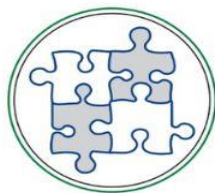


# HEATWAVE MANAGEMENT PLAN OF LAHORE (2025-2028)



**The Urban Unit**

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.





# Heatwave Management Plan of Lahore (2025-2028)

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# Abbreviations



CRI	Climate Risk Index
DC	Deputy Commissioner
EPD	Environment Protection Department
GLOF	Glacier Lake Outburst Floods
IPCC	Intergovernmental Panel on Climate Change
MC	Municipal Corporations
MCDA	Multicriteria Decision Analysis
MODIS	Moderate Resolution Imaging Spectroradiometer
NCCP	National Climate Change Policy
NDMA	National Disaster Management Authority
NDBI	Normalized Difference Built up Index
NDVI	Normalized Difference Vegetation Index
NGOs	Non-governmental Organizations
PCCA	Pakistan Climate Change Council
PCCC	Pakistan Climate Change Council
PDMA	Provincial Disaster Management Authority
PMD	Pakistan Meteorological Department
RO Filtration Plant	Reverse Osmosis Filtration Plants
UHI	Urban Heat Islands
WASA	Water and Sanitation Authority
WHO	World Health Organization
WMO	World Meteorological Organization



# Executive Summary

# Executive Summary

Climate change is increasing the risk of being exposed to extreme heat. The prospect of extended and more severe summer heatwaves is concerning for densely populated cities, with extended built-up that keep the environment hotter due to the "urban heat island effect." The global warming has specifically affected 0.005 billion people due to heatwave, with 225,600 fatalities for the duration of (1993-2022).

Swathes of Pakistan have been smothered by temperature peaks since late April, in extreme weather conditions. According to the Global Climate Risk Index (CRI) published by the non-profit group Germanwatch, Pakistan is the top most vulnerable nation in the world when it comes to the effects of climate change over the past two decades.

Lahore city experienced recent heatwaves with temperatures reaching 45°C, with a persistent increase of 05 to 07 °C above normal temperature, between late April and during May, 2025. The city has seen an outbreak of Cholera and Diarrhea as a result of the heatwave 2025. On April 15, April 25, May 14, and May 19, 2025, the National Weather Forecasting Center Islamabad issued a series of heatwave warnings. The Lahore's climatic history has also showed extreme heatwave events in last two decades. Therefore, a systematic heatwave management plan is prepared by Urban Unit Environment Team to address the issue. The Urban Unit now has developed a heatwave management plan which is advised to manage and mitigate climatic extreme events like heatwaves.

The plan is prepared after conducting a comprehensive survey related to the community perception, and risk assessment of the related water supply assets. The hotspot areas with heatwave risk were identified through remote sensing data analysis for vulnerability, hazard, and exposure indicators. Extendedly, preparedness of the survey points was analyzed, considering the local factors for available resources (green spaces, medical services, and sustainable water infrastructure) along with public awareness to mitigate impacts of heatwave. Overall, this heatwave plan outlines the state of existing infrastructure in the hotspot areas along with what should happen before, during, and after the periods of heatwaves. It also sets out strategies and actions that government and other key stakeholders could take together to prevent the impacts of extreme heat events. This heatwave management plan will be implemented for three years (2025-2028) and contains the cost of key interventions which is 23.34 million PKR.



# Contextual Review: **Heatwaves In Lahore**

# Overview

The increasing instability of the global climate system is potentially intensifying the climate variability and the frequency and intensity of extreme climatic events have been significantly increased. Deadly heatwaves are one of them!

## 1.1. Heatwaves; When extreme heat becomes a health threat

A heatwave (HW) is typically defined as a prolonged period (usually several consecutive days) when the temperature exceeds predetermined thresholds. Its precise definition varies greatly across different regions.

Pakistan follows World Meteorological Organization (WMO) definition of heatwave, that describes it as a

**‘Climatic event which occurs when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5 °C’ [1].**

The Intergovernmental Panel on Climate Change (IPCC) recent special report on ‘1.5 Degrees Celsius Global Warming’ reported that human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate [2]. This climatic change has been substantially observed in Pakistan, specifically in southern and central regions, where the frequency and intensity of heatwaves are accelerated for the past few years, potentially impacting the local and regional environment, particularly in the health and economic sector.

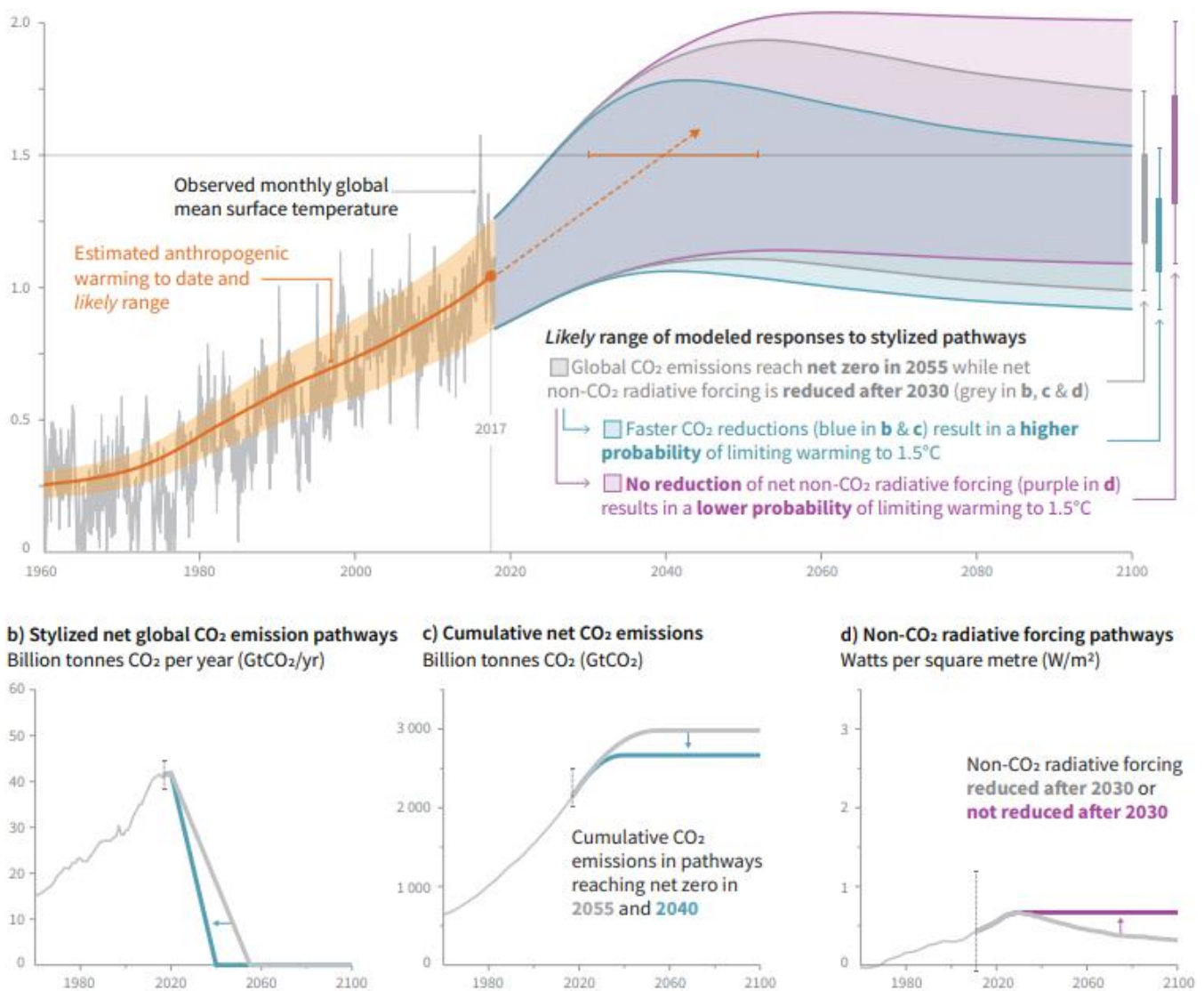


Figure 1: Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways (IPCC, 2022)

A heatwave begins when a high atmospheric pressure system settles over an area, sometimes triggered by disturbances halfway around the world. The high-pressure system compresses and heats up the air while squeezing out clouds. Without clouds above, sunlight hits the land below directly, stripping away moisture that would otherwise help cool the air. As the pressure builds up, the sun bakes the ground more, and over the course of days, heat accumulates.

## 1.2. The Growing Threat of Extreme Heat

The climate change impacts are increasingly showing definitive place in the form of global warming, which is getting profound in last two decades. Excessive emission of GHGs is constantly contributing to extreme temperature, leading to effects like; heatwaves, floods and variation in rainfall pattern. The average of annual recorded global temperature variation (Global Land-Ocean Temperature index) [3] showed the increase of 1.28°C for 2024, which is 1.47°C higher as compared to the (1859-1900) 19th century average temperature of pre-industrial era. The South Asian countries in this context are more vulnerable to the global warming because of fragile fiscal position [4]. The climate risk index (CRI) has categorized Pakistan among top ten most vulnerable countries that are affected by the climate change events, and at the 1st spot in the overall CRI ranking of 2022 [5] that was previously 56th for the tenure of (1993-2022). The heatwave is studied to get 30 times more intensified due to climate change i.e., the heatwave span of 2022 that lasted for the tenure of three months from March-May 2022 in which temperature was recorded to be 47°C to 49.5°C. This heatwave was extensively observed in the India and Bangladesh resulted 90 casualties collectively in all countries. The warming strips in (Figure 1) indicate the variation of temperature over the years from (1875-2024), with prominent high temperature (red strips) from 2000 onwards. The specified deliberation of the constantly increasing temperature for the Lahore city is provided in (Figure 2). The temperature strips for the last two decades have shown constant upsurge in the form of red color indicating higher temperature from (2000-2024), with the maximum rise of 1.5°C in average temperature.

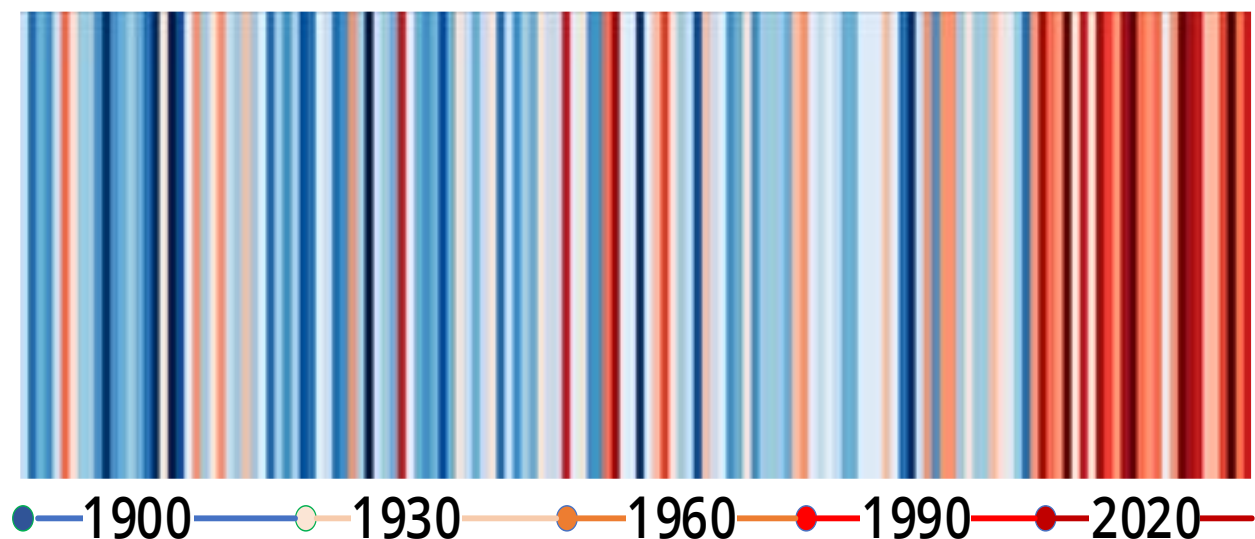


Figure 2: Ed-Hawkins Warming Strips of the Lahore City

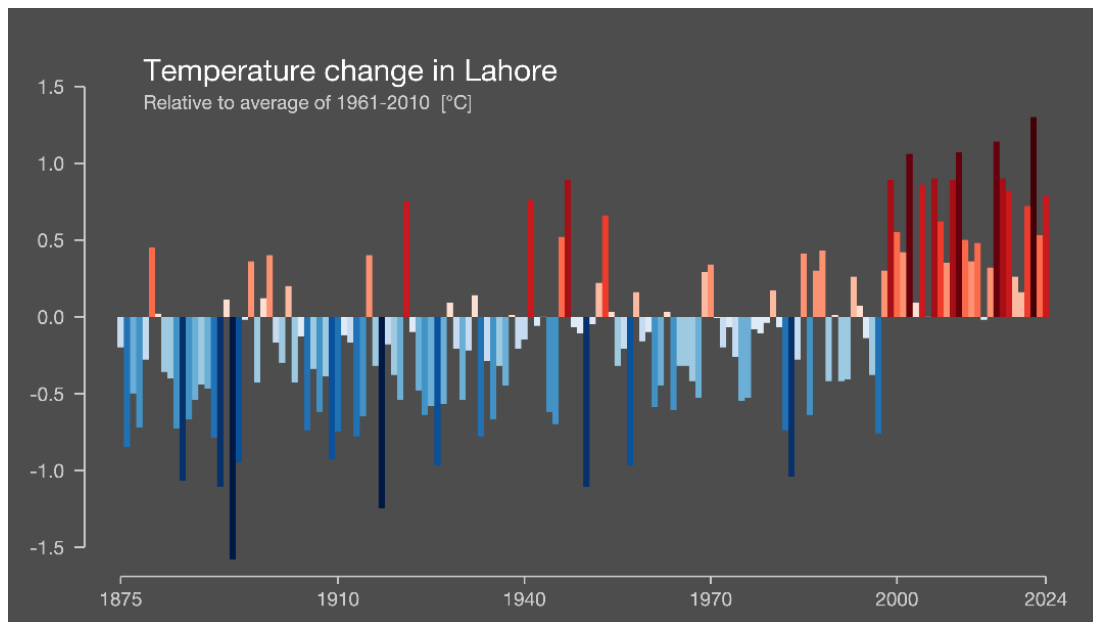


Figure 3: Temperature variation for the tenure of (1875-2024) [6]

The Urban heat island (UHI) effect in the context of heatwave is considerable factor specifically for the major cities (i.e., Lahore and Karachi) of Pakistan. Massive buildings entrap heat that is likely to increase the daytime temperature to almost (0.6-3.9 °C), and (1.1-2.8°C) increase for nighttime temperature. The lack of green spaces and the unplanned development are additional factors that contribute to the heatwave.

The social assessment study of heatwave in Pakistan showed that there are three major contributing factors to the heatwave that include; Climate change (37.4%), Urbanization (16.1%) and deforestation (45.8%). Which emphasize the importance of green spaces for the inclusive reduction of increasing temperature and global warming in general [7]

### 1.3. The Scorching Reality: Current State and Vulnerability of Lahore to Heatwaves

This study is focusing on Lahore city, located on the eastern bank of the river Ravi, covering 1772 km<sup>2</sup> of area. The intensity and frequency of extreme climatic events such as excessive rainfall, heatwaves, and flash floods have increased in the city [8].

Recent report on climate change in urban centers of Punjab, highlighted that the historic data shows Lahore has experienced extreme temperature changes, with the overall temperature increase of 2.08°C [9] as compared to previous years, categorizing it 7<sup>th</sup> in the list of the urban center with worst case temperature scenario. The previous records of heatwave events in Lahore shows that the in 2022, from April 20 to May 20 temperature

increased to the maximum of 49°C, resulted significant health impacts. The intensity and frequency of extreme climatic events such as excessive rainfall, heatwaves, and flash floods have increased in Lahore city.

One of the major reasons for extreme heat events in Lahore is an uncontrolled and unplanned urban expansion that has detrimental impacts on the urban green spaces of the city which are not even vanishing at a very fast pace but also resulting in higher land surface temperature in the concrete areas. The below figure exhibits the increase in the built area of Lahore city from 2014– 2024.

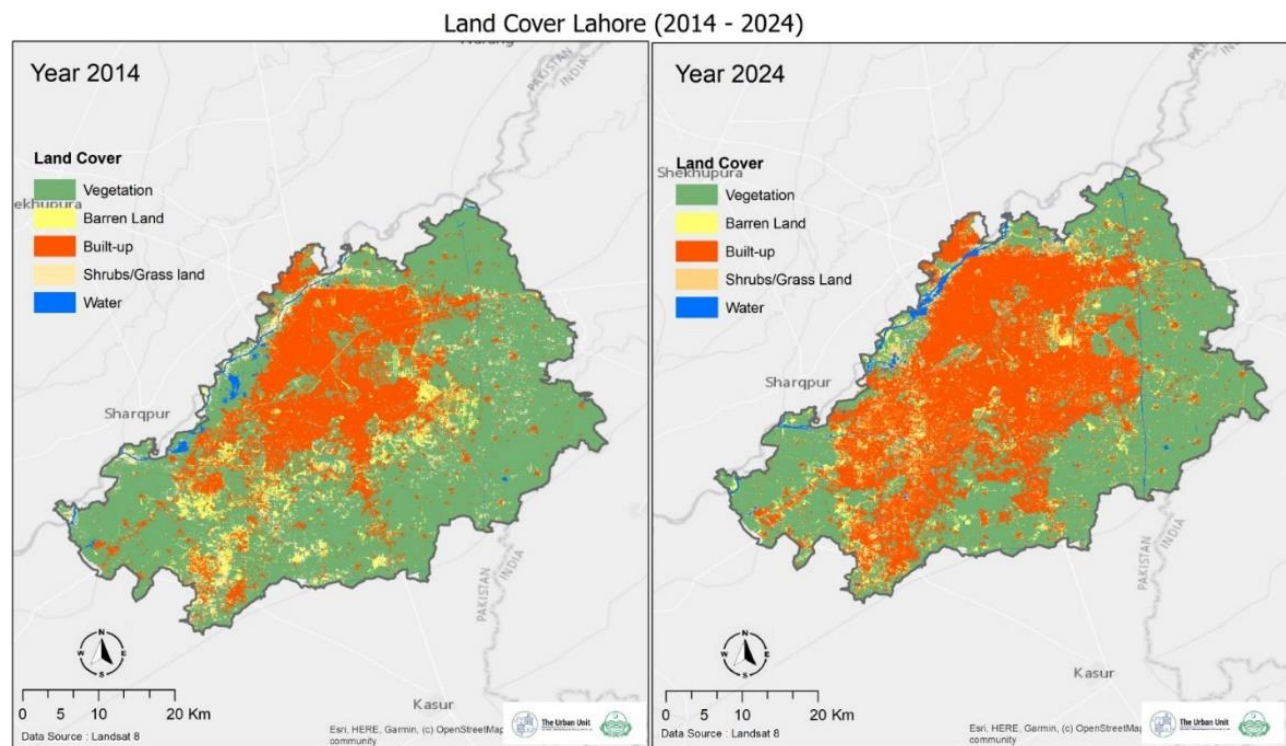
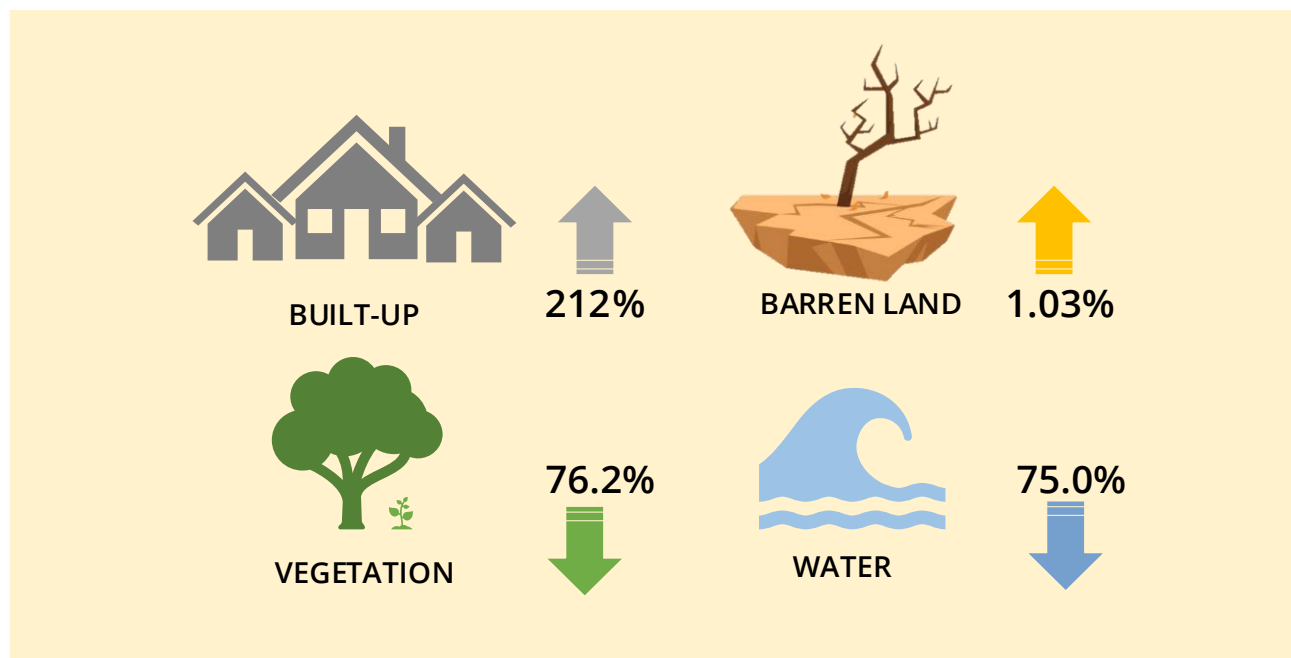


Figure 4: Landcover Change in Lahore (2014 -2024) (The Urban Uni- 2025)

The comparison of landcover changes in Lahore city from 2014 to 2024 showed an increase in buildup from 297 km<sup>2</sup> in 2014 to 927 km<sup>2</sup> in 2024. The vegetative cover has consequently got impacted with major decline from 769.6 km<sup>2</sup> in 2014 to just 182.8 km<sup>2</sup> in 2024, leading to the increase in barren land from 591.1 km<sup>2</sup> in 2014 to the 597.2 km<sup>2</sup> in 2024. The availability of water also got impacted from excessive urban load leading to the decline from 90.1 km<sup>2</sup> in 2014 to 22.5 km<sup>2</sup> in 2024.



