COMPREHENSIVE REVIEW OF HEATWAVE EVENTS IN PAKISTAN (2015 – 2025)

National Institute of Disaster Management

National Disaster Management Authority

This document has been prepared under the patronage of

Lieutenant General Inam Haider Malik HI(M),
Chairman (NDMA)

Editorial Team

M. Tanveer Piracha
Executive Director (NIDM)

Talyaa Najam (Chief Author)
Assistant Manager (NIDM)

Contents

1. Introduction

"A heat wave is an extended period of unusually high temperatures and often high humidity that causes temporary modifications in lifestyle and may have adverse health effects on the affected population."

Heat waves are classified among the most dangerous weather phenomena globally. Major heat waves are associated with negative effects on society and ecosystems, including excess mortality in the population and reduced vegetation product, and often linked to rapidly emerging flash droughts.

In Pakistan, heatwaves typically occur during the pre-monsoon summer months, with the most intense periods often observed from May to June. During heatwaves in Pakistan, the peak hours when temperatures are at their highest are generally between **11:00 AM and 4:00 PM**. The Pakistan Meteorological Department advises the public to avoid outdoor activities during these peak sunlight hours to reduce the risk of heat-related illnesses. NDMA timely forecasted the areas impacted by the heatwave based on projected temperature and relative humidity profiles for the year 2025 (Fig. 1,2,3).

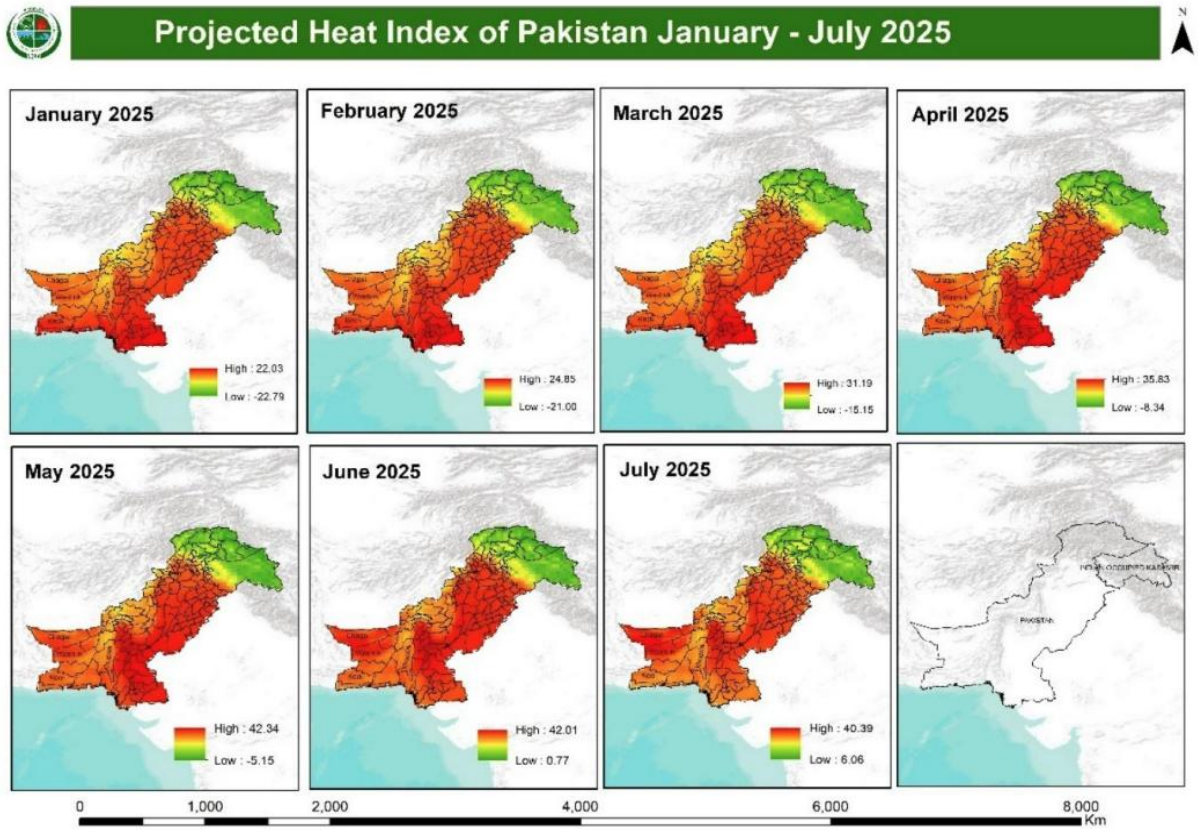

Figure 1 Projected Heat Index of Pakistan (Jan-July 2025)

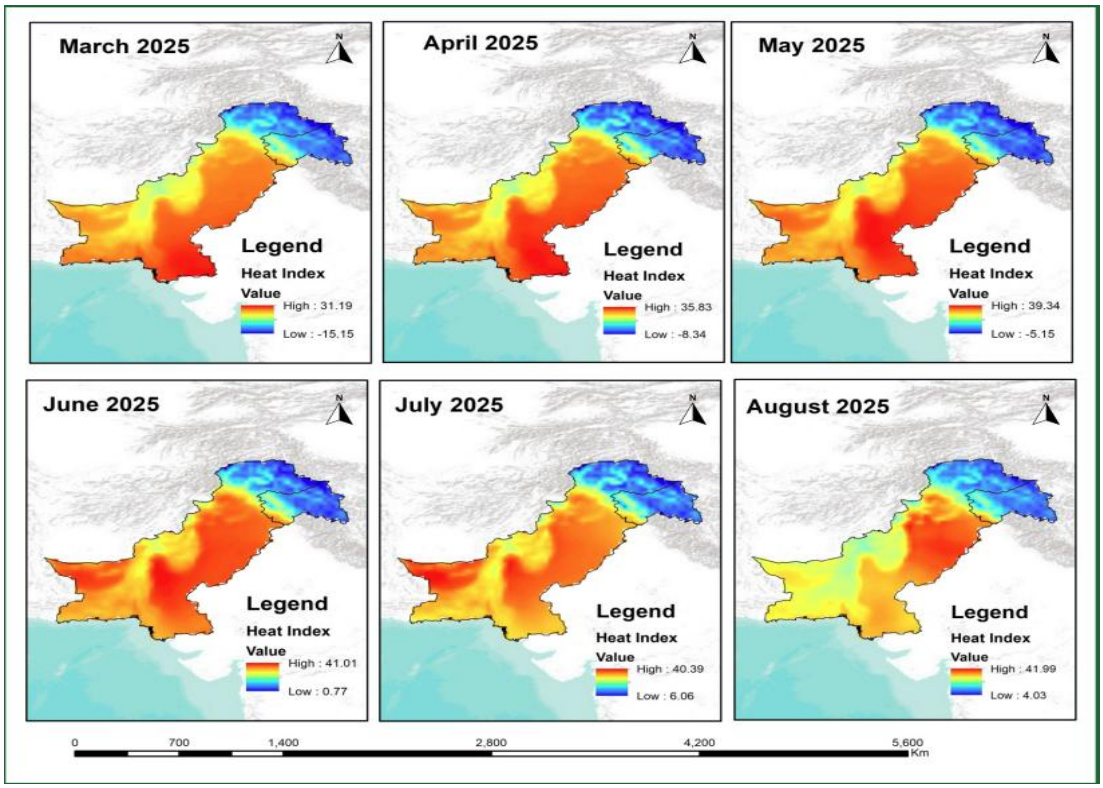

Figure 2 Projected Temperature of Pakistan (Mar - Aug 2025)

