
Heat Stress Acclimatization Interventions for Employee Productivity in ISO 14001 certified Firms in Kenya in the Context of Climate Change

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Abstract

Globally, extreme temperature occurrences associated with climate change and rise in atmospheric temperature have been observed to be increasing in frequency, duration and intensity. These have negative effects on human health and safety, employee productivity and rate of economic growth. Some organizations have taken steps to address these heat related public health issues. There is however inadequate knowledge on the extent of implementation, effectiveness and acceptability of the existing heat adaptation intervention measures in many vulnerable communities. The general objective of this study therefore was to assess heat acclimatization interventions and implementation outcomes in ISO 14001 certified firms in Kenya. The study adopted descriptive research design. The unit of observation was 37 purposively selected senior executives in the identified firms. Mean responses received in a Likert scale of 1 – 5 for each of the tested items was calculated using descriptive statistics. The study recorded 75.68% response rate, with 42.9% of the respondents indicating that their firm has implemented infrastructural heat adaptation interventions such as cool-housing, shade and water provision, while 42.9% disagreed that the firm has in place technological intervention measures such as personal heat stress sensors and specialised material. When asked to indicate whether employees are aware about heat related mental health issues such as depression, suicide and substance abuse, 46.4% were not sure. When asked to comment on the appropriateness and wide acceptance of the current heat adaptation interventions in their respective firms, 42.9% of the study participants responded in the affirmative, while 21.4% were not sure. The study revealed that a substantial number of respondents were not sure or disagree with the current heat adaptation interventions. This implies that there is vulnerability to health threats associated with prolonged exposure to extreme heat events, hence negative social and economic outcomes such as hospitalization burden, low employee productivity and reduction in household income. The study recommends need for more studies in heat stress areas in Kenya, sensitization activities, review of heat adaptation measures and legal framework to mitigate effects of climate change. The expected study output is employee wellbeing and enhanced productivity for economic growth.

Keywords: Heat Stress, Acclimatization Interventions, ISO 14001, Employee Productivity.

1. Background Information

Globally, change in climate patterns and weather conditions in terms of average temperature that persists over a long duration of time has been identified as a threat to the realization of sustainable development objectives, especially those related to health and wellbeing, job creation, food security and housing (IPCC, 2019). Extreme temperature events associated with climate change and rise in atmospheric temperature for instance, have been observed to be increasing in their frequency, duration and intensity (National Weather Service, 2017; US EPA, 2016). This has a causation effect to changes in wind, moisture, heat circulation patterns and extreme heat events (Buonocoret *et al.*, 2019). Negative health implications of prolonged exposure to extreme heat events include heat exhaustion, heat cramps, heat stroke and death (Sailor, Baniassadi, O'Lenick&Wilhelmi, 2019; Uejio *et al.*, 2016; Holmes, Phillips & Wilson, 2016), as well as a range of mental health impacts, such as increases in irritability, aggression, domestic violence, depression, suicide and use of alcohol or other substances to cope with stress (World Health Organization, 2017; Campbell *et al.*, 2018; Mayrhuber *et al.*, 2018). In addition to poor health, exposure to high temperature has been linked to a reduction in labour productivity because employees under heat stress tend to slow down during work hours and tend to take more breaks to rehydrate and cool down (Park, 2016; Kim, Kabir, Ara Jahan, 2014). Reduced productivity by employees impacts negatively the overall performance of an enterprise translating to a less productive economy (Buonocoret *et al.* 2019).