The temperature variation during summers in Lahore stresses substantial issuance of several health advisories/heatwave alerts in Lahore. The frequency and intensity are now accompanied with another increasing factor i.e., duration of heatwaves. Current extreme heat events are prolonged in nature and causing water stress on water (reservoirs), crops, vegetable and orchards, increased energy and water demand, higher vulnerability to health-related illnesses and reduction in water base flow.

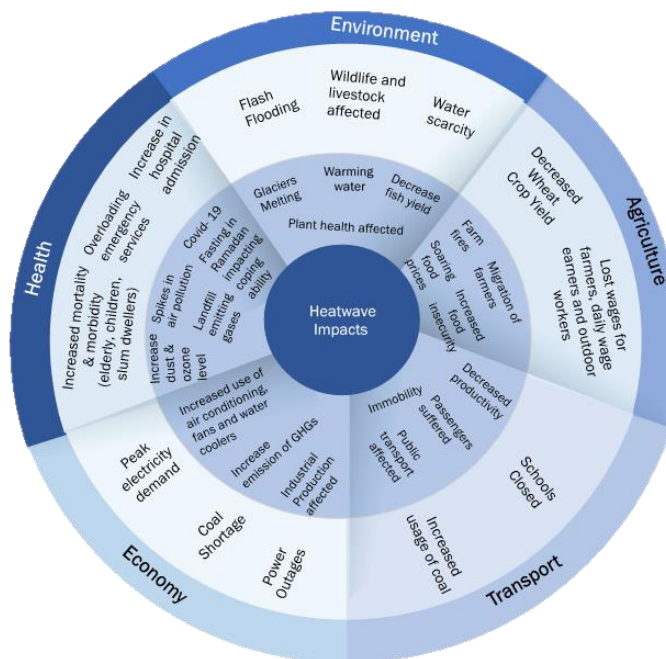


Figure 5: Conceptual Design of Impact Pathways in Pakistan (WMO)



# Heatwaves Risk Assessment of Lahore

# Heatwave Risk Landscape: Current State assessment of Lahore

The current state assessment of Lahore city is described below in detail, elucidating the methodological approach and the resultant outcomes;

## 2.1. Urban heat Risk Assessment

The risk assessment integrates multiple factors that range from land surface temperature and green cover to the social aspects of the relevant community, each parameter holds substantial weightage in the overall results. In consideration of the Lahore city which is well-known for the extensive urban expansion, dense population, traffic congestion, and bad quality of environment due to overload on the unplanned settlements. The environmental injustice coupled with poor socio-economic status increases the risk of heat impact on the community. The underling conditions are important to investigate the associated impacts of the heatwave in relation to the areas that are likely to be at more risk [10]. The method for the risk assessment comprehensively considered indicators (i.e., NDVI, urban sprawl, specific age group) for the categories of heat vulnerability, hazard and exposure.

### 2.1.1. Heat vulnerability

The heat vulnerability of Lahore city is presented in (Figure 2), that considered five key indicators to quantify the vulnerability index. The measured indicators comprise of environmental conditions as NDVI for understanding of the density and health of green cover, along with the social consideration of vulnerable age group (elders and children), in extreme conditions access to health facilities and the vulnerable areas with minimal facilities (slums). The results of the spatial analysis shows that almost half of the area is susceptible to vulnerability conditions from moderate to highest value. The low

vulnerability is however was dominantly observed in the northern Lahore for the Nishtar and Wahga town due to more green spaces, less susceptible communities and areas.

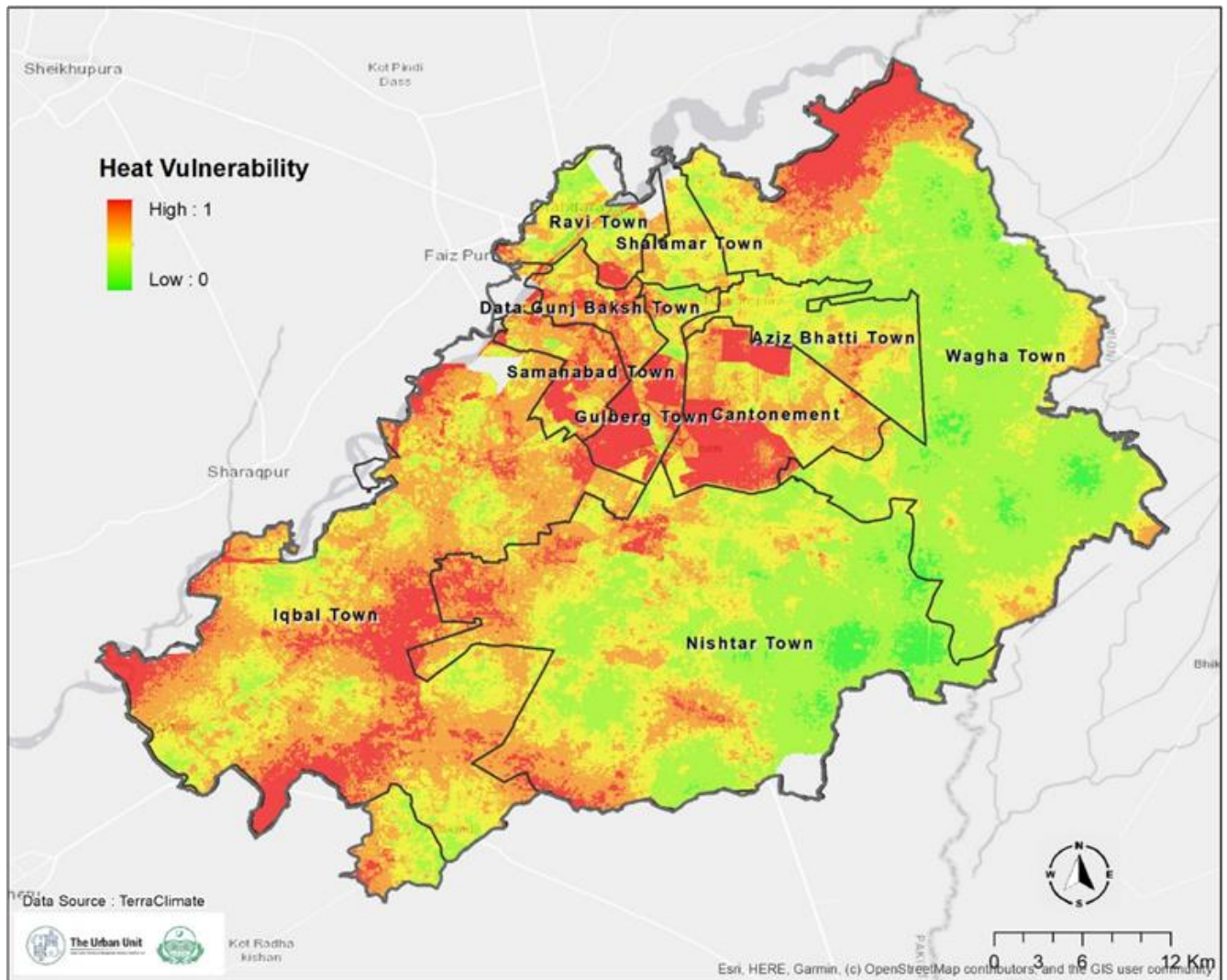


Figure 6: Heat Vulnerability of Lahore City

### 2.1.2. Heat Hazard

The hazard of urban heat was measured according to the three indicators that includes Land surface temperature (LST), Urban Heat Island (UHI), and Built-up. The surface temperature was considered for the association of the high temperature to the urban heat. However, the UHI intensifies the heatwave because of entrapping extra heat in buildings (built-up) which is the factor responsible for UHI. The outcomes of the analysis provided in (Figure 3) demonstrate the highest hazard for the central zones that are compacted with high built-up that lead to more entrapped and resultantly high temperature. Areas of

almost all towns are categorized to be in heat hazard zones, except for the minimal zone of Wahga town that is least hazardous for urban heat effect.

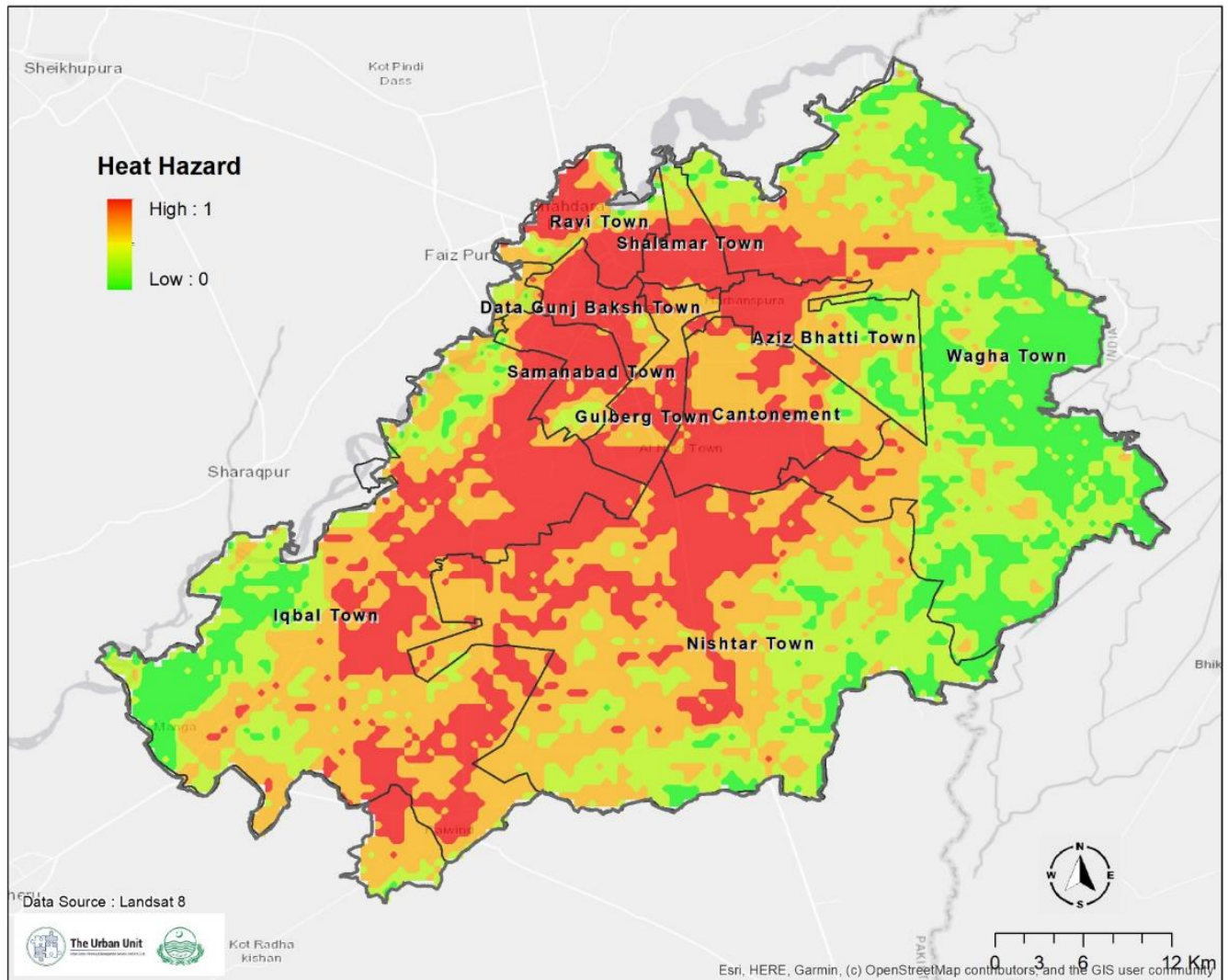


Figure 7: Urban Heat Hazard of Lahore City

### 2.1.3. Heat Exposure

The exposure to the heat in Lahore city as an urban center was quantified for the intensity of the urban activities at night (Night light time) NLT, along with population density and Land use Landcover (LULC), which specifically highlights the impact of reducing natural cooling because of increasing built-up or improper land use. The heat exposure of the city is presented in (Figure 4) that illustrates the spatial spread of heat exposure. The analysis shows that the exposure to heat is relevantly less for the city, and centralized to the congested settlements. The towns with large areas are comparatively less exposed to heat, due to considerably more spacious, and defined zones

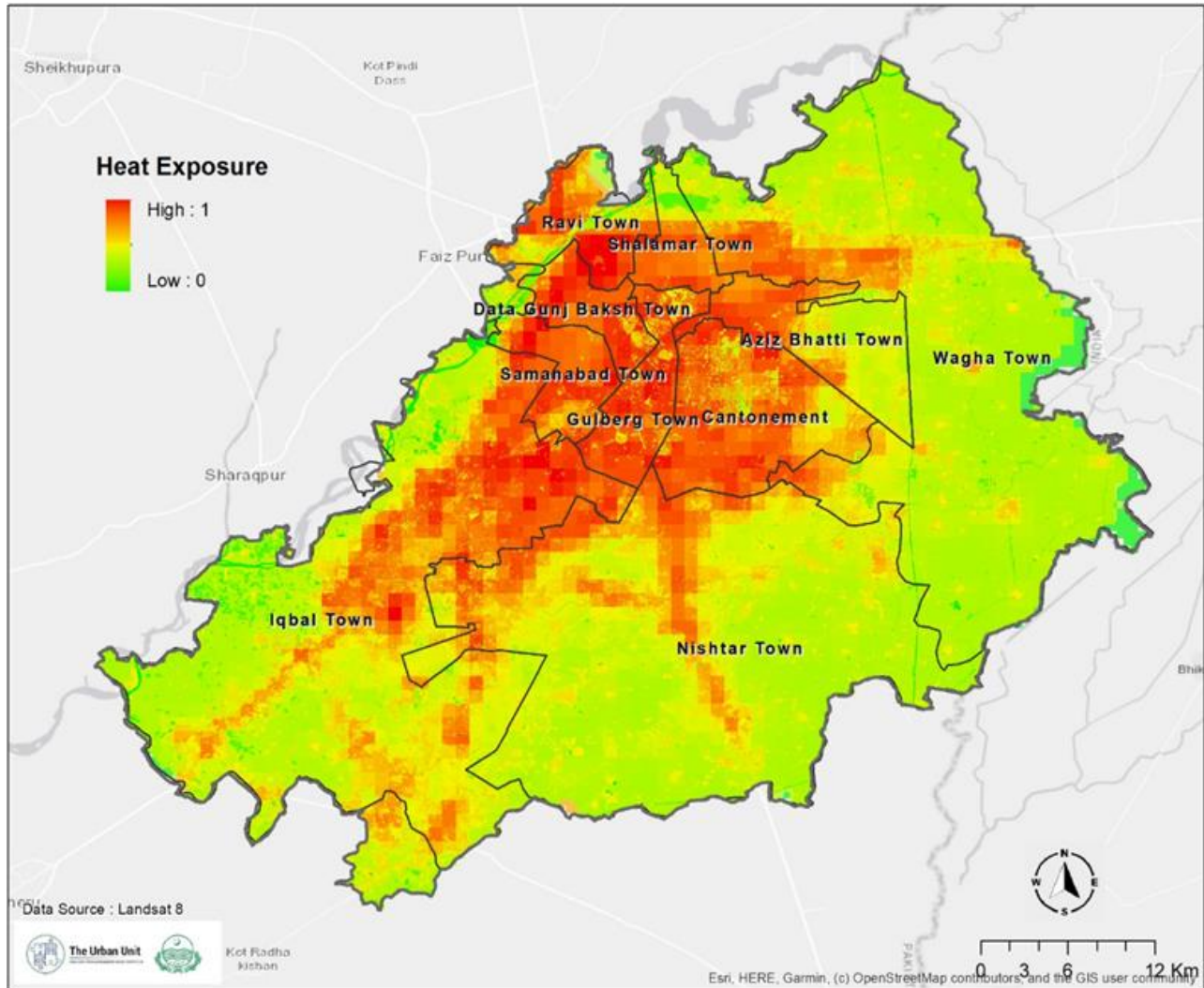


Figure 8: Urban Heat exposure of Lahore City

The comprehensive understanding of the heat risk was further analyzed in collective consideration of the factors. The heat risk is presented in (Figure 6) as the product of the heat hazard, exposure and vulnerability. The methodology was followed as per the studied literature used for spatial analysis of the urban heat vulnerability and risk [11] The communal risk of heat for city was also found to be significant encompassing areas from almost all town with the moderate to higher risk factor for the central towns. The areas on peripheries of the Lahore are relevantly less populated, and have less build-up which makes it spacious enough to be considered as low risk zones.

The tabular explanation of the factors along with the indicators are also explained in (Table 1), with the specified category, its associated indicators and justified reasoning of the consideration in risk assessment.

Table 1: Specifications for the Urban Heat risk assessment

Urban Heat risk assessment		Hazard*Exposure*Vulnerability
Category	Indicator	Rationale
<b>Hazard assessment</b>	Land Surface Temperature (LST)	High temperature exuberates urban heat island effect
	Urban Heat Island (UHI)	Identifies urban areas with intensified heat stress
	(NDBI) Built-up Index	Built-up areas intensify heat hazard b reducing natural cooling
<b>Exposure assessment</b>	Population Density	High population are more exposed to heat-related risk
	Night Light Time (NLT)	Urban density and activity amplify heat exposure
	Land Use Land Cover (LULC)	Build-up and barren lands intensify heat vulnerability b reducing natural cooling
<b>Vulnerability assessment</b>	NDVI	Low vegetation reduces cooling and increases the vulnerability to heat
	% Of Elderly population	More vulnerable to heat stress
	% Of Children population	More vulnerable to heat stress
	Health Facilities Access	Ensures heat facilities are located to manage heat related illnesses.
	Slums	informal settlements lack adaptive capacity, increases vulnerability to heat stress

The heat risk assessment further revealed that the central and south-western parts of the city, including Ravi Town, Data Gunj Bakhsh Town, Samanabad Town, Gulberg Town, and Iqbal Town, are at high risk of heat vulnerability. Localities including Garhi Shahu, Islampura, Chauburji, Anarkali, Liaqatabad, Rehmanpura, Ichra, Muslim Town, Wahdat Colony, Garden Town, Gulberg, Askari, Shadman, and Shah Jamal have a significant concentration of children under the age of 10, further increasing heat-related risks. Areas

such as Lyton Road, Temple Road, Mozang, Sadi Park, Shamaspora, Miani Sahib, Walled City, Zia Colony, and Hope Colony are particularly susceptible to severe impacts during heat waves due to the presence of slums and katcha (semi-permanent) houses. Moreover, neighborhoods such as the Walled City, Garden Town, Model Town, Walton Cantt, and Samanabad are particularly vulnerable due to a high percentage of elderly residents.