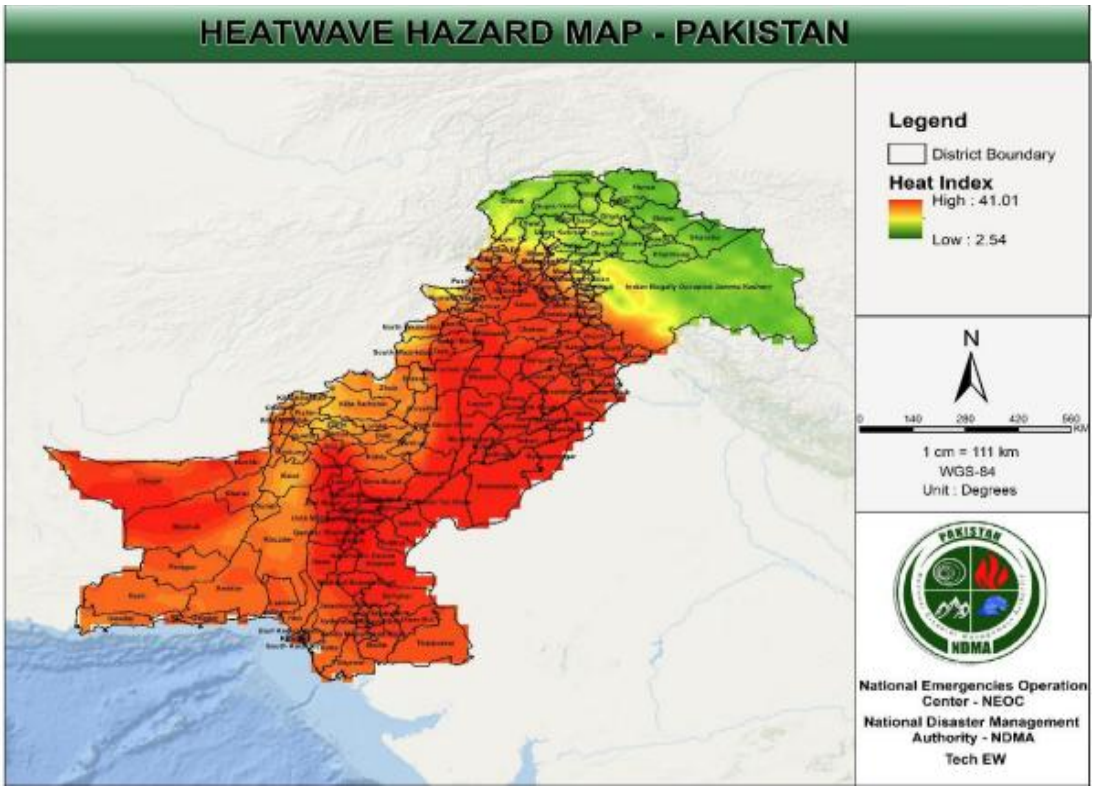

Figure 3 Heatwave Hazard Map

1.1 Future Heatwave Scenario based on climatic modelling

Future climate modeling and heatwave frequency projections are critical for understanding the long-term impacts of climate change and for informing evidence-based policy and planning. The Intergovernmental Panel on Climate Change (IPCC) provides comprehensive global and regional climate scenarios based on various greenhouse gas emission trajectories, such as Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs). These projections offer valuable insights into anticipated changes in temperature extremes, frequency and intensity of heatwaves, and alterations in precipitation patterns. Utilizing these models enables more robust risk assessments and supports the development of long-term climate adaptation strategies, particularly in high-risk countries like Pakistan.

At the national level, the Pakistan Meteorological Department (PMD) has been advancing localized climate projections that incorporate regional climatic variability, topographical diversity, and historical weather patterns. These projections are instrumental in identifying geographic areas likely to experience heightened vulnerability to extreme heat events in the coming decades. Integrating such data into development planning can enhance the design and implementation of targeted interventions, including early warning systems, heat action plans, urban resilience measures, and climate-resilient agriculture. Incorporating future climate scenarios into strategic frameworks is essential to shift from reactive disaster management to proactive, climate-resilient development, ensuring preparedness for both moderate and extreme climate outcomes beyond 2025.

2. Urban Heat Island Effect (UHI)

The term "heat island" referred to as built up areas that are hotter than nearby rural areas". While, an urban heat Island Effect (UHI) referred to as a "city or Metropolitan area that is significantly warmer than its surrounding natural areas due to certain anthropogenic activities" (United Nations Environment Protection Agency, 2017). It is estimated that for a city having one million or more population size could have an average 1 to 3 °C hotter air temperature than its neighborhoods. This difference can reach to its high limit as 12°C in the evenings. The UHI induce inhabitants to increase energy demand for cooling of their homes, workplaces, shopping areas, and indoor activities centers etc., that ultimately give rise to greenhouse gas emission and air pollution. Moreover, public and private health expenditure increases due to heat related morbidity and mortality.

3. Impacts of heatwave

Heatwaves characterized by prolonged periods of extreme temperatures, have significant direct and indirect impacts on health, the environment, and socio-economic systems.

3.1 Direct impacts

Heatwaves cause a range of direct impacts with immediate consequences for human health, environment, agriculture, and mental well-being. High temperatures directly lead to heat-related illnesses such as heat cramps, heat exhaustion, heatstroke, and dehydration. These conditions often worsen pre-existing cardiovascular, respiratory, and renal diseases, particularly among vulnerable populations including the elderly and those with chronic health conditions. Mortality rates rise significantly during extreme heatwave events. Heatwaves intensify the risk of wildfires and amplify the urban heat island effect, contributing to localized temperature spikes. In agriculture, crops suffer direct heat damage, resulting in reduced yields or complete failure, while livestock experience heat stress and dehydration. Additionally, prolonged exposure to extreme heat causes psychological stress, leading to mental health challenges such as anxiety, irritability, and depression. The 2024 heatwave resulted in 2,547 reported cases of heatstroke, 133 livestock deaths, and 568 human fatalities, underscoring the severe impacts on food production, labour capacity and public health.

3.2 Indirect impacts

Heatwaves cause a range of indirect impacts that extend well beyond immediate consequences. Warmer temperatures expand the range and activity of disease vectors, increasing the spread of illnesses such as dengue and malaria. Economically, prolonged heat reduces workforce productivity especially among outdoor workers and drives up healthcare costs due to increased hospital admissions. Droughts triggered by extreme heat intensify water scarcity, threatening agriculture, drinking water supplies, and sanitation systems. In the most severe cases, some areas may become uninhabitable, leading to forced migration and displacement. Ecosystems also suffer as species unable to adapt to rising temperatures face heat-induced stress and extinction, resulting in biodiversity loss. Social inequalities deepen as marginalized communities often lack access to cooling, healthcare, and clean water bear the impact of these effects. These far-reaching consequences highlight the urgent need for adaptive strategies to protect vulnerable populations, preserve ecosystems, and safeguard economic stability in the face of rising heat extremes. Additionally, energy infrastructure is strained due to high demand for cooling systems, often resulting in power outages. Climate-driven crop yield declines are already taking a major toll on Pakistan’s economy. By 2050, reduced wheat and rice yields are projected to cost Pakistan’s economy nearly $19.5 billion, according to comprehensive crop and

economic modelling. This decline, coupled with rising commodity prices and weakened household consumption, is expected to intensify economic stress. Immediate impacts are already evident: in 2023, Sindh experienced a 34% drop in cotton production, while mango and banana yields have declined by 30–60% in recent years due to recurring heatwaves. These losses have directly affected farmers' incomes and slowed industrial output linked to these crops.

4. Vulnerable Areas to Heatwaves

Heatwaves have emerged as a serious and recurring threat across Pakistan, with varying intensities and impacts depending on the region. Certain regions are more vulnerable to heatwaves due to geographical, climatic, socio-economic, and infrastructural factors. In Pakistan, the following areas are particularly susceptible:

4.1. Sindh

In Sindh, cities like Jacobabad, Larkana, and Dadu frequently record highest temperatures globally, often exceeding 50°C. Jacobabad has been highlighted internationally for reaching life-threatening thresholds where both temperature and humidity approach the limits of human survivability. These conditions pose extreme health risks, particularly in areas lacking adequate water, electricity, or cooling systems. Urban centres such as Karachi face a compounded challenge due to the urban heat island effect, high population density, limited green spaces, and poorly designed infrastructure. Informal settlements in Karachi, often made of concrete with poor ventilation, further trap heat, leading to increased morbidity and mortality during extreme heat events.

4.2. Punjab

In Punjab**,** southern districts including Multan, Bahawalpur, and Rahim Yar Khan experience long and intense heatwaves, particularly between May and July. These areas, being major agricultural hubs, face dual vulnerabilities: not only does the extreme heat affect human health, particularly that of outdoor workers and farmers, but it also threatens crop yields, water availability, and livestock survival. The socio-economic repercussions are significant, with poor rural communities struggling to access healthcare or financial buffers during prolonged heat spells.

4.3. Balochistan

Balochistan is another highly vulnerable province with towns namely Turbat, Sibi, and Nokkundi regularly registering some of the highest temperatures in Asia. The region's arid terrain, water scarcity, and underdeveloped infrastructure amplify the impacts of heatwaves. Prolonged heat stress in these areas has critical consequences for public health and livelihoods, especially among marginalized populations with limited access to healthcare, cooling, or safe shelter. The lack of robust early warning systems and emergency services further exacerbates vulnerability in these remote districts.

