Heat Action Plan (HAP)

Dhangadhi

2025

Nepal Red Cross Society

IFRC

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Climate Centre

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ABBREVIATIONS

CFL	compact fluorescent light
DAO	District Administration Office
DC	District Chapter
DDMC	District Disaster Management Committee
DEOC	District Emergency Operation Centre
DHM	Department of Hydrology and Meteorology
DoHS	Department of Health Services
DMP	Disaster Management Plan
DRR	disaster risk reduction
DTR	diurnal temperature range
ECMWF	European Centre for Medium-Range Weather Forecasts
FCHV	Female Community Health Volunteer
FGDs	focus group discussions
GEV	Generalized Extreme Value
HAP	Heat Action Plan
HI	Heat Index
Hi_{max_d}	daily maximum Heat Index
Hi_{max_90p}	90th percentile of Hi_{max_d}
Hi_{max_95p}	95th percentile of Hi_{max_d}
Hi_{max_ann}	annual maximum Heat Index
HRI	heat-related illnesses
HSIs	Heat Stress Indices
IEC	information and education campaign
I/NGOs	International/Nongovernmental Organizations
KIIs	key informant interviews
LDMC	Local Disaster Management Committee
LED	light emitting diode
LEOC	Local Emergency Operation Centre
LST	land surface temperature
NEA	Nepal Electricity Authority
NPABSON	National Private and Boarding Schools' Organization Nepal
NRCS	Nepal Red Cross Society
NWP	Numerical Weather Prediction
NWS	National Weather Service
PABSON	Private and Boarding Schools' Organization Nepal
PHA	Private Hospital Association
PV	photovoltaic
RH	relative humidity
RL	return level
RP	return period
RRT	rapid response team
T_{air}	near-surface temperature
T_d	dewpoint temperature
TLO	Tole Lane Organization
UHI	urban heat island
WDMC	Ward Disaster Management Committee
WHO	World Health Organization

EXECUTIVE SUMMARY

Dhangadhi Sub-Metropolitan City is vulnerable to high temperatures and is currently facing the adverse effects of extreme heat, which poses significant risks to health, productivity and economic growth. The Urban Heat Island (UHI) effect exacerbates these challenges, making certain wards of Dhangadhi considerably hotter than the surrounding rural areas, particularly in densely populated wards.

About the Heat Action Plan (HAP): This HAP presents a framework for planning, implementing, coordinating and evaluating actions to address extreme heat across various timescales. The HAP also aims to assist the Dhangadhi Sub-Metropolitan City, Nepal Red Cross Society (NRCS) and Kailali District Chapter by providing guidance on when and where to act before and during heatwave days, as well as outlining the necessary activities for preparedness and response during the heat season. Additionally, the plan includes long-term strategies for city planning, building design, energy reduction and water management to mitigate the overall impact of heat.

Approach for developing the HAP: The HAP is based on extensive research, which includes temperature distribution analysis from 1990–2023, land use studies and land surface temperature data from the years 2000, 2010 and 2023. It also incorporates inputs from household surveys with 984 respondents, key informant interviews (KIIs) and 25 focus group discussions (FGDs) involving five vulnerable population groups.

Heatwave risks: According to the Department of Hydrology and Meteorology (DHM) in Nepal, the hottest months in Dhangadhi are April to June. In 1990–2023, there were 421 days when temperatures reached 40°C or higher. Following the DHM definition, the classifications of these heatwaves in Dhangadhi are summarized in the table below:

MILD HEATWAVE (90th percentile)	**MODERATE HEATWAVE** (95th percentile)	**EXTREME HEATWAVE** (99th percentile)
Occurs when maximum temperature exceeds **37.7°C** for three or more consecutive days	Occurs when maximum temperature exceeds **39.4°C** for three or more consecutive days	Occurs when maximum Temperature exceeds **41.7°C** for three or more consecutive days

Source: Author's illustration based on DHM data

The city has experienced several heatwave events over the years, with numerous instances of mild heatwaves. Among these, the highest number of mild heatwave days were recorded in 2017 and 2019. Likewise, the highest number of moderate heatwave events occurred in 2005 and 2019, while the most extreme heatwave events were observed in 2005 and 2021, as per the DHM. During the pre-monsoon season, there is a significant diurnal temperature range (DTR), characterized by a considerable difference between daytime and nighttime temperatures, allowing people to rest more comfortably at night. However, nighttime temperatures remain elevated during the monsoon season and do not drop significantly. This lack of nighttime cooling increases the risk of heat-related health issues, particularly for children, older adults and low-income families who lack access to cooling options.

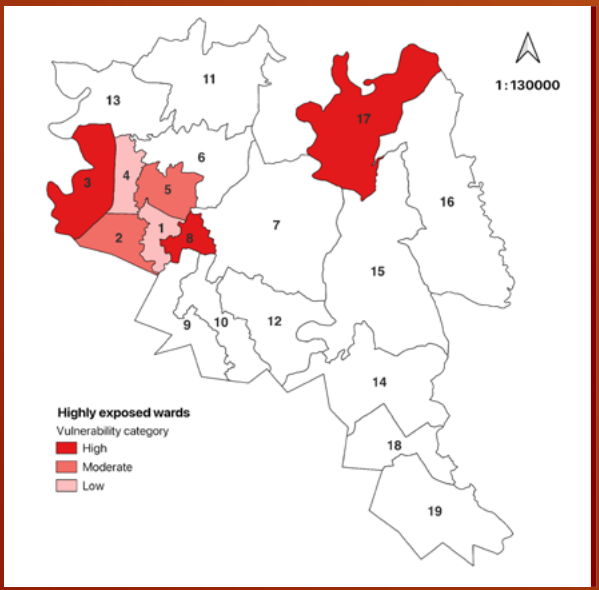
Vulnerable groups and their coping mechanisms: In Dhangadhi, eight different vulnerable population groups have been identified. These are:

- children under five years old
- elderly adults, especially over 65 years old
- individuals with chronic medical conditions
- individuals with disabilities
- individuals with low socioeconomic status
- outdoor workers
- people living in densely built areas
- pregnant and lactating women

These groups are particularly susceptible to the dangers of extreme heat due to their limited access to shade, water and cooling devices, which increases their risk of experiencing heat-related illnesses. Common symptoms experienced by city residents, especially those in vulnerable groups, during heatwaves include difficulty sleeping, fatigue, headaches and thirst. Communities have reported that health, electricity supply and water availability are the three most impacted areas during heatwaves.

When it comes to coping strategies, women tend to be more cautious than men. Depending on their resources, they often utilize shade, adjust their clothing and avoid heat exposure as much as possible. There is also a recognized need for targeted awareness and support for groups most affected by heat, particularly those with limited means to protect themselves.

Heat hotspots: The heat hotspots that require immediate action have been identified based on three key components: exposure, vulnerability and adaptive capacity to heat risks.



Source: Author's illustration based on data obtained from CBS (2021) and Landsat imagery

In Dhangadhi, Wards 3 and 8 have been identified as the most vulnerable areas, followed by Wards 17, 2, 5, 1 and 4 respectively. The primary factors contributing to these heat hotspots, particularly in Wards 1, 2, 4 and 5, include high population density, extensive built-up areas and busy highways with blacktop surfaces and heavy traffic. These wards represent the main urbanized sections of the city. In Ward 17, the heat hotspots are primarily associated with socioeconomically vulnerable populations who have limited resources to cope with extreme heat.

Heat threshold: Determining the appropriate time to act before or during heatwave days is crucial. A threshold analysis was conducted using historical temperature and humidity data from 1979–2023 across Kailali. This data is used to calculate the Heat Index (HI), which measures heat stress and is associated with health impacts, including mortality. The analysis suggests that a heatwave alert should be issued when the maximum Heat Index (HImax) reaches or exceeds 40.1°C for two consecutive days or 41.6°C for one or more consecutive days.

Communication of heat alert: A heat alert facilitates coordination among all relevant departments and engages with local media to promote awareness about extreme heat-risk safety. A Heat Task Force is responsible for coordinating and communicating actions both before and during extreme heat events, providing the necessary support for implementing the action plan.

Suggested actions to reduce the heat impact and build resilience:
The HAP provides a prioritized action list, divided into three main components:
preparedness, response and long-term adaptation.

Preparing for a heatwave: Preparing for heatwaves is essential to mitigate the effects of extreme heat events and safeguard the residents of Dhangadhi. The city's preparedness initiatives emphasize ten prioritized actions:

- identifying key stakeholders in the city
- establishing dedicated heat resilience teams or task forces within the municipality or local government
- planning for changing school schedules in the morning during the heat period / scheduling examinations before the start of the heat period
- adding additional hospital beds and managing fans and coolers
- arranging capacity-building programmes for healthcare professionals
- installing water ATMs to ensure access to clean drinking water
- providing incentives for low-income households, such as portable handheld or electric fans, and household-level solar photovoltaic (PV) systems
- changing workers' schedules and shifts
- developing a ward/municipal level plan for heat response/action activities
- developing heat awareness messages and raising awareness by distributing pamphlets; TV and radio broadcasts; and social media postings (Facebook, Twitter).

The Heat Task Force of Dhangadhi Sub-Metropolitan City oversees all activities in collaboration with the NRCS, Kailali District Chapter and various stakeholders. These include the media, Department of Health Services (DoHS), Nepal Electricity Authority (NEA) in Dhangadhi, Department of Water Supply and local community-based organizations.

Responding to a heatwave: Responding to a heatwave involves taking immediate action to keep individuals and communities safe from the dangers associated with extreme heat. These actions aim to prevent health risks, protect vulnerable groups and minimize heat-related impacts. The city's response efforts focus on ten prioritized actions:

- providing heat alert messages to residents for timely response and protection
- distributing heat relief supplies such as water, electrolyte beverages and cooling towels to affected communities
- activating cooling centres
- door-to-door outreach in high-risk neighbourhoods to distribute heat relief supplies
- water bell for students (reminder to drink water)
- installing water pots for animals
- enforcing regulations to protect outdoor workers from excessive heat exposure
- recording data on each patient suffering from a heat-related illness who visits a healthcare facility, and producing weekly reports on the public health impacts
- deploying medical units such as a rapid response team (RRT) to provide on-site medical care and assistance to those affected by heat-related illnesses
- Making sure water and electricity supplies are available to hospitals and other critical facilities during heat events.

The Dhangadhi Sub-Metropolitan City Heat Task Force coordinates all activities for the heat response initiative. This effort involves collaboration with the NRCS, Kailali District Chapter, Local Disaster Management Committee (LDMC) and Ward Disaster Management Committee (WDMC). All stakeholders work together to implement the citywide heat response plan effectively.

Long-term adaptation measures to build heat resilience: These measures are crucial for tackling the underlying causes of heatwave impacts and ensuring that communities can adapt sustainably to the increasing heatwave challenges. Focusing on long-term strategies can enhance communities' abilities to withstand heatwave events. The city's long-term plan includes ten prioritized actions to achieve this goal:

- planting along roadsides, planting in parks, maintaining green areas
- promoting green roofing
- establishing dedicated heat wards in government hospitals
- quantifying heat-related data
- implementing cool roofs and green coverage to enhance heat resilience in healthcare facilities
- offering incentives or rewards for residents who implement heatwave mitigation measures, such as installing reflective roofing or upgrading insulation
- raising awareness of energy-efficient appliances such as LED (light emitting diode) bulbs or CFL (compact fluorescent light) bulbs
- promoting fish farming for heatwave resilience and food security
- incorporating measures into building codes to standardize good practices
- establishing partnerships with educational institutions to incorporate heatwave preparedness into school curricula.

The Dhangadhi Sub-Metropolitan City coordinates activities with various stakeholders, including the NRCS, Kailali District Chapter and other relevant organizations such as the Department of Forestry, Department of Urban Development and Building Construction, Department of Roads, and the WDMC.

WAY FORWARD

The Dhangadhi Heat Action Plan is vital for the city's climate adaptation strategy, which is currently lacking. The city has a Disaster Management Plan (DMP), so it is essential that local authorities align the HAP with this DMP. The next immediate step is for the local government to officially adopt the HAP and integrate it into the city's disaster management or governance processes. This should be accomplished by endorsing the HAP at a city board or council meeting. The HAP must be recognized as part of the city's overall disaster management and adaptation efforts rather than considered in isolation.

1. INTRODUCTION

1.1. DHANGADHI HEAT ACTION PLAN (HAP) 2025

The Heat Action Plan (HAP) outlines a series of steps aimed at reducing seasonal heat risks, alongside long-term urban planning to tackle extreme heat affecting vulnerable populations. It details the coordinated actions of relevant stakeholders and the necessary interventions needed before, during and immediately after heatwaves to minimize health risks and the fatalities associated with extreme heat.

In Dhangadhi, the intensity and frequency of heatwaves have been increasing, making this HAP an essential benchmark for safeguarding public health, minimizing economic disruption and fostering sustainable, climate-resilient communities.

The specific objectives of the HAP for Dhangadhi include:

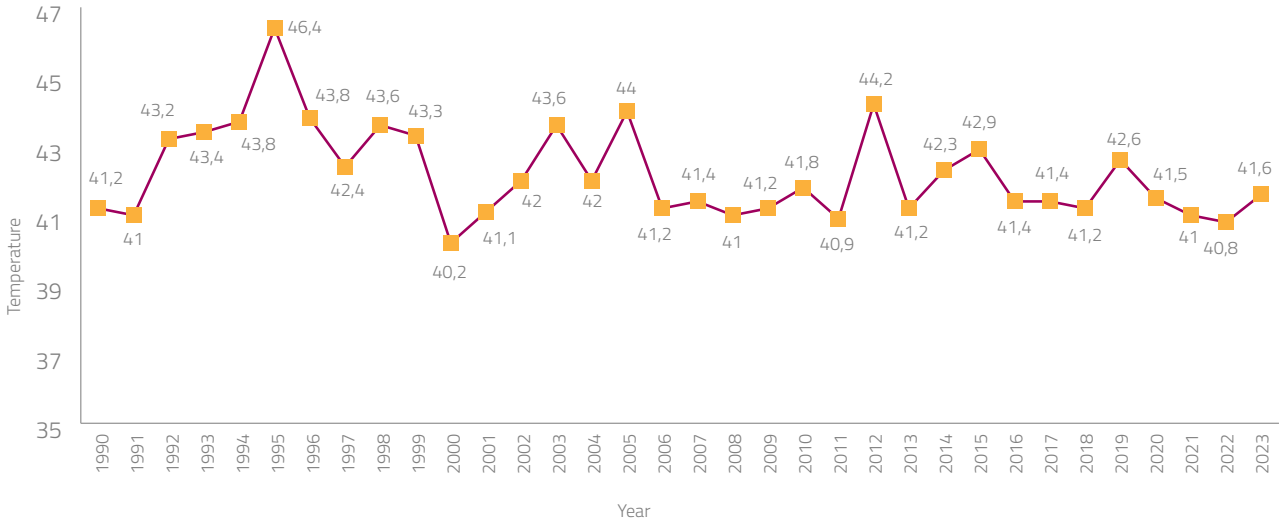
- understanding extreme heat events and extreme heat risk in Dhangadhi city
- identifying heat hotspot and people vulnerable to heatwaves
- establishing thresholds for the early warning of heatwaves and accordingly to anticipate, prepare for and respond to extreme heat risk
- building capacity on heatwave risk, impacts and possible measures to reduce the effects among key city stakeholders including governmental, non-governmental and private entities
- determining the heat threshold for the early warning system
- understanding the existing heat alert system in the city and outlining a framework for effective heat alert communication
- defining the preparedness and response measures to reduce heat impacts
- elaborating long-term planning measures to enhance the city's resilience to extreme heat
- mapping the different stakeholders and suggesting an effective coordination mechanism for preparedness, response and long-term adaptation measures to heatwaves.

1.2. RATIONALE – HAP IN DHANGADHI

Extreme heat is a silent killer that has persisted for years, particularly in the Terai region of Nepal, where summer temperatures can reach up to 45°C during heatwaves. Reports indicate instances of annual heat-related mortality (Kandel & Shyangtan, 2024). Due to its geographical location in the Terai plains, Dhangadhi experiences significantly elevated temperatures, especially during the pre-monsoon and summer seasons. The Terai plains of Nepal have a hot subtropical climate characterized by both heat and humidity (WWF, 2012). Its low elevation, combined with heat retention and limited air circulation, further intensifies the heat (Kandel & Shyangtan, 2024). Additionally, a lack of natural shade and increased urbanization exacerbates the urban heat island (UHI) effect, leading to more intense heatwaves (Bhusal & Salike, 2022).

Extreme temperatures have severe consequences for the residents of Dhangadhi. Several news articles have outlined the impacts and risks of heatwaves in the city. For instance, in 2006, five people died from heatstroke (The Himalayan Times, 2007). During heatwaves, schools often close, disrupting children's education. The rising temperatures make it difficult for students to concentrate and affects their mobility (The Himalayan Times, 2019). Hospitals report an increase in admissions for conditions such as fever, skin diseases and food poisoning. Notably, the number of beds in Seti Provincial Hospital in Dhangadhi increased from 21 to 38, as most wards and units are filled during the summer months due to heatwave-related illnesses (The Kathmandu Post, 2024).

FIGURE 1. MAXIMUM TEMPERATURE



Source: Author's illustration based on data obtained from DHM

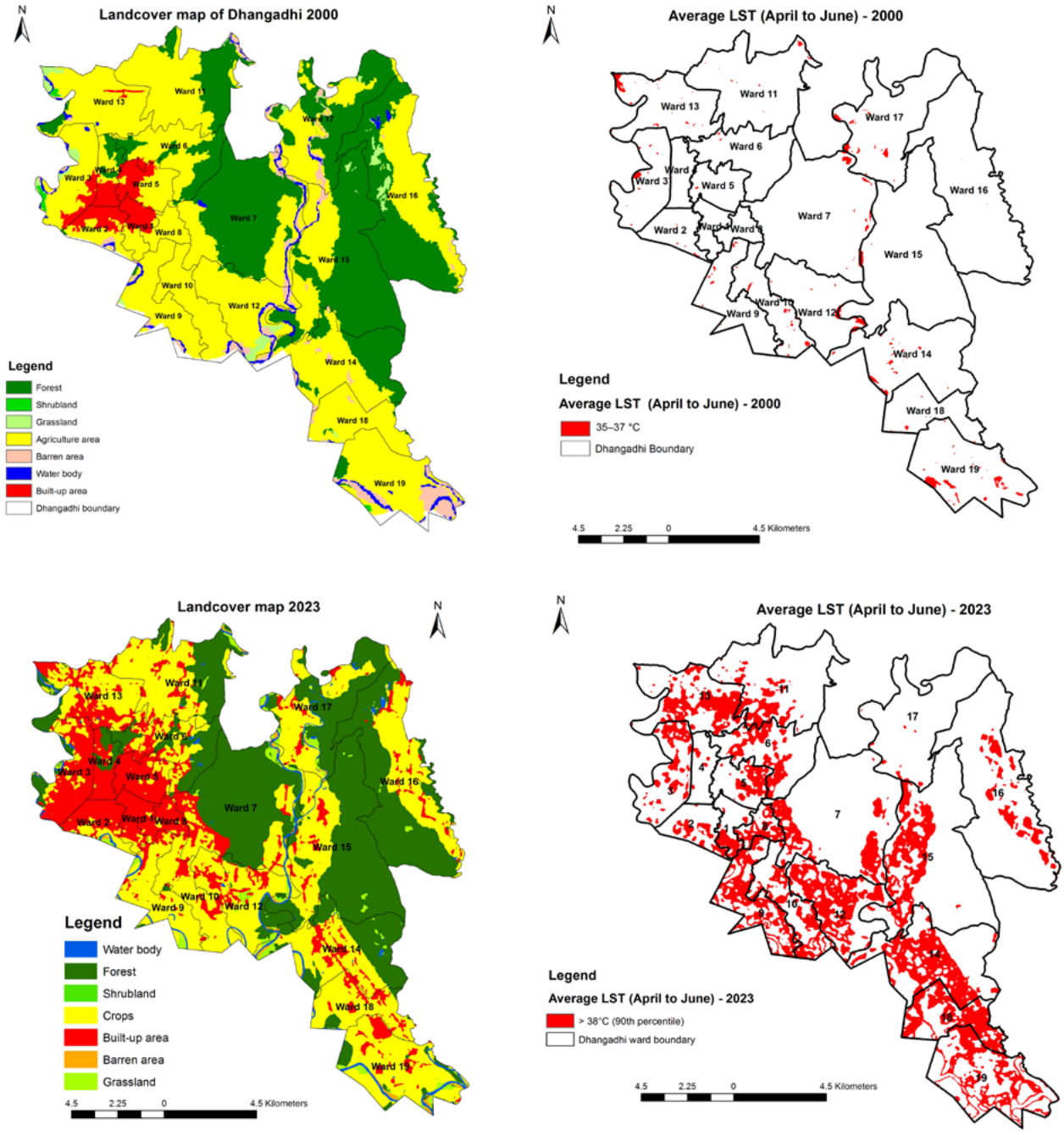
Figure 1 illustrates the maximum temperature of each year in 1990–2023. As observed, the highest maximum temperature, 46.4°C, was recorded in 1995, while the lowest, 40.2°C, occurred in 2000. Notably, for the past 33 years, the maximum temperature has exceeded 40°C every year.

Furthermore, in Dhangadhi, the annual average maximum temperature has been increasing by approximately 0.02°C per year (DHM, 2024a). This gradual rise indicates that heatwaves are likely to become more frequent, leading to increased impacts on both health and the environment.

THE ANNUAL AVERAGE MAXIMUM TEMPERATURE HAS BEEN INCREASING BY APPROXIMATELY 0.02°C PER YEAR

Rapid urbanization in Dhangadhi has led to an increase in concrete infrastructure, the expansion of impervious surfaces and a shift from agricultural activities to urban income-generating activities such as commerce and industry (also shown in Figure 2), all of which contribute to the heat island effect. As a result, the city faces a heightened risk of heatwaves. Figure 2 shows how changes in land-use patterns in Dhangadhi in 2000–2023 are one of the factors contributing to increasing the land surface temperature (LST) from April to June during those years.

FIGURE 2. LANDCOVER AND LST MAP OF DHANGADHI



Source: Author's illustration based on satellite image

When comparing the land-use maps from 2000 and 2023, there has been an exceptional increase in the built-up area of 393.2 per cent. Agricultural land has decreased by 24.2 per cent since 2000. This change is primarily due to the conversion of agricultural land into built-up areas, particularly observed in Wards 5, 7, 8, 10, 12 and 13. The significant growth in built-up areas indicates rapid urbanization and infrastructure development.

The land-use patterns of 2000 and 2023 have been analysed alongside the average LST from April to June for both years. This comparison helps to understand how different types of land cover, such as forest cover and urban areas, influence surface temperature patterns.

In 2000, only a few areas experienced high heat levels (35–37°C). However, LST 2023 illustrates a noticeable increase in surface temperatures compared to the LST data from 2000, showing an expansion of areas facing extreme heat. This rise in temperature and the growth of heat-affected areas is likely attributed to rapid and unplanned urbanization in Dhangadhi.

Furthermore, Dhangadhi has a significant population of socioeconomically vulnerable groups, including daily wage labourers, outdoor workers, farmers and residents of informal settlements, as well as vulnerable age groups such as the elderly, infants and young children. According to a community perception survey, 98 per cent of respondents reported that they believe temperatures have increased over the past few years and that extreme heat occurs annually (Figure 3). Among those surveyed, 71 per cent of women and 64 per cent of men believe that heatwaves are becoming more frequent, occurring at least several times each year (Figure 4).

DHANGADHI HAS A SIGNIFICANT POPULATION OF SOCIOECONOMICALLY VULNERABLE GROUPS, INCLUDING DAILY WAGE LABOURERS, OUTDOOR WORKERS, FARMERS AND RESIDENTS OF INFORMAL SETTLEMENTS, AS WELL AS VULNERABLE AGE GROUPS SUCH AS THE ELDERLY, INFANTS AND YOUNG CHILDREN

FIGURE 3. PERCEPTIONS OF RISING TEMPERATURES

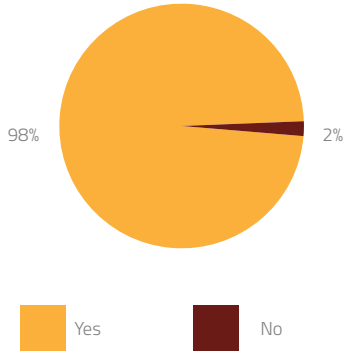
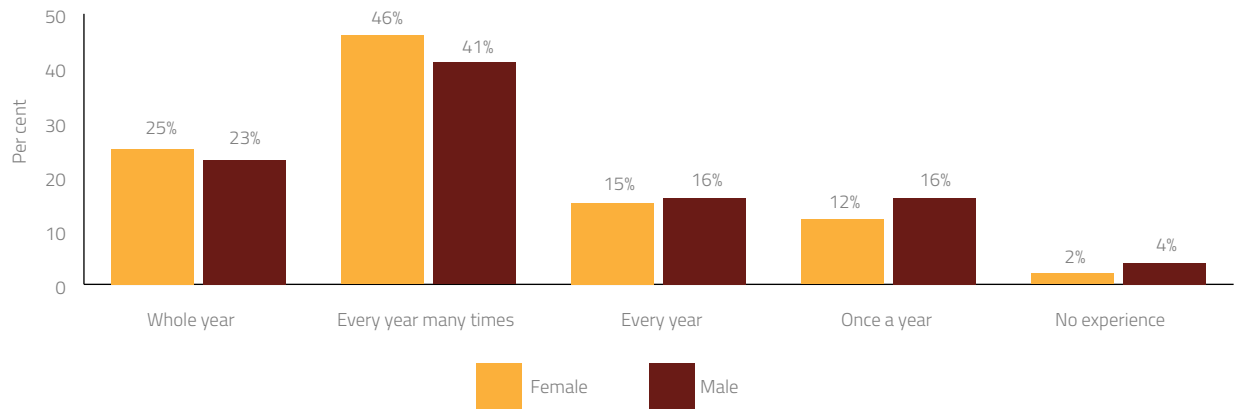


FIGURE 4. BELIEFS ABOUT INCREASING HEATWAVE FREQUENCY

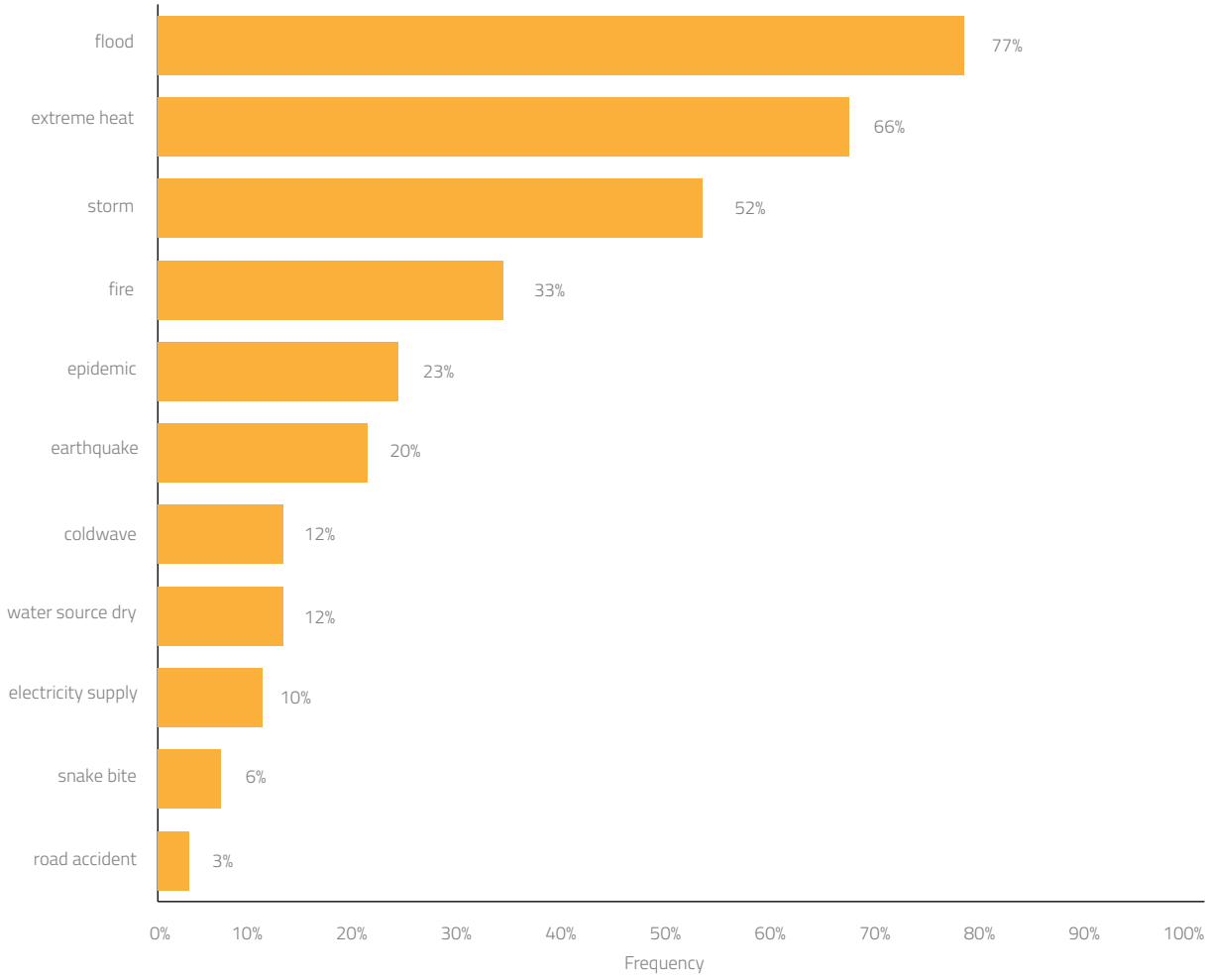


Source: Author's Illustration based on Community Perception Study

The perception study indicates that participants perceive heat as a significant threat to their well-being. The high percentage of respondents reporting frequent exposure to heat suggests possible health, social, economic and environmental consequences for the community. Additionally, the respondents also identified extreme heat as the most frequently mentioned stressor (Figure 5). It is essential to address these impacts through targeted interventions and a comprehensive HAP to safeguard public health, minimize economic losses and enhance community resilience in Dhangadhi.