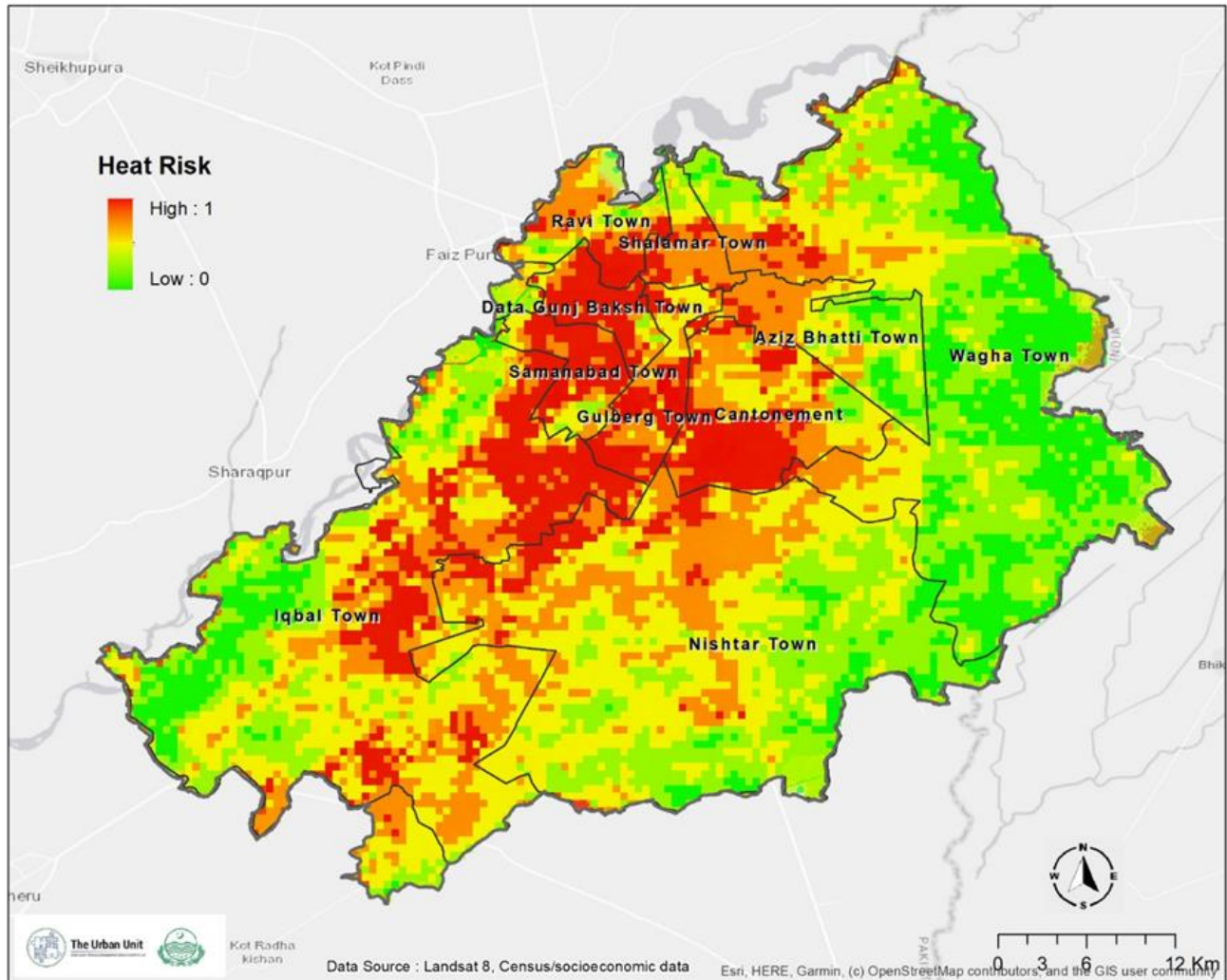


Figure 9: Urban Heat Risk of Lahore City



# Heatwave Vulnerability: **Community Voices** from Lahore

# Findings from Heatwave Consultations in Lahore

## 2.2. Perception and Awareness towards Heatwaves

The present study highlights the public perception and basic understanding of the heat wave. The survey was conducted for the data collection of demographic and socio-economic parameters, along with the preliminary awareness and knowledge regarding heatwave. The components of the survey comprehensively covered heatwave prevalence, health implications, mitigation strategies, information sources, and the government initiatives in different towns of Lahore.

### 2.2.1. Demographic and Economic Profile of the Respondents

The cross-sectional study included 42 respondents, in which 37 were male and 5 were female. The majority of the informants had a primary level of education that account for 16 in total, followed by 15 respondents with secondary education, 7 of those were illiterate, and the least number of 4 participants were with university level education.

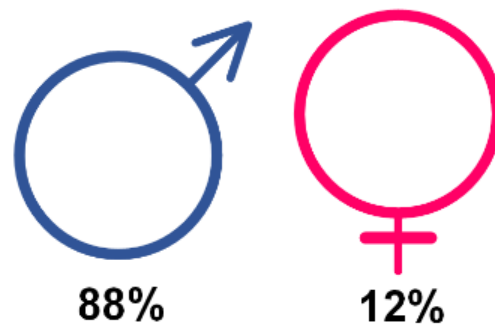


Figure 10: Gender distribution of Respondents

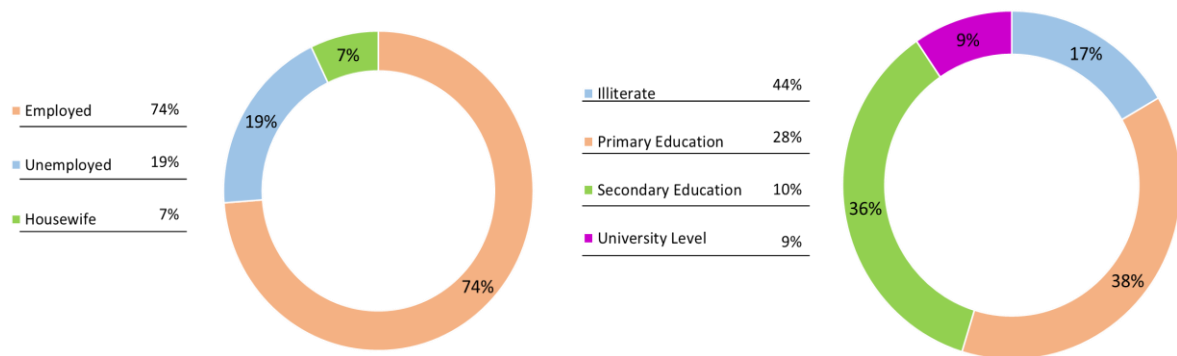


Figure 11: Employment Status and Educational Background of respondents

### 2.2.2. Knowledge of Heatwaves

The understanding of the respondent's regarding heatwave was determined on the basis of their familiarity with the basic knowledge and handling procedures during heatwave. The majority of the 35 data providers were familiar with the peak temperature hours of (12 pm to 5 pm) specifically in hot summer days. The least of 7 respondents have showed unfamiliarity with the heatwave. Additionally, the frequency of heatwave was dominantly observed by the 26 informants, in contrast to the 16 that have experienced no prominent change in temperature.

Table 2: Basic knowledge of Respondents regarding Heatwave

Knowledge and Perception	YES	NO
Do you know about the heatwave?	59%	41%
Do you know about high-temperature hours (12PM-5PM) in summers?	81%	19%
Do you believe that heatwaves is likely to occur more frequently in your area?	62%	38%

### 2.2.3. Health Impacts of Heatwave

The association of the health-related issues with the heatwave was determined on the basis of the frequent symptoms of excessive heat related problems experienced by the respondents. In this aspect, participants have identified a range of health issues including dehydration, excessive sweating, extreme thirst, exhaustion, muscle cramps, headaches, accelerated pulse, fever, faintness, dizziness, food poisoning, and sunburn.

Among these, headache was the most commonly experienced symptom, reported by the 14 participants. Ten respondents identified excessive sweating as the major concern, specifically during outdoor activity, followed by exhaustion reported by the 9 respondents. The factor of extreme thirst was also reported by the 3 respondents. Additionally, three participants admitted to have limited knowledge on heatwave and its resultant health impact symptoms. The least frequently mentioned symptoms were accelerated pulse, dehydration, and other unspecified symptoms account for 1 respondent for each.

The measures for avoiding impacts of heatwave was also determined, in which majority of 16 respondents indicated that increasing fluid intake is the most effective way to prevent heat-related health issues. Staying indoors was the second most commonly opted precautionary measure, recorded for the 9 participants. The usage of air conditioners or fans as cooling options was opted,

The symptoms you and people around you may experience in heatwave

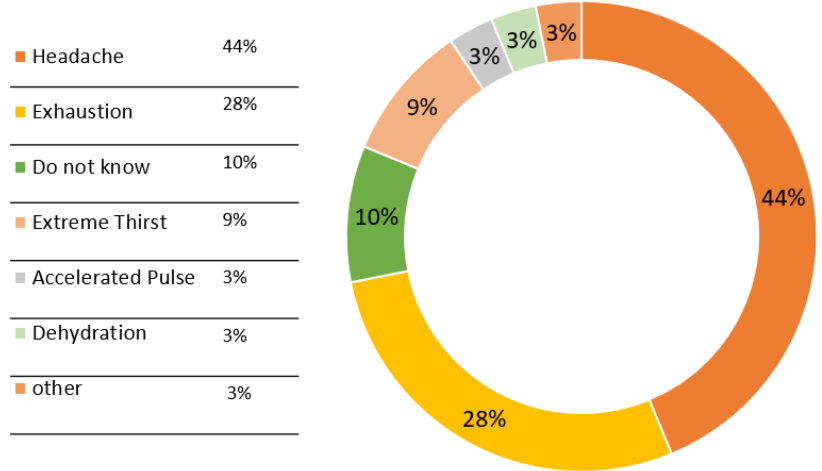


Figure 12: Symptoms experienced during heatwave

Which measure do you think is better to avoid heatwave impact?

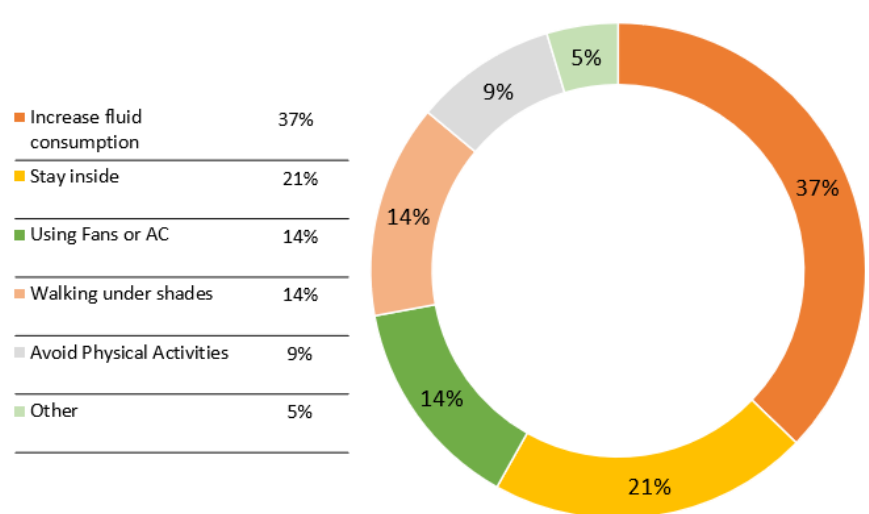


Figure 13: Perception on preventive measures to avoid heatwave

along with seeking shady areas as a temporary substitute, was each reported by 6 respondents, indicating that these measures are considered moderately effective. Additionally, 4 participants advised avoiding physical activity during heatwaves, while 2 suggested other unspecified precautions.

According to the reported data of the informants, the perception of majority of 16 participants is that individuals engaged in outdoor activities were considered to be most exposed to peak temperature hours, and most vulnerable to heatwave. The elder population was considered to be second most vulnerable proportion, as per insights of 14 participants. The Babies over the age of twelve months was mentioned by 5 respondents to be most exposed. Two participants pointed to people with mental health challenges as the most susceptible, while another 2 mentioned individuals with physical disorders and another 2 specified an "other" group. One respondent believed that people on medication are particularly susceptible to heat-related issues. This finding aligns with a study by [12], which notes that outdoor workers are at an increased risk of heat-related illnesses and injuries. Additional studies have shown that high temperatures contribute to rise in health problems at workplace, particularly for laborers associated with in outdoor work related activities.

The groups which are highly at risk to suffer from heatwave

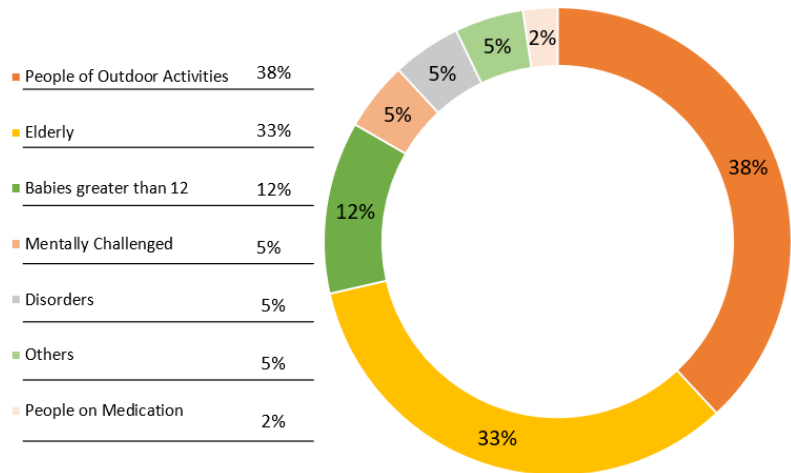


Figure 15: Community perception on highly vulnerable groups

What to do when someone suffers from heatstroke?

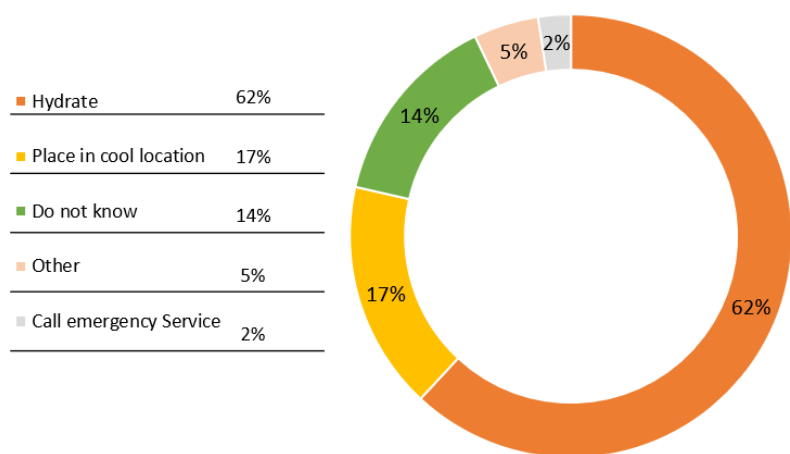


Figure 14: Community knowledge of first aid for heat stroke patients

Moreover, respondents were asked about preventive measures they take to avoid heatstroke. The 26 individuals identified staying hydrated as the most effective strategy. Another 7 participants have recommended moving the affected person to a cooler area, and following standard first aid guidelines. However, 6 informants admitted that they were unsure how to respond, revealing a gap in public awareness. Meanwhile, 2 respondents suggested alternative methods, and only 1 prioritized calling emergency services.

### 2.2.4. Effective Source of Information

The survey findings on the most influential mode of communication reveal that television is most consumed and reliable source of information for spreading awareness regarding heatwaves, as per the identification of 18 respondents. Additionally, ten participants reported not consulting any source for heatwave-related information. A total of 5 respondents finds Google as useful source, while 4 informants rely on newspapers for getting informed to heatwave alerts. Three individuals cited alert messages as their primary source, and only 2 reported relying on medical professionals or healthcare providers.

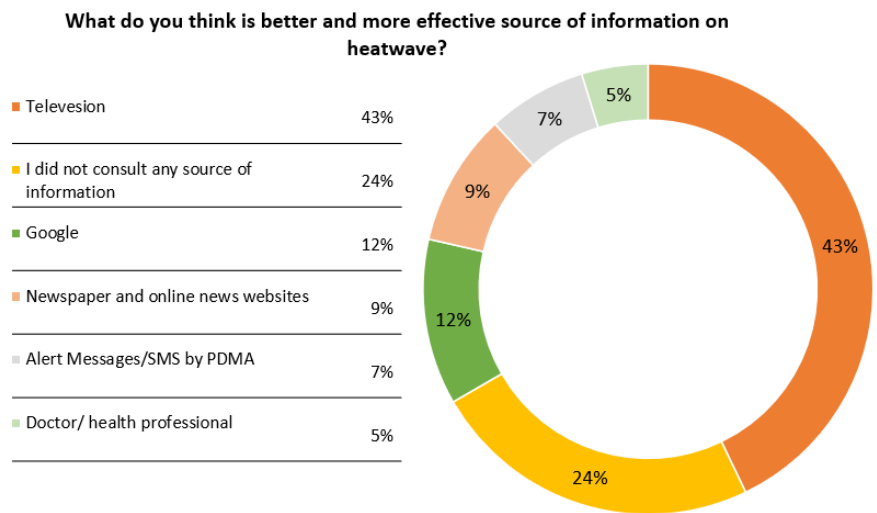


Figure 16: Effective Sources of information

### 2.2.5. Availability of Facilities

The availability of facilities was also determined from the respondents, and asked for the identification of department that is most useful in addressing emergency situations like heatwave, the majority 17 respondents have identified the Health Department. Five participants mentioned other government departments, while 4 cited non-governmental organizations (NGOs). Both the Water and Sanitation Agency (WASA) and the Provincial Disaster Management Authority (PDMA) were each identified by 7 respondents. The choice of WASA may be attributed to its role in maintaining water supply and ensuring access to clean drinking water during extreme heat, while references to the PDMA reflect some public awareness of its responsibility for disaster preparedness and emergency response. Only 2 respondents believed that the Municipal Corporation (MC) is actively involved, suggesting a perceived lack of visibility or effectiveness at the local government level.

The majority of respondents (26) reported the installation of water coolers in their area as a targeted initiative to mitigate the effects of heatwaves. This reflects a widely adopted strategy aimed at providing immediate relief from extreme temperatures by ensuring access to cool drinking water in public

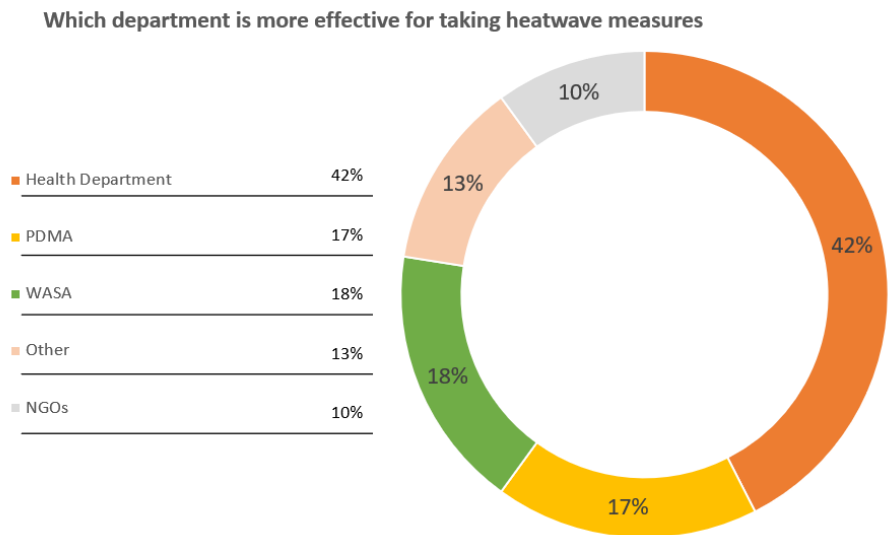


Figure 17: Effectiveness of Government Departments

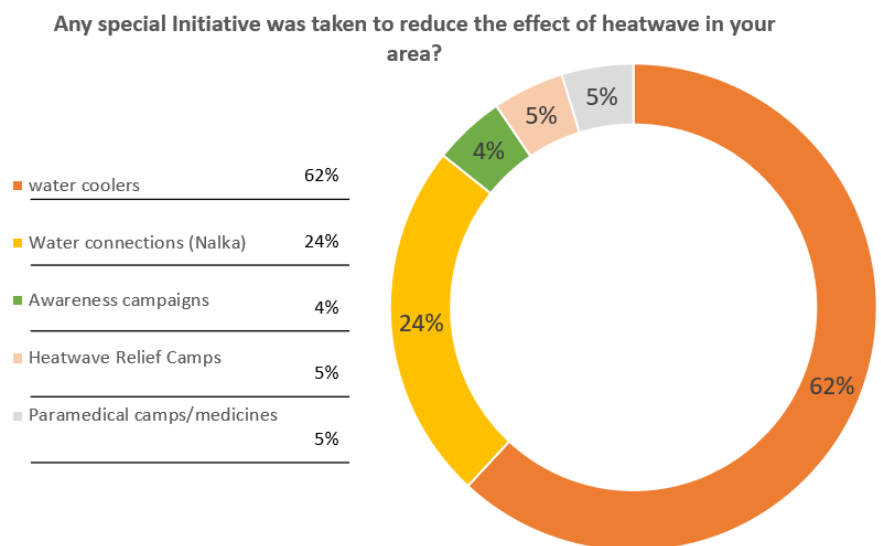


Figure 18: Actions from Government Departments for heatwave impact mitigation and preparedness

spaces. Additionally, 10 participants noted the installation of water connections, such as nalkas, representing a more permanent infrastructure solution to enhance water accessibility in heat-prone areas.

In contrast, fewer respondents observed other interventions. Only 2 participants each reported the presence of paramedical camps, awareness campaigns, and heatwave relief camps. The establishment of paramedical camps indicates efforts to provide basic healthcare services during periods of intense heat, particularly for vulnerable populations. Awareness campaigns were designed to educate the public about the risks of heatwaves and appropriate precautionary measures. Meanwhile, relief camps offered temporary shelter and support during peak heat conditions. Although these latter measures reached fewer individuals, they reflect a multifaceted and inclusive approach to heatwave management.

