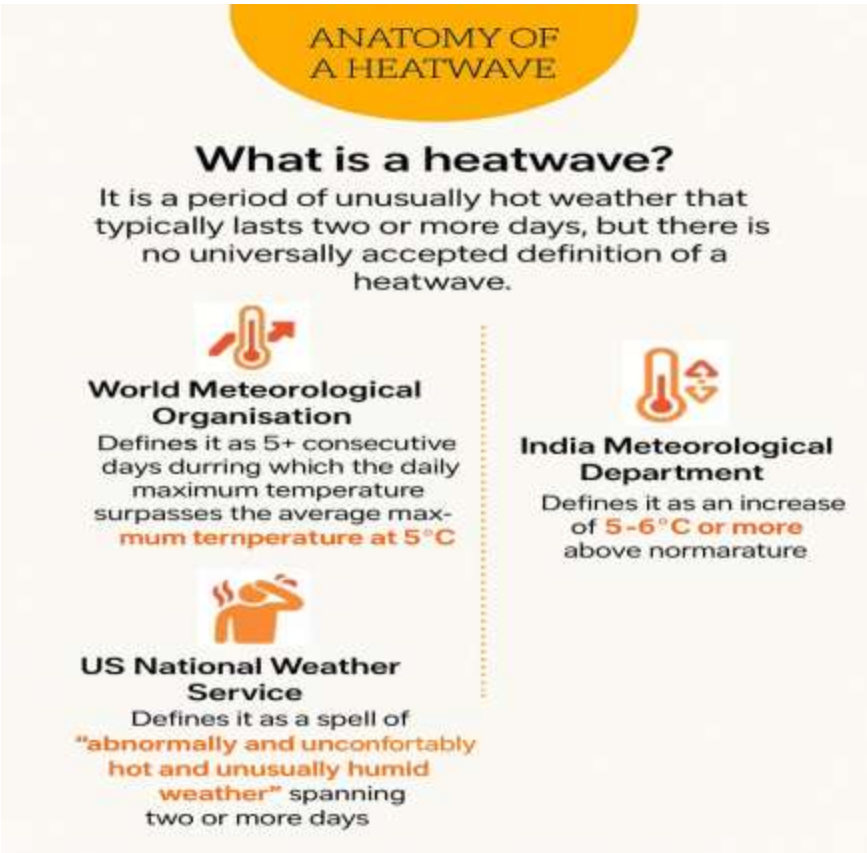
HEATWAVE IN INDIA:
CAUSES & CONSEQUENCES

Context:

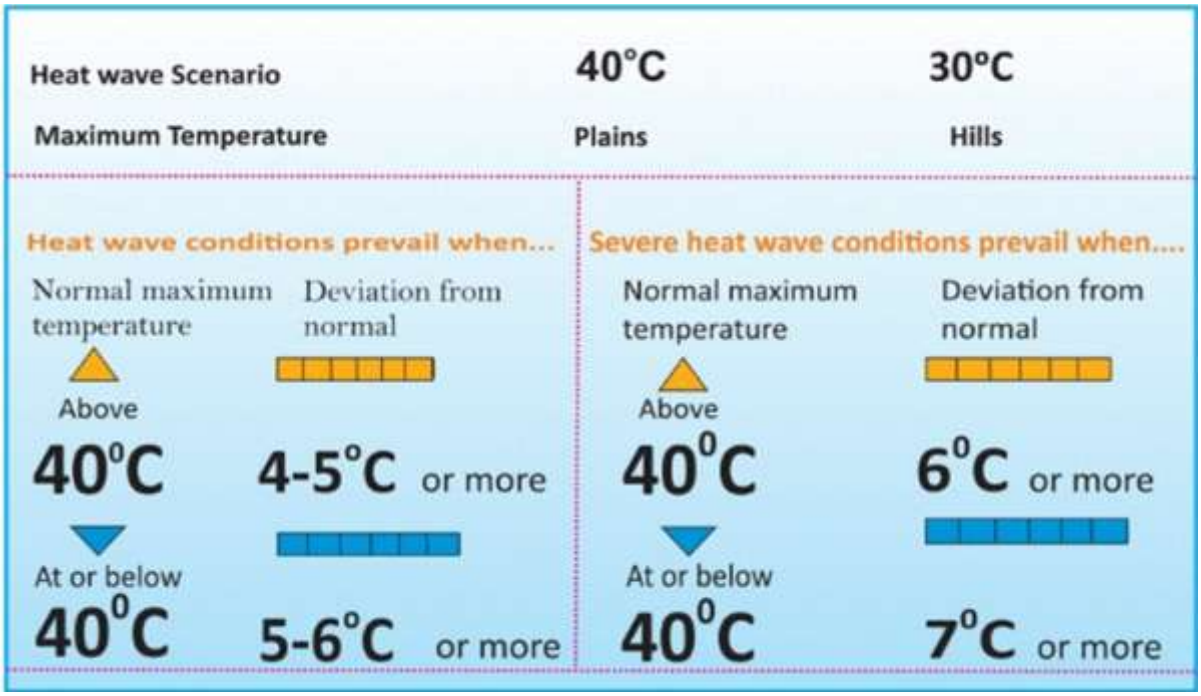
- According to the report, published on **May 20, 2025** by the **New Delhi**-based **Council on Energy, Environment and Water (CEEW)** think tank, nearly **60% of Indian districts**, home to **three-quarters of the population**, face a **"high to very high" risk** from **extreme heat**, with **rising night-time temperatures** and humidity compounding the health impact.

1. What are Heat Waves?

- **Qualitatively-** Heat wave is a condition of air temperature which becomes fatal to the human body when exposed.
- **Quantitatively-** It is defined based on the temperature thresholds over a region in terms of actual temperature or its departure from normal.
- In certain countries it is defined in terms of the **heat index based on temperature and humidity** or based on extreme percentile of the temperatures.



2. How are Heat waves defined in India?



In India IMD defines heatwave based on the following criteria.

Physiography of regions	Condition
Plain	• The maximum temperature recorded at a station is **40 degrees Celsius or more.**
Coast	• The maximum temperature recorded at a station is **37 degrees Celsius or more**.
Hills	• The maximum temperature recorded at a station is **30 degrees Celsius or more.**

Based on Departure from Normal Temperature

- Heat Wave- Departure from **normal is 4.5°C to 6.4°C**
- Severe Heat Wave- Departure from **normal is >6.4°C**

Based on Actual Maximum Temperature

- Heat Wave- When actual **maximum temperature ≥ 45°C**
- Severe Heat Wave- When actual **maximum temperature ≥ 47°C**

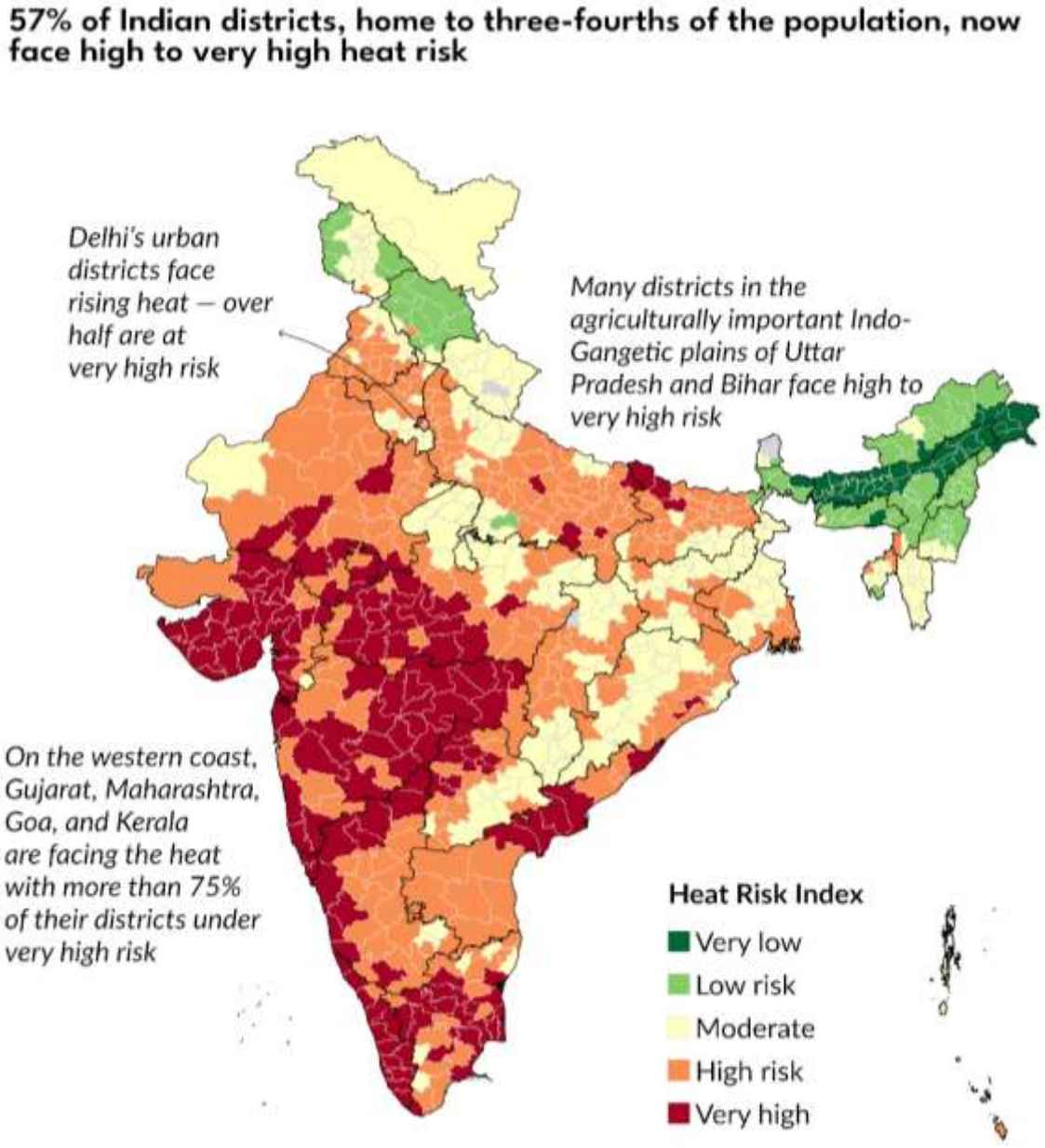
Heat Wave is declared if above criteria are **met in at least 2 stations** in a Meteorological subdivision for **at least two consecutive days.**

3. Enlist key highlights of the report of Council on Energy Environment and Water (CEEW)?

Findings	Description
Past Impact of Heat Wave	• Over the last **40 years (1981–2022),** heat extremes in India have **increased linearly, contributing to major heat waves in 2013, 2016, 2019, 2022, and 2024.** • However, in the last decade, **very warm nights have increased faster than very hot days**.

	• Nearly **70 per cent of districts experienced five or more additional very warm nights per summer** (March to June), while **only around 28 per cent of districts saw a similar increase in very hot days**. • **Warmer nights** are particularly concerning as they make it **harder for the body to cool down and recover from daytime heat.**
Extent	• About **57 per cent of Indian district**s, home to **76 per cent of the country's population**, are currently at **high to very high risk from extreme** heat. • The top ten states and UTs with the highest aggregate heat risk are **Delhi, Maharashtra, Goa, Kerala, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, and Uttar Pradesh.**
Warm Nights	• The rise in **very warm nights** is most evident in **densely populated districts**,often home to **Tier I and II cities**. • For example, over the last decade, compared to the previous three, **Mumbai experienced 15 more very warm nights per summer**, Bengaluru 11, Bhopal and Jaipur 7 each, Delhi 6, and Chennai 4. • This trend is likely largely **driven by the urban heat island effect,** where **heat absorbed during the day** is released at night, keeping cities warmer.
Relative humidity	• **Relative humidity**, a compounding factor of **high heat,** has **increased by up to 10 per cent across North India** and Indo-Gangetic Plain over the last decade, where **farm workers spend long hours outdoors**.

