"MISSED WARNINGS, MISSED OPPORTUNITIES"

optimising heat alert communication for community resilience in Dhangadhi city, Nepal

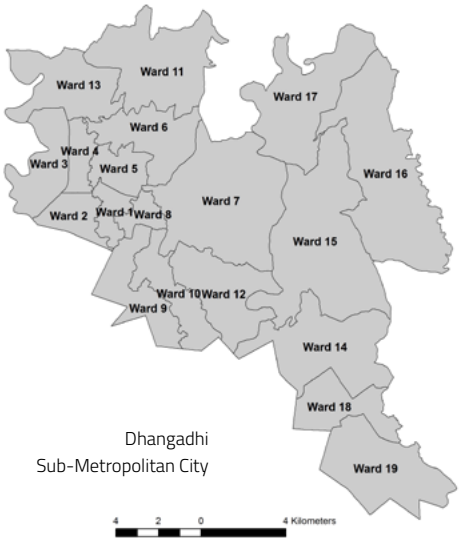
The risk to people from extreme heat in Dhangadhi is growing, but the agility and reach of warnings is not keeping pace.

In this brief, communities themselves point to gaps and suggest ways the communication of alerts could be improved.

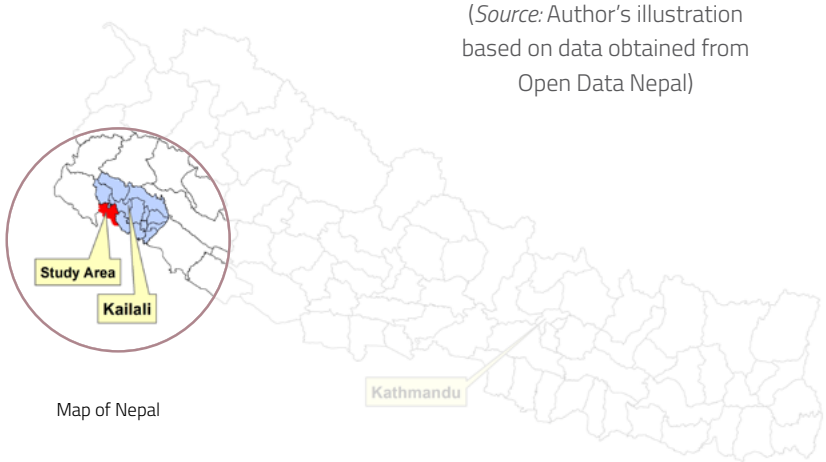
Heat risks are rising in Dhangadhi

Extreme heat has emerged as a significant global threat to human life and well-being. Climate change exacerbates this risk, contributing to increasingly intense and frequent heatwave events worldwide. Nepal's *Terai*[1] region is highly exposed to heatwaves. The region regularly experiences severe heatwave events or days with extreme heat. During summer, temperatures reach 45 degrees Celsius, contributing to annual heat-related deaths (Subedi *et al.,* 2022, Kandel & Shyangtan, 2024). Located in the far west of the Terai region, Dhangadhi city is susceptible to heat risks because of its low-lying elevation, rapid urbanisation and few green spaces (Kandel & Shyangtan, 2024, Bista, 2021).

1 A flat, alluvial lowland area located in southern Nepal.



Dhangadhi Sub-Metropolitan City



Map of Nepal

Study area (*Source:* Author's illustration based on data obtained from Open Data Nepal)

