# Reducing Heat Impacts

## in Rajshahi City, Bangladesh

POLICY BRIEF

### Background

More intense and frequent heatwaves are now being experienced worldwide due to the impacts of climate change. South Asia is a region that has faced several heatwaves in past years, including heatwave in 2015, the fifth deadliest in recorded history which caused the deaths of approximately 3,500 people[1]. A study published by AGU indicates that even if we limit global warming at 1.5 °C, it is likely that heatwaves will become increasingly common in the South Asia region [2].

Aerial view of Bhadra Mor - a critical road junction in Rajshahi City/ Md. Wahidur Rahman, RUET

1 https://www.unescap.org/resources/disasters-asia-and-pacific-2015-year-review
2 https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020GL091191

The risk of extreme heat is a serious concern, especially in rapidly growing cities such as Rajshahi in Bangladesh. Rapid urbanisation and associated impacts including; increasing concrete infrastructure, deforestation, disappearing water bodies, increasing amounts of dry and impervious surfaces, diverse economic activities and the adverse impacts of climate change, all serve to exacerbate the heat island effect in cities. A heat exposure analysis conducted in 13,115 cities from 1983 to 2016 suggests that global exposure to heat risks in cities has increased by 200 per cent[3].

The purpose of this policy brief is to suggest actions that might be taken by Rajshahi City in Bangladesh to improve resilience and preparedness around extreme heat events in the future. These actions are often aligned with existing policies, as reviewed by this brief, and integrated with the existing structures of governance in Rajshahi. Based on the review of existing policies and the risks associated with heatwaves in Rajshahi, short-term (days to months) and long-term strategies (more than five years) are proposed based on desk research, interviews with key local stakeholders and consultations with disaster risk management and health officials in Rajshahi City. These policies are designed to provide Rajshahi officials with actions to respond to acute heatwave events when they occur, while building resilience against increasing heat stress in the future.

## Heatwaves in Rajshahi City

Rajshahi is the fourth largest city in Bangladesh. It stands on the northern bank of the river Ganges covering an area of 96.72 square kilometres. Rajshahi is classified as one of the regions experiencing high temperatures during the pre-monsoon season (March to May).

The maximum temperature exceeds 39°C almost every year and humidity levels sometimes reach 65% (BMD data, 1990-2020). In summer, temperatures reach 42 °C or more in the city[4] on the hottest days. Due to the heat, about 188km$^2$ vegetation has been lost of a 2,428km$^2$ area in Rajshahi district from 1998 to 2018[5]. Heat-related deaths are not systematically tracked in Rajshahi, but given the trends in heat and anecdotal evidence, the impacts are likely to be significant. For example, stakeholders interviewed from Rajshahi City mentioned that heatwave impacts have worsened in recent years and older people, daily wage earners (e.g. auto drivers, rickshaw drivers and street hawkers) and pedestrians are amongst the most vulnerable populations. Moreover, heatwaves pose adverse impacts on the livelihoods of daily wage earners. Results of a small scale survey with rickshaw pullers and auto drivers indicate that they lose 20 and 18 percent of their incomes respectively, if they reduce their working day by four hours over a three day period during high heatwave days.

3 https://www.pnas.org/content/118/41/e2024792118
4 Shahid, S., Wang, X. J., Harun, S. Bin, Shamsudin, S. B., Ismail, T., & Minhans, A. (2016). Climate variability and changes in the major cities of Bangladesh: observations, possible impacts and adaptation. Regional Environmental Change, 16(2), 459–471. https://doi.org/10.1007/s10113-015-0757-6
5 Kafy, A.-A. (2018). Importance of Surface Water Bodies for Sustainable Cities: A Case Study of Rajshahi City Corporation. *Souvenir World Town Planning Day*. Bangladesh Institute of Planners (BIP).

## A review of existing policy frameworks

Bangladesh has a number of policy frameworks relevant to addressing heat risks. In this section, we highlight some of the key frameworks and how they can be applied to heat, or where gaps exist and heat may need to be better integrated.