Impacts of heat stress arising from prolonged exposure to extreme heat events is projected to intensity due to global warming (Rohat, Flacke, Dosio, Dao, van Maarseveen, 2019; Mayrhuber *et al.*, 2018; Nangombe *et al.*, 2018). This conclusion on projected increase in atmospheric temperature has also been corroborated by the United Nations Intergovernmental Panel on Climate Change responsible for advancing knowledge on human-induced climate change (IPCC, 2022). At the global, regional and national levels, greenhouse gas emissions and related increase in temperature and rising sea level is expected to increasingly impact on labour productivity, industries and economies that depend on natural resources and favorable climatic conditions (Sailor, Baniassadi, O'Lenick&Wilhelmi, 2019; World Health Organization, 2018; National Weather Service, 2017; Lucas, Epstein, Kjellstrom, 2014). With continued global warming, heat related deaths are expected to increase at a higher rate than the reduction in cold related deaths (US EPA. 2016; Vaidyanathan, Malilay, Schramm, Saha, 2020). At the community level, climate related events including heat stress are expected to result in degradation of livelihoods and related lasting mental health consequences in affected communities (Taylor *et al.*, 2018; WHO, 2017).

At the global, regional and national levels, there is increasing call for consensus around policy framework to guide the implementation of mitigation and adaption intervention measures to reduce the magnitude and speed of future climate change by reducing emission of heat trapping gases or removal of carbon dioxide from the atmosphere (IPCC, 2022; Mwasiagi, 2020). At the local level, individual organizations including ISO 14001 certified firms have taken steps to address heat related public health issues for employees' wellbeing, enhanced productivity and competitiveness (Cedeno *et al.*, 2018; Obradovich, Migliorini, Mednick& Fowler, 2017; Park, 2016). This is because the health and wellbeing of the human factor, in addition to the combined skill and expertise is a key determinant of organizational productivity, hence a pillar in the

creation and sustenance of competitive advantage (Hitt, Arregie & Holmes, 2020; Collings, Mellahi & Cascio, 2019). One of the main heat adaptation intervention measures to alleviate extreme heat in the work places has been the use of mechanical cooling equipment and other technologies, in the absence of which buildings would not be passively habitable (Sailor, Baniassadi, O'Lenick & Wilhelmi, 2019; Holmes, Phillips & Wilson, 2016). The level of implementation, effectiveness and acceptability of the heat adaptation measures remains a topic of debate by the academia, industry, policy formulators and other stakeholders (Nangombe *et al.*, 2018; Gao, Kuklane, Östergren, Kjellstrom, 2018; Lundgren, Kuklane, Gao & Holmér, 2013).

2. Problem Statement

Extreme heat events and rise in atmospheric temperature associated with climate change have been observed to be increasing in their frequency, duration and intensity (IPCC, 2022; Rohat, Flacke, Dosio, Dao, van Maarseveen, 2019). This has been attributed to activities related to greenhouse gas emissions estimated to have caused about 1.0 °C of global warming above the pre-industrial level (IPCC, 2019). The increase is likely to go beyond 1.5 °C between 2030 and 2052 if the current rate of greenhouse gas emission is sustained (IPCC, 2022; Beckmann, Hiete & Beck, 2021). According to the Lancet 2020 countdown report on health and climate change, vulnerable populations globally were in year 2019 exposed to an additional 475 million heatwave events reflected in excess morbidity and mortality (Lancet, 2020). Other studies have also reported that exposure to extreme heat events has negative effects not only on human health and safety, but also employee productivity and the rate of economic growth (Mayrhuber *et al.*, 2018; Nangombe *et al.*, 2018). For instance, India and Indonesia's losses of potential labour capacity in year 2019 was equivalent to 4-6% of their respective annual gross domestic product, while in Europe, the monetized cost of heat related mortality in year 2018 was the average income of 11 million European citizens (Lancet, 2020). Heat stress is therefore expected to result in degradation of livelihoods and related negative effects such as lasting mental health consequences in affected communities (Taylor *et al.*, 2018; Cedeno *et al.*, 2018; Obradovich, Migliorini, Mednick & Fowler, 2017; WHO, 2017). Taking urgent action on Heat stress arising from climate change is therefore necessary given the economic and social consequences such as low labour productivity and the burden ill health continues to place on nations' healthcare systems due to costs incurred by governments, the afflicted individuals and family members (Mwasiaji, Sang & Chengo, 2021; Rohat, Flacke, Dosio, Dao, van Maarseveen, 2019).