THE PERCEPTION STUDY INDICATES THAT PARTICIPANTS PERCEIVE HEAT AS A SIGNIFICANT THREAT TO THEIR WELL-BEING. THE HIGH PERCENTAGE OF RESPONDENTS REPORTING FREQUENT EXPOSURE TO HEAT SUGGESTS POSSIBLE HEALTH, SOCIAL, ECONOMIC AND ENVIRONMENTAL CONSEQUENCES FOR THE COMMUNITY.

FIGURE 5. TOP-RANKED STRESSORS IDENTIFIED BY VULNERABLE GROUPS



Source: Author's illustration based on community perception study

1.3. APPROACH FOR DEVELOPING THE HAP

In this HAP study, a holistic and inclusive approach has been followed. The Figure below shows the detailed processes and methodologies used.

FIGURE 6. STUDY APPROACH

Source: Author's illustration

2. HEATWAVE AND ITS RISK IN DHANGADHI

2.1. TEMPERATURE VARIATION IN DHANGADHI CITY

The daily maximum temperature data collected from the local observation station of the DHM from 1990–2023 were analysed (Table 1). April, May, and June are identified as the hottest months, with a greater likelihood of experiencing heatwaves during this time. Together, these three months account for a total of 421 days when maximum temperatures reach or exceed 40°C.

TABLE 1. NUMBER OF MAXIMUM TEMPERATURE DAYS AT DHANGADHI 1990–2023

Max temperature (°C)	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total	% of total
40 °C and greater	-	-	-	62	194	165	-	-	-	-	-	-	421	3,5%
38 — 40°C	-	-	4	192	268	176	3	2	-	-	-	-	645	5,3%
36 — 38°C	-	-	25	321	248	176	67	23	10	-	-	-	870	7,2%
30 — 36°C	-	26	597	413	318	458	845	870	875	854	132	-	5388	44,6%
25 — 30°C	69	442	370	25	20	43	105	120	90	149	770	277	2480	20,5%
20 — 25°C	533	430	51	-	-	-	-	-	-	4	81	585	1684	13,9%
Less than 20°C	430	48	-	-	-	-	-	-	-	-	-	125	603	5,0%

Source: Author's illustration based on data obtained from DHM

2.2. HEATWAVE IN DHANGADHI

A heatwave is defined as a period of excessively high temperatures lasting for more than three consecutive days. The specific threshold temperature for a heatwave varies depending on local climatic conditions and meteorological circumstances. Because the definition of a heatwave is influenced by regional climate and weather patterns, there is no universal definition that applies everywhere. In Nepal, the DHM has categorized heatwaves into three levels: mild, moderate and extreme.

TABLE 2. DEFINITION OF HEATWAVE, DHM

MILD HEATWAVE	MODERATE HEATWAVE	EXTREME HEATWAVE
annual count of days with at least three consecutive days where the maximum temperature exceeds the 90th percentile for a given period.	annual count of days with at least three consecutive days where the maximum temperature exceeds the 95th percentile for a given period.	annual count of days with at least three consecutive days where the maximum temperature exceeds the 99th percentile for a given period.

Source: DHM, 2024b

Following the DHM definition, heatwaves based on extreme temperatures in Dhangadhi were identified by analysing historical temperature data from the last 33 years (1990–2023) in the city. The classifications of these heatwaves are summarized in the table below:

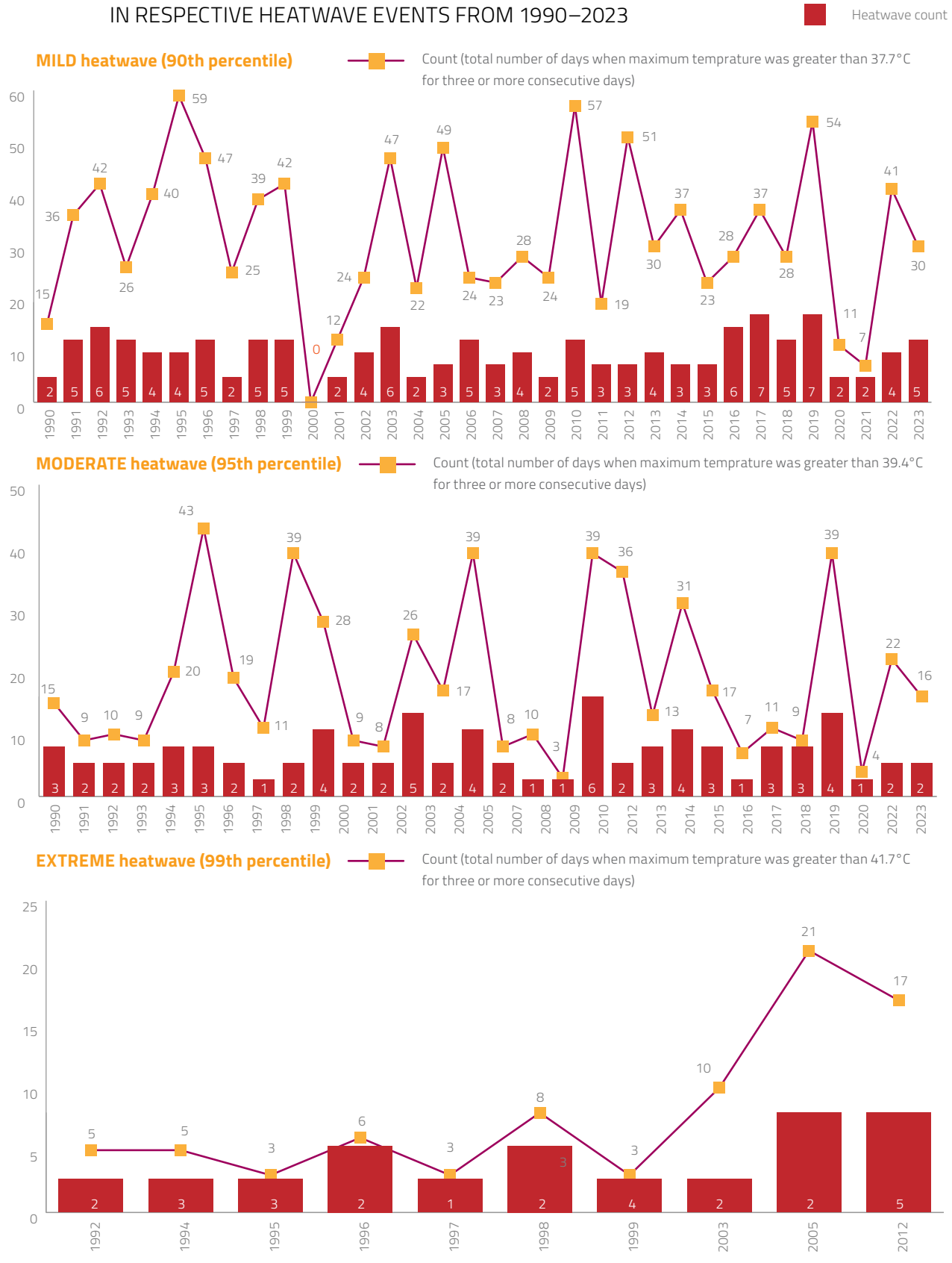
TABLE 3. MILD, MODERATE AND EXTREME HEATWAVES IN DHANGADHI

MILD HEATWAVE (90th percentile)	MODERATE HEATWAVE (95th percentile)	EXTREME HEATWAVE (99th percentile)
Occurs when maximum temperature exceeds **37.7°C** for three or more consecutive days	Occurs when maximum temperature exceeds **39.4°C** for three or more consecutive days	Occurs when maximum temperature exceeds **41.7°C** for three or more consecutive days

Source: Author's illustration based on DHM data

Figure 7 shows the number of heatwave events at the 90th percentile, 95th percentile, and 99th percentile that occurred each year from 1990–2023, specifically from April to June, as these months are the hottest.

FIGURE 7. NUMBER OF HEATWAVE EVENTS AND NUMBER OF DAYS IN RESPECTIVE HEATWAVE EVENTS FROM 1990–2023



Source: Author's illustration based on data obtained from DHM

The numbers highlighted in red indicate the total number of hot days categorized by the levels of heatwave intensity during specific years, as shown in Figure 7. A heatwave event is defined by examining temperatures over several consecutive days. For instance, let's look at the temperatures recorded from April to June in 2021, detailed in Table 4.

TABLE 4. TEMPERATURE ABOVE 37.7°C FOR THREE OR MORE CONSECUTIVE DAYS IN 2021 (90TH PERCENTILE OR MILD HEATWAVE)

DATE	MAXIMUM TEMPERATURE (°C)
13/04/2021	38.2
14/04/2021	38.7
15/04/2021	38.6
16/04/2021	38.2
06/06/2021	37.7
07/06/2021	38.2
08/06/2021	37.7

Source: Author's illustration based on data obtained from DHM

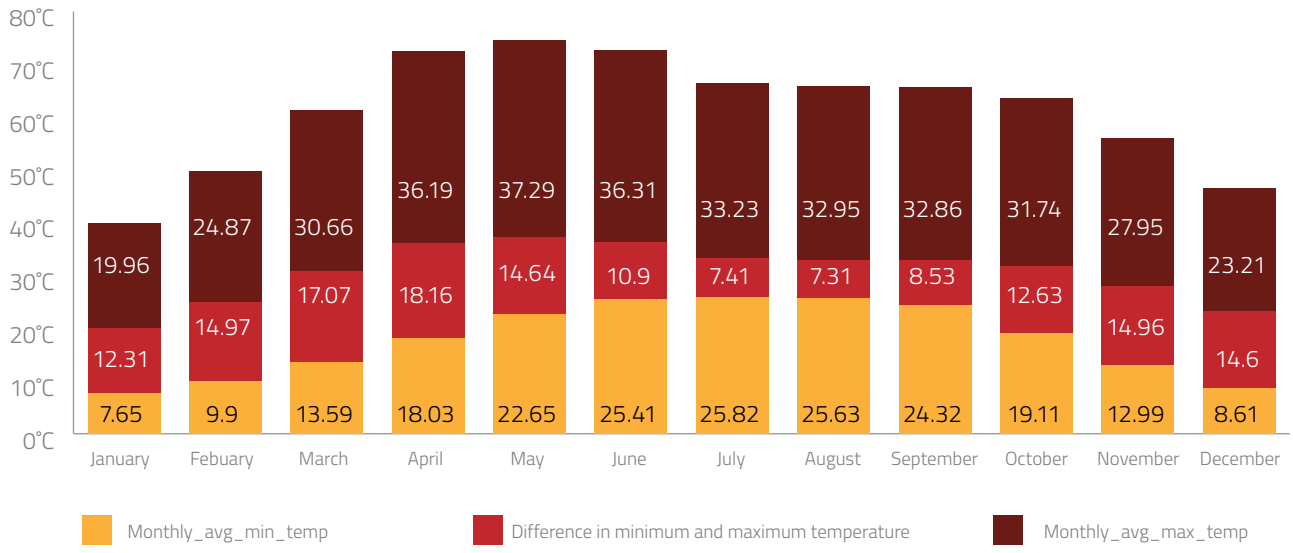
In 2021, from 13–16 April, temperatures were recorded at 38.2°C, 38.7°C, 38.6°C and 38.2°C respectively. These consistently high temperatures, with each day reaching 37.7°C or higher, indicate a four-day heatwave event. Similarly, from 6–8 June 2021, temperatures persisted above 37.7°C for three consecutive days, meeting the criteria for a heatwave. Therefore, in 2021, two different heatwave events occurred, lasting a total of seven days.

The highest number of days with temperatures exceeding 37.7°C for three consecutive days was observed in 2017 and 2019. Each year experienced seven separate heatwave events lasting 37 days in 2017 and 54 days in 2019 (Figure 7). This is followed by 1992, 2003 and 2016, with six heatwave events, lasting for 42 days, 47 days and 28 days, respectively. The count of heatwave events per year varies, with some years experiencing multiple heatwaves. In contrast, some years, such as the year 2000, did not see any heatwave events. This indicates that, while individual years may vary, the overall rise in average maximum temperatures can lead to frequent and intense heatwaves.

In the 95th percentile or moderate heatwave scenario, the highest count of days with temperatures exceeding 39.4°C for three consecutive days was observed in 2010 and 2019, with six and five heatwave events respectively lasting 39 days. This is followed by 2012, with 36 days and two heatwave events. It is interesting to note that the years 2000, 2011 and 2021 did not see any moderate heatwave events, further indicating variability in the upward trend of heatwave events.

The third figure of Figure 7 shows the occurrence of extreme heatwave events in Dhangadhi city. The highest number of days with temperatures exceeding 41.7°C for three consecutive days was observed in 2005, with three heatwave events lasting 21 days. Extreme heatwave events were observed in ten different years in 1990–2023. Figure 8 shows the monthly average maximum and minimum temperature in 1990–2023 along with the difference in monthly average maximum and minimum temperature. Understanding monthly trends is crucial in predicting and preparing for future heat events in Dhangadhi.

FIGURE 8. MONTHLY AVERAGE MAXIMUM AND MINIMUM TEMPERATURE (1990–2023)



Source: Author's illustration based on data obtained from DHM

The highest monthly average maximum temperatures are recorded in April, May and June with values exceeding 35°C. In contrast, the lowest monthly average maximum temperatures occur in December, January and February. Similarly, the peak monthly average minimum temperatures are observed in June, July and August, averaging around 25°C, while the lowest monthly average minimum temperatures are found in December, January and February.

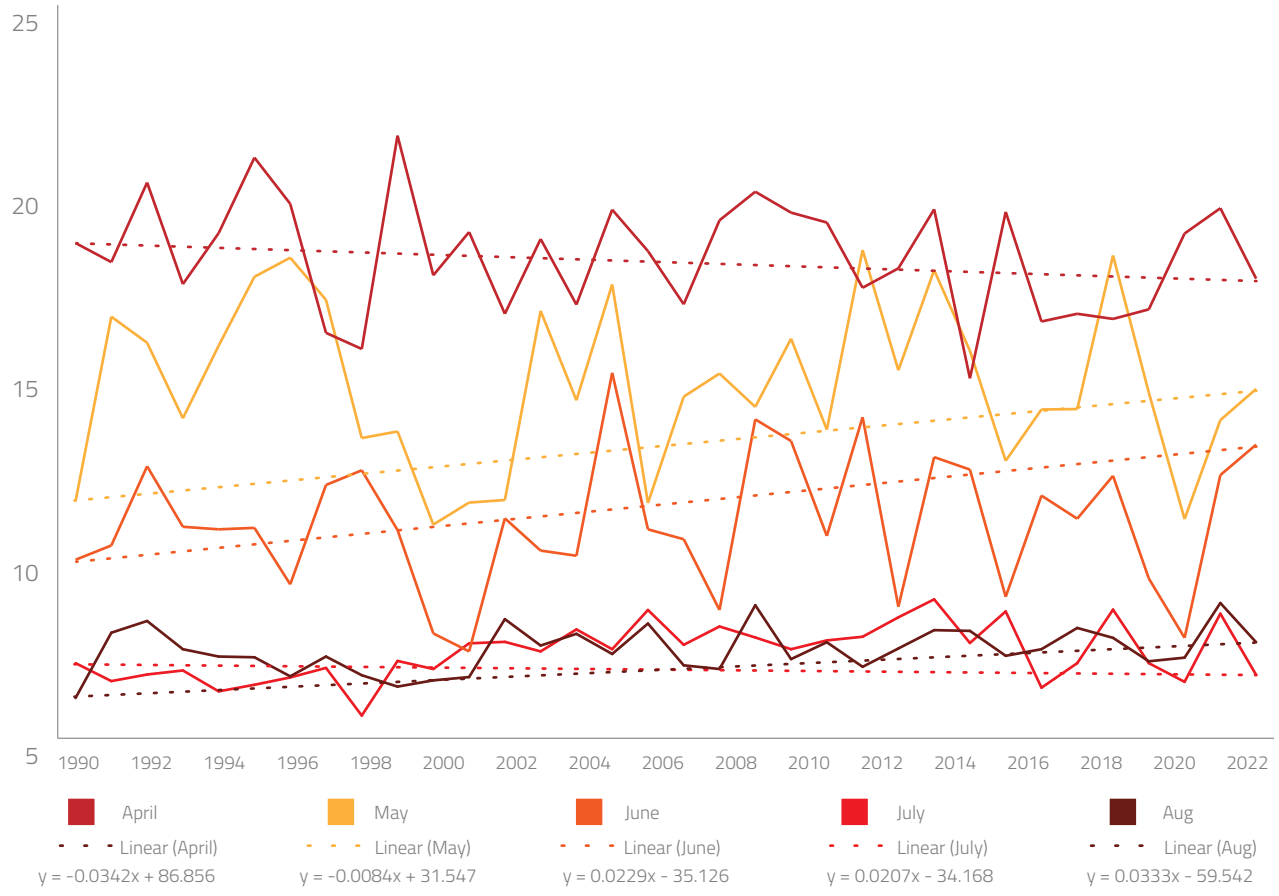
The difference between the monthly average maximum and minimum temperatures – known as the diurnal temperature range (DTR) – is illustrated in Figure 8. According to the DHM, April, May and June are the hottest months in Dhangadhi and, during this period, the DTR is significantly high. This temperature difference, often exceeding 10°C, indicates that nighttime temperatures are considerably cooler than those during the day. The cooler nights provide relief from the heat for the most vulnerable individuals, allowing them to recover from the extreme daytime temperatures.

During July and August, daytime temperatures offer some relief, with the average maximum reaching around 33°C. However, the difference between the average maximum and average minimum temperatures during these months is relatively low, at just 8°C. The average minimum temperature is about 25°C, indicating that nighttime temperatures are also elevated. This lack of cooling at night significantly impacts vulnerable populations, who suffer greatly because there is little to no relief from the heat when trying to sleep.

The human body relies on cooler nighttime conditions to recover from heat exposure accumulated throughout the day. When nighttime temperatures remain high, the risk of heat-related illnesses increases, sleep patterns can be disrupted, and cardiovascular stress is elevated, particularly among susceptible populations such as individuals with pre-existing heart or respiratory conditions, the elderly, infants and low-income populations who may lack access to cooling solutions (Tao et al., 2023).

Although July to September is considered the monsoon season, these months can still pose heat risks due to elevated nighttime temperatures. Many vulnerable individuals opt to sleep outside during the summer to cool off, but they often face discomfort and an increased risk of heat-related illnesses such as dehydration, heat exhaustion and heat stroke during this period.

FIGURE 9. DIFFERENCE BETWEEN MONTHLY AVERAGE MAXIMUM AND MINIMUM TEMPERATURE



Source: Author's illustration based on data obtained from DHM

Figure 9 illustrates the difference between the monthly average maximum and minimum temperatures for April, May, June, July and August from 1990–2023. The Figure also includes trend lines for each month, along with their respective slopes.

Notably, the difference between the monthly average maximum and minimum temperatures in April and May is decreasing at rates of 0.03°C and 0.01°C per year, respectively. In contrast, the temperature differences for June, July and August are on the rise, with increases of 0.02°C, 0.02°C and 0.03°C per year, respectively.

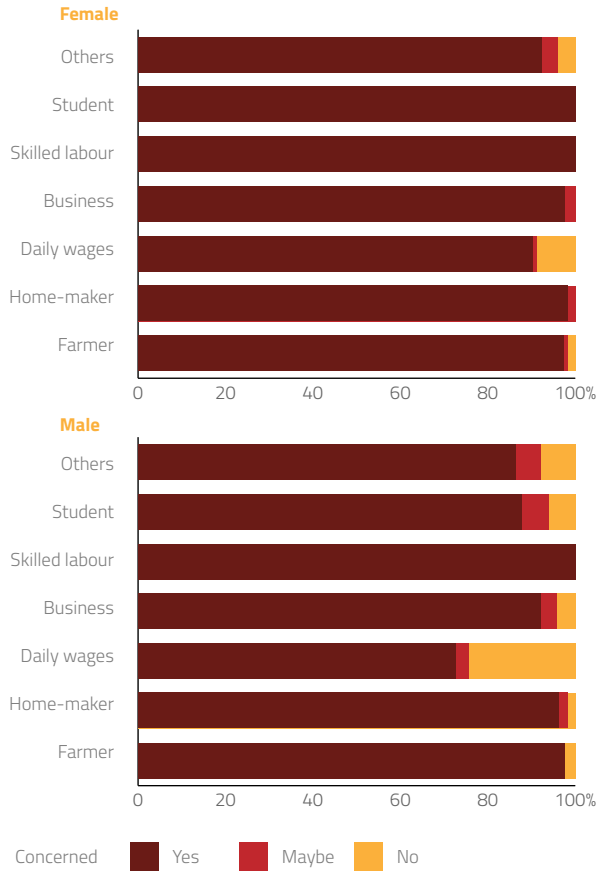
The declining DTR in April and May indicates that the difference between daytime and nighttime temperatures is becoming smaller. This trend is primarily attributed to a faster increase in nighttime temperatures compared to daytime temperatures in Dhangadhi city (DHM, 2024a).

2.3. HEATWAVE RISK IN DHANGADHI BASED ON COMMUNITY PERCEPTION

The community perception study, which included 984 respondents (579 females and 405 males), shows that 92 per cent of respondents, regardless of age, gender, occupation or education level, are concerned about the risks associated with extreme heat. The occupational distribution of respondents includes 4.6 per cent students, 4.2 per cent skilled labourers, 7.8 per cent businesspeople, 21.6 per cent daily wage workers, 29.5 per cent home-makers (previously referred to as housewives), 30.9 per cent farmers, and 1.4 per cent falling under the 'others' category, which includes government staff and retired individuals. As shown in Figure 10, women express greater concern over the risks associated with extreme heat compared to men.

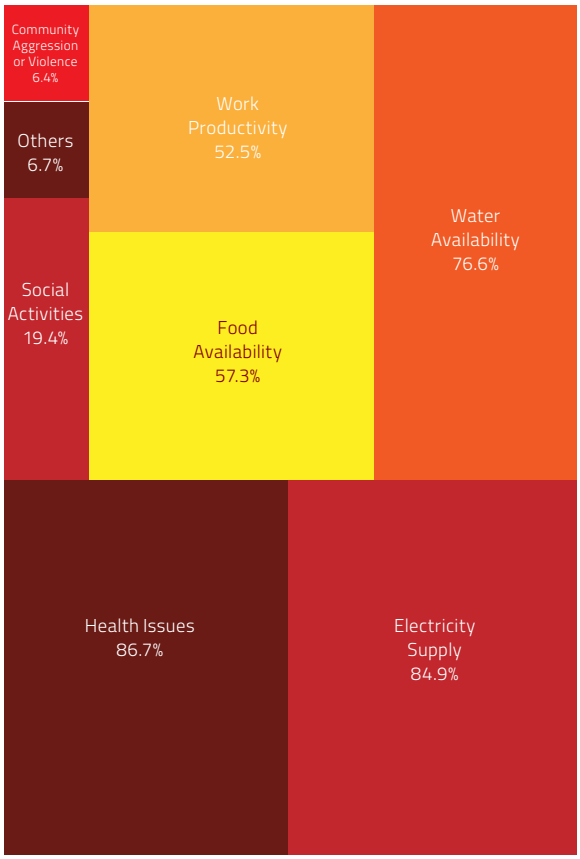
THE COMMUNITY PERCEPTION STUDY, WHICH INCLUDED 984 RESPONDENTS (579 FEMALES AND 405 MALES), SHOWS THAT 92 PER CENT OF RESPONDENTS, REGARDLESS OF AGE, GENDER, OCCUPATION OR EDUCATION LEVEL, ARE CONCERNED ABOUT THE RISKS ASSOCIATED WITH EXTREME HEAT.

FIGURE 10. CONCERNED ABOUT EXTREME HEAT-RELATED RISKS



Source: Author's illustration based on community perception study

FIGURE 11. IMPACT OF HEAT ON DAILY LIFE AND SERVICES



Source: Author's illustration based on community perception study

Communities have identified health, electricity supply and water availability as the three most affected areas due to extreme heat. This concern is recognized by both males and females, as well as across all occupational and age groups. Among the most vulnerable groups, farmers and daily wage workers reported the most significant impacts on food availability and work productivity.