4.4. Khyber Pakhtunkhwa

In Khyber Pakhtunkhwa, although the province is generally known for its cooler highland regions, the low-lying southern areas such as Dera Ismail Khan have become increasingly susceptible to heatwave conditions. These districts are heavily reliant on agriculture and outdoor labour, which makes the population particularly exposed to heat-related stress. The region's limited adaptive capacity, low public awareness, and insufficient investment in climate-resilient infrastructure contribute to growing vulnerability.

4.5. Gilgit Baltistan and Azad Jammu and Kashmir

Gilgit Baltistan and Azad Jammu and Kashmir, traditionally considered cool and temperate, are now beginning to experience unusual heatwave patterns due to climate change. Although absolute temperatures may not be as high as in the plains, the sudden increase in warmth disrupts delicate alpine ecosystems and accelerates glacial melt, increasing the risk of glacial lake outburst floods (GLOFs). These climatic shifts threaten both biodiversity and the water security of downstream communities that depend on glacial runoff.

4.6. Urban Centers

Major urban centers like Lahore, Islamabad, and Rawalpindi are also facing severe heatwave challenges due to rapid urbanization, air pollution, and the proliferation of concrete infrastructure. These cities experience temperature amplification due to the lack of tree cover and green infrastructure, and are often ill-prepared for prolonged heat events. Populations in dense urban neighbourhoods, particularly low-income communities, face heightened risks due to poor housing, limited access to air conditioning, and overburdened health systems.

4.7. Desert Areas

Finally, desert regions such as Tharparkar in Sindh and Cholistan in Punjab are particularly susceptible to heatwaves due to their arid climates, scarce water resources, and socio-economic deprivation. These areas routinely experience extreme heat coupled with drought-like conditions, placing immense stress on human and animal populations. Marginalized groups, especially women and children, bear the brunt of the crisis due to inadequate access to water, healthcare, and mobility during emergencies.

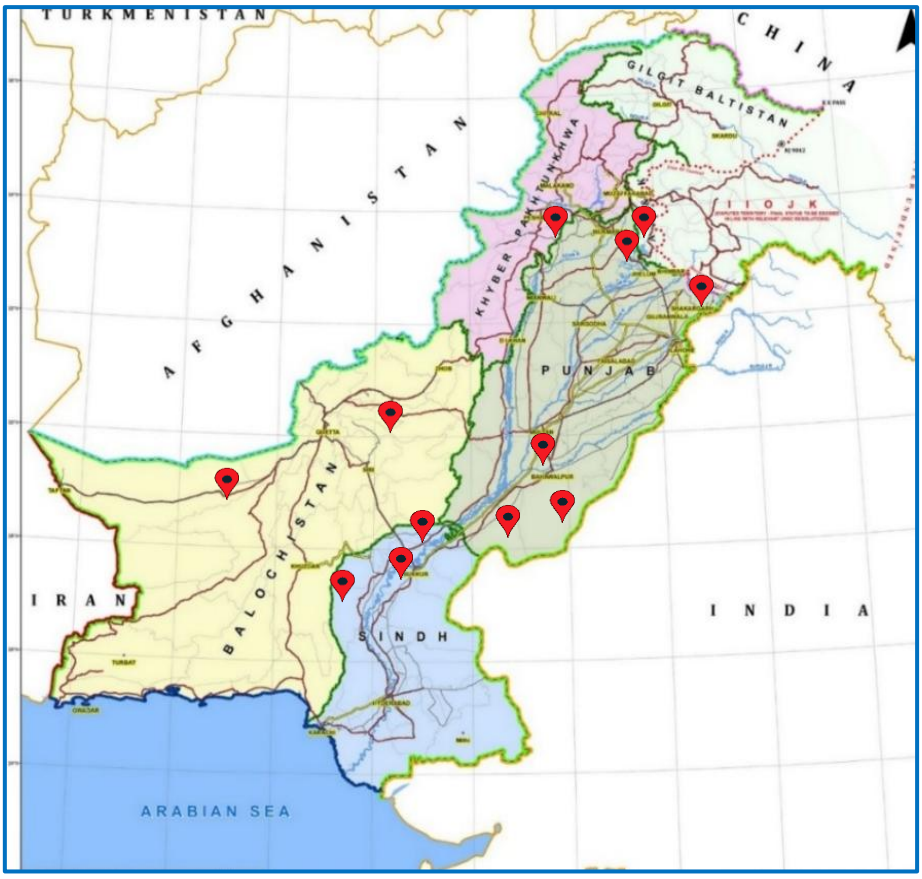

Figure 4 Heatwave Vulnerable Areas of Pakistan

5. Contributing Factors to Vulnerability

I. Limited access to cooling systems and healthcare increases risk.
II. Crowded urban areas exacerbate the urban heat island effect.
III. Inadequate housing, lack of green spaces, and limited access to water worsen conditions.
IV. Rural populations reliant on outdoor work face direct exposure.

Table.1 Thresholds by PMD Heatwave Management Committee

Alert	Criteria	Public Advisory
Normal Day	Forecast < 40°C	
Hot Day Alert	Forecast 40°C - 41.9°C	- Avoid outdoor activities. - Cover your head. - Drink more water. - Wear light colored and loose cotton clothes.
Hot Day Warning	Forecast ≥ 42°C	- Avoid heat exposure. - Drink sufficient fluids. - Replenish body salt through IV fluids. - Wear light colored and loose cotton clothes. - Walk and sit under shades.
Heatwave Emergency	Forecast ≥ 42°C and minimum temperature > 30°C for 2 or more consecutive days. *Significant levels of heat related illness and mortality reports.	- Extreme care needed for vulnerable people. - Avoid heat exposure. - Drink sufficient fluids. - Replenish body salt through ORS. - Wear light colored and loose cotton clothes. - Walk and sit under shades. - Call emergency helpline for any additional assistance.

Source: PMD

6. Historical events

6.1 June 2015 – Karachi and Southern Sindh

Karachi and surrounding areas in southern Sindh experienced one of the deadliest heatwaves in Pakistan's history in mid to late June 2015. Temperatures soared to unprecedented levels with cities like Larkana and Turbat recording highs of up to 49°C, while Karachi reached 45°C, highest temperature since 1979. This extreme event resulted in approximately 1350 deaths, with over 1,200 fatalities in Karachi. The timing of the heatwave coincided with the holy month of Ramadan. This increased the population's vulnerability to dehydration, especially among the elderly and those with pre-existing health conditions. The crisis was further intensified by widespread electricity outages, which disrupted access to cooling systems and water supplies, severely impacting the urban poor.

Hospitals across Karachi were crowded with patients suffering from heatstroke, and morgues such as those managed by the Edhi Foundation, exceeded their capacity, prompting expedited burials to manage the increasing number of bodies. In response, the government declared a state of emergency, while military and paramilitary forces

established heat-relief camps across the city. Public holidays were announced in an effort to keep people indoors.

The 2015 heatwave underscored critical gaps in emergency preparedness and infrastructure resilience in Pakistan. It brought to light the urgent need for public awareness campaigns focused on heat safety, as well as the establishment of early warning systems to better prepare for and mitigate future extreme weather events. This tragedy became a catalyst for initiating discussions on climate adaptation strategies and urban heat management in the country.

6.2 April 2017 – Sindh and Punjab

Several regions of Pakistan, including Larkana, Mohenjo Daro, Sibi, and Lahore, experienced an unusually severe heatwave in April 2017. Larkana recorded a scorching temperature of 51°C, setting a new national record for the month of April. This early-season heatwave caught both authorities and the public off guard, as such high temperatures are typically expected later in the summer. The intense heat led to at least four reported deaths in Hyderabad and caused a range of health issues, particularly among vulnerable populations such as children, the elderly, and outdoor workers. Additionally, the heatwave triggered dust storms and light rain in some areas, which further impacted agricultural activities by damaging crops and reducing yield.

The response to the 2017 heatwave was limited, with minimal mitigation measures in place at the time. There was a noticeable lack of early warning dissemination and coordinated public health messaging. This event emphasized the urgent need for Pakistan to develop comprehensive heatwave preparedness plans, especially as climate change increases the likelihood of such extreme weather events occurring earlier in the year. It also highlighted the importance of integrating climate resilience into agricultural and public health planning.

