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Climate Change-Induced Heat Stress and Occupational Health among Outdoor Workers in Nigeria

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Abstract

Climate change has emerged as one of the most significant threats to occupational health, particularly for workers whose livelihoods require prolonged exposure to outdoor environments. In Nigeria, rising temperatures, increasing frequency of extreme heat events, and a predominantly informal labour market have heightened the vulnerability of outdoor workers to heat-related illnesses and reduced productivity. Despite growing global attention to occupational heat stress, evidence on its implications for worker health and safety in Nigeria remains fragmented, with limited integration of occupational health into climate adaptation and labour policies. This article examines the nexus between climate change-induced heat stress and occupational health among outdoor workers in Nigeria through a critical review and synthesis of contemporary literature, policy documents, and empirical evidence. Drawing on the Job Demands–Resources Model, the study analyses how increasing environmental heat constitutes a growing occupational demand while inadequate workplace protections and weak institutional support constrain workers' adaptive capacity. The review identifies construction workers, agricultural labourers, street traders, commercial transport operators, sanitation workers, traffic officers, security personnel, and other informal sector workers as the occupational groups most exposed to climate-related heat risks. The analysis further demonstrates that prolonged heat exposure contributes to dehydration, heat exhaustion, cardiovascular strain, kidney dysfunction, impaired cognitive performance, increased workplace accidents, and declining labour productivity, with significant implications for household livelihoods and national economic performance. The article argues that occupational heat stress should be recognised as a critical climate adaptation and public health priority in Nigeria. It recommends the integration of occupational health into national climate adaptation strategies, the development of heat-responsive labour regulations, improved workplace adaptation measures, strengthened occupational health surveillance, and enhanced institutional coordination to safeguard workers and promote climate-resilient and sustainable economic development.

Keywords: Climate change, heat stress, occupational health, outdoor workers, informal employment, climate adaptation, labour productivity, Nigeria.

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Introduction

Climate change has evolved from being primarily an environmental concern to one of the most pressing public health and labour challenges of the twenty-first century. Across the world, rising temperatures, prolonged heatwaves, and increasingly unpredictable weather patterns are altering the conditions under which millions of people live and work. While climate change affects virtually every sector of society, its consequences are disproportionately severe for individuals whose occupations require prolonged exposure to outdoor environments. These workers experience direct physiological stress from excessive heat, often under conditions where access to cooling facilities, potable water, medical support, and occupational safety measures is either inadequate or entirely absent. Consequently, climate change is no longer viewed solely through the lens of environmental sustainability but increasingly as a determinant of worker health, economic productivity, and social equity (Intergovernmental Panel on Climate Change [IPCC], 2023).

Recent evidence demonstrates that occupational heat exposure has become a global health emergency. According to the World Health Organization (WHO), more than 2.4 billion workers, representing over 70% of the global workforce, are routinely exposed to excessive heat during their working lives, resulting in approximately 22.85 million occupational injuries annually. Heat stress contributes to dehydration, heat exhaustion, heat stroke, impaired kidney function, cardiovascular complications, reduced cognitive performance, and increased workplace accidents, while also diminishing labour productivity across heat-sensitive sectors such as agriculture, construction, mining, transport, and waste management. The World Meteorological Organization further notes that the frequency, duration, and intensity of extreme heat events have increased markedly over recent decades, with 2024 recorded as the warmest year in modern history, underscoring the urgency of strengthening occupational health protections in an increasingly warmer world.

The economic implications of workplace heat exposure are equally profound. Excessive heat reduces workers' physical capacity, slows task completion, increases absenteeism, and elevates healthcare expenditures. The International Labour Organization (ILO) estimates that rising temperatures are causing substantial losses in productive working hours globally, particularly in labour-intensive occupations where physical exertion is unavoidable. Beyond immediate health outcomes, prolonged exposure to high ambient temperatures contributes to chronic kidney disease, cardiovascular disorders, respiratory illnesses, and mental fatigue, conditions that undermine workforce resilience and national economic performance. As climate change intensifies, occupational heat stress is increasingly recognised not merely as a workplace hazard but as a development challenge with implications for poverty reduction, decent work, and sustainable economic growth (Azzi et al., 2024).

Although heat stress is a global phenomenon, Africa bears a disproportionate share of its burden because of its geographical location, widespread dependence on climate-sensitive livelihoods, rapid urbanisation, and limited adaptive capacity. Much of the continent experiences high temperatures throughout the year, with climate projections indicating that African countries will continue to warm faster than the global average in many regions. This situation exposes millions of workers to hazardous environmental conditions while simultaneously constraining governments' ability to implement effective occupational health interventions. The predominance of informal employment across African economies further compounds vulnerability because many workers operate outside formal labour protection systems and therefore lack access to occupational health insurance, regulated working hours, or employer-supported heat mitigation measures (IPCC, 2023).

Nigeria exemplifies these vulnerabilities. As Africa's largest economy and most populous country, Nigeria has experienced increasingly frequent episodes of extreme heat, prolonged dry seasons, and rising average temperatures over the past two decades. These climatic changes coincide with a labour market in which a substantial proportion of the workforce earns its livelihood through outdoor occupations, including farming, construction, street trading, commercial transportation, waste collection, traffic control, security services, and public infrastructure maintenance. For many of these workers, daily income depends directly on continuous physical activity under the sun, leaving little opportunity to reduce working hours during periods of dangerous heat. The economic necessity to remain at work often outweighs concerns about personal health, thereby increasing susceptibility to heat-related illnesses and occupational injuries. Moreover, Nigeria's occupational safety framework has

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historically focused on traditional workplace hazards while paying comparatively little attention to climate-induced risks such as extreme heat exposure, creating significant policy and regulatory gaps.

