CARIAA
Collaborative Adaptation Research Initiative in Africa and Asia

HI-AWARE

2

Too Hot to Bear

Concerted efforts needed to address urban heat in South Asia

About HI-AWARE

HI-AWARE aims to enhance the adaptive capacities and climate resilience of the poor and vulnerable women, men, and children living in the mountains and flood plains of the Indus, Ganges, and Brahmaputra river basins. It seeks to do this through the development of robust evidence to inform people-centred and gender-inclusive climate change adaptation policies and practices for improving livelihoods.

The HI-AWARE consortium is led by the International Centre for Integrated Mountain Development (ICIMOD). The other consortium members are the Bangladesh Centre for Advanced Studies (BCAS), The Energy and Resources Institute (TERI), the Climate Change, Alternative Energy, and Water Resources Institute of the Pakistan Agricultural Research Council (CAEWRI-PARC) and Wageningen Environmental Research (Alterra). For more details see www.hi-aware.org.

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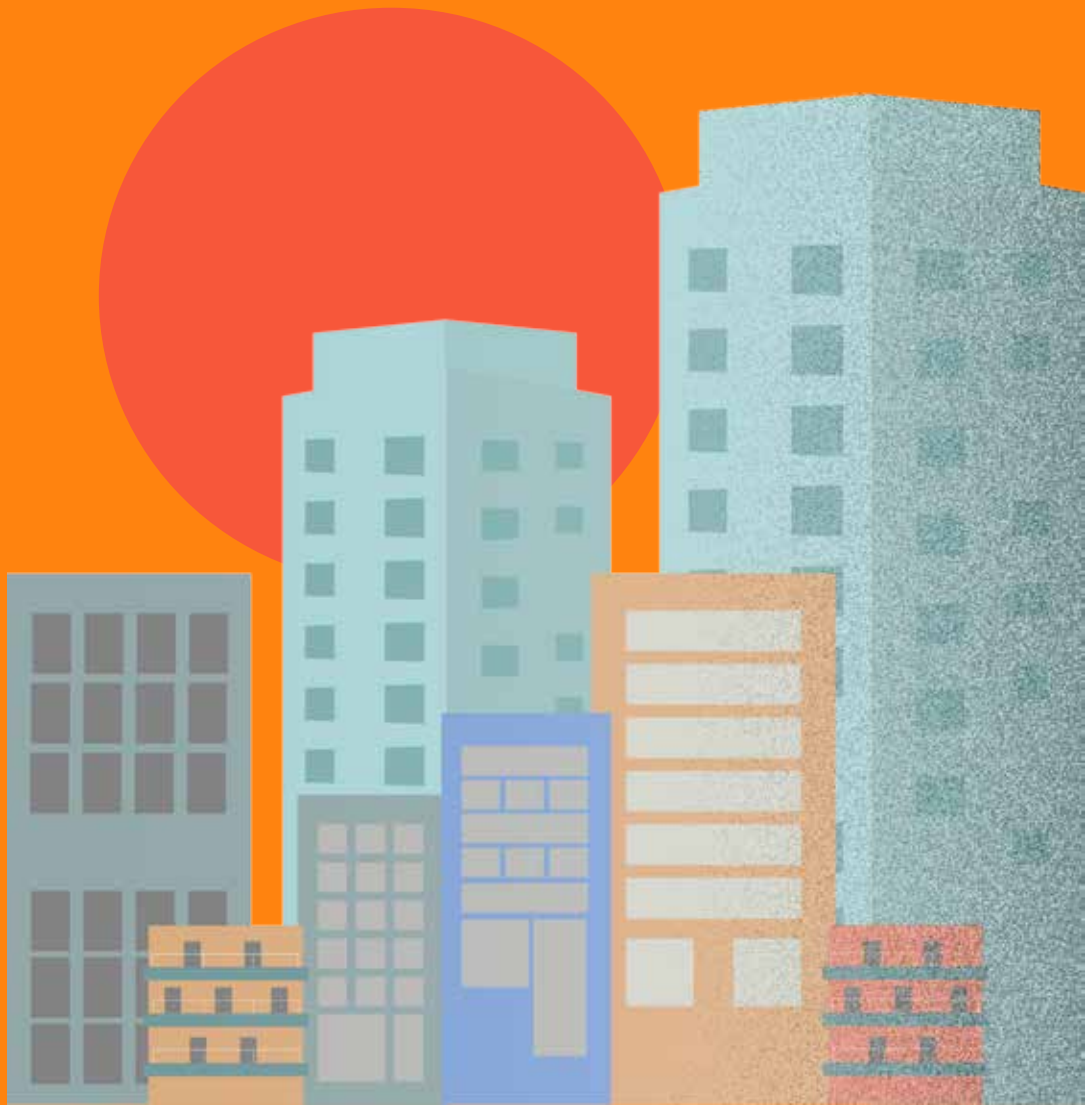
Key Message

