

Heat Waves in India: Climate Change Impacts and Adaptations

Heat waves cause more deaths than any other natural disasters in the world, and India is one of the most vulnerable to heat stress. Also, even in the best-case scenarios, the frequency of severe heatwaves is projected to rise by 30 times the current climate by the end-21st century in India. Therefore, this study focuses on the impacts of heat waves in India and the possible adaptation responses of the Indian Government. Since adopting various new policies in 2016 such as the addition of early warning systems such as 5-day forecast and seasonal forecast by the Indian Meteorological Department (IMD), and public awareness campaigns, there is a decline in death rates in India since 2016. This shows that the Indian Government is on track to adapt to the heat exposure related to climate change. However, few policy gaps were noticed in this study such as lack of funding in heat wave-related policies e.g., “Cool Roof Scheme” because heat waves are not being considered as a “National Disaster” by the Government of India etc. Therefore, this study suggests that heat waves should be recognized as a national disaster. Also, during peak hours of heat waves, human movement is suggested to be restricted. Moreover, this report recommends a set of guidelines for employers in India to adapt to heat exposure in workplaces.

Introduction-:

Climate change is one of the most pressing issues confronting the world's population today, and it is likely to worsen in the future(1). According to existing climate change commitments by the countries, the globe may warm by 1.5^o C –4.8^o C by 2100 compared to 1960-1990. 50% of the total employees work in the agriculture sector in India (2). Therefore, India is likely to be severely impacted by climate change since the production of various crops such as rice, wheat, maize etc. is projected to decrease(2). Also, there is evidence that India is already facing the effects of climate change which includes an increase in flooding, the number of cyclones and their impacts, extreme heat events etc.(2, 3).

Recent studies have shown that climate change has already increased the likelihood of severe heat waves (or extreme heat events)(4). Also, as India’s temperature warms in the twenty-first century, the frequency, intensity, and duration of severe heat events may rise along with population exposure to those events(5, 6). Evidence suggests that heat waves cause more deaths than any other natural disaster in various regions of the world(7). Therefore, it is important to address the potential impacts of heat waves in India and their adaptation responses.

Heat Wave and Vulnerability-:

Heat waves are periods of abnormally high surface temperatures that have severe impacts on agriculture, health, ecosystems, and the national economy(5). It is a heat wave condition in India when the highest temperature in a certain location exceeds 45^o C for two days in a row (**as defined by Indian Meteorological Department**)(3, 8). Also, if the daily maximum temperature is 5^o C higher than the average temperature for five or more days, it is considered as a heat wave condition(3).

Extreme heat events have the greatest influence on water resources, which evaporate quickly during heat waves. So, humans, natural habitats, and economic activities such as agriculture are more vulnerable during extreme heat events (9). As a result, heat waves can damage human health, both directly and indirectly(5, 9).

Heat Stress is caused by heat waves and high humidity levels, coupled with a lack of ventilation and direct sunshine. It has the potential to jeopardize the human body's capacity to keep its core temperature within the range of physiological functioning(10). When heat stress increases, the human physiological processes get disrupted and the body generates or absorbs more heat than it dissipates. This causes the core internal temperature of the body to rise, causing pain, health problems such as heat cramps, dehydration, heat stroke(10). The most serious health hazard of heat wave events is heat stroke, which can cause death(3, 8).

On the other hand, the most vulnerable people to extreme heat events are infants, people with chronic diseases such as heart condition or high blood pressure (11, 12). People who are overweight or obese (approximately 200 million people in India) are also considered vulnerable to heat exposure (11, 12). Particularly, people with a disadvantaged socioeconomic standing, who are socially isolated, and who are homeless are the most vulnerable to heat waves (3, 8, 13).