At the global level, the Paris agreement was introduced in 2015 for the purpose of limiting global temperature increase below the pre-industrial levels (IPCC, 2022; Gao *et al.*, 2018). At the regional and national levels, there are efforts by governments, non-governmental organizations and, business enterprises to address heat related public health issues so as to reduce risks and costs associated with climate change by taking action to lower greenhouse gas emissions and implement adaptation measures (Gao *et al.*, 2018; Mwasiaji, 2020). However, there is still no global consensus and binding policy framework around climate change financing and mitigation strategies (IPCC, 2022). There is also inadequate knowledge on the extent of implementation, effectiveness and acceptability of the existing heat intervention measures especially in many vulnerable communities in the global south (Nangombe, 2018; Park, 2016; Sailor, Baniassadi, O'Lenick & Wilhelmi, 2019). There is need therefore for studies around heat stress

acclimatization intervention measures and implementation outcomes to inform policy direction to guide planning and operationalization of heat stress mitigation measures (Campbell *et al.*, 2018; Holmes, Phillips & Wilson, 2016). Hence the current study to assess heat adoption interventions and implementation outcomes in ISO 14001 certified firms in Kenya.

3. Study Methods

The study adopted descriptive research design study because of the need to observe and describe the phenomenon in a natural environment, and the opportunity it offers to integrate qualitative and quantitative data collection. The unit of analysis was Environmental Management Systems (ISO 14001) certified firms in Kenya (KEBS, 2022). ISO 14001 certified firms were chosen for this study for two main reasons. First, ISO 14001 standard can be implemented by large or small firm, regardless of its field of activity (KEBS, 2022; Castillo-Peces, Mercado-Idoeta, Prado-Roman & Castillo-Feito, 2017). Second, ISO 14001 certified firms that meet requirements of the standard on a consistent basis have demonstrable ability to provide a conducive working environment that satisfies stakeholders' needs and expectations, while also complying with the relevant statutory and regulatory requirements (Mwasiaji, Sang & Chengo, 2020; Anttila & Jussila, 2017; ISO, 2015). All the four (4) firms from various sectors and economic activities in Kenya were identified as per the list obtained from the Kenya Bureau of Standards (KBS, 2022). This was done to ensure inclusion of only legally registered firms that have implemented the environmental management systems. The four (4) listed firms were judged not to be too many, hence prudent to include all of them in the study.

Human Resource Managers, Senior Executives and or staff representatives responsible for Health Services, Employee Relations, Staff Wellness, Staff Union, Estates Maintenance, Occupational Health and Safety were identified as the unit of observation because they were judged to be in a better position to respond to items touching on heat adaptation interventions and related implementation outcomes in their respective firms. Using this purposive method, a total of thirty seven (37) respondents from all the four (4) firms were identified for the study, making it unnecessary to establish the sampling fraction. The collected data using a Likert type scale of 1 – 5 for each of the tested item was analysed using descriptive statistics (Likert, 1932).

4. Literature Review

This study reviewed relevant theories and empirical studies on climate change and human health, as well as extant literature on heat adaptation intervention measures in response to rise in atmospheric temperature.

4.1 Theories Underpinning the Study

Numerous theoretical frameworks have been applied in seeking to understand and explain climate change acclimatization, heat adaptation behaviour or individuals' responses to climate change risks or those from natural hazards (Zhang *et al.*, 2020; Valois *et al.*, 2020; Murtaghet *et al.*, 2019; Akompab *et al.*, 2013). There is for instance the theory of Planned Behaviour that was applied in studies seeking to establish climate change adaptation for food security in agricultural related production (Zhang *et al.*, 2020); the Health Belief Model (Akompab *et al.*, 2013), the Value Belief Norm (Zhang *et al.*, 2020), or the Theory of Planned Behaviour (Valois *et al.*, 2020). There is also the Protective Action Decision Model (PADM) that has not been widely applied in