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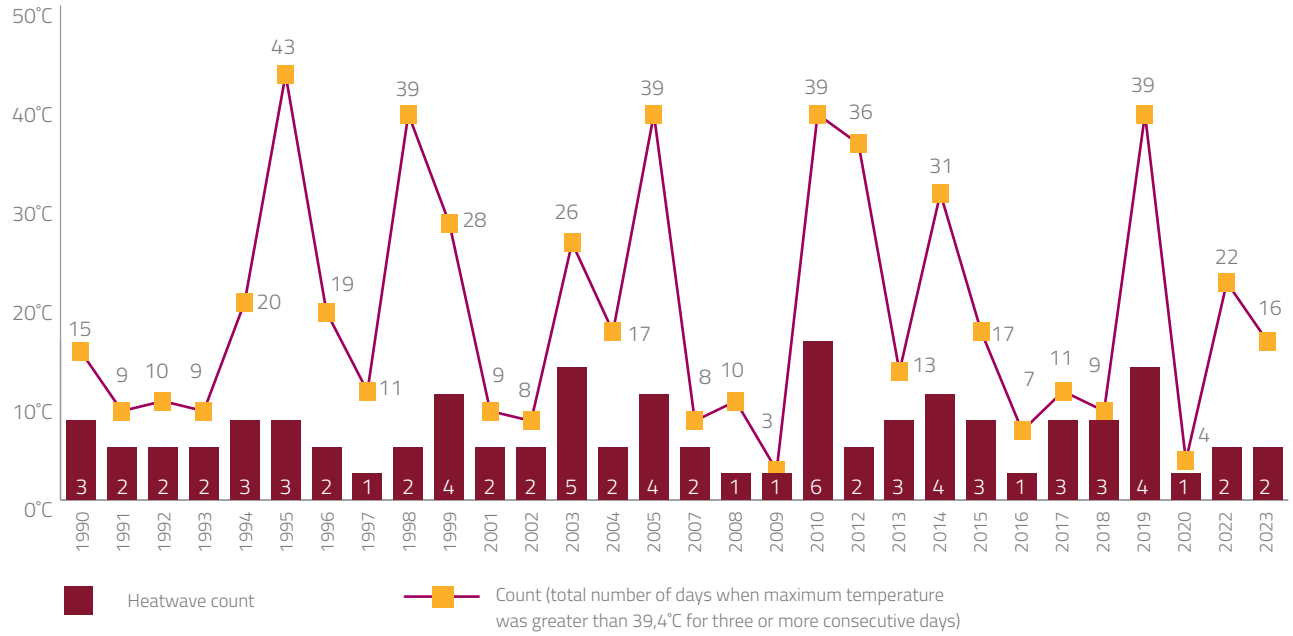
The highest maximum temperature ever recorded in Dhangadhi is 46.4 degrees Celsius, recorded in 1995. In the last 33 years (1990-2023), the maximum temperature has exceeded 40°C each year, indicating persistently high temperatures. The average maximum temperature from 1990 to 2024 shows a slight increase of approximately 0.02°C per year. While this indicates a slow rise in temperature over time, it also highlights how Dhangadhi has consistently experienced very high temperatures. As temperatures continue to remain high every year, the city faces greater stress on health systems, livelihoods, and infrastructure, increasing its vulnerability to heatwaves. The region's dense population and limited access to cooling infrastructure further increases exposure and reduces the ability to cope with extreme heat (CBS, 2021).

April, May and June are the hottest months in the city. On average there are 13 days each year when maximum temperatures reach or exceed 40°C (421 days in the last 33 years). According to the Department of Hydrology and Meteorology's (DHM) definition of heatwave, moderate heatwave events[2] occurred in Dhangadhi in 30 different years during the period 1990–2023.



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)

Heat risk perception study in Dhangadhi

A heatwave perception study was conducted in Dhangadhi to explore the community's understanding of heat risks, identify the communication needs of at risk groups, and develop strategies to enhance preparedness and resilience against the increasing threat of heatwaves. One of the critical aims of the study was to assess the awareness, access to, and utilization of extreme heat risk information and alerts, among different population groups.

The study involved household surveys with a sample size of 985 respondents and approximately 25 Focus Group Discussions (FGDs) targeting five specific groups: people living in informal settlements, pregnant and lactating women, outdoor workers, students and older individuals with chronic diseases. Notably, the surveys and FGDs were conducted in 2024 during the peak hot months of June and July.

