HEAT ACTION PALN FOR ODISHA 2019
Heat Action Plan for Odisha 2019
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1. Special Relief Organization (Sro)
2. Odisha State Disaster Management Authority (OSDMA)
3. India Meteorological Department
4. Housing and Urban Development Department
5. Panchayati Raj & Drinking Water Department
6. Department of Health and Family Welfare
7. Labour and Employee's State Insurance Department
8. Department of School and Mass Education
9. Department of Energy
10. Department of Commerce and Transport
11. Department of Water Resources
12. Department of Industry/ Steel and Mines
13. Department of Tourism and Culture (Tourism)
14. Women and Child Development Department
15. Department of Forest and Environment
16. ST &SC Development, Minorities and Backward Classes Welfare Department
17. Department of Fisheries and Animal resources
18. Knowledge Partner
19. Civil Society Organizations/ Corporate Social Sectors
20. District Administration
 Maintenance of Data on Heat Related Deaths and Illness
**LIST OF ABBREVIATIONS**

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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ANM</td>
<td>Auxiliary Nurse Midwife</td>
</tr>
<tr>
<td>ASHA</td>
<td>Accredited Social Health Activist</td>
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<tr>
<td>BCC</td>
<td>Behavioral Change Communication</td>
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<td>BMC</td>
<td>Bhubaneswar Municipal Corporation</td>
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<tr>
<td>CHC</td>
<td>Community Health Center</td>
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<tr>
<td>DHH</td>
<td>District Headquarters Hospital</td>
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<tr>
<td>DPH</td>
<td>Directorate of Public Health</td>
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<tr>
<td>EOC</td>
<td>Emergency Operation Centre</td>
</tr>
<tr>
<td>EWS</td>
<td>Early Warning System</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HAP</td>
<td>Heat Action Plan</td>
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<tr>
<td>H&amp;UD</td>
<td>Housing and Urban Development</td>
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<tr>
<td>IEC</td>
<td>Information, Education and Communication</td>
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<tr>
<td>IMD</td>
<td>India Meteorological Department</td>
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<tr>
<td>IIPH-B</td>
<td>Indian Institute of Public Health-Bhubaneswar</td>
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<tr>
<td>MHU</td>
<td>Mobile Health Unit</td>
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<td>MRP</td>
<td>Maximum Risk Point</td>
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<td>NDMA</td>
<td>National Disaster Management Authority</td>
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<td>NHM</td>
<td>National Health Mission</td>
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<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
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<tr>
<td>OSDMA</td>
<td>Odisha State Disaster Management Authority</td>
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<tr>
<td>ORS</td>
<td>Oral Rehydration Solution</td>
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<tr>
<td>PHC</td>
<td>Primary Health Center</td>
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<tr>
<td>RI</td>
<td>Routine Immunization</td>
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<tr>
<td>RIMES</td>
<td>Regional Integrated Multi-Hazard Early Warning System</td>
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<tr>
<td>SDH</td>
<td>Sub Divisional Hospital</td>
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<tr>
<td>SDMC</td>
<td>State Drought Monitoring Cell</td>
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<tr>
<td>SIHFW</td>
<td>State Institute of Health and Family Welfare</td>
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<tr>
<td>SRC</td>
<td>Special Relief Commissioner</td>
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<tr>
<td>SRO</td>
<td>Special Relief Organization</td>
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<tr>
<td>TERI</td>
<td>The Energy and Researches Institute</td>
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<tr>
<td>ULB</td>
<td>Urban Local Bodies</td>
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<tr>
<td>UHI</td>
<td>Urban Heat Island</td>
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<tr>
<td>VHND</td>
<td>Village Health Nutrition Day</td>
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<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
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Odisha State Disaster Management Authority (OSDMA), is mandated under the Disaster Management Act, 2005 to prepare Heat Action Plan for the State in comprehensive manner by involving all Stakeholders. This Heat Wave Action Plan 2019 is updated as per the guideline 2017 of NDMA, Government of India and improvised by taking into account on the rise in heat wave and its stress and impact on social economic lives of people of the state. The Action Plan suggests a number of mitigation, preparedness and response activities to tackle the menace of the heat wave. Mass awareness through electronic and print media has been accepted as the key to tackle heat wave.

OSDMA takes this opportunity to sincerely acknowledge all the concerned Government Departments for their valuable inputs in preparing the Heat Wave Action Plan 2019. OSDMA also sincerely acknowledges the contribution of Dr. Bhuputra Panda of IIPH, Bhubaneswar and Dr. H.R. Biswas, Director of IMD for their valuable insights in making the Heat Wave Action Plan 2019. The contribution made by the team at State Drought Monitoring Cell (SDMC) deserve sincere acknowledgement.

Above all, OSDMA sincerely acknowledge time to time guidance and advice of Bishnapada Sethi, IAS Commissioner-Cum-Secretary to Govt., Disaster Management & Managing Director, OSDMA.

(Dr. Pradeep Kumar Nayak)
Chief General Manager
Chapter 1

Introduction
Heat Action Plan for Odisha 2019
Objective of Heat Wave Action Plan

The Heat Wave Action plan aims to provide a framework for implementation, coordination and evaluation of extreme heat response activities in cities/town that reduce the negative impact of extreme heat. The Plan’s primary objective is to alert those at risk of heat-related illness in places where extreme heat conditions either exist or are imminent, and to take appropriate precautions. The Plan also calls for preparedness measures to protect livestock/animals as extreme heat causes significant stress to them as well. The heat wave action plan is intended to mobilize departments and communities to help protect their neighbours, friends, relatives, and themselves against avoidable health problems during spells of very hot weather. The Plan also intends to help early warning agencies as well as the media. The administrative/preventive actions that need to be taken by multiple agencies/ministries/departments are enumerated in Table 5. All States/district/cities/town can learn from their/others’ experiences and develop a plan to deal with heat wave effectively.

Background

What is Heat Wave?

Heat wave is a condition of atmospheric temperature that leads to physiological stress, which sometimes can cause deaths as well. The World Meteorological Organization defines a heat wave as five or more consecutive days during which the daily maximum temperature exceeds the average maximum temperature by five degrees Celsius. Different countries define heat wave differently in context of their local conditions. In India, as per IMD classification, heat wave is considered if maximum temperature of a station reaches at least 40°C or more for plains, 37°C or more for coastal stations and at least 30°C or more for hilly regions. Following criteria are used to declare a heat wave:

a) Based on Departure from Normal
   - Heat Wave: Departure from normal is 4.5°C to 6.4°C
   - Severe Heat Wave: Departure from normal is >6.4°C

b) Based on Actual Maximum Temperature (for plains only)
   - Heat Wave: When actual maximum temperature ≥ 45°C
   - Severe Heat Wave: When actual maximum temperature ≥47°C

To declare a heat wave, the above criteria should be met at least at two stations in a Meteorological sub-division for at least two consecutive days. A heat wave will be declared on the second day. The level of heat discomfort is determined by a combination of meteorological (temp, RH, wind, direct sunshine), social/cultural (clothing, occupation, accommodation) and physiological (health, fitness, age, level of acclimatization) factors. There will be no harm to the human body if the environmental temperature remains at 37° C. Whenever the environmental temperature increases above 37° C, the human body starts gaining heat from the atmosphere. If humidity is high, a person can suffer from heat stress disorders even with the temperature at 37°C or 38°C as high humidity does not permit loss of heat from human body through perspiration.

Heat Wave Situation in Odisha

In the year 1998, the State of Odisha faced an unprecedented Heat Wave situation, as a result of which 2042 persons lost their lives. Though extensive awareness campaigns have largely reduced the number of casualties during post 1998 period, still a good number of casualties are being reported each year. Heat wave has become a menace during the hard summer causing insurmountable human suffering. The poor people, farmers and workers are the most vulnerable groups.

Figure 1: Heat Wave related death in Odisha 1999-2018

![Heat Wave Deaths in Odisha](source: O/o Special Relief Commissioner, Odisha)

Geo-physical Snapshot of Odisha

Odisha is surrounded by the states of West Bengal to the north-east, Jharkhand to the north, Chhattisgarh to the west and north-west, Telangana to the south-west and Andhra Pradesh to the south. The state has 480 km of coastline along the Bay of Bengal on its east. According to the 2011 census of India, the total population of Odisha is 4,19,74,218, of which 2,12,12,136 are male and 2,07,62,082 are female, or 979 women per 1000 men. This represents a 14.0% increase over the population in 2001. The population density is 270 per square kilometer. The state projects distinct yet homogeneous features of topography. With a blend of several physiographical features in Odisha, the state exhibits three broad distinct morphological features: coastal plains, southern mountainous and plateau, western rolling uplands. The summer season in Odisha commences in March and stretches till June. The temperatures are quite high during this time and the sun very harsh. The maximum temperature of Odisha, in the summer season, goes well above 40 degree Celsius. The pattern of Heat Wave is different in different parts of the state, like coastal area experiences humid heat, whereas western part experiences more dry heat.