heat risk and heat adaptation literature, to help better understand people's heat adaptation behaviour. Another theoretical framework is the Protection Motivation Theory (Rogers, 1983), originating in health psychology and used extensively in risk research since the 1970s to assess individual's response to perceived threats of health problems and motivation to respond to the threats (Murtagh *et al.*, 2019). This Protection Motivation theory hypothesizes that the intention to enact a particular behaviour to mitigate a threat, is a proximal determinant of behaviour and is itself primarily determined by threat appraisal and coping appraisal (Murtagh *et al.*, 2019). The protection motivation theory was later extended and applied to other social science studies such as those on environmental degradation and response measures (Bagagnanet *et al.*, 2019).

This study chose to apply the Protection Motivation Theory (PMT) because it has successfully been applied widely in studies seeking to examine influences on preparedness for aspects of climate change, such as farmers' responses to drought (Dang, Li, Nuberg, & Bruwer, 2014; Truelove, Carrico, & Thabrew, 2015) and householders' responses to flood threat (Bubeck *et al.*, 2013). The application of the PMT to this study was judged to be useful in assessing factors examine factors affecting climate change adaptation and mitigation strategies in ISO 1400 certified firms in Kenya.

4.2 Downstream Effects of Extreme Heat

Numerous studies have variously reported the causal links between drivers of climate change such as greenhouse gas emissions as a result of human activities, and their impacts (Fajardy *et al.*, 2019; IPCC, 2019; Campbell *et al.*, 2018). Such impacts of global climate change are many, some more direct, while others are indirect (Lancet, 2020; IPCC, 2022). For instance, impacts of climate change have been reported to manifest through changing likelihood and intensities of extreme weather events, such as floods, heatwaves, droughts and storms, and slow-onset changes, such as glacial retreat and sea-level rise (Watts *et al.*, 2019; IPCC, 2022). Other negative effects of climate change are damage to property and infrastructure, disease, deaths, the loss of livelihoods, loss of biodiversity, and other economic losses arising from reduced productivity (IPCC, 2022). Health impacts of global climate change for instance have been reported throughout the world, including spread of dengue virus across South America, the cardiovascular and respiratory effects of record heatwaves and wildfires in Australia, western North America, and western Europe, and the undernutrition and mental health effects of floods and droughts in China, Bangladesh, Ethiopia, and South Africa (WHO, 2018; Lancet, 2020). Food security at the global level is also threatened by rising temperatures and increases in the frequency of extreme weather events associated with climate change. For instance, global yield potential for major crops declined by 1.8–5.6% between 1981 and 2019 (Lancet, 2020). In addition to the direct impacts of climate change, greenhouse gas emissions also increase the risks associated with socio-political instability that may lead to conflict or refugee flows (US EPA, 2016; IPCC, 2022). For instance, growing water stress in regions that are drying as a result of climate change drives food and financial insecurity, and may increase political instability (IPCC, 2019).

Despite worldwide understanding of the impacts of climate change and the future humanitarian crises in the absence of rapid reductions in greenhouse gas emissions, deforestation rates continue to increase (US EPA, 2016; Rohat *et al.*, 2019; WHO, 2018). Climate change is therefore a global crisis, though one whose impacts will be felt unequally around the world, with the greatest harm likely to disproportionately affecting vulnerable communities and individuals

in the Global South, and future generations (Nangombe *et al.*, 2018; Mayrhuber *et al.*, 2018). Unless drastic action is taken to eliminate net emissions of greenhouse gases from human activity and remove historical emissions from the atmosphere, the impacts of global climate change will continue for a long time to come (Mayrhuber *et al.*, 2018). Unfortunately, some of its consequences, such as sea-level rise or glacier retreat, will become more severe over time, even if human emissions ceased today (Lancet, 2020; IPCC, 2019; Zhao, 2018).