COMMUNITIES HAVE IDENTIFIED HEALTH, ELECTRICITY SUPPLY AND WATER AVAILABILITY AS THE THREE MOST AFFECTED AREAS DUE TO EXTREME HEAT.


Photo Credit: Dambaraj Giri

PHOTO 1: FGD with the elderly adult group

3. VULNERABLE GROUPS IN DHANGADHI

Extreme heat can have serious health impacts on everyone; however, certain groups are at a higher risk. The city has identified eight vulnerable population groups, as detailed in the Figure 12. These vulnerable groups in Dhangadhi are particularly susceptible to the dangers of extreme heat due to their limited access to shade, water and cooling devices, which increases their risk of experiencing heat-related illnesses.

FIGURE 12. VULNERABLE GROUPS IN DHANGADHI

Children under five years old
Dhangadhi city has about 14,052 infants. Since babies haven't fully developed their ability to cool down through sweating, they are more vulnerable to heat stress. They also depend on caregivers to notice and respond to signs of heat-related illness.

Elderly population (over 65 years old)
Dhangadhi city has around 10,703 elderly residents. Many of them have pre-existing health conditions like heart disease or diabetes, which can get worse during extreme heat. This increases their risk of heat-related illnesses such as heat exhaustion or stroke. Additionally, older adults may find it harder to cope with extreme heat and may not always recognize it as a danger.

Individuals with chronic medical conditions
People with chronic conditions like heart disease, asthma, or diabetes struggle to regulate body temperature, making them more sensitive to heat. For example, someone with heart disease may experience a faster heartbeat or chest pain during extreme heat.

Individuals with disabilities
People with disabilities in Dhangadhi often depend upon caregivers for daily tasks, including staying cool and hydrated. Limited mobility can make it harder for them to access cooler spaces, and they may not get help quickly during heatwaves.

Individuals with low socioeconomic status
People with low socioeconomic status, including those living in slums and poorly built homes with thatched roofs, are especially vulnerable during extreme heat. Most slum areas are in Wards 5, 6, 12,13, and 17. Many lack fans or coolers, leading to higher indoor temperatures and a greater risk of heat-related illnesses during heatwaves.

Outdoor workers
Outdoor workers in Dhangadhi, like construction workers, street vendors, traffic police, farmers, and auto drivers, often do heavy work in direct sunlight and heat. This exposure, along with air pollution, makes them more prone to dehydration and heat-related illnesses.

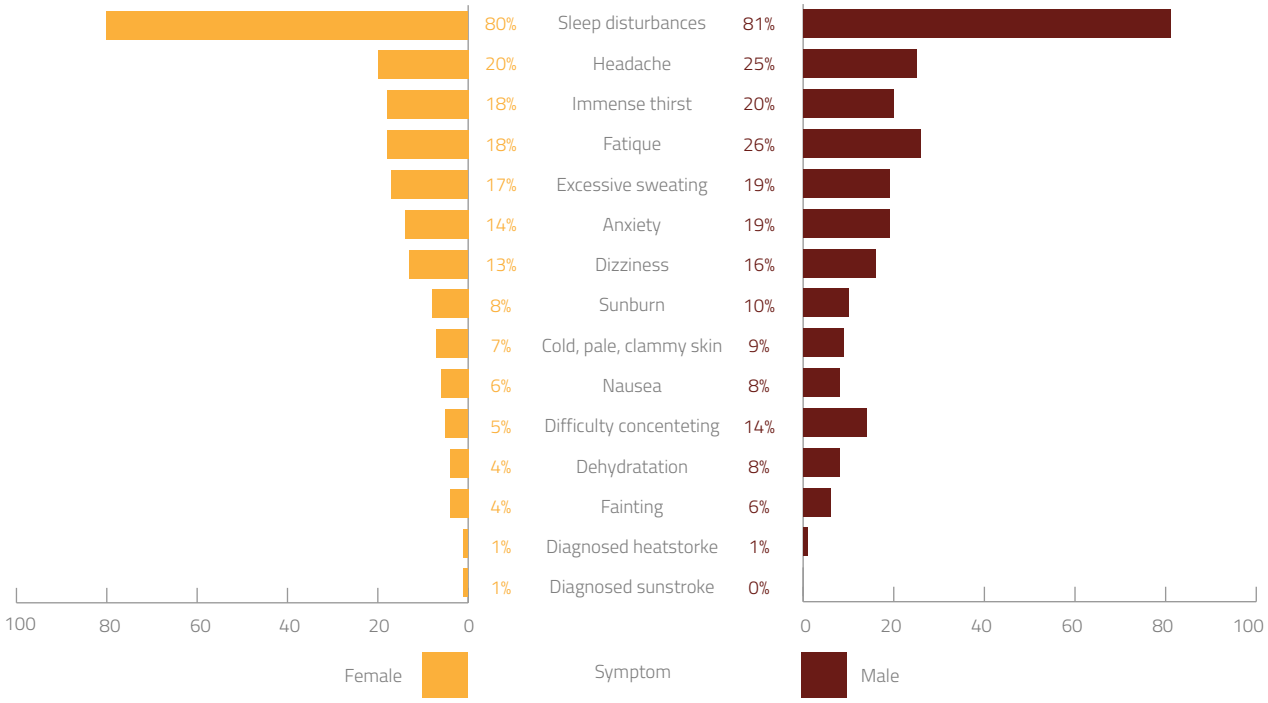
People living in densely built areas
Densely built urban areas, such as Wards 1, 2, 3, 4, 5, and 8, absorb and retain more heat, creating what's known as the urban heat island effect. With many people and buildings, these areas produce more heat, raising temperatures further.

Pregnant and lactating women
Pregnant women are also more sensitive to heat due to increased blood volume, making them prone to dehydration and a higher risk of early labour after a heatwave. Lactating women need extra water since breastfeeding causes significant fluid loss.

Source: Author's illustration

Based on the FGDs with five groups of differently vulnerable people (as described in Section 1.3), it is evident that all of these groups are highly susceptible to heat, particularly in heat hotspots throughout the city. They exhibit significant heat-related symptoms and experience varying degrees of illness, as illustrated in Figure 13.

FIGURE 13. HEAT SYMPTOMS OBSERVED AMONG VULNERABLE GROUPS



Source: Author's illustration based on community perception study

It is noteworthy that a higher percentage of males report experiencing each symptom compared to females. Specifically, 80 per cent of respondents, regardless of gender, indicate that they suffer from sleep disturbances. Additionally, 25 per cent of men and 20 per cent of women experience headaches. Finally, only 1 per cent of both men and women report being diagnosed with heatstroke.

In terms of age groups, almost all respondents under 18 years old report symptoms such as immense thirst, excessive sweating, headaches, and fatigue, likely due to increased physical activity in hot conditions. For those aged 18–49, over two-thirds experience sleep disturbances – such as difficulty in falling asleep or staying asleep, followed by headaches, thirst, fatigue, excessive sweating, anxiety and dizziness. Among individuals aged 50 and above, sleep disorders are the primary concern, with less than 20 per cent reporting other symptoms during extreme heat. When analysing occupational groups, sleep disturbances are highly prevalent across all occupations, with over 70 per cent of workers experiencing them. Other common symptoms across occupational categories include headaches, thirst, fatigue, excessive sweating, anxiety and dizziness.

Photo Credit: Dambaraj Giri

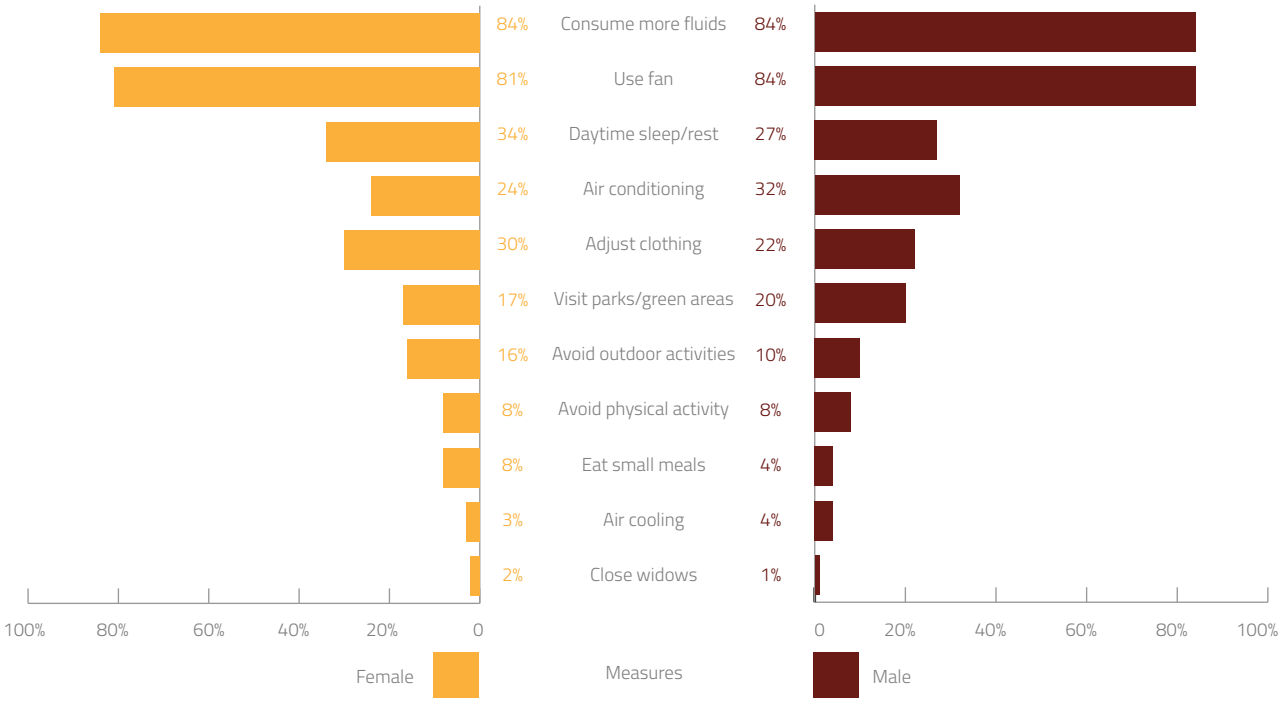
PHOTO 2-3: Vulnerable groups living in mud houses with very little to no ventilation and low socioeconomic status in the informal settlements in Dhangadhi

Photo Credit: Dambaraj Giri

3.1. HEAT RISK AWARENESS AND EXISTING COPING MECHANISMS OF VULNERABLE COMMUNITIES

The most common coping mechanisms that city residents use to handle extreme heat events include regularly drinking fluids and using fans. These strategies are employed by people of all genders, age groups, occupations and income levels. Furthermore, to find cooler locations, many residents seek shelter under trees.

FIGURE 14. COPING MECHANISM OF THE VULNERABLE GROUPS BY GENDER



Source: Author's illustration based on community perception study

The study indicates that females tend to be slightly more cautious about heat exposure than males. This is evidenced by their observed coping mechanisms, which include the increased use of fans, adjusting their clothing and seeking shaded or cooler areas such as parks. Several factors may contribute to this behaviour, including cultural and social roles that often involve women managing heat exposure for themselves and others, including children and elderly family members. Additionally, personal risk perceptions might significantly influence coping behaviours, leading women to be more cautious about heat-related risks. This reflects the differences in risk perception as well as concerns about heat-related health issues. However, only 16 per cent of females and 10 per cent of males reported avoiding outdoor activities during extreme heat.

These relatively low percentages for both genders suggest a lack of awareness or concern about the dangers of heatwaves. Additionally, the respondents may also have been influenced by work limitations because most of them were involved in agriculture, construction or other outdoor labour-intensive sectors where avoiding heat exposure is impossible. For instance, only 20 per cent of farmers engaged in agriculture, 13.6 per cent of construction workers, and 12.2 per cent of skilled workers (Figure 15) reported that they avoided working outdoors when it was hot. These figures indicate that, while precautions are taken by some employees in these sectors, the majority remain exposed in the long-term, likely due to economic necessity and work requirements.

FIGURE 15. COPING MECHANISMS OF THE VULNERABLE GROUPS BY OCCUPATION

Measures	Farmer	Home-maker	Daily wages	Business	Others	Student	Skilled labour
Use fan	73%	87.9%	84%	94.8%	89.8%	68.9%	90.2%
Consume more fluids	87.5%	81.4%	81.7%	74%	84.7%	91.1%	92.7%
Adjust clothing	19.1%	28.3%	29.6%	40.3%	27.1%	44.4%	24.4%
Air conditioning	25.3%	21%	40.2%	32.5%	27.1%	26.7%	26.8%
Daytime sleep/ rest	39.5%	32.1%	22.5%	27.3%	23.7%	26.7%	19.5%
Visit parks/ green areas	20.4%	12.1%	20.7%	26%	13.6%	17.8%	22%
Avoid outdoor activities	20.4%	8.6%	13.6%	5.2%	8.5%	22.2%	12.2%
Avoid physical activity	10.2%	5.5%	11.2%	2.6%	6.8%	8.9%	9.8%
Eat small meals	3.3%	13.1%	3.6%	9.1%	3.4%	6.7%	-
Air cooling	2%	2.8%	7.7%	1.3%	5.1%	6.7%	2.4%
Close widows	0.7%	3.1%	1.2%	-	1.7%	2.2%	-

Source: Author's illustration based on community perception study

PHOTO 4: A household with low socioeconomic status uses indigenous methods, such as vegetation, to cover the roof to reduce the indoor temperature.

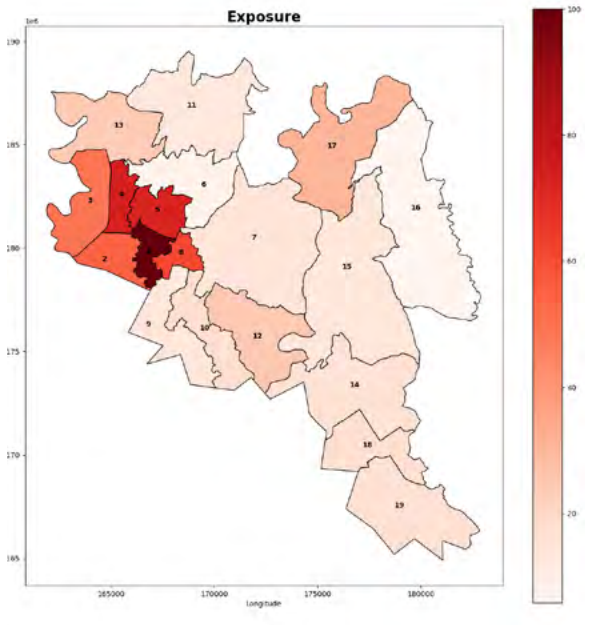
4. HEAT HOTSPOTS IN DHANGADHI

Heat hotspots identify areas where action is needed due to a population's significantly higher exposure to heat risks and vulnerability, compared to those living in surrounding regions. This increased risk arises from a combination of natural and human-made factors. The determination of these heat hotspots is based on three main components: exposure, vulnerability and adaptive capacity. For Dhangadhi, each component includes specific indicators that have been identified through careful analysis and consultations with experts. Detailed information about these indicators can be found in Annex A.

A heat hotspots map has been created for Dhangadhi, combining these exposure and vulnerability factors as well as people's adaptive capacity. For the exposure analysis, three key parameters were examined: population density, built-up area and heat hotspot area. Based on this analysis, the wards in Dhangadhi with the highest exposure to heat are Wards 1, 2, 3, 4, 5 and 8 (see Figure 16). These wards are particularly vulnerable for several reasons – they all have high population densities, which contribute to increased heat generation from human activities and buildings; additionally, Wards 1 and 5 contain a significant amount of built-up areas, resulting in higher temperatures due to the heat absorption and retention by these human-made surfaces.

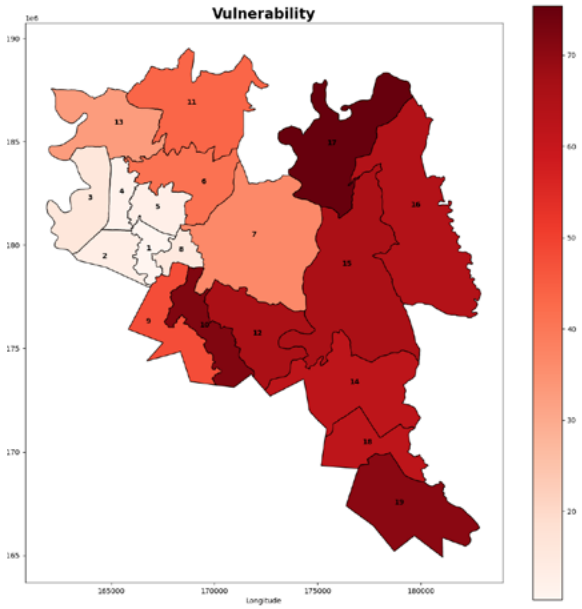
The vulnerability map identifies Wards 10, 17 and 19 as the most vulnerable areas in Dhangadhi (see Figure 17). This assessment is based on an analysis of nine different factors, including socioeconomic, physical and adaptive elements (see Annex A for details). Overall, this approach to heat hotspot mapping allows us to focus on areas that face both high exposure to heat and high vulnerability in Dhangadhi, as shown in the following figures:

FIGURE 16. EXPOSURE MAP



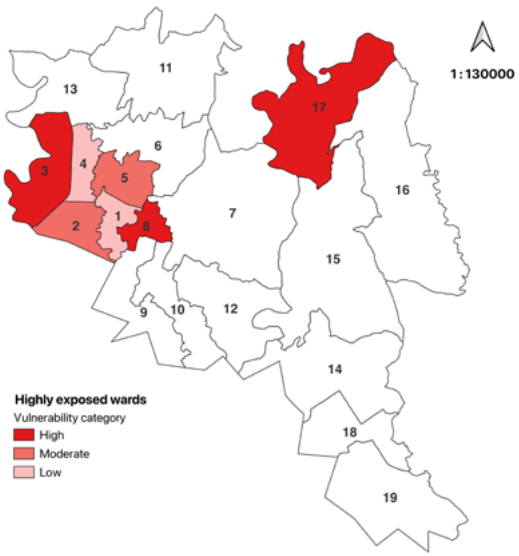
Source: Author's illustration

FIGURE 17. VULNERABILITY MAP



Source: Author's illustration

FIGURE 18. HEAT HOTSPOTS



Source: Author's illustration based on data obtained from CBS (2021) and Landsat imagery

Among all the wards, Ward 3 and Ward 8 have been identified as the most vulnerable, followed by Wards 17, 2, 5, 1 and 4 respectively. The primary factors contributing to the presence of heat hotspots in these wards – particularly in Wards 1, 2, 4 and 5 – include high population density, extensive built-up areas and busy highways with blacktop surfaces and heavy traffic. These wards represent the main urbanized sections of the city. Similarly, the heat hotspots in Ward 17 are primarily associated with the presence of socioeconomically vulnerable populations who have limited capacity to cope with extreme heat. The hotspots map can help the Dhangadhi Municipality and other public and emergency services in prioritizing their resources and efforts.

5. HEAT EARLY WARNING AND ALERT COMMUNICATION

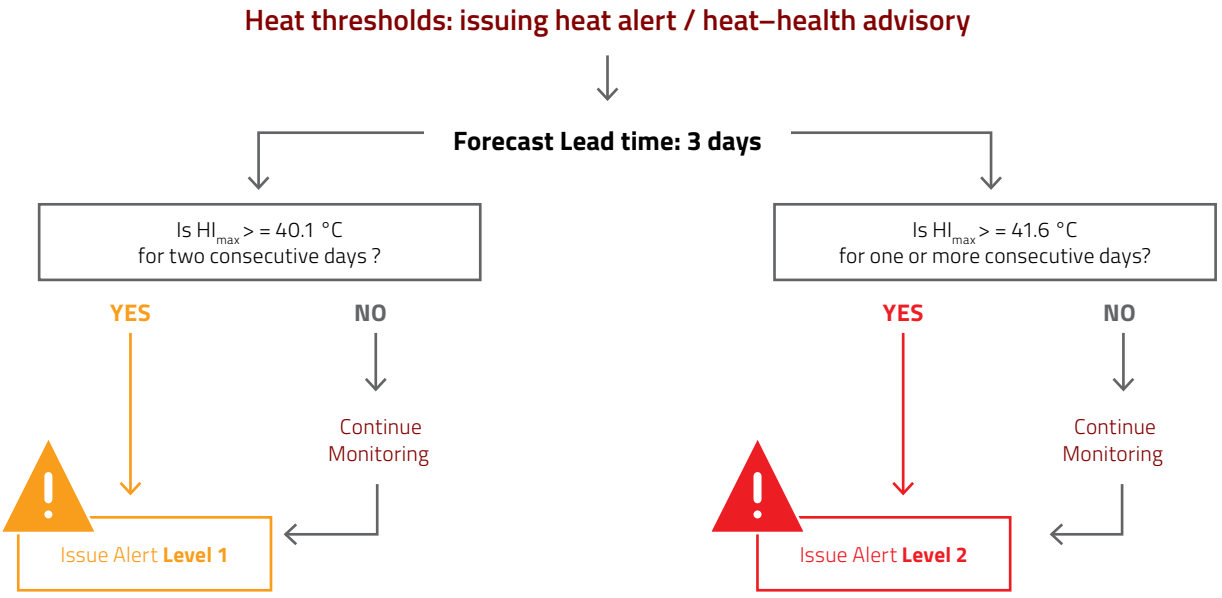
5.1. HEAT THRESHOLD FOR EARLY WARNING

Determining when to act before or during heatwave days is critical. A heat threshold was established through a comprehensive assessment of dangerous ambient heat stress conditions. This analysis utilized historical hourly records of near-surface temperature (Tair, units: °C) and relative humidity (RH, units: %) from 1 January 1979 to 31 December 2023 across the wider Kailali district, including the Sub-Metropolitan city of Dhangadhi. These two factors were combined to create the hourly near-surface Heat Index (HI, units: °C), which is commonly used in operational heat alerts to indicate ambient heat stress conditions.

Additionally, in accordance with standard practices among environmental epidemiologists, daily all-cause mortality counts were examined in relation to exposure to daily HI. This analysis helps identify the heat thresholds relevant for health impacts in this region.

Detailed information about the meteorological and health data sources used to develop the heat–health threshold can be found in Annex B.1. Moreover, the rationale, choices and development of the daily maximum HI (HI_{max_d}) threshold are explained in Annex B.2.

FIGURE 19. SCHEMATIC OF THRESHOLD CRITERIA IN DHANGADHI



Source: Author's illustration

TABLE 5. POSSIBLE HEAT DISORDERS FOR PEOPLE IN HIGH-RISK GROUPS WHEN EXPOSED TO DIFFERENT THRESHOLDS OF HEAT INDEX

CATEGORY	HEAT INDEX	POSSIBLE DISORDER FOR PEOPLE IN HIGH-RISK GROUPS
Extreme danger	130°F or higher (54°C or higher)	Heatstroke or sunstroke likely.
Danger	105–129°F (41–54°C)	Sunstroke, muscle cramps, and/or heat exhaustion lightly. Heatstroke possible with prolonged exposure, and/or physical activity.
Extreme caution	90–105°F (32–41°C)	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure, and/or physical activity.
Caution	80–90°F (27–32°C)	Fatigue possible with prolonged exposure, and/or physical activity.

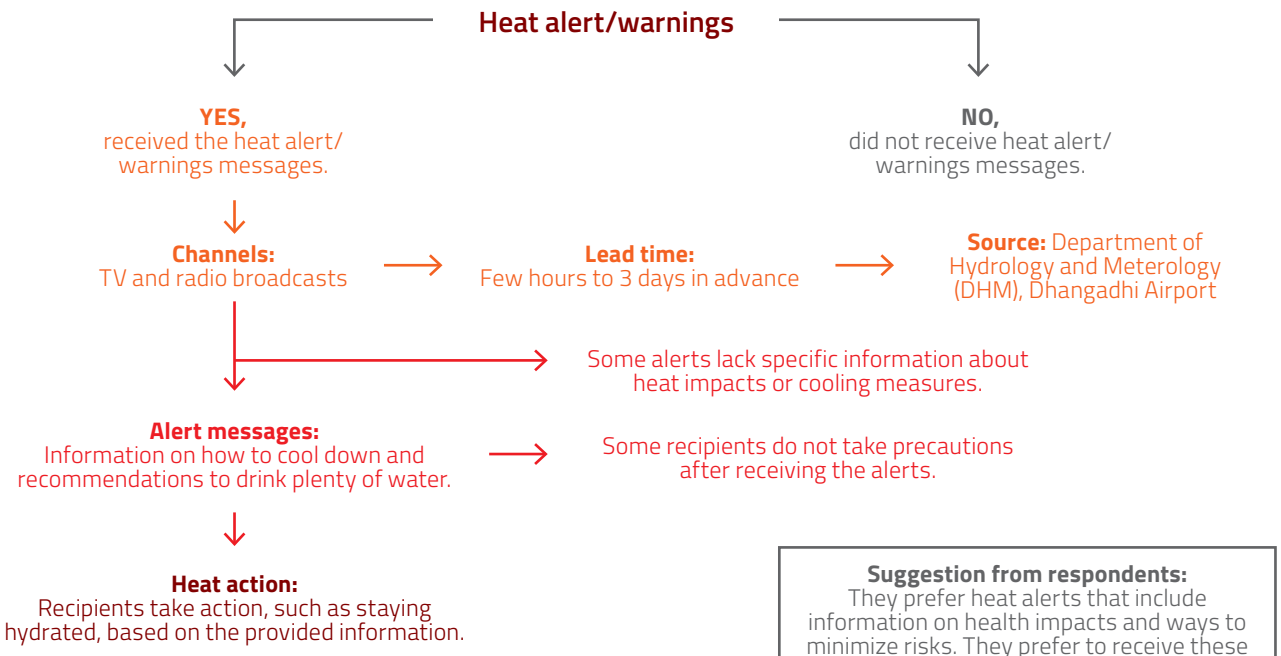
Source: NOAA–NWS

The proposed framework, as summarized in Figure 20, recommends issuing warnings based solely on consecutive day criteria. The table above (Table 5) lists the categories of associated index and possible heat disorders for people in high-risk groups, while the corresponding colour codes in the rows indicate a descending level of risk.

5.2. PRESENT HEAT ALERT COMMUNICATION PRACTICES

The heat alert system in the city is disorganized and ineffective due to inconsistent communication and limited coverage. Alerts are issued by the DHM based on the readings from their Kailali station and using their own Numerical Weather Prediction (NWP) model, but the dissemination is not optimal. As a result, some residents receive alerts while others do not, leading to gaps in preparedness and response. These heat alerts are primarily communicated through media channels such as television and radio, which provide information on cooling measures and recommendations to stay hydrated. However, the alerts often lack specific details about the impacts of heat and effective cooling strategies. Those who do receive heat alerts typically take action by drinking plenty of water and avoiding outdoor activities, but some recipients fail to take the necessary precautions even after receiving the alerts.