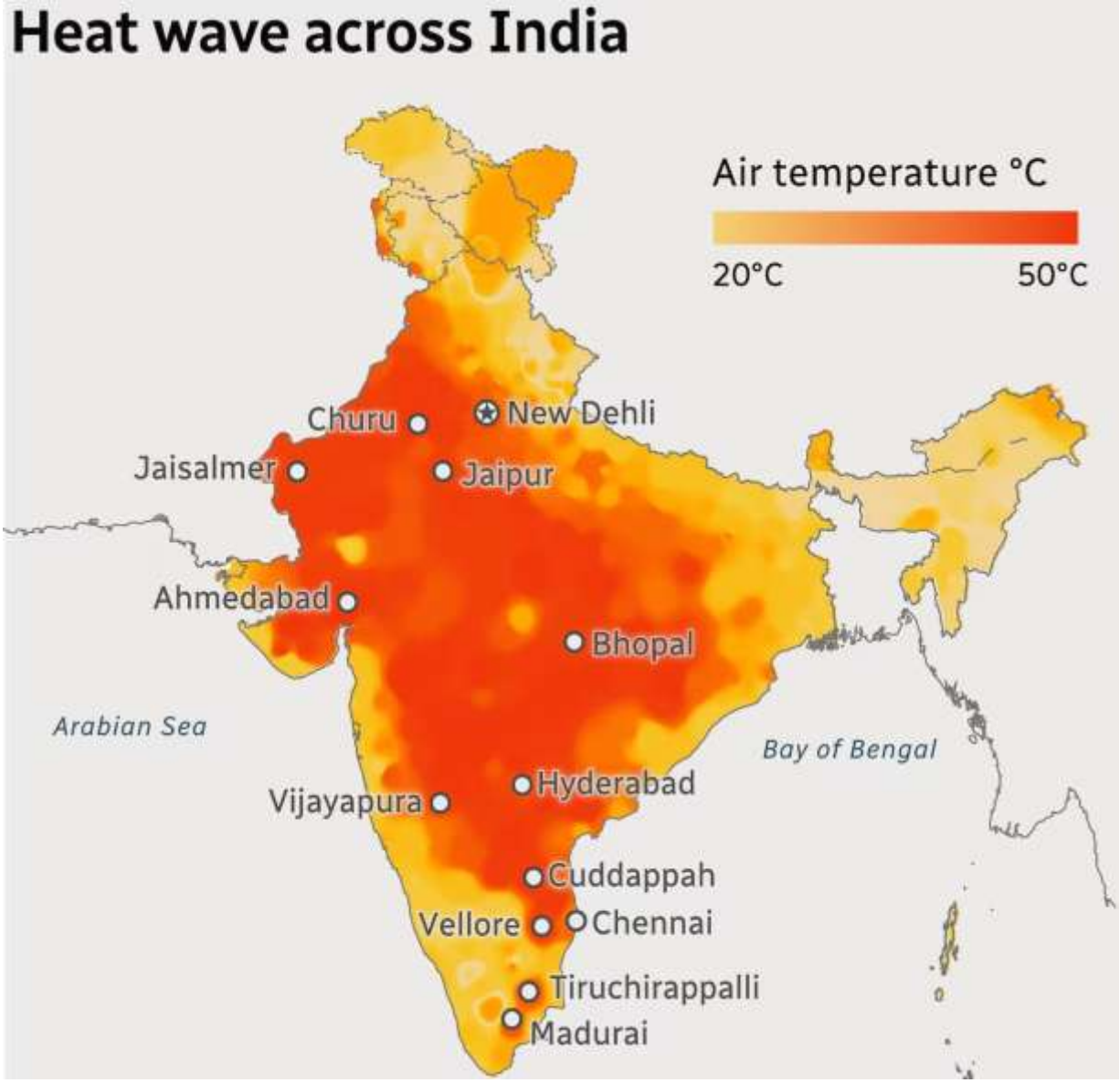
	• Traditionally drier cities such as **Delhi, Chandigarh, Kanpur, Jaipur and Varanasi are now seeing higher humidity levels.** • When **body temperature exceeds 37°C**, **sweating is the primary cooling mechanism**, but high humidity hinders evaporation causing heat stress.
Vulnerable area	• Districts with **high human population** density including **Mumbai, Delhi**, and many parts of the Indo-Gangetic Plain face the **highest exposure to extreme heat.** • Between **2005 and 2023**, built-up areas have expanded rapidly, **particularly in Tier II and III cities such as Pune, Thoothukudi, Kolhapur, Mysuru, Kozhikode, Ajmer, Gurugram, and Guwahati**. • Built-up and **concretised surfaces trap heat during the day and release it at night**, worsening nighttime heat. • Many districts in **Andhra Pradesh, Maharashtra, Haryana, Punjab, Chhattisgarh, Bihar, and Uttar Pradesh** are **highly vulnerable to extreme heat** due to the combined impact of rising temperatures and **underlying socio-economic and health vulnerabilities.**



4. What are the heat wave prone states over India?

- **Heat waves** generally occur over plains of **northwest India, Central, East & north Peninsular India from March to June**.
- It covers **Punjab, Haryana, Delhi,Uttar Pradesh,Bihar, Jharkhand, West Bengal, Odisha, Madhya Pradesh, Chhattisgarh, Rajasthan, Gujarat, parts of Maharashtra & Karnataka, Andhra Pradesh and Telangana.**

- Sometimes it occurs over **Tamilnadu & Kerala also.** Therefore, most of the **states of India are prone to heat waves in varying degrees.**



5. How does the India Meteorological Department (IMD) monitor the Heat wave?

- IMD has a big network of surface observatories covering the entire country to measure **various meteorological parameters like Temperature, Relative humidity, pressure, wind speed & direction** etc.

- Based on daily maximum temperature station data, climatology of **maximum temperature is prepared for the period 1981-2010 to find out the normal maximum temperature** of the day for a particular station.
- **Thereafter, IMD declared a heat wave** over the region as per its definition.

6. What is impact based heat wave warning issue by India Meteorological Department (IMD)?

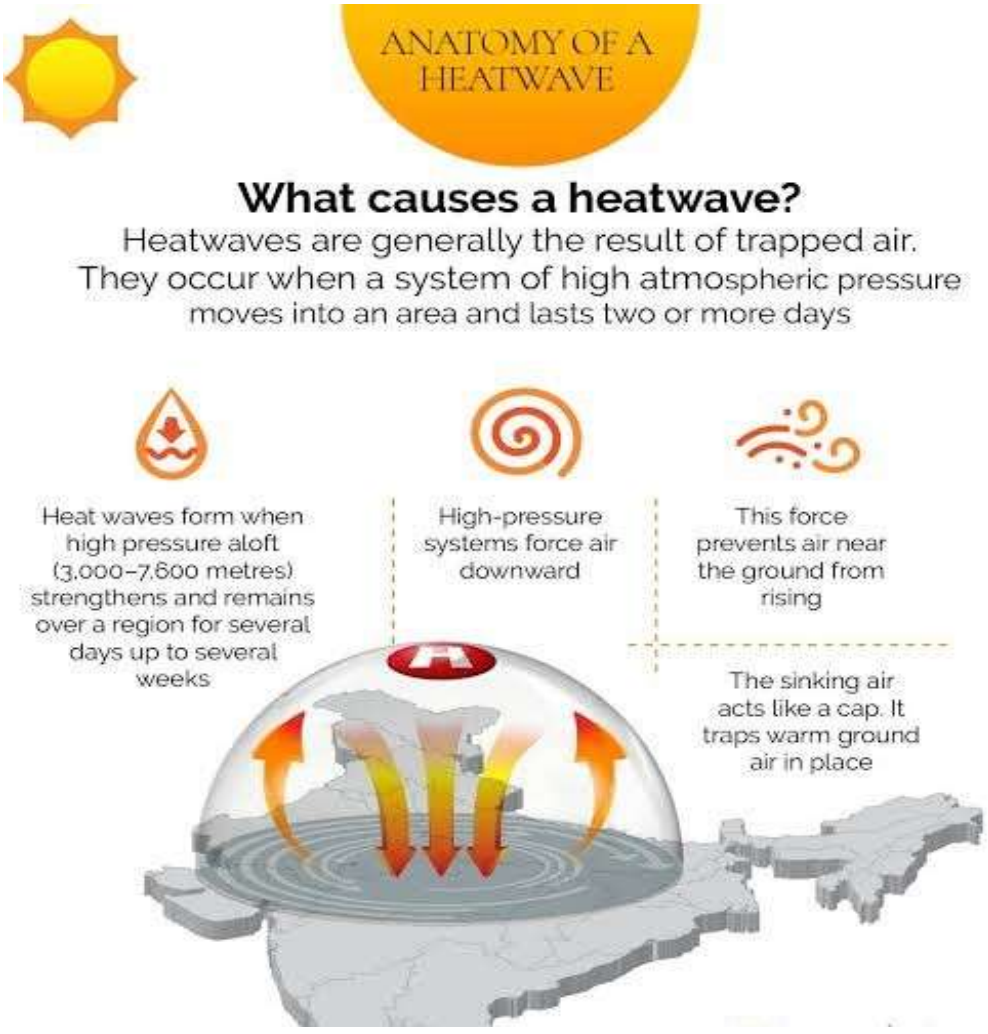
- **India Meteorological Department issues following color code impact based heat warning jointly with the National Disaster Management Authority.**

Heat Wave Warning

Warning	Impact	Suggested Actions
Nil	Comfortable temperatures	No cautionary action required
Heat wave conditions at district level, likely to persist for 2 days	Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases.	Avoid heat exposure
i. Severe heat wave conditions likely to persist for 2 days. ii. With varied severity, heat wave is likely to persist for 4 days or more.	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
i. Severe heat wave likely to 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.

7. What are favorable conditions for Heat wave?

Condition	Analysis
Transportation / Prevalence of hot dry air over a region	• **There should be a region of warm dry air and appropriate flow pattern for transporting hot air over the region.**
Absence of moisture in the upper atmosphere	• **As the presence of moisture restricts the temperature rise.**
The sky should be practically cloudless	• **To allow maximum insulation over the region.**




ANATOMY OF A HEATWAVE
This high concentration of pressure makes it difficult for other weather systems to move into the area, which is why a heatwave can last for several days or weeks
The high-pressure inhibits winds. It also prevents clouds from entering the region
The end result is a continual build-up of heat at the surface that people experience as a heat wave

8. How do Heat Waves form?

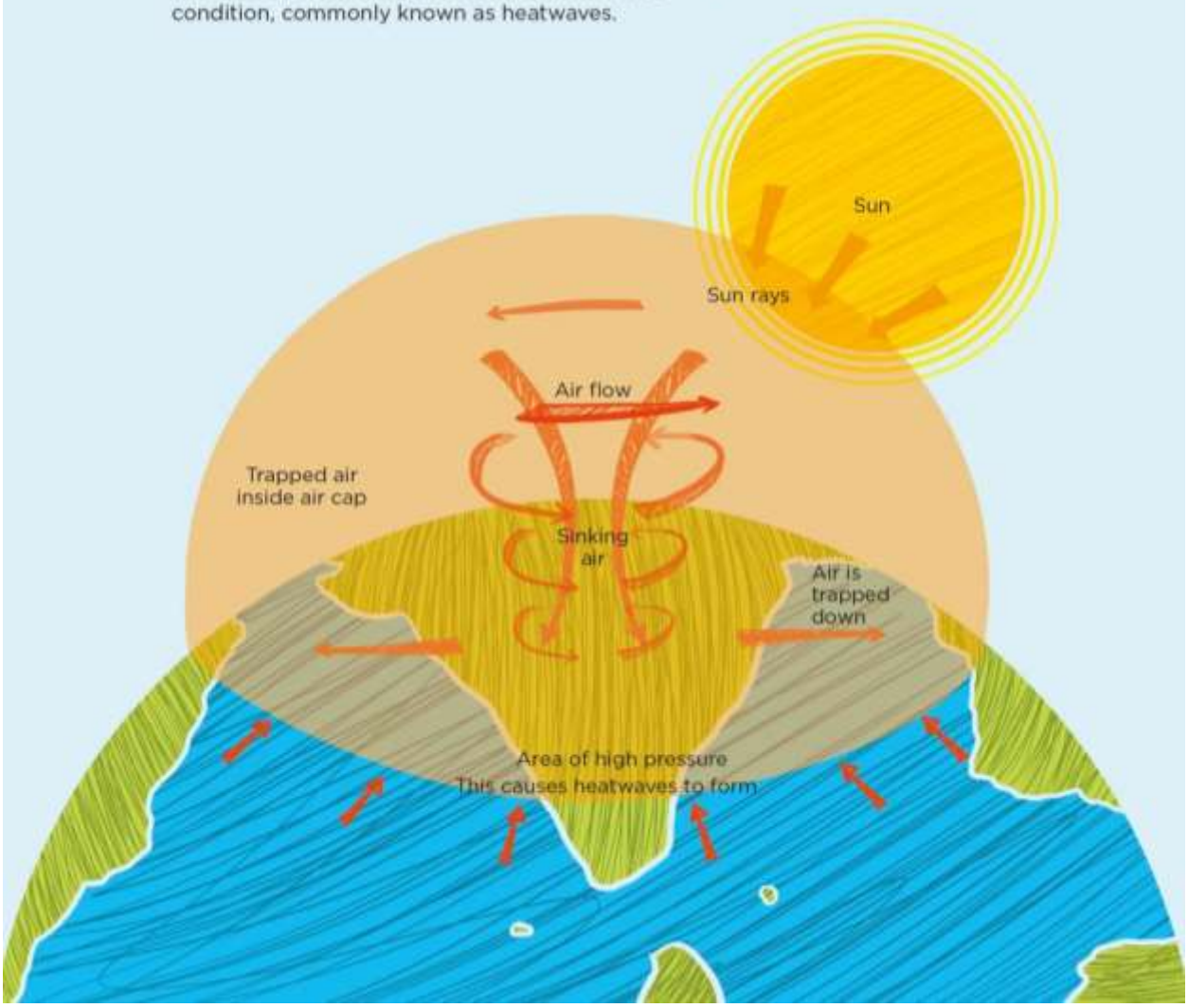
How do heatwaves form?