4.3 Employee Wellbeing and Productivity

Empirical evidence suggests that rise in atmospheric temperatures caused by climate change will make “heat stress” events more common and intensive (WHO, 2018; Sailor *et al.*, 2019). By 2100, the exposure to extremely high temperatures is expected to be four to eight times higher than in the 2010s (Wang *et al.*, 2020; Lancet, 2020). Heat stress in excess of that which the body can tolerate aggravates workers’ occupational risks and vulnerability (Vaidyanathan *et al.*, 2020; IPCC, 2019). Heat stress has for instance been associated with a range of mental health impacts including increased irritability and symptoms of depression and with intensification in suicide (WHO, 2017; Sailor *et al.*, 2019). Heat stress has also been linked to upsurge in aggressive behaviour, incidences of domestic violence, and increased use of alcohol or other substances to cope with stress (WHO, 2017). Several studies have also reported a significant relationship between heat stress and problems with memory, attention and reaction time (IPCC, 2019; WHO, 2018; Obradovitch *et al.* 2017). Excessive heat during work does not only create occupational health risks for workers, but also restricts a worker's physical functions and capabilities, hence reduced labour productivity. Estimates based on labour force trends and a global temperature rise of 1.5°C by the end of the twenty-first century, shows that 2.2 per cent of total working hours worldwide will be lost to high temperatures by year 2030, which is equivalent to a productivity loss of 80 million full-time jobs (Lancet, 2020). Park (2016) for instance reported that excessive heat to a worker operating at moderate work intensity loses about 50 per cent of work capacity. Exposure to excessive heat levels can lead to heatstroke and in some cases, death (Vaidyanathan *et al.*, 2020; Sailor *et al.*, 2019; Rohatet *et al.*, 2019). Though all workers in all economic sectors are affected, some occupations such as those found in agriculture, construction, refuse collection, emergency repair work, transport, tourism and sports, are however more at risk of heat stress than others because they involve more physical effort and/or take place outdoors (IPCC, 2019; Park, 2016; Lucas, Epstein & Kjellstrom, 2014; Lundgren *et al.*, 2013). There is also evidence showing that indoor workers in factories and workshops without proper temperature regulations are also at risk of heat stress and do find performing even basic office and desk tasks difficult as mental fatigue sets in (Sailor *et al.*, 2019). IPCC (2022) and Nangombe *et al.* (2018) report suggested that by limiting global warming to 1.5°C by 2100 would generate a net global benefit of US\$264–610 trillion. The economic case of containing rise in atmospheric temperatures at 1.5°C is further strengthened when considering the benefits of a healthier workforce and reduced health-care costs to employers and communities (Wang *et al.*, 2020; Lancet, 2020; Park, 2016)

4.4 Mitigation for Occupational Heat Stress

Projections based on empirical data suggests that global temperatures are expected to continue if the current trend in emitting heat-trapping greenhouse gases to the atmosphere is maintained

(Zhang, 2020; Zhao, 2018; Taylor *et al.*,2018). The consequences of exposure to extreme temperature for human health can be fatal if adaptation measures will not have been taken (IPCC, 2019; WHO, 2018; Vaidyanathan *et al.*, 2020). There are calls therefore for formulation and implementation of effective adaptation measures as a strategy for protecting people from exposure to high-temperature, including during night time (Zhao, 2018). Mitigation measures can be implemented based on policy implementation and at individual level. Employers for instance can play a critical role in the implementation of effective heat stress adaptation and intervention measures to reduce the impact of exposure to high-temperature. Although it is the government that sets regulations and standards, employers are responsible for providing a safe and healthy workplace and ensuring that working conditions conform to the set occupational health standards in the work place (Gao *et al.*,2018; Campbell *et al.*,2018). Health and safety regulations require employers to evaluate risks in the workplace, and to protect members of staff from serious hazards, including heat stress related dangers (Murtagh, Gatersleben& Fife-Schaw, 2019; Park, 2016; Lucas, Epstein &Kjellstrom, 2014). Depending on the local context, employers could for instance put in place infrastructural measures in buildings, such as solar powered air conditioning, cool roofs, misting and ventilation systems to protect indoor workers (Buonocore *et al.*, 2019; Fajardy *et al.*, 2019; Holmes, Phillips & Wilson, 2016). Members of staff on the other hand can individually take action to reduce their body temperature, such as by drinking water frequently, taking breaks more breaks in cool and shaded areas especially during particularly hot periods, wearing appropriate clothing if working outside, and being alert to the symptoms of heat exhaustion or heatstroke (Rohat *et al.*, 2019; Mayrhuber *et al.*, 2018; Taylor *et al.*, 2018; Akompabet *et al.*,2013).