2 Occurs when maximum temperature exceeds 39.4°C for three or more consecutive days.

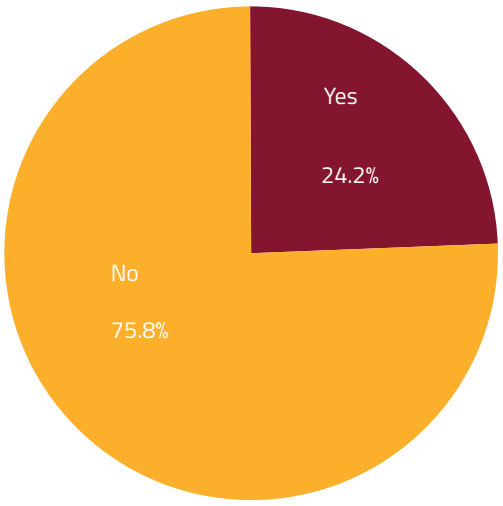
"I don't receive any heat alerts, and from what I've heard, neither do many others. The alerts don't reach everyone, especially those who really need it, like us farmers. This leaves us unprepared when the heatwave comes."

A farmer during the FGD

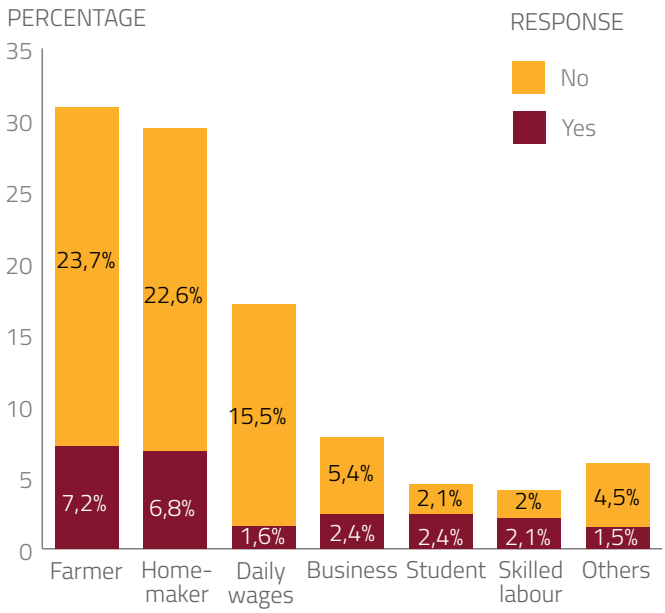
Most respondents have not received heat alerts

A majority (75.8%) of the survey respondents said they don't receive any heat forecast or alert messages. This gap in receiving the heat alert persists irrespective of their education, gender and occupation. They also reported that the city's current heat alert communication system is inconsistent and has limited coverage. Alerts are issued by the DHM, but the dissemination is not optimal. As a result, some residents receive alerts while others do not, leading to gaps in preparedness and response. The majority of farmers, homemakers and daily wage earners, identified as being among the most vulnerable groups in the city, reported receiving no heat alert.

Have you received any heat alert messages or warnings?



(Overall perceptions of the community)



(Perceptions based on occupations)

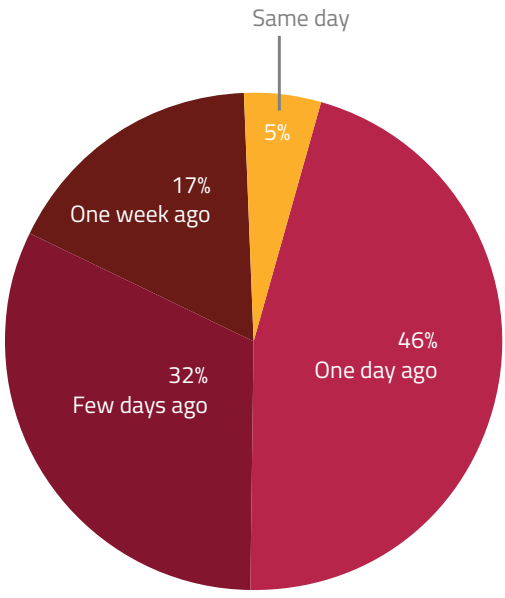
"Existing channels like radio and TV are not always sufficient for heat alert messages to reach vulnerable populations such as elderly people and persons with disabilities."