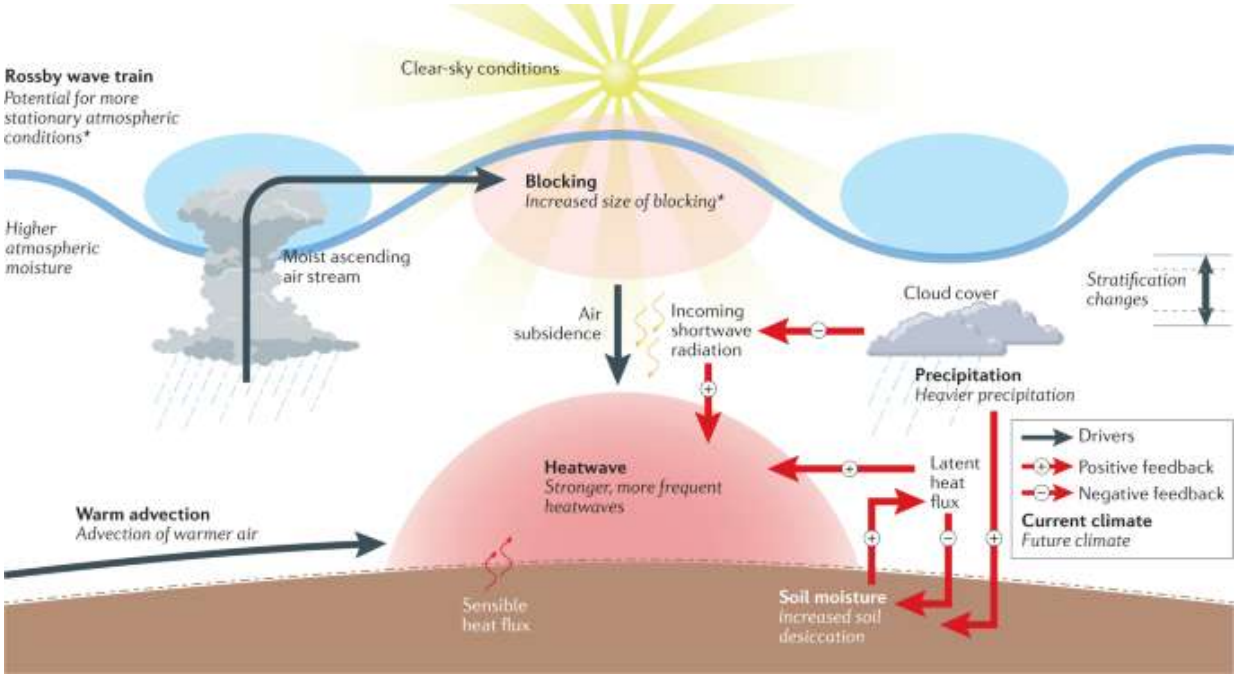
Our weather is a result of many factors: the rotation of Earth on its axis, its revolution around the sun and the unequal distribution of sunlight. Areas around the equator where the sunrays fall directly are hotter than the areas around the poles, where the sunrays reach at an angle. The hot air in the areas around the equator swirl in a downward pattern (see diagram), creating a high pressure. Heatwaves are the result of the trapped air in these areas.

The sinking air also acts like a cap, trapping the warm ground air in place. As opposed to cycling around the globe, the trapped air simply stays put and becomes warmer like the inside of an oven. This causes the extreme heat condition, commonly known as heatwaves.

How to avoid a heatstroke:

- Wear lightweight, light-coloured clothing.
- Avoid high-protein foods and meat. Eating these can increase the body's heat production.
- Drink lots of water. Avoid carbonated drinks.
- Avoid getting too much sun. Sunburns make it harder for the body to cool off.
- Cars heat up extremely fast. Do not spend time in a parked car with windows closed.



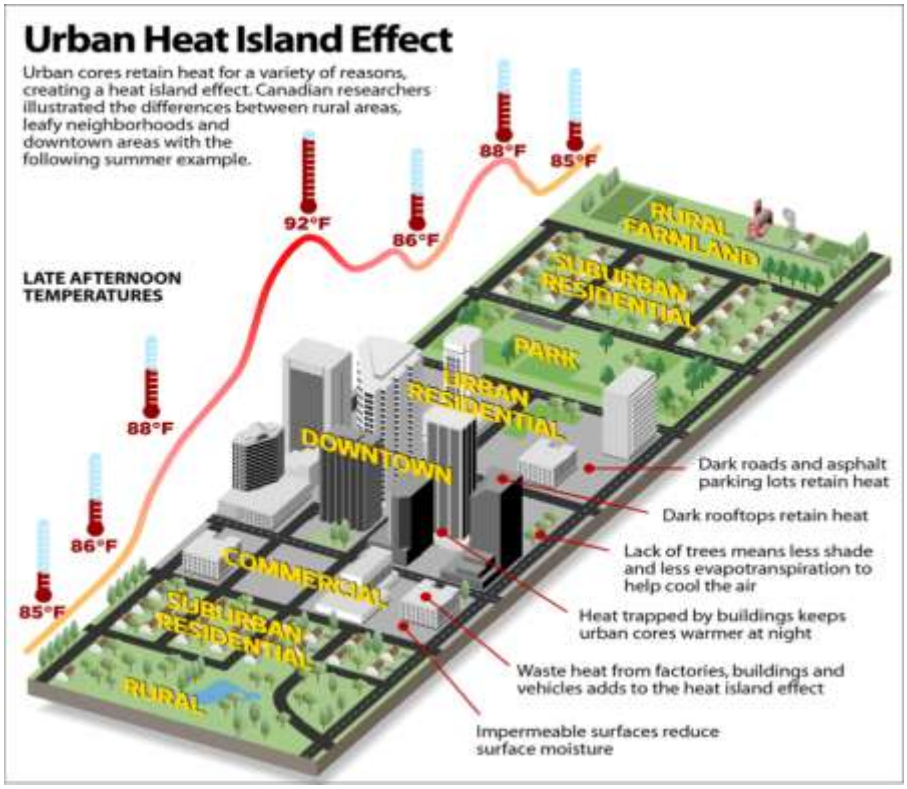


9. What are the factors behind the increase in Heatwaves in India?

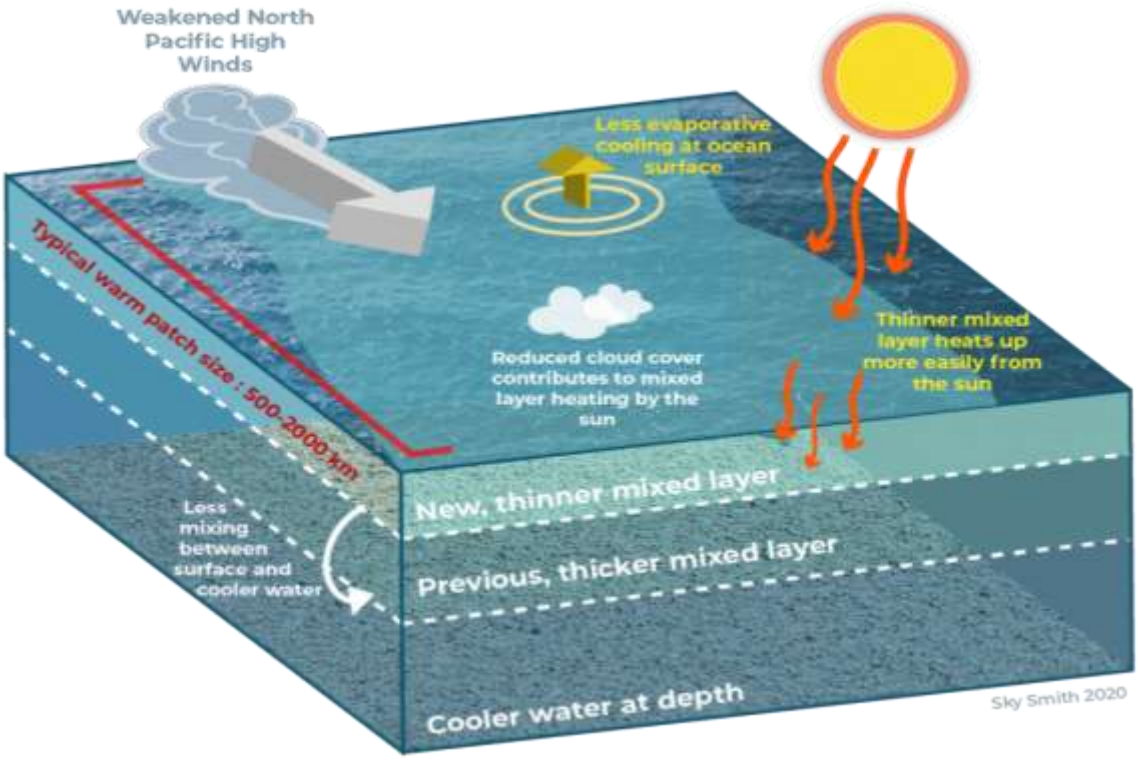
- There are **multiple reasons** why **heat waves occur in India**, and they are **primarily caused by a combination of meteorological, geographical, and human factors.**
- Some of the significant contributors to heat waves in India include:

Factor	Description
Meteorological Factors	• Heat waves in India can be caused by meteorological factors include **high-pressure systems over northwestern India**, the **Arabian Sea, and the Bay of Bengal.** • This creates a **stagnant air mass that traps hot and dry air,** leading to higher temperatures. • The climate can also be affected by the **El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD)**, which can contribute to the occurrence of heat waves.

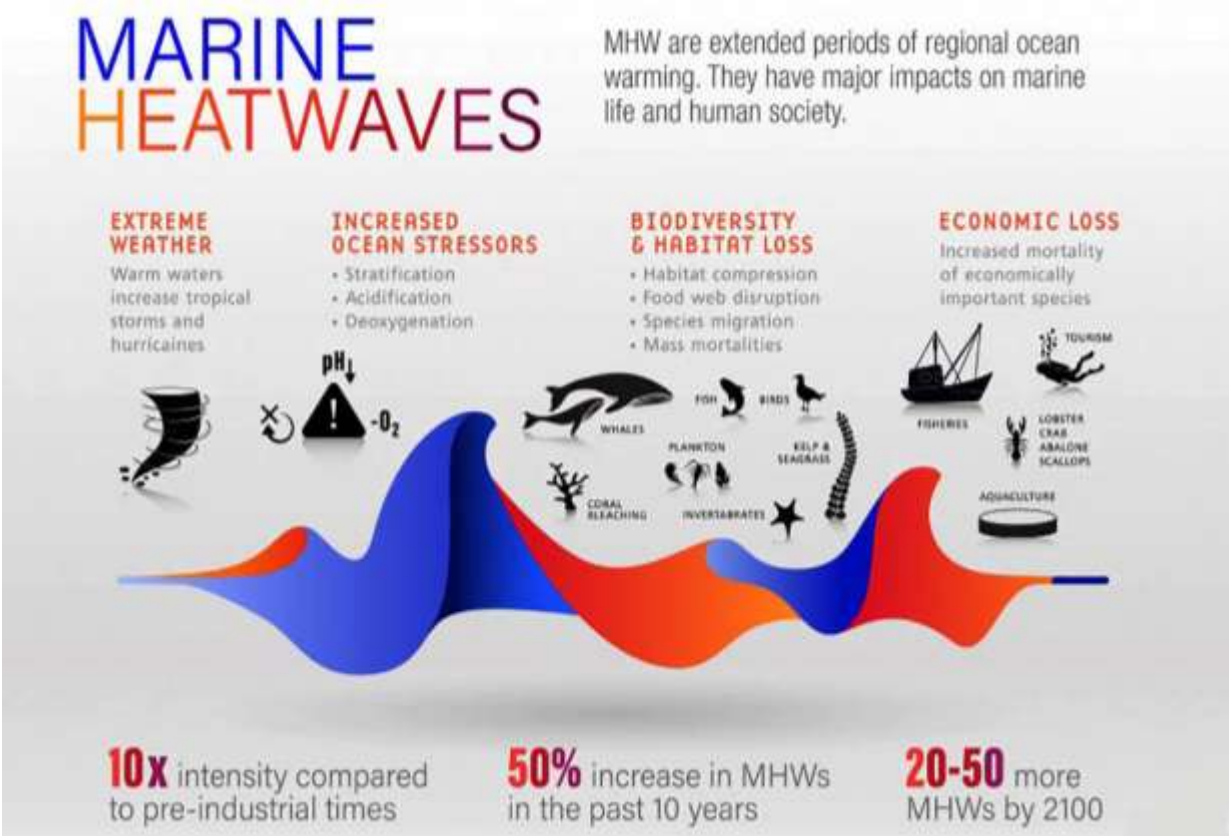
Geographical Factors	• **India's position near the equator** results in high levels of solar radiation all year round, especially during the summer season. • The country's terrain, which includes **deserts, semi-arid areas, and high-altitude regions**, can also worsen the conditions of heat waves.
Human Factors	• Human activities like **urbanization, deforestation, and poverty can increase temperatures** and create **heat island effects,** making vulnerable populations more susceptible to heat-related illnesses due to the **lack of access to cooling and drinking water, and inadequate public health infrastructure.** • **"Urbanization alone has led to an overall 60% enhancement in warming in Indian cities,"** as per the study published in the **journal Nature stated.**
Urban heat island	• The **Intergovernmental Panel on Climate Change (IPCC)** Working Group-II, which assesses impacts of, and vulnerabilities to climate change, has noted that the **urban heat island effect leads to cities experiencing air temperatures that are several degrees warmer than surrounding areas**, especially during the night, **"reducing adaptive capacity"**.

