(0.004)	(0.004)	(0.004)
Physical exertion		1.21***	1.23***
		(0.067)	(0.068)
Outdoor working hours		1.11**	1.08*
		(0.045)	(0.046)
Sector			
Construction			0.78
			(0.195)
Emergency service			1.05
			(0.361)
Education			1.00
			(0.267)
Health & Social Care			0.59*
			(0.166)
Transport, Logistics			1.33
			(0.344)
Entertainment/events/ sports			0.75
			(0.206)
Constant	0.33**	0.16***	0.16***
	(0.151)	(0.077)	(0.087)
Observations	1,247	1,247	1,247

Note. Odds ratios are reported; robust standard errors are shown in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Managers, directors and senior officials is the reference category for occupations. Agriculture is the reference category for sectors.

Table 8: Logistic regression results for negative health and wellbeing effects

	Model 1	Model 2	Model 3
Gender = Male	1.22	1.14	1.12
	(0.161)	(0.153)	(0.153)
Age >= 40	0.73**	0.81	0.76**
	(0.096)	(0.109)	(0.105)
Born in UK	1.11	1.07	1.03
	(0.305)	(0.293)	(0.289)
Citizenship in UK	1.06	1.03	1.10
	(0.382)	(0.370)	(0.400)
Education >= Degree level	1.12	1.14	1.15
	(0.164)	(0.169)	(0.174)
Income > £40K	1.07	1.02	1.04
	(0.144)	(0.140)	(0.142)
Level of seniority (1 Apprentice - 4 Senior)	1.05	1.05	1.10
	(0.094)	(0.094)	(0.103)
Administrative occupations	0.52***	0.57**	0.58**
	(0.122)	(0.135)	(0.137)
Associate professional and technical occupations	1.04	1.05	1.05
	(0.279)	(0.286)	(0.290)
Caring, leisure and other service occupations	1.11	1.12	1.16
	(0.304)	(0.310)	(0.329)
Elementary occupations	2.41**	2.26**	2.24*
	(0.971)	(0.943)	(0.942)
Process, plant and machine operatives	1.68	1.55	1.53
	(0.736)	(0.669)	(0.680)
Professional occupations	1.00	1.10	1.07
	(0.185)	(0.208)	(0.206)
Sales and customer service occupations	1.31	1.28	1.23
	(0.441)	(0.428)	(0.413)
Skilled trades occupations	1.77***	1.50*	1.52*
	(0.386)	(0.334)	(0.341)
Others	0.42**	0.42**	0.40**
	(0.169)	(0.167)	(0.159)

	Model 1	Model 2	Model 3
Permanent contract	0.96	1.01	0.98
	(0.150)	(0.160)	(0.160)
Fulltime job	0.76*	0.71**	0.70**
	(0.119)	(0.113)	(0.113)
Trade union in workplace	1.00	1.00	1.00
	(0.002)	(0.002)	(0.002)
Member of Trade Union	1.00	1.00	1.00
	(0.005)	(0.005)	(0.005)
Physical extertion		1.02	1.02
		(0.022)	(0.024)
Outdoor working hours		1.17***	1.18***
		(0.046)	(0.049)
Sector			
Construction			0.93
			(0.235)
Emergency service			1.53
			(0.532)
Education			1.34
			(0.363)
Health & Social Care			0.98
			(0.274)
Transport, Logistics			1.39
			(0.364)
Entertainment/events/ sports			1.06
			(0.292)
Constant	0.48	0.37**	0.29**
	(0.223)	(0.173)	(0.153)
Observations	1,247	1,247	1,247

Note. Odds ratios are reported; robust standard errors are shown in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Managers, directors and senior officials is the reference category for occupations. Agriculture is the reference category for sectors.

Factors associated with payment changes and sick leaves due to extreme weather events for workers

For each dependent variable, Y=1 if the participant selected the corresponding disruption at least once among the extreme weather events that affected them.