6.3 March – June 2023 Nationwide

From March to June 2023, Pakistan experienced an extended and widespread heatwave that affected multiple provinces, including Punjab, Khyber Pakhtunkhwa, and parts of Sindh. The annual national mean temperature for 2023, for Pakistan as a whole, was 0.51 °C above the 1961–1990 average, placing it as 18th warmest year on record during past sixty-three years During this period, temperatures consistently exceeded 40°C in several regions, leading to severe disruptions in daily life and posing significant health risks, particularly to the elderly, children, and those with pre-existing medical conditions. The intensity and duration of the heatwave were unprecedented for the early months of the year, indicating a shifting climate pattern and increasing vulnerability to extreme temperatures.

At least 22 fatalities were reported from Mardan and Islamabad, while countless others suffered from heat-related illnesses. The government took emergency measures to mitigate the impact, including the closure of schools across Punjab, which affected over 26 million children. This step aimed to reduce exposure to extreme heat for students and teachers alike. In addition to domestic responses, Pakistani authorities and climate advocacy groups renewed calls for international support and cooperation to address the growing impacts of climate change, highlighting the country's limited capacity to respond to recurring environmental disasters. The 2023 heatwave emphasized the pressing need for long-term climate resilience planning, improved healthcare preparedness, and sustained public awareness initiatives.

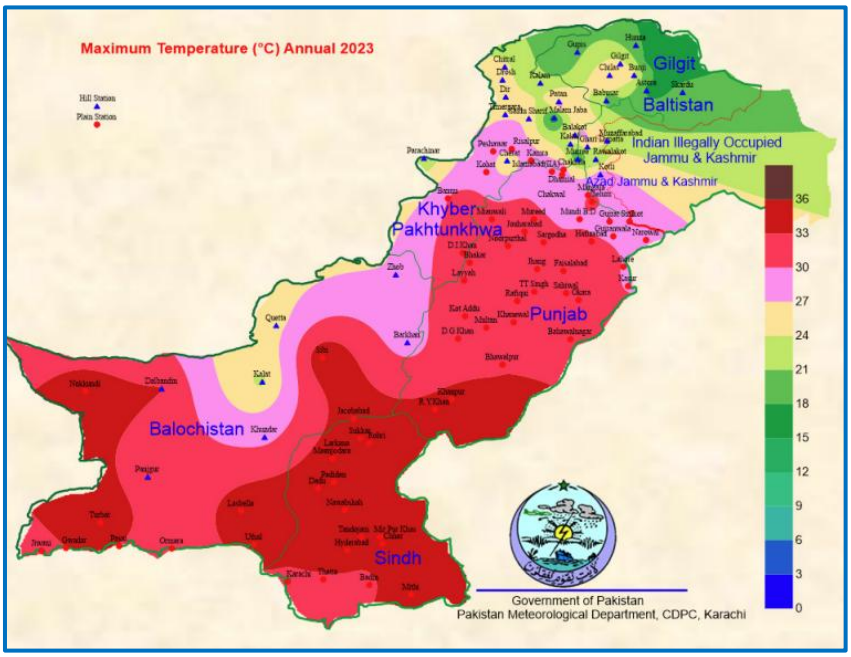

Figure 5 Maximum Annual Temperature 2023

6.4 May – July 2024 Sindh Province

Pakistan was struck by an exceptionally intense heatwave Between May and July 2024, with the province of Sindh bearing the brunt of its impact. Major urban centres such as Karachi and historically heat-prone regions like Mohenjo Daro experienced extreme temperatures, with Mohenjo Daro recording a staggering 52.2°C approaching national heat records. This prolonged heat event led to a significant public health crisis, resulting in multiple casualties due to heatstroke and related complications. The heatwave exacerbated existing vulnerabilities in the region, particularly in areas already affected by previous environmental disasters. Ongoing power outages hampered access to cooling systems, while water scarcity intensified the risk of dehydration and heat-related illnesses. The situation also worsened food insecurity, as extreme temperatures and water shortages threatened agricultural productivity and supply chains

In response, local and provincial authorities, supported by humanitarian organizations, established heatwave response camps to provide emergency care and shelter. Public awareness campaigns were launched to educate citizens about preventive measures against heat-related illnesses. The International Rescue Committee (IRC) raised alerts about the compounded risks faced by communities still recovering from previous floods and droughts, calling for increased international attention to Pakistan's escalating climate vulnerabilities. This event reinforced the need for a multi-sectoral

approach to disaster preparedness, climate adaptation, and resilient public health infrastructure.

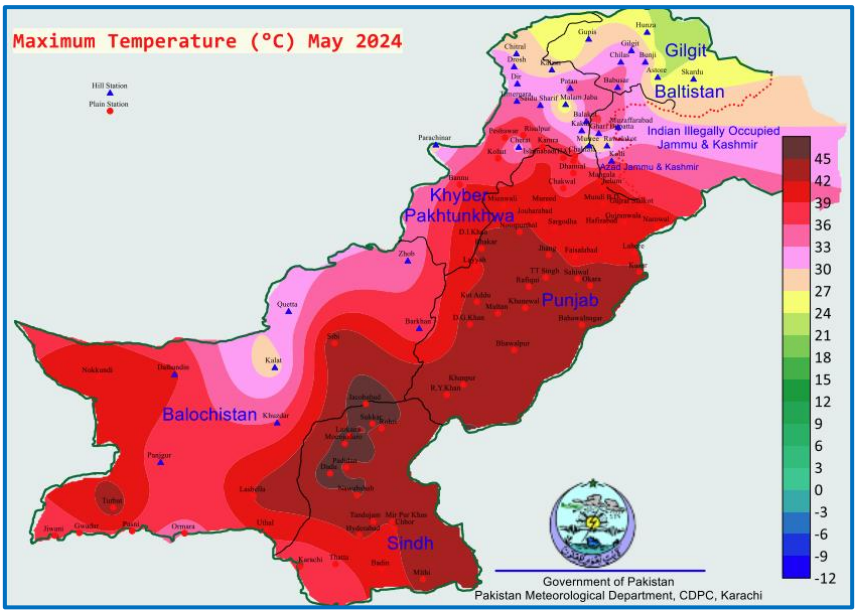

Figure 6 Maximum Annual Temperature 2024

7. Heatwave Management Strategies in Pakistan

7.1 Prevention and Preparedness

7.1.1 Public Engagement and Community Education

Raising public awareness is the cornerstone of heatwave risk reduction. Launching widespread community campaigns—through media, schools, mosques, and local organizations—can help educate citizens about the dangers of extreme heat. Emphasis should be placed on preventive behaviors such as maintaining hydration, avoiding outdoor activities during peak sun hours, and recognizing early symptoms of heat-related illnesses. In parallel, municipalities should actively promote initiatives that enhance urban resilience—such as increasing green cover, creating shaded pathways, and encouraging the use of heat-resilient construction materials. Use TV, radio, social media, SMS, and print to share heatwave alerts, engage local influencers and community leaders for trusted messaging, and deliver targeted content for vulnerable groups like children, elderly, outdoor workers, and people with disabilities.

7.1.2 Heat Monitoring and Early Warning Systems

A robust early warning system is critical to preventing loss of life during heatwaves. Integrating meteorological forecasts with satellite imaging and GIS technologies can provide accurate, real-time assessments of emerging heat threats. These systems must be designed to reach all segments of society, particularly the elderly, the chronically ill, and those living in informal settlements. Timely alerts via mobile phones,

radio, loudspeakers, community networks and social media platforms (WhatsApp groups, Facebook alerts, Twitter) can empower residents to take protective actions before conditions worsen.

7.1.3 Regulatory Framework and Policy Development

Governments at all levels should enact and enforce legislation that mandates the creation of local and regional heat action plans. These policies should ensure that urban development incorporates climate-smart principles favoring energy-efficient architecture, cool roofing technologies, and widespread integration of green infrastructure. Regulatory incentives can also encourage builders and developers to prioritize thermal comfort in their designs. Policies should mandate heatwave information campaigns across all media channels, ensuring timely alerts and safety messages are clearly disseminated to the public, especially vulnerable populations.

7.1.4 Climate-Responsive Urban Design

Cities must be reimagined through the lens of climate resilience. Urban planners should advocate for heat-conscious layouts that include reflective pavements, ventilated public buildings, water bodies, and shaded communal areas. Investments in passive cooling techniques and adaptive urban designs such as heat-reflective materials and rooftop gardens can significantly reduce surface and ambient temperatures, making cities safer during extreme heat events. Integrate digital billboards and public screens in urban centers to display real-time heatwave warnings and public safety messages, enhancing visibility and immediate public awareness.

7.2 Emergency Response and Relief

7.2.1 Rapid Deployment Teams and Cooling Services

During heatwave emergencies, the establishment of quick-response units is essential. These teams should be trained and equipped to set up mobile cooling centers, distribute drinking water and oral rehydration salts, and offer first-aid support to heat-affected individuals. Mobile outreach units can be used to monitor local temperature conditions and extend services to hard-to-reach or high-risk populations.