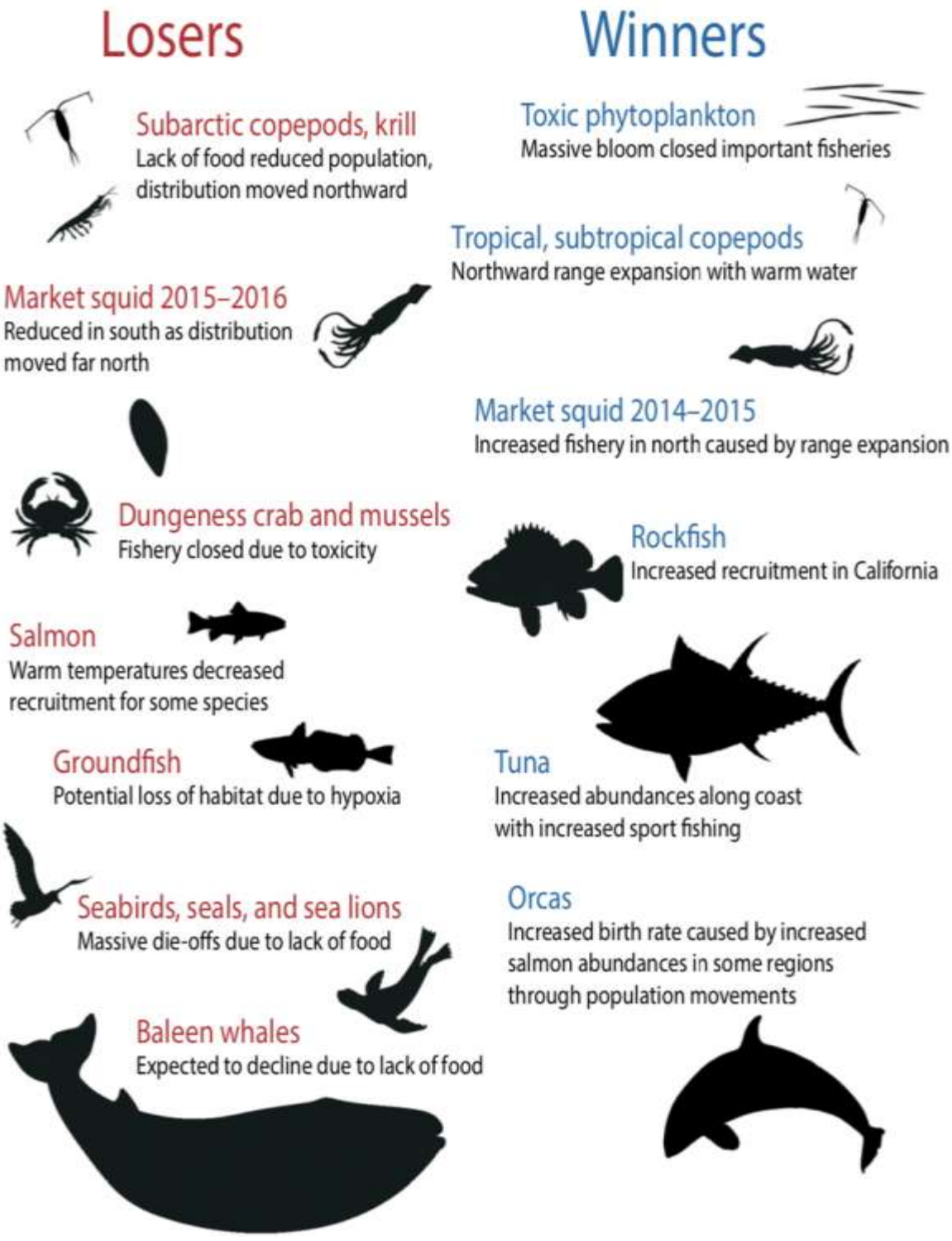


10. What is a Marine Heatwave?

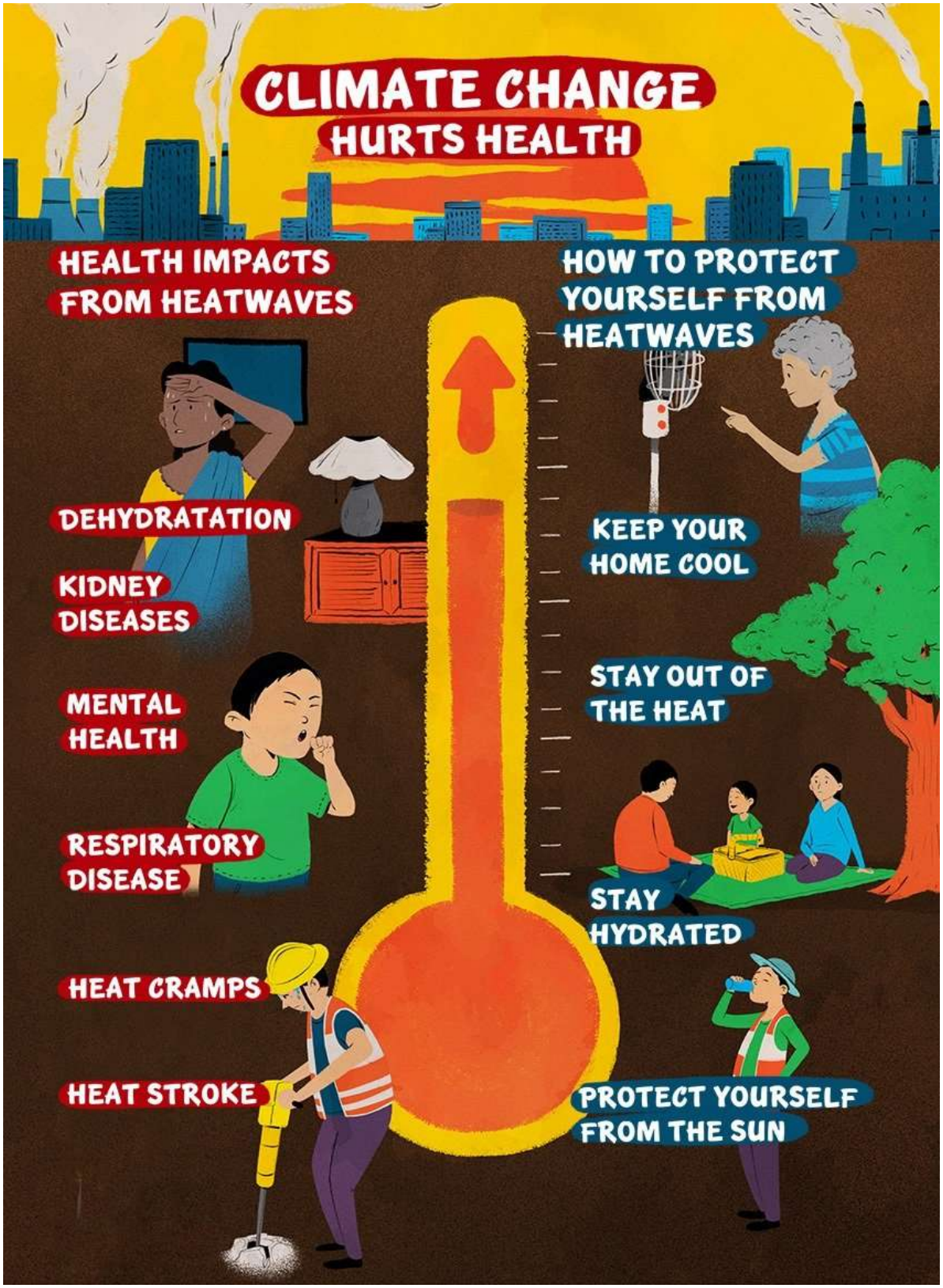


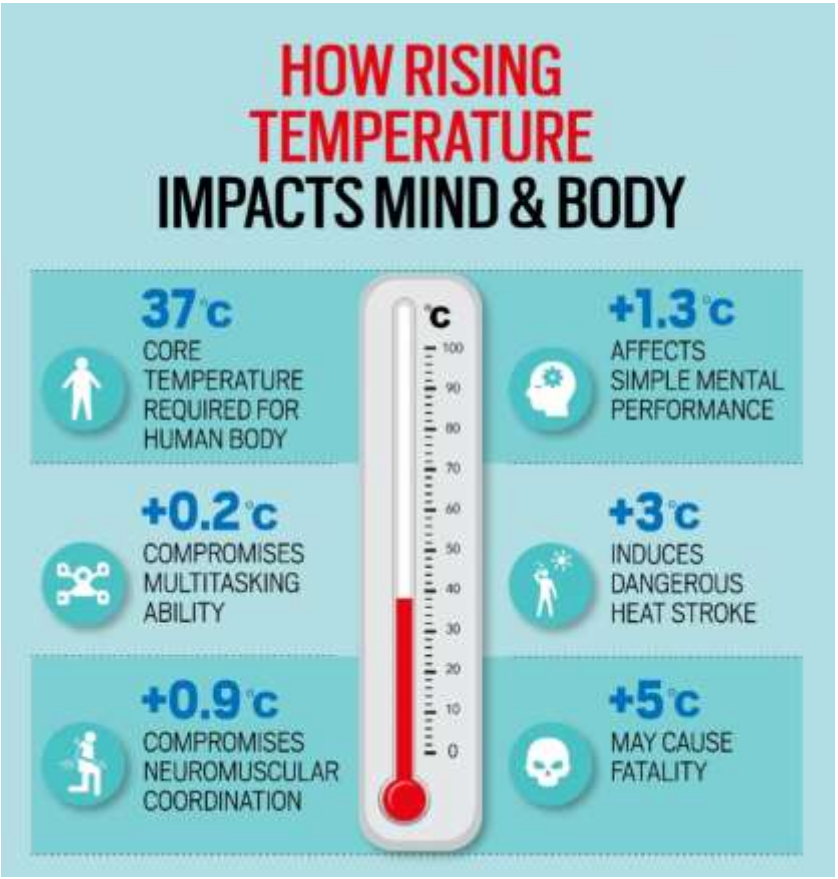
- A **marine heatwave** is a **period of unusually high ocean temperatures** and is **defined by its duration and intensity.**
- One of the most common ways that scientists measure the **ocean's temperature is through sea surface temperature.**
- A marine heatwave is defined as when **seawater temperatures exceed a seasonally-varying threshold for at least 5 consecutive days.**

