

ODISHA

HEATWAVE DYNAMICS

A Report on Heat Wave Scenario of Odisha



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INTRODUCTION

As April heralds the summer season in Odisha, residents are grappling with an oppressive heat wave exacerbated by low moisture levels. Urban and industrial areas particularly bear the brunt of this scorching heat, indicating a potentially harsher season ahead for the state.

What is a Heat Wave?

IMD defines heat waves both qualitatively and quantitatively. **As per the qualitative definition, a heat wave is a state when the temperature reaches a level that poses a significant risk to human health upon exposure.** From the quantitative angle, heat wave condition is defined by specific temperature thresholds of a region, either in terms of actual temperature or its deviation from the normal temperature. Some countries define it in relation to the heat index, which factors in both temperature and humidity or by considering extreme temperature percentiles.



A heat wave is considered if the maximum temperature of a station reaches at least 40°C or more for Plains and at least 30°C or more for Hilly regions.



Declaration of Heat Wave condition Based on Departure from Normal is 4.5°C to 6.4°C.



Declaration of Heat Wave condition Based on Actual Maximum Temperature: when actual maximum temperature $\geq 4.5^\circ\text{C}$.



AIMS AND OBJECTIVES

The aim of the study is to address the pressing issue of heat waves in Odisha amid the current intense summer. The objective of the report is to comprehensively document past heatwave occurrences in the state, analyze the causes, and outline their detrimental impacts on health, agriculture, energy, the economy, and the environment. Drawing from these findings, the report offers a set of recommendations aimed at mitigating the adverse effects of heat waves.



PAST RECORD OF HEAT WAVE IN ODISHA



A DISTRICT-WISE VISUAL OF THE HEAT WAVE BETWEEN 1969 AND 2019 IN ODISHA

Total Number of **Disasterous Heat Wave Day** (Annual) in Odisha During the Period from 1969 to 2019

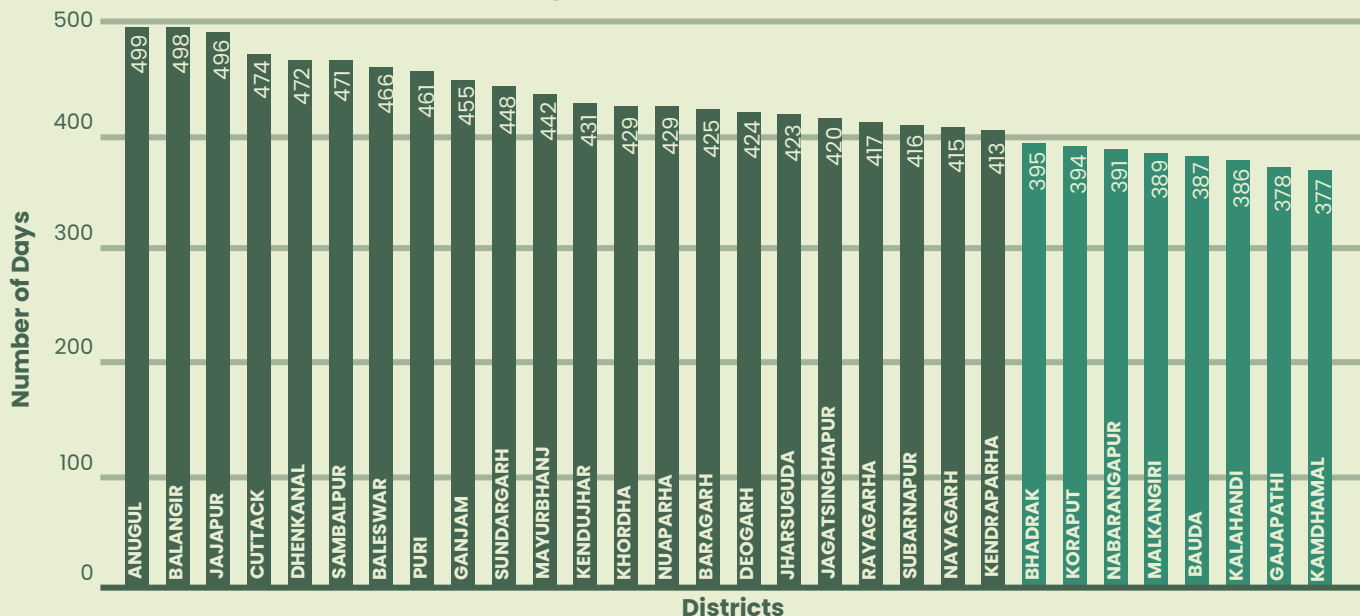


Figure 1: Annual Heat Wave Data Analysis for Odisha between 1969 and 2019

Data Source: <https://imdpune.gov.in/hazardatlas/heatnew.html>

Based on **IMD Pune data**, the following insights can be drawn from the district-based heat-wave analysis for the state of Odisha.



The overall experience of heat days in Odisha has been considerably higher than in other eastern Indian states for the past 50 years period (1969–2019).



Angul, the northern district of the state, known for its industry and mining activities, experienced the highest number of heat wave days, totalling 499 days.



22 out of 30 districts of Odisha were categorized as red (401 to 700 heatwave days) from 1969 to 2019.



The capital city of Bhubaneswar, located in the Khordha district, also endured a significant number of heat wave days, totalling 429 during the same period.



All districts of Odisha fall under a moderate normalized vulnerability index range of 0.25 to 0.50.





A DISTRICT-LEVEL VISUAL OF THE 40°C TEMPERATURE AND ABOVE BETWEEN 2019 AND 2023

Between 2019 and 2023, an analysis of heat days during the summer months was conducted using maximum temperature data obtained from the IMD Pune website. This analysis focused on identifying days with temperatures reaching 40°C and above in Odisha, specifically during April, May, June, and July. Through a mapped representation, the total count of days experiencing temperatures equal to or exceeding 40°C over the past five years (2019–2023) has been visually depicted.