Past Heat Waves in India-:

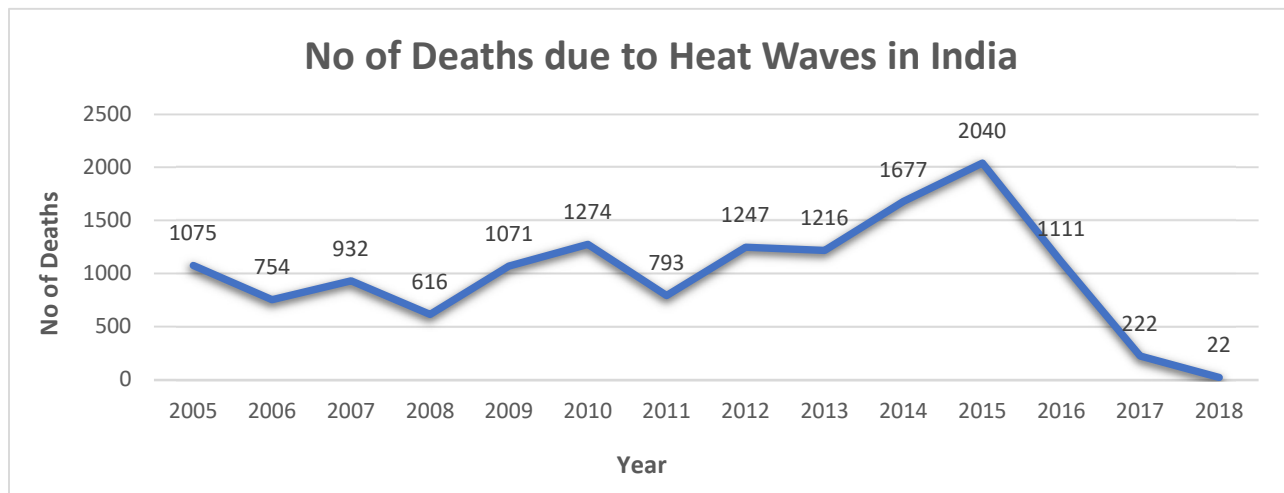
The Government of India has recorded more than 14,000 deaths due to heat waves since 2005(3). However, some media such as “Business Standards” and “India Spend” have accused the Govt. of India of reporting only 10% of the actual death due to heat exposure(14, 15). The compensation for dead heat wave victims is cited as the main reason for this underreporting of deaths due to heat waves(14, 15).

On the other hand, the number of people admitted to hospitals due to extreme heat events has increased from nearly 29,000 in 2015 to nearly 40,000 in 2017(3, 6). Also, the number of states affected by heat waves has gone up from 9 in 2015 to 23 in 2019. The percentage of districts facing heat waves has seen a surge from 30% in 2015 to more than 50% in 2018(3). Previous studies have reported that out of the 10 most severe heatwaves in India from 1951 to 2015, five of these have happened after 1995 (17). The reason for the increase in these extreme heat events has been credited to climate change(3, 5). Also, in India, heat waves have been found to have a strong link to poor crop production, depletion of natural water supplies, and poor economic conditions among the affected population(7, 17).

Future Projections-:

The climate models most commonly used in climate change impact research project an increase of 0.4°C - 1.6°C in average surface temperature in the best-case scenarios and 2.6°C - 4.8°C in the worst-case scenarios in 2081-2100 in comparison with 1961-1990 with different degrees of unreliability(3, 5, 8). On the other hand, if the current trend in average surface temperature persists, the most reliable models project an increase of 1.1°C - 3.1°C in 2081-2100 (compared to 1961-1990) with a varying level of uncertainties (3, 5, 8). Since an increase in average temperature is linked with an increase in the frequency of heat waves, the frequency of heat waves in India is projected to increase in future, even in the best-case scenarios(1, 3–5). And the North-West and South-East of India (Rajasthan, Telangana, Andhra Pradesh) along with Odisha and West Bengal are projected to be some of the most affected heat stress regions(5, 7, 17). Even if the global mean temperature is limited to 2°C above pre-industrial levels, the frequency of severe heatwaves in India is projected to rise by 30 times the current climate by the end-21st century(17).