7.2.2 Community-Based Action and Volunteerism

Local participation plays a vital role in ensuring timely and context-sensitive response. By training community volunteers, especially in heat-prone districts, local authorities can build grassroots capacity to manage heatwave impacts. These volunteers can assist in distributing supplies, checking on vulnerable neighbors, and raising alerts.

Creating localized heat action networks enables communities to self-organize and respond swiftly in the face of rising temperatures.

7.3 Post-Heatwave Recovery and Long-Term Resilience

7.3.1 Health Surveillance and Support Programs

The aftershock of a heatwave often sees a rise in heat-induced illnesses. Establishing health surveillance systems to track cases of heatstroke, dehydration, and other related conditions can inform targeted medical outreach. Recovery programs should offer rehabilitative services, including long-term health monitoring and public education on managing heat stress and building personal resilience.

7.3.2 Ecological Restoration and Natural Cooling

Rebuilding environmental buffers is essential for mitigating future heatwave effects. Initiatives should focus on restoring damaged green spaces and reforesting urban and peri-urban areas with heat-tolerant species. Additionally, efforts to rehabilitate water bodies and improve groundwater recharge can strengthen natural cooling mechanisms, particularly in vulnerable rural communities.

8. Adapting to Rising Temperatures: Local and Global Best Practices

As global temperatures continue to rise, both local and international academic institutions are increasingly contributing to research, innovation, and community-based strategies to adapt to extreme heat conditions. A key area of focus has been urban and architectural modifications that mitigate the impact of heatwaves. Green roofs, for instance, not only provide shade but also absorb less heat, thus cooling roof surfaces and the surrounding air. Tree planting around buildings, parking lots, and open areas serves as a natural shield against the sun and reduces ground-level temperatures significantly.

Innovative construction methods are gaining ground in response to rising temperatures. The use of materials with high solar reflectance, heat-resistant paints containing compounds like boric acid and calcium chloride, and natural substances such as limestone or adobe helps insulate structures and maintain cooler indoor environments. Techniques such as double-roof systems or the use of plastic bags filled with compacted earth for walls are proving effective in low-resource or refugee settings. Moreover, narrow streets and shaded alleys in urban planning help maximize natural shade and minimize solar radiation exposure.

It is recommended to use rammed earth as a primary building material in desert regions such as Thar and Cholistan. Its high thermal mass and local availability make it ideal for maintaining indoor comfort and reducing the need for mechanical cooling. Cob earth blocks should be encouraged for rural housing in arid areas like Tharparkar and Bahawalpur. They are affordable, easy to produce using local materials, and provide natural temperature regulation. To minimize heat gain, it is advisable to apply reflective coatings such as white elastomeric paint or aluminium-based films on roofs and external walls. These materials significantly improve indoor thermal comfort in high-sunlight areas like Cholistan and Thar. The use of double roof systems is recommended to reduce indoor heat transfer. This design creates an insulating air gap that enhances ventilation and lowers roof surface temperatures, especially beneficial in regions with extreme heat. Compressed Earth Blocks should be adopted as a sustainable alternative to fired bricks. Their thermal efficiency, strength, and low environmental impact make them suitable for use in desert construction, while also supporting local production and job creation. It is recommended to insulate building envelopes using materials like EPS, polyurethane foam, straw bales, or mud plaster. Proper insulation is essential in desert climates to maintain indoor comfort, lower energy consumption, and protect building structures from thermal stress.

Cooling technologies, especially those powered by solar energy such as fans and air conditioning units, offer sustainable solutions to stay comfortable in high heat. Low-tech cooling strategies, such as evaporative cooling through wet cloth or mats, continue to provide affordable relief, especially in rural and underserved regions. Thermal insulation using earthen pots on the roof surface can help minimize heat.
Passive cooling approaches that harness natural ventilation and building orientation are being recommended globally to reduce dependence on energy-intensive air conditioning systems.

In agricultural and desert regions, the implementation of smart irrigation systems including drip irrigation and recycled water mechanisms has emerged as a critical adaptation measure to combat water scarcity and sustain crop production under rising temperatures. At the same time, companies must assess and reduce their carbon footprint as part of broader climate adaptation and mitigation efforts, ensuring they compensate for any remaining emissions through credible carbon offset strategies.








9. Role of private entities in mitigating heat risks

9.1 Construction & Real Estate

Private firms can significantly reduce urban heat through climate-resilient design. Adaptive strategies such as reflective roofs, cool pavements, green roofs, and passive ventilation not only enhance thermal comfort but also cut energy consumption. For instance, reflective surfaces and urban greening are proven methods to mitigate urban heat island effects. In Karachi, retrofitting buildings with energy efficient cooling systems and expanding rooftop gardens have been promoted to reduce indoor heat and overall urban temperatures. Additionally, sustainable building practices like passive solar design and resource efficient materials are gaining traction in domestic architecture

9.2 Energy Sector

Private energy companies, through public-private partnerships, play an essential role in transitioning Pakistan's energy infrastructure to more heat-resilient, reliable systems. Initiatives such as grid-enhancing technologies improve resilience to heat-driven energy demand. Meanwhile, private sector working on solar and wind energy projects are helping diversify supply, reduce fossil fuel dependency, and alleviate strain during heatwaves. As highlighted by Overseas Investors Chamber of Commerce & Industry (OICCI), numerous corporations are investing in solar installations and water recycling within plants, targeting a 50% reduction in GHG emissions by 2030.

9.3 Technology & Data

Tech firms contribute critical tools heatwave early warning systems, AI-driven thermal mapping, and IoT-enabled building controls for proactive adaptation. In Pakistan, anticipatory action pilots like those by Welthungerhilfe and Concern have utilized hazard forecasting models to activate community-level heatwave alerts and cooling centres odihpn.org. Furthermore, AI-enabled HVAC systems (e.g., intelligent building controls) optimize energy use while maintaining comfort, helping reduce heat-related strain on electricity grids.

9.4 Transport Sector

Private transport operators can reduce urban heat and improve resilience via electrified fleets and green infrastructure. Research on battery electric bus (BEB) adoption in Pakistan highlights that, despite higher upfront costs, BEBs become 30% more cost-effective over 6–7 years and significantly reduce emissions—benefiting urban climates during heatwaves. Additionally, shaded stops, airflow-optimized station design, and clean-energy transport options reduce commuter heat exposure and lower ambient temperatures.

10. Global Heatwave Management Case Studies

10.1 Middle East – United Arab Emirates (UAE): Smart Architecture and Cooling Innovation

10.1.1 Background

With summer temperatures soaring above 50°C, the UAE has developed innovative cooling strategies focused on sustainable design and technology.

10.1.2 Best Practices

a. Energy-efficient construction with insulation, reflective materials, and smart ventilation systems (e.g., Estidama Pearl Rating in Abu Dhabi).
b. Large-scale centralized cooling plants to reduce electricity use by up to 50% compared to conventional air conditioning.
c. Revival of “Mashrabiya”— a traditional wooden lattice screens that reduce indoor temperatures while maintaining airflow.
d. Use of high-albedo pavement and cool roofs to mitigate the urban heat island effect.




10.1.3 Impact

UAE's integration of ancient cooling wisdom with modern smart technology has significantly improved comfort and reduced energy costs in extreme heat.

10.2 Saudi Arabia – Heat Resilience During Hajj Pilgrimage

10.2.1 Background

Millions of pilgrims visit Makkah annually, often during intense summer heatwaves, requiring unique, large-scale heat management.

10.2.2 Best Practices

a. Installation of massive misting systems to provide evaporative cooling and reduce temperatures by up to 10°C.
b. Use of white marble and massive umbrella structures to provide shade.
c. Deployment of mobile clinics and surveillance systems to detect and treat heatstroke instantly.

10.2.3 Impact

These infrastructure-based strategies allow safe movement of millions in peak heat with minimal heat-related casualties.

10.3 Nigeria – Community-Based Awareness and Indigenous Cooling

10.3.1 Background

Northern Nigeria, especially states like Sokoto and Maiduguri, regularly face extreme heat above 45°C, affecting agriculture and public health.

10.3.2 Best Practices

a. Traditional technology uses two clay pots and sand to create evaporative cooling, preserving food and medicine in rural areas.
b. Promote shaded bus stops and marketplaces using cost-effective materials like woven palm fronds and corrugated iron sheets.

10.3.3 Impact

These low-tech, community-driven solutions have proven effective in increasing resilience and saving lives with minimal resources.