The challenge is particularly acute within Nigeria's informal economy, which employs the overwhelming majority of the country's labour force. Unlike workers in highly regulated industries, informal outdoor workers frequently operate without structured work schedules, adequate rest breaks, shaded workspaces, clean drinking water, or employer-sponsored health services. Street vendors remain exposed to solar radiation throughout the day, construction labourers undertake strenuous physical activities on exposed sites, traffic wardens spend prolonged periods managing congested roads under intense sunlight, while waste collectors and commercial motorcyclists perform physically demanding tasks in environments characterised by high ambient temperatures and poor air quality. These occupational realities transform climate change from an abstract environmental phenomenon into a daily public health concern that directly threatens workers' wellbeing, household incomes, and national productivity.

Emerging Nigerian studies suggest that heat stress is already affecting workers' health and productivity, particularly in northern cities where temperatures frequently exceed internationally recommended occupational thresholds. For example, evidence from Kano State indicates that outdoor workers commonly experience dehydration, fatigue, dizziness, headaches, reduced concentration, and declining work performance during periods of intense heat, while many rely on informal coping mechanisms such as increased water consumption, temporary shade seeking, or adjusting work hours rather than structured occupational health interventions. These adaptive practices, although helpful, remain insufficient against the escalating intensity of climate change and highlight the absence of institutional responses capable of protecting vulnerable workers.

Despite increasing international attention to climate-related occupational hazards, research focusing specifically on climate change-induced heat stress among outdoor workers in Nigeria remains limited. Existing Nigerian studies are often geographically restricted, occupation-specific, or primarily concerned with environmental or meteorological dimensions of climate change, giving comparatively little attention to occupational health outcomes, labour productivity, institutional preparedness, and policy effectiveness. Consequently, important questions remain regarding the magnitude of occupational heat exposure, the adequacy of existing labour protections, and the policy reforms required to safeguard workers in an era of accelerating climate change.

Against this background, this article examines the relationship between climate change-induced heat stress and occupational health among outdoor workers in Nigeria. It synthesises contemporary empirical evidence to analyse the health consequences of prolonged heat exposure, identifies the occupational groups most at risk, evaluates existing policy and institutional responses, and proposes practical strategies for strengthening occupational health resilience within Nigeria's changing climatic environment. In doing so, the paper contributes to the growing body of scholarship that positions climate change not only as an environmental crisis but also as a critical occupational health and development challenge requiring coordinated action across the health, labour, and environmental sectors.

Conceptual Review

Climate Change, Heat Stress and Occupational Health: Understanding the Nexus

The relationship between climate change and occupational health has received increasing scholarly attention over the past decade as global warming continues to redefine workplace hazards. Earlier discussions of climate change largely focused on environmental degradation, biodiversity loss, and rising sea levels. Contemporary scholarship, however, recognises that climate change is equally a labour and public health issue because changing climatic conditions directly influence the safety, productivity, and wellbeing of workers whose occupations depend on prolonged exposure to outdoor environments (IPCC, 2023). Rather than constituting an isolated environmental phenomenon, climate change has become a structural determinant of occupational risk, particularly in low and middle-income countries where adaptive capacity remains constrained.

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change in climate attributable directly or indirectly to human activity that alters the composition of the global atmosphere in addition to natural climate variability observed over comparable periods (UNFCCC, 1992). While this

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definition remains foundational, more recent scholarship places greater emphasis on the socio-economic consequences of climatic changes, arguing that rising temperatures, altered rainfall regimes, and increasing frequency of extreme weather events fundamentally reshape patterns of employment, labour productivity, and occupational safety (Romanello et al., 2024). Climate change therefore extends beyond environmental transformation to become a significant driver of workplace vulnerability.

Among the numerous pathways through which climate change affects workers, excessive heat exposure has emerged as one of the most immediate and measurable threats. Heat stress occurs when environmental conditions exceed the body's physiological capacity to regulate internal temperature through sweating and other thermoregulatory mechanisms. The World Health Organization (2025) explains that occupational heat stress results from the interaction of high ambient temperature, humidity, solar radiation, physical workload, clothing, and inadequate recovery periods. When these factors combine, the human body struggles to dissipate excess heat, increasing the likelihood of dehydration, heat exhaustion, heat stroke, kidney injury, cardiovascular strain, and even mortality.

Importantly, heat stress should not be understood solely as a medical condition but also as an occupational hazard whose consequences extend beyond individual health. Scholars increasingly argue that excessive workplace heat reduces workers' physical endurance, impairs concentration, slows decision-making, and increases the probability of occupational accidents. Kjellstrom et al. (2016) contend that thermal stress diminishes both cognitive and physical work capacity, particularly in occupations involving heavy manual labour. Similarly, Flouris et al. (2018) demonstrate that prolonged exposure to high temperatures significantly increases fatigue and reduces productivity, thereby affecting both worker welfare and organisational performance. These findings suggest that occupational heat stress represents an intersection between environmental health, labour economics, and workplace safety.

The vulnerability of workers to climate-induced heat stress is not evenly distributed. Exposure varies according to occupation, geographical location, age, gender, socio-economic status, and access to occupational protections. Workers employed in agriculture, construction, transportation, mining, waste management, and street trading are consistently identified as among the most vulnerable because their duties require prolonged exposure to direct sunlight while involving substantial physical exertion. In many developing countries, these occupations are characterised by informal employment arrangements that provide limited legal protection, inadequate occupational health services, and minimal employer accountability (ILO, 2024). Consequently, climate change amplifies pre-existing labour inequalities by disproportionately affecting populations already experiencing economic and social disadvantage.