### 2.2.6. Key Findings

The survey for the perceptions of heatwaves, highlighted several critical issues impacting effective heatwave management. Prominent concern in which is the limited public awareness and understanding of heatwaves. Nearly half of the respondents demonstrated a lack of knowledge regarding the basic concept and risks associated with heatwave, despite having low ratio of only 15% illiterate people in total respondents, which is showing the gap of understanding even for literate people. Furthermore, only 5% of the informants have reported the observation of any awareness campaigns, emphasizing the urgent need for widespread educational initiatives. Another significant issue is the inadequate understanding of appropriate emergency responses. While hydration was commonly recognized as a remedy for heatstroke, only 2% of respondents identified contacting emergency services as a necessary action. This gap in knowledge could delay critical care and increase health risks during extreme heat events.

In terms of government interventions, the majority of respondents indicated that the installation of water coolers was the most visible initiative in their communities. Other essential measures, such as relief camps, paramedical services, and public awareness campaigns, were reported by only a small fraction of participants. This points to a limited implementation and reach of broader heatwave mitigation strategies.

To improve heatwave preparedness and response, several steps are recommended:

1. **Expand Awareness Campaigns:** Given that television is the primary source of information for 43% of respondents, it should be strategically used to disseminate information on heatwave risks, preventive measures, and emergency protocols.

2. **Strengthen Emergency Response Education:** Public education programs should focus on equipping individuals with the knowledge of how to act during a heatstroke, including the importance of contacting emergency services promptly.
3. **Enhance Community-Level Interventions:** The government should increase the visibility and accessibility of relief camps, medical services, and hydration stations, particularly in high-risk urban areas.
4. **Leverage Multi-Channel Communication:** In addition to television, platforms such as mobile alerts, social media, and community outreach should be used to reach a wider and more diverse audience.
5. **Integrate Long-Term Solutions:** Urban planning should incorporate sustainable infrastructure such as green spaces, shaded areas, and permanent access to safe drinking water to build resilience against future heatwaves.

## 2.3. Conditional Assessment of Water Supply Facilities

Team conducted a comprehensive survey across various localities in 10 administrative towns of Lahore. The core objective of the survey was the collection of data regarding heatwave perception, and management practices used to cope up with the severe conditions. The survey specifically prioritized public utilities that play a significant role in well-being of a community in extreme heat. Public access to the safe drinking water, and provisioning of shades in extreme heat were examined not only for their physical presence but also for their operational reliability, ease of access, and equitable distribution within densely inhabited areas. The approach was exercised in order to assess the availability of relief features at the survey areas. Due to this reason, this report features the primary data collected and analyzed for the two main relief appurtenances, including:

- Water Filtration Plants
- Relief Camps

### 2.3.1. Water Filtration Plants

Water Filtration Plants serve as the critical infrastructure for ensuring the equitable provision of safe and sufficient drinking water to the urban population. There are approximately 573 such filtration plants spread all across the city, 449 of which are owned by WASA-L. There are different public and private entities involved in the installation of filters units; like WASA-L, Punjab Ab-e-Pak Authority, NGOs, and other private

stakeholders. The role of these assets is to contribute in the provision of water as prime need for survival, especially in extreme heat events that have increased due to climate change.

The team collected detailed information through structured engineering survey forms to better understand how well these facilities are meeting the need of local residents. The data covered a wide range of factors, including capacity of each plant, type of filtration process, availability of shaded area, water quality feedback, and source of power, which provides an adequate understanding of filtration plants for their operational conditions.

### 2.3.2. Relief Camps

Relief camps are important feature to consider as an adaptive measure to deal with heatwave. These camps are provided as an emergency aid to manage extreme weather crisis or disaster. The camps ensure to cater the emergency needs in a streamlined manner. Specifically for heatwave these medical relief camps ensure availability of appropriate shade, fans, mineral water, medical staff and equipment. However, it should be noted that not a single relief camp was observed at any of the survey points across the city.

### 2.3.3. Analysis of Filtration Plants

The team visited a total of 54 survey points across 10 towns within the city and collected data related to the overall functionality, quality of drinking water, type of filtration system used, condition of the civil infrastructure, source of water supply, serving capacity, available shades, ownership of the filtration plant, and the potential for solar/PVs installation on the plant as green energy resource.



Figure 19: Filtration plants visited across Lahore (a) Data Gunjbaksh, (b) Gulshan-e-Ravi (c) Circular Road

The data collected resulted following outcomes:

- The sampling locations selected for this survey indicated that a total of 39% of the filtration systems used ultrafiltration systems and 55% of the filter plants used RO

technology, However, only 6 percent of them fell in the category “other”, with other membrane technologies.

- 39 out of 54 visited plants had WASA supply for water. However, the rest of them had borehole connections. Notably, most plants with borehole supply were privately operated.
- Around 65% of the filter plants were owned by the public sector authorities. However, the remaining 25% were owned by private owners, particularly mosques.
- Approximately 73% of the surveyed plants had suitable spaces to install solar PVs. Among them, only one privately owned plant in a mosque, located in Shalimar town, already had it.

### Functional Status

The functional status of the filtration plants was assessed using data collected during heatwave hours to ensure a realistic evaluation of system performance under stress conditions. It was observed that 39 out of the 54 filtration plants visited were functional, accounting for approximately 72% of the total sample. However, the major chunk, i.e., 14 plants, were non-functional, comprising 26% of the total sample. The town-wise functional status of the filtration plants is detailed below in (Figure 24).

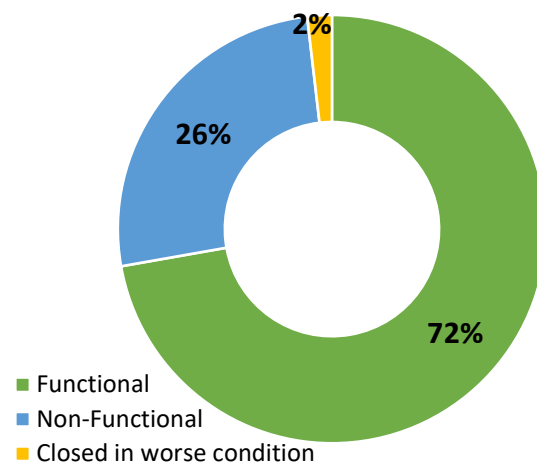


Figure 20: Functional Status of filtration plants

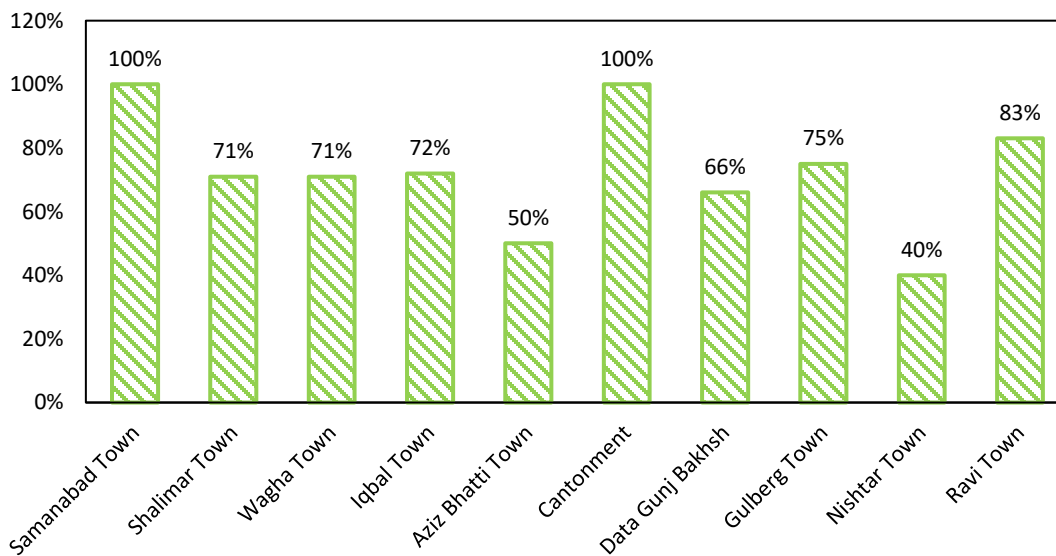


Figure 21: Town wise Functionality Status of filtration plants

**Conditional Analysis**

The survey further examined the overall condition of the filter plants in each town. The data was assessed and graded according to the Likert scale. Five grades were assigned, i.e., excellent, good, satisfactory, poor, and failure. A complete failure of the filter plant, comprising 2% of the total plants, was found in Ravi town, where the structure was extremely deteriorated and had a prolonged closure. The data revealed that 59% of the filter plants fall under the category of good, indicating a generally acceptable quality of maintenance. It reflects that these plants only require minor improvements. The remaining facilities showed varying conditions, emphasizing the need for targeted interventions based on severity.

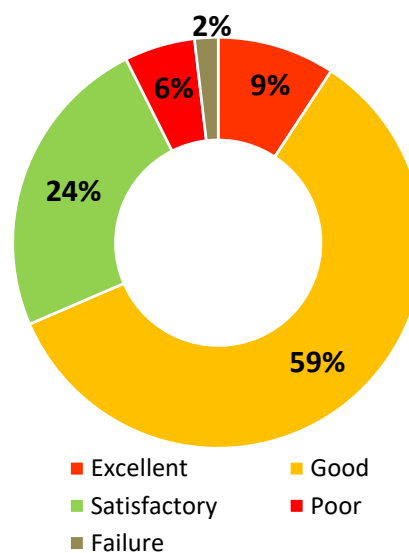


Figure 22: Conditional overview of Filtration plants

The details of condition-wise categorization of filtration plants have been further broken down individually for each town. The percentage of filtration plants from each town falling into a particular category has been provided in (Table 3).

Table 3: Conditional categorization of filtration plants

Condition	Aziz Bhatti Town	Cantonment	Data Gunj Bakhsh Town	Gulberg Town	Iqbal Town	Nishtar Town	Ravi Town	Samanabad Town	Shalimar Town	Wagha Town
Excellent	0%	0%	40%	0%	0%	0%	16%	20%	14%	0%
Good	50%	100%	40%	50%	80%	100%	34%	40%	29%	86%
Satisfactory	50%	0%	0%	67%	20%	0%	34%	40%	29%	14%
Poor	0%	0%	20%	33%	0%	0%	0%	0%	28%	0%
Failure	0%	0%	0%	0%	0%	0%	16%	0%	0%	0%

### 2.3.4. Provision of Shade Analysis

The survey also focused on the provision and type of shade available at each filter plant. The data revealed that around 59.25% of the plants had some kind of shade available, either natural or permanent. Both types of shades were present in almost comparable proportions. Around 45.45 % had natural/ trees and lacked permanent shade. These shades were found in places adjacent to parks. It is to be noted that the majority of privately operated filtration plants had permanent sheds providing shade to the public. Appropriate shade is necessary as it provides relief from the sun during times of heat. Additionally, most of them had no seating facilities for the public.



Figure 23: Provision of Shade (a) Mori Gate Park, (b) Iqbal Town

The percentage of shade in each town has been evaluated, and it was clearly seen that the Shalimar town and Ravi town have the lowest proportions of shade. It also indicates the poor civil infrastructure of the filter plants in these towns. However, the cantonment, Iqbal town, and Nishtar town had the maximum percentage of plants (100%) with shade. The following is the graph attached;

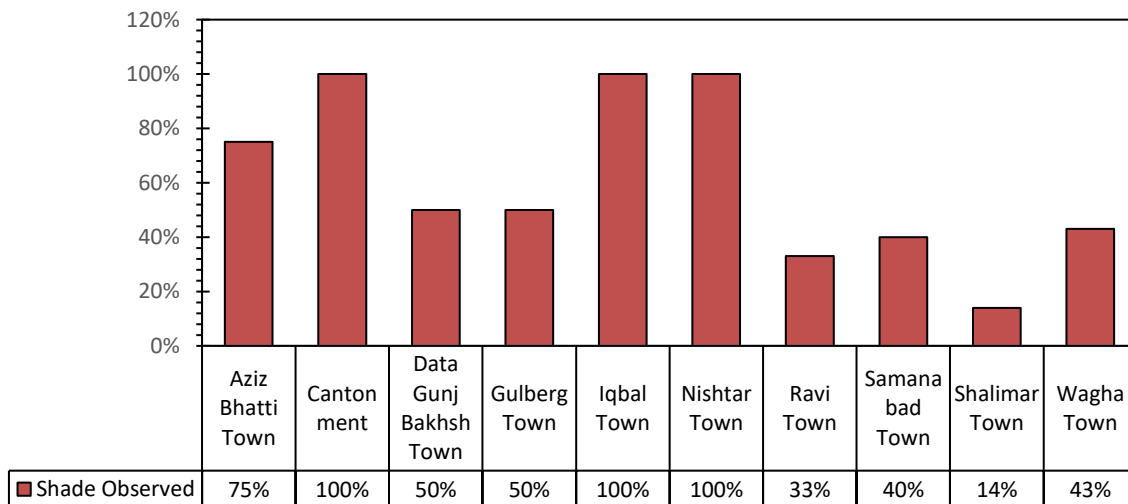


Figure 24: Percentage of Shades observed in each town



# **Heatwave Resilience Index: A Weighted Assessment of Key Urban Services**

# Assessment of Community Resilience to Heatwaves in Lahore

## 2.4. Heatwave Resilience assessment

The impacts of heat waves are shaped by a complex interplay of climatic, environmental, socio-economic, and institutional factors. While external elements such as regional climatic shifts, global warming trends, and natural topography contribute to the frequency and intensity of heat wave events, social determinants such as poverty, aging populations, informal housing, and occupational exposure exacerbate vulnerability at the community level. These aspects are critical in understanding risk profiles, but often lie outside the immediate scope of policy control or require long-term structural change.

In contrast, there exists a set of controllable factors—elements that can be directly shaped or enhanced through governance, planning, resource allocation, and public intervention. These factors serve as entry points for building institutional resilience and reducing exposure and sensitivity to extreme heat. Among the range of possible interventions, four priority areas have been identified in this risk assessment exercise for their strategic relevance, feasibility of implementation, and potential to deliver both immediate and sustained impact. The studied factors included, sustainable water supply, healthcare systems, public awareness, and green spaces.

### 2.4.1. Prioritization of Factors

These four controllable factors form the backbone of an integrated heat wave management framework. Their selection is rooted in practicality and impact potential, aligning closely with urban planning, health equity, and climate adaptation goals. However, in order to effectively manage and contribute toward mitigation of heat wave impacts, it is imperative to understand the relative significance of these factors. Given the multi-dimensional nature of heat wave management, and its ability to span across sectors such as green urban planning, public health, environment, and public preparedness, a structured, transparent, and rational framework is required to assess the inter-relatability of these factors.

The relative weightage of the considered factors and the order to precedence is indicated in the figure below.



Public Awareness weighted highest at 35% focused on the population’s knowledge and behavior in relation to heat-wave risks, including recognition of heat-related symptoms, hydration practices, and responses to official heat-wave alerts. Areas with higher awareness demonstrated stronger readiness and behavioral adaptation, which significantly reduces heat-related health risks.

The Conditional Assessment of Filter Plants (25%) evaluated the operational efficiency, maintenance status, and reliability of water filtration units. In the face of rising temperatures, functioning filter plants serve as critical public assets, ensuring access to clean drinking water an essential line of defense during heat-waves.

The remaining factors Proximity to Green Spaces and Proximity to Hospitals (20% each) play supporting but vital roles. Green spaces contribute to local cooling, countering the urban heat island effect, while proximity to hospitals improves emergency response capability, reducing the consequences of heat-related illnesses. The final percentage rating based on the individual weighted score of the factors is then categorized to assign grade based on the overall risk factor of the area. This was achieved by generating ranges and assigning the unique grades to each numbered range. The ranges that make up each grade have been tabulated here

Grade	Range
A	> 80%
B	65% - 80%
C	50% - 65%
D	< 50%

## 2.4.2. Field Assessment & Mitigation Measures for Factors

This section discusses the mitigation measures and outlines the field assessments conducted to evaluate contributing factors.

### *Public Awareness and Early warning*

Public awareness is an important factor to enhance community understanding, preparedness, and response capabilities to extreme heat events through targeted public knowledge and communication strategies. The main goals include but are not limited to the following.

- Improve public knowledge of heat wave risks and health impacts.
- Promote protective behavior and adaptive practices during heat events.
- Increase engagement of vulnerable groups.
- Foster a culture of preparedness and shared responsibility within communities.

The survey conducted by the Urban Unit indicated that majority of community remains unaware of the threat of heat-wave, highlighting serious concerns and an evident lack of effective communication strategy. Questionnaire related to public awareness were floated and the perception of general population were gauged, as provide in pervious section in (Table 2). It was indicated that a major share of population (41%) remains unaware of basic knowledge regarding heatwaves. The preferred communication medium for disseminating information about heat waves was also asked, with 43% respondents preferring Television as the optimal medium.

Public awareness is a critical, controllable lever in mitigating the human impacts of heat wave, and a coordinated and inclusive awareness strategy can enable communities to act decisively and protect themselves during extreme heat events. As provided in pervious section (Figure 19), using television (TV) as a public awareness tool during a heat wave can be highly effective due to its broad reach, immediacy, and ability to deliver visual and emotional content. Following are some impactful ways for utilizing TV to raise public awareness and promote safety during a heat wave:

- Emergency alerts and tickers
- Short Public Service Announcements (PSAs)
- Weather Forecast Segments
- Talk shows & Morning programs

- Community storytelling and testimonials
- Educational Info graphics and Visuals

An early warning system with the help of effective public awareness technique is the first line of defense against the health and social impacts of heat-waves. It enables proactive, coordinated action, minimizes casualties, and strengthens community resilience in a warming world. A heat-wave early warning system is a set of tools and processes designed to monitor and predict extreme heat events, communicate timely alerts and enable preventive actions to protect vulnerable populations.

Early warnings allow for timely interventions to manage load on resources during heat-wave time. Moreover, it can help to save most vulnerable part of community by taking timely decisions like school time-offs or time setting with respect to peak heatwave hours. Early Warning Systems enables hospitals to staff up emergency departments and prepare for heat-related illnesses like heat stroke, dehydration, and cardiovascular stress. Additionally, early information to general public enables them to take timely steps to protect themselves.

### *Sustainable Water Infrastructure*

Sustainable water supply plays a crucial role in mitigating effects of heat waves. A significant component of the public water supply infrastructure is the water filtration plants. Filtration plants act as dispensing stations for drinking water, helping prevent dehydration during heat wave hours. Public Filtration Plants across Lahore were surveyed during this exercise to assess their functional status and reliability in providing relief to general public. It was assessed that up to 74% of water filtration plants were operational during heatwave hours, with 26% being in-operational mostly due to maintenance issues. However, the perception of the respondents regarding accessibility of water resources shows that majority of 80% use filtered water for drinking purpose, while 69% of those have to travel distance of an average more than 1 km for collection of water from filtration plant.

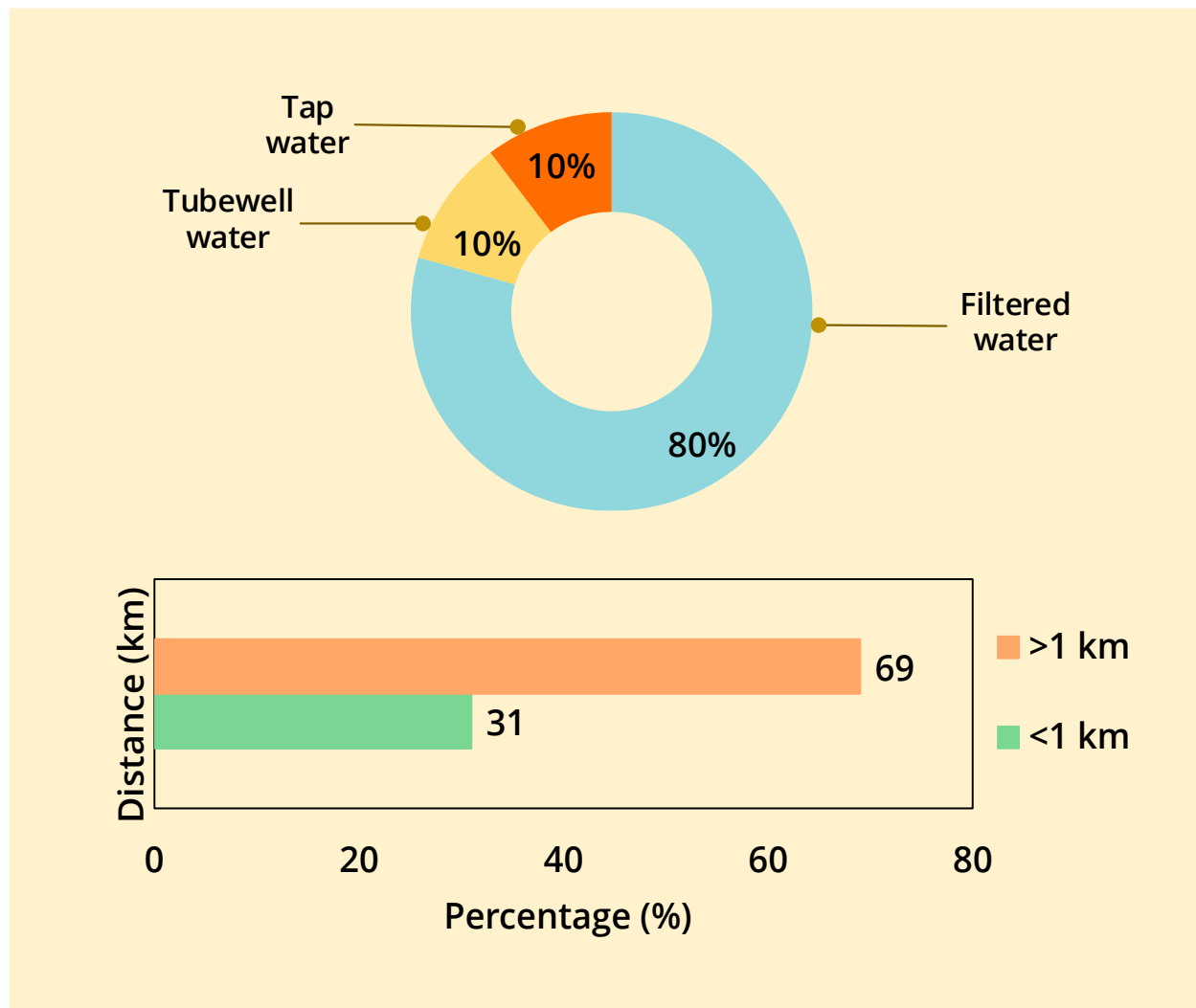


Figure 25: Accessibility to water sources, (a) Type of water source consumed by the respondents, (b) Average distance travels for collection of water

It was also assessed that most of filtration plants installed by WASA Lahore operate during tube well hours, indicating the need of auxiliary storage or increasing tube well timings to cope with the increased demand for water during heatwave hours. The conditional assessment of filter plants also indicated generally positive trend with up to 92% of filtration plants in Excellent to Fair condition.

