



Heatwaves and human survival in rapidly warming urban environments

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Abstract

Climate change is causing heatwaves to happen more often and become more intense around the world. This is creating serious problems, especially in cities where many people live close together. Higher temperatures, along with rapid urban growth and weak infrastructure, are making cities harder to live in. Buildings, roads, and vehicles trap heat, making urban areas much hotter than nearby rural places due to the Urban Heat Island Effect. This paper looks at the main reasons behind extreme heat, such as global warming and loss of green spaces. It also explains how heatwaves affect people's health by causing dehydration, heatstroke, and even death in severe cases. In addition, high temperatures reduce work productivity and put pressure on electricity systems because of increased use of air conditioning. The paper also discusses possible solutions, like planting more trees, improving city planning, and using better building materials to reduce heat. It highlights the need for strong government action and public awareness. In conclusion, if steps are not taken soon, many cities could become too hot to live in safely, leading to serious problems for human survival and quality of life.

Keywords: Climate change, heatwaves, urban heat island effect, urbanization, human health impacts

Introduction

Climate change is widely recognized as one of the most serious global challenges of the 21st century. It is not only affecting the environment but also directly impacting human life, especially in urban areas. One of the most dangerous consequences of climate change is the increasing frequency and intensity of heatwaves. These extreme heat events are becoming more common and more severe, posing a serious threat to human survival, particularly in cities where population density is high. Cities are especially vulnerable to rising temperatures due to the Urban Heat Island Effect, a condition in which urban areas experience significantly higher temperatures than nearby rural regions. This happens because cities are filled with concrete buildings, asphalt roads, and other surfaces that absorb and retain heat. In addition, human activities such as transportation, industrial processes, and energy consumption release extra heat into the environment. As a result, cities remain hotter for longer periods, especially during the night, making it difficult for people to recover from daytime heat. Recent heatwaves around the world, including in India, have shown how dangerous extreme temperatures can be. Many regions have recorded unusually high temperatures, leading to health emergencies, water shortages, and power outages. These events highlight that climate change is no longer a distant or theoretical issue—it is already affecting daily life. According to the Intergovernmental Panel on Climate Change, "heatwaves are very likely to occur more often and last longer as global temperatures continue to rise."^[1] This statement emphasizes the growing risk that extreme heat poses to human populations, especially in urban settings. The impact of heatwaves is not limited to discomfort; it has serious consequences for public health. Prolonged exposure to high temperatures can cause dehydration, heat exhaustion, and heatstroke, which can be fatal in severe cases. Vulnerable groups such as the elderly, children, and outdoor workers are particularly at risk. The World Health Organization also warns that "extreme heat events are among the leading causes of weather-related deaths

globally."^[2] This highlights the urgent need to address the problem before it worsens further. In addition to health risks, rising temperatures also affect economic productivity and urban infrastructure. Workers find it harder to perform tasks in extreme heat, especially in outdoor jobs like construction and transportation. At the same time, increased use of air conditioning puts pressure on electricity systems, often leading to power shortages. Roads, railways, and buildings can also be damaged by prolonged exposure to high temperatures. Given these challenges, an important question arises: are cities becoming unlivable due to extreme heat? This paper aims to explore this issue by examining the causes of rising temperatures, the impacts of heatwaves on human life, and the possible solutions to reduce these effects. Understanding this problem is essential for developing strategies that can protect urban populations and ensure a sustainable future.

Review of Literature

Existing studies clearly show that climate change is the main reason for increasing heatwaves. The IPCC states that "human influence has warmed the climate at an unprecedented rate"^[3]. Similarly, WMO confirms that "recent years have been the warmest on record globally"^[4]. Urbanization is another major reason. Research shows that "urban areas are warmer than their rural surroundings due to human activities"^[5]. UNEP highlights that "urban green spaces are essential for reducing heat stress and improving resilience"^[11]. WHO states that "extreme heat is one of the leading causes of weather-related mortality"^[7]. ILO adds that "heat stress is projected to reduce total working hours worldwide"^[8].

Objectives of the Research

- To understand causes of heatwaves
- To analyze impacts on human survival
- To study urban livability under extreme heat
- To suggest solutions for mitigation

Research Questions

- What are the main causes of increasing heatwaves?
- How do heatwaves affect human health and economy?
- Are cities becoming unlivable due to heat?
- What solutions can reduce heatwave impact?

Research Methodology

This study is based on secondary data collected from international organizations such as IPCC, WHO, WMO, UNEP, ILO, and IEA. A qualitative research method has been used to understand climate change patterns and heatwave trends. According to IPCC, "climate-related risks are increasingly assessed using observed data and model-based evidence" [10]. This method helps in understanding global environmental changes without field surveys or experiments.

Causes of Increasing Heatwaves

1. Climate Change

Climate change is the main reason behind the increase in heatwaves around the world. It is caused by global warming, which happens when greenhouse gases like carbon dioxide trap heat in the Earth's atmosphere. Human activities such as burning fossil fuels, deforestation, and industrial growth have made this problem worse. As a result, temperatures are rising steadily, leading to more frequent and intense heatwaves. According to the Intergovernmental Panel on Climate Change, "human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years." [3] This shows that current temperature rise is mainly due to human actions. Similarly, the World Meteorological Organization states that "global temperatures continue to rise, with recent years being the warmest on record." [4] These findings highlight the serious impact of climate change. Although global efforts like the Paris Agreement aim to reduce warming, the situation is still worsening.