Heat waves are expected to increase in intensity and duration in South Asia. Heat thresholds in cities are exceeded months on end already. Individual solutions for keeping houses and neighbourhoods cool will not be sufficient – concerted efforts are needed at the urban landscape, community and individual levels to address the challenge of increasing urban heat in South Asia.



Introduction

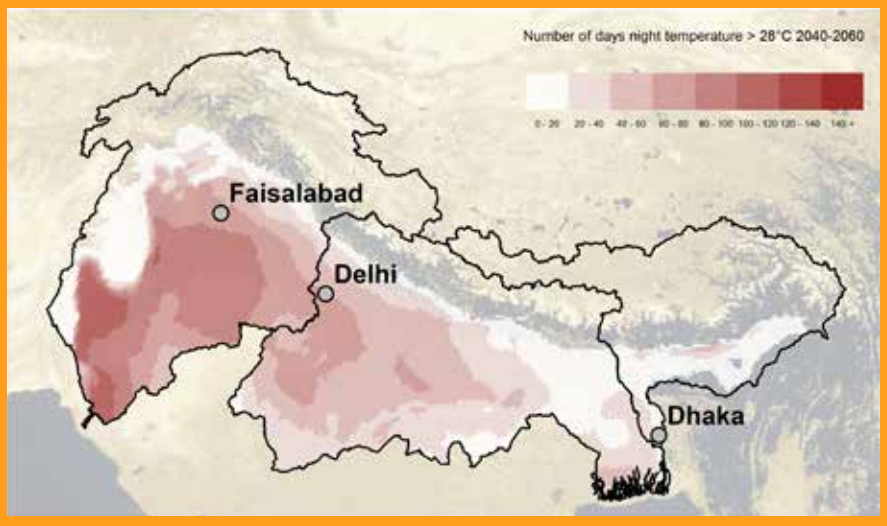
The past three years have been the hottest on record in the modern era (NOAA, 2018). The heat wave events of 2015 in Pakistan and India that cost more than 3,500 lives (Guha-Sapir et al. 2015) showed the catastrophic consequences that extreme temperature can have on humans, even in a region where one would expect people to be accustomed to heat. Heat-related mortality has been defined by the IPCC as one of the key risks for South Asia (Hijioka 2014).

Heatwaves are expected to continue to increase in frequency, duration and intensity. HI-AWARE research shows that the area in the Indus, Ganges and Brahmaputra basins exposed to regular temperature extremes will more than double by 2050. It is not only the heatwaves that matter, though. Due to rising temperatures, the comfortable spring season will get shorter and the period of prolonged heat, also during the nighttime, will get longer. HI-AWARE research on internet searches of individuals in India for air conditioning devices in 17 states revealed that people already start to feel discomfort with outdoor temperature thresholds as low as 26 °C, with warmer states having higher thresholds up to 32°C. While people in warmer areas seem to be adapted to higher levels of heat than people living in cooler regions, this adaptation is reduced in locations which have strong seasonal temperature differences such as the HKH.

Urban microclimates have a role in creating higher temperatures in some parts of cities: heat is exacerbated by the urban fabric; concrete and built up mass, limited ventilation and many anthropogenic sources of heat make cities several degrees warmer than the countryside, especially during nighttime (Oke, 1982). The implications of this microenvironment can be substantial.