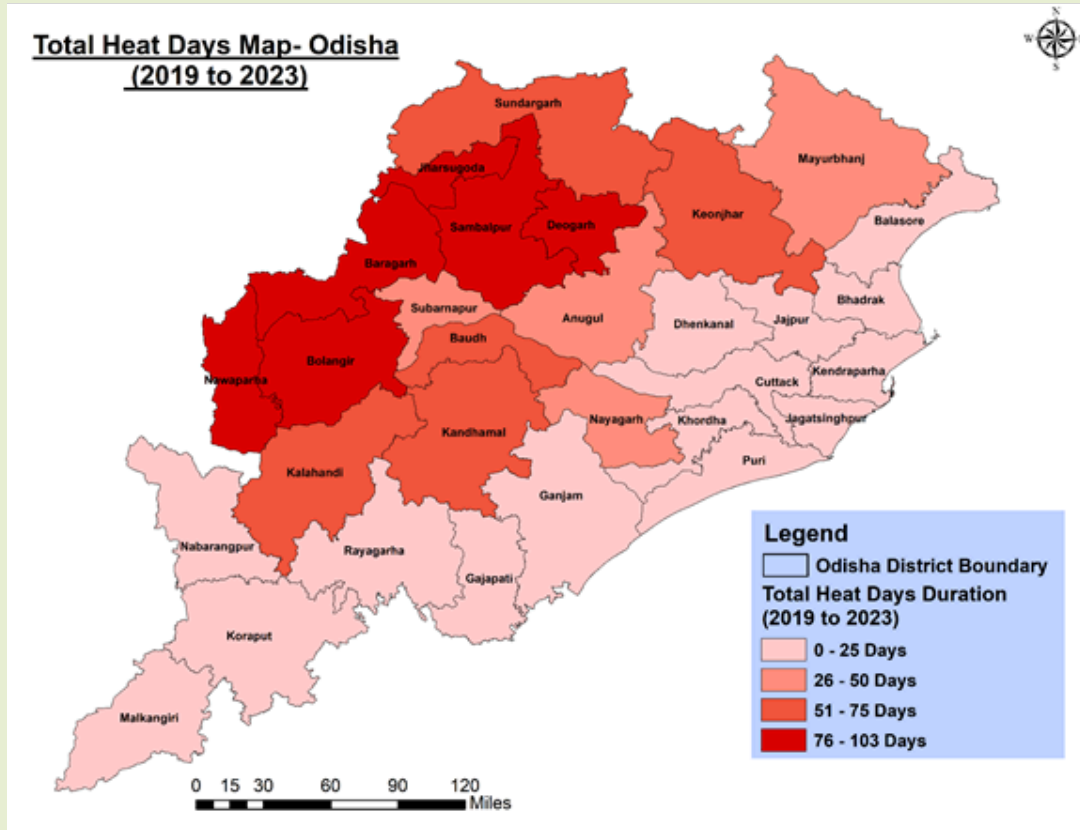


Figure 2: Annual Heat Day Map for Odisha between 2019 and 2023
Data Source: https://www.imdpune.gov.in/cmpg/Griddata/Max_1_Bin.html

The map visually represents that-



Western districts, including Nawaparha, Bolangir, Baragarh, Sambalpur, Deogarh, and Jharsugoda, experienced more days (75 to 103) with temperatures reaching 40°C and above compared to other regions of Odisha in the last 5 years (2019–2023).



Anugul district, which previously had the highest number of heat wave days, saw a decrease in the frequency of high-temperature days between 2019 and 2023, with only 25 to 50 days exceeding 40°C.



A clear distinction is observable between the eastern and western districts of Odisha regarding the prevalence of days with temperatures of 40°C or higher.



IMPACT STUDY ON EFFECTS OF HEAT WAVES

A primary survey was conducted on **815 people** in the east Indian states (West Bengal, Jharkhand, and Odisha) in April 2024 to capture people's perceptions of the current heatwave situation, how it has changed over the years, the problems people are facing due to the rising temperatures, and how their daily lives are affected. The Google form was shared via several platforms with people, and the responses were completely anonymous.

This report focuses on **245 responses from Odisha, where 69% were males and 31% were females.** The survey exclusively targeted urban areas, engaging participants from diverse ages and occupational backgrounds.

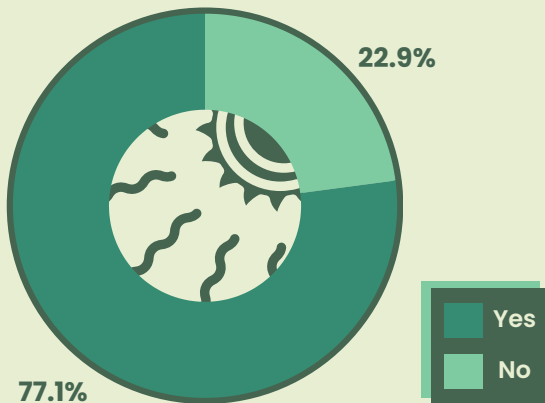


All respondents unanimously stated that the intensity of heat waves has escalated over the years.



Perception of death and health effects from heat waves:

PEOPLE'S PERCEPTION ON DEATH DUE TO THE HEAT WAVE IN ODISHA



77% respondents said they know individuals who have succumbed to heat waves.



Headache, dizziness, nausea and heat rash are some of the commonly noticed health issues by the respondents from Odisha.



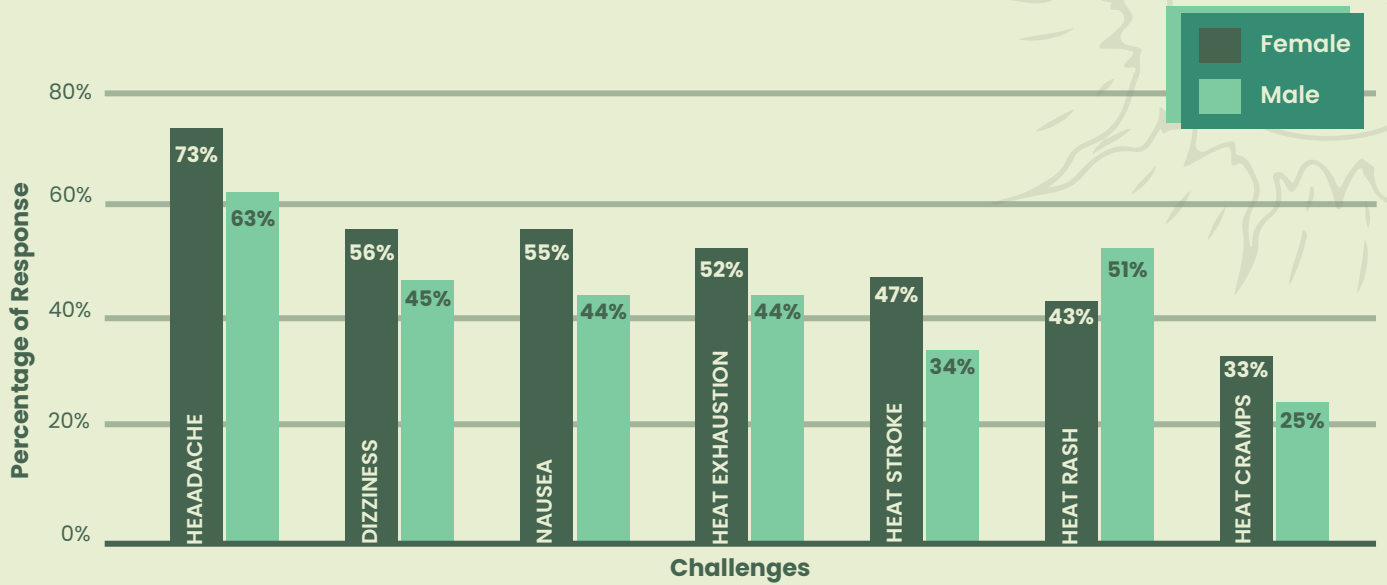
Irrespective of gender roles, a majority of the respondents were noticed to cite headaches as the most common general concern due to heat waves.