2. Urbanization

Urbanization means the fast growth of cities. When cities grow quickly, trees and green areas are removed and replaced by buildings, roads, and concrete surfaces. These surfaces absorb more heat from the sun and release it slowly. Because of this, cities become hotter than nearby villages. This is called the "urban heat island" effect. It can increase temperature, cause discomfort, and harm human health and nature. A scientific report states, "Urban areas are warmer than their rural surroundings due to human activities" [5]. This means that human actions like building cities and reducing greenery make cities hotter than natural areas. Deforestation means cutting down trees in large numbers. Trees help in cooling the environment by providing shade and releasing water vapor into the air (a process called transpiration). When forests are removed, this natural cooling system is lost. As a result, the temperature of the area increases and the climate becomes hotter and drier. It also disturbs rainfall patterns and harms wildlife. A scientific report states, "Forests play a crucial role in regulating the Earth's climate system" [6]. This means trees help in keeping the environment cool and stable. They provide shade, reduce heat, and release moisture into the air, which helps in lowering the temperature. Trees also help in maintaining proper rainfall and support clean air. When trees are cut down, all these benefits are lost. As a result, the area becomes hotter, drier, and less healthy for humans, animals, and plants.

Impacts of Heatwaves on Human Survival

1. Health Risks

Heatwaves are long periods of very high temperature. They can cause serious health problems like dehydration (loss of water in the body), heat exhaustion (feeling weak and tired), and heatstroke (a dangerous condition where the body overheats). Some people are more at risk, especially elderly people, children, and outdoor workers who stay in the sun for long hours. According to the World Health Organization, "Extreme heat is one of the leading weather-related causes of death" [7]. This means very high temperatures can be very dangerous and can even cause death, especially if proper care like drinking water and staying cool is not taken.

2. Economic Consequences

High temperatures can affect people's ability to work properly. In very hot weather, workers feel tired, lose energy, and cannot focus well. This reduces productivity, especially in outdoor jobs like construction and agriculture where people work under the sun. Due to heat, working hours may also be reduced, which affects income and overall economic growth. A report by the International Labour Organization states, "Heat stress is projected to reduce total working hours worldwide" [8]. This means extreme heat will make people work less efficiently, leading to loss of jobs, income, and productivity.

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Are Cities Becoming Unlivable?

Rapid climate change and increasing urbanization are making many cities dangerously hot. In several parts of the world, temperatures are rising to levels where normal outdoor activities become difficult and sometimes unsafe. Extreme heat not only causes discomfort but also increases the risk of serious health problems like heatstroke and dehydration. People living in crowded cities with less green space are more affected because there is little natural cooling. According to the Intergovernmental Panel on Climate Change, "Climate change is increasing the frequency and intensity of heat extremes in urban areas" [10]. This means that cities are experiencing more frequent and stronger heatwaves than before, making daily life harder for people. If global warming continues without proper control, many cities may reach temperature levels that humans cannot tolerate for long periods. This can reduce the quality of life, affect health, and even force people to migrate to cooler areas. It also puts pressure on resources like water and electricity. Therefore, it raises serious concerns about the future sustainability and livability of cities, highlighting the urgent need for better planning, more green spaces, and climate-friendly solutions.

Results and Discussion

Heatwaves are becoming more frequent and intense due to the combined effects of climate change and rapid urbanization, posing a serious threat to the sustainability and livability of cities worldwide. As clearly stated in the IPCC Sixth Assessment Report, "It is virtually certain that hot extremes, including heatwaves, have become more frequent and more intense across most land regions"^[14]. This increasing trend reflects the strengthening influence of anthropogenic climate change on extreme weather events. Urban areas are particularly vulnerable due to high population density, extensive built-up surfaces, and reduced vegetation cover. These conditions intensify the urban heat island effect, resulting in higher temperatures in cities compared to surrounding rural areas. The United Nations Environment Programme highlights that insufficient green infrastructure reduces the ability of cities to regulate heat, thereby increasing exposure to thermal stress and associated risks^[11]. From a public health perspective, the World Health Organization clearly states that "heatwaves pose a growing risk to human health and well-being"^[15]. Heatwaves can lead to serious health impacts such as heat exhaustion, heatstroke, and worsening of cardiovascular and respiratory diseases. Vulnerable groups, including the elderly, children, and outdoor workers, are especially at risk. In addition, the International Labour Organization reports that increasing heat stress negatively affects labour productivity and working conditions, particularly in outdoor and informal sectors^[8]. Further supporting evidence from the World Meteorological Organization indicates that the global climate system is experiencing more frequent and severe extreme temperature events, including heatwaves^[4]. Moreover, the International Energy Agency highlights that rising temperatures are increasing the demand for cooling systems, which may place additional pressure on energy infrastructure and potentially increase greenhouse gas emissions if not managed efficiently^[13]. Overall, the findings clearly indicate that urban regions are becoming increasingly exposed to heat-related climate risks. Without effective adaptation measures such as expansion of urban green spaces, implementation of heat-resilient infrastructure, and early warning systems, urban livability and sustainability may be significantly compromised in the future. Strengthening climate adaptation and mitigation strategies is therefore essential to protect public health and ensure sustainable urban development.