10.4 Egypt – Public Cooling and Urban Adaptation in Cairo

10.4.1 Background

Cairo faces increasing heatwaves intensified by dense urban sprawl and limited green cover.

10.4.2 Best Practices

a. Conversion of concrete rooftops into gardens, improving insulation and reducing local temperatures.
b. Cairo's transportation authority has equipped metro lines and new buses with air conditioning and solar-powered fans.
c. Shaded public spaces and water misting fans have been installed in collaboration with local authorities.

10.4.3 Impact

Egypt's hybrid approach of public-private innovation has improved urban resilience and public awareness of heatwave dangers.

10.5 India – Pune's Hyperlocal Heat Index and Ahmedabad's Cool Roofs

10.5.1 Background

India experiences some of the world's deadliest heatwaves, especially in central and western states.

10.5.2 Best Practices

a. White reflective roofing system to reduce indoor temperatures by up to 7°C.
b. Mobile tented shelters for street vendors and traffic police to offer relief during peak heat hours.

10.5.3 Impact

These practical and scalable solutions have not only saved lives but also serve as models for other developing regions facing heat extremes.

a. Implement water-saving techniques and collabourate with local authorities for sustainable water management.
b. Employ evaporative cooling techniques, such as wetting a cloth or mat, to naturally cool down spaces.

11. Heatwaves in Pakistan: Gap Analysis

i. Most risk assessments are generalized and fail to account for Pakistan's diverse geography and climate. Specific regions such as Sindh's urban centers (Karachi, Hyderabad) and rural areas (Tharparkar, Umerkot) experience vastly different heatwave impacts, requiring tailored strategies.
ii. Indigenous knowledge of coping with extreme heat, such as traditional housing designs (mud huts, ventilated structures) and cultural practices (use of lightweight clothing), is underutilized in urban planning and community-based interventions.
iii. Coordination between provincial and municipal authorities is weak, resulting in delayed responses and inefficient resource allocation during heatwaves. For instance, the lack of synchronization between Karachi Metropolitan Corporation (KMC) and Sindh’s provincial disaster management authorities was evident in past heatwave crises.
iv. Urban areas often rely on concrete-heavy designs that exacerbate the urban heat island (UHI) effect. Unlike international cities employing cool pavements and shaded corridors, Pakistani cities largely neglect such measures. Rural areas face challenges with non-heat-resistant housing that traps heat during extreme temperatures.
v. Pakistan's labour force, particularly outdoor workers (e.g., construction workers, farmers, and street vendors), is among the most vulnerable to heatwaves. Workplace safety regulations and heat-adaptive work practices (e.g., flexible work hours, cooling stations) are either absent or inadequately enforced.
vi. Women in rural areas often face additional burdens during heatwaves, such as increased water collection efforts and caregiving roles. Policies and interventions seldom address these gendered impacts, leaving women more exposed to heat-related risks.
vii. Cooling technologies, such as affordable fans or air conditioners, remain inaccessible to a significant portion of the population, particularly in low-income households. Public cooling centers are sparse, and their coverage is limited.

viii. Major urban centers lack basic hydration facilities like water fountains or kiosks in public spaces, which are vital for preventing heat-related illnesses during peak heat hours.
ix. Heatwave awareness campaigns are sporadic and fail to drive behavioral changes, such as the adoption of protective clothing, staying hydrated, and identifying early symptoms of heatstroke.
x. Limited accessibility of early warning alerts in remote areas like (Kaloorkot, Darya Khan, Sadiqabad, Khanpur, Kadhan, Golarchi, Yazman and Hasilpur).
xi. Limited climate-resilient urban planning (heat-absorbing concrete, lack of green spaces).
xii. Rural areas lack ambulance access for heatstroke patients
xiii. Lack of awareness campaigns/training (survival tactics) in rural areas.

12. Lessons learnt

12.1. Karachi, Sindh (2015 Heatwave)

i. Post-2015, the Sindh government and Karachi Metropolitan Corporation (KMC) began collabourating with NGOs to develop Karachi Heatwave Management Plan with early warning systems and public awareness components.
ii. Lack of coordination between KE (Karachi Electric), hospitals, and emergency responders in 2015 led to system failure. Post-event, drills and inter-agency coordination mechanisms were instituted.
iii. Establishment of temporary heat shelters in mosques, schools, and community centers, especially in high-risk districts like Korangi, Orangi, and Lyari.
iv. Utilization of SMS alerts, radio, and local TV for broadcasting heatwave warnings and precautions.

12.2. Southern Punjab (Multan, Bahawalpur, Dera Ghazi Khan)

i. After high admissions of heatstroke in Multan's Nishtar Hospital and Bahawal Victoria Hospital in Bahawalpur, cooling rooms and hydration wards were integrated into emergency preparedness protocols.
i. Focused public education in rural areas about recognizing early symptoms of heatstroke, dehydration, and first aid, using local languages and mosques.
ii. Based on repeated high heat incidents, schools and outdoor labour work in areas like D.G. Khan and Muzaffargarh are now often rescheduled or given holidays during red alerts.

12.3. Interior Sindh (Jacobabad, Sukkur, Larkana)

i. Jacobabad became part of international pilot programs (e.g., by IFRC and BBC Media Action) that tested locally tailored heat adaptation strategies.

ii. Due to gender vulnerability, special outreach to women in rural households on hydration, child care during heat, and cooking time adjustment was introduced.
iii. Use of whitewashed rooftops, mud insulation, and heat-resilient shelters tested and promoted in Larkana and nearby villages.

12.4. Balochistan (Turbat, Sibi, Dalbandin)

i. Events in Balochistan prompted government to include heatwaves in their provincial climate adaptation strategies
ii. Due to limited grid electricity, solar water coolers and dispensers were piloted in Turbat and Sibi.
iii. Improved meteorological coverage and forecasting in previously under-reported areas helped communities prepare better in advance.

12.5. Northern Areas (Islamabad, Rawalpindi, Peshawar)

i. Post-2021 heat events in Islamabad and Peshawar, urban tree plantation drives and rooftop gardening became part of local adaptation plans.
ii. The Islamabad Capital Territory (ICT) incorporated heatwaves in disaster management planning via NDMA guidance.
iii. After instances of student fainting in Peshawar and Rawalpindi schools, education departments started enforcing mandatory hydration breaks and relaxed uniforms.

13. Survival guide

Extreme heat can be fatal for people of all ages, including those with chronic illnesses, pregnant women, and the elderly. However, there are numerous actions we can do to shield our loved ones and ourselves from the heat.

i. Adopt cool roof technologies, such as reflective coatings and green roofs, to lower building temperatures.
ii. Avoid outdoor activities during peak heat hours.
iii. Stay hydrated by drinking plenty of water and natural juices (e.g., sattu, mint).
iv. Wear natural materials like cotton to stay cool.
v. Take baths with neem water to reduce body heat.
vi. Wear light-coloured to stay cool.
vii. Close curtains or blinds during the hottest part of the day to block out the sun's heat.
viii. Use high-SPF sunscreen/sunblock to prevent sunburn on your skin.
ix. Understand about the signs and symptoms of heat exhaustion and heatstroke, such as headache, nausea, fast heartbeat, and disorientation.
x. Encourage the use of energy-efficient appliances and lighting to reduce heat generation and lower energy costs.

14. Recommendations

i. Develop region-specific heatwave vulnerability maps using GIS and satellite data to tailor interventions.
ii. Integrate traditional cooling practices with modern design in rural and urban housing projects.
iii. Establish heatwave-specific task forces at municipal levels to coordinate early warnings, public awareness, and emergency responses.
iv. Invest in cool pavements, green roofs, and shaded pedestrian pathways to mitigate the UHI effect.
v. Introduce policies mandating heat-adaptive work hours, breaks, and shaded rest areas for outdoor workers.
vi. Ensure heatwave interventions address the unique needs of women, such as access to water and childcare facilities.
vii. Provide subsidies for affordable cooling technologies and establish public cooling centers in densely populated areas.
viii. Install water kiosks in urban and rural areas, particularly along high-traffic roads and in markets.
ix. Implement year-round campaigns targeting heatwave preparedness and early response, leveraging schools, mosques, and local media for outreach.

15. References

Ahmad, S. A. S. (2024). heat wave in pakistan: A burning issue. *Journal of Akhtar Saeed Medical & Dental College*, *6*(01).

Al Hurini, A., Nemmar, A., Moawad, K., Khan, R., & Muttappallymyalil, J. (2024). The Impact of Increased Heat on the Physical, Mental, and Social Health Domains of Adults in the United Arab Emirates in 2024. *Cureus*, *16*(12).