FIGURE 20. HEATWAVE ALERT MESSAGES



Source: Author's illustration based on community perception study

THE COMMUNITY PERCEPTION STUDY FOUND THAT 26 PER CENT OF RESPONDENTS HAD RECEIVED INFORMATION OR MESSAGES ABOUT EXTREME HEAT RISKS, WHILE 74 PER CENT HAD NEVER RECEIVED SUCH INFORMATION

The community perception study found that 26 per cent of respondents had received information or messages about extreme heat risks, while 74 per cent had never received such information, as illustrated in Figure 21. Habits for checking the weather forecast varied among those who had received heat alerts (26 per cent) – the majority (46 per cent) checked the forecast one day in advance, followed by 32 per cent who checked it a few days prior. Additionally, 17 per cent monitored the forecast a week in advance, while only 5 per cent checked it on the same day (Figure 22).

FIGURE 21. COMMUNITIES RECEIVE INFORMATION ABOUT EXTREME HEAT RISKS

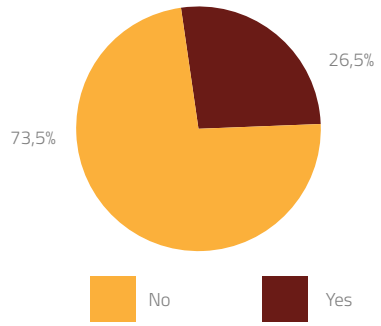
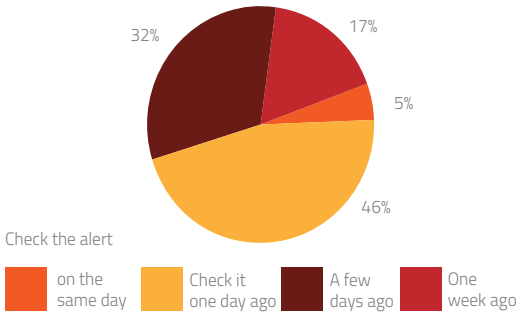


FIGURE 22. ADVANCE NOTICE PERIOD FOR WEATHER ALERTS RECEIVED BY RESPONDENTS



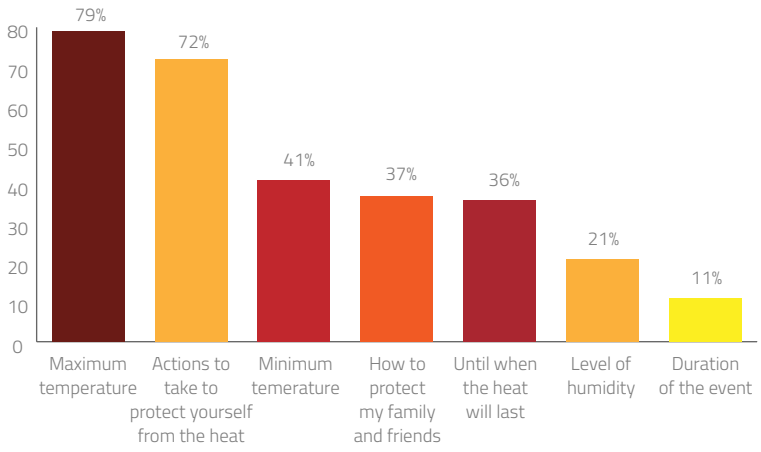
Source: Author's illustration based on community perception study

Among the 26 per cent of respondents who had received alerts or warnings about extreme heat, the majority – 79 per cent – received information about maximum temperatures. Additionally, 72 per cent were provided with guidance on protective actions to take against heat. Furthermore, 41 per cent received updates on minimum temperatures and 37 per cent obtained information on how to protect their family and friends from extreme heat.

When it comes to obtaining weather information, nearly 59 per cent of respondents relied on family and neighbours, making this the most common source, as illustrated in Figure 23. Approximately 33 per cent received updates from Facebook and radio, while only 18–20 per cent depended on TV, WhatsApp or community leaders. Newspapers were the least utilized source for weather updates.

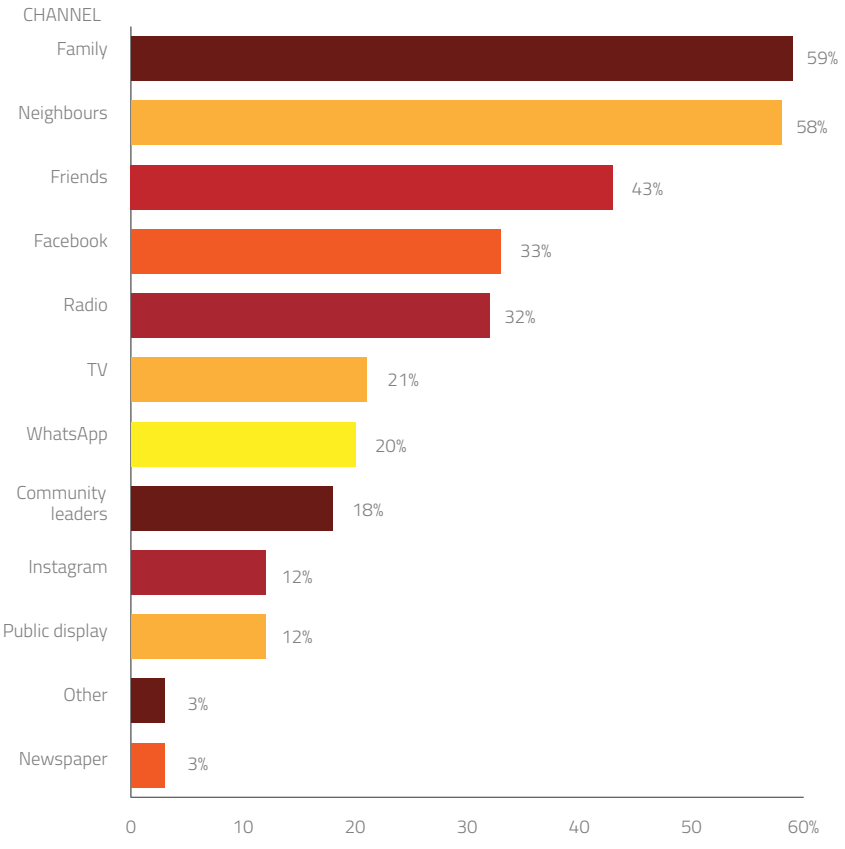
Communities recommend that heat alerts include information about the health impacts of extreme heat, as well as practical ways to reduce its associated risks. They also expressed a preference for receiving these messages via mobile phone and radio as well as through in-person communication to ensure broader accessibility and timely communication.

FIGURE 23. INFORMATION RECEIVED IN EXTREME HEAT ALERTS



Source: Author's illustration based on community perception study

FIGURE 24. SOURCES OF WEATHER INFORMATION COMMONLY USED BY RESPONDENTS

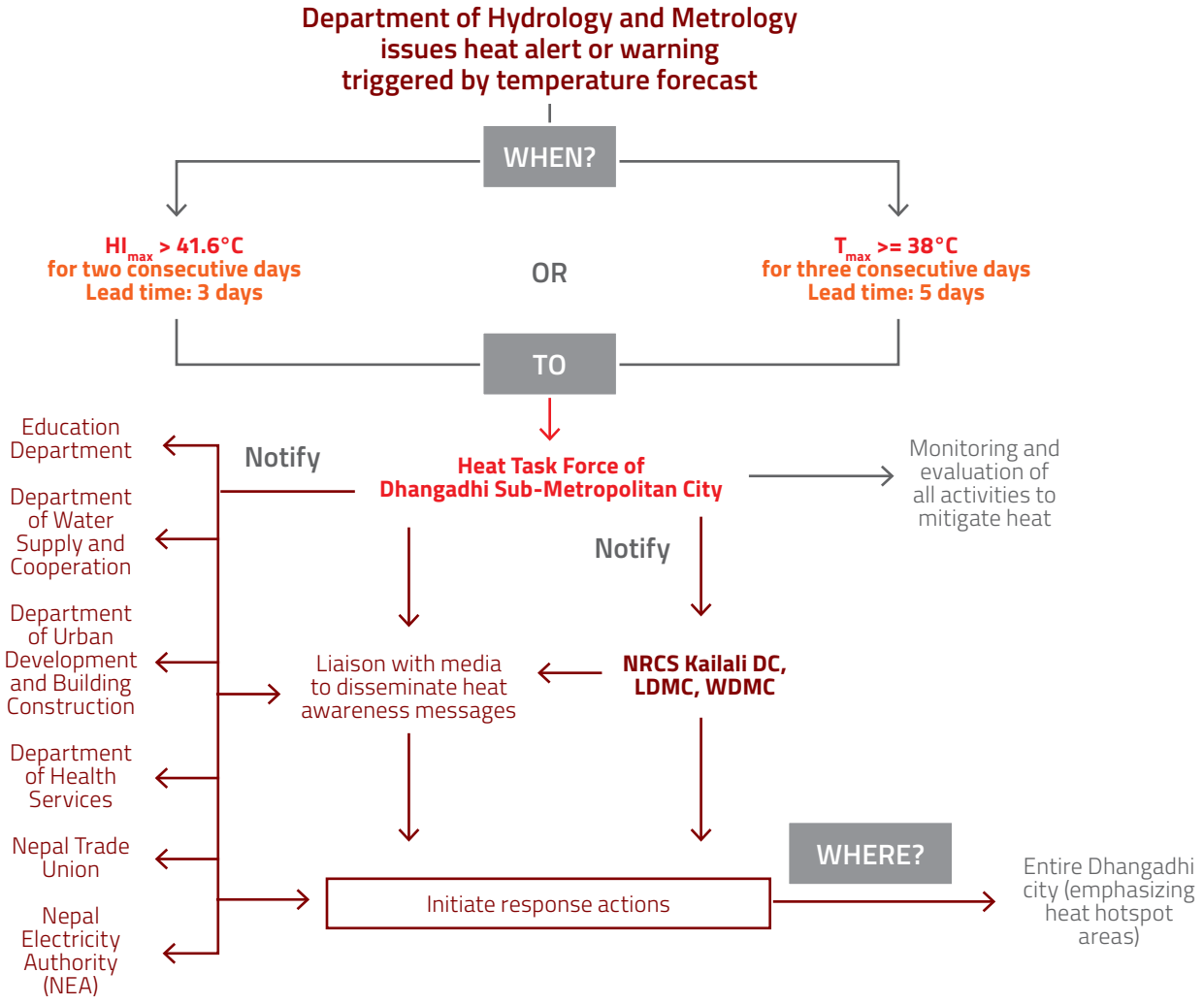


Source: Author's illustration based on community perception study

5.3. PROPOSED COMMUNICATION PLAN FOR ACTIVATING HEAT ALERT SYSTEM IN DHANGADHI

When the DHM issues a forecast for a heat alert or warning, the Heat Task Force of Dhangadhi Sub-Metropolitan City could implement the following communication framework to ensure that heat alert communications are managed systematically. This framework facilitates coordination among all relevant departments and engages with local media to promote awareness about heat safety, as shown in Figure 25.

FIGURE 25. PROPOSED COMMUNICATION PLAN



Source: Author's illustration

The Task Force will continuously monitor heat-related activities to ensure timely and effective responses. Additionally, the Heat Task Force is responsible for coordinating and communicating actions both before and during extreme heat events, providing the necessary support for implementing the action plan. Table 6 lists the members of the Heat Task Force.

TABLE 6. MEMBERS OF HEAT TASK FORCE IN DHANGADHI

DESIGNATION	NAME OF ORGANIZATION
Administration Officer	District Administration Office
DRR focal person	Dhangadhi Sub-Metropolitan City
President	NRCS, Kailali DC
Coordinator	Forum of youth initiative Nepal (FAYA Nepal)
Meteorologist	DHM
Head of Office	Water Supply Corporation, Dhangadhi
Head of Office	Nepal Electricity Authority, Dhangadhi
Head of Office	District Forest Office
Coordinator	Seti Provincial Hospital
Divisional engineer	Urban Planning and Infrastructure Department, Dhangadhi
Coordinator	Chamber of Commerce and Industry, Kailali
Media focal person	Media channels such as Dinesh Kahabar
Head of Office	District Health Office, Kailali
Coordinator	Local Disaster Management Committee (LDMC)

Source: Author's illustration

Collaboration with community leaders from LDMC/WDMC and representatives from International/Nongovernmental Organizations (I/NGOs) such as Mercy Corps, Care Nepal and GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit or German Society for International Cooperation) should be considered an essential part of the Heat Task Force. It is recommended that these organizations are included as formal members, given their expertise in community engagement and disaster risk reduction.

6. STAKEHOLDER COORDINATION

Stakeholder coordination is crucial for implementing the HAP, which aims to enhance preparedness, response and long-term adaptation strategies to reduce the heat risks in the city. This coordination involves the active participation of key stakeholders, including government agencies, healthcare providers, public service departments, community-based organizations and the private sector. Dhangadhi Sub-Metropolitan City will take the lead in these efforts, with the NRCS, Kailali DC serving as co-leads. Together, they will work with all relevant stakeholders on various heat-related initiatives (see Figure 26).

FIGURE 26. STAKEHOLDER COORDINATION

STAGE 1

- Stakeholders mapping & coordination for planning
- Strategy/identification of the response activities for heat season
- Developing the communication plans
- Update the HAP if needed
- Resource allocation (for both short-term response and long-term adaptation)
- Planning of the long-term adaptation measures

Proposed stakeholders

- DHM
- Heat Task Force
- Dhangadhi Ward Committees
- LDMC and WDMC
- Department of Urban Development and Building Construction

STAGE 2

- Activate the heat alert and protocols based on DHM alerts or seasonal forecasts (February-March for preparedness; April-June for response)
- Inform key stakeholders for the response measures
- Initiate the implementation of long-term adaptation measures (e.g, reflective roofing, housing ventilation, green spaces)

Proposed stakeholders

- DHM
- LDMC and WDMC
- Heat Task Force
- Department of Urban Development and Building Construction

STAGE 3

- Issue a media advisory to inform the public on how to stay safe during a heatwave
- Awareness campaign
- Coordinate and proceed with implementation of long-term adaptation measures)

Proposed stakeholders

- LDMC and WDMC
- Dhangadhi Ward Committees
- Media channels such as Dhangadhi Khabar, Atariya Online, Dinesh FM etc.
- Department of Urban Development and Building Construction
- Department of Health Services

STAGE 4

- Conduct the response activities planned such as activating cooling centres, distributing of drinking water)
- Stakeholders' coordination for the implementation

Proposed stakeholders

- Heat Task Force
- Local Emergency Operation Centre (LEOC) and District Emergency Operation Centre (DEOC)
- LDMC and WDMC
- Department of Urban Development and Building Construction

STAGE 5

- Stakeholders' coordination for after-action review
- Documentation on lessons leamt
- Recommendations sharing
- Develop relief and recovery plan for follow-up actions
- Evaluate the effectiveness of both immediate response and long-term adaptation measures

Proposed stakeholders

- Heat Task Force
- Dhangadhi Ward Committees
- LDMC and WDMC
- Department of Urban Development and Building Construction

Overall implementation will be led by Dhangadhi Sub-Metropolitan City and Nepal Red Cross Society (NRCS), Kailali District Chapter (DC)

Source: Author's illustration

By emphasizing the importance of stakeholder engagement, cities can create strategies that enhance resilience and safeguard the well-being of their citizens during heatwaves. Ongoing coordination and proactive measures are necessary to successfully implement the Heat Action Plan in Dhangadhi.

The previous chart illustrates the city's overall heat action coordination. However, the coordination among stakeholders has been further expanded and tailored to address various aspects of heat risk management, including preparedness, response and long-term adaptation.

PHOTO 5: Stakeholders participate in group discussions during one of the workshops.

7. PREPAREDNESS FOR HEATWAVE

Preparing for a heatwave is essential and involves taking specific steps in advance to improve responses and coping strategies during the event. Effective preparedness can significantly reduce both recovery costs and the suffering of residents in the city. The preparedness to heatwave risks also includes educating the community on how to recognize early warning signs of an impending heatwave and understand protective measures, such as staying hydrated, using cooling methods and avoiding excessive outdoor activities during peak heat hours. The figure opposite outlines the proposed measures for heatwave preparedness in Dhangadhi.

FIGURE 27. PREPAREDNESS MEASURES

STRENGTHENING GOVERNANCE FOR HEAT RESILIENCE

1. **Identifying key stakeholders in the city**
2. **Establishing dedicated heat resilience teams or task forces within municipal government or local government**
3. Appointing a Heat Officer to lead the Heat Action Plan

EDUCATION

4. **Planning for changing school schedules in the morning during heat period / scheduling examinations before the start of the heat period**
5. Workshops for teachers regarding heat protection tips and materials that they can disseminate in classrooms

HEALTH

6. **Adding additional hospital beds and managing fans and coolers**
7. Updating existing databases regularly, including hospital admissions and emergency case records to track heat-related cases
8. **Arranging capacity-building programmes for healthcare professionals**
9. Stockpile emergency supplies such as bottled water, electrolyte drinks, first aid kits, and cooling supplies and check inventories for basic equipment and medicines required for emergency

WATER ATM/ COOLING CENTRES

10. **Installing water ATMs to ensure access to clean drinking water**
11. Setting up cooling centres; creating community cooling centres in public buildings

INCENTIVES

12. **Providing incentives for low-income households such as portable handheld fans or electric fans/household level solar PV**

PLANS AND POLICIES

13. **Changing workers' schedules and shifts**
14. **Developing a ward/municipal level plan for heat response/action activities**
15. Reviewing plans for water allocation and plan to avoid power cuts during heat events
16. Updating Climate/Disaster/Heat Action Plan and policies

AWARENESS AND CAPACITY-BUILDING

17. **Developing heat awareness messages and raising awareness through distributing pamphlets; TV and radio broadcasts; and social media postings (Facebook, Twitter)**
18. Capacity-building for occupationally exposed groups and their supervisors
19. Conducting a community awareness campaign for women on heat education
20. Training to Red Cross volunteers and individuals working with disaster response to effectively identify signs of heat-related illnesses
21. Installing LED screens with rolling temperature and humidity
22. Raising awareness of the dangers of burning areas of forest and jungle as it impacts health and the environment, and increases the temperature

Source: Author's illustration

7.1. HIGHLY PRIORITIZED ACTIONS

Ten priority actions have been identified. Stakeholders and vulnerable community groups in the city have prioritized these key preparedness activities. These actions are discussed in the tables below:

KEY ACTIVITY	1. IDENTIFYING KEY STAKEHOLDERS IN THE CITY
Target area(s)	Dhangadhi city
Target group	All the residents in Dhangadhi
Sector(s)	Disaster/Emergency Management, Planning
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	All respective stakeholders of the Dhangadhi Sub-Metropolitan City NRCS, Kailali DC DHM, Kailali Nepal Electricity Authority Department of Water Supply and Cooperation Local Disaster Management Committee Ward Disaster Management Committee Tole Lane Organization (TLO) Department of Forestry I/NGOs such as Practical Action, United Nations Development Programme etc.
Brief	A stakeholders' committee will guide the Heat Task Force and the local government in planning and decision-making for various heat-related actions, including preparedness measures. The stakeholders' consultation process will facilitate the sharing of diverse knowledge, experiences and lessons learned, ensuring that everyone benefits from these exchanges. Therefore, it is crucial to identify key stakeholders and establish a coordination mechanism among them. All stakeholders should share a common vision and develop clear objectives for combatting heat. Additionally, the roles and responsibilities of each stakeholder must be clearly defined to avoid overlapping duties. The Dhangadhi Sub-Metropolitan City will take a lead role in identifying key stakeholders and actively involving them in activities related to heat preparedness. LDMC and NRCS teams will liaise and coordinate with WDMCs, TLOs and secondary stakeholders such as the Nepal Electricity Authority, DHM, Department of Water Supply and Cooperation, Department of Forestry. This collaborative approach will ensure the roles and responsibilities of all the stakeholders are comprehensive to address heat-related challenges within the Municipality.
Case study	During the development of the Ahmedabad Heat Action Plan, the project team developed a stakeholder network map and identified how the various municipal players fit together. This network identified key organizations and agencies likely to play important roles in the development and implementation of the Heat Action Plan. The project team had identified stakeholders at the national, state and local levels to ensure active participation and effective implementation of the plan. Link to case study: https://bit.ly/4gaQSnf

KEY ACTIVITY	2. ESTABLISHING DEDICATED HEAT RESILIENCE TEAMS OR TASK FORCES WITHIN THE MUNICIPALITY OR LOCAL GOVERNMENT
Target area(s)	Dhangadhi Sub-Metropolitan City
Target group	Municipal government officials, local authorities and relevant stakeholders
Sector(s)	Disaster/Emergency Management, Governance and Policy
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	DDMC (District Disaster Management Committee) LDMC TLO WDMC I/NGOs
Brief	To enhance heat resilience, it is essential to establish a Heat Task Force Committee – a dedicated group of stakeholders from various sectors, including municipal authorities, healthcare, disaster response and community organizations. The Task Force will drive processes related to heat action in the city. The Committee's primary role will be to lead and coordinate efforts to combat heat-related challenges and improve resilience across the Municipality. The Task Force will ensure a localized and tailored approach, addressing the specific needs of the city. This will help to create active coordination and integration to enhance heat resilience across the Municipality. Dhangadhi Sub-Metropolitan City will establish a Heat Task Force Committee in coordination with DDMC and LDMC. TLOs and WDMCs will be involved to ensure that actions are more localized and relevant to the city.
Case study	The Siddharthnagar city of Nepal has taken proactive steps by establishing a Heat Steering Committee comprising relevant stakeholders. They are responsible for all the coordination, preparedness and response activity in the city. Committee members include a coordinator, Environment and Disaster Management Committee, DHM, media, Department of Water Supply and Cooperation and the national electricity authority.

KEY ACTIVITY	3. PLANNING FOR CHANGING SCHOOL SCHEDULES IN THE MORNING DURING HEAT PERIOD / SCHEDULING EXAMINATIONS BEFORE THE START OF THE HEAT PERIOD
Target area(s)	School/colleges
Target group	School students
Sector(s)	Education
Primary stakeholder	Education Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Private and Boarding Schools' Organization Nepal (PABSON) National Private and Boarding Schools' Organization Nepal (NPABSON) School Management Committees Resource Centres NRCS, Kailali DC
Brief	Changing school schedules to reduce students' exposure to extreme heat is an essential measure in heat preparedness. This involves adjusting school start and end times to avoid peak heat hours, typically in the afternoon when temperatures are highest. This approach will help to minimize students' exposure to heat-related health risks such as dehydration, heatstroke and fatigue. The Education Department of Dhangadhi Sub-Metropolitan City will lead the initiative to adjust school schedules, moving classes to the morning hours during heat periods. It will also coordinate the scheduling of examinations before the onset of extreme heat. The Education Department of Dhangadhi Sub-Metropolitan City will coordinate with PABSON, NPABSON and the School Management Committee to implement these changes so that students are safe and don't have to travel to school during peak heat. Generally, classes should end by 10–10.30 a.m. so that students can return home by 11.00 a.m.
Case study	In India, the government of Jharkhand announced adjustments to school hours after the India Meteorological Department issued a heat alert. Government officials changed the school timing; for example, students from kindergarten to 8th grade attended school from 7.00–11.30 a.m., while older students in grades 9–12 had classes extended until 12.00 p.m. Link to case study: https://bit.ly/4feZurs

KEY ACTIVITY	4. ADDING ADDITIONAL HOSPITAL BEDS AND MANAGING FANS AND COOLERS
Target area(s)	All hospitals and clinics of Dhangadhi
Target group	Patients seeking treatment at these hospitals and clinics, especially those affected by heat-related illnesses
Sector(s)	Health
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Division of Dhangadhi Sub-Metropolitan City NRCS, Kailali DC Hospitals of Dhangadhi
Brief	Strengthening hospital capacity in advance of heatwaves is vital to ensure that healthcare facilities can accommodate and treat an increasing number of patients suffering from heat-related illnesses. This proactive preparation would ensure that hospitals are prepared to handle any sudden rush of patients and admit them accordingly. The Health Division of Dhangadhi Sub-Metropolitan City and the Department of Health Services will jointly work to enhance hospital capacity. This could be done by adding additional beds, in addition to proper cooling facilities through the provision of fans and coolers during heatwaves. NRCS and Kailali DC can also assist by distributing fans and coolers to governmental hospitals in Dhangadhi.
Case study	In 2018, St Mary's Hospital in Newport on the Isle of Wight in the United Kingdom opened 15 additional beds on top of its usual capacity of 244 because of a surge in patients due to a heatwave. This shows a very positive adaptation against the health challenges posed by periods of heat. Link to case study: https://bit.ly/3D8MMxj

KEY ACTIVITY	5. ARRANGING CAPACITY-BUILDING PROGRAMMES FOR HEALTHCARE PROFESSIONALS
Target area(s)	All hospitals and clinics of Dhangadhi
Target group	Medical staff at Seti Provincial Hospital and Nursing Hospital and other private clinics Nursing staff, paramedics, field staff, family physicians, paramedics and future healthcare and public health professionals
Sector(s)	Health and Emergency Preparedness
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Department of Dhangadhi Sub-Metropolitan City World Health Organization (WHO) WDMC NRCS, Kailali DC Private Hospital Association (PHA)
Brief	Capacity-building programmes for healthcare professionals involve organizing training/workshops that enhance the knowledge and skills of healthcare workers. These programmes focus on increasing their preparedness and effectiveness in managing public health challenges, including heat-related illnesses (HRI), especially during heatwaves. This programme will ensure that healthcare professionals are ready to respond quickly and effectively during extreme heat events. Training programmes for health workers at the Seti Provincial Hospital and Nursing Hospital, along with other private clinics, will be set up by the Department of Health Services in collaboration with the Health Department Dhangadhi Sub-Metropolitan City. Guidelines from the WHO will be referred to in developing and facilitating these sessions. The WDMCs, NRCS and Kailali DC will help to run these programmes at the community level so that health workers in different places are prepared to handle the increased incidence of heat-related cases and emergencies effectively.
Case study	In 2013, in Ahmedabad, India, Mount Sinai School of Medicine led a focus group discussion with local medical professionals during a 'Health effects of heat in relation to climate change' workshop. The discussion focused on understanding the health impacts of heatwaves, the challenges of managing HRI and effective strategies to prepare healthcare professionals for heat-related health risks. Link to case study: https://bit.ly/3x70GNF

KEY ACTIVITY	6. INSTALLING WATER ATMs TO ENSURE ACCESS TO CLEAN DRINKING WATER
Target area(s)	Ward 4 and Ward 7
Target group	Daily workers such as labourers, street vendors and auto drivers
Sector(s)	Water and Sanitation
Primary stakeholder	Disaster Management Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC WDMC Department of Water Supply and Cooperation NRCS, Kailali DC I/NGOs
Brief	A water ATM is a water dispensing system that provides clean, potable water to the public. Water ATMs help ensure that vulnerable populations, such as outdoor workers, street vendors and others, have access to clean water during heatwaves, reducing the risk of dehydration and heat-related illnesses. The Disaster Management Department, jointly with the LDMC, will lead the installation of water ATMs in busy areas such as bus parks and auto stands to provide clean drinking water to daily workers/labourers, street vendors and auto drivers. The Department of Water Supply and Cooperation will ensure that clean drinking water is available in the water ATMs during the peak heat season. After the installation of the water ATMs, the WDMC will take overall responsibility for the maintenance and smooth supply of water to the water ATMs. The pre-identified locations for installing water ATMs are in the bus park road of Ward 4 and Dhangadhi chowk of Ward 7. The pre-identified locations are also shown in Annex C – Figure C-1.
Case study	Nepalgunj – one of the hottest cities in Nepal – records temperatures above 40°C during heatwaves. During these extreme heat events, the government, in association with the Department of Water Supply and Cooperation and WDMC, installed water ATMs at strategic locations within the city of Nepalgunj. A very simple technology like a water ATM can play an important role in building resilience during heatwaves.