An elderly adult during the FGD

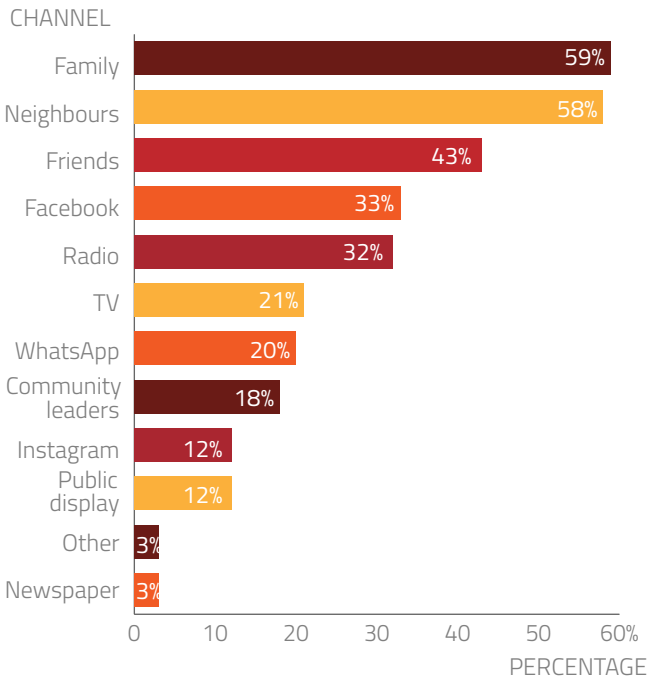
Community members typically receive alerts a day in advance via informal channels, such as family, neighbours, or friends

More than 50 per cent of the 24.2 per cent of respondents who reported receiving heat alert communication, said they receive the weather alert, including heat messages either on the same day or one day in advance. This suggests that communities who access weather or heat alert messages do not have sufficient time to implement preparedness measures to reduce the adverse impacts of heat. The source of the heat alert messages is another critical aspect. Almost 75 per cent of survey respondents reported that they receive heat or other weather information from family and neighbours. This indicates one-to-one communication is an effective channel for disseminating heat alert communication.

What is the time for receiving a heat alert?



What are the channels you usually receive the heat alerts?



"Street plays and community-based awareness activities can help us understand the heat message better— these will be more interesting and easier for us to follow."

People living in informal settlements shared this during the FGD

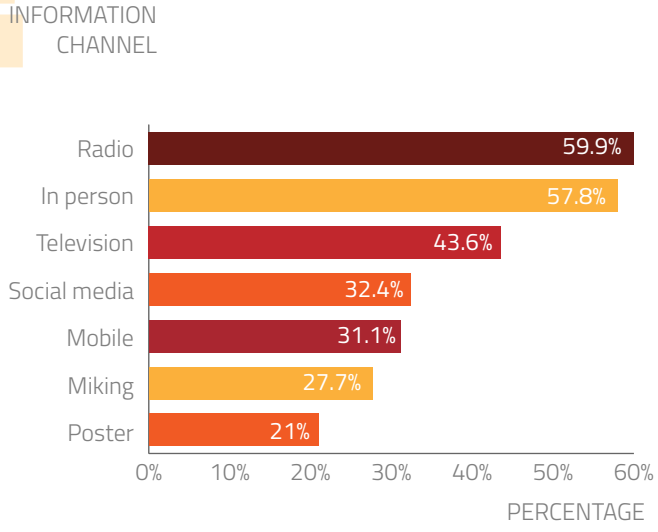
Radio, in person communication and television are the most recommended channels to strengthen the heat alert communication system in the city