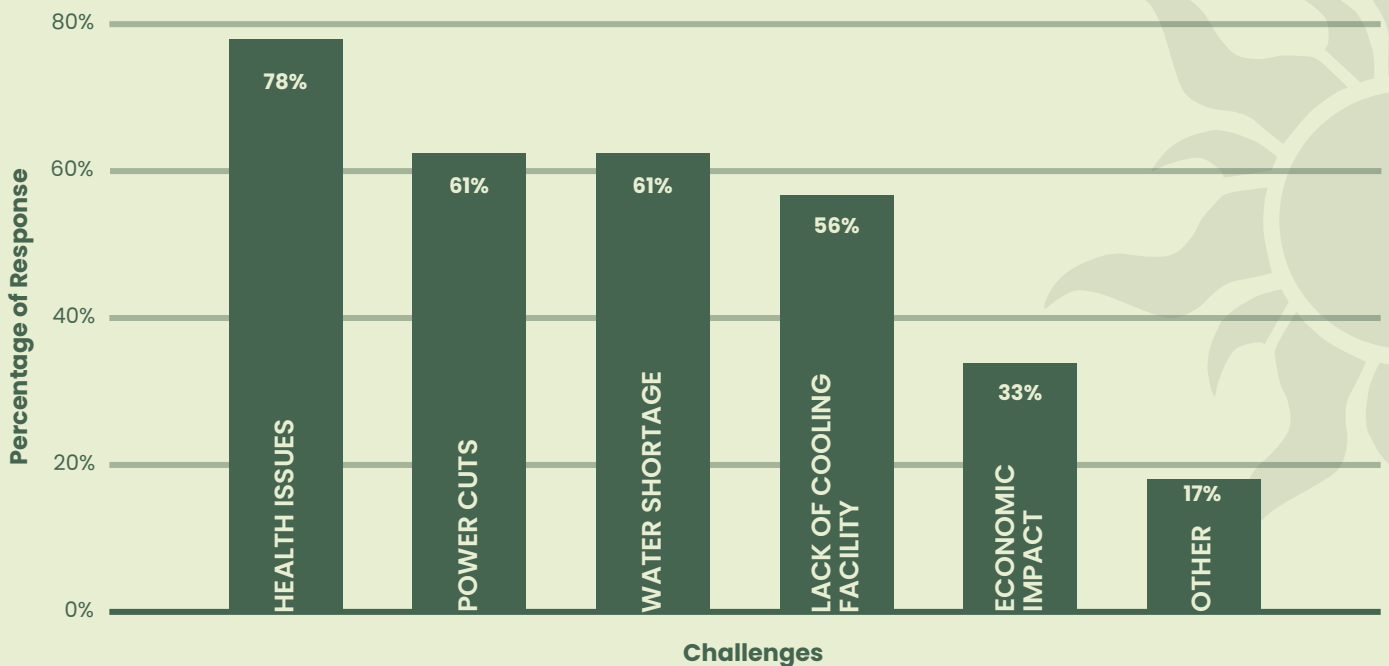
73% females and 62% males faced heat exhaustion during heat waves.



Female & Male Health Issues due to Heat Wave in Odisha



Major challenges faced by people during heat wave in Odisha



OTHER CHALLENGES:



In Odisha, health concerns top the list of challenges among respondents during heatwaves. **Over 77% of participants encounter physical issues in these conditions.**



During heatwaves, infrastructural challenges like **frequent power cuts (61% response) and water shortages (61% response) emerge as major hurdles.**