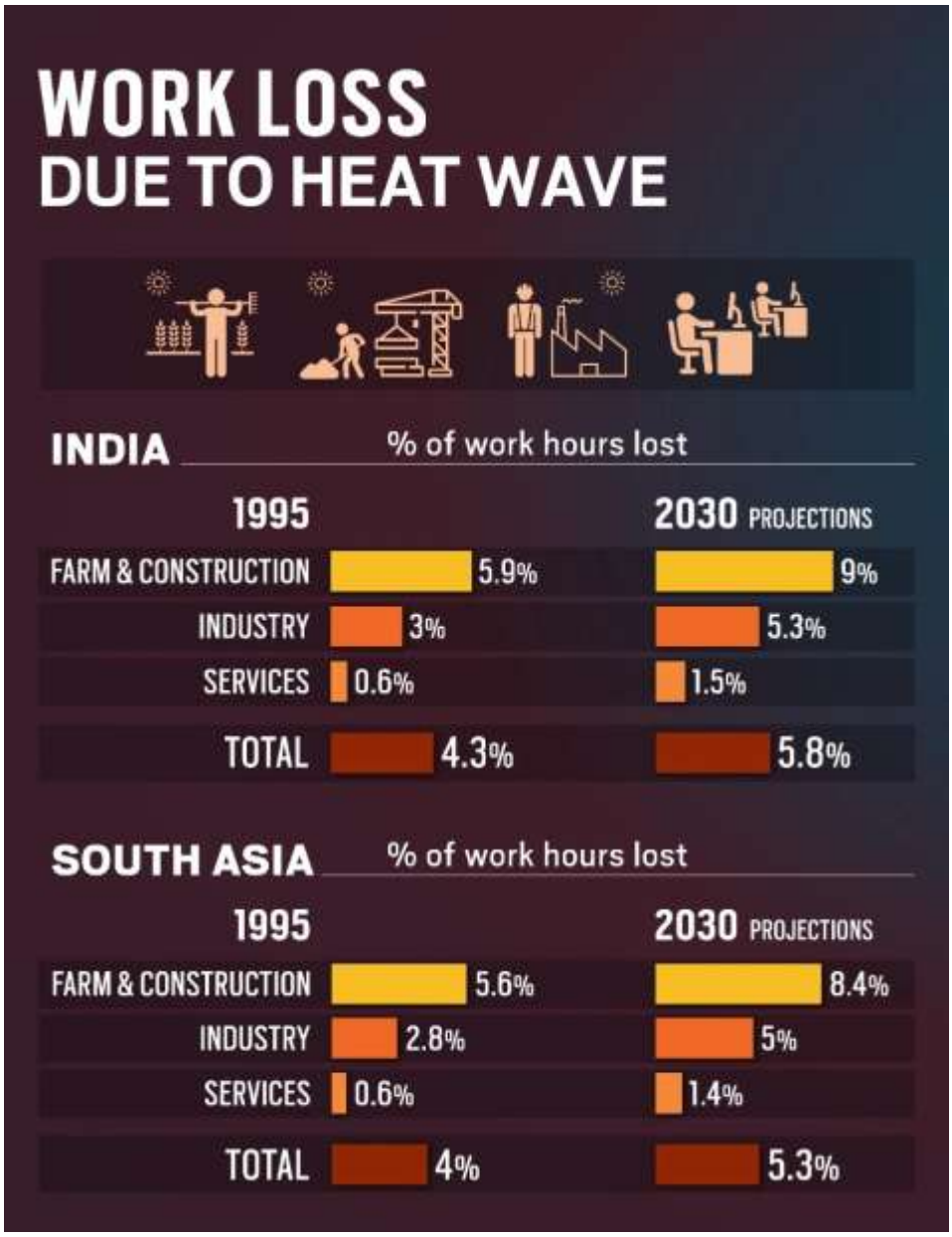



Losers
Winners
Subarctic copepods, krill
Lack of food reduced population, distribution moved northward
Toxic phytoplankton
Massive bloom closed important fisheries
Tropical, subtropical copepods
Northward range expansion with warm water
Market squid 2015–2016
Reduced in south as distribution moved far north
Market squid 2014–2015
Increased fishery in north caused by range expansion
Dungeness crab and mussels
Fishery closed due to toxicity
Rockfish
Increased recruitment in California
Salmon
Warm temperatures decreased recruitment for some species
Groundfish
Potential loss of habitat due to hypoxia
Tuna
Increased abundances along coast with increased sport fishing
Seabirds, seals, and sea lions
Massive die-offs due to lack of food
Orcas
Increased birth rate caused by increased salmon abundances in some regions through population movements
Baleen whales
Expected to decline due to lack of food

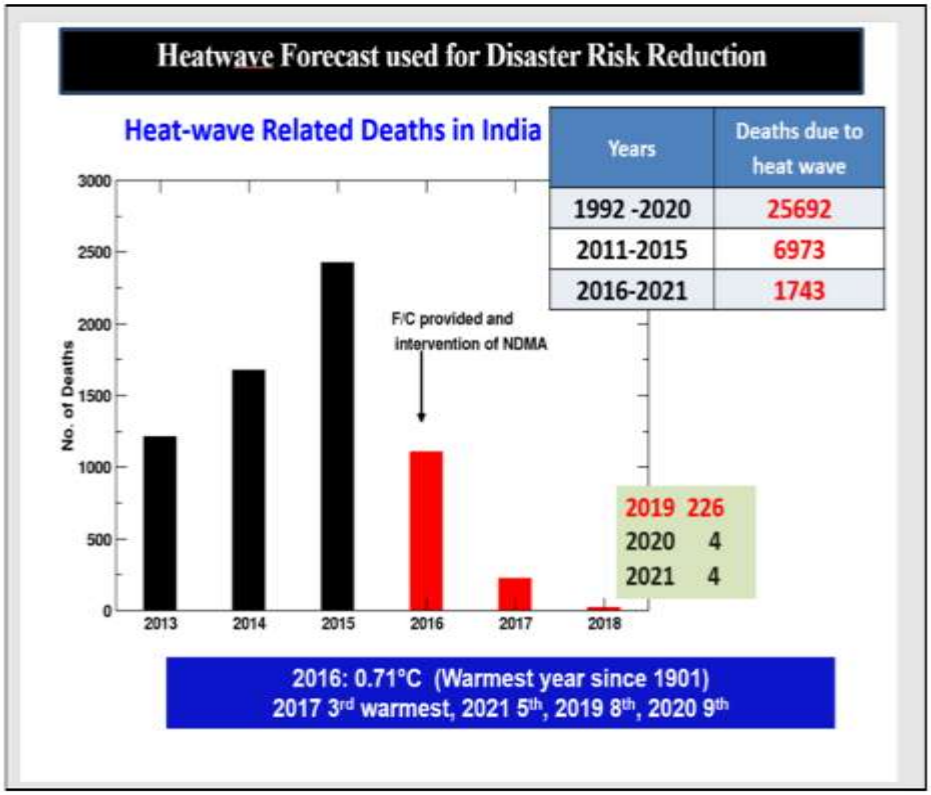
11. What are the effects of Heatwaves?

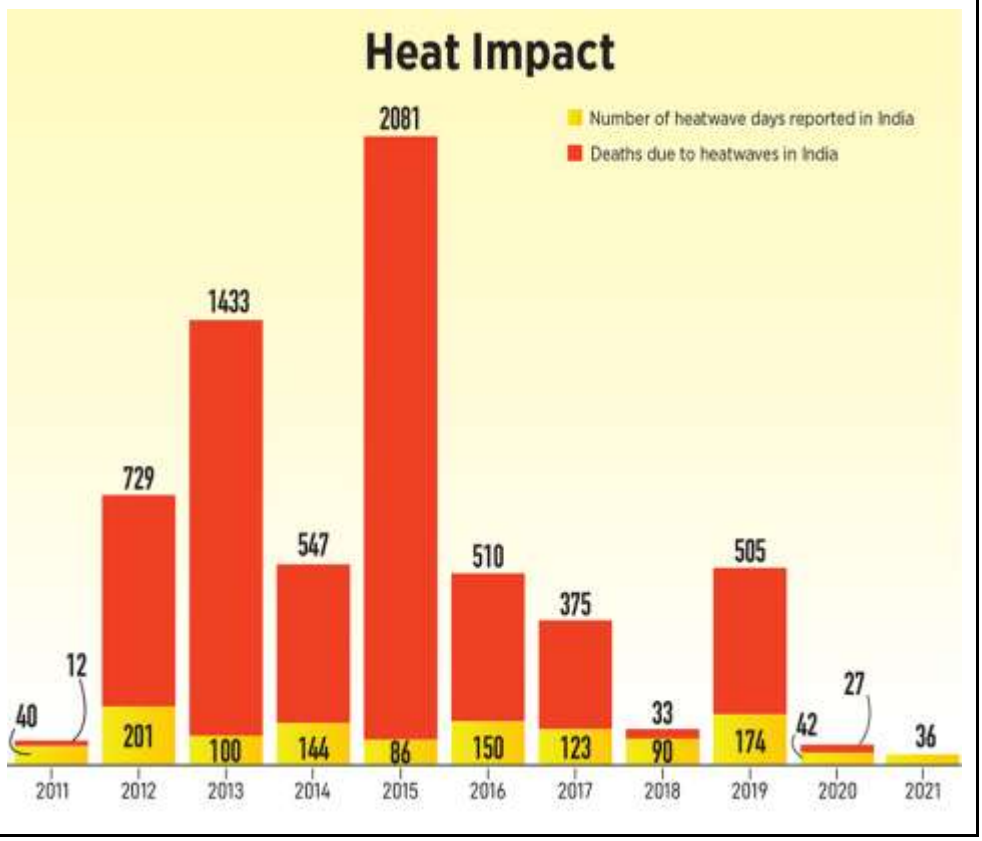


Effects	Description
Health	• Heatwaves can have significant impacts on health, depending on the **timing, intensity, and duration of high temperatures.** • Exposure to excessive heat can lead to various illnesses, including **heat cramps, heat exhaustion, heatstroke, and hyperthermia.** 
Economy	• A **2020 McKinsey Global Institute** paper estimated that "**an increase in lost labour hours due to rising heat** and humidity could put approximately **2.5-4.5 per cent of GDP at risk by 2030**, equivalent to **roughly $150-250 billion.**"

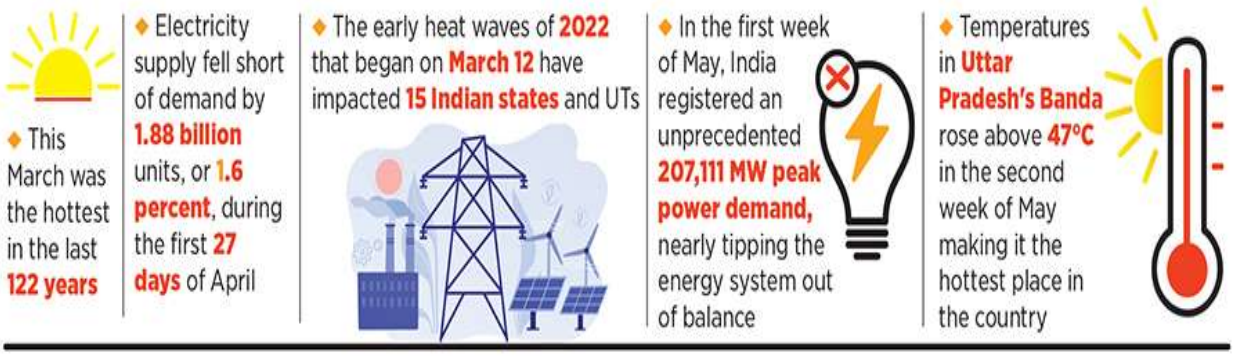

WORK LOSS
DUE TO HEAT WAVE
INDIA
% of work hours lost
1995
2030 PROJECTIONS
FARM & CONSTRUCTION
5.9%
9%
INDUSTRY
3%
5.3%
SERVICES
0.6%
1.5%
TOTAL
4.3%
5.8%
SOUTH ASIA
% of work hours lost
1995
2030 PROJECTIONS
FARM & CONSTRUCTION
5.6%
8.4%
INDUSTRY
2.8%
5%
SERVICES
0.6%
1.4%
TOTAL
4%
5.3%

Death toll


Heatwave Forecast used for Disaster Risk Reduction
Heat-wave Related Deaths in India
Years
Deaths due to heat wave
1992 -2020
25692
2011-2015
6973
2016-2021
1743
No. of Deaths
F/C provided and intervention of NDMA
2019 226
2020 4
2021 4
2013
2014
2015
2016
2017
2018
2016: 0.71°C (Warmest year since 1901)
2017 3rd warmest, 2021 5th, 2019 8th, 2020 9th