KEY ACTIVITY	7. PROVIDING INCENTIVES FOR LOW-INCOME HOUSEHOLDS SUCH AS PORTABLE HANDHELD FANS OR ELECTRIC FANS/ HOUSEHOLD LEVEL SOLAR PV
Target area(s)	Wards 6, 10, 11, 12, 14, 16, 17, 18 and 19.
Target group	Vulnerable communities and groups
Sector(s)	Social Protection, Energy
Primary stakeholder	WDMC
Secondary stakeholders	Disaster Department, Dhangadhi Sub-Metropolitan City NRCS, Kailali DC LDMC Private companies I/NGOs such as BEE Group, Practical Action, etc.
Brief	Due to the vulnerability of communities to extreme heat, targeted interventions such as providing incentives are necessary to help mitigate these impacts. Offering incentives of cooling devices, such as portable handheld fans or electric fans as well as promoting solar energy solutions at the household level, can reduce the economic burden on families and ensure that vulnerable groups have the means to protect themselves from extreme heat. The WDMCs will identify and prioritize the most vulnerable communities in Wards 6, 10, 11, 12, 14, 16, 17, 18 and 19 for the distribution of incentives like portable handheld fans or electric fans (for use in temperatures below 40°C) and for installing household-level solar PV systems. These Wards have a high concentration of informal communities. In this context, the NRCS and Kailali DC will facilitate the distribution process. Partnerships with private companies can be formed to provide or subsidize the necessary equipment. The pre-identified locations for providing incentives to low-income communities are presented in Annex C – Figure C-2.
Case study	Australia has one of the largest solar energy systems, supported by abundant sunlight and attractive incentives offered by the Government. A very important barrier to overcome, especially for low-income families, is the high upfront installation costs of the panels and systems. To address this, the Australian Government and utility companies have developed programmes and incentives to make solar energy accessible to low-income households. Link to case study: https://bit.ly/41teQpf

KEY ACTIVITY	8. CHANGING WORKERS' SCHEDULES AND SHIFTS
Target area(s)	Outdoor workplaces
Target group	Vulnerable groups who work outside during extreme heat, including farmers and agricultural workers, construction workers, street vendors, auto drivers, labourers and other outdoor workers
Sector(s)	Occupational Health and Safety
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Nepal Trade Union Private companies District Administration Office (DAO) Chambers of Commerce
Brief	Changing workers' schedules and shifts helps to protect their health by maintaining productivity during intense heat. This involves adjusting work hours to avoid the hottest parts of the day, typically shifting outdoor or physically demanding tasks to cooler morning or evening hours. The Dhangadhi Sub-Metropolitan City will liaise with the Nepal Trade Union and private companies to change the times and shifts of workers to cooler parts of the day during heat periods. The DAO and the Chambers of Commerce will also be involved to ensure compliance and support from businesses across the region. This will help to ensure that the new schedules are well-communicated and implemented with the contribution of these stakeholders for both workers and employers.
Case study	California is one of the largest agricultural-producing states in the US and, during summer, it can get as hot as above 40°C. Outdoor workers such as farm workers do heavy labour outdoors and, therefore, are highly vulnerable to heat-related illnesses. For this, employers within California's agricultural industry have modified work schedules and implemented heat illness prevention measures to help protect workers. Link to case study: https://bit.ly/4gs4oSS

KEY ACTIVITY	9. DEVELOPING A WARD/MUNICIPAL-LEVEL PLAN FOR HEAT RESPONSE/ACTION ACTIVITIES
Target area(s)	Dhangadhi Sub-Metropolitan City
Target group	All the residents of Dhangadhi
Sector(s)	Disaster/Emergency Management, Governance and Policy
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	NRCS, Kailai DC LDMC WDMC NGO/INGOs
Brief	Developing a ward- or municipal-level plan for heat response/action will help to address all the needs and challenges related to heat. This plan will outline specific actions and stakeholder responsibilities to mitigate the impacts of extreme heat within the community. By including the heat response plan within a broader municipal framework, it ensures that heat preparedness is integrated into existing local governance structures. It will be easier for the municipality to mobilize resources, coordinate actions and implement timely interventions. Dhangadhi Sub-Metropolitan City, in coordination with NRCS, Kailali DC, LDMC, WDMC and all departments of the metropolitan office, will coordinate the preparation of a Municipal Heat Action Plan. Dhangadhi Sub-Metropolitan City can also collaborate with local NGOs to provide technical support and resources, enabling the creation of a tailored Heat Action Plan for Dhangadhi.
Case study	The Nepalgunj Municipality has developed the first municipal heat action plan of Nepal to establish a localized framework for mitigating and adapting to heatwave impacts, protecting vulnerable populations and enhancing community resilience. Link to case study: https://bit.ly/4ejXj6W

KEY ACTIVITY	10. DEVELOPING HEAT AWARENESS MESSAGES AND RAISING AWARENESS THROUGH DISTRIBUTING PAMPHLETS; TV AND RADIO BROADCASTS; AND SOCIAL MEDIA POSTINGS (FACEBOOK, TWITTER)
Target area(s)	Dhangadhi city
Target group	All the citizens of Dhangadhi
Sector(s)	Communication
Primary stakeholder	NRCS, Kailai DC
Secondary stakeholders	Private sector Media LDMC WDMC Lions club, Jaycees, Lio club and Rotary clubs
Brief	The heat awareness messages help to inform the public about the risks associated with extreme heat and provide guidance on how to protect themselves. By distributing heat awareness messages through posters, pamphlets, TV and radio, communities can be educated about the signs and symptoms of heat-related illnesses, and the preventive actions they should take during extreme heat. NRCS and Kailali DC will lead the awareness campaigns on heat risks and safety precautions among members of the public. This will be done through various media, which includes using microphones, sharing pamphlets within busy areas, broadcasting through TV and radio, and posting on social media (such as NRCS and Kailali DC's Facebook and Twitter accounts as well as the Dhangadhi Sub-Metropolitan City's official website). The WDMC will ensure that the information reaches all community members, particularly those in vulnerable areas. The required materials for the awareness campaign, such as banners and posters, have already been prepared and can be accessed via this link: https://preparecenter.org/toolkit/heat/heat-action-posters/. NRCS and Kailali DC can also increase awareness of the benefits of neem leaves water, such as its cooling effects and potential to relieve heat-related discomfort. The media can also share the heat awareness videos, which can be found at this link: https://vimeo.com/showcase/9459591.
Case study	Nepalgunj City launched an integrated HAP in 2023 as an adaptation measure for heatwaves and to reduce the health risks among the general public. One of the major components of the HAP was to develop heat awareness messages and distribute them through different platforms. Multiple channels were used to share information such as TV, radio, microphones, social media and pamphlet distribution etc. Through this, a wide range of population groups received heat awareness messages. Link to case study: https://bit.ly/4ejXj6W

7.2. MODERATELY PRIORITIZED HEAT PREPAREDNESS ACTIONS

The preparedness actions listed in the table below are essential, but they are prioritized moderately compared to the measures previously highlighted by stakeholders and communities in Dhangadhi. While this set of activities should not be overlooked, the local government and emergency service providers can address these preparedness actions at a later stage, given critical factors such as resource availability and time constraints.

TABLE 7. HEAT PREPAREDNESS MEASURES

HEAT OFFICER

KEY ACTIVITY	APPOINTING A HEAT OFFICER TO LEAD THE HEAT ACTION PLAN
Target area(s)	Dhangadhi city
Target group	Communities most vulnerable to heat-related impacts
Sector(s)	Governance and Policy
Primary stakeholder	Disaster Department of the Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC WDMC NRCS, Kailali DC I/NGOs
How to carry out the activities	The Disaster Department of Dhangadhi Sub-Metropolitan City will appoint a Heat Officer to be in charge of the development, implementation and monitoring of the Heat Action Plan. LDMC and WDMC will work very closely with the Heat Officer to ensure coordination in implementing all elements of the plan. The specific responsibilities of the Heat Officer would be heading the public awareness campaigns, liaising with various stakeholders and ensuring the efficient use of resources to minimize the impacts of extreme heat on vulnerable populations. The Heat Officer will serve as a contact point in the city for all heat-related initiatives.
Case study	Case study from Monterrey, Mexico: https://bit.ly/4hJaAGL

PUBLIC AWARENESS

KEY ACTIVITY	CONDUCTING A COMMUNITY AWARENESS CAMPAIGN FOR WOMEN ON HEAT EDUCATION
Target area(s)	Informal settlements or communities living in heat-prone areas
Target group	Women from vulnerable groups, including home-makers, pregnant and lactating women, women working outdoors and women living in informal settlements with limited access to cooling resources.
Sector(s)	Public Health, Gender & Social Protection
Primary stakeholder	WDMC
Secondary stakeholders	Federation of Nepali Women Volunteers (FNVI) Women, Children and Senior Citizen Service Centre (WCSCSC) NRCS, Kailali DC NGOs and private organizations
How to carry out the activities	WDMC will develop an intensive community awareness and mobilization programme to educate women about heat-related risks and protection measures. However, this initiative will not be limited to short-term actions but will be integrated into a longer term approach that will address the root causes of women's increased vulnerability to heat. The programme will be designed to explore the social and economic factors that contribute to their vulnerability. The mobilization and engagement of women from these communities will be done by FNVI and WCSCSC primarily. NRCS, Kailali DC and private organizations can collaborate to provide educational materials and conduct workshops, including the facilitation of discussions on heat safety issues.

KEY ACTIVITY	INSTALLING LED SCREENS WITH ROLLING TEMPERATURE AND HUMIDITY
Target area(s)	Public spaces with high traffic, such as marketplaces, hospitals and schools
Target group	Vulnerable populations, namely outdoor workers and auto drivers
Sector(s)	Communication
Primary stakeholder	Disaster Management Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	WDMC NEA NRCS, Kailali DC Private sector DHM
How to carry out the activities	The Disaster Management Department will arrange LED display boards, which will display real-time temperature and humidity data. These displays can be installed in all major locations that are most visited by the vulnerable populations, like outdoor workers and auto drivers, to provide them with critical heat-related information. WDMCs will assist in identifying optimal locations for the LED screens and ensuring that they are effectively maintained. The NRCS Kailaili DC can assist in raising awareness about the locations and benefits of these LED screens to ensure maximum utility and outreach. The identified locations for LED installation are: Dhangadhi Chowk and the Dhangadhi border (Nepal-India border).

KEY ACTIVITY	RAISING AWARENESS OF THE DANGERS OF BURNING AREAS OF FOREST AND JUNGLE AS IT IMPACTS HEALTH AND THE ENVIRONMENT, AND INCREASES THE TEMPERATURE
Target area(s)	Forest-adjacent communities, particularly those in heat-prone regions
Target group	Local communities living near forests
Sector(s)	Environmental Protection and Public Health
Primary stakeholder	WDMC
Secondary stakeholders	Forest Division and Environment Division Community Forest User Group Federation of Community Forestry Users Nepal (FECOFUN)
How to carry out the activities	WDMCs can undertake campaigns to educate communities about the negative impacts of burning forests or jungles. This initiative will help to highlight that such activities are very damaging to health, leading to environmental degradation and contributing to increasing temperatures. It is also important to assess the root causes of forest burning, such as agricultural practices, lack of awareness or reliance on fire for clearing land. The Forest Division and Environment Division of FECOFUN can also provide expertise and support for the campaign, educating people about the environmental and health consequences of forest fires. The Forest Division and Environment Division, in coordination with WDMC, can jointly develop and promote alternatives such as sustainable farming practices, controlled burning methods and firebreaks.

CAPACITY-BUILDING

KEY ACTIVITY	TRAINING FOR RED CROSS VOLUNTEERS AND INDIVIDUALS WORKING IN DISASTER RESPONSE TO EFFECTIVELY IDENTIFY SIGNS OF HEAT-RELATED ILLNESSES
Target area(s)	Dhangadhi city
Target group	Red Cross volunteers/Individuals working in disaster response
Sector(s)	Disaster Risk Reduction (DRR) and Public Health
Primary stakeholder	NRCS, Kailali DC
Secondary stakeholders	LDMC Department of Health Services Health Division of Dhangadhi Sub-Metropolitan City Gaur Sahakari Sanstha I/NGOs
How to carry out the activities	The NRCS, Kailali DC and LDMC can organize the training sessions for Red Cross volunteers and individuals working in disaster response to effectively identify signs of heat-related illnesses, such as heat exhaustion and heatstroke. This will help the volunteers to recognize early signs and symptoms of heat-related illness, allowing them to provide timely assistance. This will be carried out in collaboration with the Department of Health Services and the Health Division of Dhangadhi Sub-Metropolitan City, which will provide medical expertise with training resources. Gaur Sahakari Sanstha will support this effort by making available facilities or other resources as appropriate.
Case study	Case study of the volunteers training in Phoenix, Arizona, USA: https://bit.ly/4bIt08b

KEY ACTIVITY	WORKSHOPS FOR TEACHERS REGARDING HEAT PROTECTION TIPS AND MATERIALS THAT THEY CAN DISSEMINATE IN CLASSROOMS
Target area(s)	School/colleges
Target group	All schoolteachers
Sector(s)	Education
Primary stakeholder	NRCS, Kailali DC
Secondary stakeholders	Education Department of Dhangadhi Sub-Metropolitan City PABSON NPABSON School Management Committee
How to carry out the activities	NRCS and Kailali DC will conduct a heat workshop for schoolteachers. The workshop aims to educate the schoolteachers about heat risk and protection measures and share the educational materials such as brochures, posters and heat safety toolkits to be used at the classroom level for raising awareness. The Education Department at Dhangadhi Sub-Metropolitan City will help in this activity by ensuring participation from both public and private schools. PABSON, NPABSON and School Management Committees can assist in organizing and promoting the workshops, ensuring wide reach and engagement.
Case study	Case study from Nepal: https://bit.ly/3EoLoqQ

KEY ACTIVITY	CAPACITY-BUILDING FOR OCCUPATIONALLY EXPOSED GROUPS AND THEIR SUPERVISORS
Target area(s)	Workplaces in heat-prone regions, particularly outdoor and high-exposure areas such as construction sites, factories.
Target group	Traffic police, hawkers, street vendors, auto drivers, rickshaw pullers, outside workers
Sector(s)	Occupational Health and Safety
Primary stakeholder	NRCS, Kailali DC
Secondary stakeholders	Nepal Trade Union WDMC Donor agencies Chamber of Commerce
How to carry out the activities	NRCS and Kailali DC will collaborate with the WDMC and Nepal Trade Union to implement capacity-building programmes for workers who are occupationally exposed to extreme heat, as well as their supervisors. This will include training on heat stress management, safety protocols and emergency response. The workers from trade unions can actively engage in such programmes to enable a workforce that is well-prepared to handle the challenges of heat. Donor agencies may be involved to give financial and technical support to the programme, and through these collective efforts, both workers and supervisors will become more resilient, reducing the risks associated with occupational heat exposure.
Case study	Case study from Ahmedabad: https://bit.ly/3x70GNF

EMERGENCY MANAGEMENT

KEY ACTIVITY	STOCKPILE EMERGENCY SUPPLIES SUCH AS BOTTLED WATER, ELECTROLYTE DRINKS, FIRST AID KITS AND COOLING SUPPLIES AND CHECK INVENTORIES FOR BASIC EQUIPMENT AND MEDICINES REQUIRED FOR EMERGENCIES
Target area(s)	All hospitals and clinics of Dhangadhi
Target group	
Sector(s)	Utilities Management
Primary stakeholder	Health Division of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC PHA
How to carry out the activities	Before the heat season, the Health Division of Dhangadhi Sub-Metropolitan City will check the stockpiling of emergency supplies, including bottled water, electrolyte drinks, first aid kits and cooling supplies and check inventories for basic equipment and medicines required for emergencies in all hospitals and clinics of Dhangadhi. This will help prepare the health services to respond to heat-related emergencies.

KEY ACTIVITY	SETTING UP COOLING CENTRES; CREATING COMMUNITY COOLING CENTRES IN PUBLIC BUILDINGS
Target area(s)	Community/public buildings such as government offices, malls
Target group	Vulnerable populations, namely outdoor workers and auto drivers
Sector(s)	Urban Planning
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC NRCS WDMC Department of Drinking Water Supply and Cooperation NEA, Kailali Private sector
How to carry out the activities	Dhangadhi Sub-Metropolitan City will establish and lead cooling centres in strategic locations. LDMC and WDMC will jointly select the sites and ensure such cooling centres are accessible to the most vulnerable populations like outdoor workers, auto drivers, etc. A team from the NRCS will support this process with the volunteers and resources required to establish and operate the centres, along with the fans, water and basic medical facilities in collaboration with the Department of Drinking Water Supply and Cooperation and NEA, Kailali. While the use of air conditioning (A/C) can provide immediate relief, it may lead to maladaptation by increasing energy consumption and greenhouse gas emissions, contributing to further environmental degradation. Therefore, cooling centres should also prioritize the use of energy-efficient fans, natural ventilation and natural cooling solutions such as shading and green spaces. Private organizations can assist by providing funding, equipment or facilities. The Dhangadhi Sub-Metropolitan City can also request that cooling rooms in public malls and government offices be opened to allow the most susceptible people to rest there for a little while. This will provide relief during extreme heat and reduce heat-related illnesses.
Case study	Case study from Hanoi, Vietnam: https://bit.ly/4c5HSNB

POLICY AND PLANNING

KEY ACTIVITY	REVIEWING PLANS FOR WATER ALLOCATION AND PLANNING TO AVOID POWER CUTS DURING HEAT EVENTS
Target area(s)	Regions prone to heatwaves where water and electricity demand spikes during extreme heat events such as hospitals, clinics and schools.
Target group	Water supply authorities
Sector(s)	Utilities and Infrastructure Management
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	WDMC LDMC Water Department Nepal Electricity Authority
How to carry out the activities	Dhangadhi Sub-Metropolitan City will spearhead the review and adjustment of water allocation plans and strategies to prevent power cuts during heat events. WDMC and LDMC will closely coordinate with the Water Department and Nepal Electricity Authority on maintaining the delivery of uninterrupted essential services during periods of extreme heat. This coordination will cover an assessment of resource availability, developments in forecasting demand related to heatwaves, and the establishment of contingency plans. As a result, this proactive approach will mitigate some of the effects of heat events on water and electricity supplies, and ensure there are no shortages in residents' services.

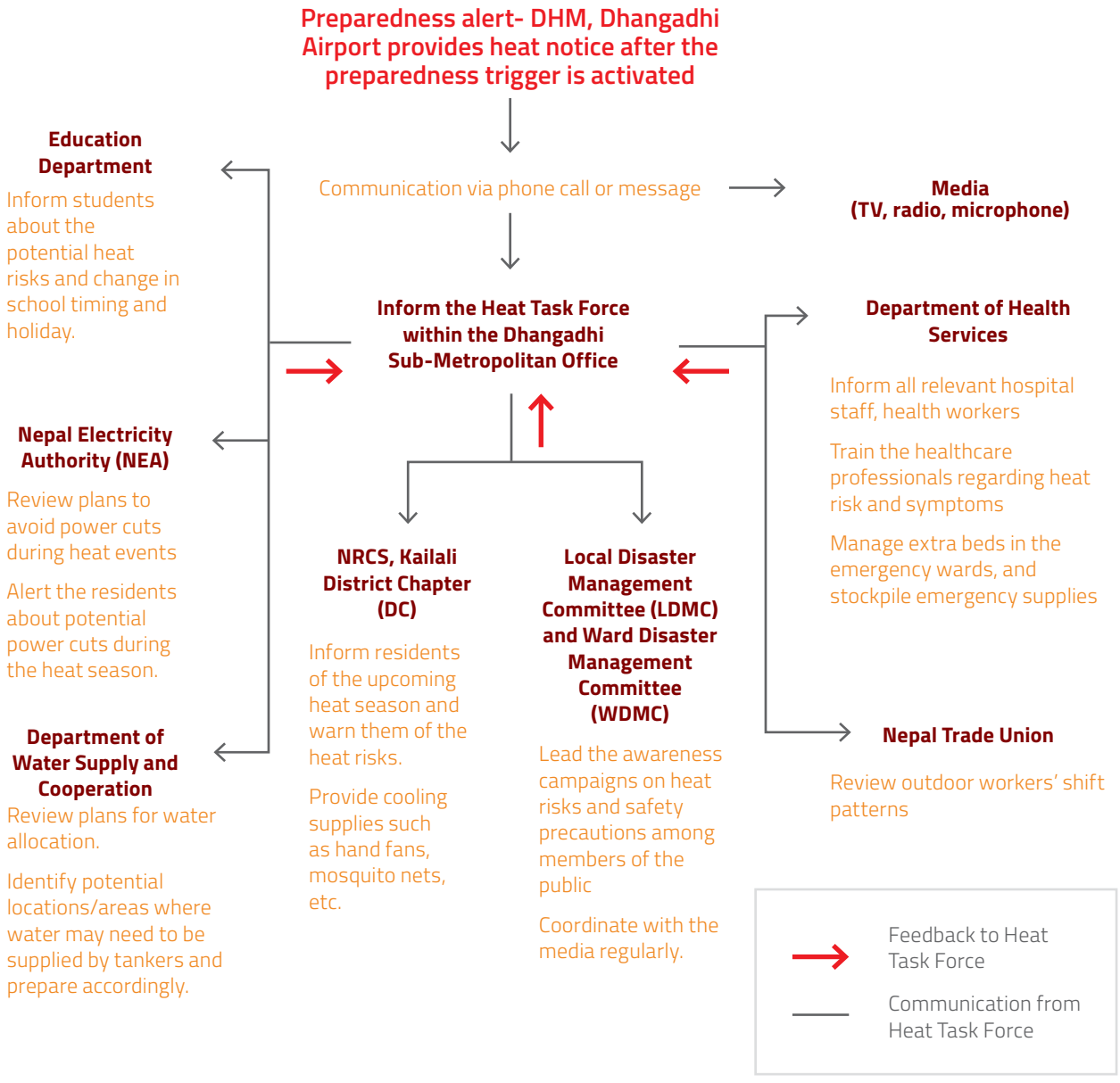
KEY ACTIVITY	UPDATING CLIMATE/DISASTER/HEAT ACTION PLANS AND POLICIES
Target area(s)	Dhangadhi city
Target group	DSM and Disaster Management Department
Sector(s)	Governance and Policy, Planning
Primary stakeholder	Disaster Management Department
Secondary stakeholders	LDMC NRCS, Kailali DC WDMC
How to carry out the activities	The Disaster Management Department of the Dhangadhi Sub-Metropolitan City will review and update climate and disaster plans and policies in close coordination with the LDMC and WDMC to take up the challenge of increasing heatwave events along with other climate vulnerabilities. The LDMC/WDMC will closely collaborate with the NRCS and Kailali DC to incorporate local insights into the reviewed plans to ensure they are responsive to communities' needs. These community-based DRR strategies can then be integrated within NRCS policies with technical assistance and support provided by the Kailali DC.
Case study	Case study from India: https://bit.ly/3FziZix

KEY ACTIVITY	UPDATING EXISTING DATABASES REGULARLY, INCLUDING HOSPITAL ADMISSIONS AND EMERGENCY CASE RECORDS TO TRACK HEAT-RELATED CASES
Target area(s)	Seti Provincial Hospital and Nursing Hospital, and other private clinics
Target group	Heat-related patients
Sector(s)	Public Health and Data Management
Primary stakeholder	Health Division of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Department of Health Services WDMC District Health Officer (DHO), Kailali
How to carry out the activities	The Health Division of Dhangadhi Sub-Metropolitan City will be responsible for ensuring that databases related to hospital admissions and the record of emergency cases are updated regularly. These will include data on trends and patterns of heat-related illnesses with a specific focus on age and sex disaggregation. The Health Division of Dhangadhi Sub-Metropolitan City will ensure that the data is systematically integrated into a centralized database.

7.3. STAKEHOLDER COORDINATION – PREPAREDNESS

The following Figure shows the heatwave preparedness flowchart for stakeholders in Dhangadhi. This flowchart outlines the specific roles and actions that each stakeholder should take during the preparedness season to minimize heat-related risks. The Heat Task Force of the Dhangadhi Sub-Metropolitan City will lead all activities in coordination with the NRCS and Kailali DC, and other stakeholders. It will be responsible for coordinating all internal and external activities and communications related to heatwave preparation. This flowchart aims to clearly define the responsibilities of each stakeholder, thereby reducing confusion and preventing duplication of effort.

FIGURE 28. STAKEHOLDER COORDINATION FOR PREPAREDNESS



Source: Author's illustration based on stakeholder workshop

8. RESPONSE FOR HEATWAVE

Heatwave response refers to the actions taken to protect individuals and the community from the harmful effects of extreme heat. These measures are typically implemented when a heatwave is anticipated or occurring. The primary goals are to reduce health risks, safeguard vulnerable populations and minimize damage.

In Dhangadhi Sub-Metropolitan City, stakeholders and vulnerable communities have identified the following response actions. These activities have been classified through workshops, key informant interviews (KIIs), household surveys and focus group discussions (FGDs). During the peak heat season, which lasts from April to June, it is crucial for relevant stakeholders to carry out the following response measures.