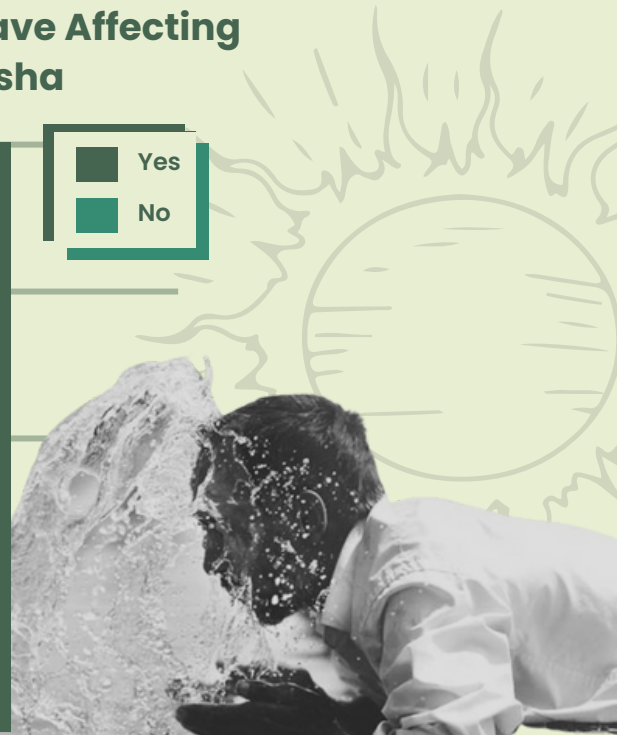
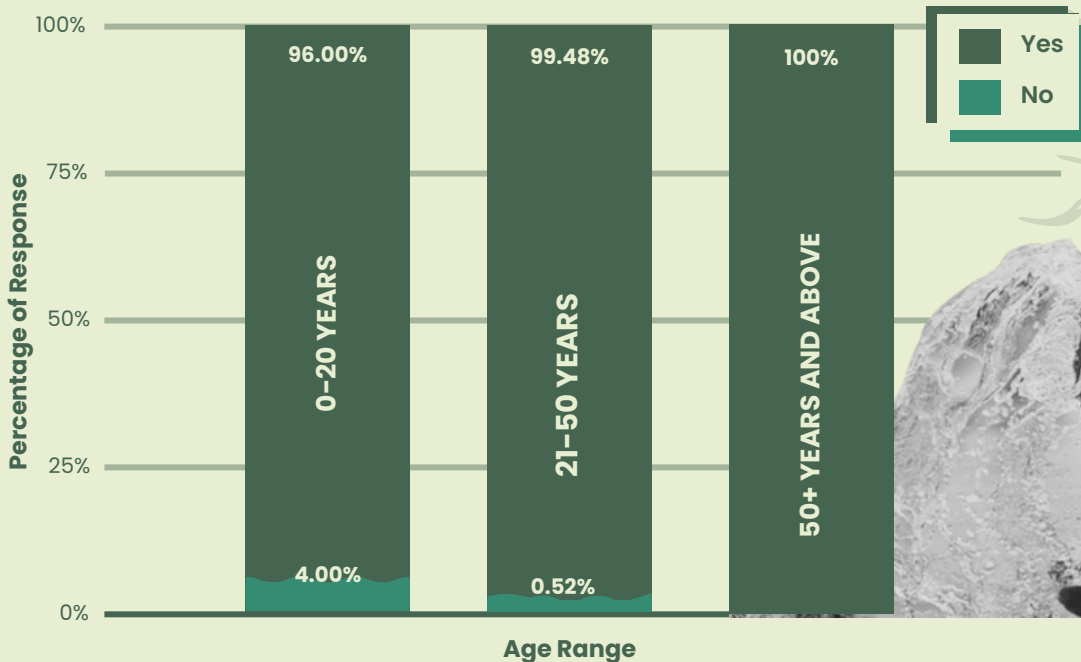


During extreme heat events in the state, **56% of respondents reported limited access to cooling facilities**, indicating a significant challenge in addressing this issue.



Heat waves are causing significant **economic strain for 33% of individuals surveyed.** As a result, the people of Odisha are experiencing various health and infrastructural challenges due to this financial burden.

People's Perception on Heat Wave Affecting Daily Activities in Odisha



IMPACT ON DAILY ACTIVITIES:

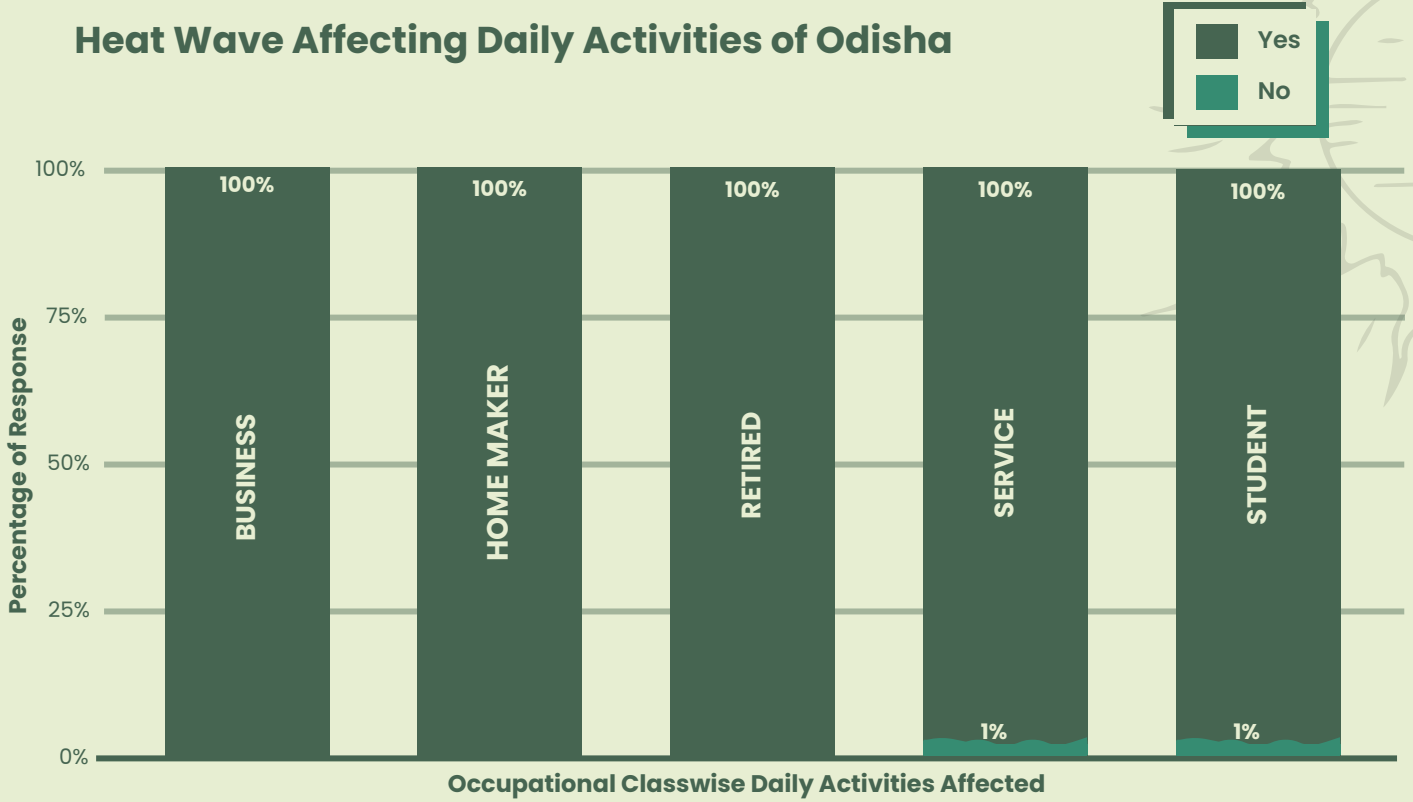


Irrespective of age and gender, the day-to-day activities of the people of Odisha are being affected due to heat waves.