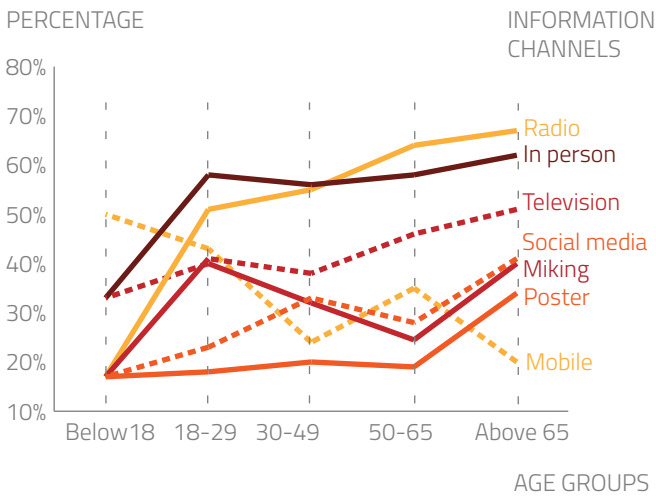
The three preferred communication channels for receiving heat alert information in Dhangadhi are radio (59.9 per cent), in person or one-to-one communication (57.8 per cent), and television (43.6 per cent). Communities also used social media, miking (announcing via loudspeakers or microphones) and posters for heat awareness and behavioural change messages.

An analysis of preferences by age group reveals that across all groups (except for the six respondents under 18), the most favoured channels for receiving information about extreme heat are radio and in-person or one-to-one communication (from friends, family, neighbours and teachers). Interestingly, the preference for television as a channel for heat alert communications is significantly lower among middle-aged individuals and youth compared to other age groups. Youth respondents also show less enthusiasm for social media to receive heat alert messages.

It would be valuable to further investigate why these groups prefer radio and in-person communication over television and social media.

What are the preferred communication channels to receive heatwave-related messages?



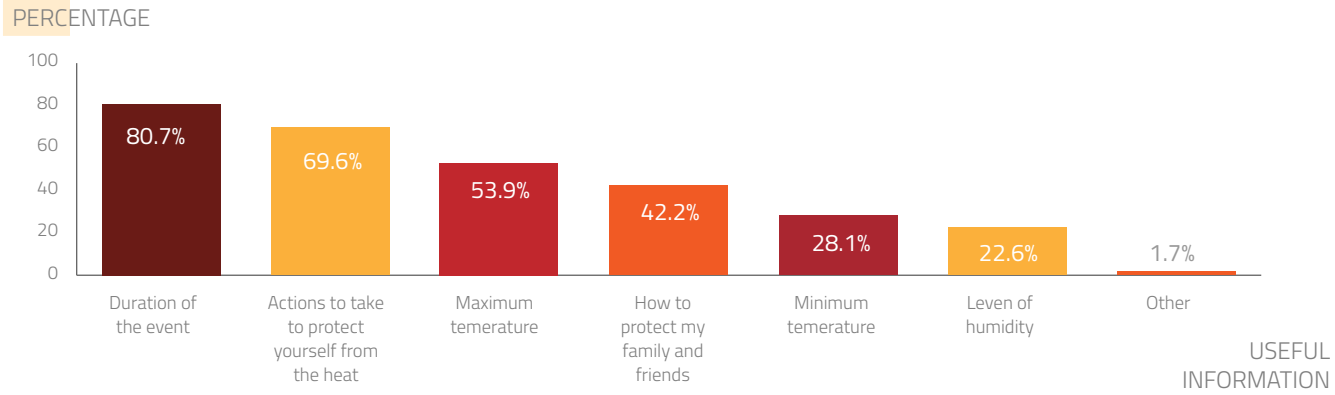


Duration of the heatwave event is the most preferred information for designing heat alerts

The three main pieces of information communities would like to receive in heat alerts are: the duration of the heatwave event, the suggested actions to protect themselves from the adverse effects of a heatwave, and information on the maximum temperature.

Communities seem less concerned about humidity, among the least prioritized aspects of heat alert communication. This suggests a lower awareness of the combined risks of heat and humidity, which can exacerbate heat-related health impacts.