5. Study Findings and Implications

5.1 Characterization of Respondents

All the four (4) Environmental Management Systems (ISO 14001)certified firms listed by the Kenya Bureau of Standards (KBS, 2022) and operating in Nairobi Metropolitan region were included in this study. The study recorded 75.68% response rate, which means that twenty eight (28) out of thirty seven (37) Human Resource Managers, Senior Executives and or staff representatives responsible for Health Services, Employee Relations, Legal Services, Staff Wellness, Staff Union, Estates Maintenance, Occupational Health and Safety functions participated in the study. The non-response was probably due to a combination of factors including time constraint on the part of the participants, unwillingness to respond to items on the data collection tool. The response rate from the various firms is as presented in Table 5.1.1

Table 5.1.1: Response Rate

S/N	Cert No	Scope of ISO 14001 Certification	RESPONSE	%
1	ENV/20	Training, Research, Innovation and production	8	28.57
2	ENV/008	Healthcare Services and Medical Training	5	17.86
3	ENV/12	Production of Beer, Cider, Spirit and Beverages	8	28.57
4	ENV/030	Extraction of Edible oils from oil bearing seeds	7	25
Total			28	100

As presented in Table 5.1.1, the distribution of respondents in ISO 14001 certified firms in Nairobi Metropolitan region were provision of Training, Research, Innovation and Production at 28.57%, Provision of Healthcare Services and Medical Training at 17.86%, Production of Beer, Cider, Spirit and Adult Non- Alcoholic Beverages (ANADS) and ready to drink Spirit based products at 28.57%, while Extraction of Edible oils from oil bearing seeds were at 25%. The distribution of respondents in Table 5.1.1 assures a well-spread sample from all the ISO 14001 certified firms in the Nairobi Metropolitan Region, Kenya.

5.2 Responses on Heat Stress Acclimatization Interventions

When asked to give their opinion on heat stress acclimatization interventions in the sampled ISO 14001 certified firms, the responses are as presented in Table 5.2.1.

Table 5.2.1: Items on Heat Stress Acclimatization Interventions

Opinion on intervention type	SD %	D %	NS %	A %	SA %	Mean Response
The firm has in place sensitization programmes to raise employee awareness on clothing, hydration technologies or plans	10.7	17.9	39.3	21.4	10.7	3.0
The firm has put in place technological interventions personal heat stress sensors and specialised materials	32.1	42.9	17.9	7.1	-	3.6
The firm has implemented infrastructural interventions such as shelter design, cool housing, shade provision, water provision	-	3.6	17.9	42.9	35.7	4.1
The firm has within its compound adequate nature-based interventions such as parks, green roofs/walls, tress, standing water body	25	60.7	10.7	3.6	-	1.9
The firm has formulated and fully implemented policy interventions such as occupational safety regulations, built environment policy framework	7.1	17.9	42.9	28.6	3.6	3.0
The senior management is aware about the negative effects of prolonged exposure of employees to extreme heat events	17.9	28.6	32.1	17.9	3.6	2.6
The management in the firm continually makes annual budget allocation on heat adaptation intervention measures	17.9	25	28.6	21.4	7.1	2.8
Employees in the firm are aware of the heat adaptation interventions implemented by the management in the firm	10.7	21.4	35.7	25	7.1	3.0