Different temperature zones and temperature ranges are given in Figure 2.
Figure- 2 : Different Temperature Zones in Odisha and Their Temperature Ranges

Coastal Odisha: q > 35°C < 39°C (Gopalpur, Paradeep, Puri); North-Central Odisha: q > 42°C < 44.5°C (Balasore, Cuttack, Baripada, Phulabani, Keonjhar, Chandbali, Bhubaneswar); Western Odisha: q > 44.5°C <= 48°C (Titilagarh, Bhawanipatna, Jharsuguda, Bolangir, Anugul, Sambalpur, Sundergarh, Hirakud) and Southern Odisha: q > 39°C <= 40°C (Koraput)

Rationale for Strengthening the Heat Action Plan (HAP)

Heat Waves in Odisha in the year 1998 killed 2042 people. In the year 1999, the state implemented first HAP in the state. Despite having a HAP in place the state experienced another massive Heat Wave casualty in the year 2005 by losing 236 lives. There could have been many possible reasons, which are going to be exacerbated in coming years with growing urbanization, population and industrialization. The problem is further going to be magnified with ongoing climate change. According to estimates, the scenario is likely to become aggravated in coming years\(^1\), and the World Meteorological Organization (WMO) predicts heat related fatalities will double in less than 20 years. This demands the policy makers and researchers to revisit and strengthen the current HAP. Our preliminary review finds that, till date mostly the Heat Wave measures have been preventive in nature. However, prolonged summer periods, increased temperature and climatic changes require designing adaptive measures and building resilience in the informal economy sector (vulnerability assessment and alternate livelihood generation of the vulnerable population) along with the preventive actions. Under these circumstances, adaptation is a key response strategy to minimize potential deaths and other adverse health effects of Heat Waves.\(^2\)

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Surprisingly, while coastal Odisha experiences less rise in temperatures compared to western Odisha, our analysis reveals that there is an increased incidence in heat related illness in coastal Odisha which merits further attention. One of the factors could be the difference in humidity levels across the zones, while plausibility may be the lower adaptability of the people in coastal areas towards sudden increase in heat. Particularly, in view of Odisha’s distinct geophysical region, it is important to determine region specific thresholds combining temperature and humidity (thermo-hygrometric index) causing Heat Wave related morbidity and consequent mortality. At the same time, there is a need to assess community vulnerability for Heat Wave. Accordingly, suitable strategies can be designed to prevent and mitigate the problem. Limited attention has been given to community vulnerability assessment as well as creating mechanisms for building community resilience in the context of Heat Wave.

### Impact of Heat Wave on Agricultural Productivity

Apart from, impact on human life, the Heat Wave has also been found to profoundly affect crop production both in terms of quantity and quality. Primarily, crop loss happened due to flower drop and higher mortality in new plantations. Kharif crops are more impacted than Rabi crops owing to variability in rainfall associated with Heat Wave. Since, Kharif crops are sown in May to June and harvested in September to October; any extreme change in temperature would affect the productivity. Within Kharif, particularly rice production is significantly affected with decreased grain yield which is a matter of concern as rice is a staple diet of all Odisha’s population.

### Impact of Heat Wave on Life and Livelihood

The human thermoregulatory system has limits. Our muscles generate heat, which must be shed to the environment to maintain our core temperature of about 36.7°C. Evaporation of sweat helps human bodies to keep cool when it is hot, however, when there is excessive sweating it leads to dehydration with consequent rise in internal body temperature which is fatal. More or less, Odisha’s
population might be acclimatized to heat and humidity but there is an upper level of heat tolerance limit. However, acclimatization to heat can only offer limited protection. When temperature soars beyond the tolerance limit, precautionary measures like avoiding the sun and physical exertion, maintaining hydration, and resting in a cool place are suggested.

However, serious challenges arise when extreme heat events linger for prolonged periods, as cessation of activities for weeks is often not an option. Especially, majority of Odisha’s individuals are working in unorganized and informal sectors that have to earn their daily livelihood. Thus, on the advent of long spells of Heat Wave they either have to stay indoors and compromise their source of income or run the risk of succumbing to Heat Wave related illness upon continuing to work. This necessitates exploring alternate options for such kind of vulnerable population for income generation to sustain a healthy life. In view of the above, there was a need to revisit and strengthen the existing Heat Wave response plan in order to make it more specific and strategic.

**Early Warning and Communications**

1. **Forecast and Issuance of Heat Alert or Heat Warning**

India Meteorological Department (IMD), Ministry of Earth Sciences, is the nodal agency for providing current and forecast weather information, including warnings for all weather-related hazards for optimum operation of weather-sensitive activities. It provides warning against severe weather phenomena like tropical cyclones, squally winds, heavy rainfall/snow, thunder-squall, hailstorm, dust storms, heat wave, warm night, fog, cold wave, cold night, ground frost, etc. It also provides real time data and weather prediction of maximum temperature, heat wave warning, extreme temperatures, and heat alerts for vulnerable cities/rural areas.

IMD issues forecasts and warnings for all weather related hazards in short to medium range (valid for the next five days) every day as a part of its multi-hazard early warning system. These warnings, updated four times a day, are available at

http://www.imd.gov.in/pages/heatwave.php

A new system of exclusively heat-related warnings has been introduced with effect from 03 April, 2017. These warnings, valid for the next 5(five) days, are issued around 1600 hours IST daily and are provided to all concerned authorities (Departments of health, disaster management, Indian Red Cross and Indian Medical Association, NDMA etc.) for taking suitable action at their end. A bulletin in extended range with outlook for the next two weeks (for all hazards including heat wave) is issued every Thursday (available at http://www.imd.gov.in/pages/extended.php).

In addition to the above, Climate Forecast System based forecasts maps of daily maximum temperatures and their departures from normal for the next 21 days (issued every Thursday) are also available on IMD website

(http://nwp.imd.gov.in/cfs_all.php?param=tmax and

From 2016, IMD has introduced a system of issuing seasonal temperature outlooks for the next three months. For 2017, the first outlook valid for March to May was issued on 28 February, 2017; and the second one valid for April to June was issued on 02 April, 2017. These seasonal outlooks are issued in
the form of a press release on the IMD website, and through electronic and print media. These are also provided to all concerned Chief Secretaries, Disaster Managers and to the health sector through the India Medical Association (IMA).

The operational system of weather forecasts and warnings is summarized in the chart below:

**2. Identification of Colour Signals for Heat Alert**

IMD currently follows a single system of issuing warnings for the entire country through a colour code system as given below (Figure-4). This system advises on the severity of an expected heat hazard. However, threshold assessments carried out in different parts of the country tells us that there are different cut-off points that determine the warning signals appropriate for a specific state/region. The States should, therefore, carry out their respective threshold assessments for mortality and provide the information to IMD so that it can provide specific warning alerts to those States.

**Figure-4: Color code, Meaning, Temperature Details and Action Needed**

<table>
<thead>
<tr>
<th>Green (No action)</th>
<th>Normal Day</th>
<th>Maximum temperatures are near normal</th>
<th>Comfortable temperature. Cautionary action required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Alert (Be updated)</td>
<td>Heat Alert</td>
<td>Heat wave conditions at district level, likely to persist for 2 days</td>
<td>Moderate temperature. Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases. Avoid heat exposure.</td>
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</tbody>
</table>
| Orange Alert (Be prepared) | Severe Heat Alert for the day | (i) Severe heat wave conditions may persist for 2 days. 
(ii) With varied severity, heat wave is likely to persist for 4 days or more. | High temperature. Increased likelihood of heat illness symptoms in people who are either exposed to sun for a prolonged period or doing heavy work. High health concern for vulnerable people e.g. infants, elderly, people with chronic diseases. Avoid heat exposure – keep cool. Avoid dehydration. |
| Red Alert (Take Action) | Extreme Heat Alert for the day | (i) Severe heat wave may persist for more than 2 days. 
(ii) Total number of heat/severe heat wave days likely to exceed 6 days. | Very high likelihood of developing heat illness and heat stroke in all ages. Extreme care needed for vulnerable people. |
3. Prevention, Preparedness and Mitigation Measures

Cool Roofs to Provide Affordable Thermal Comfort: Urban residents living in slums have fewer options available to adapt to rising temperatures. This increases their vulnerability to heat and results in greater adverse impacts of extreme heat on these communities. In their issue brief "Rising Temperatures, Deadly Threat", the NRDC and IIPH Gandhinagar identified several specific factors that increase the vulnerability of slum residents to extreme heat:

- **Higher Exposure to Extreme Heat**: Slum residents are more likely to be exposed to heat since they work primarily outside or in unventilated conditions, they live in homes constructed of heat-trapping materials with tin or tarpaulin roofs, and their communities lack trees and shade.

- **Greater Susceptibility to Health Effects of Extreme Heat**: Lack of access to clean water, poor sanitation, over-crowding, malnutrition, and a high prevalence of undiagnosed/untreated chronic medical conditions due to poor access to healthcare heighten slum community members’ susceptibility to extreme heat’s effects on health.

- **Fewer Adaptation Options Available**: Slum residents lack control over their home and work environments, with limited access to (and inability to afford) reliable electricity and cooling methods like fans, air coolers and air conditioning, insufficient access to cooling spaces, and a dearth of health information on which to act. All these factors reduce slum residents’ opportunities to adapt to increasing temperatures.

An affordable solution is cool roofs. A cool roof is a white reflective roof that stays cool in the sun by minimizing heat absorption and reflecting thermal radiation to help dissipate the solar heat gain. Studies have shown that cool roofs can be up to 30° C cooler than conventional roofs, and can bring the indoor temperatures down by 3-5° C. When implemented on a large scale, cool roofs can reduce the urban heat island effect in a city.\(^1\)\(^2\) Cool roofs include coatings and treatments such as lime-based whitewash, white tarp, white china mosaic tiles and acrylic resin coating, and provide an affordable solution for providing thermal comfort.