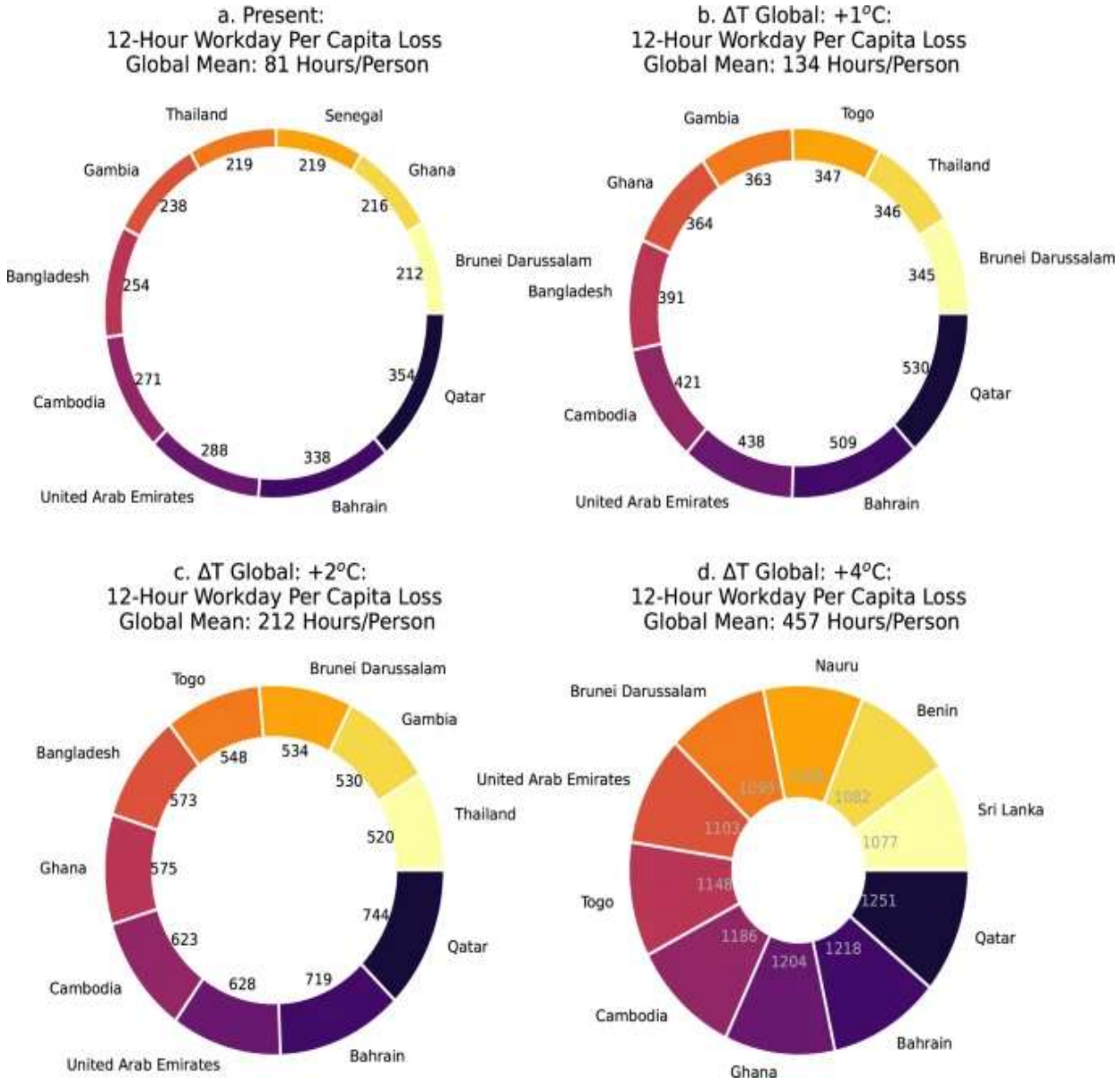

Heat Impact
Number of heatwave days reported in India
Deaths due to heatwaves in India
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
40
12
201
729
100
1433
144
547
86
2081
150
510
123
375
90
33
174
505
42
27
36

Labour Productivity	• According to an **ILO study at 34°C**, workers can **lose up to 50% of their work capacity.**
Social Impacts	• Heat waves can have **social impacts, such as increased crime rates, social unrest, and migration.** • Populations that are vulnerable are at a higher risk of being affected.
Environmental Impact	• **Extreme heat** can **increase** the risk of other disasters like **droughts and wildfires.** • They can also lead to the spread of **disease-carrying insects, such as mosquitoes and ticks.**
Power Breakdown:	• Heatwaves can cause **power breakdowns** due to excessive usage of **air conditioners**, leading to high electricity consumption and outages.



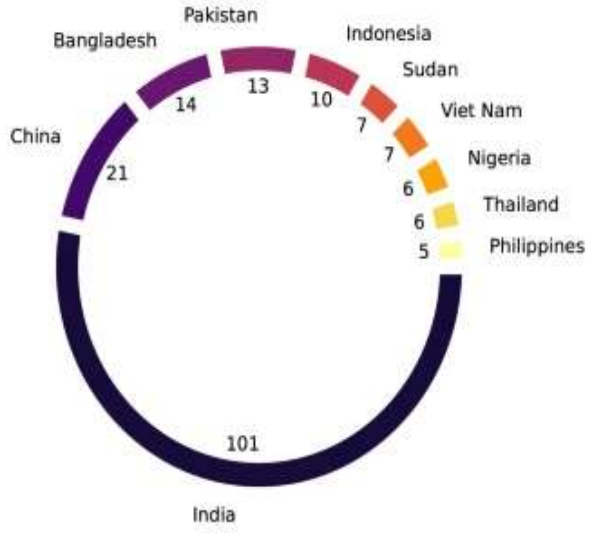
12. How Heat Waves Impact Global Labor productivity?

Countries with the highest per-capita labor losses from heat exposure.

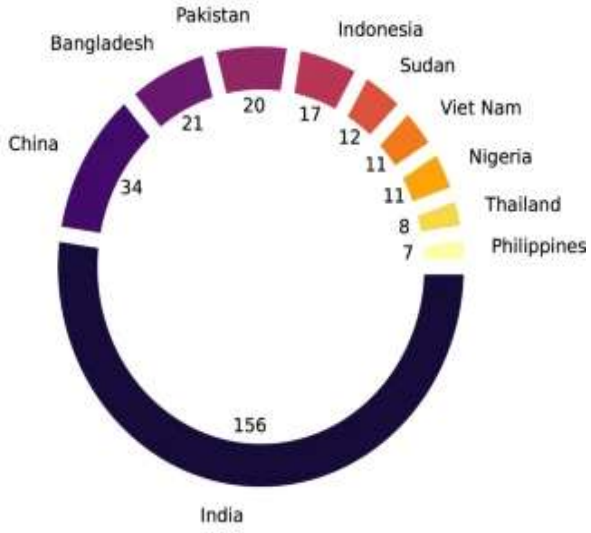


Countries with the most population-weighted labor losses from heat exposure.

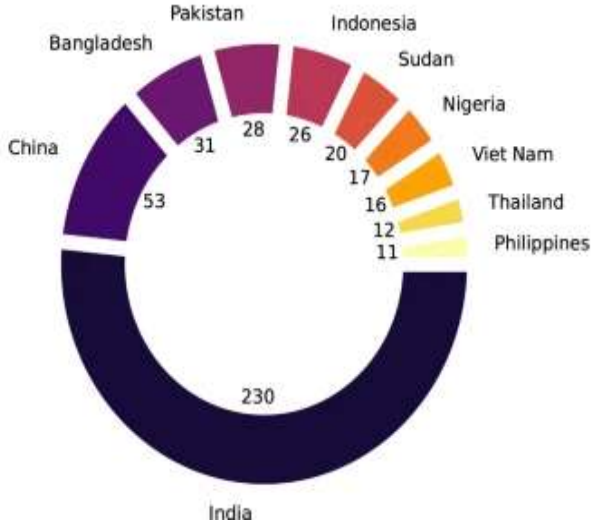
a. Present:
12-Hour Workday Population-Weighted Loss
Global Sum: 228 Billion Hours



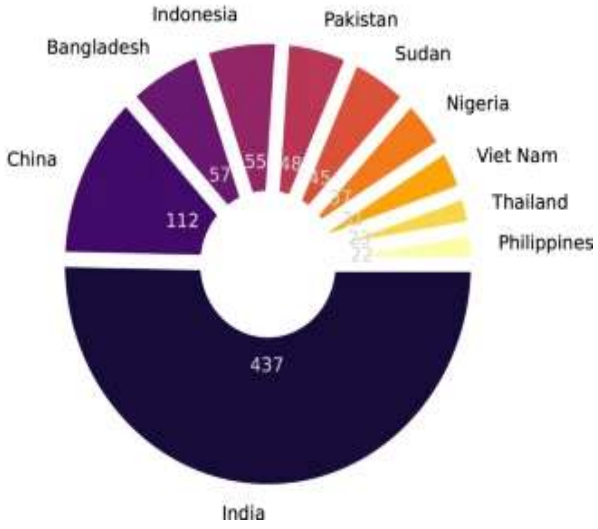
b. ΔT Global: +1°C:
12-Hour Workday Population-Weighted Loss
Global Sum: 362 Billion Hours



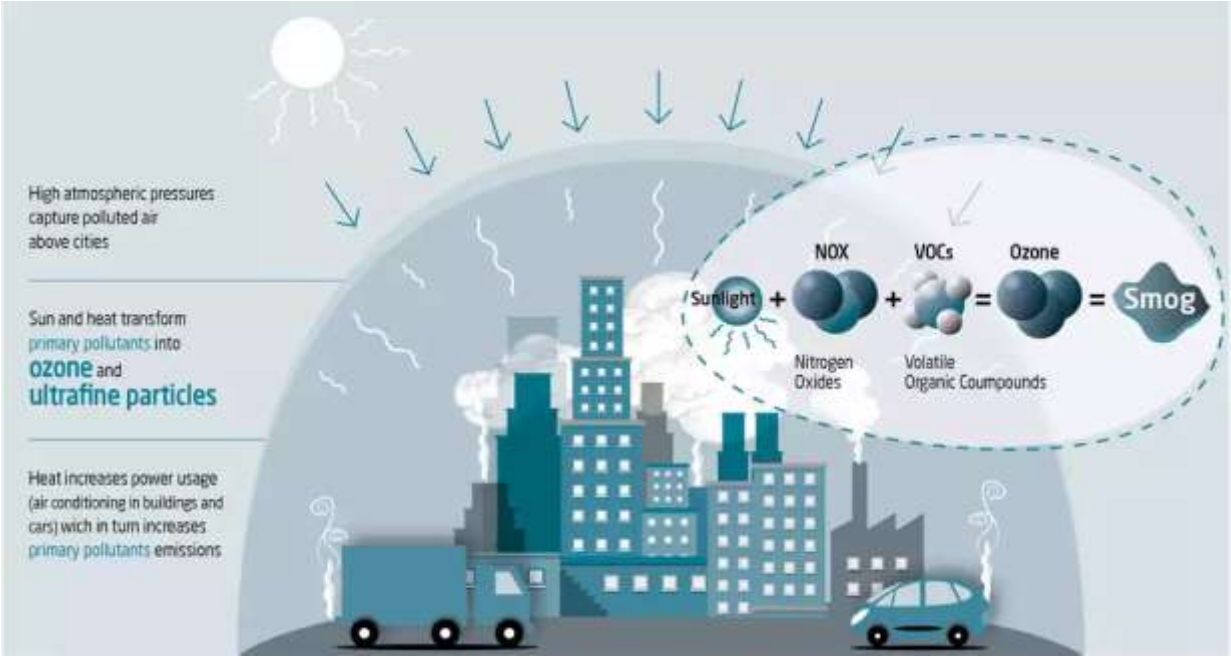
c. ΔT Global: +2°C:
12-Hour Workday Population-Weighted Loss
Global Sum: 547 Billion Hours



d. ΔT Global: +4°C:
12-Hour Workday Population-Weighted Loss
Global Sum: 1091 Billion Hours



13. Mention how Heat Waves contribute to air pollution?



Impact	Description
Heat increases primary pollutants emissions	• **Heat triggers more air conditioning power usage in buildings** and cars, and this **additional power usage emits more air pollution.** • **Climate change with longer warm periods**, can also cause a **greater production of plant-based allergens such as pollen** (source US White House report). • Other side effects of heat can increase air pollution, such as **wildfires that produce high quantities of particles**, this pollution can reach densely populated areas, **transported by winds.**
High atmospheric pressure keeps	• **Heat waves and poor air quality** often go hand-in-hand because **lingering high pressure creates a stagnant environment**.