For short term action plan, upgrading of water infrastructure is important with conditional assessment of the surveyed filter plants discussed in earlier sections. It is also proposed to provide proper shades and seating facility near filter plants as short-term relief to public during heat-wave. The analyzed trend of shade and seating availability at filtration plants is indicated in (Figure 29).

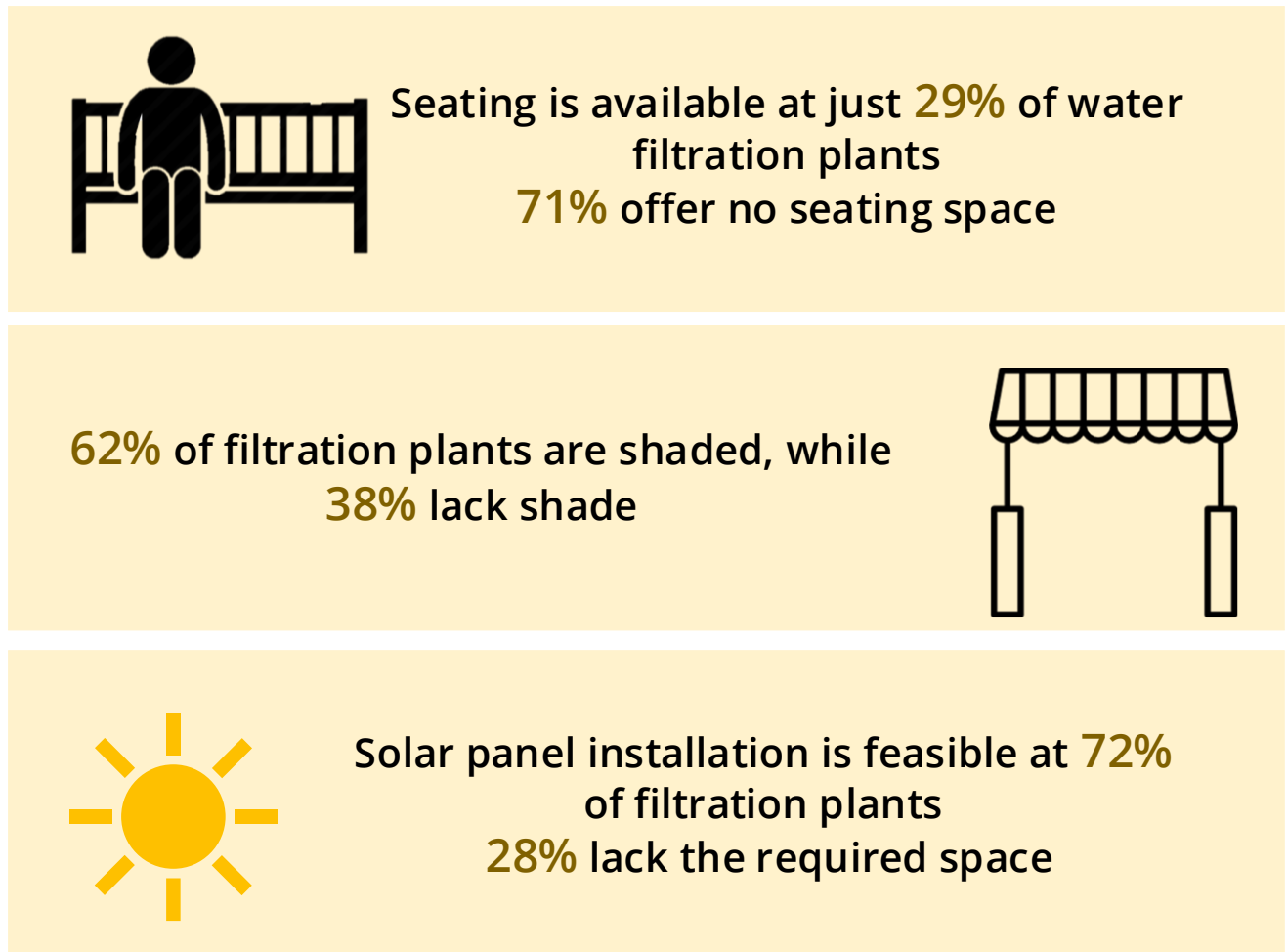


Figure 26: Analyzed trend of observations (a) Seating availability, (b) Shades availability and (c) Space for the installation of Solar panel.

### Healthcare

Access to healthcare system is another important aspect of heatwave management. The perception of public regarding which department they believe plays important role while dealing with heat-wave situation was also enquired. 46% respondents claimed health department as the most critical for dealing with heatwave situations, indicating the significance of healthcare services in light of public perception.

Health care units or hospitals must develop linkages with the weather forecasting departments and/or with National Disaster Management Authority (NDMA) for effective measures to tackle heatwave situation. Hotspot areas for heatwave can be termed as Emergency Zones, utilizing major healthcare infrastructure and nearby hospitals as standby emergency camps during heatwave hours. Health department should ensure the

presence of cooling systems, ventilated spaces and maintain essential stocks of IV (intravenous) fluids, life-saving medicines, and supplies in hospitals

. The health care staff should have training on heatstroke management, first aid, and emergency responses.

### *Green Spaces*

Green spaces are natural, multifunctional tools in heat-wave management for any city. They are not only essential for reducing land surface temperature but also for ensuring healthy lifestyle, and make urban environments more livable and resilient in existing situation of rising global temperature. Investing in and maintaining green infrastructure is essential for both immediate heat relief and long-term climate adaptation. Green spaces mitigate the urban heat island (UHI) effect, which occurs when cities become significantly warmer than surrounding rural areas due to human activities and dense infrastructure.

Lahore is a major metropolitan, and it has been observed during the last few decades that green areas of the city are being replaced by concrete structures, causing a rise of approximately 2.4 degrees in urban areas as compared to the surrounding rural areas. A report published by the Urban Unit indicated that the concrete cover of the city has increased to 759 km<sup>2</sup> over the past 20 years from an initial 438 km<sup>2</sup> in 2000. In a similar context, the green areas of the city saw a reduction from 1,550 hectares in 2001, to 1,298 hectares in 2022.

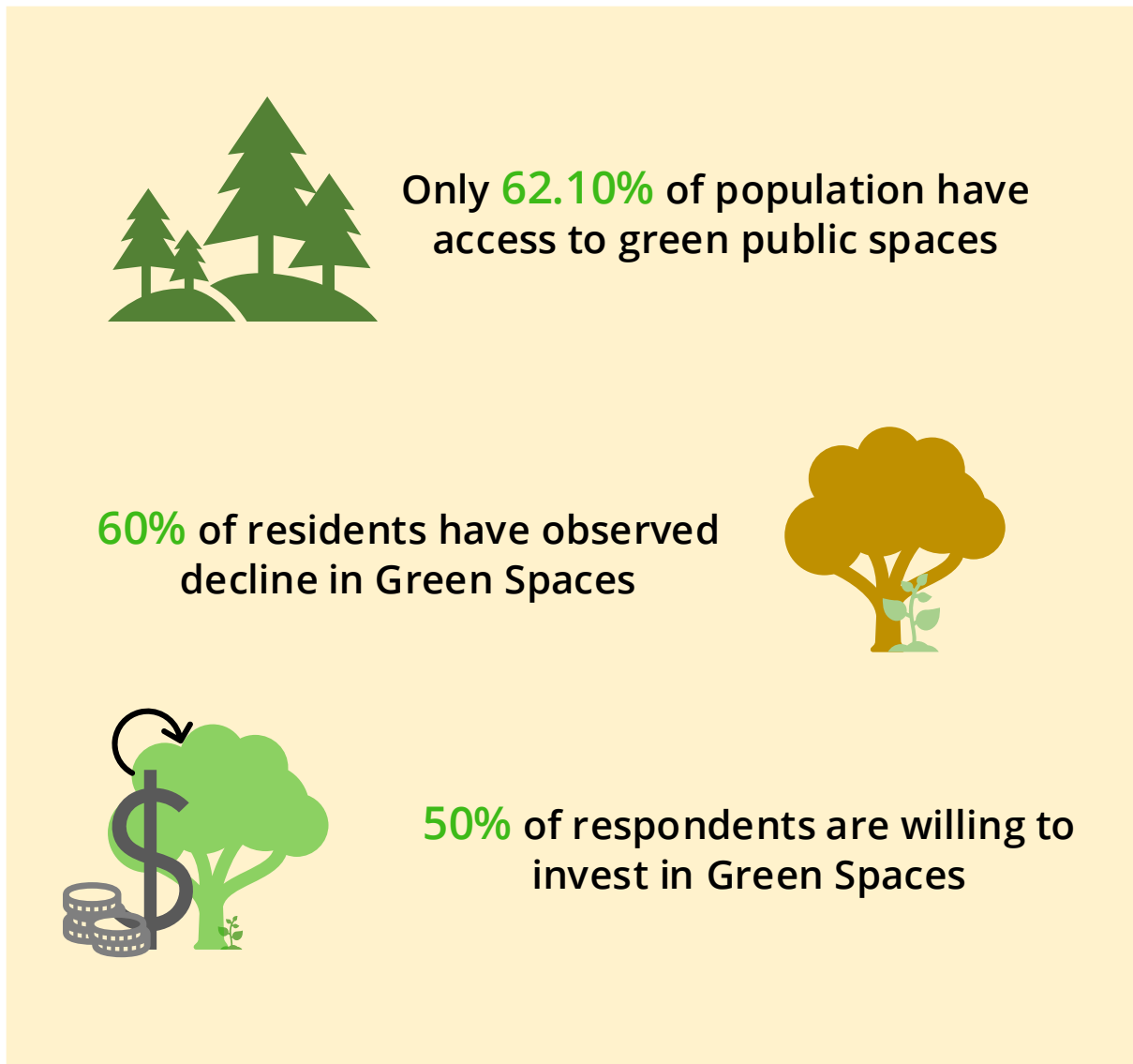


Figure 27: Perception of respondents on Green Spaces (a) Access to Green Spaces, (b) Reduction in Green Spaces, and (c) Willingness to invest for Green Spaces.

The public insights on green spaces were also determined during community survey provided in (Figure 29), which shows that only 62.10% of informants have access to the green spaces, as nearby parks of the residential areas. However, 37.90% have no access to any green space. The reduction in parks have also been observed by 62.10% the residents, which shows alarming situation for the overall environmental and public health factors. The willingness of the public to invest in green spaces was just 50%, primarily due to lack of trust on the managing departments.

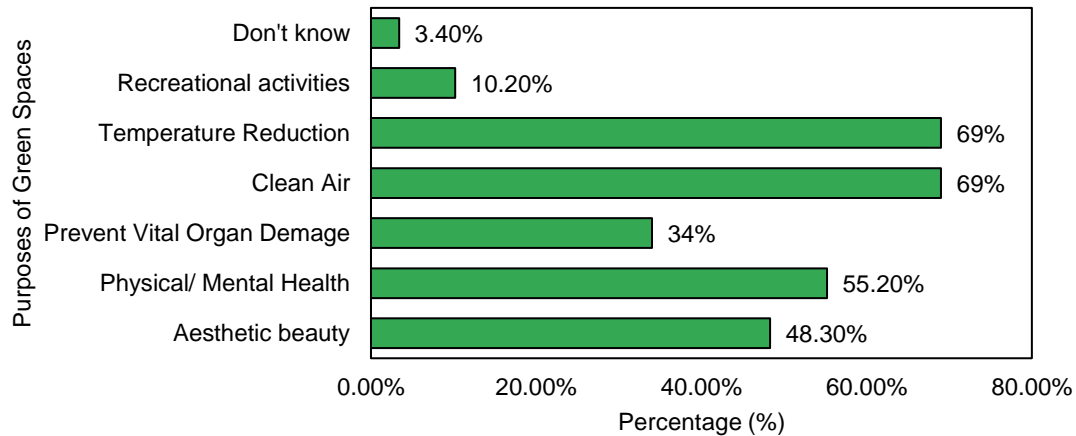


Figure 28: Insights of respondents on the primary purpose of Green Spaces.

The survey also showed diverse understanding of the public regarding purpose of green spaces presented in (Figure 30), in which majority of (69%) informants acknowledge the usefulness of green spaces for the reduction of temperature and controlling air pollution of the city. It is therefore important to understand that green spaces are not just recreational areas; they are crucial for cooling the environment, improving public health, and enhancing the city's resilience against heat-waves. Preserving and expanding these areas should be a priority to ensure a sustainable and livable urban future

### 2.4.3. Capacity assessment

Based on the studied framework, the Lahore District showed variable levels of heatwave risk across its administrative towns:

- **Iqbal Town** was identified as a low-risk zone, owing to high public awareness, well-maintained filter plants, ample green spaces, and good accessibility to health facilities. Its strong performance across all indicators makes it one of the most resilient areas in the district.
- **Samanabad Town** is similarly classified as a low-risk area, ranked slightly higher as compared to Iqbal Town in overall risk. The consideration of individual factors has shown that green spaces are relevantly low along with the spatial distribution of heat services that contribute to its relative positioning.
- Moderate-risk areas include **Nishtar Town** and **Shalimar Town**, where infrastructure performance and public awareness were variable, and gaps in green space and access to health facilities were more noticeable. These areas may not be in immediate crisis but would benefit from targeted improvements to reduce vulnerability under projected heat-wave conditions.
- **Ravi Town and its surroundings** were quantified to be high-risk, characterized by low public awareness, deterioration of filter plant infrastructure, and limited proximity to both green spaces and healthcare services. These deficits suggest a higher potential for community stress and adverse health outcomes during extreme heat events.

This risk classification provides a foundation for prioritized action in heat-wave preparedness. Public awareness campaigns, strategic investment in filter plant maintenance, expansion of urban green infrastructure, and improved healthcare connectivity will be essential to enhancing Lahore’s resilience to heat stress particularly in its more vulnerable zones.

Table 4: Heatwave Resilience Index of Survey points

Area	Latitude	Longitude	Public Awareness (35)	Water Supply (25)	Green Spaces (20)	Proximity to Health-care (20)	Ratings (100)	Grades
Gulberg Town	31.52361	74.34438		15	17	13	69	B
	31.52670	74.35680		15	16	13	68	B
	31.51620	74.35810	24	20	15	12	71	B
	31.54970	74.35870		20	12	14	61	C
	31.57720	74.33630		15	12	12	54	C
Ravi Town	31.58041	74.32686		15	16	16	62	C
	31.56709	74.31739	15	0	15	14	44	D
	31.59090	74.29970		5	18	12	53	C
	31.58610	74.29920		20	14	10	62	C
	31.56710	74.29360		25	20	15	78	B
Data Gunj Baksh Town	31.55577	74.32171		20	17	20	75	B
	31.57230	74.29970		15	15	15	63	C
	31.58327	74.30067	18	25	15	16	74	B
	31.44417	74.35525		20	17	17	74	B
	31.44303	74.35461		20	17	17	74	B
Nishtar Town	31.46842	74.34733		20	15	15	70	B
	31.45244	74.35242		20	18	18	76	B
	31.46667	74.33784	20	20	12	12	64	C
	31.55925	74.42260		20	10	10	62	C
	31.55242	74.41169		20	14	10	66	B
Aziz Bhatti Town	31.54916	74.40823		15	14	14	65	B
	31.54965	74.38386	22	15	12	14	63	C
	31.59365	74.42243		15	7	11	49	D
	31.59486	74.42117		20	7	12	55	C
	31.58984	74.43479		20	9	9	54	C
Wagha Town	31.59314	74.42061		20	9	9	54	C
	31.59144	74.41297		20	9	9	54	C
	31.60053	74.41379		20	11	7	54	C
	31.60220	74.41457	16	20	11	7	54	C
	31.60581	74.39915		10	5	11	44	D
Shalimar Town	31.58413	74.40609		15	14	14	61	C
	31.58941	74.38308	18	10	20	16	64	C

Heatwave Management Plan of Lahore (2025 – 2028)

	31.57961	74.35307		15	17	17	67	B
	31.58366	74.40160		10	15	15	58	C
	31.57420	74.38315		20	13	15	66	B
	31.55230	74.28290		25	18	15	85	A
	31.53460	74.29410		20	14	12	73	B
	31.53190	74.32331		15	16	18	76	B
	31.52589	74.32070		15	15	14	71	B
	31.52778	74.31970		20	15	14	76	B
	31.50399	74.27437		15	17	13	72	B
	31.51120	74.27808		15	18	15	75	B
	31.51120	74.27620		25	18	15	85	A
	31.50774	74.28379		20	20	10	77	B
	31.52421	74.28848		15	16	16	74	B
Samanabad	31.51833	74.29265		10	16	15	68	B
Town	31.51534	74.29964	27	15	20	18	80	A
	31.37793	74.18284		25	18	16	89	A
	31.38257	74.19009		25	18	17	90	A
	31.45456	74.22851		20	20	18	88	A
	31.45558	74.23181		25	16	15	86	A
Iqbal Town	31.47173	74.26582	30	15	16	15	76	B

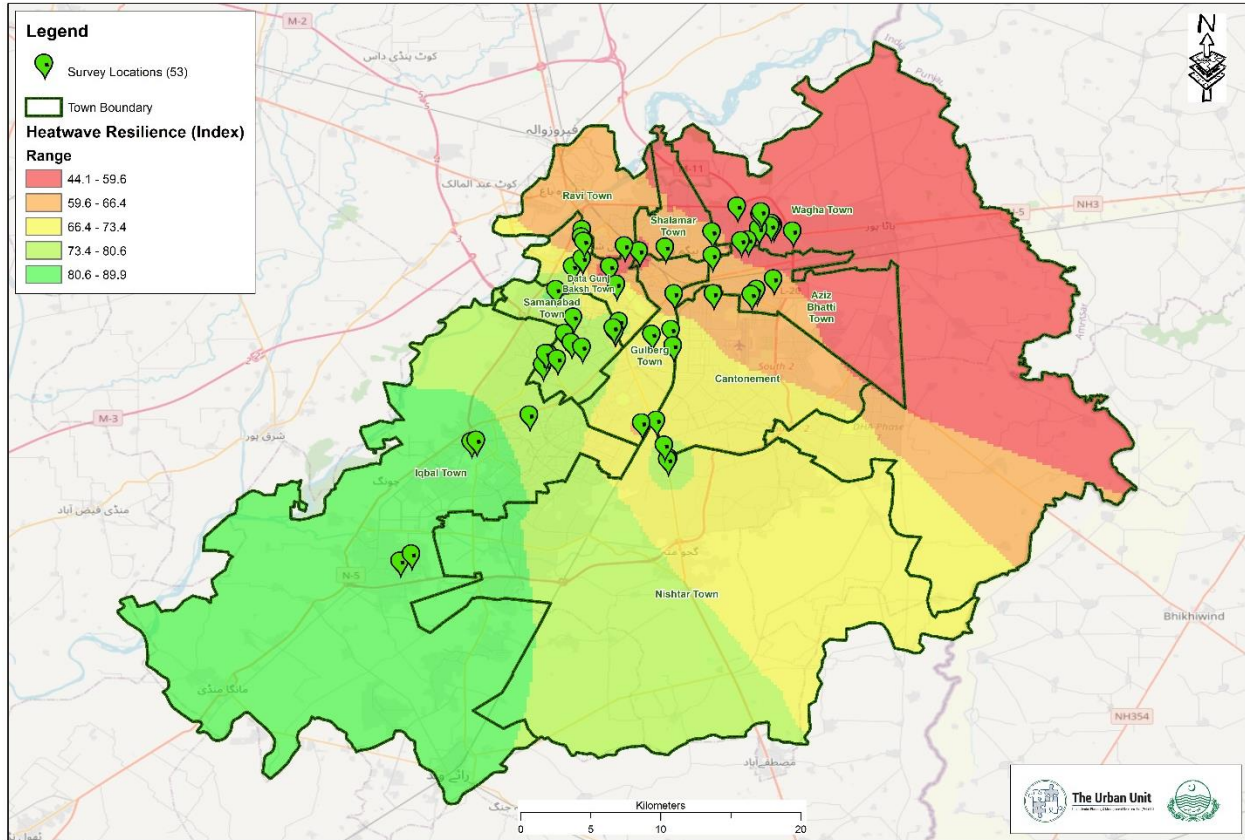


Figure 29: Heatwave resilience Index of survey points

The background of the slide is an aerial photograph of a dry, cracked landscape. A prominent, jagged yellow crack runs diagonally from the top left towards the center. The ground is a mix of orange, red, and yellow tones, indicating parched earth. The title text is centered over a semi-transparent yellow horizontal band.