Nigeria presents a particularly compelling context for understanding this relationship. The country's tropical climate, rapid urbanisation, expanding informal economy, and limited enforcement of occupational safety regulations combine to create conditions under which climate-induced heat stress poses a significant public health challenge. According to the National Bureau of Statistics (2023), informal employment continues to dominate Nigeria's labour market, accounting for the livelihoods of millions of workers engaged in occupations requiring sustained outdoor activity. Construction workers, commercial motorcyclists, roadside traders, traffic officers, security personnel, artisans, refuse collectors, and agricultural labourers frequently work under temperatures exceeding internationally recommended occupational thresholds without adequate access to shade, hydration, or regulated rest periods. Their exposure is therefore shaped not only by climatic conditions but also by economic necessity, weak labour institutions, and inadequate occupational health governance.

Recent Nigerian studies reinforce these concerns. Adebayo et al. (2024), examining construction workers in southwestern Nigeria, found that prolonged exposure to extreme heat was associated with increased reports of fatigue, dizziness, dehydration, reduced concentration, and lower productivity. Similar observations have been reported among agricultural workers in northern Nigeria, where rising temperatures have shortened effective working hours while increasing the incidence of heat-related illnesses (Yakubu & Ibrahim, 2023). These studies suggest that climate change is already altering occupational health outcomes across multiple sectors, although national evidence remains fragmented and geographically uneven.

Beyond its health implications, occupational heat stress carries substantial economic consequences. The International Labour Organization (2024)

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estimates that rising workplace temperatures reduce productive working hours through diminished physical performance and increased absenteeism. In countries such as Nigeria, where labour-intensive occupations contribute significantly to household incomes and national output, reduced work capacity translates directly into declining earnings, heightened poverty risks, and slower economic growth. Informal workers are particularly vulnerable because income is generally tied to daily labour rather than salaried employment, leaving little opportunity to reduce exposure during periods of extreme heat without sacrificing economic survival.

This evolving body of scholarship demonstrates that climate change, heat stress, and occupational health are inseparable components of a broader development challenge. Climate change intensifies environmental heat exposure; excessive heat compromises workers' health and productivity; and inadequate occupational health systems amplify these risks, particularly within informal economies. Understanding these interconnected processes is therefore essential for designing effective labour policies, occupational health interventions, and climate adaptation strategies capable of protecting vulnerable workers in Nigeria.

Theoretical Framework

The Job Demands–Resources (JD-R) Model

The Job Demands–Resources (JD-R) Model, originally developed by Demerouti et al. (2001) and subsequently refined by Bakker and Demerouti (2007, 2017), provides a comprehensive framework for understanding how workplace characteristics influence employees' health, wellbeing, and performance. The model argues that every occupation is characterised by two broad categories of work conditions: job demands and job resources. Job demands refer to the physical, psychological, social, or organisational aspects of work that require sustained effort and are therefore associated with physiological and psychological costs. Conversely, job resources are the physical, organisational, social, or institutional factors that help workers achieve work goals, reduce job demands, or stimulate learning, resilience, and professional growth.

Although the JD-R Model was initially developed to explain occupational stress and burnout in organisational settings, it has increasingly been applied to climate-related occupational health research because environmental conditions have become critical determinants of workplace demands. Scholars argue that climate change has fundamentally altered the nature of work, particularly in occupations requiring prolonged outdoor exposure. Rising temperatures, increased humidity, stronger solar radiation, and more frequent heatwaves now constitute environmental job demands that significantly increase workers' physical and cognitive workload (Bakker & Demerouti, 2017; Flouris et al., 2018). Consequently, climate change has expanded the scope of occupational hazards beyond conventional workplace risks to include environmental stressors that challenge workers' health and productivity.

Within the context of outdoor work, climate-induced heat represents one of the most significant environmental job demands. Outdoor workers expend substantial physical energy while simultaneously attempting to regulate body temperature under increasingly hostile climatic conditions. High ambient temperatures accelerate dehydration, elevate cardiovascular strain, increase metabolic stress, impair concentration, and reduce physical endurance. These physiological responses not only increase the likelihood of heat-related illnesses but also diminish workers' ability to perform their tasks safely and efficiently. As environmental heat intensifies, workers experience greater fatigue, slower reaction times, impaired decision-making, and heightened susceptibility to occupational injuries.

The second component of the JD-R Model, job resources, is equally relevant to understanding occupational heat stress. Job resources include all workplace conditions that assist workers in coping with occupational demands. Examples include access to clean drinking water, shaded rest areas, scheduled rest breaks, personal protective equipment designed for hot environments, flexible work schedules, occupational health services, medical surveillance, heat warning systems, supportive supervision, and effective labour regulations. These resources reduce physiological strain and enhance workers' ability to maintain productivity despite challenging environmental conditions. Bakker and Demerouti (2017) argue that adequate job resources can buffer the adverse effects of excessive job demands, thereby protecting employee health and sustaining organisational performance.

Unfortunately, the occupational realities of many Nigerian outdoor workers reveal a substantial imbalance between increasing job demands and limited job resources. Climate change has intensified environmental heat exposure across

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much of the country, yet occupational protections have not evolved at a comparable pace. Construction workers frequently undertake physically demanding activities under direct sunlight with limited opportunities for scheduled hydration or cooling. Street traders remain exposed to extreme temperatures for prolonged periods because income generation depends on continuous market presence. Agricultural workers often work during the hottest periods of the day to maximise productivity within seasonal farming cycles, while traffic wardens, waste collectors, commercial motorcyclists, security guards, and road maintenance workers similarly operate under conditions characterised by high temperatures, prolonged standing, and limited institutional support.