FIGURE 29. RESPONSE MEASURES

ALERT AND AWARENESS PROGRAMMES

1. **Providing heat alert messages to the residents for timely response and protection**
2. Raising awareness by distributing pamphlets; TV and radio broadcasts; and social media postings
3. Awareness through LED boards by sharing temperature and awareness messages
4. Operating a telephone helpline for elderly people

HEAT RELIEF DISTRIBUTION

5. **Distributing heat relief supplies such as water, electrolyte beverages, and cooling towels to affected communities**
6. Distributing reusable soft plastic ice packs
7. Drinking water distribution to the public through tankers.
8. **Door-to-door outreach in high-risk neighbourhoods to distribute heat relief supplies**

MEDICAL SUPPORT AND CARE

9. **Deploying medical units such as Rapid Response Teams (RRT) to provide on-site medical care and assistance to those affected by heat-related illnesses**
10. Increasing staffing at hospitals to attend to the influx of patients during a heat alert
11. **Record data on each patient suffering from a heat-related illness who visits a healthcare facility, and producing weekly reports on the public health impacts**

COMMUNITY SUPPORT AND OUTREACH

12. **Activating cooling centres**
13. **Water bell for students (reminders to drink water)**
14. **Installing water pots for animals**

RESOURCE MANAGEMENT

15. **Making sure water and electricity supplies are available to hospitals and other critical facilities during heat events**
16. Wetting pavements (concrete surfaces) in public spaces

WORKER PROTECTION

17. **Enforcing regulations to protect outdoor workers from excessive heat exposure**

ACTION PLAN

18. Activating heat response plans city-wide
19. Continuously monitoring the activities listed under the plan
20. Conducting post-event assessments to evaluate the effectiveness of heatwave response efforts and identify areas for improvement

Source: Author's illustration based on stakeholder workshop

8.1. HIGHLY PRIORITIZED ACTIONS

The top ten actions, prioritized by the stakeholders and community, are highlighted in Figure 29. Details on these highly prioritized actions are described in the following tables and case studies have been provided:

KEY ACTIVITY	1. PROVIDING HEAT ALERT MESSAGES TO THE RESIDENTS FOR TIMELY RESPONSE AND PROTECTION
Target area(s)	Dhangadhi city
Target group	All the citizens of Dhangadhi
Sector(s)	Early Warning Systems, Communication
Primary stakeholder	Disaster Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	DHM Media Information and Communication Department, Dhangadhi Sub-Metropolitan City Local Emergency Operation Centre (LEOC) District Emergency Operation Centre (DEOC)
Brief	Heat alerts are timely warnings issued to residents with information on extreme heat conditions along with ways of staying safe and minimizing health risks. These alerts are crucial for reducing heat-related illnesses and deaths. By providing heat alerts, residents can prepare and adjust their activities to avoid exposure during peak heat hours, reducing the risk of heat exhaustion, heatstroke and other health issues. During the heat season, the Disaster Department of Dhangadhi Sub-Metropolitan City will receive a heat alert from DHM, which the Disaster Department will share with residents through the Information and Communication Department and various media. The media will also play a critical role in broadcasting these messages on television, radio and online platforms such as Atariya online, Dinesh Kahabar, Today TV, etc. This message will warn residents about the impacts of heat and provide the necessary information to stay cool and hydrated. The DHM can also coordinate with telecommunication companies to send out heat alerts directly to residents' mobile phones.
Case study	The Bangladesh Meteorological Department regularly issues alerts about impending and ongoing heatwaves based on forecasts, informing people of the risk and advising them how to mitigate it. This notification typically explains how long the heatwave will last and lists all the necessary precautions. Link to case study: https://bit.ly/3Fgjluu

KEY ACTIVITY	2. DISTRIBUTING HEAT RELIEF SUPPLIES SUCH AS WATER, ELECTROLYTE BEVERAGES AND COOLING TOWELS TO AFFECTED COMMUNITIES
Target area(s)	Construction sites, industrial areas and informal settlement of Wards 1, 2, 3, 4, 5, 8 14, 17, 18 and 19 and Seti Provincial Hospital
Target group	Vulnerable groups
Sector(s)	Public Health, DRR
Primary stakeholder	Disaster Management Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	WDMC NRCS, Kailali DC Health Division of Dhangadhi Sub-Metropolitan City Department of Drinking Water Supply and Cooperation TLOs LEOC
Brief	The distribution of heat relief supplies includes dispensing heat relief materials such as water, electrolyte beverages and cooling towels. These supplies will be given out to the community to cope with the extreme heat. This is an important action as it helps in the prevention of heat illnesses and ensures that vulnerable people have proper hydration and cooling measures. The Disaster Management Department of Dhangadhi Sub-Metropolitan City will lead the initiative to distribute heat relief supplies to communities affected by extreme heat. WDMC will identify the most affected areas and coordinate with local I/NGOs and the LEOC as well as the NRCS and Kailali DC to ensure the vulnerable population receives the necessary supplies.
Case study	The Heat Relief Network in Phoenix, Arizona, USA distributes supplies, including bottled water, electrolyte drinks and cooling towels to the homeless and other high-risk populations. Link to case study: https://bit.ly/3Dc1548

KEY ACTIVITY	3. DOOR-TO-DOOR OUTREACH IN HIGH-RISK NEIGHBOURHOODS TO DISTRIBUTE HEAT RELIEF SUPPLIES
Target area(s)	Wards 9, 14, 16, 18 and 19
Target group	Vulnerable populations
Sector(s)	Community Outreach
Primary stakeholder	NRCS, Kailali DC
Secondary stakeholders	Ward Committee DDMC I/NGOs
Brief	A door-to-door outreach programme is a method of going to vulnerable people's homes to distribute the necessary heat relief items – water, electrolyte drinks and cooling towels, and to inform them about heat risks. This helps in mitigating the effects of extreme heat for vulnerable populations, such as the elderly, children and people with pre-existing medical conditions. The NRCS and Kailali DC will distribute these items door-to-door in high-risk neighbourhoods of Wards 9, 14, 16, 18 and 19. These are the wards where the largest elderly and infant populations live. The Ward Committee will help the NRCS team to identify vulnerable neighbourhoods. The team can also deliver information and education campaign (IEC) materials related to heatwave safety, symptoms of heat-induced illnesses and emergency contact numbers. The NRCS and Kailali DC can also keep records of households visited and the supplies given. The pre-identified location of door-to-door visits is given in Annex C – Figure C-3.
Case study	The Government of the Netherlands produced a National Heat Plan in 2007 following the deadly heatwave of 2006. The Netherlands Red Cross provided door-to-door outreach among the elderly to provide wellness checks and share key messages on staying safe during a heatwave. Link to case study: https://bit.ly/3OQrQh2

KEY ACTIVITY	4. DEPLOYING MEDICAL UNITS SUCH AS A RAPID RESPONSE TEAM (RRT) TO PROVIDE ON-SITE MEDICAL CARE AND ASSISTANCE TO THOSE AFFECTED BY HEAT-RELATED ILLNESSES
Target area(s)	All the citizens of Dhangadhi
Target group	Vulnerable communities and groups suffering from heat-related illnesses, including heatstroke, dehydration and heat exhaustion
Sector(s)	Emergency Response
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Division, DSC Hospitals Youth clubs NRCS, Kailali DC DAO District Police, Dhangadhi Sub-Metropolitan City
Brief	A Rapid Response Team (RRT) is a specialized medical team – convened during an extreme heat event – that consists of a highly trained nurse and medical staff qualified to identify the signs of heat-related illness, including heat exhaustion, heatstroke and other heat-related health issues. The team provides immediate care and assistance to those affected. An RRT helps to ensure that the health effects from heatwaves are reduced and that people at risk have timely access to medical resources. Medical units, including RRTs, will be mobilized through the collaboration of the Department of Health Services and the Health Division of Dhangadhi Sub-Metropolitan City to provide on-site care for individuals affected by heat. The NRCS and Kailali DC can study the most heat-affected areas in order to formulate a plan on how many RRTs should be deployed in coordination with the Health Division of Dhangadhi Sub-Metropolitan City. The Red Cross Youth Clubs can help in mobilizing volunteers and community support.
Case study	After the development of a HAP for Surat – a port city in Gujarat, India – the Health Department of Surat Municipal Corporation has been deploying Mobile Medical Units in heatwave-prone areas to provide immediate medical assistance to the vulnerable communities. Link to case study: https://bit.ly/3OW8M0X

KEY ACTIVITY	5. RECORD DATA ON EACH PATIENT SUFFERING FROM A HEAT-RELATED ILLNESS WHO VISITS A HEALTHCARE FACILITY, AND PRODUCING WEEKLY REPORTS ON THE PUBLIC HEALTH IMPACTS
Target area(s)	All healthcare facilities in Dhangadhi, including hospitals, clinics and health centres.
Target group	Patients suffering from heat-related illnesses, including heatstroke, dehydration and heat exhaustion
Sector(s)	Data Management, Public Health
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Department Dhangadhi Sub-Metropolitan City Ward Health Centres NRCS, Kailali DC
Brief	Maintaining comprehensive records of heat-related illnesses in healthcare facilities involves systematically documenting all cases of heat-related conditions such as heatstroke, dehydration and heat exhaustion. This approach ensures that all cases are recorded to help authorities monitor the trend, assess the effectiveness of interventions, and enhance responses to future heat-related health crises. By keeping detailed records, healthcare facilities can provide timely and targeted responses during future heat events. The Department of Health Services, along with the Health Division of Dhangadhi Sub-Metropolitan City, will maintain full records of all cases of heat-related illness across the city's healthcare facilities. All health facilities will record the case details, treatment provided and outcome. Health facilities will regularly update their records and send this data to the Department of Health Services. This will help to analyse the public health impact of heatwaves.
Case study	Following a devastating heatwave in 2010, the Ahmedabad Municipal Corporation in India developed one of South Asia's first Heat Action Plans. A critical component of the plan is its focus on healthcare data, which was used to track heat-related illnesses and enhance hospital preparedness. Hospitals and clinics carefully record patients showing up with heat-related illnesses. These are collected on a weekly basis over the heat season for tracking trends in the public health consequences of extreme heat events. Link to case study: https://bit.ly/3ORqkeB

KEY ACTIVITY	6. ACTIVATING COOLING CENTRES
Target area(s)	Strategically identified locations across Dhangadhi
Target group	Vulnerable groups such as street vendors, auto drivers, outside workers etc.
Sector(s)	Public Health
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC WDMC NEA office Department of Drinking Water Supply and Cooperation I/NGOs and humanitarian organizations NRCS, Kailali DC
Brief	Cooling centres are places where people can cool down during hot weather. These centres are equipped with air conditioning or fans to provide a controlled, cooler environment, helping to mitigate the effects of heatwaves and extreme temperatures. The centres are an effective way to prevent or reduce the negative health impacts of severe heat as they provide a safe environment for individuals, especially the elderly, children and those with pre-existing health conditions. The Dhangadhi Sub-Metropolitan City will work with the LDMC and WDMC on activating cooling centres during heatwaves. The NEA office will ensure that the cooling centres are well serviced with an uninterrupted supply of electricity. The Department of Drinking Water Supply and Cooperation will maintain an adequate water supply at the centres. The LDMC, NRCS and Kailali DC can offer further help to manage the cooling centres. The Environment Department of Dhangadhi can also increase shaded areas or greenery around the cooling centres. The Dhangadhi Sub-Metropolitan City can also seek assistance from I/NGOs and humanitarian organizations to ensure the functioning and maintenance of these centere. During the peak heat season, i.e., from April to June, these cooling centres can be open from 11 a.m. to 4 p.m.
Case study	During the heatwave in August 2019 in Viet Nam, the Viet Nam Red Cross Society activated cooling centres based on the forecast. Four community cooling centres were opened to provide immediate heat relief to outside workers and commuters. On average, the centres were 7°C cooler than the scorching heat outside. Link to case study: https://bit.ly/3BtvudF

KEY ACTIVITY	7. WATER BELL FOR STUDENTS (REMINDERS TO DRINK WATER)
Target area(s)	Schools
Target group	All school students
Sector(s)	Education
Primary stakeholder	Education Division of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	School Management Committees PABSON and NPABSON Department of Drinking Water Supply and Cooperation
Brief	Water bells for students is a system implemented in schools where a bell or alert is rung at regular intervals to remind students and staff to drink water throughout the day. This initiative helps the school community to avoid dehydration and the associated health problems in schoolchildren and staff during in the heat season. The School Management Committees will closely collaborate with the Education Division of Dhangadhi Sub-Metropolitan City on mainstreaming water bells into schools' daily routines. The water bell will ring as a reminder to drink water twice a day at 11.30 a.m. and 2.30 p.m. Implementation and scheduling of the water bell system can be monitored by the NRCS and Kailali DC. Similarly, the Drinking Water Corporation will provide the school with an adequate supply of pure drinking water
Case study	With rising temperatures in Kerala, India, Keralan schools are ringing in a simple yet effective solution to keep students hydrated: the water bell system. This system has been reintroduced to tackle the rising heat and to ensure the well-being of students during school hours. The water bell system directly addresses heat concerns. Link to case study: https://bit.ly/3GWPzvt

KEY ACTIVITY	8. INSTALLING WATER POTS FOR ANIMALS
Target area(s)	All the citizens of Dhangadhi
Target group	Street animals, birds
Sector(s)	Animal Welfare
Primary stakeholder	Livestock Department
Secondary stakeholders	TLOs Private sector WDMC Residents of Dhangadhi
Brief	Installing water pots is an initiative to provide clean drinking water to animals during extreme heat. Through this, street animals such as dogs and cats as well as birds will be able to drink hygienic water. Locals in Dhangadhi will be asked to help by placing water pots throughout their neighbourhoods and keeping them topped up with water. This action is essential to prevent dehydration and heat-related distress in street animals and birds. The Livestock Department will initiate a citywide installation of water pots for street animals and birds. TLOs and WDMCs will collaborate in installing and maintaining the water pots in selected localities to ensure maximum coverage. This initiative can be supported by the private sector through the provision of the resources needed.
Case study	The Water for Voiceless (WFV) initiative was set up to implement water bowls across Tumakuru in India. The organization distributed around 3,500 water bowls in Bengaluru in areas like Domlur, Indiranagar, Jayanagar and Rajarajeshwari Nagar. In Tumakuru city alone, a further 3,000 water bowls have been distributed so far, demonstrating WFV's commitment to the hydration of animals and birds in heat-prone areas. Link to case study: https://bit.ly/41wp3kx

KEY ACTIVITY	9. MAKING SURE WATER AND ELECTRICITY SUPPLIES ARE AVAILABLE TO HOSPITALS AND OTHER CRITICAL FACILITIES DURING HEAT EVENTS
Target area(s)	All hospitals and other critical facilities in Dhangadhi, such as healthcare centres, cooling centres and emergency shelters.
Target group	Patients, healthcare workers and other individuals relying on critical facilities
Sector(s)	Utility Management
Primary stakeholder	Department of Health Services
Secondary stakeholders	Department of Drinking Water Supply and Cooperation NEA
Brief	Ensuring the continuous supply of water and electricity to hospitals and other critical facilities during heat events is essential for the smooth operation of healthcare and emergency services. This measure is critical because interruptions in water or electricity supplies can compromise the ability of healthcare facilities to provide adequate care, particularly for vulnerable populations. Although these actions may seem similar to the preparedness measures related to stockpiling supplies, they focus on different aspects of the heatwave response. Ensuring the availability of water and electricity for hospitals during a heatwave is something that local authorities need to prioritize while the heatwave is occurring. The Department of Health Services will ensure that hospitals and other critical facilities have a full and reliable supply of water and electricity. The Department will coordinate with the Department of Drinking Water Supply and Cooperation and the NEA to devise back-up plans to ensure uninterrupted supplies of these essential utilities.
Case study	In Victoria, Australia, public health services are well prepared to manage the risk of critical infrastructure failure, such as in the supply of electricity/air conditioning. But, while they have back-up emergency generators in situ, sometimes these might also fail. Recognizing this risk, the Department of Health provides 25 million Australian dollars annually as part of the Engineering Infrastructure Program to back-up health services' back-up plans. Link to the case study: https://bit.ly/3P08eHb

KEY ACTIVITY	10. ENFORCING REGULATIONS TO PROTECT OUTDOOR WORKERS FROM EXCESSIVE HEAT EXPOSURE
Target area(s)	Dhangadhi
Target group	Outdoor workers (construction workers)
Sector(s)	Occupational Health and Safety
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Chamber of Commerce DAO Nepal Trade Union Private sector
Brief	Enforcing regulations that protect outdoor workers during extreme heat – such as ensuring they have appropriate working hours – is crucial for their health and well-being and reducing the incidence of heat-related illnesses. This action will help to implement guidelines for outdoor labourers that ensure maximum allowable working hours during peak heat days, scheduling regular breaks, and designating rest areas such as shaded/green areas, as well as refreshments such as water and electrolyte drinks. The DAO, in collaboration with Dhangadhi Sub-Metropolitan City and the Chamber of Commerce, will enforce regulations to protect outdoor workers from extreme heat. The Nepal Trade Union will develop and implement these guidelines.
Case study	California's 'Heat injury and illness prevention in outdoor and indoor work settings' is a set of robust regulations for outdoor workers requiring the provision of shade, drinking water and regular breaks. This regulation also includes mandatory training about heat hazards. Link to case study: https://bit.ly/3VyIFRk

8.2. MODERATELY PRIORITIZED HEAT RESPONSE MEASURES

The response actions outlined in the following table are moderately prioritized compared to the measures previously mentioned by stakeholders and communities in Dhangadhi city. These actions are also crucial for mitigating the negative impacts of heatwaves; however, the local government currently faces significant resource constraints. Given these challenges, the local government and emergency service providers may choose to delay prioritizing these tasks until the previously mentioned actions have been addressed.

It is important to note that if the Heat Task Force and local government determine that some of the actions listed here – such as an awareness campaign focused on people's immediate needs during hot days – require higher prioritization, they can choose to implement them before or concurrently alongside the highly prioritized heat response measures.

TABLE 8. HEAT PREPAREDNESS MEASURES

EMERGENCY RESPONSE & RELIEF MEASURES

KEY ACTIVITY	ACTIVATING HEAT RESPONSE PLANS CITYWIDE
Target area(s)	Dhangadhi city
Target group	All the residents of Dhangadhi
Sector(s)	Governance and Policy, DRR
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	WDMC LDMC TLOs NRCS, Kailali DC
How to carry out the activities	The Dhangadhi Sub-Metropolitan City will activate and implement the Heat Action Plan to address heat-related risks. WDMC and LDMC will coordinate at the local level to implement the heat response plan and ensure that heat safety measures are enforced in their respective areas.
Case study	Case study from France: https://bit.ly/4gpLzzx

KEY ACTIVITY	DISTRIBUTING REUSEABLE SOFT PLASTIC ICE PACKS
Target area(s)	Heat-prone regions, particularly those with limited access to cooling resources
Target group	Health centres, ambulances and hospitals
Sector(s)	Health, DRR
Primary stakeholder	Health Division, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	NRCS, Kailali DC PHA Private sector
How to carry out the activities	The Health Division, Dhangadhi Sub-Metropolitan City will take full responsibility for the purchase of reuseable soft plastic ice packs to ensure that they are safe and of good quality. The NRCS team will distribute the ice packs in selected health centres, ambulances and hospitals in Dhangadhi to ensure they are readily available for use.

KEY ACTIVITY	DRINKING WATER DISTRIBUTION TO THE PUBLIC THROUGH TANKERS
Target area(s)	Wards 9, 11, 12, 15, 17
Target group	Families living in informal settlements or areas with water shortages
Sector(s)	Water and Sanitation
Primary stakeholder	Department of Drinking Water Supply and Cooperation
Secondary stakeholders	Dhangadhi Sub-Metropolitan City NRCS, Kailali DC WDMC LEOC
How to carry out the activities	Dhangadhi Sub-Metropolitan City, in coordination with the NRCS and Kailali DC will identify the most water-stressed areas of the city. The Department of Drinking Water Supply and Cooperation will manage the water supply, ensuring the availability of tankers and operational resources. WDMC and LEOC can coordinate at the ward level to facilitate this distribution, making sure that water reaches the intended beneficiaries by addressing any local challenges.
Case study	Case study from the Red Crescent Society of Tajikistan; activating drinking water distribution based on a forecast: https://bit.ly/3Rc7wIB

KEY ACTIVITY	WETTING PAVEMENTS (CONCRETE SURFACES) IN PUBLIC SPACES
Target area(s)	High traffic flow areas of Dhangadhi such as main highways (Wards 1, 2 3, 4 etc.)
Target group	All the residents of Dhangadhi
Sector(s)	Urban Planning
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Ministry of Physical Infrastructure and Transport
How to carry out the activities	During the heat seasons, Dhangadhi Sub-Metropolitan City can take the initiative to wet pavements in public spaces and main roads where there is high traffic flow, such as the main highway within Dhangadhi city. This will help decrease the surface temperature and provide relief to the residents, especially pedestrian workers. This can be done around 1.00 p.m. when the road has heated significantly.

AWARENESS CAMPAIGN

KEY ACTIVITY	RAISING AWARENESS BY DISTRIBUTING PAMPHLETS; TV AND RADIO BROADCASTS; AND SOCIAL MEDIA POSTINGS
Target area(s)	Dhangadhi city
Target group	All the residents of Dhangadhi
Sector(s)	Communication
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Ward office Female Community Health Volunteers (FCHVs) NRCS, Kailali DC Media LDMC
How to carry out the activities	Dhangadhi Sub-Metropolitan City will oversee the distribution of heat awareness pamphlets about heat safety and the prevention of heat-related illnesses. The necessary materials for awareness campaigns, including banners and posters, have already been prepared and can be found at this link: https://preparecenter.org/toolkit/heat/heat-action-posters/. Media partners will be engaged to broadcast heat safety messages with information on TV and radio. They can also share heat awareness videos (https://vimeo.com/showcase/9459591). This will include tips for staying safe during heatwaves. FCHVs and the NRCS will assist in disseminating information through their networks, engaging community members and ensuring that they reach all residents, especially those in high-risk areas.
Case study	Case Study from the Philippines: https://bit.ly/3EoLoqQ

KEY ACTIVITY	AWARENESS-RAISING THROUGH LED BOARDS SHOWING TEMPERATURE AND PROTECTION MESSAGES
Target area(s)	Public spaces with high traffic, such as marketplaces, hospitals and schools
Target group	All the residents of Dhangadhi (especially pedestrians, outdoor workers, street vendors, etc.)
Sector(s)	Public Awareness, Communication
Primary stakeholder	Disaster Department of Dhangadhi Sub-Metropolitan City
Secondary stakeholders	NRCS, Kailali DC DHM NEA DAO Private sector Banks Federation of Nepalese Chamber of Commerce & Industries (FNCCI)
How to carry out theactivities	Dhangadhi Sub-Metropolitan City's Disaster Department will coordinate the installation of LED boards in strategic locations across Dhangadhi, such as busy intersections, marketplaces, and areas frequented by outdoor workers and street vendors. DHM will share the real-time temperature data to be displayed on the boards along with heat awareness messages. The Disaster Department of Dhangadhi Sub-Metropolitan City will also develop and update the awareness messages in coordination with the NRCS, Kailali DC and other stakeholders.
Case study	Case study from Nepal: https://bit.ly/3EoLoqQ

CAPACITY STRENGTHENING / HEALTH SYSTEM PREPAREDNESS

KEY ACTIVITY	OPERATING A TELEPHONE HELPLINE FOR ELDERLY PEOPLE
Target area(s)	Wards with more elderly people
Target group	Elderly people
Sector(s)	Social Protection
Primary stakeholder	Department of Women, Children and Senior Citizens
Secondary stakeholders	NRCS, Kailali DC
How to carry out the activities	The Department of Women, Children and Senior Citizens can take lead responsibility for establishing a telephone helpline that will address heat-related and other general concerns. NRCS and Kailali DC can provide the necessary support for training to fully equip staff.
Case study	Case study from Spanish Red Cross Society: https://bit.ly/3Rc7wIB

KEY ACTIVITY	INCREASING STAFFING AT HOSPITALS TO ATTEND TO THE INFLUX OF PATIENTS DURING A HEAT ALERT
Target area(s)	Hospitals and healthcare facilities in Dhangadhi
Target group	Patients affected by heat-related illnesses
Sector(s)	Health, Emergency Preparedness
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Division of Dhangadhi Sub-Metropolitan City
How to carry out the activities	The Department of Health Services will assess the expected increase in patient volume during heat alerts and determine the additional staffing needs. The Department can also compile a staffing plan that includes temporary staffing to handle the surge in patients effectively.

MONITORING AND REVIEW

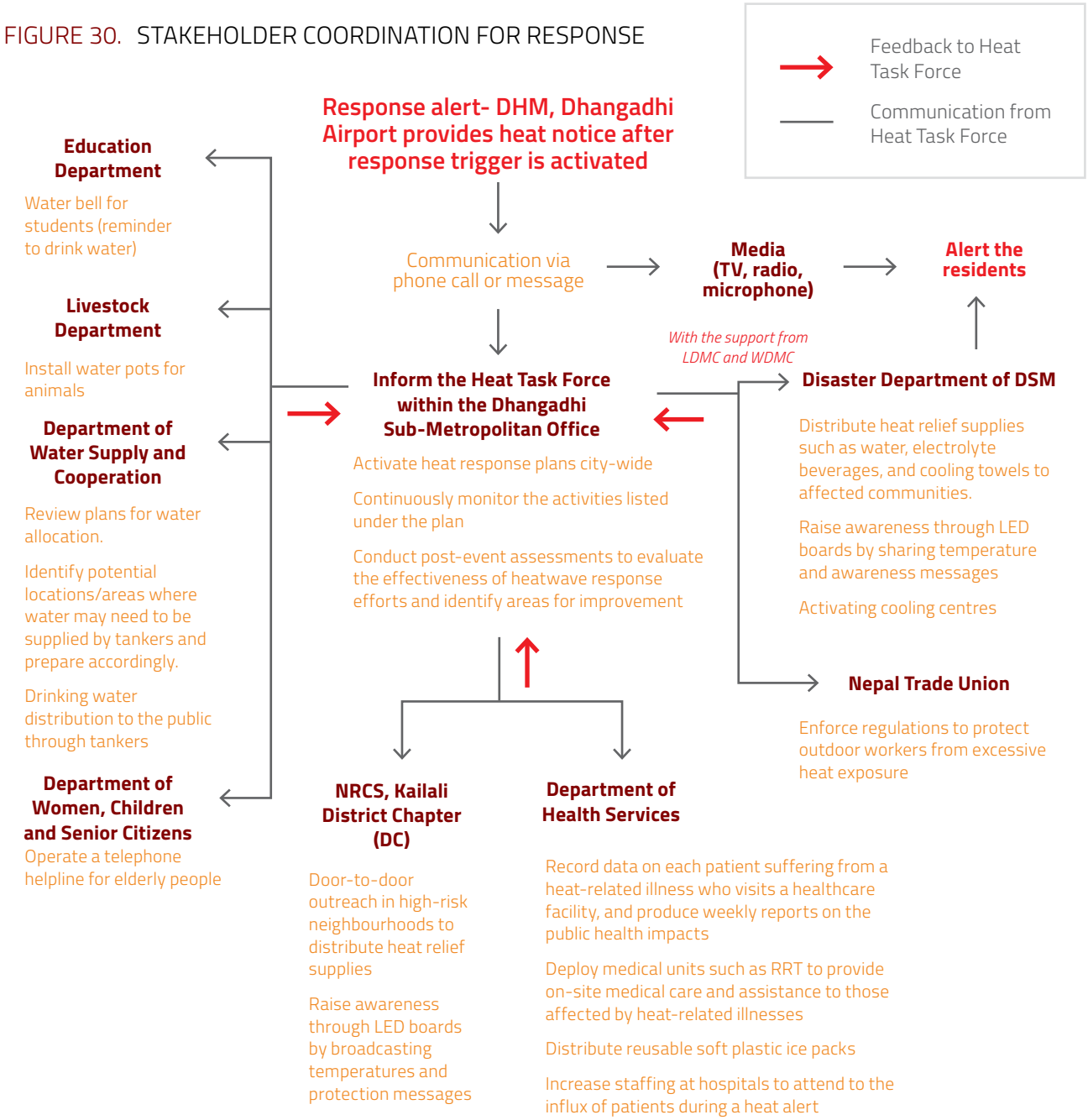
KEY ACTIVITY	CONTINUOUSLY MONITORING THE ACTIVITIES LISTED UNDER THE HAP
Target area(s)	Dhangadhi city
Target group	All the residents of Dhangadhi
Sector(s)	Monitoring and Evaluation
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	DDMC NRCS Kailali DC WDMC
How to carry out the activities	Dhangadhi Sub-Metropolitan City will form a monitoring team that comprises DDMC, NRCS, Kailali DC and WDMC. The Dhangadhi Sub-Metropolitan City can assign specific roles to these teams to monitor different activities under the Heat Action Plan. NRCS, Kailali DC and WDMC will provide regular updates on the progress of activities within their respective jurisdictions

KEY ACTIVITY	CONDUCTING POST-EVENT ASSESSMENTS TO EVALUATE THE EFFECTIVENESS OF HEATWAVE RESPONSE EFFORTS AND IDENTIFY AREAS FOR IMPROVEMENT
Target area(s)	Dhangadhi city
Target group	All the residents of Dhangadhi
Sector(s)	Monitoring and Evaluation
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	NRCS, Kailali DC WDMC
How to carry out the activities	Dhangadhi Sub-Metropolitan City, in collaboration with NRCS and Kailali DC, will carry out post-event assessments in order to determine the effectiveness of the response efforts to the heatwave. The NRCS and Kailali DC will assess the efficiency of communication channels, resource allocations, and community engagement. The assessment results of Dhangadhi Sub-Metropolitan City would then be a tool to help identify ways in which the heatwave preparedness and response plans, policies and procedures could improve.