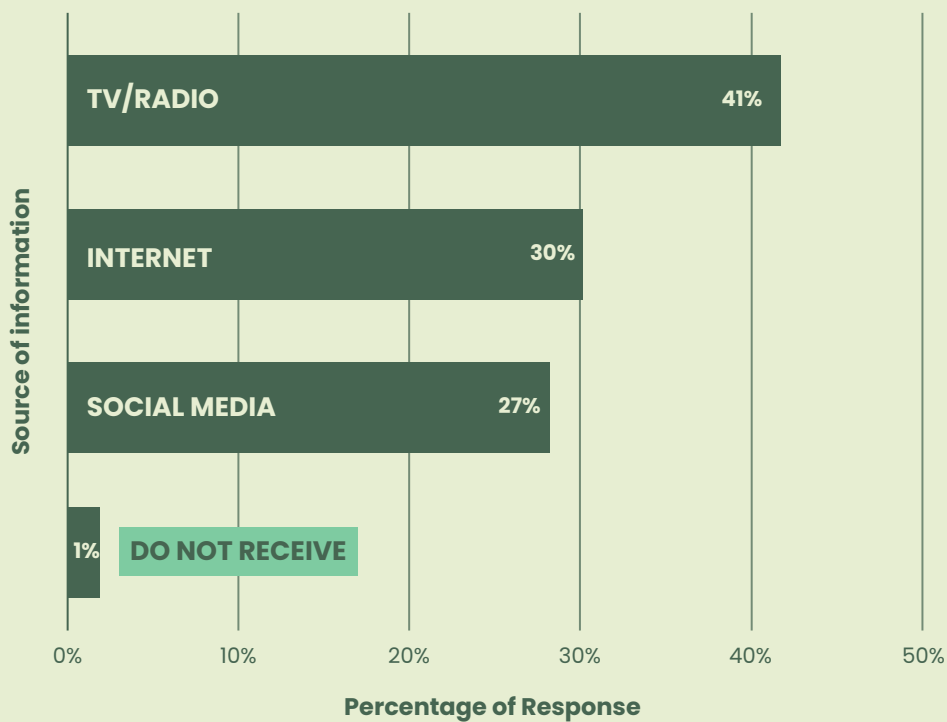


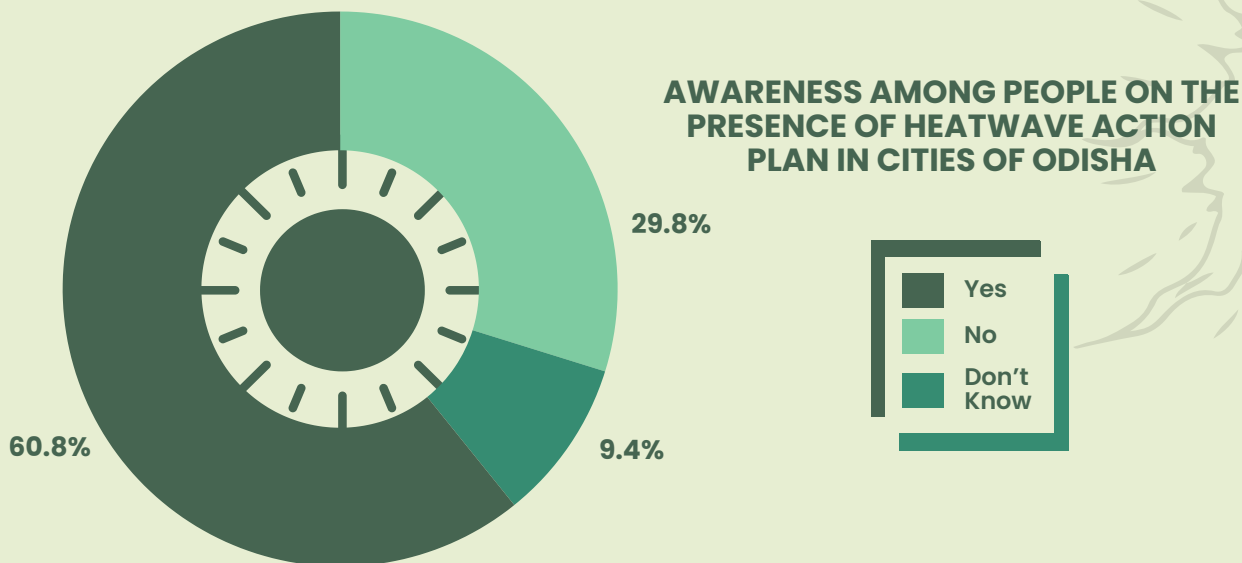
The response pattern shows that primarily indoor dwellers, **Homemakers and retirees**, bear the full force of heat waves.

Heat Wave Affecting Daily Activities of Odisha



Sources of Heat Wave - Related Information in Odisha





PEOPLE'S AWARENESS AND SOURCE OF INFORMATION



In regards to information regarding heat waves, **42% of responses came** that people **mostly get information about heat waves through TV/Radio.**



Internet sources (30% of the survey responses) and social media (27% of the survey responses)



While **a small number of respondents cited a lack of information**, the overall scale of this issue is significant, warranting government attention to address the needs of this population.



61% of the surveyed population is cognizant of the government's heat wave action plan (HAP).



Of the remaining respondents, **30% are confident in the absence of such action plans in Odisha**, while the remaining **9% lack awareness of their existence.**

PEOPLE'S SOLUTION:



As the urban areas experience the worst impacts of heat waves, **near about 30% of the respondents have suggested modifying the urban planning to mitigate this extreme scenario.**