1. Studying the Effects of Heat Stress on Health and Productivity

Effect of heat stress on health and productivity of high risk population in Bhubaneswar (Conducted by IIPH-Bhubaneswar, funded by IRADe)

The study aimed to assess the impact of heat-stress on vulnerable population. IIPHB conducted a survey during May-Jun, 2018 on vulnerable households and individuals with high risk occupations. We identified 10 hot-spot clusters in Bhubaneswar city and interviewed 25 to 30 randomly selected households, and about 100 individuals with high-risk occupation (HRO).

Key Findings

Household

1. At household level, the frequently reported symptoms of exposure to heat stress were: sweating (91.4%), headache (45.4%), dizziness (41.9%), %), dehydration (37.1%), excessive thirst (30.2), and heat rash (29.9%). The median discomfort period ranges from 10 am to 4 pm. Majority of respondents were aware of the treatment facilities available within the city, though the most preferred methods for receiving heat-stress information were Radio/TV (78.4) and Newspapers (27.5).

2. Comfortable clothing, using hand fans, electric fans/ac/cooler, and drinking water frequently were frequently used mechanisms to cope with heat-stress at individual level. About 77% and 63% households sought treatment from public and private healthcare providers, respectively. Distance and poor quality were the major reason for not availing public health care services. Though majority of households (84%) used piped water as principle source of drinking water, about 28% didn’t have access to toilet at the household level.

3. With respect to financial risk protection, it was found that about 83% households did not have any health insurance.

High Risk Population

1. 99% of high risk population faced problem due to heat-stress. Some of the frequently reported symptoms were: sweating (95%), excessive thirst (53%), dizziness (52%), headache (41%), heat rash (41%), dehydration (29%), and heat cramp/muscle cramp (17%). With respect to their health seeking behavior, it was found that 79.8% of respondents sought treatment from public healthcare providers. Distance (48.4) and poor quality (25.8) emerged as the main reasons for not availing public health care services for those who didn’t seek treatment. On an average, each respondent spent INR 182/- towards treatment. Further, 90% HRIs have no health insurance.

2. Drinking water frequently (92), comfortable clothing (57), frequently splashing your face with water/wet cloth (38) were most sought-after mechanisms to cope with heat-stress, since almost none (98%) had cooling facilities at workplace.

3. Two third of respondents reported that they had taken leave during summer due to excessive heat and the average length of such leaves was found to be 6 days. About 52% respondents reported loss in monthly income between INR 1,000 and INR 10,000.
2. Vulnerability Assessment

The study was conducted in the slums of twin cities- Bhubaneswar and Cuttack.

Key Findings

- In comparison to non-slum areas, slum residents are more at risk of getting exposure to heat because of the housing structures, heat trapping materials on roof (asbestos and tin), overcrowding, lack of electric supply, and access to water supply and exposure to additional heat during cooking because of use of solid fuel chullah. Slum dwellers suffered from skin diseases and infections. Chronic conditions and prolonged use of medication predisposes individuals to adverse effects of heat.

- The adaptive practices vary across the area because of socio-economic conditions and affordability. People in slum areas are more dependent on water and other traditional cooling mechanism, whereas, HHs in non-slum areas spends more on personal protection and architectural modification to avoid heat exposure.

- Nearly 80% of slum people believes, avoidance of sun, drinking enough liquids and proper clothing will save them from heat related events, whereas, more than 90% of non-slum people think that proper dressing, avoiding sun and taking rest in cooler place can prevent heat related illness.

- Males staying indoor were two times higher at risk of getting heat illness compared to females. Presence of kitchen outside the home makes the residents two times more vulnerable towards the heat exposure and illness. Presence of chronic conditions predisposes higher risk (2-4 times) of getting heat illness. Practice of cooling methods like use of fan/ac/cooler decreases the chance of getting heat illness by 60%. Further, it was found that most of the hazards occurred during the transport to the workplace.

Suggested Proposal for Preventing Heat Illness at Work

While Travelling to Workplace:

- Provision of more public transport instead of using bike/cycle
- Travel timing to office should not be between 12 noon-3pm (including lunch)
- Shedding at public bus stops with water facility
- ‘First aid’ training of the drivers, conductors, students and others
- Senior citizen and other diseased people should adopt special precaution with an identity card
- Promote selling of water in public transport ‘not carbonated drinks’
- All the transport services should have cold water, ice box and first aid box
- Plantation of more trees on road side and at major public stoppages
- First aid box should have two components: Medical emergency and Environmental hazards (Sun stroke, chemical spill)

At Workplace:

- Change of working time (if possible) and encourage shift duty hours
- Provide adequate shedding, water, ice box and ‘first aid’ at workplace
- Change in timing of lunch or provision of canteen at workplace with quality food
- Work station designing such as shifting of heavy work station from top floor (Also in hospitals wards for vulnerable group of patients)
- Adequate ventilation and cooling mechanism (albedo painting)
- Creation of heat resistant building instead ‘tin roofed’ vending zones.
- Periodic checking of health status working in direct sun such as construction workers, manual labourers
- Plantation and creation of green environment at workplace.
- Specific Do’s and Don’ts for key occupation groups has to be developed and shared

3. Determining the Heat Threshold

The threshold study was conducted for Bhubaneswar city, one of the near coastal cities of Odisha, which experiences long and scorching summers like other cities of India. The months of March to July for the years 2007 to 2014 were considered for the analysis. Daily records of maximum and minimum temperature and humidity at 08.30 and 17.30 hours were collected from Bhubaneswar meteorological station. Daily all-cause mortality data for those days was collected from Bhubaneswar Municipal Corporation, which were included as the outcome in the time-series dataset. Days of the week and days of the year were the other variables.

Poisson regression method was used to model the all-cause mortality data, where the maximum temperature was the principal explanatory variable, which was included in the model with a fixed thin-plate regression spline with 3 degrees of freedom. The curvi-linear relationship between the relative risk of mortality and maximum temperature was plotted; 95% confidence intervals plotted for the curve. From the ensuing plot it was inferred that two threshold points for maximum temperature – the first being the point where the point estimate of relative mortality risk crossed the null value, referred to as minimum risk point (MRP); and the second threshold point being that when the lower limit of the 95% confidence interval of the relative risk crossed the null value, referred to as the excess risk point (ERP).

The threshold temperature for Bhubaneswar city was found to be between 36.2°C and 40.5°C.
Urban Heat Island (UHI) is a situation with elevated air or surface temperatures in urban areas in contrast to their non-urban rural vicinities. The phenomenon is present in all big and small cities around the world with varying intensity. UHI has adverse effect on human health can also significantly affect the economic productivity. The Ib-Valley region of Odisha is a rapidly growing industrial hub in Odisha with a range of large industries, such as steel, aluminum, thermal power plants, as well as coal mining. There are concerns that this district is highly vulnerable to heat island (HI) effect, and the relative importance of these effects is not well understood.

The key findings of the study are:

1. There has been a steady build-up of heat in the region over the years resulting in higher night time temperatures. Coal Mining, Industries, Urban settlements and open non-vegetated surface have been identified as thermal hot spots. - based on Remote Sensing – Land Surface Temperature Model

2. ‘Bhushan Steel Area’ and ‘Market Road’ are hotspot locations in summer; ‘Market Road’ is hotspot location in monsoon as well as combined period (summer and monsoon). This is likely because of the high built-up area on market road. - based on Ambient Air-Temperature-Thermal Retentivity Model.

3. ‘Bhushan Steel Area’, ‘Municipality’, and ‘Market Road’ are hotspot locations in summer; ‘OPGC’, ‘Market Road’, ‘Municipality’ are hotspot locations in monsoon; ‘Bhushan Steel Area’, ‘Market Road’, ‘OPGC’ are hotspot locations in the combined period. Higher heat sources, combined with higher built-up as well as more rotating population contributes to the higher heat index.- based on Ambient Air Temperature- Heat Index Model.

4. Coal Mining, Industries and Urban settlements are high thermal sources; forests, vegetation and water bodies are high thermal sinks. - based on Remote Sensing- Biophysical Model.

5. Coal Mining – Impact of bio-reclamation of de-coaled area (in terms of heat release per unit de-coaled area) highest for Lajkura and Lakhanpur, least for Lilari.- based on Heat Release Model.

This action plan is a framework to develop comprehensive strategies for mitigation and adaptation of the heat island effect. The sectoral contribution of different sources and sinks to heat islands has been analysed to determine where actions can be targeted. Sector specific measures to reduce the heat island effect over the Ib-valley region in Jharsuguda have been recommended on the basis of analysis of the contribution of each measure to the reduction in heat release.

**Coal Mining**

Key measures recommended for the five open cast coal mining projects viz. Samleshwari, Lakhanpur, Lajkura, Lilari and Belpahar include:
a) Improved management of de-coaled areas through creation of water bodies in void spaces to reduce self-oxidation as well as act as a heat sink as well as through increased bio-reclamation area within the mine boundary;

b) Setting up of more coal washeries which would reduce the ash content of coal, thereby reducing its self-oxidation potential – an exothermic process which releases heat into the ambient atmosphere;

c) Moving from 95% to 100% surface miner technology for coal removal which would completely replace the conventional blasting operations, thereby improving the stability of benches and high-walls. This would consequently result in reduced self-combustion of loose coal due to the limited presence of oxygen; and

d) Large-scale afforestation of the diverted forest area.