SD- Strongly disagree; D-Disagree; NS-Not sure; A-Agree; SA-Strongly agree

As presented in Table 5.2.1, most of the respondents (39.3%) indicated that the firm has in place sensitization programmes to raise employee awareness on clothing, hydration technologies or plans (mean response 3.0). When asked to confirm whether the firm has in place technological interventions personal heat stress sensors and specialised materials, 42.9% of the respondents disagreed (Mean response 3.6), while 42.9% of the respondents indicated that the firm has implemented infrastructural interventions such as shelter design, cool housing, shade provision,

water provision (mean response 4.1). When asked to comment on whether the senior management is aware about the negative effects of prolonged exposure of employees to extreme heat events, 17.9% (mean response 2.6) of the respondents disagreed, same as the percentage of employees who also disagreed that the management in the firm continually makes annual budget allocation on heat adaptation intervention measures (mean response 2.8).

To establish the level of performance of ISO 14001 certified firms in Kenya in relation to the tested items, a One-Way Analysis of Variance (ANOVA) was conducted on the mean response on the eight tested items. The study established a mean response rate of 3. The respondents were then asked to give their opinion on extreme heat related outcomes in Kenya. The percentage and mean response scores are as presented in Table 5.2.2.

Table 5.2.2: Items on Extreme Heat Related Outcomes

Opinion on Extreme Heat related outcomes	SD %	D %	NS %	A %	SA %	Mean Response
Employees are aware about heat related health impacts such as dehydration, electrolyte imbalance and increased heart rate	3.6	28.6	35.7	21.4	10.7	3.1
The cost incurred in implementing heat adaptation interventions in the firm represents value for money	12.6	35.7	25	21.4	7.1	3.6
Many firms in Kenya have fully complied with government policies and global best practices on environmental management, occupational safety and health	7.1	14.3	53.6	17.9	7.1	3.0
The management is aware about heat related wider outcomes such as labour productivity, hospital burden and household incomes	7.1	21.4	35.7	28.6	7.1	3.1
The current heat adaptation interventions in the firm are appropriate and widely accepted by employees in the firm	0	10.7	21.4	42.9	25	3.8
Employees are aware about heat related health impacts such as mortality linked to heat including low birth weight, preterm birth, kidney dysfunction	17.9	25	35.7	17.9	3.6	2.6
The current heat adaptation interventions in the firm works as intended and can be sustained in the long-term	7.1	10.7	28.6	35.7	17.9	3.5
Employees are aware about heat related mental health impacts such as depression, suicide and substance abuse	14.3	17.9	46.4	14.3	7.1	2.8
Non-management workers are aware that extreme temperature events are associated with climate change	10.7	25	32.1	21.4	10.7	3.0
Line managers agree that extreme temperature events are associated with climate change and rise in atmospheric temperature	7.1	14.3	35.7	25	17.9	3.3

SD- Strongly disagree; D-Disagree; NS-Not sure; A-Agree; SA-Strongly agree

As presented in Table 5.2.2, most of the respondents (46.4%) indicated that they are not sure whether employees in their respective firms are aware about heat related mental health impacts such as depression, suicide and substance abuse (mean response 2.8). Similarly, 53.6% of the respondents are not sure whether many firms in Kenya have fully complied with government policies and global best practices on environmental management, occupational safety and health (mean response 3.0). This is despite 42.9% of the respondents indicating that the current heat adaptation interventions in the firm are appropriate and widely accepted by employees in the firm (mean response 3.8).

To establish the level of performance of ISO 14001 certified firms in Kenya in relation to the tested items, a One-Way Analysis of Variance (ANOVA) was conducted on the mean response on the ten tested items. The study established a mean response rate of 3.18 as presented in Table 5.2.3.