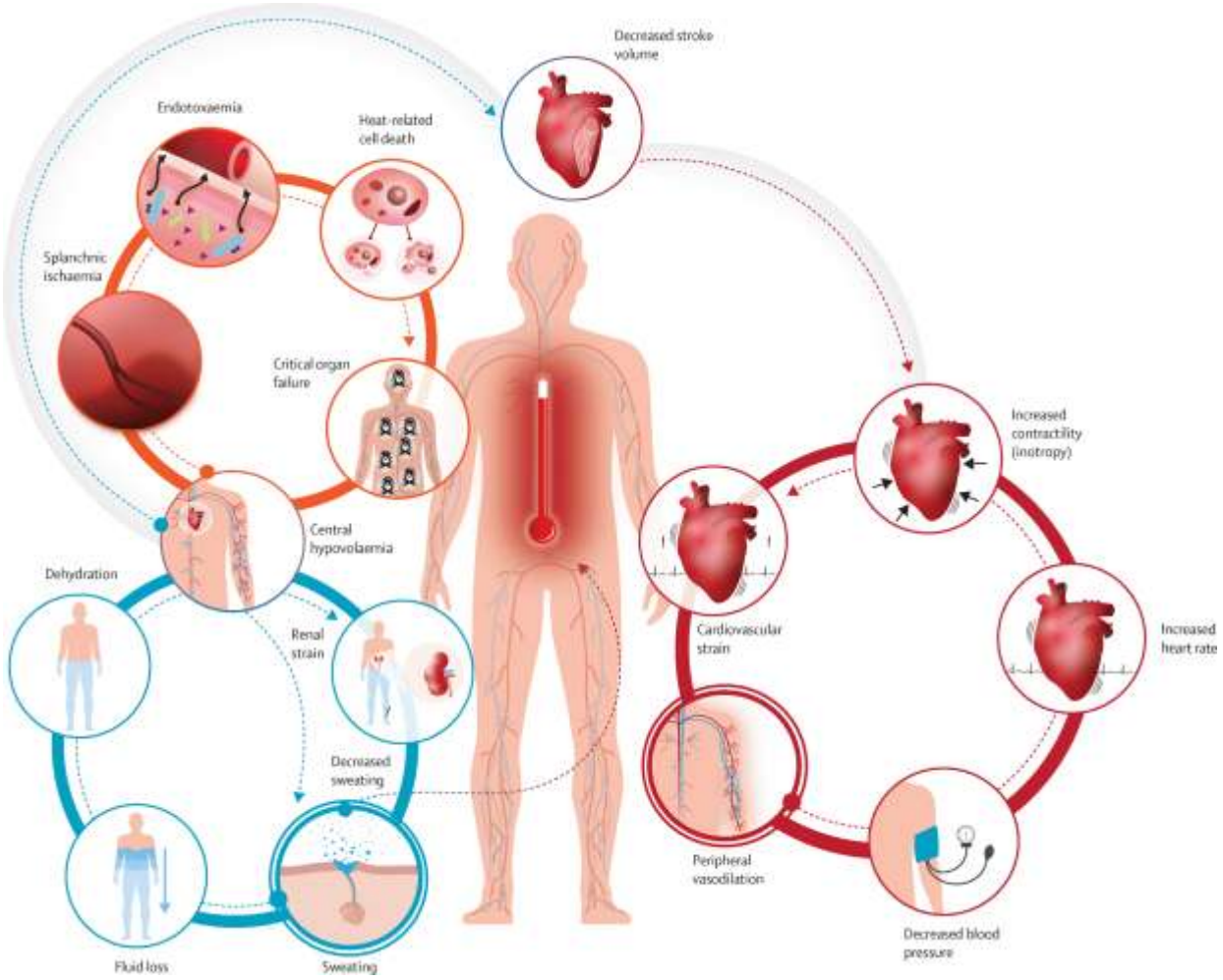
air pollution at ground level, making its level increase	• With light winds and no precipitation, **pollutants don't get cleared from the air**, and they **build up right above ground level.** • When air quality is poor, people may experience an **acute worsening of their condition**, with **shortness of breath**, a feeling that they can't catch their breath, a **tightening in the chest**, a cough from the irritation or even bronchitis.
Sun and heat transform and worsen air pollution	• **Sunlight and high temperature trigger chemical reactions** between **primary air pollutants** such as **nitrogen oxides** (emitted by engines) and **oxygen, causing a chemical reaction that forms ozone.** • The **hotter the day** and the more intense the sun, the **more ozone is formed.** • **Ozone is a very active oxydant,** which exacerbates lung diseases s**uch as asthma and can cause breathing difficulties** even in healthy individuals. • **Heat and sun** also **transform primary particles into secondary smaller particles** that can be **more toxic.**

14. What are the impacts of Heat Waves on Agriculture?

Impact	Description
Water resources	• Because of the **close relationship between climate and water, heat waves intensify** the **water crises in several regions,** especially in arid and semi-arid areas.

Wild/Forest fires	• **Forest Survey of India** has estimated that **21.4 per cent (1,524,21 sq.km) area under forest is vulnerable to forest fires.**
Crops	• **High temperatures beyond a certain optimum level reduce plant growth** by affecting the shoot net assimilation rates, and thus the **total dry weight of the plant is collectively termed as heat stress,** which is one of the most important factors limiting crop.
Livestock	• Under heat stress, a number of **physiological and behavioral responses of livestock vary in intensity** and duration in relation to the **animal genetic makeup and environmental factors.**
Poultry	• **Heat stress interferes** with the **broilers comfort** and **suppresses productive efficiency, growth rate**, feed conversion and live weight gain due to changes in behavioural, **physiological and immunological responses.**
Fisheries	• **Heat Waves can affect fisheries and aquaculture** via **acidification,** changes in **sea surface temperatures** and **circulation patterns**, frequency and severity of extreme events and **sea level rise** and associated ecological changes.

15. Mention impact of heat waves on human health?



Impact	Symptoms	First Aid
Sunburn	• **Skin redness and pain, possible swelling, blisters, fever and headaches.**	• 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 get medical attention.

Heat Cramps	• Painful **spasms usually in leg and abdominal muscles** or extremities. **Heavy Sweating.**	• Move to a cool or shaded **place.** Apply **firm pressure on cramping** muscles or **gentle massage to relieve spasm.** • Give **sips of water.** • If **nausea** occurs, **discontinue.**
Heat Exhaustion	• **Heavy sweating, weakness,skin cold, pale, headache and clammy. Weak Pulse.Normal temperature possible. Fainting,vomiting.**	• Get victims to **lie down** in a **cool place.** • **Loosen Clothing. Apply cool, wet cloth.** • **Fan or move the victim to an air-conditioned place.** • Give **sips of water** slowly and If nausea occurs, discontinue. • If **Vomiting** occurs, seek immediate medical attention. Or call **108 and 102 for Ambulance.**
Heat Stroke(Sun Stroke)	• **High body temperature.** • A **core body temperature of 104 degrees Fahrenheit (40 degrees Celsius) or higher is the main sign of heatstroke.** • **Change in mental state or behavior.**	• **Heat stroke** is a **severe medical emergency.** • **Call108 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**

	Confusion, agitation, slurred speech, irritability, delirium, seizures and coma can all result from heatstroke. • **Change in sweating pattern.** • **In heat stroke brought on by hot weather, skin feels hot and dry to the touch.** • **However, in heat stroke brought on by strenuous exercise, sweating may be profuse.** • **Nausea and vomiting. Someone with heat stroke may feel sick to their stomach or vomit.** • **Flushed skin.** • **Skin may turn red as body temperature increases.** • R**apid breathing. Breathing may become rapid and shallow.**	**to reduce** body temperature. Use extreme caution. • Remove **clothing.** • Use **fans and/or air conditioners.** • **DO NOT GIVE FLUIDS ORALLY** if the **person is not conscious.** • There are a few **stages of heat injury, and heatstroke** is the most serious. • It can happen **if body temperature rises to 104 F (40 C) or higher.** • **Heatstroke** needs emergency care. • If it's **not treated, heatstroke can quickly damage the brain, heart, kidneys and muscles.** • This damage gets worse the longer treatment is delayed, which increases the **risk of serious complications or death.**

	• **Racing heart rate.** • **Pulse may significantly increase because heat stress places an extreme burden on the heart to help cool the body.** • **Headache. Heatstroke may cause the head to throb.**	

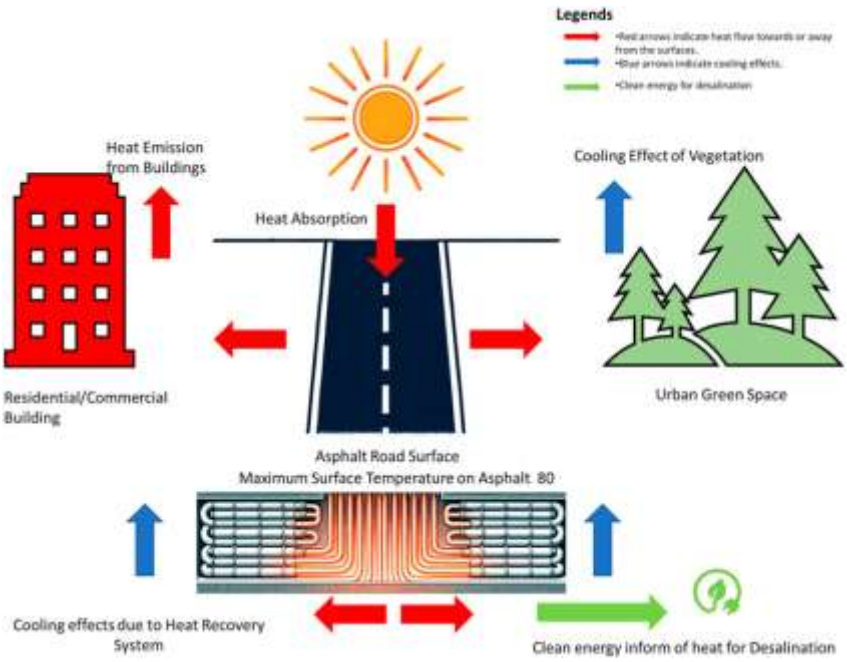
16. Enlist the contribution of Civil Engineers to Heat Wave mitigation?

- **Innovations in civil engineering** are driving significant advancements in **Heat Wave mitigation**.

- These innovations are **transforming traditiona**l practices and paving the way for a **more sustainable future.**

Mitigation Approaches	**Analysis**
Sustainable Design and Construction	• One of the **primary ways civil engineers contribute to climate change mitigation** is through the **adoption of sustainable design and construction practices.** • This involves using **materials and methods that reduce greenhouse gas emissions and minimize environmental impact.** Examples include: • **Green Building Materials:** ▪ Using materials like r**ecycled steel, bamboo, and fly ash** in concrete **reduces the carbon footprint** of construction projects. • **Energy-Efficient Building Designs:** ▪ Incorporating features such as **natural lighting, ventilation, and solar panels reduces energy consumption and reliance on fossil fuels.**
Green Roofs and Walls	• **Green roofs and walls** are **innovative solutions** that help **mitigate the urban heat island effect, improve air quality, and enhance building insulation.** • These systems involve **planting vegetation on rooftops and building facades**, providing numerous environmental benefits such as: • **Temperature Regulation:** ▪ **Reducing indoor temperatures and lowering energy consumption for cooling.**

	• **Stormwater Management:**
	  ▪ Absorbing **rainwater, reducing runoff, and decreasing the risk of flooding.**
	• **Biodiversity:**
	  ▪ Creating **habitats for wildlife in urban areas.**

Geotechnical Engineering Innovations	• Advancements in **geotechnical engineering are improving the sustainability** and **resilience of infrastructure projects.**
	• Innovative techniques include:
	• **Soil Stabilization:**
	  ▪ Using environmentally friendly methods to enhance the **strength and stability of soil, reducing the need for extensive excavation** and material use.
	• **Ground Source Heat Pumps:**
	  ▪ Harnessing the **earth's natural heat for energy-efficient heating** and **cooling systems in buildings.**
	 

Hybrid and phase change materials	• Alternatives such as **hybrid systems, composed of timber together with concrete**, are **increasingly being used** in construction, and can help **reduce environmental impacts**, while also providing the **desired thermal mass.** • **Phase change materials (PCMs)** are **remarkable materials that are able to store or release energy in the form of latent heat, as the material changes phase**. • So when it's cold, **the substance changes to solid phase (i**t freezes), and **releases heat.** • When it **becomes liquid again**, **the material absorbs heat, providing a cooling effect.** • PCMs can have **even greater thermal mass than stones or concrete**. • Research has found that **these materials can reduce the internal temperatures by up to 5°C.** • If added to a **building with AC**, they can **reduce electricity consumption from cooling by 30%.** • **PCMs** have been hailed as a very promising **technology by researchers**, and are available **commercially – often in ceiling tiles and wall panels.** • **Some PCMs** can cause a **quarter of the CO_2 emissions** that others do, so choosing the **correct product is key.** • **Manufacturing processes** should become **more efficient over time**, making **PCMs increasingly worthwhile.**

Windows and shading	• **Opening windows** is a common way people try to cool buildings ,but air inside will be just as **hot as outside.** • The **simplest way to keep the heat out is with good insulati**on and **well-positioned windows.** • Since the sun is **high in summer, external horizontal shading such as overhangs and louvres are really effective.** • **East and west facing windows** are more difficult to shade. • **Blinds and curtains** are not great as they block the view and daylight, and if they are **positioned inside the window**, the **heat actually enters the building.** • For this reason, **external shutters** – like those often seen on old buildings in **France and Italy – are preferable.** 

Sustainable Transportation Solutions	• **Transportation** is a **significant contributor to greenhouse gas emissions.** • **Civil engineers are developing sustainable transportation** solutions to reduce these emissions and promote **greener mobility options.** • Innovations include: • **Electric Vehicle Infrastructure:** ▪ **Designing and constructing charging stations** to support the widespread adoption of electric vehicles. • **Public Transit Systems:** ▪ **Developing efficient and reliable public transportation networks** that reduce reliance on private vehicles. • **Pedestrian and Bicycle Infrastructure:** ▪ **Creating safe and accessible pathways for walking and cycling**, encouraging **active and sustainable transportation.**

17. What are the initiatives taken by the government to address the issue of heatwaves?

Policy/Initiatives	Description
National Disaster Management Plan (NDMP)	• Provides a framework for **heatwave mitigation** under disaster management, including **early warnings, capacity building,** and inter-agency coordination.
National Action Plan on Climate Change (NAPCC)	• Addresses adaptation under its "**National Mission on Sustainable Agriculture**" including managing heat stress on crops/livestock.