**Industries**

Key measures recommended in industries include:

a) Stockpile inventory management which would enable optimizing coal purchase and keeping the stockpile inventory at an optimum level, thereby not only resulting in cost savings but also environmental benefits;

b) Stockpile design changes from cuboidal to dome-shaped so that lesser surface area is exposed to environment, consequently resulting in lower heat radiation.

**Urban Planning**

Traffic congestion in certain parts of the district has been identified as a key issue to be addressed. Some of the measures that can be taken in this regard include shifting the bus terminus away from the market road, construction of flyover at strategic points, construction of new approach road to SH10 (Sambalpur-Jharsuguda bypass road), etc. In addition, plantation of trees with higher LAI (Leaf Area Index) bordering along the pavements of national highways, state highways and newly proposed roads, have also been included under the urban planning section. Species specific recommendations have been provided for national and state highways, city artillery roads and the municipal areas. Jharsuguda airport has been identified as a priority area for undertaking plantation activities due to extreme barrenness of the area. In the buildings sector, green roofing has been recommended as a voluntary measure to reduce ambient air temperature as well as cooling demand of air conditioners. Adopting higher albedo road surface materials such as concrete, where possible, can also go a long way to mitigate the rise in temperature.

**Agriculture**

In the agriculture sector, the key recommendation includes moving towards conservation tillage, which not only improves the productivity of land but also increases the surface albedo of the land mainly during the fallow period, thereby reflecting most of the incoming solar radiation back into the atmosphere.

**Adaptation**

On the adaptation front, the focus is on developing coping mechanisms to deal with heat stress in the hotspot regions. This involves coordination among agencies such as Indian Meteorological Dept.
Heat Action Plan for Odisha 2019

(IMD), state government agencies, and urban local bodies. Apart from the government establishment, civil society also plays a key role in creating public awareness and knowledge dissemination. Additional roles have been recommended for the various government agencies over and above their current role in heat wave action plan. It has been recommended to increase the number of Automatic Weather Stations (AWS) especially in the heat-wave prone districts to obtain a spatial distribution of temperature. This would improve the quality of early warning forecasts sent by IMD to the state government. Odisha State Disaster Management Authority (OSDMA) to undertake capacity building measures to deal with emergency response and preparedness for heat wave and heat island effects, especially among the health workers and district medical officers. The DM office is the key point to implement emergency response measures. This must be equipped with information on heat-stress vulnerable regions in the municipality and villages. In addition, they must ensure water availability in kiosks at strategic points; create public awareness through newspapers and radios on hotspot zones, direct municipalities and panchayats to ensure the safety of women and children in the vulnerable zones, etc.
Existing Institutional Mechanisms to Address Heat Wave in Odisha
Chapter 2

Existing Institutional Mechanisms to Address Heat Wave in Odisha
Ongoing Activities of Government of Odisha

Every year all the District Collectors are instructed to take required precautionary measures for mitigating the heat-wave situation and the Chief Minister reviews the preparedness activities of the related departments. The chain of command that is followed after the issuance of a heat alert as depicted in figure 4.

Figure 5: Flow of Information Followed in Government of Odisha During a Heat Wave Alert

(Source: OSDMA)
During the summer months (March to June), the EOC (Control Room) at the state and also at the district levels become alert about Heat Wave warning from analyzing the daily reports of India Meteorological Department (IMD). It currently provides weather forecast information on the basis of satellite imagery, mathematical modeling, GPS Sonde monitoring and Doppler radar system. It gives weather forecasting taking into account the temperature (both dry bulb temperature and dew point temperature), wind pattern, cloud pattern and a few other parameters. The temperature/city forecast is done two times a day i.e. at 10 AM, & 6 PM for one week in respect of 16 cities in the State of Odisha. Besides city forecast, forecast along with warning are also issued for next five days at 10 AM, 1 PM, 6 PM & 9 PM. The 1 PM forecast is forwarded to state agencies and media by fax and E-mails.
IMD gives a Heat Wave forecast particularly during the months from March to mid-June. The cut off temperatures for Heat Wave Forecast is

- 37 °C for the coastal areas
- 40 °C for the interior areas

The IMD also provides warnings based on heat index (based on temperature and humidity). The reliability of these forecasts is up to a level of 85%. It disseminates information directly to Special Relief Commissioner (SRC) and Odisha State Disaster Management Authority (OSDMA) by fax along with various state agencies, Doordarshan, All India Radio (AIR) and other media houses by mails. In case of an expected Heat Wave, mails are also sent to all the district collectors for alertness and preparedness for action.

Immediately upon receipt of such a warning, the state and district Emergency Operation Centres make necessary arrangements for flashing the warning through all forms of media. Simultaneously, departments of Health and Family Welfare, School and Mass Education, Labour & Employees’ State Insurance, Transport and Commerce, Public Health Engineering & other related departments remain alert and put necessary emergency measures in place. The OSDMA is the nodal agency which is responsible for the prevention and mitigation activities. The most important work of the OSDMA is to sensitize the necessary stakeholders, engage in their capacity building in forms of intra-departmental trainings and prepare and share the guidelines for different occupational groups, institutions, urban local bodies, PRI and civil societies. It works in tandem with the Special Relief Organization which acts as the main executing body under the leadership of the SRC during a Heat Wave condition and issues directives to all the concerned governmental and non-governmental organizations for a prompt action. Apart from this, the OSDMA also involved in establishing the Heat Wave related mortality tracking system and updating the data set periodically.

**Ex-Gratia Relief**

Earlier, the State Government had made provision in the Odisha Relief Code for payment of Rs.10,000/- towards ex-gratia relief to the bereaved family of each sunstroke victim. Since, there is no provision in the items and norms of expenditure for incurring expenditure from the State Disaster Response Fund (SDRF) & National Disaster Response Fund (NDRF) to provide relief to the victims of ‘Heat Wave’, the State Government was incurring such expenditure out of the Chief Minister’s Relief Fund (CMRF). However, the State Govt. has declared Heat Wave as a State Specific Disaster with effect from 1st April 2015 under the revised provisions of SDRF/NDRF norms & made provision for payment of ex-gratia of Rs. 50,000/- to the next of kins of the sunstroke victims.

**Process of Awareness and IEC plan:**

The proposal is initiated from the concerned nodal officer DPH and it communicates to State Institute of Health and Family Welfare (SIHFW) which develops the prototype of IEC in consultation with DPH. Once the prototype is approved by DPH, funding is released and the materials are printed at SIHFW and distributed to districts and to lower levels. For media (print and electronic), the SIHFW sends the prototype to Information and Public Relations (I&PR) Department. They publish it in Newspapers and disseminate it in electronic channels.
Figure 7: Process of IEC Material Development at the State Level

- Nodal Officer at DPH initiates the annual plan
- DPH issues directives to SIHFW
- SIHFW develops IEC in consultation with DPH
- I & PR Department sends them to the print and electronic media
- DPH approves and releases budget
- SIHFW disseminates the IEC at the District Level
Chapter 3

Standard Operating Procedures (SOP) for Different Departments, District Administrations and Others
1. Special Relief Organization (SRO)

Under the direction of the Special Relief Commissioner the SRO would ensure the following:

- Issue appropriate directives to the concerned departments for taking preparatory and precautionary measures for Heat Wave management.
- Posters and IEC materials on safety tips relating to heat-wave are prepared and distributed by Department of Health & Family Welfare for general awareness of the public. Advertisements on such safety tips to be given through local newspapers, radio and television channels.
- To instruct All India Radio, Doordarshan and other private Television channels to organize discussions and other programmes for creating public awareness.
- Issue directives to Department of Forest and Environment, Fisheries and Animal Resources, Women and Child, Health and Family Welfare and OSDMA for awareness activities, provision of water and essential preparatory measures concerning Heat Wave management.
- Action plan for mitigating water scarcity problems in different towns and rural areas, where acute scarcity of drinking water is felt, to be prepared. Required numbers of water tankers are to be deployed for supply of drinking water and defunct tube wells to be replaced / repaired. Essential medicines, saline and ORS packets to be stored in the District Headquarters Hospitals, Community Health Centers and Primary Health Centers. Special arrangements to be made and separate beds are earmarked for treatment of heat-stroke patients in different Hospitals.
- The working hours for daily labourers need to be re-scheduled i.e. from 6 a.m. to 11 a.m. and 3.30 pm to 6 pm. Orders to be given to make provision of drinking water at the work sites.
- Plying of buses during peak hours i.e. between 11.00 AM to 3.30 PM to be regulated. Orders to be given to carry portable water and ORS in public transport vehicles.
- Power distributing companies to be instructed to ensure uninterrupted power supply in summer.
- The time table of the schools to be re-scheduled from 6.30AM to 10.30 AM.
- Facilitate involvement of Civil Society Organisations for taking different mitigation activities.
- An amount of Rs. 50,000/- as ex-gratia relief to the bereaved family of each sunstroke victim is provided by the State Government.

2. Odisha State Disaster Management Authority (OSDMA)

Constitute State Steering Committee for strengthening the state heat action plan

- Convene State Steering Committee meetings to review and update the heat action plan annually and share the revised heat action plan in a broader platform
- Periodic coordination meetings with all the departments towards implementation of heat action plan
- Incorporate and update information related to Heat Wave in the existing website of OSDMA.
- Review of current IEC initiatives and accredit all IEC materials along with knowledge partners
- Promote research on heat related morbidity, mortality and mitigation measures in collaboration with knowledge partners located in the state.
Organize capacity building programs on Heat Wave prevention and management for different stakeholders.

Mobilization of funds for heat action plan review, documentation and Heat Wave management.