In addition, indoor temperatures can differ greatly from outdoor temperatures. Understanding individual exposure levels of vulnerable groups is of importance for health intervention strategies, house constructions and spatial planning purposes. A better understanding of varying heat exposure related to the environment can help design low-cost cooling options. Although air conditioners may effectively reduce heat stress indoors, they increase outdoor temperature in their immediate surroundings, are still very energy intensive and expensive and therefore not accessible to the poor.

Within HI-AWARE, a three-pronged approach was adopted for understanding outdoor and indoor heat stress conditions in three cities in the HKH region, consisting of evidence based research.



Number of days with night time temperatures > 28°C degrees for mid-century (2040 - 2060, mean of selected RCP 4.5 model projections)

In Delhi, Dhaka and Faisalabad intra-urban microclimatic patterns were measured using a special device (a vehicle mounted weather station measuring air temperature, relative humidity, solar radiation and wind speed) developed for application within HI-AWARE.

In the same three cities, in low-income neighbourhoods, an indoor heat measurement campaign was conducted during hot conditions, wherein 135 houses were covered and the real-life variation in heat exposure and thermal comfort was assessed.

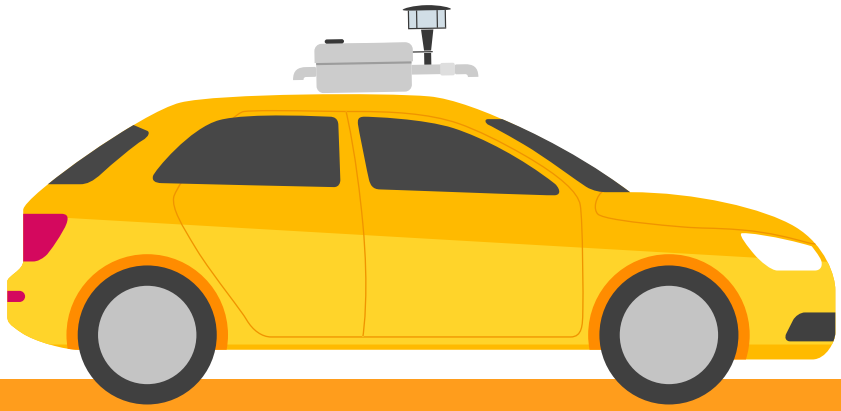
Additionally, HI-AWARE tested an innovative solutions to reduce the risks of heat waves for the most vulnerable groups; a special modular roof with insulation characteristics called 'ModRoofs', in a small pilot consisting of 15 houses in New Delhi.

Major Findings

Intra-urban night time temperature differences reached up to nearly 7 °C (on average about 3 °C), and the largest differences occur after days with sunny weather conditions. Open and greener neighbourhoods tend to be cooler during the night than densely built up ones in terms of air temperature, but during daytime differences may reverse in terms of perceived heat (which is also influenced by other heat related parameters like humidity, wind speed and radiation). Therefore, it is important to consider perceived temperature when evaluating heat patterns rather than air temperature alone. While air temperature was found to decrease somewhat after the onset of the monsoon, perceived temperature still rises because of increased humidity.

Our indoor measurements show that nighttime temperatures in people's houses are up to 8 °C higher than official reported outdoor temperatures from weather stations and stay way above comfortable sleeping thresholds for months on end. People need cool nights to recover from the heat of the day and long periods of warm sleepless nights impact people's health and reduces productivity. Poor people are most affected as they live in dense, built-up neighbourhoods, which are warmer, work in poor conditions and cannot afford buying or running air conditioners.

Heat in low-income houses can be further reduced with low-cost measures like natural ventilation, good insulation of the roofs and walls, and shading. Using evaporative coolers, smart roof and wall structures and creating options for cross-ventilation can reduce indoor temperature substantially (up to 5–6 °C). However, caution must be exercised when implementing passive cooling techniques. Our measurements revealed that existing measures which reduce daytime indoor heat stress may have the opposite effect during nighttime. The positive experiences of ModRoof owners-claiming their houses were much cooler during heat waves - could not be verified by our small pilot; no significant cooling effect was observed and more testing is needed.