Bangladesh has a comprehensive climate change action plan, the *Bangladesh Climate Change Strategy and Action Plan 2009* (BCCSAP 2009). It aims to eradicate poverty and achieve economic and social well-being for people through climate change adaptation, disaster risk reduction (DRR), low carbon development and mobilising international climate finances. The BCCSAP includes five key thematic focus areas:

1. Food security, social protection and health
2. Comprehensive disaster management
3. Infrastructure for building climate resilience
4. Research and knowledge management
5. Capacity building and institutional strengthening

Drought management and undertaking research on the impact of climate change on health (including the incidence of malaria and dengue, diarrheal diseases, and heatstroke) has been recommended as one of the actions under the abovementioned thematic focus area of food security, social protection and health. However, heat risk is not explicitly integrated within the other thematic areas. For instance, comprehensive disaster management mainly focuses on improvement of flood forecasting and early warning systems and improvement of cyclone and storm-surge warning, whereas it could also focus on heat risk management and improvement of early warning systems for heatwaves.

The *National Adaptation Plan (NAP)* for Bangladesh is currently under revision, but in the list of priorities already published in the existing NAP, a general statement addressing the impacts of climate change on human health has been highlighted. It is unclear if heat risk will be addressed in the updated NAP.

The *Bangladesh National Building Code* of 2006 determines general building requirements, controls, regulations, fire protection, building materials, structural design, construction practices and safety, building services, signs and outdoor displays. Each of these parameters could be adapted using a heat lens. For instance, structural design could include high ceilings and other design features for natural ventilation. It could emphasise the use of building materials that minimise heat gain and provide fast heat loss, taking into consideration current and future temperature projections and an increase in heatwave events.

*Natural Water Body Protection and Preservation of Open Space and Playground Act 2000* aims to restrict encroachment of the water bodies and open spaces, and prevent changes to land-use patterns in cities. This rule directly aligns with reducing heat island effects, and there is a provision for strict punishment in the event the rule is breached. However, the respective city or development authorities need to enforce this law more vigorously.

The *Building Construction Act of 1952* prevents the haphazard construction of buildings. Rajshahi Development Authority (RDA) is the nodal agency for permissions and approvals of building plans relating to any construction project in Rajshahi City. If the impacts of climate change, especially extreme heat, are linked to the National Building Code and Building Construction Act, the RDA could take a pivotal role in the enforcement of these laws and in building heat resilience in the city.

**Older adults living under the scorching sun in informal settlements in ward 26, Rajshahi City / Md. Wahidur Rahman, RUET**

## Strategies for managing heat risks

There are many strategies that the City of Rajshahi could consider to reduce the impacts of heat waves. However, it's important to look across different timescales as heat action requires both short and long-term strategies.

### Short-term strategies

Short-term strategies for strengthening resilience to heat stress focus on public messaging and awareness and on the provision of immediate needs during a heatwave event. These are strategies that the City of Rajshahi can implement quickly to predict heatwaves, prepare people for their onset and manage cooling needs during an acute event.

*Public messaging for communicating heat warnings*

The first line of defence against a heatwave is having early warning and time to prepare. Heat waves are already considered serious hazardous events by the Rajshahi City Corporation (RCC) and they can be integrated as hazards under the responsibility of the disaster management committee of the RCC together with the district administration. The disaster management committee and Rajshahi District Authority could work in conjunction with the Bangladesh Meteorological Department (BMD) to develop an impact-based heatwave forecast upon which to trigger public alerts and responsive actions.

Once a heatwave is forecast, alerts can be sent out to the public via flyers, SMS, social media, local television stations and local radio stations. To ensure that all community members, including youth and those with language barriers, understand the alerts quickly and easily, BMD forecasts will need to be adapted into easy to understand language and simple colour-coded warnings e.g. yellow, orange and red, which can be used to indicate the severity of the heatwave  imminent hazard. The respective authorities can also make reference to the Common Alerting Protocol (CAP) for formulating the alerts.