Ensure that IMD and the Municipal Corporations provide mortality data (all causes) to them every quarter.

Review and follow-up action on monthly basis

Include heat wave under IDSP (Integrated Disease Surveillance Programme)

DPOs responsibilities- to coordinate with Department of Health & Family Welfare, Govt. of Odisha.

3. India Meteorological Department

Issue early warning and disseminate heat alert to all the key stakeholders

Issue bulk emails to the key institutions/ key offices and persons.

Media brief using TV/ Radio/ FM/ Newspapers

Provide temperature data for determination of Heat alert and for better mitigation activities, daily as well as annually.

Provide 5 days forecast and warning on heat wave for all the districts of Odisha.

Provide past 24 hours weather data

Provide city forecast for 7 days consisting of Maximum and Minimum Temperatures, sky condition & weather of selected cities of Odisha.

4. Housing and Urban Development Department

Give directives to Urban Local Bodies (ULBs) /Development Authorities to take up appropriate measures for tackling heat wave

Promote and construct ‘Heat Resistant Building’ as a mitigating measures in the long run.

Improve sanitation and hygiene of the water distribution points

Give directives to Urban Local Bodies (ULBs) /Development Authorities to increase access to public parks, water bodies, public libraries for general public.

Create small, accessible green spaces by using vacant spaces such as side lots, parking medians, spaces between buildings and roads.

Keep large public parks open during peak hours to provide cool resting spaces for the public.

Give directives and ensure cool roofs initiative to paint roofs white (albedo paint), create green roofs and walls, and plant trees in neighborhoods to keep them cool.

Develop a strategy to incorporate the green belt concept in urban planning, evaluate the efficacy of these initiatives and the highest priority locations for intervention.

Issue directives to ULB/Development Authorities for use of K-glass, doubly glazed glass in buildings and vehicles which prevent the extra entry of heat inside.

Provision of funds in the departmental budget for capacity building.
Implement building codes that entail passive cooling practices such as increased reflectivity of building roofs, green roofs, increased natural ventilation and rainwater harvesting. Incentive mechanisms (e.g., reduced taxes) can be used to accelerate green infrastructure development.

Promote green energy technology, energy efficient building promotion, restricted use of heat producing equipment, and increasing use of renewable energy

Provision of funds for Heat Wave management.

Provide annual mortality data from their vital statistics division of Municipalities to the OSDMA Urban Local Bodies

Temperature and Forecast Displays: Municipal corporations and/or districts officials could publicly display temperature and weather forecasts so people could plan to avoid unessential travel or work on the hottest predicted days. Priority should be given to strategic locations where many people can view the information, and to highly vulnerable sites. Each hospitals, institutes and other strategic places should display the temperatures using digital boards in their campuses.

Safe drinking water supply: Provision of safe, cold drinking water supply in slum areas can help the residents beating heat. Regular water supply and uninterrupted power supply can bring some relief to scorching heat during summer.

Shelter home provision: The shelter homes present in different locations is currently being used only during cyclone or flood. These shelter houses can be prepared to provide rest during summer. Provision of electric fans, drinking water and basic medical services with emergency number can act as a safer place for slum population.

Public access to cool places: Access to schools, club houses, can be increased. Currently, most parks, lakes, swimming pools, public libraries and shopping malls are not located near to slum areas. These areas are not easily accessible because of many social and spatial factors. Cooling spaces could be provided throughout the city in locations close to slum communities. For example overnight homeless shelters, hostels for students, libraries or sport clubs and special shelter homes at bus stop and railway stations.

- Providing drinking water through water kiosk (Jal Jogana Kendra/Jala Seva Shibira/ Paniya Jala Kendra) at strategic points
- Public announcements through public address system.
- Restrict plying of city public transport.
- Provision of ice pack, first aid and water at City public transport vehicles plying during peak hours.
- Provision of vats (near tube wells) for drinking water for animals
- Provision for Water sprinkling to settle down the suspended particles on roads.
- Issue advisories for Albedo painting of office building /houses/apartment/schools/hospitals and other buildings

5. Panchayati Raj & Drinking Water Department

- Prepare Vulnerability population and area map
- Sensitize vulnerable population on Heat Wave
Public announcement about the do’s and don’ts issued by the department of Health and family welfare and OSDMA.

- Provision of water kiosks, tube wells, tankers at strategic locations.
- Provision of funds in department budget for capacity building.
- Encourage for alternative livelihood activities.
- Restrict the working hours from 11 AM to 3 PM under MGNREGA
- Supply of Drinking water and shade nets at working sites
- Construction of ponds, artificial lakes for cooling the environment by evaporation
- Identification of cooler places
- Provide cool shelter during summer (must be explored through innovation and partnership)
- Provision of funds for Heat Wave management.

6. Department of Health and Family Welfare

- For the year 2018, the IEC activities in print and electronic media w.e.f 1st April for public awareness and precautionary measures
- These awareness activities should not be confined to the summer season only. Rather it has to be done throughout the year to inculcate good practices to change general mindset of the people towards heat.
- Take necessary steps for albedo/white painting of roof tops of all hospitals, CHCs, PHCs and patient resting areas.
- Instructions to be issued from Health and Family Welfare Dept to all health officials to share copy of the post-mortem report of heat wave as well as other disaster related causalities with the Tahasildars to make the process of ex-gratia payment smooth
- Take necessary steps to prevent diarrhea and other health hazards during summer season

Chronic Diseases and Medication:

People at risk should be identified in particular persons with chronic conditions (single or multiple). IEC materials should be more designed towards people with chronic conditions. The do’s and dont’s for each chronic illness during summer would help in guiding individuals towards heat.

- Capacity building of Health Care Service Providers (Doctor, Nurses, Pharmacist and health workers) on diagnosis and management heat related illness.
- Maintaining data base and surveillance on heat related morbidity and mortality.
- Provision for Health facility readiness to manage heat affected patients (beds, staff, inventories, ambulance etc.).
- Special attention towards high risk patients like geriatric/pediatric/pregnant women etc.
- Training of 108 workers and ‘Mobile Health Units (MHU)’ for management of heat related cases
- Display do’s and don’ts of Heat Waves on ‘Swasthya Kantha’ (village health wall),
- Sensitize community on Heat Wave related issues at Kishori Swasthya Mela (adolescent health meet), and village Health Nutrition Day (VHND) and Routine Immunization (RI) sessions and distribution of IEC materials
Heat Action Plan for Odisha

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- Strengthen the control rooms for providing heat related information.
- Establishment of mobile base alert system through the ASHA/ ANM/ health workers for effective and immediate assessment of heat stroke cases.
- Development of specific reporting form for heat related events including morbidity and mortality.
- Coordinate with private hospitals to collect heat related morbidity and mortality data.
- Provision of power back up during summer.
- Provision of funds for Heat Wave management.
- Provide annual mortality data from their vital statistics division to the OSDMA.

7. Labour and Employee’s State Insurance Department

- Issue directives for flexible working hours to restrict heat exposure.
- Guideline for workers to protect from heat exposure and provision of First Aid, drinking water and cooling space at work site.
- Awareness activities for construction workers, factory laborers, manual laborers and workers whose occupations require intensive work outdoors during extreme heat about the risks, signs, and symptoms of heat stress.
- Training on heat illness diagnosis and management for factory medical officers.
- Advisory for one A/C relief chamber at factory facilities for emergency.
- Ensuring health centers/dispensary are open during peak summer hours.
- Ensure overseeing construction sites, quarries, factories and other vulnerable worksites, particularly during high temperature periods, to enforce labor laws related to heat safety.
- Provision of funds for Heat Wave management.

8. Department of School and Mass Education

- Restriction of school timing (6.00 am to 11.00 am) during summer.
- Ensure Avoidance of physical activities during school hours.
- Issue directive for Albedo painting on school roofs.
- IEC activities on Heat Wave prevention and management in schools.
- Promote School Safety Plan.
- Encourage Plantation of trees and promote green campus.
- Provision for safe drinking water, ice packs, ORS etc at schools and examination centers.
- Training to the teachers and mock drills among students via special workshops and classes on identification, health risks and the subsequent management during Heat Waves.
- Provision of funds for Heat Wave management.

9. Department of Energy

- Create awareness among people on energy conservation.
- Develop a policy for power cuts depending on vulnerable areas and population.
- Guideline for workers of the department
- Power shedding should be cut down/reduced during severe heat (frequency and timing)
- The timing should be announced before one day
- Frequency and regularities should be maintained
- Provision of power back up for life line institute
- Provision of funds for Heat Wave management.

10. **Department of Commerce and Transport**
- Provision for creating awareness among drivers and other staffs
- Issue a guidelines for each public transport to address Heat Wave
- Restriction of bus plying times during peak hours.
- Provision of safe drinking water, ice pack, ORS in buses and provision of cool resting spaces at bus stops.
- Provision of water kiosk on highways
- Provision of funds for Heat Wave management.

11. **Department of Water Resources**
- Release water in canals during summer.

12. **Department of Industry/ Steel and Mines**
- Issue directives for Heat Wave prevention and management for industries and mines.
- Generate awareness through IEC activities.
- Provision for water sprinkling to settle down the suspended particles.
- Provision of funds for Heat Wave management.

13. **Department of Tourism and Culture (Tourism)**
- Ensure proper registration of tourists who are visiting the State.
- Ensure availability of heat relief measures at tourist places
- Display of Heat Wave precautionary measures for tourists during summer at tourist points and related information in website of department of tourism.
- Ensure the availability of drinking water and cool resting sheds
- Restrict the timing of the visit of tourist places during peak summer days
- Provision of funds for Heat Wave management.