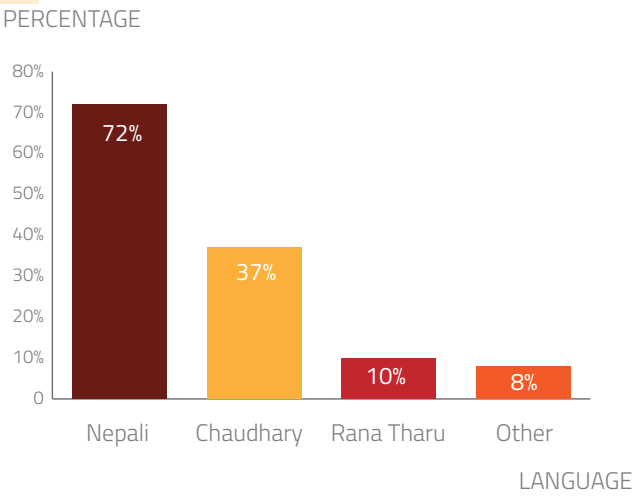
What type of alert messages or information would you like to receive to help reduce heatwave risks?



The overwhelming majority of people prefer Nepali language for receiving heat alert communications while a sizable number of respondents indicated a preference for local languages

Communities want to receive information in Nepali and local languages. Thirty seven per cent of respondents expressed a preference for receiving heat alert messages in Chaudhary while 10 per cent indicated a preference for alerts in the Rana Tharu language.

What is your preferred language for receiving heat alerts messages?



Enhancing heat alert communication in Dhangadhi

Effective communication of heat alerts is essential for enhancing resilience against extreme heat events. It enables timely protective actions, minimises health and societal consequences, and ultimately saves lives (VanderMolen *et al.,* 2021). Early warning and proactive communication also allow local authorities, hospitals and emergency services to allocate resources and activate their preparedness plans quickly (WMO & WHO, 2015; Oberai, 2025). For instance, a Heat Action Plan in Ahmedabad, India, which involved an early warning system and public awareness campaigns, significantly reduced heat-related deaths following an extreme heatwave in 2010 (Ahmedabad Municipal Corporation, 2019).

Currently, the heat warning system in Dhangadhi is not optimal. Based on the FGD findings, the heat warning system in the city is fragmented, overly generalised, and lacks localisation and contextual relevance. As a result, it often fails to inform all city residents, particularly vulnerable groups. However, the Department of Hydrology and Meteorology (DHM) and the Dhangadhi city authority can play a crucial role in improving and streamlining the heat alert communication system.

The city must enhance stakeholder collaboration: Effective stakeholder coordination ensures clear, actionable warning messages reach all at-risk communities. Involving local organisations and leaders in the dissemination process can enhance trust and encourage community-wide participation in heat mitigation strategies (Fritze *et al.,* 2009). The city authority must collaborate with DHM, which is responsible for communicating heat alerts, and implement a comprehensive approach to heat alert communication in the city. These alert messages should be developed in partnership with vulnerable populations, including outdoor workers, women, and elderly residents.

The city has formed a heat task force for developing the Heat Action Plan (HAP). The city authority has to ensure the task force is active and engaged in streamlining the heat alert communication system in the city. While designing an effective heat alert communication system, the city authority, the heat task force and DHM must consider three critical components to support protective actions: reach, relevance, and effectiveness (Sen *et al.,* 2022; Dunlap, 2024).

Alert messages should be clear and consistent: Alert messages should be simple, direct, and tailored to the target audience, aligning with their preferences as described in the perception survey findings. They must clearly convey information about the duration and severity of heat events and the maximum temperature expected. Various communication channels should be used that can effectively reach vulnerable groups, encouraging straightforward actions to mitigate risks, such as staying hydrated and seeking shade (Vetter & Horn, 2022). City authorities and the DHM should identify the preferred communication channels revealed in the perception survey and ensure that messages are easily understandable and actionable. Heatwave risks can be more effectively managed by adapting communication to local languages, such as Chaudhary and Rana Tharu, in addition to Nepali, and considering cultural practices and daily realities. This approach fosters a proactive, people-centred model that supports long-term heat resilience.

Increase the lead time for forecasting: The DHM should reassess or expand its computational model and forecasting capacity to increase the lead time for early warnings of heatwaves or extreme heat to at least three days. This will allow communities and local authorities sufficient time to prepare for potential extreme heat events.

Heat alert communication is a social process requiring equity, trust, and ongoing collaboration among government, media, and communities. By learning from past shortcomings and bridging the current gaps between warning systems and public response, Dhangadhi can enhance its management of heatwave risks.

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