National Adaptation Plans (NDA) for Extreme Heat Events -:



Some of the key policies of the Heat Action Plans (**HAP**) set by The Government (**Govt.**) of India are-: enhancing community involvement and public awareness for extreme heat events, introducing an early warning system so that both public and hospital staffs can be prepared for the heat waves (especially for the severe ones) (3, 18).

1. Public Awareness Campaigns-:

Various channels of communications have been utilized to build strategic media coverages of climate change and its association with heat waves in regional languages among the population such as televisions, newspapers, Twitter, Facebook, radios, pamphlet hoardings, LED displays in key public places such as big markets, hospitals, schools, parks, cinemas etc(3, 8). One of the keys focuses of such campaigns is to aware the public of the precaution measures for extreme heat events set by the Govt. Since the precaution measures are different from state to state, only a few key precautions are shown in table 2 (3, 8, 18).

A study was carried out in the state of Odisha in 2012 to see whether such awareness campaigns work or not(19). It was reported that heat wave awareness initiatives can drastically lower the number of people who die from heat exposure(19). From various HAPs (3, 8, 18, 14), it may be concluded that such initiatives may have been very useful in reducing the death tolls due to heat waves all over India during recent years.

2. Implementation of Early Warning Systems -:

One of the key reasons for reduction in mortality may be associated with implementation of 5-day forecast of daily maximum temperature by Indian Meteorological Department (IMD) in over 350 cities since 2016 compared to 100 in 2016(8, 18). These warnings are updated four times per day(3, 8, 18).

Since 2017, All the reports of the 5-day forecasts are provided to the authorities concerned with heat exposure management i.e., health departments of all the states, state authorities of disaster management, NDMA (National Disaster Management Authorities), Indian Red Cross, Indian Medical Association (**IMA**) (3, 8, 18).

Table 2-:

Precaution Measures during Extreme Heat Events-:

1. Always stay hydrated.
2. Wear cotton clothes of light colours.
3. Avoid giving water to the person fainting due to heart attack.
4. Say no to alcohol during heat waves.
5. Always consult the doctors even in case of slight discomfort.
6. Take extreme care of the vulnerable people.

Table 2 shows few of key precaution measures imposed by various state officials in India.

Source-: (3, 8, 18)

Also, since 2016, seasonal temperature forecasts for the next three months (e.g., Mar-May, Apr-Jun, May-Jul) are presented to all the concerned authorities in the printed format and electronic medium (accessible at the official website of IMD) (3, 8, 18). These daily 5-day forecasts and seasonal forecasts have been proven to be crucial for precaution measures by the respective authorities since it allows for preparedness and response to assure water supply, ice-pack stocking, and Oral Rehydration Solutions (ORS) and other essential medicines, adequate arrangements of enough beds and medical equipments for the potential patients, in hospitals and clinics (3, 8, 18).

Especially, this early warning system has been helpful for the “Rapid Response Teams” (a kind of medical emergency team) to be placed in the heat wave hotspot regions in time before severe heat waves which may have contributed to the downward trends in heat wave deaths since 2015 (3, 8, 18).

Because of combined efforts by all stakeholders, the total number of official deaths has decreased from more than 2000 in 2015 to 22 deaths in 2018 (Table 1)(3). From the declining trend of deaths since 2015 (table 1), it may be concluded that heat action plans have been successfully implemented. Despite all the success in recent years, the projected increase in the magnitude and frequency of the heat waves due to climate change suggests that a step up is needed in disaster response (3, 8, 15, 17, 18). Outlined below are 3 policy recommendations to strengthen India’s adaptation response due to heat waves.