14. **Women and Child Development Department**
- Use the Village Health Nutrition Day (VHND) and RI sessions for creating awareness and educate young girls and mothers regarding the dangers of Heat Waves, its related health impacts and the precautionary measures to be taken.
- Display IEC materials at Anganwadis and encourage Anganwadi workers to disseminate Heat
Wave related information with special focus on infants, children below five years, pregnant and lactating mothers, and geriatric population to protect them from dehydration.

- Provision of drinking water and first aid at all the Anganwadi Centers, old age homes, Child Care Institutions (CCIs).
- Provision of funds for Heat Wave management

15. Department of Forest and Environment

- Ensure proper afforestation (greenery) under public place.
- Continuous watch in the forest area to avoid forest fires.
- Directive for making water available for animals in reserved/protected forests and make necessary provisions, where necessary.
- Issue directives to the Zoo Authorities for special arrangements for the animals in zoo to protect them from the effect of Heat Wave.
- Provision of drinking water like ponds/water bodies for wild life
- Directive for provision of water to human habitations facing water scarcity inside reserved forests
- Promote rain water harvesting
- Provision of funds for Heat Wave management.

16. ST &SC Development, Minorities and Backward Classes Welfare Department

- Provision of availability of safe drinking water, ORS packets, ice packs and other required first aid material in school to manage Heat Wave related illness.
- Capacity building of key functionaries-trainings on Heat Wave management.
- Awareness generation among students through IEC materials display and activities.
- Changing the timing of examinations, changing the school timings.
- Provision of funds for Heat Wave management.

17. Department of Fisheries and Animal resources

- Ensure construction of vats near tube wells for roaming livestock to provide them drinking water.
- IEC activities for Animal Care during heat.
- Activate field staff to create awareness among the Livestock farmers on the Animal Management during Heat Wave conditions.
- Capacity building of veterinary officials on diagnosis and management heat related illness.
- Maintaining data base and surveillance on heat related morbidity and mortality.

18. Knowledge Partner

(i) India Institute of Public Health, Bhubaneswar (IIPH-B)

- Conduct health effect and threshold studies in Angul, Talcher, Titlagarh, Bhawanipatna, Balangir and Jharsuguda.
Provide technical support for strengthening the HAP for Odisha, improving health system preparedness and on developing communication strategy for behavior change by giving evidence and recommendations.

Conduct operational research studies to gather evidence on the heat related mortality and morbidity.

Undertake mapping of vulnerable groups of population by using a structured questionnaire and suggest alternate livelihood strategies for the vulnerable populations.

Develop policy briefs on community vulnerability, concurrent monitoring and process evaluation of implementation of Government strategies.

Evaluate of the role of media on disseminating Heat Wave related alerts and precautionary measures and suggest better communication strategies.

Undertake concurrent monitoring in key locations.

(ii). RIMES

OSDMA collaborated with RIMES (Regional Integrated Multi-Hazard Early Warning System for Africa and Asia), Thailand for development of Decision Support System (DSS) for timely and effective dissemination of the heat-wave and other hazard warning information.

“SATARK” (*System for Accessing, Tracking and Alerting Disaster Risk Information based on Dynamic Risk Knowledge*) is a web and smart phone (App) in GIS platform for notifying users about different hazards such as Heat wave, Lightning, Floods, Cyclones, T-sunami and Droughts.

The application integrates the observation and forecast data from Indian Meteorological Department (IMD), and the best available global forecast products like European Center for Medium range Weather Forecast (ECMWF).

Based on the disaster events the advisories can be disseminated at different time scales (Weekly, Daily and Hourly).

Block level and location specific alerts are issued through Mobile App, E-Mail, SMS and other available sources.

The advisories are available in both Odia and English languages through SATARK mobile Application, which is freely available in Google app store.

19. Civil Society Organizations/ Corporate Social Sectors

To support the Govt. departments in generating awareness in community

Support in setting up Jal Jogana Kendras (water kiosks) on high ways, remote places

Distribute IEC materials duly accredited by the state health department and OSDMA

Promoting healthy living style during summer

Support the state government in establishing shelter and sheds

20. District Administration

Public Awareness campaign through electronic and print media on Heat Wave precautionary measures (Do's & Don’ts)

Give directions to prevent the Sunstroke deaths to various line departments/functionaries as per the Heat Action Plan.
Heat Action Plan for Odisha 2019

- Involve Civil Society Organizations and PRI members in awareness campaign and other measures to tackle the situation arising out of Heat Wave.

- Action plan for mitigating water scarcity problems in different towns and rural areas to be prepared. Water scarcity areas are to be identified in advance and supply of water for drinking and other uses through tanker to those areas has to be ensured. Preventive maintenance of tube wells has to be ensured. Suitable arrangement also to be made to promptly respond to reports of water scarcity anywhere in the district.

- Jala Jogana Kendras (Water Kiosks) are required to be opened by Urban Local Bodies/ Gram Panchayats at market places, bus stands and other congregation points. Civil Society Organizations also to be encouraged/involved for opening of Jala Jogana Kendras.

- Construction/repair of vats also to be ensured for roaming livestock.

- Provision of drinking water in all schools and colleges are to be ensured.

- Ensuring that the timing of classes and examinations in schools and colleges during summer are rescheduled between 6.30 AM and 10.30 AM.

- Water and Health needs of all Child Care Institutions within the district should be properly monitored.

- Life saving medicines, saline, ORS to be stored in dispensaries, PHCs, CHCs and District Headquarters Hospitals sufficiently to meet the crisis. Special arrangement may be made and separate beds be earmarked for treatment of heat stroke patients in different hospitals.

- The timing for engagement of labourers/workers at worksites may be rescheduled. No work should be executed during heat wave during the peak hours from 11.00 AM to 3.00 PM. The employer should make necessary arrangements for supply of drinking water, ORS packets and provision of rest shed at worksite.

- Provision of portable water and ORS packets must be made in public transport vehicles. During severe heat wave condition, timings of public transport services should be rescheduled and plying of buses during peak hour, i.e., between 11.00 AM to 3.00 PM should be restricted.

- Distributing Company should be instructed to ensure uninterrupted power supply during heat wave period or during peak hours. Uninterrupted power supply also to be ensured for critical facilities such as hospitals and urban health centers.

- All effort should be made to see that no human causality takes place due to heat wave. However, if any information on causality is received or report published in newspaper, it should be immediately enquired into.

- Prompt steps are also to be taken for payment of ex-gratia to bereaved family where, upon enquiry, the death is confirmed to be due to sunstroke.

**Maintenance of Data on Heat Related Deaths and Illness**

As per “Guidelines for preparation of Action Plan – Prevention and Management of Heat-Wave 2017” issued by National Disaster Management Authority (NDMA), New Delhi, data on age group, sex, occupation, economic status of those who died due to heat wave, place of death etc. are to be collected and furnished for proper analysis and under taking mitigation measures.
As per the instructions issued by the Special Relief Commissioner vide letter No. 1777/ R & DM (DM) Dated 03.04.2018 information as per **Format-I** (Annexed) may be collected and furnished to the Department along with every joint enquiry report of heat stroke deaths. Besides, a permanent register with detailed information as per **Format- II** (Annexed) is to be maintained both in the Tahasil Office and District Office and weekly report in the said format to be submitted to the Department every Monday by 1.00 PM.

Further, data on heat related illness is needed to carry out meaningful analysis of heat related health events and undertaking appropriate measures. Information of all cases of heat related illness and deaths as per **Format- A** (Annexed) needs to be collected by the Directorate of Health Services and submitted to the Department daily.
Chapter 4

Dealing with Heat Related Illness
Prevention of Heat Related Illness

Heat waves characterized by long duration and high intensity have the highest impact on morbidity and mortality. The impact of extreme summer heat on human health may be exacerbated by an increase in humidity. There is growing evidence that the effect of heat wave on mortality is greater on days with high levels of ozone and fine particulate matter. Global climate change is projected to further increase the frequency, intensity and duration of heat waves and attributable death (WHO).

Heat related illness is avoidable. It can be best prevented if the vulnerable populations/communities are made aware of prevention tips, basic Do’s and Don’ts through effective use of various media. Knowledge of effective prevention and first-aid treatment, besides an awareness of potential side-effects of prescription drugs during hot weather, is crucial for physicians and pharmacists to best mitigate the effects of heat illnesses.