Table 5.2.3: Mean Responses Rate

Item Description	Number of Tested Items	Mean Response Rate	Standard Deviation
Opinion on Extreme Heat Related Outcomes	10	3.18	0.73

When asked what policies and actions can be pursued or changed so as to enhance heat adaptation interventions and reduce vulnerabilities to extreme heat events in Kenya, eight policy issues and effective implementation processes were stated as presented in Table 5.2.4.

Table 5.2.4: Suggestions on Heat Stress Acclimatization Intervention in Kenya

Item Description	f	%
Provision of clean water drinking fountains to help people stay hydrated	25	20
Formulate policy to make it mandatory for urban forests and street trees	23	18.4
Building codes to provide for landscaping and roofs with plant cover	21	16.8
Training to staff and management on climate change associated health threats	20	16
Formulate policy to make ISO 14001 certification mandatory for all firms	14	11.2
Cascade environmental education to lower levels of the school curriculum	9	7.2
Fully enforce existing laws on environmental protection	7	5.6
Curb corruption that allows unsustainable exploitation of natural resources	6	4.8

As presented in Table 5.2.4, 20% of the respondents indicated that there is need for policy reforms to ensure provision of clean water drinking fountains to help people stay hydrated, followed by 18.4% who proposed policy formulation to make it mandatory for urban forests and street trees.

6. Discussion and Implications of the Findings

This study revealed that employees in ISO 14001 certified firms in Kenya are not sufficiently aware about climate change and the consequences of exposure to extreme temperature for human health, including mental health illnesses such as depression, suicide and substance abuse. A

significant number of respondents are also not sure whether many firms in Kenya have fully complied with government policies and global best practices on environmental management, occupational safety and health. When asked to comment on the appropriateness and wide acceptance of the current heat adaptation interventions in their respective firms, 42.9% of the study participants responded in the affirmative, while 21.4% were not sure. The study also revealed that a substantial number of respondents were not sure or disagree with the current heat stress adaptation interventions. The findings seem to suggest that employees in ISO 14001 certified firms in Kenya are vulnerable to health threats associated with prolonged exposure to extreme heat events, hence negative social and economic outcomes such as hospitalization burden, low employee productivity and reduction in household income. Though there is inadequate literature on climate change in Kenya, and particularly empirical data on heat adaptation interventions and implementation outcomes in Kenya, the findings of the study on issues of climate change risk are in agreement with numerous studies conducted in other national, social, economic and industrial contexts (Wattset *al.*, 2020; Arunrat *et al.*, 2017; Beckmann & Hiete, 2021; Campbell *et al.*, 2018; Murtagh Gatersleben & Fife-Schaw, 2019). This finding therefore means inability of ISO 14001 certified firms in Kenya to optimize organizational performance and mitigate the negative effects of heat stress and enhance their contribution to Kenya's big four agenda and realization of Vision 2030.

7. Conclusion and Recommendations

The main purpose of this study was to assess heat adaptation interventions and implementation outcomes in ISO 14001 certified firms in Kenya. After a review of existing literature and empirical data generated by this study, it is concluded that climate change related risks are real to vulnerable communities, including employees in the sampled firms who appear at risk of health threats associated with prolonged exposure to extreme heat events, hence negative social and economic outcomes such as hospitalization burden, low employee productivity and reduction in household income. While this study contributes to existing literature on climate change, the study has identified emerging data gaps as a result of limited real-world data sets on adaptation behaviour within and across communities. As a starting point, there is need for global action to come up with a binding legal framework to facilitate significant reduction in greenhouse gas emissions so as to reduce climate change related risks to vulnerable populations. Prioritizing heat stress intervention strategies for the most vulnerable communities would contribute to a more equitable future within and across communities. The study further recommends additional works in heat stress areas in northern, lower eastern, parts of rift valley, and coastal regions in Kenya. There is also need for more studies in other parts of the global south, more sensitization activities, review of heat adaptation intervention measures and legal framework to promote safety at work places and mitigate effects of climate change. The expected study output is employee wellbeing and enhanced productivity for economic growth.

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