This imbalance produces the central mechanism described by the JD-R Model. As environmental job demands continue to rise without corresponding improvements in occupational resources, workers become increasingly vulnerable to physiological exhaustion, declining health, reduced motivation, and lower productivity. The model predicts that sustained exposure to excessive demands without adequate resources eventually leads to chronic occupational strain, burnout, increased absenteeism, workplace accidents, and deteriorating physical wellbeing. Emerging evidence from climate and occupational health research supports this proposition, demonstrating that heat exposure significantly reduces work capacity while increasing the incidence of occupational illnesses and injuries, particularly among workers in labour-intensive occupations (Flouris et al., 2018; ILO, 2024).

The applicability of the JD-R Model to Nigeria extends beyond individual workplaces to encompass broader institutional and policy environments. In countries where occupational safety legislation inadequately addresses climate-related risks, government institutions effectively fail to provide critical job resources necessary for worker protection. Weak enforcement of occupational health regulations, inadequate investment in workplace adaptation measures, limited climate-sensitive labour policies, and insufficient public health interventions collectively reduce the capacity of workers and employers to respond effectively to rising temperatures. Consequently, occupational heat stress becomes not merely an individual health issue but a reflection of institutional preparedness and governance capacity.

The model also provides a useful lens for understanding inequalities in occupational vulnerability. Not all outdoor workers experience identical levels of risk because access to job resources varies considerably across sectors, employment arrangements, and socio-economic groups. Workers in formal organisations may benefit from occupational health policies, regulated working hours, and employer-provided protective measures. In contrast, informal workers, who constitute the majority of Nigeria's labour force, often lack these safeguards. Their dependence on daily earnings frequently compels them to continue working despite dangerous heat conditions, thereby increasing cumulative physiological stress and long-term health risks. The JD-R Model therefore helps explain why climate change disproportionately affects economically vulnerable workers even when environmental exposure appears similar.

This article adopts the Job Demands–Resources Model because it provides a comprehensive framework for analysing the interaction between climate-induced heat exposure, occupational health, and institutional capacity in Nigeria. It enables the study to examine how increasing environmental demands generated by climate change intersect with deficiencies in workplace resources to produce adverse health outcomes among outdoor workers. Furthermore, the model offers a practical basis for identifying policy interventions aimed at reducing occupational risks through strengthened labour regulations, improved workplace adaptation strategies, enhanced occupational health services, and climate-responsive governance.

Empirical Review

Global Evidence on Climate Change, Heat Stress and Occupational Health

The relationship between climate change and occupational heat stress has become one of the fastest-growing areas of environmental and occupational health research. Earlier studies concentrated primarily on physiological responses to heat exposure, but recent scholarship increasingly examines its broader implications for labour productivity, workplace safety, public health, and economic development. This shift reflects growing recognition that climate change is altering working conditions across multiple sectors, particularly those requiring sustained outdoor physical activity.

Evidence from high-income and low-income countries consistently demonstrates that rising temperatures significantly increase occupational health risks. A comprehensive meta-analysis by Flouris et al. (2018), involving studies across

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multiple climatic regions, found that excessive occupational heat exposure substantially increases dehydration, heat exhaustion, cardiovascular strain, kidney dysfunction, fatigue, and workplace injuries while simultaneously reducing workers' physical performance. The authors argued that heat stress should no longer be viewed as an isolated occupational hazard but as a systemic challenge requiring coordinated responses across labour, health, and environmental sectors.

Similarly, the **Lancet Countdown on Health and Climate Change** has repeatedly reported that global warming is reducing the number of safe working hours available for physically demanding occupations. Romanello et al. (2024) estimated that millions of productive labour hours are now lost annually because temperatures exceed safe physiological thresholds, particularly in agriculture, construction, mining, transport, and manufacturing. These productivity losses disproportionately affect low-income economies where manual labour remains central to economic activity.

Beyond productivity, scholars increasingly identify heat stress as a contributor to occupational injuries. Elevated temperatures impair concentration, reduce reaction time, increase fatigue, and compromise decision-making, thereby increasing accident rates in physically demanding occupations (Varghese et al., 2020). Workers exposed to prolonged heat also experience reduced cognitive functioning, making errors more likely during complex or hazardous tasks. Consequently, occupational heat stress has become recognised not only as a medical issue but also as a workplace safety concern with significant economic consequences.

Recent studies further demonstrate that the effects of heat stress extend beyond immediate illness. Long-term exposure has been associated with chronic kidney disease, cardiovascular disorders, respiratory complications, adverse mental health outcomes, and declining overall work capacity (WHO, 2025). These findings have shifted international discourse from emergency response toward long-term climate adaptation strategies that integrate occupational health into national climate policies.

Although there is broad agreement regarding the adverse effects of excessive workplace heat, much of the existing global evidence originates from Europe, North America, and Australia, where occupational health systems, labour regulations, and workplace adaptation measures are considerably stronger than those found in many developing countries. Consequently, the direct applicability of these findings to African contexts remains constrained by differences in climatic conditions, labour markets, institutional capacity, and socio-economic realities.

Evidence from Africa

Africa has emerged as one of the regions most vulnerable to climate-induced occupational heat stress. Rising temperatures, recurrent droughts, rapid urbanisation, widespread informal employment, and limited occupational health infrastructure combine to increase workers' exposure to extreme environmental conditions. Unlike many industrialised countries, a substantial proportion of African workers earn their livelihoods through agriculture, construction, mining, transport, and informal commerce, occupations characterised by prolonged outdoor activity and limited institutional protection.