The HI-AWARE vehicle mounted weather station, which measures and stores air temperature, relative humidity, solar radiation, wind speed and GPS data.

Policy Actions

HI-AWARE research shows there is scope to reduce temperatures indoors and outdoors. Single solutions will not be sufficient, though. Improved house construction, behavioural adjustments and smart city design need to go hand in hand.

Transformative solutions should not only target the middle-class and well-off, but also the poor in densely built up low-income and informal settlements. It is these settlements that often face the brunt of heat waves and suffer from chronic heat exposure resulting from a lack of resources. Providing the right incentives, and information, to renters and landowners to improve conditions in these settlements, and supporting innovators of new low-cost materials and building styles, should be a government priority. An immediate need is to reevaluate urban planning and to ensure both inclusivity and sustainability across scales, in order to address heat stress which is aggravated by the population influx into urban areas in South Asia.

Current heat action plans focus predominantly on management during short-duration stress-periods – the alarming heat waves – and act as emergency response, thereby ignoring the hidden risk of prolonged high temperatures, especially during nighttime. More radical and fundamental changes are needed if people in South Asia are to adapt well to rising temperatures and urbanization.

The recommendations given here can be taken up by local development authorities, urban units, city corporations, and municipalities.

Looking Ahead

Will temperatures become too hot to bear in South Asian cities? HI-AWARE has explored outdoor and indoor exposure to heat and has sought ways to cope and adapt. Our conclusions:

1. Early heat warning systems in South Asia tend to focus on extreme temperatures, in the hot, pre-monsoon period. But exposure to prolonged high temperatures and rising humidity, also during the hot and humid monsoon season, requires attention. Appropriate heat indices need to be applied.

2. Green open neighborhoods tend to be cooler during the night than densely built low-rise neighborhoods in terms of air temperature. It is important, though, to consider perceived temperature when evaluating heat patterns and not solely air temperature; during daytime differences may reverse in terms of perceived heat compared to nighttime.

3. Individuals from low income groups in urban areas are exposed to nighttime indoor temperatures higher than what is recommended for a comfortable sleeping environment, potentially causing health issues and leading to lower economic productivity.

4. Heat in low-income houses can be reduced with low-cost measures like natural ventilation, shading and good insulation of roofs and walls.

5. Standalone measures are not enough - a combination of measures for different housing types, together with a more climate smart city design is needed. Improved building design, street corridors designed as ventilation paths, increased vegetation and open water bodies may provide partial relief, although these may be insufficient to fully bear with urban heat

This brief is based on the following HI-AWARE publications:

Lutz AF, ter Maat HW, Wijngaard RR, Biemans H, Syed A, Shrestha AB, Wester P, Immerzeel W.W. (2018) South Asian river basins in a 1.5 °C warmer world. Regional Environmental Change, under review.

When do Indians feel hot? Internet Searches Indicate Seasonality Suppresses Adaptation To Heat. Singh et al., Environmental Research Letters (2018)

Recalibrating the urban thermometer - indoor heat exposure in a low income setting in South Asia. Singh et al. (forthcoming)

Patterns of outdoor exposure to heat in three South Asian cities. Jacobs et al.(forthcoming)

HI-AWARE Toolkit: Literature Review of Critical Climate-Stress Moments in the Hindu Kush Himalaya. A Resource Kit. Groot et al., 2018.

Additional supporting references:

Guha-Sapir D, Below R, Hoyois P. 2015. Em-dat: The emergency events database. In: Nature. Brussels, Belgium:Université Catholique de Louvain (UCL) - CRED, D.

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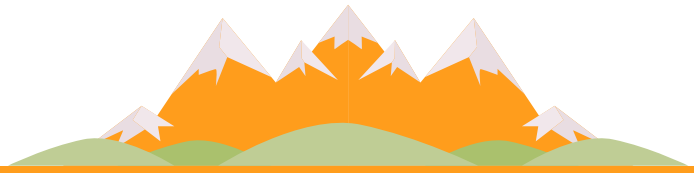

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