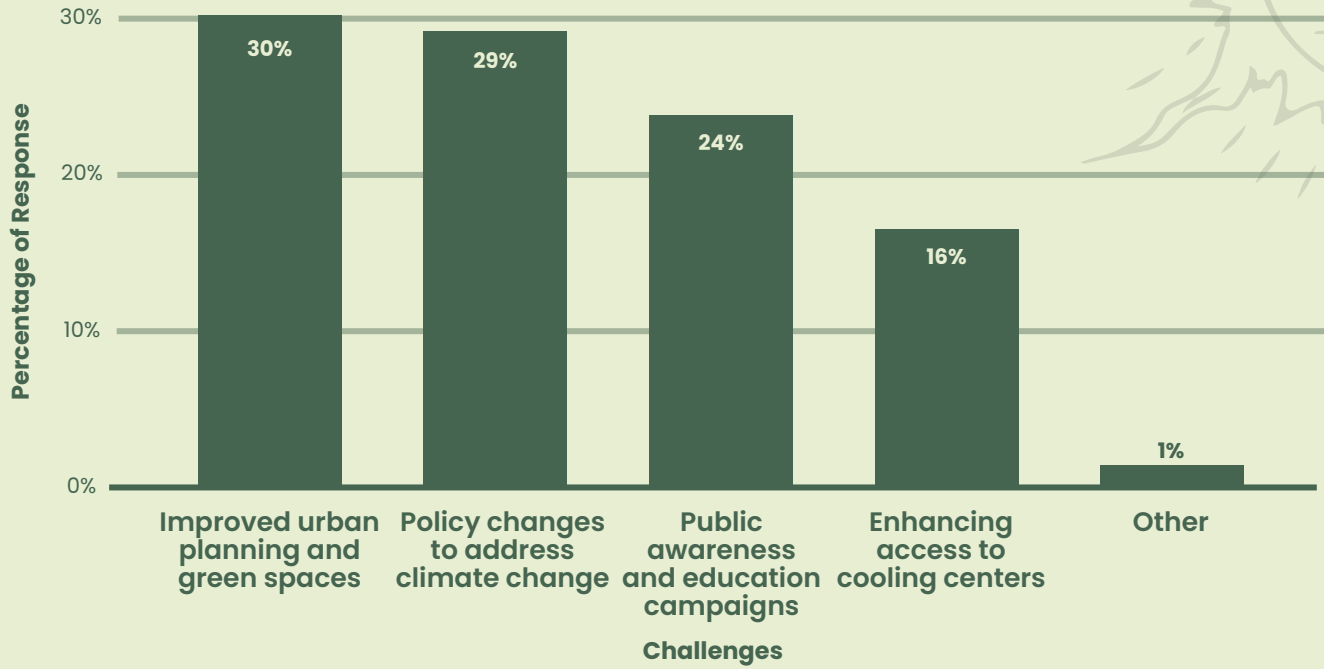


Policy changes to address the climate change scenario (29%) and public awareness and education policies (24%) emerged as two other popular solutions of the respondents for mitigating heatwaves in the long run.



99% of the respondents in Odisha think that the government authorities should take more action to address the impacts of heat waves

PEOPLE'S OPINION ON MITIGATION MEASURES OF HEAT WAVE





REASONS BEHIND THE HEAT WAVE

THE PRIMARY CAUSES BEHIND THE HEAT WAVE CONDITIONS IN ODISHA



Influence of Northwesterly/Westerly dry air coupled with high solar insolation.



The absence of sea breeze both during the day and night, leads to higher temperatures.



Low humidity percentages, preventing the occurrence of 'kalboisakhi' or norwester.



Limited upper-level moisture flow through Odisha, which further exacerbates the situation as any moisture present tends to evaporate rapidly, resulting in the dissipation of clouds even if they form in the afternoon.



Coastal districts experienced relatively lower temperatures, but the capital city Bhubaneswar still records higher.



The relative humidity in Bhubaneswar fell, exacerbating the effects of the high temperatures.



CLIMATE INFLUENCES



Global Temperature Rise: WHO and WMO reports indicate a clear correlation between global temperature increase and the escalation of heatwaves, with each 0.5°C rise leading to intensified and more frequent heatwaves.



Human-Induced Climate Change: IPCC's Sixth Assessment Report underscores the role of human activities in exacerbating heatwaves since the 1950s, with continued warming projected to amplify their frequency and intensity.



Regional Impacts: Studies reveal regional impacts of climate change on heatwaves, such as the Climate Shift Index indicating Bengal's susceptibility to temperature changes, and projections suggesting a significant rise in heatwave occurrence with +1.5°C and +2.0°C warming.



El Niño Influence: Research highlights the influence of El Niño events on heatwaves in India, with El Niño years associated with higher heatwave occurrence due to delayed Indian Summer Monsoon onset and weakened south-westerlies in the Arabian Sea.



Marine Heatwaves: Studies by the Indian Institute of Tropical Meteorology demonstrate a significant increase in marine heatwaves in the western Indian Ocean and the Bay of Bengal, indicating the broader impact of climate change on ocean temperatures and potential implications for heatwave formation.



HUMAN INFLUENCE

Global climate change, fueled by human actions, has led to more frequent, intense, and prolonged heatwaves across India. Projections suggest a tenfold increase in heatwave risk under Representative Concentration Pathway (RCP) scenarios for the twenty-first century, impacting over 70% of Indian land areas. States like Himachal Pradesh and Kerala, previously less affected, now witness a higher frequency of extreme temperatures due to anthropogenic activities.



Greenhouse Gas Emissions: Human activities, notably greenhouse gas emissions, worsen the greenhouse effect, amplifying heat waves.



Land Use Changes: Alterations in land use patterns, and increasing built-up areas like industrial, and residential areas contribute to the intensification of heat waves, exacerbating their impacts.

EFFECTS OF HEAT WAVE

Heatwaves are deadly events that take several lives every year. As per a **study by the University of Cambridge**, the deadly heat waves of India fuelled by climate change are endangering the development of India in terms of health, production, infrastructure and environment.

EFFECTS ON HEALTH

Death of individuals due to heatwave is a common phenomenon in the entire subcontinent.



More than 24,000 deaths were attributed to heatwaves between 1992 and 2015 (Ravindra et al. 2024).



Deadly heatwaves fuelled by climate change in 2022 made **almost 90 per cent of Indians more vulnerable to public health issues, food shortages and increased risks of death** (Casciato, 2023).



The spectrum of illnesses caused by heat waves spans from superficial and mild conditions that are easily manageable (such as prickly heat, heat-related swelling, heat cramps, and heat exhaustion) to those constituting a medical emergency, such as heat stroke. Heat stroke stands out as the most severe among heat-related illnesses, characterized by impaired brain function resulting from uncontrolled body heating, akin to a stroke (Patel, 2024).



As per IMD report-



Heatwaves can result in **heat exhaustion and heat stroke**, both of which pose life-threatening risks if not promptly treated. Symptoms may include nausea, dizziness, headache, rapid heartbeat, and confusion.



Elevated temperatures can induce **dehydration** when individuals do not intake sufficient fluids, leading to symptoms like **headaches, fatigue, and assorted health complications**. Furthermore, heatwaves can worsen respiratory issues like asthma by fostering the accumulation of air pollution, which can irritate the lungs. Additionally, heightened temperatures heighten the likelihood of cardiovascular problems such as heart attacks and strokes, particularly among those with preexisting cardiovascular conditions.