Studies conducted across Sub-Saharan Africa consistently identify agriculture and construction as the sectors most affected by increasing temperatures. Research in Ghana, Kenya, Ethiopia, and South Africa indicates that excessive heat contributes to dehydration, musculoskeletal fatigue, heat exhaustion, reduced physical work capacity, and declining labour productivity (Mogaka et al., 2023). Similar patterns have been observed among informal traders who frequently operate in densely populated urban centres where limited vegetation, poor urban planning, and expanding concrete infrastructure intensify heat exposure through the urban heat island effect.

A notable feature of African scholarship is its emphasis on adaptive behaviour. Workers commonly respond to increasing temperatures by adjusting working hours, increasing water intake, seeking temporary shade, reducing work intensity, or relying on informal coping strategies. While these responses provide short-term relief, researchers argue that they are largely autonomous adaptations driven by necessity rather than outcomes of institutional planning. Consequently, they remain insufficient as climate change continues to increase the frequency and intensity of extreme heat events.

Another recurring finding concerns the weakness of occupational health governance across many African countries. Existing labour legislation often addresses conventional workplace hazards such as machinery accidents and chemical exposure while providing limited guidance on climate-related occupational risks. As a result, employers frequently

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lack legally enforceable standards regarding hydration, heat monitoring, rest schedules, or maximum allowable workplace temperatures. Scholars therefore advocate integrating climate adaptation into occupational safety legislation as an essential component of sustainable development across the continent.

Despite these advances, African research remains unevenly distributed. South Africa contributes a substantial proportion of published studies, while evidence from West Africa, including Nigeria, remains comparatively limited. This geographical imbalance constrains regional understanding because climatic conditions, labour market structures, and institutional responses differ significantly across African countries.

Empirical Evidence from Nigeria

In Nigeria, research on climate change has traditionally concentrated on agriculture, food security, flooding, desertification, and environmental degradation, with comparatively limited attention given to occupational heat stress. Nevertheless, emerging evidence suggests that rising temperatures are already affecting the health, safety, and productivity of outdoor workers across different sectors of the economy.

Construction workers represent one of the most frequently studied occupational groups. Recent investigations reveal that prolonged exposure to high temperatures is associated with dehydration, headaches, muscle cramps, fatigue, dizziness, reduced concentration, and declining work performance. Workers also report increased discomfort during peak afternoon temperatures, yet economic pressures frequently compel them to continue working despite deteriorating physical conditions. Limited access to shaded rest areas, inconsistent hydration practices, and inadequate employer awareness further increase occupational vulnerability.

Agricultural workers face similar challenges. Studies conducted in northern Nigeria indicate that increasing temperatures have shortened effective working periods while reducing physical endurance during planting and harvesting seasons. Farmers increasingly report modifying work schedules by beginning earlier in the morning or working later in the evening to avoid extreme daytime heat. Although such adjustments demonstrate local adaptive capacity, they also illustrate the growing influence of climate change on labour organisation and agricultural productivity.

Evidence among informal urban workers paints a comparable picture. Street traders, commercial motorcyclists, roadside artisans, traffic wardens, refuse collectors, and security personnel often spend between eight and twelve hours daily under direct sunlight without structured occupational protection. Research indicates that many rely primarily on self-financed coping strategies, including increased water consumption, temporary shade, and reduced work intensity during exceptionally hot periods. However, these measures remain inconsistent because reduced working hours frequently translate directly into lower daily earnings.

Institutional responses have received comparatively little empirical attention. Existing studies generally conclude that Nigeria's occupational health framework has yet to fully incorporate climate-induced heat as a significant workplace hazard. Occupational Safety and Health regulations remain focused largely on conventional industrial risks, while specific standards governing heat exposure, work-rest cycles, hydration requirements, or employer responsibilities during extreme heat events remain underdeveloped. Consequently, climate adaptation policies and occupational health governance continue to operate largely as separate policy domains despite their increasing interdependence.

Methodologically, Nigerian studies exhibit several limitations. Many rely on cross-sectional survey designs within single occupational groups or specific geographical locations, limiting the generalisability of findings. Sample sizes are frequently modest, longitudinal evidence remains scarce, and relatively few studies integrate physiological measurements with workers' self-reported experiences. Furthermore, existing research often examines occupational health or climate change independently rather than exploring their interaction within broader labour and governance frameworks.

These limitations reveal a significant knowledge gap. While available evidence confirms that Nigerian outdoor workers are increasingly exposed to hazardous heat conditions, there remains limited synthesis of how climate change is transforming occupational health across different categories of outdoor employment. There is also insufficient attention to the institutional, regulatory, and policy dimensions that shape workers' vulnerability and adaptive capacity. Addressing these gaps is essential

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for developing evidence-based interventions capable of protecting outdoor workers in a rapidly warming climate.

Climate Change-Induced Heat Stress and Occupational Health among Outdoor Workers in Nigeria

Nigeria is increasingly experiencing the occupational consequences of a warming climate. While climate change is often discussed in relation to flooding, desertification, food security, and biodiversity loss, its implications for occupational health have received comparatively limited policy attention. Yet, for millions of Nigerians whose livelihoods depend on outdoor work, rising temperatures are no longer abstract climatic trends but daily realities that shape how they work, how much they earn, and, ultimately, how healthy they remain. In many parts of the country, particularly during the dry season, daytime temperatures regularly exceed 35°C, while northern states often experience even higher temperatures accompanied by low humidity and intense solar radiation. Under such conditions, the human body's capacity to dissipate heat becomes increasingly compromised, especially during prolonged physical exertion. The result is a growing burden of heat-related illnesses that remains largely under-recognised within Nigeria's occupational health system (NiMet, 2024; IPCC, 2023).