# **Heatwave Management Plan**

# Heatwave Management Plan

The 2022 heatwave in Lahore raised the urgency and commitment of provincial stakeholders to develop a coordinated response action plan at the city level to prepare and mitigate future heatwave effects. The summer season in Lahore generally lasts from April to October. Extreme temperature and low humidity levels are experienced during the onset of the summer season, which is followed by monsoon showers, and finally high humidity season. However, climate change has altered the start and end of all seasonal variations, along with the intensity of local temperature, rainfall, and humidity, as was discerned during the heatwave of 2022. The vulnerability of heatwaves is often seasonal and occurs during a specific time of year based on the geography and local climate. It is impertinent that preparedness and plans should be formulated after vulnerability mapping, weather forecasts, consultative meetings, etc. to enhance community preparedness and mitigation during the heatwave.

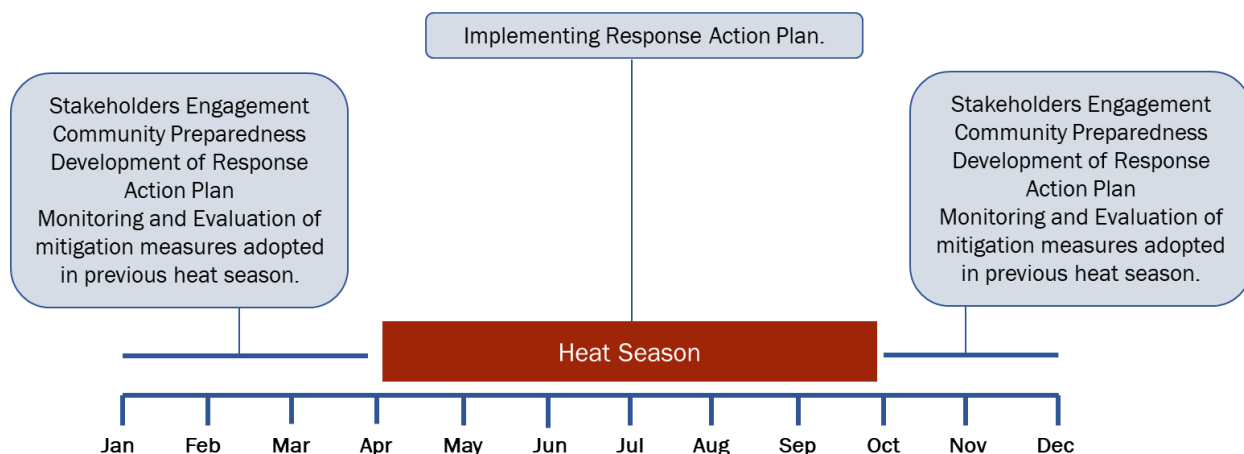


Figure 30: Heatwave Management Plan Layout (Pre-During-Post)

This section comprises of action measures that will be taken before, during, and after the heatwave season in Lahore city.

## 3.1. Early Warning System:

An early warning system for a heatwave is a meteorological alerting mechanism that provides information to the general public and governing stakeholders about the impending rising temperature, its impacts, and stimulates the need to implement an action plan for its prevention and mitigation. The joint report of World Meteorological Organization (WMO) and World Health Organization (WHO) on development of warning system for heatwaves and health risks, discusses following key components of an early warning system [13];

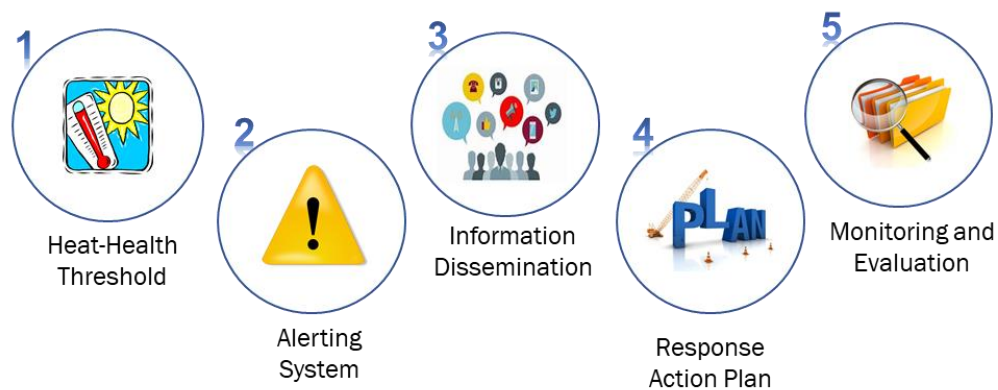


Figure 31: Key Components of Early Warning System for Heatwave

An early warning system for heatwave preparedness and mitigation provides a basis for a broader action plan, that is implemented when risks are met. The success of an action plan depends on standards developed based on the availability of reliable data, community awareness plan, stakeholders' identification and engagement, formalizing defined actions for each stakeholder, and composing an implementable action plan focusing upon the community under risk.

### 3.1.1. Heat-Health Thresholds:

The Pakistan Meteorological Department is mandated for weather observations and provides current and forecasted weather information for optimization of weather-sensitive operations. The PMD issues warning against severe weather phenomena including drought, heavy rains, heatwaves, etc. Lahore city has the characteristic climate of tropical areas, comprising of extreme temperatures and humidity levels, which puts it at higher risk of impacts.

The regional meteorological station and health departments of the city are the key players in defining heat-health thresholds. These thresholds can be developed through availability of updated and reliable data and forecast patterns specific to Lahore city.

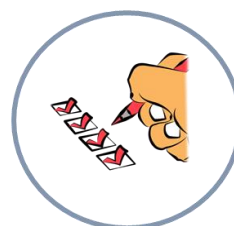
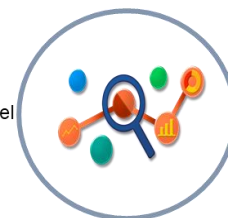


### Data Availability

- Availability of Humidity, temperature, and Health data of the locality.
- Level of available data. i.e., municipality, city, so on.
- Quality of available data, i.e., year of data collected, source, etc.

### Climate Forecasts

- Availability of climate forecasts.
- Quality of projected forecasts, i.e., model used, year of forecast, how far along forecasts have been made.
- In case of non-availability, the required forecasts should be developed.



### Setting Thresholds

- Time of Occurrence of heatwaves.
- Setting temperature and humidity thresholds based on population, vulnerable groups, vulnerable locations, temperature and humidity tolerance indexes.

### 3.1.2. Surveillance and Alerting System:

Forecasting heatwaves well in advance of their occurrence provides the time for preparedness. The following set of information will be reviewed on regular basis to anticipate heatwaves and take appropriate action throughout the heat season.

- Regular forecast of maximum and minimum temperature for the next 7 days from RMC Lahore
- Reports on heat-related health impacts and fatalities from all clinics, hospitals, and health centers.

The forecasting of extreme temperatures is significant for declaring heatwave emergencies and initiating mitigation measures. The health impact reports can assist in identifying the additional ongoing impacts to define health-related thresholds.

#### Alerting System:

The response action plan in Lahore will be implemented based on a three-tier alerting system.

Table 5: Three-tier Alert System

Alert	Criteria	Public Advisory	Government Response
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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.	Increased communication in media on heat issues.
Hot Day Warning	Forecast $\geq 42^\circ\text{C}$	Avoid Heat exposure. Drink sufficient fluids. Replenish body salts through IV Fluids. Wear light colored and loose cotton clothes. Walk and sit under shades.	High level of public awareness, increased focus, and preparedness of government agencies.
Heatwave Emergency	$\geq 42^\circ\text{C}$ Forecast and minimum temperature $\geq 30^\circ\text{C}$ 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 salts through ORS. Wear light colored and loose cotton clothes. Walk and sit under shades. Call emergency helpline for any additional assistance.	Declaration of Heatwave Emergency

The yellow and orange alerts will be used to increase public awareness and institutional readiness of administrative and facilitating departments. Pakistan Meteorology department will issue the following statements, that will be replicated and used by PDMA and RMC Lahore;

- Regular information statements regarding heatwave forecast events for administrative departments.
- Public advisory statements for during alert and warning notices.
- Heatwave Watch when there is potential risk of heatwave.
- Emergency Alert statements when there is a risk of heatwave lasting for more than 2 days.

### 3.1.3. Declaring a Heatwave Emergency:

Pakistan Meteorology Department will issue a notice when the defined temperature thresholds are met, based upon the forecasted weather patterns. The PMD will declare emergency notice in Lahore city, when:

1. The maximum dry bulb temperature measured at RMC, Jail Road Lahore is forecasted to be  $\geq 42^\circ\text{C}$  with no significant relief, and night time air temperatures are not expected to drop below  $30^\circ\text{C}$  for at least 2 days.
2. When there are significant levels of heat-related illness and even mortality there must be a declaration of heatwave Emergency and rapid response.

Once the heatwave emergency is declared, action plans will be triggered by the administrative and facilitating departments across the Lahore division. Heat-related illnesses and mortality will be monitored throughout the heat season to determine potential events that raise health concerns. The plan will be reviewed and improved

considering the health impacts of previous heat season to increase preparedness and prevention. Heatwave emergency will also be declared by the Commissioner Office when significant number of heat related diseases and mortality are reported, regardless of the climate pattern.

## 3.2. Communication Plan:

The communication plan is as follows;

- An Emergency Response Coordinator will be responsible for the entire coordination during heatwave.
- The Emergency Response Committee will maintain constant communication with relevant departments and the general public during the heat season. The level of communication between stakeholders and response will be amplified or diminished in accordance with the level of concern issued by PMD.
- The efficient implementation of the Response Action Plan will depend upon the adequate and timely sharing of forecast information from the Pakistan Meteorology Department. Regional Meteorological Centers in Lahore will also be monitoring the regional weather patterns in coordination with PMD.
- Environment Protection Department and Environment Protection Agency in Lahore are mandated with managing the environmental concerns at provincial level in Punjab. EPD will play a key-role in coordination and implementation of response action plan.

*The facilitating departments will be tasked with the implementation of the response action plan, according to the level of issued notice. These departments will ensure the appropriate and well-timed delivery of a range of actions in accordance with the following arrangements. The operational feedback will be shared with ERC regularly, which will review the efficiency of all operations. Details are given.*

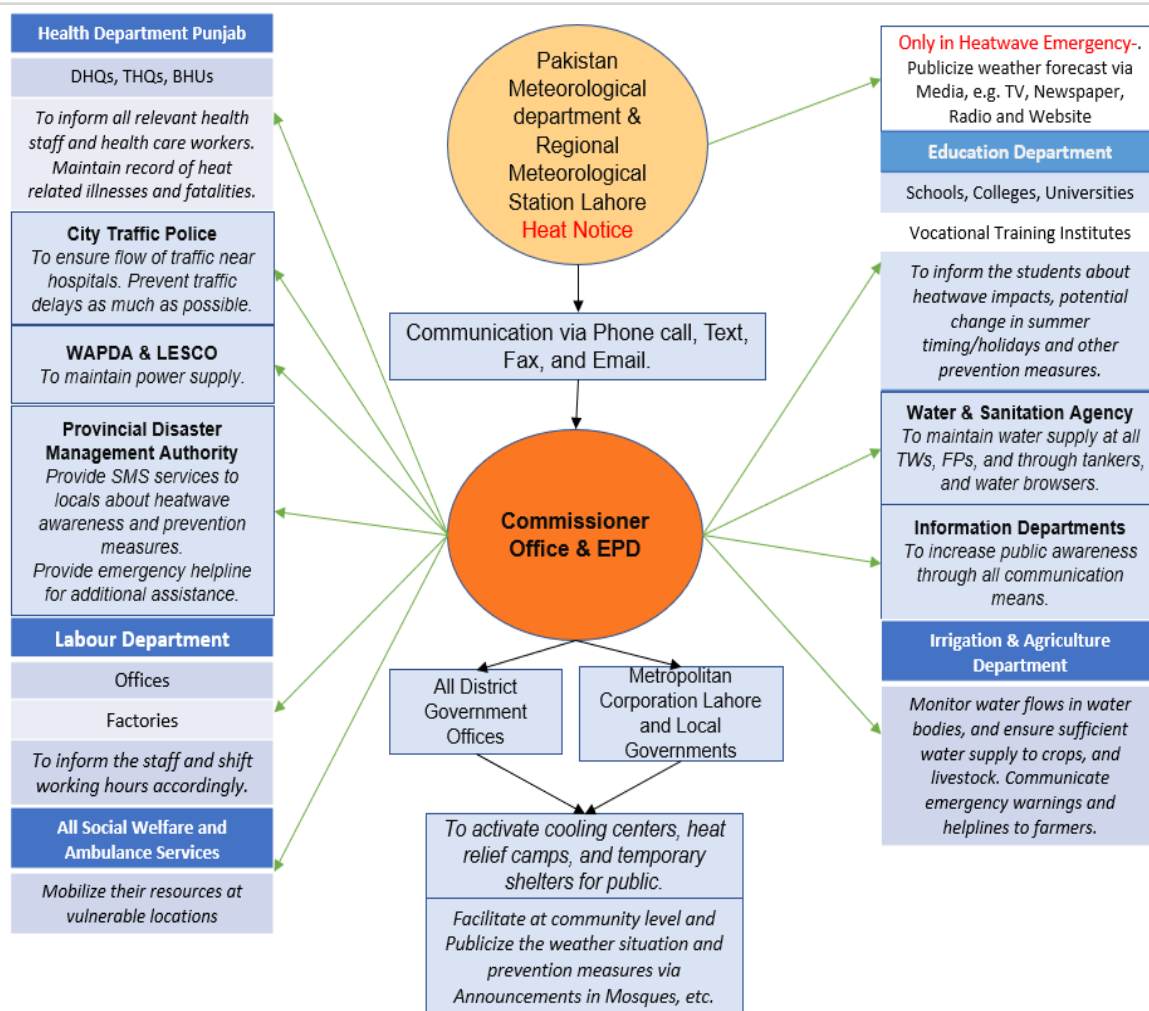


Figure 32: Communication Plan

### 3.2.1.Key Actors:

- **Deputy Commissioners (DC):** The DC will be responsible for organizing and coordinating resource deployment, including locations for heat relief camps, cooling stations, shade structures, etc. at the district level.
- **Municipal Corporations (MC):** the MC will trigger field response by ensuring that medical supplies, ice packs, relief camps, emergency response teams, and emergency contacts are in operation. The MC Officers will visit health care centers and prepare weekly reports of the municipality for ERC.
- **Union Councils:** The Union Councilors in each union will be responsible for managing community-based services, and engaging all stakeholders and the general public for increased preparedness and collaborative planning. They will also disseminate information pertinent to locations of cooling points, display information brochures, and will manage the information outreach to all people.

- **Health and Medicine Departments:** They will be responsible for information sharing and the equipment of all health care units with human resources and medicines throughout the heat season.
- **WAPDA, LESCO, WASA:** These utility agencies will be responsible for maintaining an adequate supply throughout the heat season, with a special focus on highly vulnerable areas.
- **Social Welfare Organizations:** These organizations will mobilize their resources such as ambulance services, volunteers, paramedical staff, etc. to provide emergency relief to heatwave patients. Customized awareness material focused on heat-related illness and first-aid actions will be developed and displayed in ambulances for effective and timely treatment.
- **Education & Labor Departments:** These departments will inform their relevant line departments to consider public holidays under emergency notice. They will also disseminate awareness material regarding the prevention from the heatwave.
- **Information Departments:** The information department will be responsible to publicize all awareness material through all conventional and modern communication means.
- **Irrigation & Agriculture Departments:** Information and Agriculture departments will monitor water flows in the water bodies, assist farmers in managing adequate water supply to crops and livestock, and will devise plans to safeguard the food security.

### 3.2.2. Heatwave Awareness Campaign:

Heatwave Awareness Campaigns will be conducted pre-during season in coordination with emergency response committee and key stakeholders. The aim of the campaign will be to increase awareness and preparedness of the general public well in advance of the perceived risk. The primary audience for this campaign will be;

- Locals living in Lahore (focusing the highly vulnerable locations and populations)
- Travelling visitors in Lahore (preferably people at local transit terminals)

The awareness material will include information pertinent to risk probability, prevention measures, time and magnitude of heatwave occurrence, appropriate response, and emergency contact numbers.

The paramedic staff, ambulance drivers, traffic police wardens, and emergency response volunteers will also be provided information on heat related symptoms, illness, first-aid treatments, and locations of nearest relief centers in the local language. This is significant for reducing medical surge in DHQs and THQs.

The key messages to reduce the impact of high temperature and dry conditions on public will be shared in simple, clear, and short format through local languages, via;

Leaflets	Handouts	Brochures	SMS Alert
Social Media Graphics	Display boards	Posters	

**Public Messaging:**

The information dissemination to the public will be conducted in a regular series of multiple messages before and during the heat season, and will be focused on the following six components:



Figure 33: Components of Information dissemination

Sufficient knowledge dissemination to the public is important to trigger their efforts to take precautionary measures beforehand.

### 3.3. Heatwave Emergencies

When the climate forecasts will meet or exceed the defined threshold for maximum temperature in Lahore, the PMD will issue a yellow, orange, or red notice in accordance with the threshold level or reported heat-related illnesses. The different levels of target groups are:

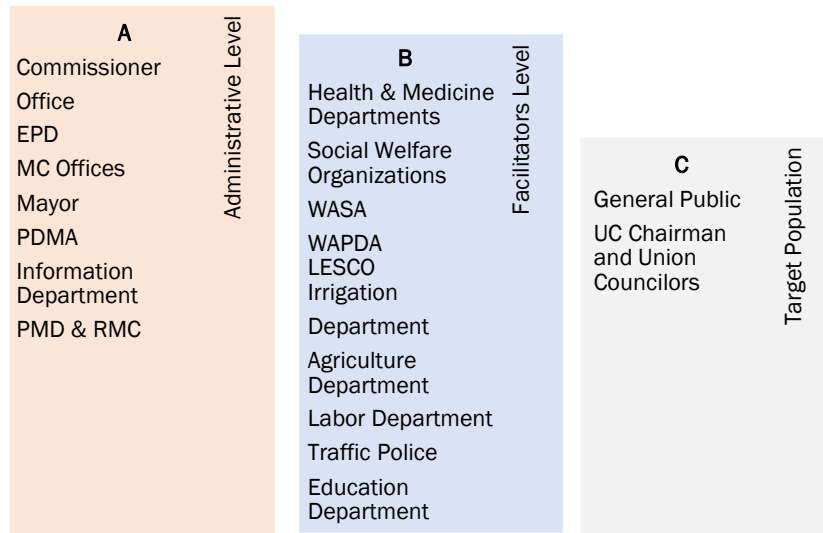


Figure 34: Level of Target Groups

The notice will be issued in coordination with the Regional Met center of Lahore, to EPD, PDMA, and other administrative departments in Lahore. The communication strategies will vary for each level of issued advisory and will increase the involvement of stakeholders according to the severity of climate situations. The alert levels will identify the issuance of three types of notices concerning potential heat risk by the PMD. These notices will identify the groups to be notified by the ERC (Emergency Response Coordinator). Mobile Applications, Social Media, and Websites will be used as vehicles for coordination. The advisory notices are as follows:

**Yellow Alert:**

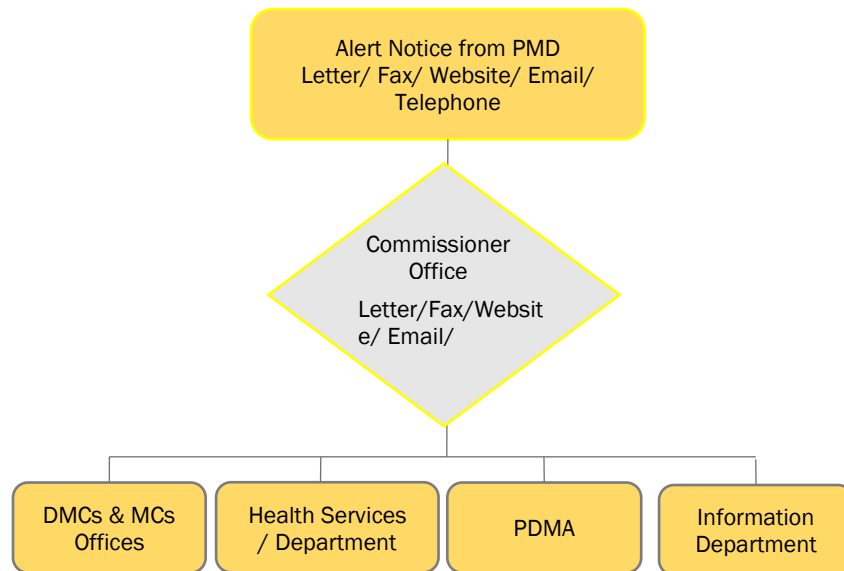


Figure 35: Yellow Alert

**Orange Alert:**

Group A and Group B will be notified for action under the Orange Warning Notice.