Table 9: Logistic regression results for "I earned more"

	Model 1	Model 2	Model 3
Gender = Male	1.84**	1.61*	1.60*
	(0.445)	(0.420)	(0.427)
Age >= 40	0.27***	0.37***	0.35***
	(0.067)	(0.098)	(0.093)
Born in UK	7.01**	6.17**	6.55**
	(6.790)	(5.578)	(5.910)
Citizenship in UK	0.20*	0.15**	0.15**
	(0.190)	(0.142)	(0.141)
Education >= Degree level	1.95**	2.15***	2.25***
	(0.555)	(0.639)	(0.684)
Income > £40K	1.52*	1.31	1.29
	(0.343)	(0.313)	(0.307)
Level of seniority (1 Apprentice - 4 Senior)	1.04	1.02	1.07
	(0.156)	(0.159)	(0.175)
Administrative occupations	0.64	0.82	0.81
	(0.279)	(0.394)	(0.387)
Associate professional and technical occupations	1.53	1.60	1.67
	(0.603)	(0.695)	(0.744)
Caring, leisure and other service occupations	0.67	0.65	0.60
	(0.424)	(0.416)	(0.419)
Elementary occupations	-	-	-
	-	-	-
Process, plant and machine operatives	3.14**	3.33**	3.30**
	(1.458)	(1.629)	(1.665)
Professional occupations	1.03	1.30	1.24
	(0.290)	(0.407)	(0.405)
Sales and customer service occupations	1.53	1.74	1.75
	(0.978)	(1.077)	(1.051)
Skilled trades occupations	1.49	1.01	1.01
	(0.508)	(0.354)	(0.356)
Others	1.02	0.93	0.83
	(0.774)	(0.677)	(0.581)

	Model 1	Model 2	Model 3
Permanent contract	0.46***	0.54**	0.50***
	(0.109)	(0.129)	(0.125)
Fulltime job	3.47***	3.00***	3.04***
	(1.246)	(1.090)	(1.148)
Trade union in workplace	0.99	0.99	1.00
	(0.005)	(0.005)	(0.005)
Member of Trade Union	1.01	1.01	1.01
	(0.012)	(0.011)	(0.011)
Physical extertion		1.63***	1.66***
		(0.165)	(0.169)
Outdoor working hours		1.36***	1.35***
		(0.082)	(0.085)
Sector			
Construction			1.03
			(0.394)
Emergency service			1.66
			(0.952)
Education			1.14
			(0.553)
Health & Social Care			1.32
			(0.641)
Transport, Logistics			1.43
			(0.662)
Entertainment/events/ sports			0.83
			(0.399)
Constant	0.03***	0.00***	0.00***
	(0.024)	(0.003)	(0.003)
Observations	1,213	1,213	1,213

Note. Odds ratios are reported; robust standard errors are shown in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Managers, directors and senior officials is the reference category for occupations. Agriculture is the reference category for sectors. Variable “Elementary occupations” is omitted from the model because there are no observations for elementary occupations when y equals 1.

Table 10: Logistic regression results for “I had to take sick leave”