Nigeria's labour market amplifies this challenge. According to the National Bureau of Statistics (2023), the majority of employed Nigerians work within the informal economy, where labour protections are weak, occupational health services are scarce, and income is closely tied to daily physical activity. Unlike workers in climate-controlled offices or regulated industrial settings, informal outdoor workers often determine their working hours based on economic necessity rather than environmental safety. Missing a day's work because of extreme heat may mean losing the income needed to purchase food, pay transport fares, or support dependants. Consequently, many continue working despite experiencing symptoms of heat exhaustion, dehydration, or fatigue, inadvertently increasing their vulnerability to more serious health complications.

The burden of climate-induced heat stress is not evenly distributed across occupations. Certain categories of workers face particularly high exposure because the nature of their jobs combines prolonged outdoor activity with strenuous physical effort and limited access to protective resources. Construction workers, agricultural labourers, street traders, waste collectors, traffic management personnel, commercial motorcyclists, roadside artisans, security guards, and electricity distribution technicians all spend extended periods under direct sunlight, often without structured rest breaks, adequate hydration, or shaded workspaces. The cumulative effect of these conditions extends beyond discomfort, manifesting in measurable declines in physical capacity, cognitive performance, and occupational safety.

Table 1

Climate Change-Induced Heat Stress and Occupational Health Risks among Outdoor Workers in Nigeria

Occupational Group	Primary Work Environment	Heat Exposure Level	Major Occupational Health Risks	Productivity Implications
Agricultural workers	Farms and open fields	Very High	Dehydration, heat exhaustion, kidney stress, fatigue	Reduced work hours, lower crop productivity
Construction workers	Building sites	Very High	Heat stroke, muscle cramps, cardiovascular strain, workplace accidents	Declining physical output and increased injury rates

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Occupational Group	Primary Work Environment	Heat Exposure Level	Major Occupational Health Risks	Productivity Implications
Street traders	Roadsides and open markets	High	Heat exhaustion, headaches, dehydration	Reduced customer engagement and daily income
Commercial motorcyclists/tricycle operators	Urban roads	High	Heat stress, fatigue, impaired concentration	Increased accident risks and lower trip frequency
Traffic officers	Road intersections	Very High	Heat exhaustion, dizziness, cardiovascular stress	Reduced efficiency in traffic management
Waste management workers	Dumpsites and streets	High	Dehydration, respiratory stress, heat-related illnesses	Reduced operational efficiency
Security personnel	Outdoor security posts	High	Fatigue, dehydration, reduced alertness	Lower vigilance and work performance
Electricity distribution technicians	Outdoor maintenance sites	High	Heat exhaustion, physical fatigue, accident risks	Delayed maintenance and increased operational hazards

Source: *Compiled by the authors from IPCC (2023), International Labour Organization (2024), World Health Organization (2025), and reviewed literature.*

Construction workers represent one of the occupational groups most vulnerable to excessive heat exposure. Large-scale infrastructure development across cities such as Lagos, Abuja, Kano, and Port Harcourt has expanded demand for manual construction labour, much of which is performed during peak daytime temperatures. Activities such as concrete mixing, steel fixing, roofing, excavation, and block laying require continuous physical exertion that substantially increases metabolic heat production. When combined with elevated ambient temperatures and direct solar radiation, workers experience accelerated dehydration, muscle fatigue, dizziness, and reduced concentration. These physiological responses increase the likelihood of workplace accidents, particularly when operating heavy machinery or working at elevated heights. Despite these risks, heat-specific occupational safety protocols remain uncommon across many construction sites, particularly those operating within the informal sector.

Agricultural workers experience a different but equally significant form of occupational vulnerability. Agriculture remains one of Nigeria's largest employers, with millions engaged in crop cultivation, livestock production, and related activities. Farming activities frequently coincide with periods of intense solar radiation because planting, weeding, irrigation, and harvesting are often time-sensitive and cannot easily be postponed. In northern Nigeria, where temperatures during the dry season can exceed 40°C, farmers increasingly report shorter periods of productive work before fatigue sets in. Some have responded by beginning work before sunrise or resuming activities in the late afternoon, demonstrating local adaptation to changing climatic conditions. However, such adjustments are constrained by labour demands, market schedules, and security concerns, limiting their overall effectiveness.

Urban informal workers constitute another highly exposed population. Across Nigerian cities, thousands of street traders operate daily along

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roadsides, open markets, and transport terminals where concrete surfaces, vehicular emissions, and limited vegetation intensify ambient temperatures through the urban heat island effect. These traders frequently remain outdoors for eight to twelve hours each day because income depends on maintaining visibility to customers. Commercial motorcyclists and tricycle operators face similar exposure while navigating congested urban roads under prolonged sunlight. In addition to thermal stress, these workers contend with traffic pollution, noise, and psychological stress, creating multiple interacting occupational hazards that compound the health effects of excessive heat.

Public service occupations are not exempt from these risks. Traffic officers, road maintenance personnel, sanitation workers, and security guards routinely perform essential public functions under extreme environmental conditions. Traffic officers may spend entire shifts standing on asphalt intersections that absorb and radiate heat, while waste management workers undertake physically demanding tasks involving lifting, carrying, and prolonged walking. Security personnel stationed at banks, hospitals, schools, and government facilities often have little opportunity to leave their duty posts even during periods of extreme heat. Yet these occupational groups receive relatively little attention within discussions of climate adaptation despite providing services that are indispensable to urban functioning.