Furthermore, the disaster management committee can plan ahead on a slightly longer timescale for future heat events. Each year, before the beginning of the hot season (April-June), the committee can meet to develop or revisit their heat action plan for the city. This plan can include alerts, public awareness raising and steps to prepare city workers and health workers to recognise the signs of extreme heat and prepare for a possible increase in patients. Toward the end of the hot season, the committee can meet again to review how the heat action plan was implemented across various heatwaves and how the plans could be improved for the subsequent year.

*Heat awareness*

It is important that the public understand how best to keep themselves safe from health risks related to heat stress and know where to access care should they need it. The Heatwave Guide for Cities provides a useful list of risks and actions that can be taken. The previously mentioned media outlets, including television and radio, will be instrumental in spreading information about simple actions to take, such as seeking shade, drinking water and checking in on vulnerable neighbours and family members.

In the days leading up to a heatwave, RCC or the District Administration could partner with various entities including; the Urban Primary Health Care Service Delivery Project (UPHCSDP), the NGO Health Service Delivery Project (NHSDP) and the Manoshi programme implemented by BRAC, to deploy community health officials to alert vulnerable groups and communities  about the incoming heatwave, while also  providing guidance for staying cool and safe. These vulnerable groups include infants and pregnant or nursing mothers, the elderly and infirm and disabled people, as well as the unhoused or those living in informal settlements. In Rajshahi, wards 1, 2, 4, 16, 24, 28 and 29 have high vulnerability due to people's low income status and occupations that often require being outdoors for long periods of the day. Such communities tend to have

less access to cooling technology and face higher health risks in the heat. They could be given information about how best to protect themselves and how to identify the signs of heat related illnesses[6].

The RCC can also ask departments to raise awareness among their city workers who are expected to work outdoors (traffic police, sanitation workers, etc.), providing information about where to cool off during the day and how to recognise the signs of dehydration and heat stroke. Hospitals and healthcare workers should be educated on the signs of heat-related illnesses and treatment of heat-related conditions. They should also be prepared for a potential increase in patients.

### *Water access and cooling centers*

To reduce the risk of heat-related illnesses for residents, the disaster management committee, in conjunction with other city agencies, could designate a series of locations as water and cooling centers for residents. Such sites can be retrofitted with active and passive cooling technologies if not already equipped with them, and could be staffed with NGO and health workers in charge of monitoring people for illnesses and providing potable water for those who need it. Potential locations in Rajshahi include Saheb Bazar Zero Point, Lokkipur Mor, the railway station and Bhadra Mor. If needed, this programme can be expanded to places of worship, libraries, community centers, and other enclosed public spaces. Locations and opening hours of cooling centers can be included in awareness raising campaigns leading up to a heatwave. These centers should be clearly marked with signage indicating their use. As an additional protective measure, construction sites could be assessed by the district authority for shade and water provision. The authority can require sites to offer both services during heatwaves or

**Informal workers (rag-pickers) working under the scorching sun in ward 26, Rajshahi City /Md. Wahidur Rahman, RUET**

6 Singh, R., Arrighi, J., Jjemba, E., Strachan, K., Spires, M., Kadihasanoglu, A., *Heatwave Guide for Cities.* 2019. Red Cross Red Crescent Climate Centre.

during the hot season overall.[7] This will help address potential risks among construction workers and laborers, some of the groups most vulnerable to heat stress.

## Long-term strategies for managing heat risk

While short-term strategies can address heatwaves as they occur and provide assistance to the public in times of acute heat stress, there are several measures that can be taken to improve overall levels of resilience in the city. Retrofitting existing infrastructure, planning the city to accommodate cooling technologies and long-term strategies for community education around heat, can all help Rajshahi to adapt to increasing heatwaves in the future.