Mitigation and Adaptation Strategies

1. Green Infrastructure

Green infrastructure plays a crucial role in mitigating rising urban temperatures and improving overall environmental quality. Planting trees, developing urban forests, and installing green roofs help reduce the urban heat island effect by providing shade and enhancing evapotranspiration. These natural solutions not only cool the surrounding air but also improve air quality, conserve biodiversity, and promote human well-being. Urban trees, for example, can significantly lower surface and air temperatures, making cities more livable during extreme heat events. Green roofs, on the other hand, act as insulating layers on buildings, reducing indoor temperatures and lowering energy consumption for cooling. As noted in a widely cited report, "Urban green spaces are essential for climate change adaptation, particularly in reducing heat stress in cities and

improving resilience to environmental challenges"^[11]. This highlights the importance of integrating nature-based solutions into urban planning policies. By investing in green infrastructure, cities can create sustainable and climate-resilient environments while also enhancing aesthetic and recreational value for residents. Such measures are cost-effective in the long term and contribute to healthier, more sustainable urban ecosystems.

2. Policy Measures

Governments play a decisive role in addressing the growing threat of extreme heat by implementing comprehensive heat action plans, strengthening urban planning frameworks, and strictly enforcing environmental regulations. Heat action plans are essential tools that include early warning systems, public awareness campaigns, and emergency response strategies to protect vulnerable populations such as the elderly, children, and outdoor workers. At the same time, effective urban planning can reduce heat exposure by promoting green spaces, improving building design, and regulating land use to minimize heat-retaining surfaces like concrete and asphalt. Enforcing environmental regulations further ensures that pollution levels are controlled and natural resources are preserved, both of which contribute to a cooler and healthier environment. As emphasized in global policy discussions, "Well-designed heat action plans and urban policies can significantly reduce heat-related mortality and enhance the resilience of cities to rising temperatures"^[12]. This underlines the importance of coordinated governance and long-term planning in combating climate-related risks. Governments that proactively integrate these measures into their policy frameworks are better equipped to safeguard public health, maintain productivity, and ensure sustainable urban development in the face of increasing climate variability.

3. Technological Solutions

Innovations in heat-resistant building materials and energy-efficient cooling systems are becoming increasingly important as cities adapt to rising global temperatures. Modern construction technologies now include reflective roofing materials, high-performance insulation, and heat-resistant concrete that reduce heat absorption and maintain lower indoor temperatures. These materials not only enhance thermal comfort but also decrease reliance on air conditioning, thereby lowering energy consumption and greenhouse gas emissions. In addition, efficient cooling systems such as district cooling, evaporative cooling, and smart ventilation technologies provide sustainable alternatives to traditional air-conditioning units. These innovations are particularly crucial in densely populated urban areas, where heat stress can severely impact public health and productivity. Furthermore, integrating smart technologies into buildings allows for better temperature regulation through automated systems that adjust cooling based on occupancy and weather conditions. Such advancements contribute to the development of climate-resilient infrastructure capable of withstanding extreme heat events. As highlighted in international research, "Improving building design and adopting energy-efficient cooling technologies are critical strategies for reducing heat exposure and enhancing urban resilience"^[13]. This emphasizes the need for continued investment in technological innovation to address climate challenges

effectively. By adopting these solutions, cities can move toward sustainable development while ensuring safer and more comfortable living environments for their populations.

Conclusion

Heatwaves are becoming more frequent and intense due to the combined effects of climate change and rapid urbanization, posing a serious threat to the sustainability and livability of cities worldwide. As clearly stated, "It is virtually certain that hot extremes, including heatwaves, have become more frequent and more intense across most land regions"^[14], which highlights the direct link between rising global temperatures and the increasing severity of heat events. Urbanization further worsens this situation, as cities replace natural vegetation with concrete and asphalt, creating the urban heat island effect that traps heat and raises temperatures significantly. The impact on human health is severe, as prolonged exposure to high temperatures leads to heat exhaustion, dehydration, and even death in extreme cases. Supporting this concern, it has been emphasized that "Heatwaves are among the most dangerous natural hazards and pose a growing risk to human health and well-being"^[15]. Vulnerable populations such as the elderly, children, and low-income groups are particularly at risk due to limited access to cooling and healthcare facilities. Additionally, infrastructure systems like electricity, transport, and water supply face increased strain during extreme heat, often leading to disruptions. Economically, heatwaves reduce labor productivity, especially for outdoor workers, and increase energy demand due to higher use of cooling systems. These combined impacts suggest that cities may become increasingly unlivable if timely action is not taken. Therefore, immediate and sustained measures such as climate mitigation, improved urban planning, and resilient infrastructure development are essential to ensure a sustainable and livable urban future.

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