National Action Plan on Human Health and Climate Change	• It aims to facilitate capacity building, surveillance, preparedness and awareness generation for **climate-sensitive health risks, including heat stress.**
Heat Action Plans	• City-level plans were initiated after the **Ahmedabad model to issue early heatwave warnings**, minimize exposure of at-risk groups and boost health system preparedness.
National Disaster Management Policy	• Mandates development of **disaster-specific action plans, including for heatwaves,** outlining prevention, preparedness and risk reduction.

18. What can you do to reduce the impact of Heatwaves?

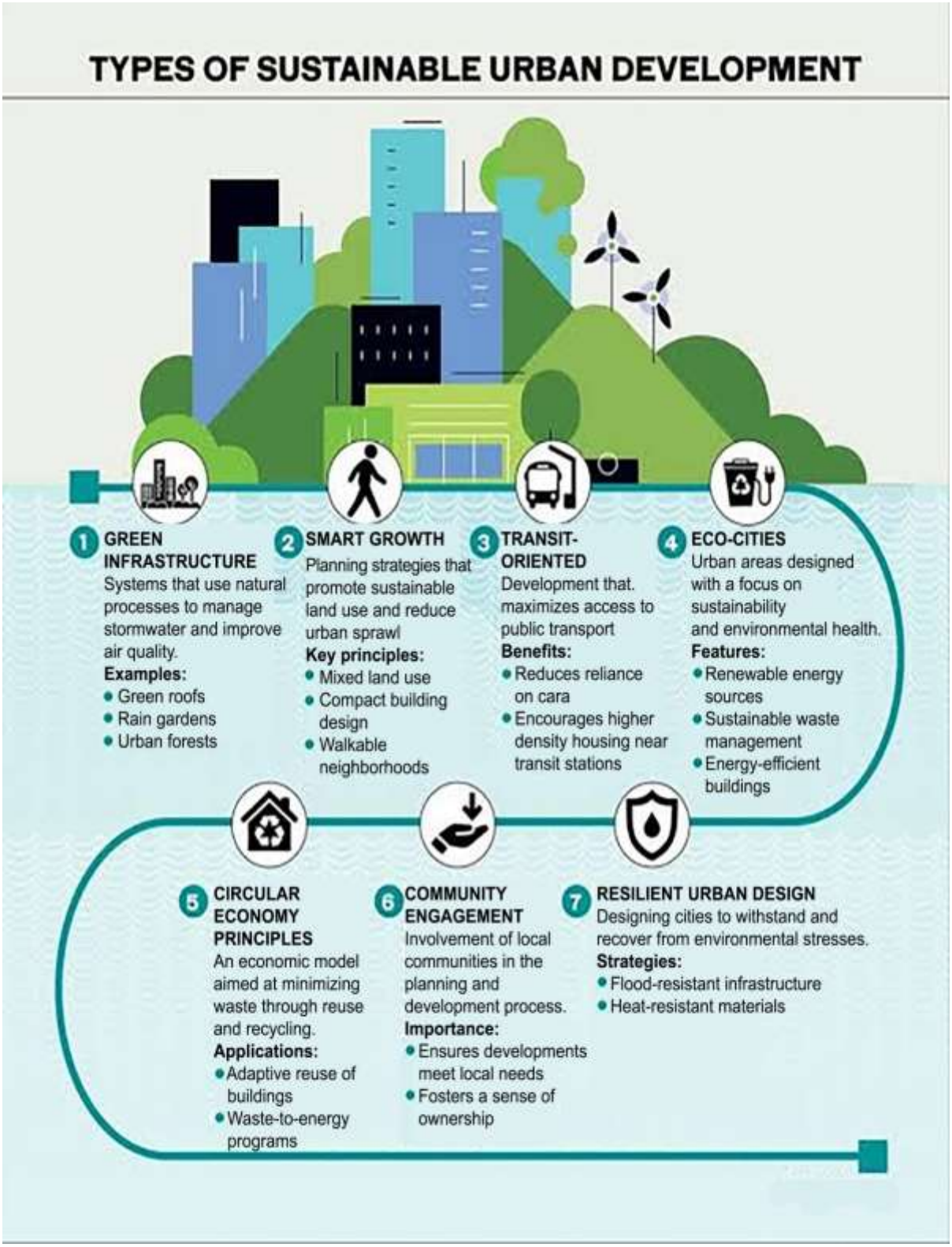
Increase shade around your home	• **Planting trees and other vegetation lowers surface and air temperatures** by providing shade and cooling through evapotranspiration. • Trees and vegetation that **directly shade your home can decrease the need for air conditioning,** making your home more comfortable and reducing your energy bill.
Install green roofs	• A green roof, or r**ooftop garden, is a vegetative layer grown on a rooftop**. • Green roofs provide shade and **remove heat from the air through evapotranspiration,** reducing temperatures of the roof surface and the surrounding air.

Use energy-efficient appliances and equipment	• **Using efficient appliances and equipment in your home can help to lighten the load on the electric grid during heat waves,** thus ensuring a more reliable supply of electricity to your community. • Replacing your **old appliances and equipment with ENERGY STAR-qualified products** can also help save you money.

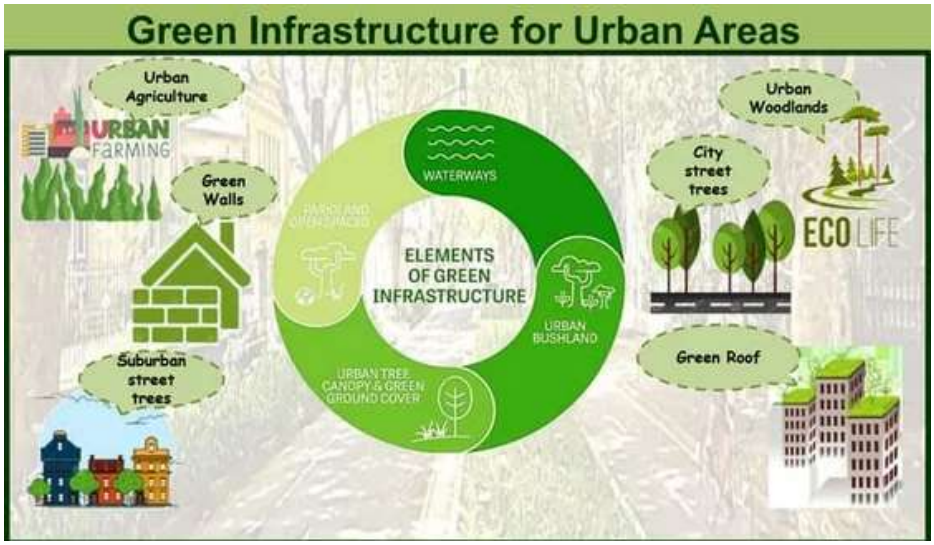
19. What are the measures one should take to minimize the impact during the heatwave?

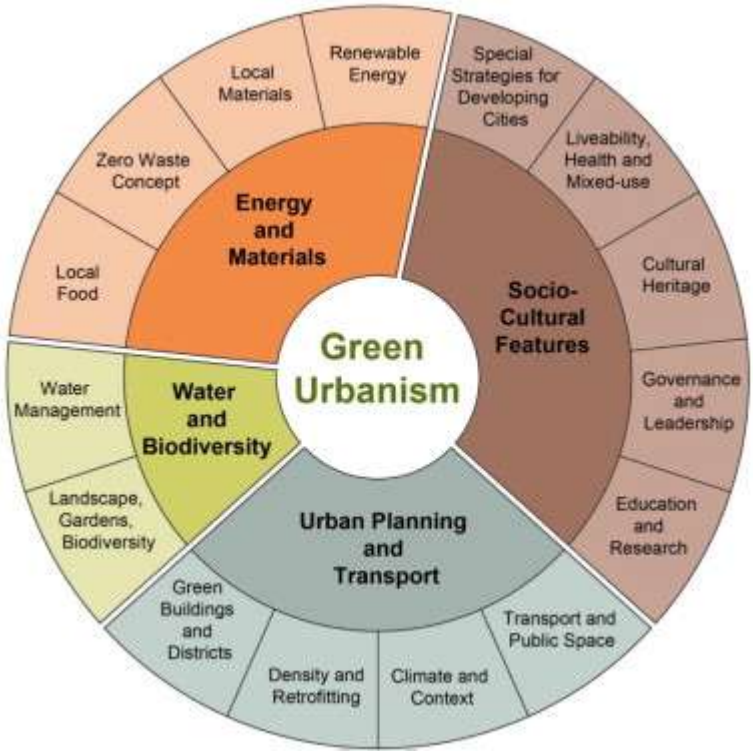
- Avoid going out in the sun, especially between **12.00 noon and 3.00 p.m.**
- Drink **sufficient water** and as often as possible, even if not **thirsty**
- **Wear lightweight, light-coloured, loose, and porous cotton clothes.**
- Use **protective goggles, umbrella/hat, shoes or chappals** while going out in the sun.
- Avoid **strenuous activities** when the outside temperature is high.
- Avoid working outside between **12 noon and 3 p.m.**
- While travelling, carry water with you.
- Avoid **alcohol, tea, coffee and carbonated soft drinks**, which dehydrates the body.
- Avoid **high-protein food** and do not eat stale food.
- If you work outside, use a **hat or an umbrella** and also use a damp cloth on your **head, neck, face and limbs**
- Do not leave **children or pets in parked vehicles**
- If you **feel faint or ill**, see a doctor immediately.
- Use **ORS, homemade drinks like lassi, torani (rice water), lemon water, buttermilk,etc.** which helps to rehydrate the body

20. What can be a possible way forward?



Way Ahead	Analysis
Urban greening	• **Urban greening** – **creating living walls, roofs and green corridors** – can benefit cities in areas of **high rainfall, including around the equator.** • The **World Economic Forum's Global Commission on BiodiverCities and Adrienne Arsht-Rockefeller Foundation Resilience Center (Arsht-Rock)** have developed the **Heat Action Platform**, an online resource that provides cities around the world with a roadmap and **tools to address extreme heat.**





Appointing Chief Heat Officers	• **Jane Gilbert** became the **world's first Chief Heat Officer in May 2021**, and as global temperatures rise it's becoming an increasingly **widespread and important role.**

Passive cooling	• A **US study** found strategies like **shading and natural ventilation** could reduce pressure on air conditioning by up to **80%.**

21. What is the relevance of the topic for UPSC CSE?

- **For Prelims:** Heat Waves, Indian Meteorological Department (IMD), global warming, urban heat island effect, El Nino , Sendai Framework for Disaster Risk Reduction 2015-30, Nature-based solutions, Intergovernmental Panel on Climate Change (IPCC), Passive cooling technology.
- **For Mains:** Role of India Meteorological Department (IMD) in mitigating severe weather events, Concept of the Heat Index.

Some previous years prelims questions.

Q1. What are the possible limitations of India in mitigating global warming at present and in the immediate future? (2010)

1. Appropriate alternate technologies are not sufficiently available.
2. India cannot invest huge funds in research and development.
3. Many developed countries have already set up their polluting industries in India.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (a)

Some previous years mains questions.

Q1. Bring out the causes for the formation of heat islands in the urban habitat of the world. (2013-5 Marks)

Some questions from this year and previous years interview transcripts.

Board Dinesh Dasa sir

- Difference between CDRI and NDMA?

Board Suman Sharma mam

- What are man made disasters?
- What to do as dm?
- Major changes in NDMA after 2005?

Board Sanjay Verma sir

- Global warming is going to affect both MP and Kerala in a similar way.
- Analyze it for me.

Board Lt. Gen Raj Shukla sir

- What is a heat wave?
- What steps should we take to deal with heat waves?

Board BB Vyas sir

- Your optional is geography, why are we facing so high temperatures and heat waves, etc (talked about the IPCC report)
- What is the solution for this?
- What are marine heat waves?

Some questions for QUIZ.

Q1. Consider the following statements regarding Heat Waves

1. It heat waves should be declared when actual maximum temperature remains 45°C or more.
2. Heat Waves often occur when high-pressure systems stall over a region.
3. High temperature and High humidity, referred to as the wet bulb temperature makes heat waves deadly.

How many of the above statements are incorrect?

Select the correct answer using the code given below:

(a) Only one
(b) Only two
(c) All three
(d) None

Ans: (d)

Some questions for POLL.

Q1. Have you ever suffered from heat stroke?

(a) YES
(b) NO
(c) Can't say.

Q2. Are you satisfied with the efforts taken to mitigate heat waves?

(a) YES
(b) NO
(c) Can't say.

■■■■