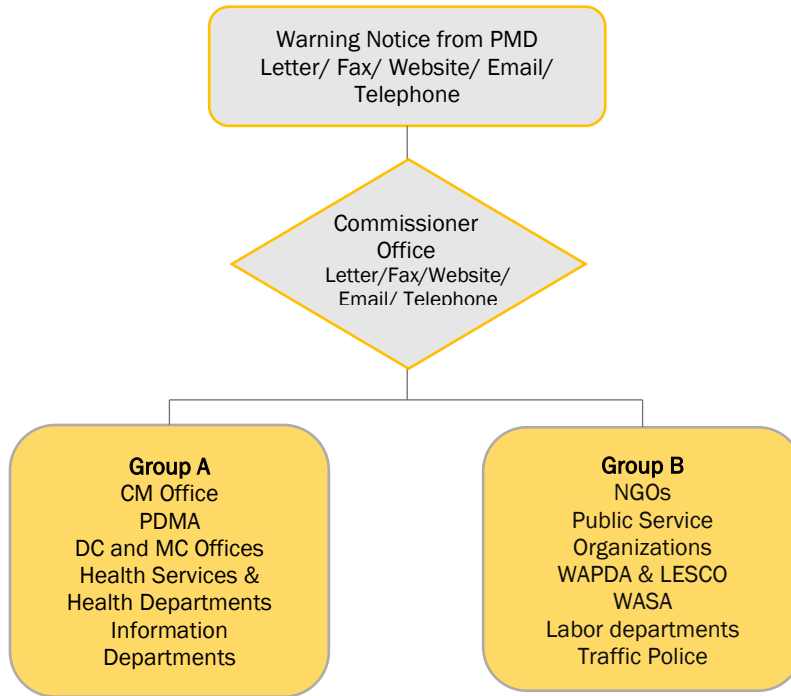


Figure 36: Orange Alert

**Red Alert:**

All groups will be notified for action under the Red Emergency declaration notice.

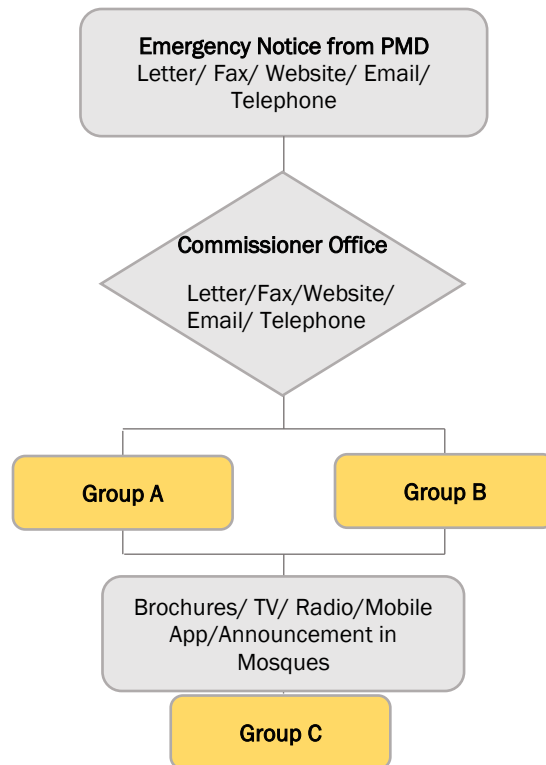


Figure 37: Red Alert

### 3.3.1. All Clear Notice:

After the heatwave has terminated, the PMD will notify the forecasts to administrative departments with an All Clear Notice. The All Clear Notice will initiate performance evaluation process.

Table 6: All-Clear Notice

All Clear Notice
After the Heat Season, PMD will issue All Clear Notice, that will terminate all actions conducted under alerts, warnings, and emergency notices. The emergency response coordinator will convene meeting with the key stakeholders to organize an evaluation of the annual heatwave management plan. The agenda of the meeting would be to discuss and review the past performance of all key players. After the consultation, recommendations for the improvement of the heatwave management plan will be recorded as minutes of the meeting and will be sent for incorporation into the revised plan.

## 3.4. Response Action Plan:

The potential outcome of such a framework can include:

- Clarity in roles and responsibilities of all major stakeholder groups in ensuring preparedness for, and timely response to heatwaves
- Scope for regular stakeholder interface, knowledge sharing and capacity building

- Draw lessons from case studies of global and national experiences
- Prioritize vulnerable states and cities with implementable interventions
- Generate inventory of potential knowledge partners and area fir future research

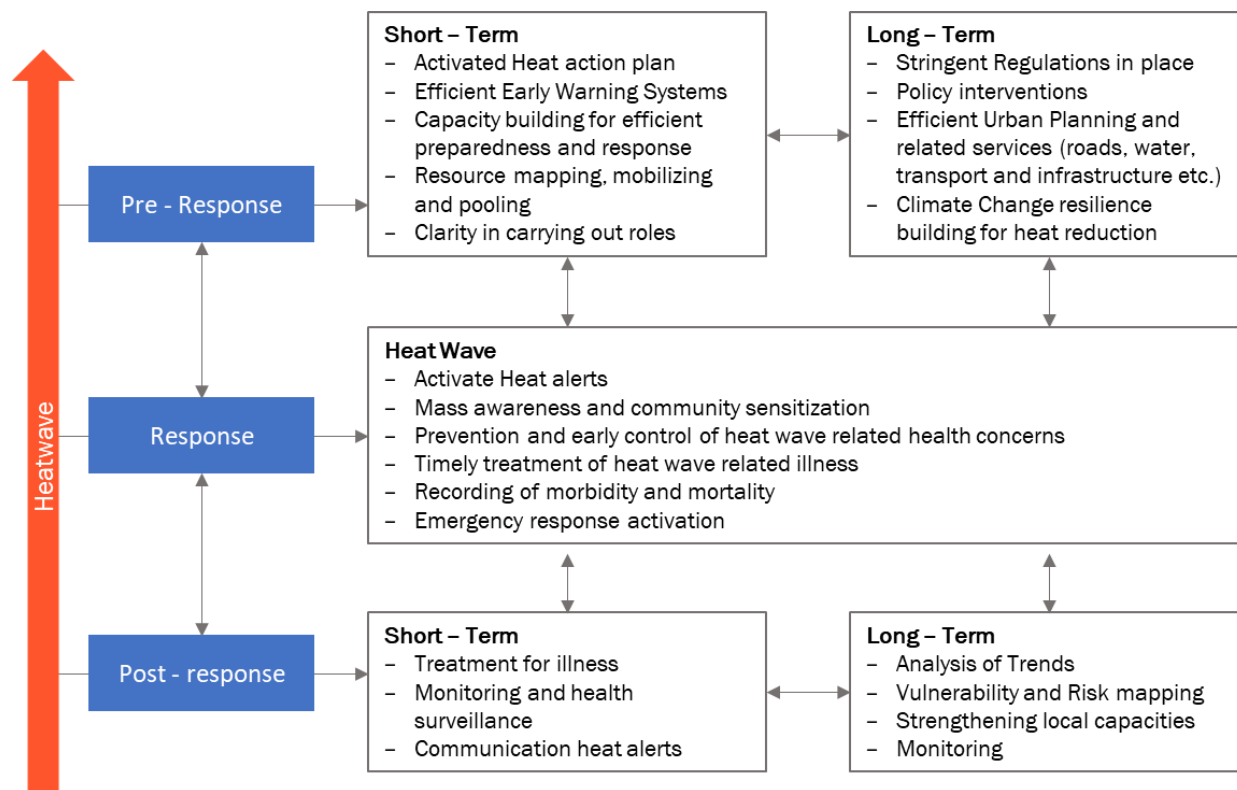


Figure 38: Response Action Plan

The actions to be taken by different departments under various levels of heatwave alerts, are included in the following tables.

Table 7: Actions to be taken during the Heatwave season

Departments	Actions	Facilitating Departments
Commissioner Office	Maintain situational awareness on potential heatwave occurrence through regular review of forecasts and notifications from PMD.	PMD & RMC NDMA & PDMA DC & MC Offices Health Department Information Department Social Welfare Organizations
	Contact focal person from each department prior to heat warnings.	
	Activate the heat alerts and response action when heat forecasts are notified in accordance with the Communication Plan.	
	Regularly monitor the situation and increase the level of alert in accordance with the severity of the situation and heat forecasts.	
Pakistan Met Department	Model forecasts, develop advisories, and share alerts with relevant departments in accordance with the communication plan.	Commissioner Office Health Departments

Departments	Actions	Facilitating Departments
	Issue heat alerts, warnings, and emergency notices based on expert guidance and heat tolerance threshold levels.	
Health & Medicine Departments	Ensure availability of information on precautionary measures in the form of brochures, posters, etc. in all health departments, relief camps, and hospitals, for the general public.	Commissioner Office Health Departments DC & MC Offices NDMA, PDMA
	Maintain a sufficient stock of medicines for all heat related health problems.	
	Monitor preparedness in all first-aid centers and relief camps through case audits and zonal health officer.	
Information Department	Initiate information dissemination process to the public in collaboration with Response coordinator via press conference about heat-related health impacts.	Commissioner Office Health Departments DC & MC Offices
	Circulate alert messages via social media and mobile applications, in collaboration with private telecom companies utilizing the central mobile database, along with the use of traditional media during a heat alert.	PDMA EPD RMC
	Circulate bulk warnings using the centralized email database maintained by the information departments.	
	Develop a direct SMS Alert system to disseminate upcoming heatwave information to medical professionals, private practitioners, and First Aid centers.	
	Utilize the local television and radio broadcast programs to provide information on prevention tips for highly vulnerable localities and ways to get emergency help.	
Labour & Education Departments	Conduct public awareness campaigns during heat alerts and warning days focusing on heat risk to labourers and workers.	Commissioner Office District Education Office Education Departments Industries Department
	Conduct information dissemination speeches during assembly and display awareness posters at schools to inform the students about the causes, impacts, and prevention measures of the heatwave.	
	Organize training for outdoor workers/labourers and other employees focusing on potential harmful impacts and prevention measures.	
District Offices & Metropolitan Corporation & Local Governments	Ensure readiness to implement the response action plan and maintain situational awareness.	Commissioner Office Police Department PMD & RMC PDMA Health Department
	Open emergency response and first aid centers in all UCs. Develop shade structures, and benches; and open mosques, and wedding halls for people to sit during high-temperature hours.	
Social Welfare Organizations	Work with EPD, PDMA, DC and MC Offices to provide necessary services to locals.	Commissioner Office DC & MC Offices
	Ensure the supply of IV Fluids and ice Packs.	
	Confirm points of contact for emergency response and maintain 24x7 emergency contact information through SMS, Email, and other contact sources.	
Water and Sanitation Authority (WASA), Lahore	Review water allocation plans under high heat alerts and warnings. Increase the duration of TWs operation and ensure sufficient water supply in low-pressure areas	Commissioner Office DC & MC Offices

Departments	Actions	Facilitating Departments
	Maintain regular contact with Emergency Response Coordinator for situational awareness.	
WAPDA & LESCO	Confirm points of contact for emergency response and maintain 24x7 emergency contact information through SMS, Email, and other contact sources.	Commissioner Office PMD & RMC DC & MC Offices PDMA EPD
	Maintain regular contact with Emergency Response Coordinator for situational awareness.	
	Review electric supply plans during days of high heat alerts and warnings.	
	Collaborate with PMD and RMC Lahore to increase the duration of power supply during high heat days.	
City Traffic Police, TEPA	Confirm points of contact for emergency response and maintain 24x7 emergency contact information through SMS, Email, and other contact sources.	Commissioner Office DC & MC Offices
	Maintain regular contact with Emergency Response Coordinator for situational awareness.	
	Review traffic control plans during days of high heat alerts and warnings.	
NDMA	Maintain regular contact with PDMA, PMD, DC and MC Offices for situational awareness.	Commissioner Office PMD & RMC DC & MC Offices EPD
	Review PDMA forecasts and operations on daily basis.	
PDMA	Ensure coordination and implementation of response action plans.	Commissioner Office DC & MC Offices PMD & RMC NDMA
	Continue SMS services and other awareness campaigns conducted by PDMA in Lahore for heatwave awareness and prevention measures.	

Table 8: Actions to be taken during the Heatwave season

Departments	Actions	Facilitating Departments
Commissioner Office	Coordinate with DC & MC Offices, WASA, WAPDA, and LESCO	PMD & RMC NDMA & PDMA DC & MC Offices Health Department Information Department Social Welfare Organizations
	Ensure access of vulnerable populations such as slum communities, and outdoor workers to shady areas and water supply. Temporary shelters, first-aid centers, and response camps should be kept open 24x7 for migratory populations.	
	Ensure timely information display for forecasts, and prevention measures.	
	Conduct consultative meetings and conferences wit response team to discuss ongoing situations during heat alert.	
Pakistan Met Department Regional Meteorological Centers.	Ensure timely coordination of all relevant information with NDMA and PDMA.	

Departments	Actions	Facilitating Departments
Health & Medicine Departments	Develop Information centers specialized for information dissemination in all health centers, hospitals, and health professionals.	Commissioner Office DC & MC Office NDMA & PDMA
	Produce regular reports (weekly basis) for the response coordinator during heat alert/	
	Ensure preparedness and response readiness of doctors/paramedical staff/human resource	
Information Departments	Display emergency contact numbers, nearby relief camps/first-aid centers/hospitals in all schools/offices/universities/factories/other public places.	Commissioner Office DC & MC Office Health departments
	Initiate awareness campaigns at all levels. E.g. media, schools, NGOs.	
Education & Labour Department	Initiate pilot projects for the provision of prevention material (such as caps, umbrellas) and distribution of ice-packs to construction workers, traffic police and transit staff.	Commissioner Office
DC & MC Offices	Declare highly vulnerable areas as emergency centers	Commissioner Office Health Department Police NDMA & PDMA
	Coordinate installation of relief camps and cooling stations.	
Local Government-Mayor & Union Councils	Ensure information access from Emergency repose coordinator through union council and mayor offices to the general public regarding current situation.	Commissioner Office DC & MC Office
Social Welfare Organizations	Mobilize human resources at all vulnerable locations.	Commissioner Office DC & MC Office Local Government
	Display awareness on ambulances and camps for public awareness.	
	Early-cooling treatment must be invoked when the patient is picked up.	
WASA	Coordinate with emergence response coordinator to determine critical areas and availability of facilities regularly.	Commissioner Office DC & MC Office
WAPDA & LESCO	Coordinate with emergence response coordinator to determine critical areas and availability of facilities regularly.	Commissioner Office DC & MC Office PMD & RMC
	Maintain regular contacts with the emergency response coordinator for situational awareness.	
City Traffic Police	Prevent unnecessary traffic delays, avoid road blockades, and restrict transit of people on rooftops during high heat hours.	Commissioner Office DC & MC Office
NDMA	Coordinate with armed forces, UN Bodies, NGOs, and philanthropists' organizations for mobilization of resources.	Commissioner Office PMD, PDMA
PDMA	Launch public awareness campaigns and ensure its outreach to the general public	Commissioner Office PMD, PDMA
	Utilize its coordination network for effective implementation of awareness plan.	

Table 9: Actions to be taken on Warning notice

Departments	Actions	Facilitating Departments
Commissioner Office	Mobilize all relevant departments to initiate response.	PMD & RMC DC & MC Offices Health Department Information Department Local Government
	Ensure all shade-supplying locations are open, activate temporary night shelters, and ensure water supply to public at all filtration plants and tube-wells.	
	Coordinate suspension of all unnecessary water usage, other than drining and cooling purposes.	

	Communicate with WAPDA & LESCO to ensure power supply protocols in all health-care centers and vulnerable locations are in place.	
Pakistan Met Department Regional Meteorological Centers.	Keep monitoring the temperature forecast patterns. Ensure timely coordination of all relevant information with all departments.	
Health & Medicine Departments	Increase the human resource at hospitals and first-aid centers by employing young volunteers to attend to the influx of patients. Maintain the record of each heat-related patient at each health-care center. Increase coordination with community health workers to increase outreach to highly vulnerable areas. Produce health impacts reports for emergency response coordinator on regular basis.	Commissioner Office DC & MC Office NDMA & PDMA
Information departments	Initiate public awareness campaign regarding the availability of relief camps, first-aid centers, emergency contacts, and nearby hospitals. Include religious scholars program anchors, and social influencers.	Commissioner Office DC & MC Office Health departments
Education & Labour Department	Advise employers of concerned organizations to shift the schedules of outdoor workers away from the peak heat hours (12:00 pm – 5:00 pm)	Commissioner Office
DC & MC Offices	Adopt all necessary arrangements required at all DHQs, and BHUs. Coordinate with Commissioner Office and Local Government Offices in Lahore Division	Commissioner Office Health Department Police NDMA & PDMA
Local Government-Mayor & Union Councils	Enable self-sufficiency of all neighborhoods, and assist vulnerable populations.	Commissioner Office DC & MC Office
Social Welfare Organizations	Mobilize the human resources and facilities at all vulnerable locations. Allocate the number of relief camps, first-aid centers, and ambulances in densely populated locations.	Commissioner Office DC & MC Office Local Government
WASA	Coordinate with emergence response coordinator to determine critical areas and availability of facilities regularly.	Commissioner Office DC & MC Office
WAPDA & LESCO	Ensure uninterrupted power supply at all critical locations such as healthcare centers and vulnerable locations.	Commissioner Office DC & MC Office PMD & RMC
City Traffic Police	Ensure the uninterrupted traffic flow near hospitals and emergency centers.	Commissioner Office DC & MC Office
NDMA	Activate all emergency operations as appropriate	Commissioner Office PMD, PDMA
PDMA	Issue timely warnings as received from Met Department.	Commissioner Office PMD, PDMA

Table 10: Actions to be taken on Emergency Notice

Departments	Actions	Facilitating Departments
Commissioner Office	Declare emergency in all hospitals.	PMD & RMC DC & MC Offices Health Department Information Department Local Government NDMA & PDMA
	Consider declaring public holidays under heatwave emergency.	
	Increase public water supply through the distribution of handouts, and facilities at all religious places, shopping centers, community parks, major roads, etc.	
	Monitor the operation of all cooling stations through designated teams.	
Pakistan Met Department	Keep monitoring the temperature forecast patterns. Ensure timely coordination of all relevant information with all departments. Ensure the	

Regional Meteorological Centers.	information outreach to the public about potential heatwave impacts through media, mobile applications, and website.	
Health & Medicine Departments	Initiate launch of mobile teams for emergency support and first-aid.	Commissioner Office DC & MC Office NDMA & PDMA
	Maintain the record of each heat-related patient at each health-care center and produce weekly reports. Report the number of heat-stroke patients and mortalities to the Commissioner on daily basis.	
Information departments	Ensure information dissemination in local languages through the use of all resources about precautionary measures during heatwave emergency.	Commissioner Office DC & MC Office Health departments
Education & Labour Department	Consider declaring public holidays under heatwave emergency.	Commissioner Office
DC & MC Offices	Monitor the activities of all subordinate departments and provide regular updates to emergency response coordinator.	Commissioner Office Health Department Police NDMA & PDMA
Local Government- Mayor & Union Councils	Engage with the social welfare organizations to manage the medical surge by ensuring access to nearest health-care center in all localities.	Commissioner Office DC & MC Office
Social Welfare Organizations	Mobilize the human resources and facilities at all vulnerable locations.	Commissioner Office DC & MC Office Local Government
	Ensure the attendance of all emergency calls from heat-affected people, and ensure their timely transport to a nearby emergency relief center.	
WASA	Ensure water supply through water browsers, water tankers, and all necessary means.	Commissioner Office DC & MC Office
WAPDA & LESCO	Coordinate with Commissioner Office and Health Care departments to ensure an uninterrupted power supply at all critical facilities and highly vulnerable areas.	Commissioner Office DC & MC Office PMD & RMC
City Traffic Police	Ensure the uninterrupted traffic flow near hospitals and emergency centers. Allocate traffic wardens at all congestion points in Lahore.	Commissioner Office DC & MC Office
NDMA	Monitor all emergency operations.	Commissioner Office PMD, PDMA
PDMA	Direct all relevant departments to implement precautionary measures.	Commissioner Office PMD, PDMA

### 3.5. Long Term Strategies

There is a need to adopt long-term strategies for a livable city that can sustain the hot temperature. There is a need for urban development, transport policies, building design and codes, energy-efficient designs, and cooling urban designs that can reduce the vulnerability of extreme heat events. The heatwave resilience strategies set out additional open doors for supporting, extra plan targets, and building political reasonability.

Nonetheless, it is emphatically suggested that open doors for an activity to reduce the heatwave impact. These longer-term methodologies structure a significant part of the general reactions to heatwave events and must be considered during the review of the plan.

There are some of the plans that must need to be considered to make the population of Lahore more resilient during the heatwave.