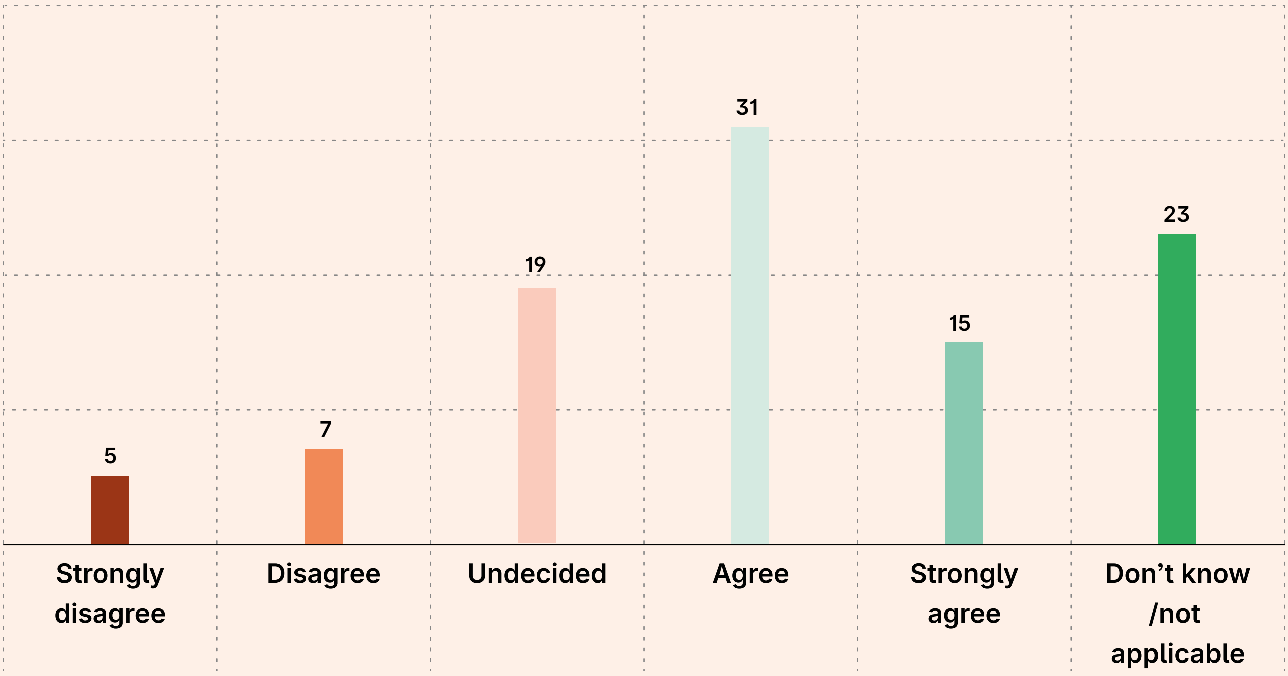
	Model 1	Model 2	Model 3
Gender = Male	1.20	1.04	1.00
	(0.286)	(0.268)	(0.257)
Age >= 40	0.25***	0.32***	0.31***
	(0.064)	(0.087)	(0.088)
Born in UK	2.33	1.99	1.62
	(2.048)	(1.768)	(1.560)
Citizenship in UK	0.73	0.69	0.77
	(0.719)	(0.697)	(0.836)
Education >= Degree level	1.31	1.36	1.43
	(0.390)	(0.436)	(0.461)
Income > £40K	1.17	0.97	1.04
	(0.279)	(0.250)	(0.279)
Level of seniority (1 Apprentice - 4 Senior)	1.06	1.05	1.06
	(0.182)	(0.187)	(0.197)
Administrative occupations	1.22	1.65	1.51
	(0.473)	(0.703)	(0.647)
Associate professional and technical occupations	0.95	0.90	0.81
	(0.466)	(0.466)	(0.431)
Caring, leisure and other service occupations	0.96	0.89	1.14
	(0.516)	(0.499)	(0.659)
Elementary occupations	-	-	-
	-	-	-
Process, plant and machine operatives	1.80	1.93	2.03
	(1.022)	(1.068)	(1.127)
Professional occupations	0.73	0.89	1.00
	(0.245)	(0.324)	(0.386)
Sales and customer service occupations	0.65	0.74	0.69
	(0.549)	(0.600)	(0.558)
Skilled trades occupations	1.50	1.01	1.00
	(0.548)	(0.383)	(0.367)
Others	-	-	-
	-	-	-

	Model 1	Model 2	Model 3
Permanent contract	0.66	0.84	0.97
	(0.181)	(0.256)	(0.311)
Fulltime job	1.78	1.47	1.28
	(0.627)	(0.545)	(0.508)
Trade union in workplace	0.99*	0.99	0.99*
	(0.006)	(0.006)	(0.006)
Member of Trade Union	1.73**	1.26	1.27
	(0.395)	(0.316)	(0.319)
Physical extertion		1.56***	1.58***
		(0.183)	(0.193)
Outdoor working hours		1.37***	1.34***
		(0.096)	(0.100)
Sector			
Construction			1.10
			(0.438)
Emergency service			2.21
			(1.291)
Education			0.49
			(0.280)
Health & Social Care			0.47
			(0.262)
Transport, Logistics			0.99
			(0.467)
Entertainment/events/ sports			1.54
			(0.695)
Constant	0.04***	0.01***	0.01***
	(0.038)	(0.007)	(0.008)
Observations	1,160	1,160	1,160

Note. Odds ratios are reported; robust standard errors are shown in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Managers, directors and senior officials is the reference category for occupations. Agriculture is the reference category for sectors. Variable “Elementary occupations”and “Others” are omitted from the model because there are no observations for elementary and other occupations when y equals 1.

Figure 10. Statement on whether organisations are doing enough to address extreme weather and climate impacts.

% of respondents (N=1,288)



Find out more

If you have found this report useful or would like further information about workers' exposure to extreme weather events across the seven sectors, please contact **Professor Vera Trappmann**, or visit the **Priestley Centre for Climate Futures website**:

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