8.3. STAKEHOLDER COORDINATION – RESPONSE

Figure 30 shows the heatwave response flowchart for stakeholders in Dhangadhi. It outlines the specific roles and actions that stakeholders should undertake during the response season to minimize heat-related risks. The Heat Task Force of Dhangadhi Sub-Metropolitan City will lead all activities in coordination with the NRCS, Kailali DC, Local Disaster Management Committee (LDMC) and the Ward Disaster Management Committee (WDMC). Together, these agents are responsible for implementing a citywide heat response plan. This flowchart provides a clear outline of each stakeholder's responsibilities, reducing confusion and preventing duplication of effort.

FIGURE 30. STAKEHOLDER COORDINATION FOR RESPONSE



Source: Author's illustration based on stakeholder workshop

9. LONG-TERM URBAN ADAPTATION MEASURES

Long-term measures are essential in addition to response and preparedness efforts, as they address the root causes of heatwave impacts. These measures ensure that communities are sustainable and resilient in the face of increasing climate challenges. The goal is to reduce vulnerability and enhance adaptive capacity over time. Stakeholders in Dhangadhi Sub-Metropolitan City have identified the following long-term measures through stakeholder workshops, key informant interviews (KII), household surveys and focus group discussions (FGDs) with communities, as illustrated in Figure 31.

FIGURE 31. LONG-TERM MEASURES

URBAN GREENING INITIATIVES

1. **Roadside planting, planting in parks, maintenance of green areas**
2. **Promoting green roofing**
3. Increasing roof reflectivity
4. Increasing cool permeable pavements

WATER MANAGEMENT

5. Promoting rainwater services
6. Promote sprinkler irrigation and spray parks

HEALTH AND EMERGENCY RESPONSE

7. **Establishing dedicated heat wards in government hospitals**
8. **Quantifying heat-related data**
9. **Implementing of cool roofs and green coverage to enhance heat resilience in a healthcare facility**

AGRICULTURE AND FOOD SECURITY

10. **Promoting fish farming for heatwave resilience and food security**
11. Distributing heat-resistant seeds and drought-tolerant crops to farmers

POLICY AND GOVERNANCE

12. **Incorporating heat mitigating measures into building codes to standardize good practice**
13. **Offering incentives or rewards for residents who implement heatwave mitigation measures, such as installing reflective roofing or upgrading insulation**
14. Mainstreaming heat risk into city/municipality planning.

EDUCATION AND AWARENESS

15. **Establishing partnerships with educational institutions to incorporate heatwave preparedness into school curricula**
16. **Raising awareness of energy-efficient appliances such as the use of LED bulbs or CFL bulbs**

SUSTAINABLE INFRASTRUCTURE DEVELOPMENT

17. Replacing tin roofs in schools with cooling roofs
18. Promoting sustainable transportation options, such as cycling lanes, pedestrian-friendly streets, and car-free zones

Source: Author's illustration based on stakeholder workshop

9.1. HIGHLY PRIORITIZED ACTIONS

The top eleven actions, prioritized by the stakeholders and community, are highlighted in Figure 31. Details on these highly prioritized actions are described in the following tables and case studies have been provided:

KEY ACTIVITY	1. ROADSIDE PLANTING, PLANTING IN PARKS, MAINTENANCE OF GREEN AREAS
Target area(s)	Roadsides, public parks and open spaces within Dhangadhi.
Target group	All residents of Dhangadhi
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Environment Department, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Department of Forestry Department of Urban Development and Building Construction Department of Roads WDMC Private sector Local clubs TLOs
Brief	Roadside and park planting involves strategically planting trees and greenery in urban spaces, such as along roads and within parks, to cool down the outdoor temperature and provide shade. This is an important measure to reduce urban heat and improve air quality. Trees contribute to lowering temperatures by creating shade and releasing moisture into the air. They also help in purifying the air through the absorption of pollutants and enhancing urban aesthetics, which can improve community well-being. The Environment Department, Dhangadhi Sub-Metropolitan City, in collaboration with the Department of Forestry and the Department of Urban Development and Building Construction, will identify appropriate spots along roadsides for planting trees as well as in the city's parks. The private sector, such as banks, can contribute through corporate social responsibility (CSR) initiatives, including funding and providing volunteers for planting activities. WDMC and local clubs will take responsibility for the maintenance of these green spaces.
Case study	The City of Melbourne in Australia has set a benchmark in leveraging urban green infrastructure as a strategy for heat adaptation and mitigation. By increasing the quantity and quality of green infrastructure wherever possible, the city has effectively enhanced cooling and thermal comfort in its urban environment. Link to case study: https://bit.ly/3ZZo0c1

KEY ACTIVITY	2. PROMOTE GREEN ROOFING
Target area(s)	Urban and semi-urban areas of Dhangadhi with significant building infrastructure
Target group	Homeowners, municipal institutions
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	LDMC NRCS, Kailali DC Private sector
Brief	Green roofs are vegetated surfaces installed on building rooftops. They turn unutilized spaces into green areas, contributing to urban sustainability. These roofs consist of layers of vegetation, soil and drainage systems, which help to regulate temperature. Such roofs are essential in urbanized areas as cities are usually hotter than their surroundings. Adding vegetation to rooftops helps to reduce heat absorption, improve insulation, lower overall building temperatures and improve air quality. The Department of Urban Development and Building Construction will work closely with LDMC to develop a comprehensive plan to promote green roofing across the city. NRCS and Kailali DC can conduct awareness campaigns to educate residents on the benefits of green roofing, such as providing shade, removing heat from the air and reducing surface and surrounding temperatures.
Case study	Singapore has developed green roofing as a key strategy in its ongoing efforts to mitigate urban heat. Green roofs create vegetated green spaces on building rooftops to create green spaces that provide environmental, economic and social benefits. Singapore's success with green roofing illustrates how urban areas can effectively address heat challenges and enhance urban resilience. Link to case study: https://bit.ly/3ZNHtMv

KEY ACTIVITY	3. ESTABLISHING DEDICATED HEAT WARDS IN GOVERNMENT HOSPITALS
Target area(s)	All government hospitals in Dhangadhi.
Target group	Patients suffering from heat-related illnesses, especially vulnerable groups
Sector(s)	Health
Primary stakeholder	Health Division, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Seti Provincial Hospital PHA
Brief	A heat ward is a special unit in a hospital that provides care to patients suffering from heat-related illnesses during intense heatwaves. Establishing such wards helps in managing the health effects of heatwaves, reducing the burden on general hospital services in cases of extreme heat. These wards ensure timely and focused care for patients with heatstroke, dehydration and other heat-related conditions, improving patient outcomes during peak heat periods. The Dhangadhi Health Division, in collaboration with Seti Provincial Hospital, will set up a fully functioning dedicated heat ward at the hospital. It will operate during periods of extreme heat, typically from April to June. The heat ward will have trained medical personnel who are able to identify and offer treatments for heat-related conditions.
Case study	Ahmedabad Civil Hospital in India has prepared two wards for heatstroke patients, with a total capacity of 24 beds divided into two emergency wards. One ward is for adults, and the other is for children under 12 years of age, suffering from heat-related illness. Link to case study: https://bit.ly/3Vwo0xW

KEY ACTIVITY	4. QUANTIFYING HEAT-RELATED DATA
Target area(s)	All hospitals in Dhangadhi
Target group	Individuals affected by heat-related illnesses and the healthcare system's stakeholders
Sector(s)	Data Management, Public Health
Primary stakeholder	Department of Health Services
Secondary stakeholders	Health Division of Dhangadhi Sub-Metropolitan City All hospitals and clinics in Dhangadhi
Brief	The systematic collection of data on heat-related illnesses involves gathering information from hospitals and clinics to monitor health impacts during heatwaves. This process includes documenting cases of heat exhaustion, heatstroke, dehydration and other heat-related conditions, ensuring that the data is accurately recorded and consistently updated. This is crucial for the identification of trends and the enhancement of health interventions. A centralized database ensures that all collected data is organized, accessible and ready for analysis to help authorities make informed decisions in enhancing heatwave response strategies. The Department of Health Services will coordinate with the Health Division of Dhangadhi Sub-Metropolitan City and all hospitals and clinics in Dhangadhi to systematically collect data on heat-related illnesses. The Department of Health Services can create a centralized database managed by the Health Division of Dhangadhi Sub-Metropolitan City to store and analyse heat-related health data.
Case study	A Heat Smart Database has been developed in Sydney, Australia as a centralized, multi-indexed tool that allows access to data on heat and helps to enhance the region's heat management capability. A single platform consolidates diverse heat-related data, research and case studies. Learning from Sydney, the Department of Health Services of Nepal could also develop a centralized, multi-indexed resource to streamline access to heat-related data. Link to case study: https://bit.ly/4grVzse

KEY ACTIVITY	5. IMPLEMENTING COOL ROOFS AND GREEN COVERAGE TO ENHANCE THE HEAT RESILIENCE OF HEALTHCARE FACILITIES
Target area(s)	Healthcare facilities of Dhangadhi city
Target group	Patients, healthcare staff, visitors
Sector(s)	Hospitals, Urban Planning
Primary stakeholder	Department of Health Services
Secondary stakeholders	Hospitals Department of Urban Planning Environment Department, Dhangadhi Sub-Metropolitan City
Brief	The implementation of cool roofs and green coverage at healthcare facilities involves using reflective roofing materials or 'cool roofs' and/or vegetative or 'green roofs' to reduce heat absorption and improve indoor temperatures. These measures help keep hospital buildings cooler, especially during heatwaves, reducing the risk of heat-related illnesses among patients and staff. The Department of Health Services can first identify hospital buildings where cool roofs and green coverage could be installed. In coordination with the Department of Urban Planning, the Department of Health Services can install insulated roofing systems or use reflective materials like white coatings, cool asphalt, or cool tiles to minimize heat absorption. The Environment Department of Dhangadhi Sub-Metropolitan City can also support these endeavours to enhance the greenery within healthcare facilities.
Case study	Karolinska University Hospital in Sweden has implemented extensive green roofs, covering over 20,000 square metres, as part of its sustainability efforts. These green roofs provide thermal insulation, reduce urban heat, help manage stormwater and create a healing environment for patients. Link to case study: https://bit.ly/3SeKyki

KEY ACTIVITY	6. PROMOTING FISH FARMING FOR HEATWAVE RESILIENCE AND FOOD SECURITY
Target area(s)	Areas suitable for fish farming in Dhangadhi
Target group	Local farmers and community members interested in aquaculture
Sector(s)	Aquaculture
Primary stakeholder	Department of Agriculture and Livestock
Secondary stakeholders	WDMC TLO
Brief	Fish farming refers to the cultivation of fish in controlled bodies of water, which can also serve multiple purposes in enhancing heatwave resilience. Not only does the promotion of fish farming help to ensure food security and develop the local economy, the water bodies used for fish farming can help to reduce the urban heat island effect as they provide cooling benefits to the surrounding area. This localized cooling effect is especially important during heatwaves. The Department of Agriculture and Livestock, with the help of WDMC and TLOs, will promote fish farming in Wards 1, 3, 4, 5, 17 and 19. This initiative will help to increase food security, support the local economy and help to reduce the temperature of nearby areas.
Case study	The government of Morang, Nepal has started a massive investment programme to enhance the production of fisheries in the city. Under the ten-year Prime Minister Agricultural Programme, Morang has been declared a 'fisheries zone'. The plan aims to increase the income of farmers while controlling urban heat. Ponds and water reservoirs developed for fisheries are natural heat sinks, where the heat is absorbed during the daytime and released slowly at night. Link to case study: https://bit.ly/41rwBVX

KEY ACTIVITY	7. INCORPORATING HEAT MITIGATING MEASURES INTO BUILDING CODES TO STANDARDIZE GOOD PRACTICE
Target area(s)	New constructions sites
Target group	All residents of Dhangadhi
Sector(s)	Urban Planning
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	Dhangadhi Sub-Metropolitan City
Brief	The incorporation of heat mitigating measures would involve reviewing and updating current building regulations. This is crucial for ensuring that the structural designs of new and existing buildings can effectively withstand extreme heat. Incorporating heat-resilient practices, such as thermal insulation and passive cooling, will allow buildings to remain cooler and have better comfort for the occupants, while minimizing the need for air conditioning. Department of Urban Development and Building Construction, in coordination with Dhangadhi Sub-Metropolitan City, can review and update existing building codes and identify gaps where heat-resilient measures are missing. The Department will update these building regulations by developing specific standards for heatwave mitigation measures.
Case study	The Buenos Aires Climate Action Plan includes strategies to enhance private sector resilience through updated building codes. These regulations mandate solar protection and ventilation in new constructions to improve heat adaptation. Link to case study: https://bit.ly/4hJaAGL

KEY ACTIVITY	8. OFFERING INCENTIVES OR REWARDS FOR RESIDENTS WHO IMPLEMENT HEATWAVE MITIGATION MEASURES, SUCH AS INSTALLING REFLECTIVE ROOFING OR UPGRADING INSULATION
Target area(s)	All areas within Dhangadhi
Target group	Homeowners
Sector(s)	Governance and Policy
Primary stakeholder	Dhangadhi Sub-Metropolitan City
Secondary stakeholders	LDMC NRCS, Kailali DC I/NGOs
Brief	A heatwave mitigation incentive programme is a scheme designed to encourage residents to invest in heat-reduction measures at their homes or within their communities. The programme offers rewards or incentives for those who take proactive action such as installing green roofs, planting trees or other heat-mitigation strategies. These actions help to reduce indoor and outdoor temperatures and improve general resilience to heatwaves within the communities. Dhangadhi Sub-Metropolitan City can develop an incentive programme in which residents are encouraged to use heatwave mitigation measures like installing a reflective roof, upgrading insulation, planting trees or other ways to cool the house. LDMC, NRCS and Kailali DC can establish eligibility criteria for participation, the nature of incentives (e.g., tax rebates, subsidies, discounts on materials, recognition awards) and how households apply or become eligible. NRCS and Kailali DC can take the lead in mobilizing volunteers for the dissemination of information regarding the programme at the community level.
Case study	The Tokyo Metropolitan Government in Japan provides subsidies and mandates eco-friendly building practices that help mitigate heatwaves, including green roofs (since 2001), to lower building surface temperatures; awards subsidies for eco-friendly housing, including solar panels and storage batteries; and mandates solar panel installation for all new homes and buildings from April 2025. This case study demonstrates examples of financial incentives and regulatory measures that encourage residents to adopt heat-resistant infrastructure. Link to case study: https://bit.ly/4111K1U; https://bit.ly/4hDvk2K

KEY ACTIVITY	9. ESTABLISHING PARTNERSHIPS WITH EDUCATIONAL INSTITUTIONS TO INCORPORATE HEATWAVE PREPAREDNESS INTO SCHOOL CURRICULA
Target area(s)	Schools/colleges
Target group	Students
Sector(s)	Education
Primary stakeholder	Education Department, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Educational institutes (all school/colleges)
Brief	Integrating heatwave preparedness into educational curricula involves covering the knowledge of heat risks and preventive actions within school and college programmes. This is a vital step in raising awareness from a very young age, so students can protect themselves and their families and wider communities during heatwaves. Educated youth also play a future role in disseminating information to their families and communities, during imminent heatwaves to come. The Education Department of Dhangadhi Sub-Metropolitan City will establish partnerships with all academic institutions, such as schools and colleges in the city, to incorporate heatwave preparedness and preventive action-related knowledge in their educational curricula.
Case study	Greater Sydney, Australia, has developed an interdisciplinary educational programme for high school students called '50°C: Climate, heat and resilience'. This educational programme helps to address urban heat challenges, recognizing the critical role of education in fostering resilience to extreme heat. The programme is a working example of how partnerships between government, educational institutions and experts can embed heatwave preparedness into school curricula. Link to case study: https://bit.ly/4grVzse

KEY ACTIVITY	10. RAISING AWARENESS OF ENERGY-EFFICIENT APPLIANCES SUCH AS THE USE OF LED (LIGHT EMITTING DIODE) BULBS OR CFL (COMPACT FLUORESCENT LIGHT) BULBS
Target area(s)	Residential areas, commercial establishments and public spaces in Dhangadhi.
Target group	All the citizens of Dhangadhi
Sector(s)	Energy, Awareness-raising
Primary stakeholder	NEA
Secondary stakeholders	NRCS, Kailali DC WDMC
Brief	Energy-efficiency awareness campaigns encourage people to use appliances that consume less electricity, such as LED or CFL bulbs. These campaigns are important in ensuring a reduction in energy demand, especially during heatwaves when power usage increases. By encouraging energy-efficient practices, communities can lower electricity costs, decrease pressure on the power grid and contribute to environmental sustainability. The NEA, in collaboration with NRCS, Kailali DC and WDMC can start an awareness campaign on the use of energy-efficient appliances such as LED or CFL bulls.
Case study	The Tokyo Green Building Programme in Japan has encouraged the implementation of energy-efficient systems, such as advanced insulation, energy-efficient lighting and energy-efficient appliances, to reduce energy consumption and greenhouse gas emissions. Link to case study: https://bit.ly/3Bf9hA5

9.1. MODERATELY PRIORITIZED LONG-TERM ADAPTATION MEASURES

The long-term adaptation measures require significant resources and time. To aid the decision-making process for the Heat Task Force and local governments, actions have been categorized into highly prioritized and moderately prioritized actions. The moderately prioritized actions listed in the following table are equally essential for augmenting heat resilience in Dhangadhi. However, local governments and emergency service providers can allocate fewer resources to these actions compared to the highly prioritized ones, or implement them after completing the more critical long-term adaptation planning actions.

TABLE 9. LONG-TERM MEASURES

URBAN INFRASTRUCTURE

KEY ACTIVITY	INCREASING ROOF REFLECTIVITY
Target area(s)	Wards 10, 12, 15, 18, 19
Target group	People living in houses with tin roofs
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	Private sector NRCS, Kailali DC
How to carry out the activities	NRCS, Kailali DC will first identify houses with low reflectivity roofs, such as tin roofs, especially in Wards 10, 12, 15, 18 and 19. The Department of Urban Development and Building Construction will lead this initiative. Increasing roof reflectivity will help to reduce indoor temperatures, providing relief to vulnerable populations living under tin roofs.
Case study	Case study of the white roof initiative from Ahmedabad, India: https://bit.ly/4c5DPAP

KEY ACTIVITY	INCREASE COOL PERMEABLE PAVEMENTS
Target area(s)	Urban areas with significant heat island effects such as Wards 1, 2, 3, 4, 5 and 8
Target group	Communities living in densely built urban areas who would benefit from reduced ambient temperatures
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Department of Roads
Secondary stakeholders	Department of Urban Development and Building Construction
How to carry out the activities	The Department of Roads along with the Department of Urban Development and Building Construction will design pavements using materials that are both reflective and permeable, such as light-coloured concrete in pedestrian zones, parks, etc. The Department of Urban Development and Building Construction can also incorporate guidelines for cool, permeable pavements into the city's urban development planning process.
Case study	Case study of cool permeable pavements from Los Angeles, USA: https://bit.ly/40KkFN2

KEY ACTIVITY	REPLACE TIN ROOFS IN SCHOOLS WITH COOLING ROOFS
Target area(s)	School/colleges
Target group	Students and teachers
Sector(s)	Education
Primary stakeholder	Education Division, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	School Management Committees WDMC
How to carry out the activities	The Education Division of Dhangadhi Sub-Metropolitan City will identify the number of schools with tin roofs. These schools should be prioritized for action because they are the most vulnerable to overheating during heat periods. The Education Division can then collaborate with School Management Committees and WDMC to develop a plan for replacing the tin roofs. The Department can also explore funding from local organizations or grants from NGOs to complete this work.

WATER MANAGEMENT & COOLING SOLUTIONS

KEY ACTIVITY	PROMOTE SPRINKLER IRRIGATION AND SPRAY PARKS
Target area(s)	Urban and semi-urban spaces, such as parks, playgrounds and public gathering places
Target group	All the residents of Dhangadhi
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	WDMC LDMC Local clubs Hotel Associations Transport Management Committee
How to carry out the activities	The Department of Urban Development and Building Construction will engage with the private sector, including local clubs, Hotel Associations and the Transport Management Committee to gather support and funding for the spray parks. The overall installation process and maintenance of the spray parks can be looked at by WDMC and LDMC. The spray parks can be constructed in high-traffic flow areas, particularly targeting vulnerable groups such as children.
Case study	Case study of spray parks from Cape Town, South Africa: https://bit.ly/4aHtDPs

KEY ACTIVITY	PROMOTING RAINWATER SYSTEMS
Target area(s)	Wards 9, 11, 12 ,15, 17
Target group	Households in water-scarce areas and schools, hospitals and community centres
Sector(s)	Water and Sanitation, Climate Adaptation
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	Department of Water Services WDMC NRCS, Kailali DC
How to carry out the activities	The Department of Urban Development and Building Construction can promote rainwater harvesting in all the wards of Dhangadhi Sub-Metropolitan City. NRCS, Kailai DC and WDMC can raise awareness about the multiple benefits of installing rainwater harvesting systems. To promote harvesting, the Department can devise schemes, such as providing incentives, subsidies and technical assistance to encourage the installation of rainwater systems.

SUSTAINABLE MOBILITY

KEY ACTIVITY	PROMOTING SUSTAINABLE TRANSPORTATION OPTIONS, SUCH AS CYCLE LANES, PEDESTRIAN-FRIENDLY STREETS, CAR-FREE ZONES
Target area(s)	Crowded areas, city centres, commercial hubs and residential neighbourhoods
Target group	Daily commuters, including students, office workers and residents.
Sector(s)	Urban Planning, Climate Adaptation
Primary stakeholder	Department of Urban Development and Building Construction
Secondary stakeholders	Environment Department, Dhangadhi Sub-Metropolitan City NEA WDMC
How to carry out the activities	In promoting sustainable transportation options, such as cycle lanes, pedestrian-friendly streets and car-free zones, the overall lead will be the Department of Urban Development and Building Construction. To achieve this, it will be necessary to redesign the streets, widen pavements and add greenery – tasks to be carried out by the Department of Roads along with the Environment Department, Dhangadhi Sub-Metropolitan City. The Department of Roads can also designate specific lanes on major roads for cyclists. NEA can help in promoting and developing electric charging stations for electric vehicles. The Department of Roads, with the support from LDMC and WDMC, can identify the areas where traffic can be reduced, such as areas around markets, places of worship or other densely populated areas.

CLIMATE-RESILIENT AGRICULTURE

KEY ACTIVITY	DISTRIBUTING HEAT-RESISTANT SEEDS AND DROUGHT-TOLERANT CROPS TO FARMERS
Target area(s)	Agricultural areas
Target group	Farmers
Sector(s)	Agriculture
Primary stakeholder	Department of Agriculture and Livestock
Secondary stakeholders	WDMC
How to carry out the activities	The Department of Agriculture and Livestock can distribute heat-resistant seeds and drought-tolerant crops to local farmers in Dhangadhi. The WDMC, NRCS and Kailali DC can help in identifying and mobilizing farmers to take part in this programme, and in disseminating information. The Department can distribute millet, buckwheat, lentils, sesame, chickpeas, etc. and share best practices for harvesting the heat-resistant crops.

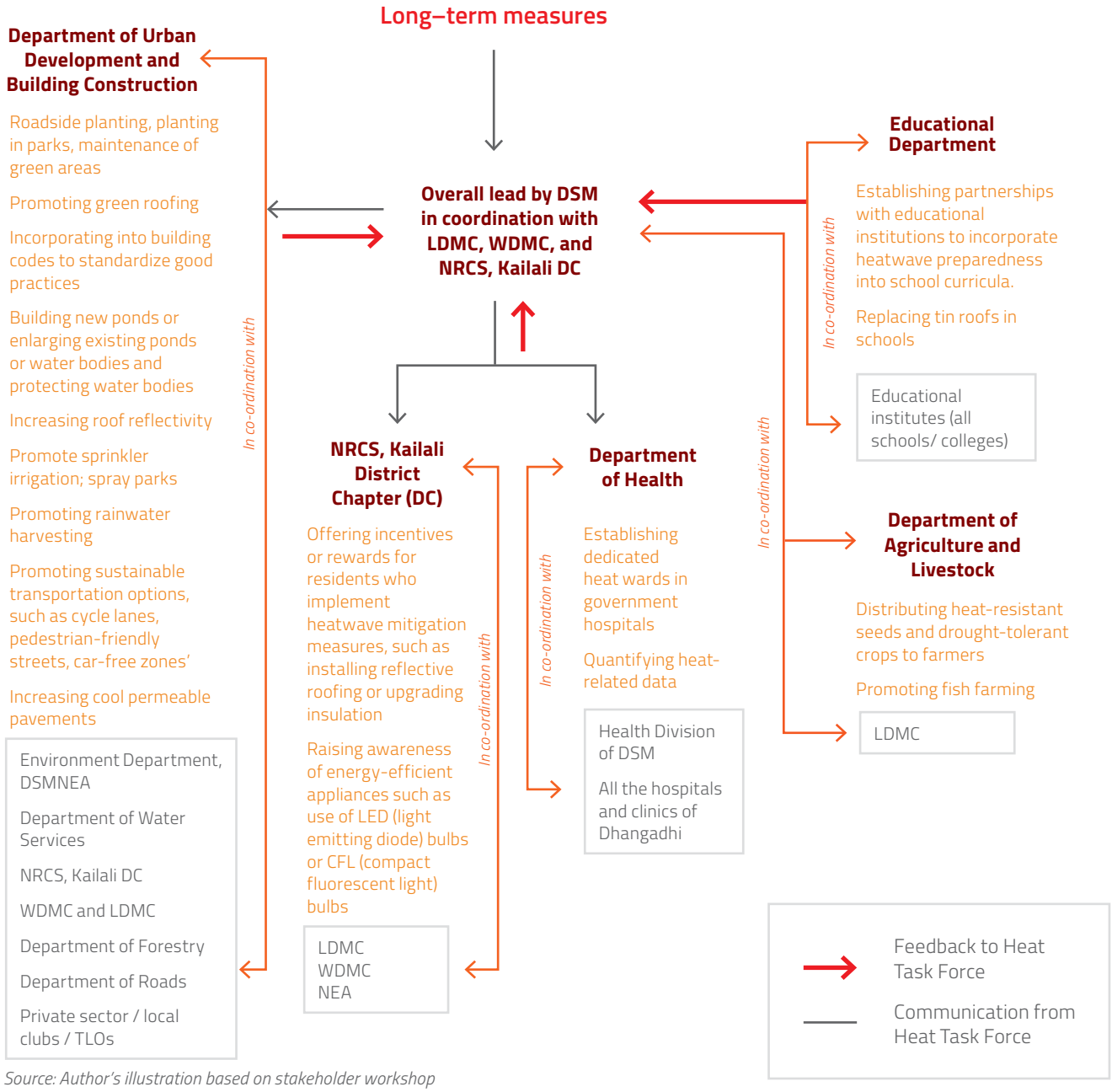
POLICY & GOVERNANCE

KEY ACTIVITY	MAINSTREAMING HEAT RISK INTO CITY/MUNICIPALITY PLANNING
Target area(s)	Dhangadhi city
Target group	Municipal authorities, urban planners and policymakers
Sector(s)	Governance and Policy, Urban Planning
Primary stakeholder	Disaster Department, Dhangadhi Sub-Metropolitan City
Secondary stakeholders	Department of Urban Development and Building Construction Environment Department, Dhangadhi Sub-Metropolitan City NRCS, Kailali DC
How to carry out the activities	The Disaster Department will mainstream heat risk into city planning in coordination with the Department of Urban Development and Building Construction. NRCS and Kailali DC can encourage the implementation of heat mitigation measures in vulnerable communities. The Environment Department of Dhangadhi Sub-Metropolitan City can also help by increasing urban greenery in the most exposed Wards such as 1, 2, 3, 4, 5 and 8. This will help to improve air circulation and reduce the urban heat island effect.