- Revise the residential and commercial building design by choosing the cool roofs, installing the cool pavements, increasing the canopy cover, and green roofing to reduce the exposure to the heatwave.
- Designing high-rise buildings, more green open spaces, acceptable transport infrastructure, and water supply and sanitation design to reduce the scattered growth.
- The walled city has become more populated and denser which is highly vulnerable to the heat island effect so there is a need of redesign, renewal and regeneration of the major areas to reduce the heatwave impact.
- At the policy level, there is a need to enhance the capacity building of the officials, encourage the collaborations among the partners, raise the public awareness, created the cooling zones and define the new standards or building bye-laws to reduce the exposure of heat.
- Decreasing the congestion by sustaining the development of a few downtown areas. Lahore, one of Pakistan's megacities, has developed and urbanized and this pattern will probably keep, considering the significantly less developed areas of the city. There is a need to change Lahore into a policy of a centric city, decreasing the traffic congestion and urban sprawl.
- There is a need to develop the rainwater harvesting tanks under the ground by WASA, develop the open spaces and parks, and increased vegetation and trees along the roads which can lead to the green urbanization of existing poor urbanization.
- Public transport demands the major focus to reduce the congestion of traffic on the roads which is a major cause of heat island effect. There is a need to better the traffic management system and encourage the public to reduce the use of their personal cars and bikes to lessen the effect of air pollution.

### 3.6. Monitoring & Evaluation

Monitoring and Evaluation is an important component to check the effectiveness of the plan. The assessment and evaluation structure include staggered markers and their suggested means and recurrence of estimation. It helps in working with boundless partner exchange on encounters and examples so that convenient and informed choices can be made at both key and functional levels.

A formal evaluation is basic to evaluate whether strategies are viable in lessening heat-related mortality and bleakness. This guides in characterizing components that need improvement, measuring the viability of variation endeavors, and assists in relating to costing compelling mediations. The following incorporates three principal components:

- Vulnerability and risk for population and health frameworks,
- Impacts on Health and health system, and
- Resilience for the health system and the population at national as well as local levels

The criteria that should be followed for the evaluation planning:

**Simplicity:** There should be simple objective of the meeting as;

- Type of information for the warning issuance
- Number of People and Coordinating agencies that will be involved in warning issuance.
- Time for monitoring, issuance of warnings and maintaining the system.

**Acceptability:** There must be the willingness of individuals who will be participated;

- Participation of the coordinating partners
- Completeness of response of different agencies

**Timeliness:** There must be a time record of warning before its issuance;

- Are the warnings delayed or timely with respect to the different activities?

**Sensitivity:** It will involve the number of times of warning issuance;

- Are How many times the warning will be an issue and what are the meteorological conditions that occurred?

**Specificity:** - The accuracy of the heatwave mortality forecast should be estimated in order to avoid the false forecasts

**Reach:** - Who is getting the information and what message they are communicating?  
- Is the information effective?

The Emergency Response Coordinator in the Office of the Commissioner will guarantee that checking data is incorporated in the arrangement's execution, regulating a course of yearly surveys, and plan refreshes as new data is accumulated.

The following steps will be involved in the evaluation process:

- The coordinator will produce the report on the following indicators as a result and lesson for the next year. This will be distributed among the public.
- The emergency response coordinator will organize the meeting in which coordinating committees and implementation partners will be involved in the review and evaluation of the plan. Each partner will come with the monitoring data and recommendations.

- The changes will be made in the plan on the basis of the results of meetings and consultations which will enhance the effectiveness of the plan. The emergency response coordinator will update the plan for next year and will be disseminated it to the coordinating parties prior to the next year's heat season.

Table 11: Evaluation questions and potential indicators for the implementation process

Evaluation Questions		Indicators
Availability of Facilities	Were water facilities, supplies, and health facilities available in the areas?	<ul style="list-style-type: none"> <li>▪ Number and type of the water and health facilities in the vulnerable areas</li> <li>▪ The water facilities are properly functional or nonfunctional.</li> <li>▪ The number of functional hours and the number of hours without water supply in each area</li> </ul>
Beneficiary satisfaction	Was the beneficiary satisfied with the available facilities?	<ul style="list-style-type: none"> <li>▪ The satisfaction rate of the beneficiaries in vulnerable areas.</li> </ul>
Identification of Vulnerable groups and places	Were the vulnerable communities all around served during heatwave occasions? What do they know about the heatwave vulnerability in their areas?	<ul style="list-style-type: none"> <li>▪ Number of the groups who are highly at risk</li> <li>▪ Geography of coverage and understanding of the heat vulnerability.</li> <li>▪ Number of the people who took advantage of facilities like cooling and relief camps</li> <li>▪ Number of the people with their demographic data who took advantage of the response actions.</li> <li>▪ Satisfaction of stakeholders and capacity building of practitioners and emergency responders to check the heat-related illness during the season</li> </ul>
Warning system	Was the warning issued timely and efficiently?	<ul style="list-style-type: none"> <li>▪ The efficiency of warning occurrence</li> <li>▪ Timeliness of alert notices and warning messages</li> </ul>
	Were the heatwave events precisely observed?	<ul style="list-style-type: none"> <li>▪ Frequency of the warnings according to the meteorological conditions.</li> <li>▪ PMD's Capacity to convey the information</li> </ul>
Framework for coordination	Major key components for the implementation of the Heatwave management plan?	<ul style="list-style-type: none"> <li>▪ Major and sufficient resources available for completing the TORS</li> <li>▪ Coordinating committee how many times reviewed the plan and gave the feedback?</li> <li>▪ Is staff appropriately available in the control room?</li> <li>▪ PMD is forecasting the information regularly and appropriately?</li> <li>▪ Are complete mortality data available from hospitals?</li> <li>▪ Is an Appropriate alert system used? Enough or not?</li> <li>▪ Additional weather stations installed (with the detailed samples along with the approx. prices)</li> <li>▪ Data collected efficiently and centralized?</li> </ul>
	Did coordinating partners consider it helpful and follow the guidance?	<ul style="list-style-type: none"> <li>▪ Views of partners on the coordination activities</li> <li>▪ Do response actions deliver by the partners during heat season?</li> <li>▪ Number of the engaged and responsible partners for their assigned roles</li> </ul>
	Were the vulnerable communities all around served during heatwave occasions?	<ul style="list-style-type: none"> <li>▪</li> </ul>

Evaluation Questions		Indicators
	Did the rate of morbidity and mortality reduce this year? Analyze the weather data and health records?	<ul style="list-style-type: none"> <li>▪ Patterns of the mortality and morbidity rates</li> <li>▪ Reduction or increment in health impacts during the season</li> </ul>
Sources of information and communication	Were the sources of information available on heatwave?	<ul style="list-style-type: none"> <li>▪ Communication with the relevant stakeholders</li> <li>▪ Number and type of notices issued by the implementing partners</li> </ul>
	Were the key notices or bulletins available for the target groups and public	<ul style="list-style-type: none"> <li>▪ Number and sources of information for a heatwave</li> <li>▪ Effectiveness of different sources and which one is more efficient source for giving information to vulnerable communities?</li> <li>▪ The capacity of the media to deliver the appropriate messages for high-risk groups</li> </ul>
	Do they understand and follow those key notices?	<ul style="list-style-type: none"> <li>▪ Any change observed in behavior and awareness</li> <li>▪ Built the capacity to cope with the heat-illness</li> </ul>
Immediate and Long-term strategies	Is heatwave relief and public awareness-related facilities available?	<ul style="list-style-type: none"> <li>▪ Posters, Brochures for heatwave awareness, electronic and social media, and heatproof shelter available in the area?</li> </ul>
	Has the city become more livable for groups and individuals vulnerable to heat events?	<ul style="list-style-type: none"> <li>▪ A number of policies and practices along with different technologies to improve the condition of the city.</li> <li>▪ Level of satisfaction of local community and other involved stakeholder with perceived changes</li> </ul>
	What kind of practices and measures are taken to reduce the urban heat island effect?	<ul style="list-style-type: none"> <li>▪ Number of urban planning, technological and policy solutions.</li> </ul>
	How heatwave management is integrated with the other kind of policy actions?	<ul style="list-style-type: none"> <li>▪ To which extent the transportation, climate change and urban development proposal help to reduce the heat impacts?</li> </ul>
Costing	What kind of resources are used for the warning and response system?	<ul style="list-style-type: none"> <li>▪ Costs of the Asset commitments for plan</li> <li>▪ Staff time spent on various exercises</li> <li>▪ Cost for climate and health related observations</li> </ul>

# Proposed Interventions

The following interventions are proposed in order to cater for and minimize the effects of Heatwave in the vulnerable areas of Lahore as identified through remote sensing analysis of climatic factors. Different interventions are provided for different drinking water appurtenances throughout the vulnerable areas of city. Following interventions are thus proposed under this exercise:

## 4.1. Provision of Sheds

It was observed during the survey that majority of filtration plants of Lahore do not have appropriate seating and shade available for public. These public level utilities play an important part by providing relief to the heat-stricken populace during especially during heatwave hours. Permanent Shed are thus proposed to be provided the scope of which is define as under:

- Provision of Permanent Sheds (Steel Frame – Fiber Glass) at 10 sites each in Data Ganj Baksh Town, Ravi Town, Shalimar Town, Samanabad Town and Gulberg Town with benches

The concept design of this intervention was developed for an ideal site, to visualize the final frame after laying and fabrication of the shed at the site, as shown below;



Figure 39: Concept Drawing for Shades at Filtration Plants

## 4.2. Provision of Electric Coolers

Electric Water Coolers are an important drinking water feature that is easy to access and does not occupy much space. This is the reason that these are proposed to be provided

at sites with clusters of population and constraint of space like markets, bus terminals and others. 2-Tap Electrical Steel Dispensers are thus proposed to be installed in Lahore with scope of the project containing:

- Provision of Electrical Steel Water Dispensers/Coolers at 25 sites across Lahore.
- Provision of Water Filtration Systems and Plumbing works for these coolers.

### 4.3. Cooling Stations

Cooling stations are medical relief camps with facilities to provide relief to the heat-stricken public and to cater for any possible medical cases. These features are established at the most vulnerable areas for heatwave, with high influx of population and less water availability. The scope of this project involves the following:

- Establishment of Cooling Stations/Medical Relief Camps at 25 sites across Lahore.
- Provision of temporary shades and fans at these camps.
- Provision of appropriate drinking water and cooling facilities at these camps.
- Provision of Medicines and Para-medical staff at these camps.





Figure 40: Concept of Cooling Stations





Figure 41: Concept of Medical Facility

## 4.4. Costing

Table 12: Proposed Interventions Cost

Sr.	Proposed Interventions	Scope	Cost (Million)
1	Provision of Permanent Sheds at Filtration Plants in Lahore	<ul style="list-style-type: none"> <li>▪ Provision of 50 No. Fiber and Steel Frame Shed at Filtration Plants in Lahore</li> <li>▪ (10 No. Sheds each for Data Gunj Baksh Town, Ravi Town, Shalimar Town, Samanabad Town, Gulberg Town)</li> <li>▪ Provision of Seating Benches</li> </ul>	15.78
2	Provision of 25 No. Electric Water Coolers for Lahore (80 Ltr)	<ul style="list-style-type: none"> <li>▪ Provision of 25 No. Water Coolers at 25 Sites</li> <li>▪ Provision of Filter System for Water Coolers</li> </ul>	2.63
3	Establishment of 25 No. Cooling Stations (Relief Camps) for Heatwave relief	<ul style="list-style-type: none"> <li>▪ Establishment of Heatwave Relief Camps at 25 Locations in Lahore</li> <li>▪ Provision of Water Coolers, Medicines, Fans, Seating Facility</li> </ul>	0.95
4	Establishment of Medical Camps	<ul style="list-style-type: none"> <li>▪ Provision of portable cabins, tables, beds, chairs, stool and benches</li> </ul>	2.25
		<b>Total Amount Rs.</b>	<b>21.61</b>
		<b>Add Contingencies Cost (3%)</b>	<b>0.648</b>
		<b>Add PST (5%)</b>	<b>1.080</b>
		<b>G-Total Amount</b>	<b>23.34</b>

An aerial photograph of a river valley, showing a winding river and surrounding terrain. A semi-transparent orange banner is overlaid horizontally across the center of the image.

# Annexure

# Annexure

## Annex – A: Stakeholder Consultation Meetings

Stakeholder consultations aimed to identify the intervention of government departments, in-process planning, and future plans pertinent to heatwave preparedness, management, and mitigation in Lahore city. Urban Unit organized consultation meetings with stakeholder departments, including the following:

### Provincial Disaster Management Authority (PDMA):

The Environment Team of Urban Unit had a meeting with Director General of PDMA on June 15, 2022. PDMA conducted significant interventions during the heatwave of 2022, which are mentioned below:

- Provision of drinking water in some of the hotspot areas
- Issuance of heatwave advisory in collaboration with Meteorology Department.
- Awareness campaign through social media and television (development of awareness brochures, TV advertisements, emergency number 1129 was communicated through all campaigns).
- Collaboration with the health department to develop separate blocks in hospitals for emergency heat stroke patients.

Incremental housing, unplanned Durban developments, rapid urbanization, and the non-availability of HR, were discussed as major challenges faced by the department. PDMA has developed SOPs for reactive handling of all kinds of emergencies and will be very effective in the implementation of the plan. The meeting resulted in the following agreed recommendations to be included in the heatwave management plan;

- Involvement of Expert in Plan-making process.
- Quantification of the affected population, and food security issues.
- Coordination of different departments to develop a holistic approach.
- A plan aimed at developing preparedness and resilience in the community should be developed.

### Water and Sanitation Authority (WASA):

The Environment Team of the Urban Unit had a meeting with XEN Engineering, WASA on June 16, 2022. Various short-term measures were adopted by WASA during heatwave, and medium-term measures have been proposed.

WASA owns 594 Tube wells, and 573 Filtration Plants in Lahore. The maintenance of Filtration Plants has been outsourced to Punjab Aab-e-Pak Authority (PAPA). PAPA has maintained 42 filtration plants from 2021-to 22, in collaboration with Al-Khidmat Foundation and UNICEF. Load-shedding and limitations of funding were the major problems issued by WASA. WASA recommended the development of an effective communication plan to raise community awareness for water conservation.

<ul style="list-style-type: none"> <li>➤ 49 low-pressure areas</li> <li>➤ Install 23 water tankers</li> <li>➤ Regulates the valves</li> <li>➤ Install Generators on 3 tube wells</li> <li>➤ Dispersed water browsers in low pressure areas</li> </ul> <p style="text-align: center; font-weight: bold;">SHORT TERM MEASURES</p>	<ul style="list-style-type: none"> <li>Replacement of 49 tube wells</li> <li>BRB Canal Project</li> <li>Underground Rainwater storage tanks</li> <li>2 RWH tanks have already been Installed</li> <li>Increased the tube wells running hours</li> </ul> <p style="text-align: center; font-weight: bold;">MEDIUM TERM MEASURES</p>
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Figure 42: Measures adopted and proposed by WASA

## Annex – B: Pictures



## Annex – C: Legal Landscape

### Climate Change Legislation in Pakistan

Pakistan's climate change action spans over two decades from the first time it ratified the United Nations Framework Convention on Climate Change (UNFCCC) back in 1994 and became an official partner in the international commitment to bring down greenhouse gas (GHG) emissions in the atmosphere. Pakistan actively participated in United Nations Conference on Human Environment and made preservation of Environment in 1973 as constitutional mandate. In 1983, Pakistan achieved another manifestation i.e., establishment of Pakistan Environmental Protection Ordinance in 1983. Under its Umbrella, National Environmental Quality Standards (1984) was prepared. Afterward, the Pakistan Environmental Protection Ordinance, 1983 was superseded by Pakistan Environmental Protection Act (PEPA), 1997, however, this Act doesn't provide any foundation to cater the climate change.

From subsequent endorsements of the goals of Kyoto Protocol 1997 and Paris Agreement 2015 to passing a National Climate Change Policy (NCCP) in 2012, followed by a Framework for Implementation of Climate Change Policy (2014-2030) and most recently, the Climate Change Act of 2017, which after a long wait provided the regulatory framework for Pakistan's climate change strategy, this confused relationship continued to develop sluggishly. However, during the same period, the implications of climate change for Pakistan changed drastically; from being a tiny voluntary partner in the developed world's wake-up to rectify its collective damage to the atmosphere, we are known today as the world's 7th most impacted country by climate change. The tragedy is that despite all of these developments, Pakistan's climate change strategy remains elusive and without any direction.

### International Agreements

Pakistan ratified the Kyoto Protocol (KP) in 2004 and the Paris Agreement in 2016, both containing mandatory goals for the signatories. KP mandated industrialized countries to cut down their GHG emissions (during 2008-2012) by 5% below their levels in the 1990s and gave developing countries the option to comply voluntarily. Subsequently and according to the latest and most ambitious commitment under the Paris Agreement of 2015, all member countries are required to implement their nationally determined contributions (NDCs) to reduce GHG emissions and bring down the rise in global temperatures from 2°C to 1.5°C by 2020. This entails introducing new laws catering to climate change or revising existing laws and/or policies to keep pace with the new global commitments, as well as developing a monitoring mechanism to ensure the implementation of the Paris Agreement. In Pakistan, the Climate Change Act of 2017 came as the first primary legislation dealing with climate change and is especially relevant in the context of the above international agreements as it empowers the federal government to make rules to give effect to the international commitments.

## **Climate Change Act 2017**

The 2017 Act establishes the Pakistan Climate Change Council (PCCC) to approve, oversee and monitor the implementation of adaptation and mitigation policies by federal and provincial ministries, divisions, departments and agencies across all sectors of the economy. To complement the PCCC, the Act establishes a separate body called the Pakistan Climate Change Authority (PCCA) tasked with researching, preparing and advising the government regarding legislative, policy and implementation measures related to climate change. This includes formulating comprehensive adaptation and mitigation policies and measures designed to primarily do the following:

- i) address the effects of climate change,
- ii) meet Pakistan's obligations under international conventions and agreements relating to climate change, and
- iii) give effect to the national climate change policy.

The problem with the Act is that while it establishes federal bodies with the specific task of implementing climate change action, it falls embarrassingly short of introducing effective measures to enable these bodies to make a difference. For example, one of the functions of the PCCA is to formulate and – after the approval of PCCC – coordinate implementation of low carbon and green growth strategies. In the absence of an express reference to set out carbon plans (emissions reduction targets), this may be taken as the closest alternative accounting for it. Assuming that is true, this provision is rendered ineffective as there is no response time given for the adaption of these strategies which allows the government to delay their implementation.

## **National Climate Change Policy 2012**

Over the last 15 years, the most comprehensive approach to climate change has been presented in the National Climate Change Policy, 2012 (NCCP). The objectives of the NCCP include mainstreaming of climate change in all sectors of the economy and minimising of risks associated with foreseeable events of climate change, such as floods and drought. While the NCCP fails to set any clear targets for national measures, it does in other respects set out a decent framework for future action plans and practice. It has been six years since its promulgation, but except for a few measures (such as the Billion Tree Campaign in Khyber Pakhtunkhwa that restored 350,000 hectares of forest land) the federal and provincial governments have remained largely inactive to implement the policy objectives.

Overall, the NCCP is successful in setting forth a road map for identifying the national factors and causes adding to the adversity of climate related problems and offering possible adaptation and mitigation solutions to address them. It makes some key recommendations which if taken seriously can prove extremely consequential to counter climate change.

However, the NCCP itself is a “soft law” and its non-binding nature means that it does not provide efficacious tools/mechanism for enforcement.

### **Framework for Implementation of Climate Change Policy (2014-2030)**

As a follow-up to the NCCP, the government introduced the Framework for Implementation of Climate Change Policy (2014-2030) in order to mainstream climate change concerns into decision-making and promote climate compatible development (an extremely important point that does not appear to have made its way to implementation). Meant to serve as a go-to document for preparing detailed provincial and local adaptation action plans, the Framework discusses adaptation plans for each sector separately and proposes actions along with an implementation timeframe for each action, which is divided into the following categories:

- Priority Actions (PA) : within 2-years;
- Short-term Actions (SA): within 5-years;
- Medium-term Actions (MA): within 10 years; and
- Long-term Actions (LA): within 20-years.

### **Punjab Climate change policy and action plan 2024**

Recently the climate change policy is also developed at provincial scale for the Punjab along with the action plan 2024. The key climate change impacts in Punjab, considered temperature change and heat stress in addition with other associated impacts to mitigate and adapt for sustainable future.

In which the Policy Action (PA) 1 for the climate change adaption set the targets that includes:

- 100% Preparation and implementation of heatwave and drought management plans for hotspot areas till 2027
- 100% Ensure the provision of shelter places and water filtration plants in heatwave hotspot areas till 2030

While the PA 3 for the cross-cutting (adaptation and mitigation) includes:

- 100% Development of Cities Climate Action Plans focusing on GHG inventory, pathway projections, risk assessment, and action plans for large cities till 2027.
- 15% Enhance carbon sinks through tree plantation and urban green/forest cover in major cities till 2035.

### **Way Forward**

While all of the laws, policies and rules discussed above indicate to an appreciable degree the legislators’ intent to counter climate change, we cannot and should not hide from the fact that the combined response has been highly ineffective for the most part.

Climate change is a matter of national security for Pakistan and our law needs to set clear milestones for climate change action and hold the government responsible if it fails to fulfill its obligations. The government needs to come up with a clear plan on how climate change laws, policies, practices will be adapted in the provinces and the provinces need to integrate the government's climate change action plan into their own detailed mitigation and adaptation plans. To ensure effective response, both the federal and provincial governments need to work in collaboration and here the PCCC established under the Climate Change Act of 2017 can play a key role.

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