Heat waves can also impact mental health, leading to **increased stress and anxiety**, particularly for those who do not have access to air conditioning or other cooling measures.

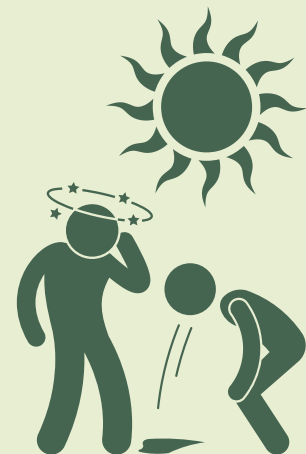
As per Heat Wave Documentation by NIDM for 2016



In 2016, nearly 30 people died in Odisha due to sunstroke as the state experienced a severe heat wave.



Maximum cases of deaths due to alleged sunstroke were reported from Khurda district, followed by Cuttack, Angul, Balasore, Ganjam, Keonjhar, and Nayagarh districts, highlighting the serious health impacts of heat waves.



EFFECTS ON FARMING

Heatwaves can significantly impact agriculture in India, posing serious threats to food security and the livelihood of farmers.



Firstly, they can result in **crop failure by causing crops to wilt and die**, reducing yields or leading to complete loss. High temperatures can also damage plant cells, hampering their ability to photosynthesize and produce food.



Secondly, heatwaves contribute to **reduced soil moisture through increased evaporation**, creating drought-like conditions that hinder crop growth.



Additionally, they **foster ideal environments for pests and insects**, necessitating increased pesticide use and causing further crop damage.



Livestock also face health challenges during heatwaves, experiencing **heat stress that reduces milk production, and fertility rates, and can even lead to death**.



Lastly, heatwaves exacerbate **water scarcity** issues by accelerating water source depletion and escalating irrigation demands, potentially sparking conflicts between farmers and other water users while impeding crop growth.

EFFECTS ON THE ENERGY SECTOR

Heatwaves have significant impacts on the energy sector, affecting the reliability of the energy grid, increasing costs, and potentially causing power outages and disruptions.



Firstly, they lead to a surge in electricity demand as people rely more on air conditioning and fans to combat the heat, straining the energy grid and risking blackouts or brownouts if the supply falls short.



Secondly, high temperatures reduce the efficiency of power plants, particularly those dependent on water for cooling, potentially leading to reduced output or shutdowns due to overheating.



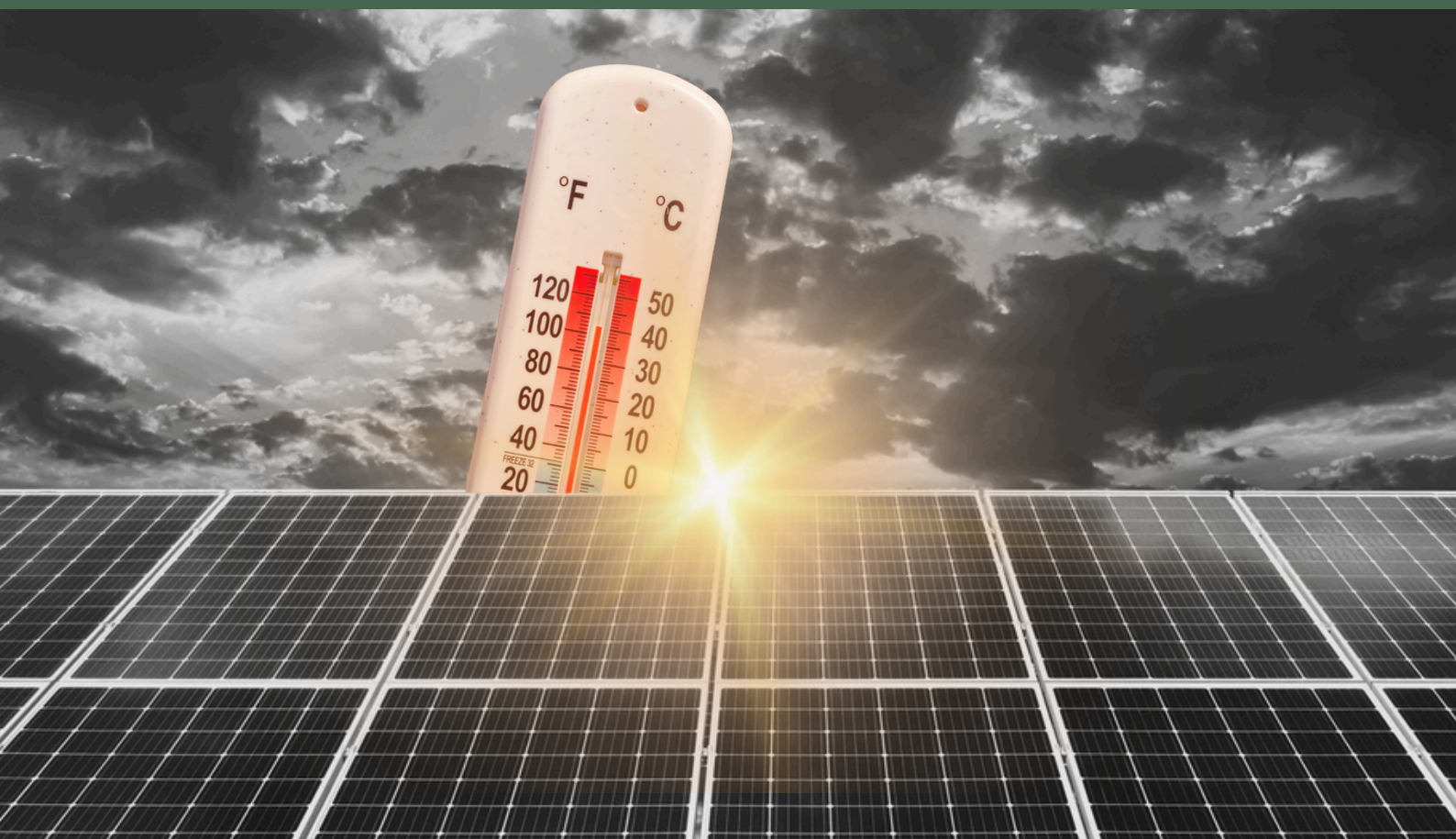
Thirdly, heatwaves can cause transmission and distribution equipment failures, resulting in power outages and decreased grid reliability, especially in equipment not designed to withstand high temperatures.