Symptoms and First Aid for Various Heat Disorders

<table>
<thead>
<tr>
<th>Heat Disorder</th>
<th>Symptoms</th>
<th>First Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat rash</td>
<td>Skin redness and pain, possible swelling, blisters, fever, headaches.</td>
<td>Take a shower using soap to remove oils that may block pores preventing the body from cooling naturally. If blisters occur, apply dry, sterile dressings and seek medical attention.</td>
</tr>
<tr>
<td>Heat Cramps</td>
<td>Painful spasms usually in leg and abdominal muscles or extremities. Heavy sweating.</td>
<td>Move to cool or shaded place. Apply firm pressure on cramping muscles or gently massage to relieve spasm. Give sips of water. If nausea occurs, discontinue.</td>
</tr>
<tr>
<td>Heat Exhaustion</td>
<td>Heavy sweating, weakness, Skin cold, pale, headache and clammy extremities. Weak pulse. Normal temperature possible. Fainting, vomiting.</td>
<td>Get victim to lie down in a cool place. Loosen clothing. Apply cool, wet cloth. Fan or move victim to air-conditioned place. Give sips of water slowly and if nausea occurs, discontinue. If vomiting occurs, seek immediate medical attention; call 108 and 102 for ambulance.</td>
</tr>
<tr>
<td>Heat Stroke (Sun Stroke)</td>
<td>High body temperature. Hot, dry skin. Rapid, strong pulse. Possible unconsciousness or altered mental status. Victim will likely not sweat</td>
<td>Heat stroke is a severe medical emergency. Call 108 and 102 for ambulance for emergency medical services or take the victim to a hospital immediately. Delay can be fatal. Move victim to a cooler environment. Try a cool bath or sponging to reduce body temperature. Use extreme caution. Remove clothing. Use fans and/or air conditioners. <strong>DO NOT GIVE FLUIDS ORALLY if the person is not conscious.</strong></td>
</tr>
</tbody>
</table>
Hospital Preparedness Measures for Managing Heat related Illness

Director/In-charge of Hospitals in State/Districts should ensure that the following measures are in place:

- A detailed action plan to tackle heat-related illnesses well in advance of hotter months.
- Standard Operating Procedures to tackle all levels of heat-related illnesses. Capacity building measures for doctors, nurses and others staff should be undertaken.
- Cases with suspected heat stroke should be rapidly assessed using standard Treatment Protocols.
- Identify surge capacities and mark the beds dedicated to treat heat stroke victims and enhance emergency department preparedness to handle more patients.
- RRT (Rapid Response Teams) to respond to any exigency call outside the hospitals.
- Ensure adequate arrangements of Staff, Beds, IV fluids, ORS, essential medicines and equipment to cater to management of volume depletion and electrolyte imbalance.
- May try to establish outreach clinics at various locations easily accessible to the vulnerable population to reduce the number of cases affected. Health Centres must undertake awareness campaigns for neighbourhood communities using different means of information dissemination.
- Primary centres must refer the patients to the higher facility only after ensuring adequate stabilization and basic definitive care.
- Hospitals must ensure proper networking with nearby facilities and medical centres to share the patient load which exceeds their surge capacities.
- All cases of heat-related illnesses should be reported to IDSP (Integrated Disease Surveillance Programme) unit of the district.

Acclimatization

Those who come from a cooler climate to a hotter climate, especially during the heat wave season, are at risk. They should be advised not to move out in open for a period of one week. This helps the body get acclimatized to heat. They should also be advised to drink plenty of water. Acclimatization is achieved by gradual exposure to the hot environment during a heat wave.

Heat Illness Treatment Protocol

Recognizing that treatment protocols may vary slightly according to the setting (EMS, health centre, clinic, hospital emergency department, etc.), the following should apply generally to any setting and to all patients with heat related illnesses:

1. Initial patient assessment primary survey (airway, breathing, circulation, disability, exposure), vital signs including temperature
2. Consider heat illness in differential diagnosis if:
   a. Presented with suggestive symptoms and signs
   b. Patient has one or more of the following risk factors:
      - Extremes of age (infants, elderly)
Debilitation/physical deconditioning, overweight or obese

c. Lack of acclimatization to environmental heat (recent arrival, early in summer season)
d. Any significant underlying chronic disease, including psychiatric, cardiovascular, neurologic, hematologic, obesity, pulmonary, renal, and respiratory disease
e. Taking one or more of the following:
   - Sympathomimetic drugs
   - Anticholinergic drugs
   - Barbiturates
   - Diuretics
   - Alcohol
   - Beta blockers

3. Remove from environmental heat exposure and stop physical activity

4. Initiate passive cooling procedures
   a. Cool wet towels or ice packs to axillae, groin, and around neck; if patient is stable, may take a cool shower, but evaluate risk of such activity against gain and availability of other cooling measures
   b. Spray cool water or blot cool water onto the skin
   c. Use fan to blow cool air onto moist skin

5. If temperature lower than 40°C, repeat assessment every 5 minutes; if improving, attempt to orally hydrate (clear liquids, ORS can be used but not necessary; cool liquids better than cold). If temperature is 40°C or above, initiate IV rehydration and immediately transport to emergency department for stabilization.

Livestock Preparedness During Hot Weather

Extreme heat causes significant stress to livestock. There is a need to plan well for reducing the impacts of high temperatures on livestock. Keeping an eye on the weather forecasts, and developing a mitigation plan for high to extreme temperature can be effective in ensuring that the livestock has sufficient shade and water on hot days.
Temperature forecast triggers issuance of heat alert or heat warning by IMD, Bhubaneswar

Urban local bodies / Panchayat Raj Dept/ department of RD notified

Odisha State Surveillance Unit of IDSP notified

PHFI/ IIPH and collaborators

SRC / State EOC HEAT ALERT as an intervention

Alert telecom companies to send text messages, IT sector

Media outreach begins

TV, Print, Radio alerts

Posters & pamphlets

Promote heat hotline

SMS alert

IIPH-B (knowledge partner will provide technical assistance to OSDMA
1. Review and develop checklist for all key departments
2. IT enabled application
3. Vulnerability assessment
4. Process monitoring and evaluation
5. Documentation
6. Scientific evidence generation
7. Capacity building
Heat Action Plan for Odisha 2019

**Figure 9:** Flow of Information from State to District During a Heat Wave Alert

**IMD issues heat alert**

- Schools and colleges
- Banks and financial institutions
- Religious places (temples, mosques)
- Construction site supervisors
- Civil society organizations
- Police department
- Water supply department

**State EOC disseminates alert**

- Municipal bodies
- District Collectors
- State EOC disseminates alert
- IMD issues heat alert

**Will hold meeting before summer (February/March)**

- Orientation on the checklist for all concerned
- Process evaluation in collaboration with IIHF-B
- Implementation of checklist
- Develop mechanism to alert to all the stakeholders
- Instruct the stakeholders on Heat Wave preparedness
- Identify strategic points for water distribution and sheds

**6**

1. Instruct the stakeholders on Heat Wave preparedness.
2. Develop mechanism to alert to all the stakeholders.
3. Process evaluation in collaboration with IIHF-B.
5. Orientation on the checklist for all concerned.
6. Will hold meeting before summer (February/March).
Figure-10: Time Duration and Importance of the Roles and Responsibilities of Concerned Departments in Execution of the Strengthened HAP

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<thead>
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<th>Short term (Before Six months of Summer)</th>
<th>Long term (Throughout the Year)</th>
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Color code indicates period of involvement in HAP
Way Forward

Heat Wave is a phenomenon culminating from multiple factors comprising both man-made and natural causes. It is being observed that the problem of intense and long heat spells is growing consistently over the last two decades almost assuming the proportion of a disaster. Further, with climate change and global warming the situation is going to be exacerbated in future. Needless to say, this poses a perpetual and major public health threat for the state with potential repercussions on human life and productivity. Thus, there is a need for efforts to design context specific and cost-effective strategies which are informed by scientific evidence and knowledge generation. Creating such evidence base can strengthen the heat action plan to achieve its stipulated goals and objectives efficiently and effectively. In the coming days it is proposed that strengthening of the heat action plan will be carried out in the following phases –

1. Determining threshold temperature for multiple cities of Odisha
2. Conducting vulnerability assessment in more cities and designing an intervention.

Figure-11: Approach Towards a Strengthened HAP Using a Schematic Diagram
Chapter 5

Annexure
Heat Wave DO’s and DON’Ts

DO’s

Must for All

- Listen to Radio; watch TV; read Newspaper and other sources for local weather news/heat advisories.
- Drink sufficient water - even if not thirsty.
- Use ORS (Oral Rehydration Solution), homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. to keep yourself hydrated.
- Wear lightweight, light-coloured, loose, cotton clothes.
- Cover your head: Use a cloth, hat or umbrella and uses protective goggles.
- Avoid caffeine, alcohol or sugared soda because they kind make fluid leave your body.

Employers and Workers

- Provide cool drinking water near work place.
- Caution workers to avoid direct sunlight.
- Schedule strenuous jobs to cooler times of the day.
- Increasing the frequency and length of rest breaks for outdoor activities.
- Pregnant workers and workers with a medical condition should be given additional attention.

Other Precautions

- Stay indoors as much as possible.
- Keep your home cool, use curtains, shutters or sunshade and open windows at night.
- Try to remain on lower floors.
- Use fans, damp clothing and take bath in cold water frequently.
- If you feel faint or ill, see a doctor immediately.
- Keep animals in shade and give them plenty of water to drink.
- Carry water with you.

DON’Ts

- Avoid going out in the sun, especially between 11.00 noon and 3.00 p.m.
- Avoid strenuous activities when outside in the afternoon.
- Do not go out barefoot.
- Avoid cooking during peak hours. Open doors and windows to ventilate cooking area adequately.
- Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body.
- Avoid high-protein food and do not eat stale food.
- Do not leave children, pets or anybody in parked vehicles - as they may get affected by Heat.
- Don’t drink ice-cold drinks as they can cause stomach cramping.

IEC Materials Disseminated by the Government of Odisha

Heat Action Plan for Odisha 2019
Heat Action Plan for Odisha 2019

ଓଡ଼ିଆତି ପ୍ରିତି ଖାବିଅରେ!