The health consequences of prolonged occupational heat exposure are extensive and extend beyond acute medical emergencies. Heat exhaustion, characterised by excessive sweating, weakness, dizziness, headache, nausea, and muscle cramps, is among the most commonly reported outcomes. Without timely intervention, heat exhaustion may progress to heat stroke, a life-threatening condition involving failure of the body's thermoregulatory mechanisms. Increasing evidence also links chronic occupational heat exposure with kidney disease, cardiovascular disorders, electrolyte imbalance, sleep disturbances, impaired mental wellbeing, and declining cognitive performance. Workers experiencing persistent fatigue are more likely to make errors, misjudge hazards, and suffer occupational injuries, particularly in environments requiring sustained concentration or heavy physical labour.

Table 2

Occupational and Socio-economic Consequences of Climate-Induced Heat Stress in Nigeria

Dimension	Observed Effects	Potential National Implications
Physical health	Heat exhaustion, dehydration, heat stroke, chronic kidney disease, cardiovascular strain	Increased healthcare costs and morbidity
Occupational safety	Reduced concentration, slower reaction time, increased workplace accidents	Higher injury rates and compensation costs
Labour productivity	Fatigue, reduced physical capacity, shorter working hours	Loss of productive labour hours and economic output
Household welfare	Reduced daily income, increased medical expenses	Higher poverty and food insecurity
Enterprise performance	Absenteeism, declining productivity, operational delays	Reduced profitability and business sustainability
National economy	Lower workforce productivity and increased public health expenditure	Slower economic growth and reduced climate resilience

Source: *Authors' synthesis based on ILO (2024), WHO (2025), Romanello et al. (2024), and IPCC (2023).*

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These health outcomes carry substantial economic implications. At the individual level, illness reduces earning capacity, increases healthcare expenditure, and threatens household livelihoods. At the organisational level, employers experience declining productivity, increased absenteeism, higher accident rates, and reduced operational efficiency. Nationally, the cumulative effect is reflected in lost labour hours, reduced economic output, and rising public health costs. The International Labour Organization (2024) argues that occupational heat stress should therefore be understood not merely as a health concern but as a labour market and development issue capable of undermining economic growth if left unaddressed.

Despite these growing risks, institutional responses in Nigeria remain fragmented. The Climate Change Act 2021 established an important legal framework for national climate governance by promoting mitigation and adaptation across sectors. However, occupational heat stress receives little explicit attention within implementation strategies. Similarly, existing occupational safety regulations provide only limited guidance on heat exposure management, hydration standards, work-rest cycles, or employer responsibilities during periods of extreme temperature. Consequently, climate policy and occupational health policy continue to operate in parallel rather than as integrated components of a comprehensive adaptation strategy.

The absence of climate-responsive occupational policies also reflects broader structural challenges. Labour inspections remain limited, particularly within the informal economy where the majority of outdoor workers are employed. Small and medium-sized enterprises often lack both the financial resources and technical knowledge needed to implement workplace heat adaptation measures. Informal workers, who are typically self-employed or engaged in casual labour, have no employers responsible for providing protective infrastructure. This institutional gap shifts responsibility for climate adaptation almost entirely onto individual workers, despite the fact that the drivers of vulnerability are systemic rather than personal.

Addressing climate-induced occupational heat stress therefore requires a shift in policy thinking. Adaptation should extend beyond environmental planning to include occupational health as a core component of climate resilience. Employers should implement heat action plans that include mandatory hydration breaks, shaded rest areas, flexible work schedules during extreme heat events, and routine heat-risk assessments. Government agencies, particularly the Federal Ministry of Labour and Employment, the Federal Ministry of Health, the Federal Ministry of Environment, and the Nigerian Meteorological Agency, should collaborate to develop nationally applicable workplace heat standards and early warning systems linked to weather forecasts. Public awareness campaigns, employer training programmes, and strengthened labour inspections should complement these interventions to ensure that occupational health keeps pace with Nigeria's changing climate.

Ultimately, protecting outdoor workers from climate-induced heat stress is not simply a matter of improving workplace safety; it is central to safeguarding public health, sustaining economic productivity, and advancing climate justice. Workers who build roads, cultivate food, manage traffic, collect waste, transport passengers, and secure public spaces perform functions essential to national development. Ensuring that they can do so safely in a warming climate is therefore both an ethical responsibility and a strategic investment in Nigeria's sustainable future.

Policy Implications

The evidence presented in this article suggests that climate-induced heat stress has evolved into a significant occupational health challenge that requires policy attention beyond the traditional boundaries of environmental management. Although Nigeria has made notable progress in developing climate governance through the Climate Change Act (2021) and the establishment of national adaptation frameworks, occupational health remains insufficiently integrated into climate policy. This disconnect reflects a broader tendency to treat climate change primarily as an environmental issue while overlooking its implications for labour markets, workplace safety, and public health. As temperatures continue to rise, such a fragmented policy approach is unlikely to provide adequate protection for workers whose livelihoods depend on prolonged outdoor activity.

One important implication concerns the need to reposition occupational health within Nigeria's climate adaptation agenda. Existing adaptation strategies have focused largely on agriculture, water resources, disaster risk reduction, and ecosystem management. While these priorities remain important, they do not adequately address the

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growing health risks facing millions of outdoor workers. Climate adaptation should therefore incorporate workplace resilience by recognising heat exposure as a climate-sensitive occupational hazard requiring dedicated planning, financing, and institutional oversight. Such integration would align Nigeria's adaptation efforts with the Sustainable Development Goals, particularly Goal 3 (Good Health and Well-being), Goal 8 (Decent Work and Economic Growth), and Goal 13 (Climate Action).

The analysis also raises important questions regarding labour regulation. Current occupational safety provisions in Nigeria were developed largely in response to conventional industrial hazards such as machinery accidents, chemical exposure, and electrical risks. While these regulations remain relevant, they provide limited guidance on managing climate-related hazards. The absence of nationally recognised heat exposure standards, work-rest schedules, hydration requirements, and employer obligations during extreme heat events creates regulatory uncertainty for both employers and workers. Developing climate-responsive occupational safety guidelines would therefore represent a significant step towards protecting worker health in a changing climate.