Additionally, heatwaves heighten the risk of wildfires, which can damage energy infrastructure such as transmission lines and power plants, necessitating costly repairs and causing further power disruptions.



Lastly, energy prices may escalate during heat waves due to increased demand and constrained supply, resulting in higher bills for consumers and businesses.



EFFECTS ON ECONOMY

As per **Greenpeace** organisation following are the effects on the economy due to the heat wave



Economic Risk: McKinsey Global Institute predicts a 2.5–4.5% GDP risk by 2030 due to increased lost labour hours from rising heat and humidity.



Monetary Equivalent: This risk translates to approximately \$150–250 billion in potential losses, highlighting the substantial economic impact of heat waves.



Crop Production Impact: Heatwaves have already affected wheat production, with India projecting a potential decrease to 105 million tonnes this year due to heatwave conditions.



Global Workforce Impact: The International Labour Organization estimates that by 2030, over 2% of total working hours worldwide could be lost annually due to extreme heat, hindering productivity.



Labour Efficiency: Heatwaves not only make it too hot to work but also force workers to operate at a slower pace, further exacerbating productivity losses.

State Government Initiatives

BHUBANESWAR HEAT WAVE ACTION PLAN 2022



Early Warning Systems and Communication:



Utilize various channels such as media, SMS, and social media to disseminate timely alerts about impending heat waves.



Engage in interpersonal communication to ensure widespread awareness of preventive measures.

Inter-agency Coordination:



Collaborate with government agencies, health departments, and emergency responders to develop response plans.



Ensure a unified approach to managing heat-related emergencies at the local level.

Community Outreach and Public Awareness:



Conduct public awareness campaigns to educate the population on preventive measures and adaptive strategies.



Target vulnerable communities through tailored outreach initiatives.

Healthcare System Preparedness:



Enhance capacity within the healthcare system to recognize and respond to heat-related illnesses.



Focus on local-level preparedness and training for healthcare professionals.

Utilization of Early Weather Forecasts:



Utilize forecasts from the Indian Meteorological Department to issue timely alerts to relevant stakeholders.



Enable proactive response measures based on forecasted heatwave conditions.

Collaboration with Non-governmental Organizations:



Partner with NGOs to develop "cool public places" and improve infrastructure to mitigate heat-related risks.



Leverage NGO support to expand community outreach efforts and provide assistance to at-risk populations.

The Bhubaneswar Heat Wave Action Plan 2022 emphasizes preparedness, coordination, and community engagement as key strategies to mitigate the impact of heat waves on public health and well-being.

Odisha government has come up with region-specific \several heat wave action plans for Bhubaneswar, Nuapada, Cuttack, Sundargarh, Dhenkanal and so on based on the past record of heat waves of the location and the district scenario and rationale of heat wave action plan for the location.





RECOMMENDATIONS ON MITIGATIVE MEASURES TOWARDS SUSTAINABILITY



ADAPTATION MEASURES:



Awareness Campaigns: Launch government-led awareness campaigns to educate the public about the risks of erratic weather and how to safeguard themselves from climate vulnerabilities through public service announcements, billboards, and outreach efforts.



Cooling Shelters: Establish cooling shelters and water stations in areas most affected by heatwaves, particularly in urban regions, to mitigate heat-related illnesses and exhaustion among the populace.



Uninterrupted Power Supply: Collaborate with electricity companies to ensure consistent power supply by enhancing infrastructure and implementing measures to manage energy demand during peak hours.



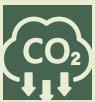
Water Infrastructure: Install roadside water filters, hand pumps, and tube wells, and prepare for rainwater harvesting to bolster water availability and resilience to water scarcity.



Cyclone Preparedness: Establish cyclone warning centres and evacuation plans to relocate residents during cyclones, along with mechanisms for delivering accurate forecasts and timely warnings to citizens.



Tree Planting: Actively plant oxygen-rich trees and saplings to enhance green cover and combat air pollution, thereby improving public health and climate resilience.



Greenhouse Gas Reduction: Implement policies to reduce greenhouse gas emissions and promote renewable energy sources like electric vehicles, solar power, and other sustainable technologies to mitigate climate change impacts.



MITIGATION MEASURES:



Reiterating Existing Laws and Action Plans: Enforce existing laws like the Air (Prevention and Control of Pollution) Act, 1981, and the National Clean Air Action Plan to combat air pollution and alleviate Kolkata's health burden.



Reducing Vehicular Emissions: Reduce private vehicle usage during high Air Quality Index (AQI) days and promote public and electric vehicles with government support to curb vehicular emissions.



Government Advisory: Disseminate flyers, leaflets, and advisories educating the public on recognizing, preventing, and managing extreme weather conditions.



Establishing Expert Committee: Form an expert committee comprising government and non-government stakeholders, medical professionals, epidemiologists, and environmentalists to develop comprehensive guidelines.



Promoting Sustainable Transportation: Designate Sundays as Bicycle Days to encourage cycling and promote electric and CNG vehicles for reduced fossil fuel consumption and healthier lifestyles.



Solar Energy Adoption: Expand the use of solar panels to accelerate the transition to renewable energy, reduce coal dependence, and mitigate mining-related land degradation.



Nature-Based Solutions: Implement afforestation initiatives and build water canals in villages to prevent desert encroachment and mitigate flooding through rainwater harvesting techniques.



Government Support for Adaptation: Advocate for a variety of adaptation solutions, including nature-based approaches, national adaptation plans, early warning systems, and climate-resilient livelihood strategies.

CONCLUSION

The report on heatwave dynamics in Odisha underscores the pressing need to address escalating temperatures and their multifaceted impacts. Historical data analysis reveals a stark increase in heatwave occurrences, particularly in urban and industrial areas, exacerbating health, agricultural, energy, and economic challenges. A primary survey underscores the severity of the situation, with respondents citing escalating health issues, infrastructural challenges, and economic strain. Recommendations focus on enhancing public awareness, fortifying healthcare systems, and implementing adaptation and mitigation measures. Collaboration between government agencies, NGOs, and communities is deemed essential for effective heatwave management. Ultimately, proactive measures are crucial to mitigating the adverse effects of heatwaves and fostering resilience in the face of a changing climate, ensuring a sustainable and equitable future for Odisha's residents.



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