Brimicombe, C., Runkle, J. D., Tuholske, C., Domeisen, D. I., Gao, C., Toftum, J., & Otto, I. M. (2024). Preventing heat-related deaths: The urgent need for a global early warning system for heat. *PLOS Climate*, *3*(7), e0000437.

Hanif, U. (2017). Socio-economic impacts of heat wave in Sindh. *Pakistan Journal of Meteorology Vol*, *13*(26).

Karim, I., Fatima, M., & Ali, M. (2024). Alarming Heat Wave-2024: The summer season in Pakistan. *Pakistan Journal of Medical & Health Sciences*, *18*(2), 1-1.

Khan, U. R., Ahmed, N., Naeem, R., Khudadad, U., Masud, S., Khan, N. U., & Razzak, J. A. (2021). Heat emergencies: perceptions and practices of community members and emergency department healthcare providers in Karachi, Pakistan: a qualitative study. *International journal of environmental research and public health*, 18(9), 4736.

Khan, N., Shahid, S., Ismail, T., Ahmed, K., & Nawaz, N. (2019). Trends in heat wave related indices in Pakistan. *Stochastic environmental research and risk assessment*, 33, 287-302.

Mehiriz, K. (2024). The effects of attitudes, norms, and perceived control on the adaptation of elderly individuals and individuals with chronic health conditions to heatwaves. *BMC Public Health*, *24*(1), 256.

Okada, Y., Hughes, F., & Ong, M. E. H. (2024). We need better preparedness and emergency responses to heat waves. *Canadian Journal of Emergency Medicine*, *26*(2), 73-74.

Qamar, W., Qayum, M., Nisa, W. U., Khaleeq, N., & Ali, A. (2024). Promoting transdisciplinary collabouration in academia: uniting for climate-resilient health. *Frontiers in Climate*, *6*, 1304643.

Ravindra, K., Bhardwaj, S., Ram, C., Goyal, A., Singh, V., Venkataraman, C., ... & Mor, S. (2024). Temperature projections and heatwave attribution scenarios over India: A systematic review. *Heliyon*, *10*(4).

Shah, S. K., Gao, Y., Ahmad, K., Khan, A., & Siddiqui, N. Climate Change and Urban Planning in Pakistan Vulnerabilities, Impacts, and Mitigation Strategies. *Impacts, and Mitigation Strategies*.

Thaker, J., Painter, J., Borwankar, V., Jain, G., & Negi, K. (2024). English and Regional Media Coverage of the 2022 Heatwave in India. *Environmental Communication*, 1-17.

Zhang, J., Chen, H., Fang, X., Yin, Z., & Hu, R. (2024). Warming-induced hydrothermal anomaly over the Earth's three Poles amplifies concurrent extremes in 2022. *npj Climate and Atmospheric Science*, *7*(1), 8.

Economic Effects of Climate Change-Induced Loss of Agricultural Production by 2050: A Case Study of Pakistan

Appendix

Heatwave Anticipatory Actions

Responder	AAs Matrix
Individuals	**1. Stay informed about local heatwave warnings and advisories:** • Individuals should stay updated on heatwave warnings issued by local authorities and take appropriate precautions to stay safe during extreme heat events. **2. Prepare a heatwave emergency kit:** • Individuals should prepare an emergency kit that includes items such as water, electrolyte beverages, sunscreen, hats, and light-coloured clothing to stay hydrated and protected from the sun during heatwaves. **3. Stay indoor during peak heat hours:** • Individuals should avoid outdoor activities during peak heat hours and seek shelter in air-conditioned or well-ventilated spaces to prevent heat-related illnesses. **4. Check on vulnerable neighbours:** • Individuals should check on neighbours, especially the elderly, children, and those with chronic illnesses, to ensure they are coping with the heatwave and offer assistance if needed.
Households	**1. Install and maintain air conditioning or fans:** • Households should install and maintain air conditioning units or fans to provide relief from the heat indoors during heatwaves. **2. Create a cool room or area:** • Households can designate a cool room or area in the home where family members can retreat during extreme heat events, equipped with fans or air conditioning. **3. Stay hydrated and stock up on emergency supplies:** • Households should stock up on plenty of water and electrolyte beverages to stay hydrated during heatwaves and ensure an adequate

	supply of emergency supplies such as non-perishable food and first aid items. 4. **Protect windows and doors from direct sunlight:** • Households should use blinds, shades, or reflective window films to block out direct sunlight and reduce indoor temperatures during heatwaves.
Local Community	1. **Establish cooling centres:** • Local communities can set up cooling centres in public buildings such as community centres or libraries to provide relief from the heat for residents without access to air conditioning. 2. **Organize outreach programs for vulnerable populations:** • Community organizations can organize outreach programs to educate vulnerable populations about the dangers of heatwaves and provide assistance, such as distributing fans or arranging transportation to cooling centres. 3. **Promote water distribution initiatives:** • Communities can organize water distribution initiatives during heatwaves to ensure that residents have access to clean drinking water, especially those experiencing water scarcity. 4. **Coordinate volunteer efforts:** • Community organizations can coordinate volunteer efforts to conduct wellness checks on vulnerable residents, distribute water and supplies, and provide transportation to cooling centres during heatwaves.
Area Disaster Management Authority	1. **Develop heatwave emergency response plans:** • Disaster management authorities should develop comprehensive heatwave emergency response plans that outline protocols for heatwave warnings, cooling centre operations, and public outreach strategies. 2. **Monitor heatwave forecasts and issue warnings:**

	• Authorities should monitor weather forecasts for heatwave conditions and issue timely warnings and advisories to residents, along with recommendations for staying safe during extreme heat events. 3. **Coordinate with healthcare facilities:** • Disaster management authorities should coordinate with local healthcare facilities to ensure they are prepared to handle an increase in heat-related illnesses and provide medical assistance during heatwaves. 4. **Provide resources for heatwave mitigation:** • Authorities should allocate resources for heatwave mitigation measures such as urban greening initiatives, cool roof programs, and distribution of heat-relief items to vulnerable populations.
Provincial Disaster Management Authority	1. **Formulate heatwave-specific response plans:** • Provincial disaster management authorities should develop and implement heatwave-specific response plans tailored to the needs of medium-density localities, including protocols for heatwave warnings, heat-related health services, and public communication strategies. 2. **Coordinate with local municipalities and communities:** • Authorities should ensure effective coordination between municipalities and communities within localities to streamline response efforts, share resources, and disseminate information about heatwave preparedness and response measures. 3. **Implement heatwave resilience measures:** • Provincial authorities should implement measures to enhance heatwave resilience in medium-density localities, such as improving access to cooling centres, promoting urban green spaces, and conducting heat risk assessments to identify vulnerable areas. 4. **Conduct training and capacity-building initiatives:**

	• Authorities should organize training sessions and capacity-building initiatives for local emergency response teams, healthcare professionals, and community volunteers to enhance their readiness to respond effectively to heatwave emergencies.
Provincial Government **(Related Departments)**	**1. Department of Health:** • Ensure healthcare are equipped to handle heat-related illnesses and emergencies during heatwaves, including adequate staffing, medical supplies, and cooling facilities. **2. Department of Urban Planning:** • Collabourate with local municipalities to integrate heatwave resilience measures into urban planning strategies, such as designing heat-resilient infrastructure, implementing cool pavement technologies, and enhancing green spaces. **3. Department of Agriculture:** • Provide guidance and support to farmers and agricultural communities in medium-density localities to mitigate the impact of heatwaves on crops, livestock, and agricultural productivity through measures such as water conservation, shade provision, and heat-tolerant crop varieties. **4. Department of Environment:** • Implement measures to reduce the urban heat island effect in medium-density localities, such as planting trees, increasing vegetation cover, and promoting sustainable land use practices to mitigate the intensity of heatwaves.
Area Military Formations	**1. Logistical support and assistance:** • Provide logistical support for the distribution of heat relief supplies, such as water, sunscreen, and cooling equipment, to the localities during heatwave emergencies. **2. Emergency response operations:** • Assist local authorities in conducting emergency response operations, including evacuations, heat-related medical assistance,

	and welfare checks on vulnerable populations in areas affected by heatwaves. 3. **Community engagement and awareness:** • Collabourate with local law enforcement agencies and community organizations to raise awareness about heatwave risks and promote heat safety measures among residents through community outreach programs and educational campaigns. 4. **Training and capacity-building:** • Conduct joint training exercises with local emergency response teams and healthcare professionals to enhance their capacity to respond effectively to heatwave emergencies.
Law Enforcement Office	1. **Traffic management and safety:** • Manage traffic and ensure the smooth flow of vehicles, especially during evacuations and emergency response operations in the localities affected by heatwaves, to minimize congestion and ensure public safety. 2. **Enforcement of heatwave safety regulations:** • Enforce heatwave safety regulations, such as restrictions on outdoor activities during extreme heat conditions and enforcement of heat-related health advisories, to protect the health and well-being of residents. 3. **Community policing and support:** • Collabourate with community policing initiatives to engage with residents, address concerns, and provide support to vulnerable populations, including the elderly, children, and individuals experiencing homelessness, during heatwave emergencies. 4. **Security planning and coordination:** • Collabourate with local businesses, security firms, and community organizations to develop security plans and coordination mechanisms to prevent heatwave-related incidents, such as looting or vandalism.
National Disaster	1. **24/7 Activation of NEOC**