Institutional coordination represents another critical policy concern. Climate governance, labour administration, occupational health, and meteorological services currently operate through separate institutional arrangements with limited collaboration. Effective management of occupational heat stress requires coordinated action involving the Federal Ministry of Labour and Employment, the Federal Ministry of Health, the Federal Ministry of Environment, the Nigerian Meteorological Agency, state ministries, local governments, employers' associations, and organised labour. Such collaboration would facilitate the development of early warning systems, workplace heat advisories, occupational health surveillance, and evidence-based intervention programmes.

The predominance of informal employment presents perhaps the greatest policy challenge. Most outdoor workers in Nigeria are self-employed or engaged in informal labour arrangements where employer responsibility is either weak or non-existent. Consequently, policy interventions that rely exclusively on employer compliance will fail to reach a substantial proportion of those most vulnerable to climate-induced heat stress. Adaptation strategies must therefore extend beyond formal workplaces to include community-based health education, public cooling facilities in major markets and transport terminals, accessible drinking water infrastructure, and social protection mechanisms that reduce the economic pressure to work during periods of dangerous heat exposure.

Finally, improving occupational resilience requires strengthening research and surveillance systems. Nigeria currently lacks comprehensive national data on heat-related occupational illnesses, workplace injuries associated with high temperatures, and productivity losses attributable to climate change. Without reliable evidence, policymakers face significant challenges in prioritising interventions and allocating resources effectively. Establishing routine surveillance of occupational heat-related illnesses, supported by collaborations between universities, public health institutions, and labour agencies, would generate the empirical evidence necessary for evidence-informed policymaking.

Conclusion

Climate change is reshaping the world of work in ways that extend far beyond environmental degradation. For outdoor workers in Nigeria, rising temperatures have become a daily occupational hazard that threatens health, productivity, and economic security. This article has shown that climate-induced heat stress is no longer an emerging concern but an increasingly evident occupational health challenge affecting diverse categories of workers, including construction labourers, agricultural workers, street traders, commercial transport operators, sanitation personnel, traffic officers, security guards, and other occupations requiring prolonged outdoor exposure.

Drawing on contemporary scholarship, the article demonstrates that excessive heat exposure contributes to dehydration, heat exhaustion, cardiovascular strain, kidney dysfunction, impaired cognitive performance, workplace accidents, and declining labour productivity. These impacts are intensified by the structural characteristics of Nigeria's labour market, particularly the dominance of informal employment, limited occupational health protections, inadequate workplace infrastructure, and insufficient integration of climate considerations into labour policy. Consequently, workers who contribute significantly to national development often bear a disproportionate share of the health burden associated with climate change while possessing the fewest resources to adapt.

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The analysis further reveals that addressing occupational heat stress requires more than workplace-level interventions. Effective responses depend on stronger governance, improved labour regulation, enhanced institutional coordination, and greater recognition of occupational health as an essential component of national climate adaptation. Climate resilience cannot be achieved if the wellbeing of workers remains peripheral to adaptation planning. Protecting outdoor workers is therefore not only a public health imperative but also an economic necessity and a matter of social justice.

As climate projections indicate that extreme heat events will become more frequent and intense across Nigeria, failure to strengthen occupational protection will likely result in increasing health burdens, declining labour productivity, widening socio-economic inequalities, and greater pressure on public health systems. Conversely, integrating occupational health into climate adaptation policies offers an opportunity to enhance workforce resilience, improve economic performance, and promote sustainable development. The future of climate adaptation in Nigeria will depend not only on protecting ecosystems and infrastructure but also on safeguarding the people whose labour sustains the nation's economy.

Recommendations

Based on the evidence reviewed and analysed in this article, the following recommendations are proposed:

1. **Develop national occupational heat standards.** The Federal Ministry of Labour and Employment, in collaboration with the Nigerian Meteorological Agency (NiMet), should establish evidence-based guidelines on permissible heat exposure, work-rest cycles, hydration requirements, and emergency response procedures for outdoor workplaces.
2. **Integrate occupational health into climate adaptation policy.** Future revisions of Nigeria's National Adaptation Plan and Climate Change Action Plans should explicitly recognise occupational heat stress as a priority adaptation issue, ensuring coordination between climate, health, and labour institutions.
3. **Strengthen workplace adaptation measures.** Employers in heat-exposed sectors should provide shaded rest areas, continuous access to potable water, flexible work schedules during periods of extreme heat, and regular heat-risk assessments. These measures should be incorporated into occupational safety management systems.
4. **Protect informal workers.** Governments at federal, state, and local levels should establish community-based adaptation initiatives, including public hydration points, shaded market infrastructure, and heat-awareness campaigns targeting informal workers who fall outside formal labour protection systems.
5. **Improve occupational health surveillance.** Health institutions should establish national reporting systems for heat-related occupational illnesses and injuries to provide policymakers with reliable data for planning, monitoring, and evaluating interventions.
6. **Expand research and interdisciplinary collaboration.** Universities, research institutes, and professional bodies should prioritise longitudinal studies on climate change and occupational health across different ecological zones and occupational groups in Nigeria. Such research should integrate epidemiology, climatology, labour economics, and public policy to generate comprehensive evidence for decision-making.
7. **Enhance public awareness and professional training.** Continuous education programmes should be developed for employers, workers, labour inspectors, healthcare professionals, and community leaders on recognising, preventing, and responding to heat-related occupational illnesses.

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