9.2. STAKEHOLDER COORDINATION – LONG-TERM MEASURES

Figure 32 illustrates stakeholder collaborations for implementing long-term measures in Dhangadhi. It features a flowchart that details specific roles and actions that each stakeholder should undertake during the implementation process. The Dhangadhi Sub-Metropolitan City will take the lead in coordinating activities with the NRCS and Kailali DC as well as other involved stakeholders. This flowchart aims to clarify the responsibilities of each stakeholder, thereby minimizing confusion and preventing duplication of effort.

FIGURE 32. STAKEHOLDER COORDINATION OF LONG-TERM MEASURES



Source: Author's illustration based on stakeholder workshop

10. WAY FORWARD

The Heat Action Plan (HAP) serves as an essential framework for initiating heat risk management in the city. It plays a crucial role in mitigating the adverse effects of extreme heat events on public health, infrastructure, the environment and the socioeconomic circumstances of the population. Moreover, it plays a critical role in the city's climate adaptation strategy, which is currently lacking in Dhangadhi. However, the city has a Disaster Management Plan (DMP), so it is essential that local authorities align the HAP with this DMP.

The next immediate step is for the local government to officially adopt the HAP and integrate it into the city's disaster management or governance processes. This should be achieved by endorsing the plan at a city board or council meeting. The HAP must be recognized as part of the city's overall disaster management and adaptation efforts rather than being considered in isolation.

Heat action requires collaboration and coordination among multiple stakeholders. Therefore, regular meetings and workshops will be essential for monitoring progress, sharing best practices, accelerating the implementation of heat action measures, evaluating lessons learned and updating the HAP. The Heat Task Force of Dhangadhi can serve as the convener of these activities. It is crucial that all members of the Heat Task Force remain committed to following and updating the HAP to build resilience and minimize the impact of heat events in the future.

Implementing all the measures outlined in the HAP at once can be resource-intensive for local governments. Therefore, the Dhangadhi Sub-Metropolitan City should identify and prioritize quick-win projects that require minimal resources for implementation. Additionally, the city can secure long-term funding by forming partnerships with government agencies, the private sector and international donors to support heat action initiatives.

Furthermore, it is crucial to periodically review and update the HAP, incorporating stakeholder feedback and adapting strategies to effectively address heat risks.

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ANNEX A: HEAT HOTSPOTS ANALYSIS

A.1 SELECTION OF INDICATORS

TABLE A–1: LIST OF INDICATORS, THEIR DIMENSIONS AND CATEGORY, AND RATIONALE BEHIND THE SELECTION OF THE INDICATORS

INDICATORS	DIMENSION	POSITIVE OR NEGATIVE INDICATORS	CATEGORY	RATIONALE FOR SELECTION
Population density	Sensitivity	Positive	Exposure	Increased population density, population growth and dispersal, and heat susceptibility.
Built-up area	Sensitivity	Positive	Exposure	Areas with dense infrastructure and buildings tend to retain heat, increasing exposure to extreme temperatures.
Heat hotspot areas	Sensitivity	Positive	Exposure	These areas experience higher temperatures, indicating increased exposure to heatwaves.
Age group population (below 5 years old and above 65 years old)	Sensitivity	Positive	Socioeconomic vulnerability	These age group populations are sensitive to the effects of extreme heat, less aware of the impacts of extreme heat and must rely on others to keep them cool and hydrated during a heatwave.
Outdoor workers	Sensitivity	Positive	Socioeconomic vulnerability	Outdoor workers are at increased risk of heat-related illnesses due to prolonged exposure to heat.
Informal settlements	Sensitivity	Positive	Socioeconomic vulnerability	Areas with non-regulated housing often lack adequate infrastructure and access to services, exacerbating sensitivity and socioeconomic vulnerability to heatwaves.
Education	Adaptive capacity	Positive	Socioeconomic vulnerability	Higher education levels indicate better awareness and ability to adopt adaptive measures. A high literacy rate is significantly associated with lower infant mortality rates and improved sanitation facilities (Subedi et al., 2022).

INDICATORS	DIMENSION	POSITIVE OR NEGATIVE INDICATORS	CATEGORY	RATIONALE FOR SELECTION
Housing structure	Sensitivity	Negative	Physical vulnerability	Tin houses/metal roofs absorb heat when directly exposed to the sun and this can have a negative impact on people living in these housing structures.
Hospitals	Adaptive capacity	Negative	Adaptive capacity	Access to a functional healthcare infrastructure is important for a community's overall health and well-being.
Household access to fans	Adaptive capacity	Negative	Adaptive capacity	Access to cooling devices like fans improves adaptive capacity by helping individuals cope with heat stress.
Household access to piped drinking water	Adaptive capacity	Negative	Adaptive capacity	Having direct access to public and private taps improves a household's ability to cope with extreme heat and other adverse conditions.
NDVI (Normalized Difference Vegetation Index)	Adaptive capacity	Negative	Adaptive capacity	Higher vegetation density indicates better natural cooling and shade, enhancing adaptive capacity.

Source: Adapted from Subedi et al, 2023 and author's illustration

ANNEX B: HEAT THRESHOLD AND TRIGGER DETERMINATION FOR THE HEATWAVE ALERT

Section B.1 outlines the meteorological and health data sources used in the development of the heat–health threshold in this report. The rationale, choice and development of the daily maximum HI (HI_{max_d}) thresholds for issuing health advisories are elaborated in Section B.2. Section B.3 evaluates the spikes in daily deaths coinciding with recent heat episodes over Dhangadhi.

B.1. DATA

B.1.1. METEOROLOGICAL DATA (AMBIENT NEAR-SURFACE AIR AND DEWPOINT TEMPERATURE) FROM ERA5

Hourly two-metre air temperature (T_{air}) and dewpoint temperature (T_d) from ERA5 (both in °C) were extracted for all grid-cells within the national boundary of the Kingdom of Nepal spanning 1979–2023.

ERA5 is a global climate reanalysis data product and resolves meteorological fields at 0.25° (~30km) gridded resolution. It is the most recent and advanced global atmospheric reanalysis from the European Centre for Medium-Range Weather Forecasts (ECMWF) family of reanalysis datasets (Muñoz-Sabater, J. *et al.,* 2021; Hersbach *et al.,* 2018, 2020).[1]

It resolves many atmospheric and land-surface parameters in near real-time, thus offering numerous meteorological parameters from 1950 to near-present day. The relative humidity (RH) required for the computing of the Heat Index (HI; Annex B.3) was computed utilizing the T_{air} and T_d.

The choice of a reanalysis data product for constructing a meteorological index was motivated by two reasons: (i) lack of historical surface observations spanning a consistent long time-period (without any data gaps) at an hourly time resolution for both variables (T_{air}, and T_d or RH)[2] required to assemble the HI; and (ii) reanalysis products and ERA5, in particular, have been previously used in environmental-health impacts assessments and are found to be a suitable alternative as meteorological exposure variables (Mistry *et al.,* 2022).

1 ERA5 is made available by the ECMWF through the Copernicus Climate Change Service (C3S) Climate Data Store (https://climate.copernicus.eu/climate-reanalysis).

2 Daily station observation records of T_{air} and RH were not available at hourly time resolution for assembling the required HI_{max_d}.

B.1.2. HEALTH DATA

Ward-level daily all-cause mortality data were gathered by the NRCS, Kailali DC for Dhangadhi. While the data covered the period 1979–2023, several gaps in data records along with the low variance in daily deaths made it unsuitable for use in an epidemiological modelling framework. Summary statistics on the full mortality series are provided below in Table B–1.

TABLE B–1: SUMMARY STATISTICS OF DAILY MORTALITY

MIN	1ST QUARTILE	MEDIAN	MEAN	3RD QUARTILE	MAX	STANDARD DEVIATION
1	1	1	1.6	2	8	0.95

B.2. THRESHOLD FOR HEAT STRESS

B.2.1. COMPOSITE METRIC FOR HEAT STRESS: THE HEAT INDEX (HI; UNITS: °C)

A commonly used meteorological exposure variable that accounts for both heat and humidity is the Heat Index (HI) first defined by Steadman (1979) and implemented by Rothfusz (1990). The HI has more recently been revised and extended by Lu and Romps (2022).[3] The HI is routinely applied as an operational heat stress metric in the US and a growing number of other countries.[4] A recently published study (Lo et al., 2023) and another in review (Guo et al., 2024) examine the relationship between a number of Heat Stress Indices (HSIs) and human mortality at a global scale, concluding that no single HSI including T_{air} can be uniformly applied as location-specific meteorological exposure variable in health-impact assessments. However, the complex exposure–mortality relationship examined using HSIs at a number of locations over mountainous regions in the tropics show that the HI performs better than other metrics including T_{air} (Guo et al., 2024).

3 The HI as defined by the U.S. National Oceanic and Atmospheric Administration (NOAA)-National Weather Service (NWS), is a widely used measure of apparent temperature that accounts for the effects of Tair and RH using Steadman's model of human thermoregulation. As noted by Lu and Romps (2022) in their recent study: "Steadman's model, however, gives unphysical results when the air is too hot and humid or too cold and dry, leading to an undefined Heat Index. Steadman's thermoregulation model is extended to define the Heat Index for all combinations of T_{air} and RH, allowing for an assessment".

4 The Indian Meteorological Department (IMD) has recently implemented the HI in its operational weather forecasts on an experimental basis. Similarly, the Thai Meteorological Department (TMD) has been issuing heat alerts using the HI https://www.nationthailand.com/thailand/general/40026353

B.2.2. SUMMARY STATISTICS OF THE HI AT DHANGADHI

The historical hourly values of the HI spanning 1979–2023 at Dhangadhi was first calculated using the extracted ERA5 T_{air} and RH (gridcell) as input variables,[5] following which the hourly fields are aggregated to daily maximum HI (Hi_{max_d}). Table B–2 provides a breakdown of the 90th (Hi_{max_90p}) and 95th (Hi_{max_95p}) percentiles of the Hi_{max_d} at Dhangadhi.

TABLE B–2: HI_{MAX_90P} AND HI_{MAX_95P} AT DHANGADHI COMPUTED USING HOURLY ERA5 T_{AIR} AND T_D

HI_{MAX_90P} (°C)	ANNUAL AVERAGE NO. OF DAYS BETWEEN 1979–2023 WITH $HI_{MAX} > HI_{MAX\_90P}$	HI_{MAX_95P} (°C)	ANNUAL AVERAGE NO. OF DAYS BETWEEN 1979–2023 WITH $HI_{MAX} > HI_{MAX\_95P}$
40.1	34	41.6	17

To facilitate interpretation of the percentile values, a Hi_{max_90p} of 40.12°C at Dhangadhi would imply that the local population would have been exposed to daily maximum values of HI above 40.1°C for about 10 per cent of days between 1979–2023 (approx. 34 days on average annually) (Table 2). Such days would fall in the categories 'extreme caution' as defined by the U.S. National Weather Service (NWS) (Table 5).

While the computed Hi_{max_90p} falls in the 'extreme caution' category by the U.S. NWS, Hi_{max_95p} with a value of 41.6°C in contrast falls in the 'danger' category. The marginal increase in the HI_{max_95p} values – by 1.5°C relative to the HI_{max_90p} – can increase additional discomfort and result in additional health complications in the vulnerable population, such as the elderly, infants and pregnant women, outdoor workers and those with existing co-morbidities (e.g., cardiovascular, diabetes and chronic kidney disease). The next steps involve estimating the return-periods (RP) and -levels (RLs) of Hi_{max_d} to understand the heat stress levels and the corresponding (average) recurrence periods.

B.2.3. ESTIMATION OF THE RETURN PERIOD (RP) AND RETURN LEVEL (RL) OF HI_{MAX} AND HEAT STRESS TRIGGER

Using Generalized Extreme Value (GEV) (Coles, 2001) implemented in the R package exTremes v.2.0 (Gilleland & Katz, 2016), the next step involves deriving the annual maximum over Dhangadhi (Hi_{max_ann}), which then forms the maxima blocks for fitting the probability density functions. This, in turn, would imply 45 Hi_{max_ann} values since the ERA5-derived HI data spans 44 years over 1979–2023.

The resulting RLs corresponding to 1-in-2-, 5- and 10-year RPs estimated using GEV are summarized in Table B–3 for Dhangadhi.

5 As noted earlier, RH is not directly available in ERA5 but derived using T_{air} and T_d.

TABLE B–3: RL OF HI_{MAX} IN °C FOR DHANGADHI CORRESPONDING TO 2- , 5- AND 10-YEAR RPS

RETURN PERIOD (RP) 1-IN- (N) YEARS	RETURN LEVEL (RL) – HI_{MAX} (°C) FOR DHANGADHI
2	45.9
5	47.7
10	48.9

The RLs fall in the mid '**danger**' range (41–54 °C) highlighted in amber in Table 5.

B.3. TRIGGER FOR THE HEATWAVE ALERT

Comparing the RL of HI_{max} for Dhangadhi in Table 4 with the corresponding HI_{max_95P} in Table B–2, an RL corresponding to any RP exceeds the Hi_{max_95P} value. For instance, while on average 17 days with daily Hi_{max} values of 41.6°C (Table B–2) have occurred annually at Dhangadhi between 1979–2023, the higher values of Hi_{max} corresponding to the 1-in-5 RP that is typically chosen for the purpose of an Early Action Protocol (EAP), would in fact be rare in occurrence.

Moreover, from a health perspective, as documented in both physiological and epidemiological literature, the moderate to adverse effects of heat on health are known to occur at the lower range of heat stress (HI > 40°C) (Guo et al., 2024), especially on the vulnerable category of the population.[6] The Hi_{max_90p} and Hi_{max_95p} thresholds evaluated in Section B.2 are in line with the recommended cautionary and dangerous alert categories. For this reason, the threshold levels for issuing a heat–health advisory at Dhangadhi are recommended to be set respectively as: (i) yellow (advisory) for a daily forecast Hi_{max} value exceeding 40.1°C, and (ii) amber or red (alert) for a daily forecast HI_{max} value exceeding 41.6°C, as explained in Section 5.

6 Put differently, the RL in Table 3, especially the one corresponding to the 1-in-5 Year RP at Dhangadhi, can be better suited for setting as a trigger in an EAP framework. Instead, here, the $\mathbf{HI_{max\_95P}}$ values that are occurring on an average 17 days annually, are already in the lower-bound of the dangerous category in Table 3, and therefore cannot be neglected for issuing heat-health risk advisories.

FIGURE C–1: IDENTIFIED LOCATIONS FOR WATER ATM

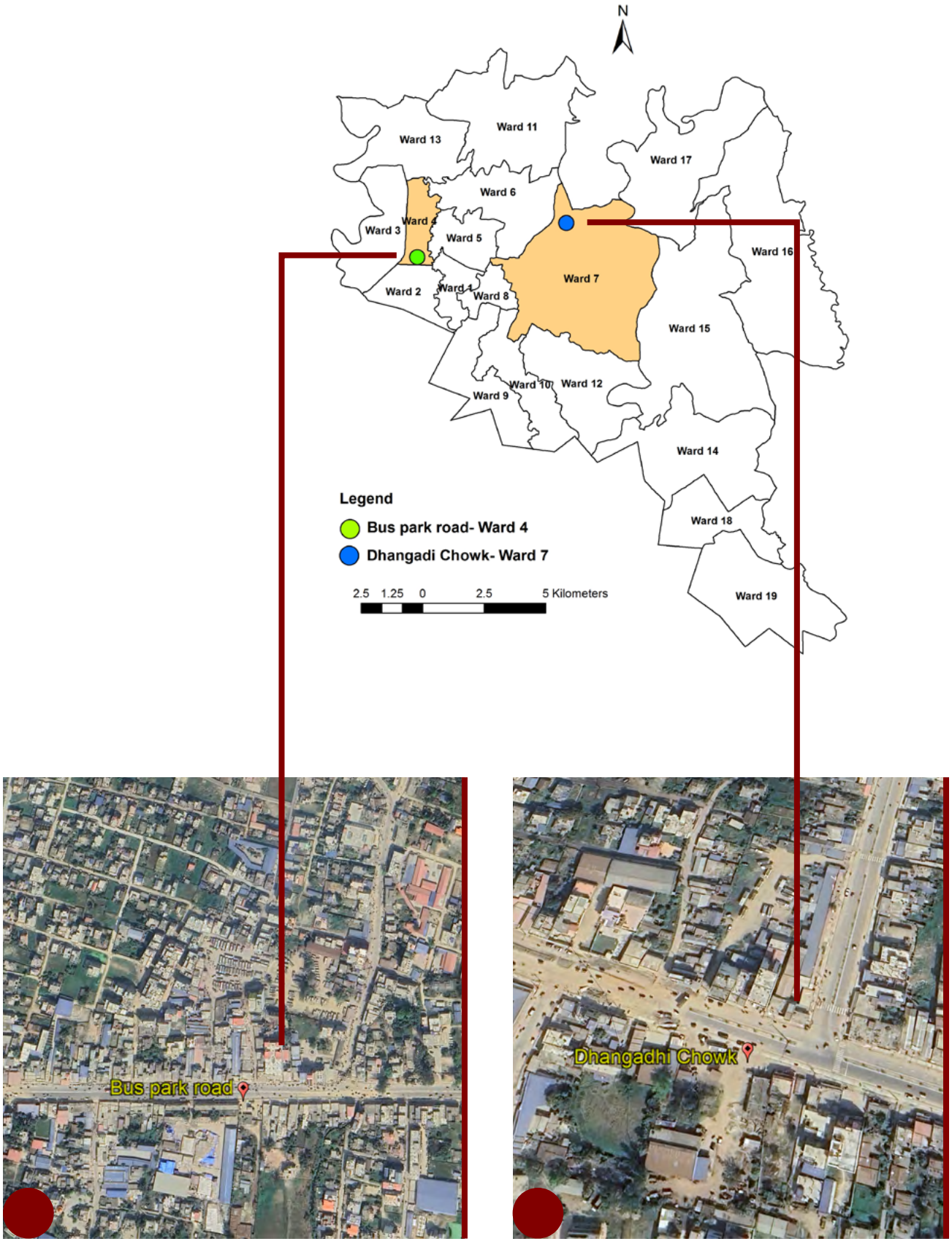


FIGURE C–2: IDENTIFIED LOCATIONS FOR PROVIDING INCENTIVES FOR LOW-INCOME HOUSEHOLDS

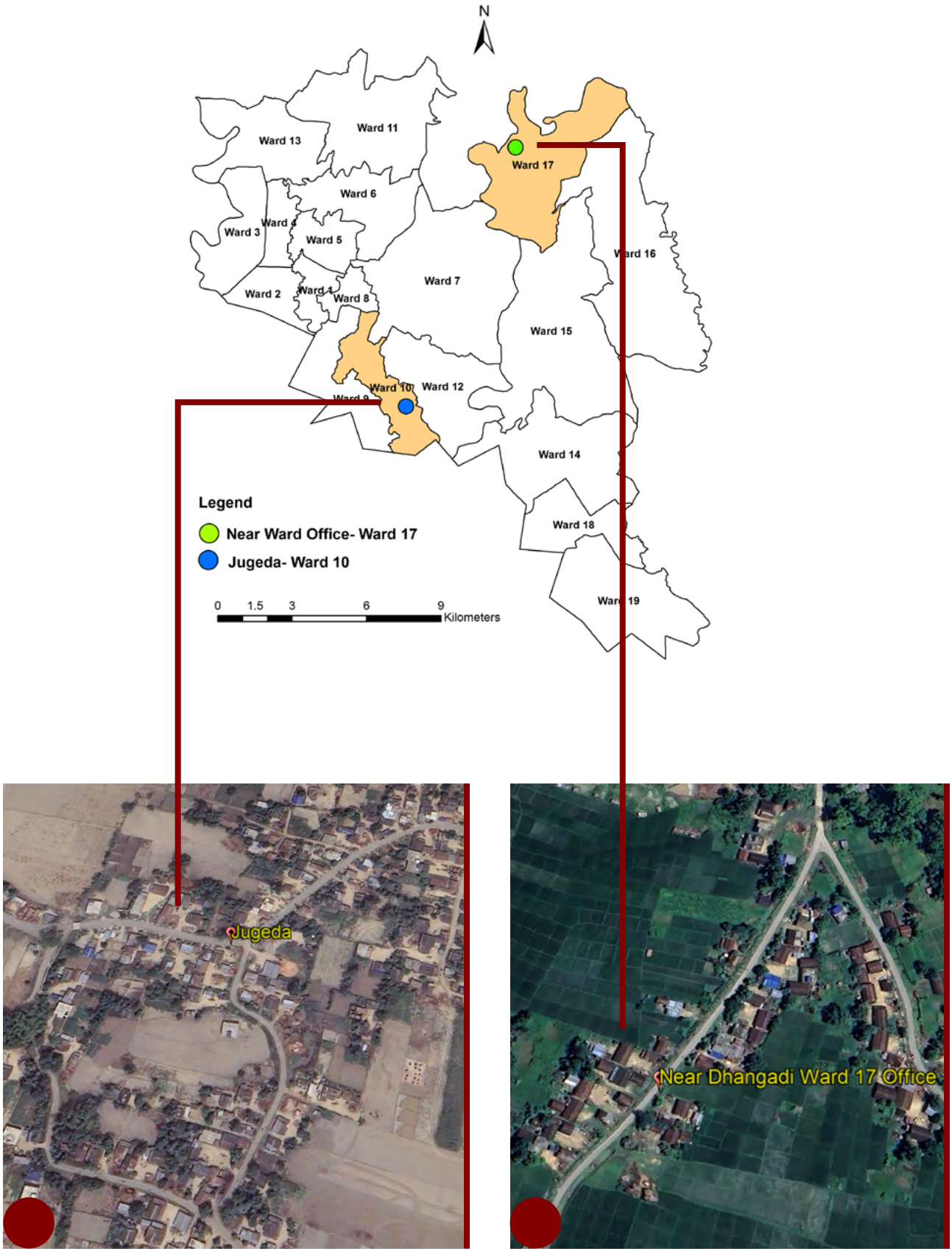
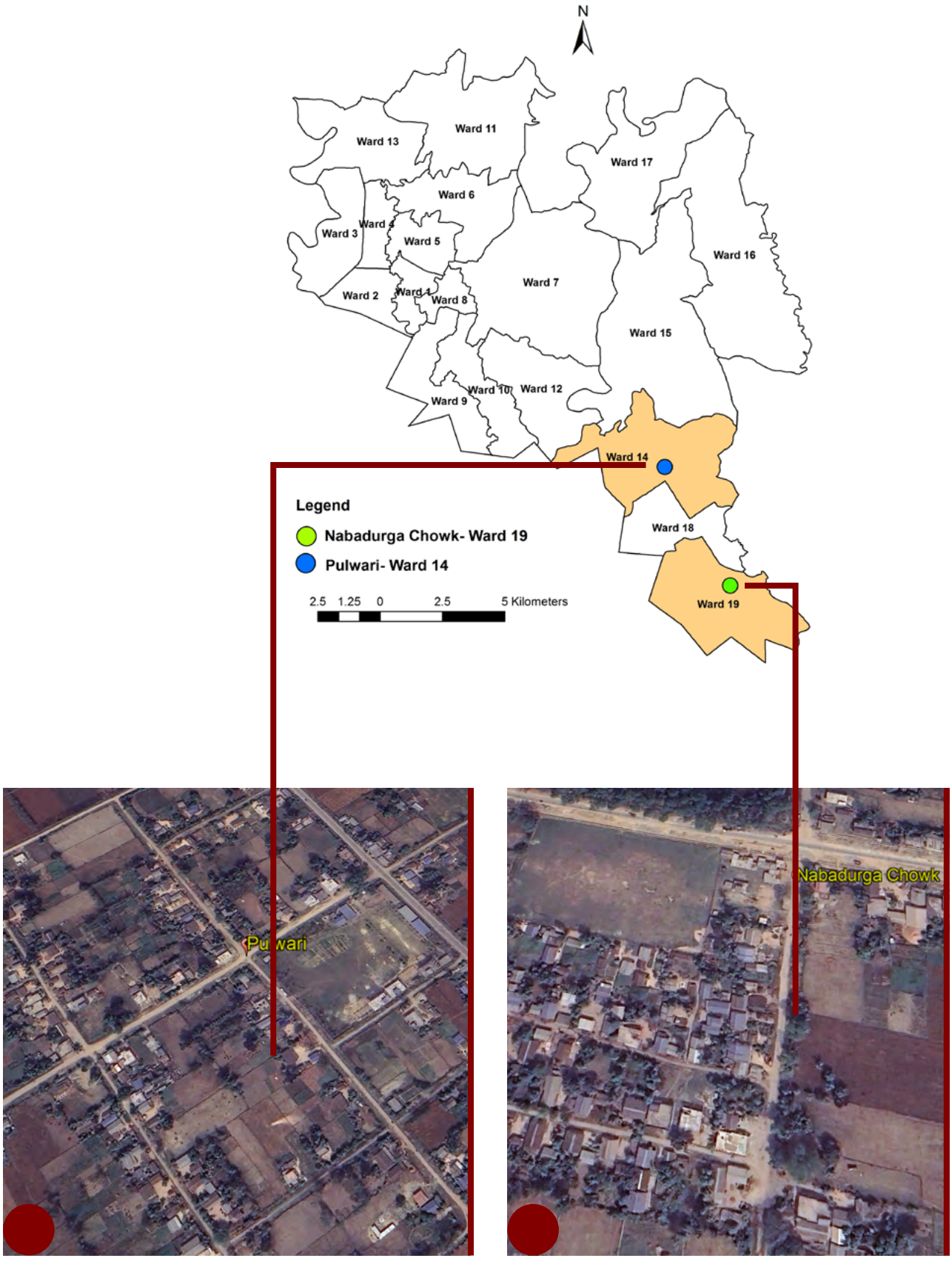


FIGURE C–3: DOOR-TO-DOOR OUTREACH IN HIGH-RISK NEIGHBOURHOODS



Nepal Red Cross Society

IFRC

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Climate Centre