IMD Warnings for Heat Waves (Colour Coded)		
Green Alert	Normal Day	Comfortable Day
Yellow Alert	Heat Wave	Moderate Health Concern for The Vulnerable People
Orange Alert	Severe Heat Wave	High Health Concern for The Vulnerable People and Manual Workers
Red Alert	Extreme Heat Wave	Very High Health Concern for Everyone

Table-3 (IMD-: Indian Meteorological Department, The Vulnerable People-: Infants, Elderly People and People with Chronic Diseases etc.) Source-: (3) (from National Guidelines for Preparation of Heat Action Plan)

- Feeling Tired
- Dryness of Throat
- Blink Vision
- Increase in Body Temperature
- Feeling dehydrated
- Headaches
- Feeling Pain in the Body
- Vomiting
- Losing Consciousness
- Lots of Sweating
- Feeling dizzy
- Slurred speech

All the symptoms of heat strokes as shown in the “Public Awareness Campaigns” in different Heat Action Plans of the states of India are shown in Table 1. Source-: (3, 8, 18)

Policy Recommendations-:

1. Access to More Funding for Cool Roof Housing Scheme for The Vulnerable Groups:-

- Despite being regarded as the deadliest hazard in the world, extreme heat events are not considered as national disaster in India under the “National Disaster Management Act 2005”(16). Therefore, the heat wave related adaptation plans such as “Cool Roof Housing” have not received any funds from national or state disaster response funds. This may have slowed down the implementation of the cool roof scheme(3, 8, 15).
- Cool roofs conserve energy while also improving thermal comfort and lowering cooling demand(15, 19). They reflect light and absorb less heat. Also, in comparison to standard roofs, indoor temperatures can be lowered by 2 to 5°C less depending on the setting(18, 20). This policy may be designed for the economically vulnerable section who struggle to buy any air conditioners or even fans(8, 18, 20). It was implemented on a smaller scale in Gujarat and the Govt. Of Gujarat considered it a success(18, 20).
- Therefore, this study suggests the Govt. of India to consider extreme heat events as a national disaster so that the subsidies may be provided to the vulnerable section of the population for the policies such as “Cool Roof Scheme”.

2. Strict Movement during Peak Hours of Heat Waves:-

- In the state of Odisha, the school and college hours are shifted to early morning sessions (6.30 am- 12 pm) from the 3rd week of February(8, 20). The Govt. offices also follow the same routine from mid-February to the end of June(8, 20). Various public programmes which employ millions of workers in Odisha are halted from 11.30 am- 3.30 pm from Apr-June(8, 20). This policy may have been very useful because after facing 2000+ deaths in 1998, since implementing this policy, Odisha averages less than 50 deaths per year ever since despite being one of the most vulnerable states to heat waves(8). A similar policy has been implemented in Qatar only this year which was designed especially for the outdoor workers(21).
- The states facing a similar intensity of heat waves to Odisha who do not have the same policy in place are Andhra Pradesh and Telangana(3, 9, 22). Most of the people dying there due to heat waves in 2015 were construction site labourers(3, 18, 20). Hence, these deaths may have been prevented had the same policy been in place.
- This policy may not be realistic to apply in the whole country for the whole summer as this may slow down the economy. Therefore, this study recommends this policy to be applied at least in the places which are projected to face “Severe Heat Wave” and “Extreme Heat Wave” (Table 3) in the 5-day forecast in the IMD.

3. Creating A Set of Guidelines for Employers:-

- Unlike Qatar, there seem to be no official guidelines in any workplaces in India regarding the safety and wellbeing of employees during extreme heat events(3, 8, 18).
- Firstly, this research recommends the Govt. of India to mandate for all employers to complete a risk assessment for the adaptation to heat exposure in the workplace together with employees. They should update it before the start of the summer every year according to the IMD heat wave projections(21).
- Secondly, all the employees may be provided free water and healthy soft drinks along with shaded rest areas during breaks and lunch hours(21).
- Thirdly, all the employees may be educated on the fundamentals of the heat waves, its relationships to climate change and its impacts etc. before the start of the summer every year(21). Also, they may be encouraged to spread their knowledge on heat waves to their friends and family and so on. This can cause a chain reaction of the heat wave related education which in turn might help the country achieve the zero-casualty due to heat exposure in future.

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