ପାଲାମରେ ଆଧୁନିକ କହିବାରେ ରାଖିବାରେ

ଲିଟି ନିକଟା କରାଇବାରେ।

ମୁଖ୍ୟମନ୍ତରାଧିକାରକ ବୁଝାଇବାରେ ସୁଶ୍ରୂଷ ବର୍ତ୍ତମାନ ପାପର୍କ, ନ୍ୟା, ଦିମାଗ, ଦିଲ ଚେତନା ସମାନ ରହାଇବ।

ମାନୁଙ୍କର ରାତାରେ ଖାବାରେ ବର୍ତ୍ତମାନ ବିଷୟତାରେ ବିଶ୍ୱାସ ରହିବ।

ଦିଲରେ ବୋଝନା କରିଥାନେ କରନେ ଆକାଶ ଛବିବାରେ, ଧାରାବାହନ କରନେ, ଧାରାବାହନେ କରନେ କରନେ କରନେ

ନାରେବାରେ ବିଶ୍ୱାସ ରହିବ।

ପାଲାମର ବୋଝନାରେ ବିଶ୍ୱାସ ରହିବ।

କୋମାଳ ପ୍ରିତିକିର୍ତିକଳୀରେ ଜାଗରଣ ରହିବ।

ଆହାରରେ ଆହାର କରନେ ଆହାର କରନେ ଆହାର କରନେ ଆହାର କରନେ ଆହାର କରନେ ଆହାର କରନେ
ଭୂଯୋଗରାଜ (Heat Wave)

ଭୂଯୋଗରାଜ କ’ନୟ?

ହିମତିରେ କାଳଟି ପାଇରାଇତୁ ୩୦୦ଚର୍ଚରାଇ ପାଇଁ ରାତ୍ରିକେ ବୃତ୍ତାନ୍ତ ଯେବାକୁ ପାଇଁ କାଲ ରାଗାନ୍ତି ପାଇରାଇତୁ ୫ାରେର ଗ୍ରହଣରେ ଦୁଇ ଘାଟିକର୍ତାମାନ, କର୍ତ୍ତା ଭୂଯୋଗରାଜ ଏବଂ ୩ର ଗ୍ରହଣରେ ଅଧ୍ୟୁକ୍ତ ଦୁଇ ଲାକ୍ଷଣିକରୁ ଅଶ୍ୟ କର୍ତ୍ତାମାନ, ବାସ୍ତୁ ଭୂଯୋଗରାଜ ବ୍ୟାପାର।

ହିମତିରେ କାଳଟି ବଡ଼ାଇରାଇତୁ ପାଇରାଇତୁ ੀରିରେ ଯେ ଏବାକୁ ପାଇଁ ବୃତ୍ତାନ୍ତାରେ ଦୁଇରେ ୧ରାଇ କ୍ରମରାତ୍ମକ ଦୁଇରେ ତୁରିବା କୁଗଲେ ପରିଶୀଳନା ଉପରତ୍ୟେମ ବୃତ୍ତାନ୍ତେ ତୁରିବା ପରିଶୀଳନା ଉପରତ୍ୟେମ ବୃତ୍ତାନ୍ତେ ତୁରିବା ପରିଶୀଳନା ଉପରତ୍ୟେ ତୁରିବା ପରିଶୀଳନା ଉପରତ୍ୟେ ତୁରିବା ପରିଶୀଳନା ଉପରତ୍ୟେମ କର୍ତ୍ତାମାନ।

ହିମତିରେ କାଳଟି ପାଇରାଇତୁ ଩୭ାରେ କ୍ରମରାତ୍ମକ ନେବା କୂଟିରାଟ ନାମ କଲାରେ କିଳିବାର ଯାଗରେ ଅପକୃତି ଅଲିକାର।

ପ୍ରସ୍ତୁତା ସମୟରେ

ଭୂଯୋଗରାଜ ଓ ଅପକୃତିକୁ ବଚନ କରିବା ପତ୍ରକର୍ତ୍ତାମାନ ଅପକୃତି ଅପକୃତି ଅପକୃତି ଅପକୃତି ଅପକୃତି ଅପକୃତି
Heat Action Plan for Odisha 2019

9. Odisha, the state of the North-East, has a rich diversity of biodiversity. The state is home to a wide variety of flora and fauna.

10. The state government has taken several initiatives to protect and conserve this biodiversity. One such initiative is the establishment of the Odisha Biodiversity Park.

11. The park is located in the heart of the state and covers an area of 1000 acres. It is a popular destination for tourists and nature lovers.

12. The park features a variety of attractions, including a museum, a library, and a research center. Visitors can also take part in guided nature walks and workshops.

13. The state government is committed to preserving and promoting this natural heritage. The park serves as a model for sustainable tourism and conservation.

14. The Odisha Biodiversity Park is an important step towards the conservation of biodiversity in the state. It is a testament to the state government’s commitment to protecting our natural resources for future generations.
From
Bishnupada Sethi
Special Relief Commissioner &
Commissioner-cum-Secretary to Govt.
(Disaster Management)

To
All Collectors

Sub: Measures to tackle Heat Wave Situation

Sir,

A copy of the “Heat Wave Action Plan for Odisha” was forwarded to you in this Department Memo No.928 dt.25.02.2017 with request to convene the meeting of the DDMA and take all required measures to tackle heat wave situation during summer 2017. Subsequently, the updated Heat Wave Action Plan was forwarded by OSDMA through e-mail dt.03.04.2017. Various measures to be taken by different Departments to tackle the heat wave situation have been enumerated under Chapter -3 (Standard Operating Procedures) of the said Action Plan. The Advisory on Heat Wave 2018 received from NDMA has also been circulated vide this Department letter No.1737/R&DM(DM) dt.29.3.2018. The district authority must take all required measures to deal with the heat wave situation during 2018.

Instructions were previously issued by the Special Relief Commissioner vide letter No.895 dt.27.04.2005 (copy enclosed for ready reference) indicating the procedures for conduct of joint enquiry by the Local Revenue Officer and Medical Officer on every report of death due to Sunstroke within 36 hours and submission of the joint enquiry report as well as the weekly report.

In the mean time, the National Disaster Management Authority (NDMA) has issued “Guidelines for preparation of Action Plan – Prevention and Management of Heat-Wave 2017”. The said guidelines requires that besides other information,
data on age group, sex, occupation, economic status of those who died due to heat wave, place/ situation of death, etc. will have to be collected and furnished for proper analysis and undertaking mitigation measures.

You are accordingly requested that while conducting joint enquiry on the reports of heatstroke deaths, information as per Format - I may be collected and furnished to this Department along with every joint enquiry report. Besides, a permanent register with detailed information as per Format – II is to be maintained both in the Tahasil office and District office and weekly report in the said format submitted to this Department every Monday by 1.00 PM. Even if, there is no death due to heatstroke during the preceding week, a ‘Nil’ report may please be submitted on Monday. Weekly reporting report must start from next Monday (9.4.2018) and continue till 15.6.2018.

Yours faithfully,

Special Relief Commissioner &
Commissioner-cum-Secretary to Govt.
(Disaster Management)

Memo No. 1778/R&DM (DM)  Date: 03/04/2018
Copy forwarded to All Revenue Divisional Commissioners with reference to this Department memo No.1738/R&DM(DM) dt.29.3.2018 for information and necessary action.

Special Relief Commissioner &
Commissioner-cum-Secretary to Govt.
(Disaster Management)
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**Heat Action Plan for Odisha 2019**

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To The Director of Public Health, Odisha

Sub: Submission of daily information on cases and deaths due to heat related illness.

Sir,

As per the “Guidelines for Preparation of Action Plan- Prevention and Management of Heat- Wave”- 2017 issued by National Disaster Management Authority (NDMA), New Delhi reliable mortality as well as morbidity data of heat related illness is required to be transmitted to carry out meaningful analysis of heat related health events and undertaking mitigation measures.

It is, therefore, requested that information on all cases of heat wave related illness and deaths as per Format-A (copy enclosed) may be collected and furnished to this Department daily with immediate effect till 15th June 2018.

Yours faithfully,

[Signature]

Special Relief Commissioner & Commissioner-cum-Secretary to Govt. (Disaster Management)

Memo No. 1716 /R&D(MM) Date: 03/06/2018

Copy forwarded to the Commissioner-cum-Secretary, Health & Family Welfare Department for information and necessary action.

[Signature]

Special Relief Commissioner & Commissioner-cum-Secretary to Govt. (Disaster Management)
Format- A

Daily Report to be Submitted by Health Department on Cases and Deaths Due to Heat Related Illness

Date:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the District</th>
<th>New cases admitted / treated due to Heat Related Illness during the day</th>
<th>Cumulative no. of cases admitted / treated due to Heat Related Illness since 1st April 2018</th>
<th>Deaths reported due to Heat Related Illness During the day</th>
<th>Cumulative no. of deaths due to Heat Related Illness since 1st April 2018</th>
<th>Remark (If any shortage of ORS / IV Fluids / Treatment facilities etc.)</th>
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(Name & Designation of the Reporting Officer)  (Signature & Seal)
References:

1. Guidelines for preparation of Action Plan- Prevention and Management of Heat Wave-2017, National Disaster management Authority (NDMA), Govt. of India

2. Climate Change Innovation Programme-Heat Island Mitigation Action Plan for Jharsuguda, Odisha by The Energy and Resources Institute (TERI)

3. Studying Health Effects of exposure to heat stress, vulnerability, and heat threshold in Odisha by Indian Institute of Public Health, Bhubaneswar, Public Health Foundation of India (IIPHB)

4. Early Warning and Communications – India Meteorological Dept. (IMD)