Management Authority	• Operationalization of a National Emergency Operations Centre (NEOC) is a strategic and dynamic process aimed at transforming a designated facility into a fully functional hub for managing and coordinating responses to national emergencies and disasters. **2. Dissemination of SITREPS** • SITREPS are being issued timely (on hourly or 2-hourly basis) to the respective Districts / Provinces to coordinate response. **3. Satellite and On Ground Monitoring** • Satellite and on ground monitoring and Reconnaissance Heatwave effected sites. **4. Risk Assessment and Mapping** • Conduct comprehensive risk assessments for Heatwave areas, identifying potential hazards and vulnerabilities. • Develop hazard maps and vulnerability assessments to guide anticipatory actions. **5. Dissemination of Timely Warnings to all stakeholders** **6. Policy Formulation** • Formulate policies and guidelines for disaster management in Heatwave prone Areas, addressing the unique challenges posed by such environments. • Ensure that national policies consider both prevention and response measures. **7. Capacity Building Trainings** • Facilitate training programs for emergency responders, local authorities, and relevant stakeholders on Heatwave disaster preparedness, response, and recovery. • Enhance the capacity of local communities to respond effectively to Heatwave emergencies. **8. Coordination with Sub-National Authorities** • Collabourate with provincial, regional, and local disaster management authorities to ensure a coherent and synchronized approach to disaster management. • Share information, resources, and best practices to enhance overall preparedness.

	9. Resource Allocation and Logistics • Allocate resources for the procurement of specialized equipment, technology, and supplies needed for disaster management. • Coordinate logistics for the rapid deployment of resources to affected areas during emergencies. **10. International Cooperation** • Collabourate with international organizations and neighboring countries to share information, resources, and expertise. • Participate in joint exercises and initiatives for cross-border disaster response. **11. Post-Disaster Recovery and Rehabilitation** • Develop strategies and plans for post-disaster recovery & rehabilitation. • Coordinate support affected communities in rebuilding their lives.
Federal Government **(Related Ministries)**	**1. Ministry of Health:** • Coordinate with healthcare providers to ensure the availability of medical resources, including heat-related illness treatment protocols, medications, and medical equipment, to respond effectively to heatwave emergencies. **2. Ministry of Environment:** • Implement measures to address climate change and urban heat island effects, such as promoting green infrastructure, sustainable urban planning, and heat-resilient building designs, to mitigate the impact of heatwaves on communities. **3. Ministry of Interior:** • Coordinate national responses to heatwave emergencies, including the deployment of emergency personnel, equipment, and resources, to support local authorities in managing heatwave-related incidents and ensuring public safety. **4. Ministry of Finance:** • Allocate funds for heatwave preparedness, response, and recovery efforts, including

	infrastructure upgrades, public health initiatives, and community resilience programs, to enhance the country's resilience to heatwave events.
Academia	**1. Research and development:** • Conduct research on heatwave dynamics, climate modelling, and adaptation strategies to improve understanding of heatwave risks and inform evidence-based policies and interventions. **2. Education and outreach:** • Provide educational programs and outreach activities to raise awareness about heatwave risks and promote heat safety measures among the public, including schools, communities, and vulnerable populations. **3. Technical assistance and expertise:** • Offer technical assistance and expertise to government agencies, NGOs, and community organizations in developing heatwave preparedness and response plans, conducting risk assessments, and implementing resilience-building initiatives. **4. Collabourative partnerships:** • Collabourate with national and local governments, NGOs, and other stakeholders to develop interdisciplinary research projects, share best practices, and foster innovation in heatwave preparedness and response strategies.
NGOs	**1. Community-based initiatives:** • Implement community-based initiatives to build resilience and promote adaptive strategies among vulnerable populations, including the elderly, children, and low-income communities, to reduce heatwave-related health risks and impacts. **2. Advocacy and policy engagement:** • Advocate for policies and regulations that prioritize heatwave preparedness, mitigation, and adaptation measures, including investments in green infrastructure, public

	health programs, and social safety nets, to protect communities from heatwave hazards. 3. **Capacity-building and training:** • Provide capacity-building workshops, training sessions, and technical assistance to local authorities, community organizations, and frontline responders to enhance their capacity to prepare for, respond to, and recover from heatwave emergencies. 4. **Public awareness campaigns:** • Conduct public awareness campaigns and communication initiatives to raise awareness about heatwave risks, heat safety tips, and available resources and support services, empowering individuals and communities to take proactive measures to protect themselves during heatwave events.
Development Partner Organizations	1. **Funding support for heatwave resilience projects:** • Provide financial support and funding opportunities for heatwave resilience projects, including infrastructure upgrades, capacity-building programs, research initiatives, and community-based interventions aimed at reducing heat-related risks and enhancing adaptive capacity. 2. **Technical assistance and knowledge exchange:** • Offer technical expertise, knowledge exchange platforms, and capacity-building workshops to support government agencies, NGOs, and local communities in developing and implementing effective heatwave resilience strategies, leveraging international best practices and lessons learned. 3. **Support for data collection and analysis:** • Assist in data collection, monitoring, and analysis efforts related to heatwave impacts, vulnerability assessments, and early warning systems, providing technical tools, methodologies, and resources to enhance the understanding of heatwave risks and inform evidence-based decision-making.

	4. **Promotion of cross-sectoral collabouration:** • Facilitate multi-stakeholder collabouration and partnerships between government agencies, civil society organizations, private sector entities, and academic institutions to foster innovation, knowledge sharing, and collective action in addressing heatwave resilience challenges and promoting sustainable development.
Humanitarian Organizations Representatives	. 1. **Emergency relief and support services:** • Provide emergency relief assistance, including food, water, shelter, and medical care, to populations affected by heatwave emergencies, particularly vulnerable groups such as refugees, internally displaced persons, and communities living in informal settlements. 2. **Collabouration with local authorities and partners:** • Collabourate closely with local authorities, NGOs, community-based organizations, and other stakeholders to assess needs, coordinate response efforts, and deliver timely and appropriate assistance to heatwave-affected communities, ensuring a coordinated and effective humanitarian response. 3. **Advocacy for vulnerable populations:** • Advocate for the rights and well-being of vulnerable populations impacted by heatwaves, including the elderly, children, people with disabilities, and marginalized groups, by raising awareness about their specific needs and advocating for inclusive policies and programs to address heat-related risks. 4. **Capacity-building and resilience-building initiatives:** • Support capacity-building and resilience-building initiatives in heatwave-prone areas, including training programs, community-led projects, and awareness campaigns aimed at

	enhancing preparedness, reducing vulnerability, and strengthening adaptive capacity to heatwave events.
DRR Media	**1. Dissemination of heatwave risk information:** • Disseminate timely and accurate information on heatwave risks, early warning alerts, and protective measures through various media channels, including television, radio, social media, and mobile platforms, to reach diverse audiences and raise awareness about heat-related hazards. **2. Public education and awareness campaigns:** • Conduct public education and awareness campaigns on heatwave preparedness, heat safety tips, and health risks associated with extreme heat, utilizing multimedia platforms, community events, and educational materials to promote heatwave resilience and behavior change. **3. Storytelling and community engagement:** • Amplify community voices and experiences through storytelling, interviews, and community engagement initiatives that highlight local perspectives on heatwave impacts, adaptive strategies, and resilience-building efforts, fostering empathy, solidarity, and collective action. **4. Collabouration with stakeholders and authorities:** • Collabourate with government agencies, NGOs, academic institutions, and local authorities to ensure accurate and consistent messaging, facilitate data sharing, and strengthen communication networks for heatwave early warning dissemination, emergency response coordination, and public outreach efforts.