### *Integrating heat risks into city planning*

Rajshahi is growing at a steady pace, with its population increasing at a rate of around two per cent in 2021.[8] Coordination between the disaster management unit and the Rajshahi Development Authority (RDA) can be key in planning city growth in a way that provides resilience to heat stress. Individual buildings can be constructed with cooling[9] roof technology, addressed below and constructed in a way that allows green infrastructure corridors to be left uninterrupted where possible. In addition, constructing buildings with cross-breeze in mind assists in passive cooling. New neighbourhoods and settlements can be organised to allow for cooling corridors as well, keeping space for breeze to flow, especially from the riverfront up into the city. To that end, preventing the construction of large buildings along the riverfront will allow breezes to flow into the city, providing a cooling effect.[10]

### *Green and reflective roofs*

Rooftops blanket a city and tend to be constructed out of heat-absorbing materials such as tin, concrete, asphalt, or tile. Shifts in roofing materials and colour range from simple to complex. Each addresses the reflection of the roof's surface, i.e. how much sunlight it reflects back, as well as the ability of the material to absorb heat. This can lower the temperature of both the interior of the building and the surrounding city.[11] Painting roofs with white lime paint or layering high albedo, China mosaic tiles or shingles on top of existing roofs are relatively inexpensive options for lowering internal and external temperatures of a building.

Green roofs are another option for increasing climate resilience in a city in a variety of ways. Green roofs entail covering the entirety of a building's roof with a layer of

7 Ahmedabad Municipal Corporation et al. (2016) 'Ahmedabad Heat Action Plan 2016'. Available at: https://drive.google.com/drive/folders/1HtIB9ma3rfkGDHrjSMjE3SFLVrs8mDX5 (Accessed: 29 January 2022).

8 *Rajshahi Population 2021* (Demographics, Maps, Graphs) (no date) World Population Review. Available at: https://worldpopulationreview.com/world-cities/rajshahi-population (Accessed: 29 January 2022).

9 Bhatta K, Pahari S. Vulnerability to Heat Stress and its Health Effects among People of Nepalgunj Sub-Metropolitan. *Journal of Nepal Health Research Council.* 2021 Jan;18(4):763-768. DOI: 10.33314/jnhrc.v18i4.2734. PMID: 33510525.

10 Ghanekar, A. *et al.* (2021) 'City Heat Resilience Toolkit'. Toolkit for Indian Cities.

11 Natural Resources Defense Council *et al.* (2018) 'Cool Roofs: Protecting local communities and saving energy'. Available at: https://www.nrdc.org/sites/default/files/ib_-_cool_roofs_-_hyd_workshop.pdf (Accessed: 28 January 2022).

vegetation that insulates buildings against heat while providing a cooling effect for the surrounding city.[12] In neighborhoods that are more densely built or have less green space, green roofs are a good alternative or addition to urban park space. Furthermore, green roofs can lessen the impacts of stormwater runoff and flooding.[13] While more expensive than reflective roof options, they have significant benefits, especially when added to larger existing structures such as government or university buildings.

### *Green and blue infrastructure management and conservation*

Green infrastructure (e.g. parks, street trees and gardens) and blue infrastructure (e.g. streams, ponds and other waterways) are essential components of a city resistant to heat stress. Maintaining green ecosystems within a city can lower surface temperatures through both shade and natural processes of evapotranspiration.[14] Blue spaces, while often overlooked, can be more than twice as effective at cooling the surface temperature of cities than green spaces and are thus critical to a city's climate response.[15] Populations most vulnerable to the effects of heat tend to live in neighbourhoods with less cultivated green and blue infrastructure, making it even more important in those areas to focus on mitigating heat stress. Achieving this cooling effect can be accomplished by maintaining and shoring up the health of existing ecosystems and the riverfront, and creating new reservoirs, ponds as well as planting trees and gardens in patches throughout the city itself. Green and blue spaces in cities also provide a high number of co-benefits, including greenhouse gas reduction, improved air quality, management of flooding and stormwater runoff and improved mental and physical health for residents.[16]

It is important that the plant species planted and their locations take into account several factors. They should be native to the Rajshahi region, reflect community preferences and be easy and inexpensive to care for.[17] In addition, blue infrastructure in places with mosquito-borne diseases should include some movement of water through fountains, waterfalls, or pond pumps, avoiding overgrowth of vegetation allowing natural predators to join the ecosystem and control the mosquito population.

### *Energy management planning for additional demand*

Hot weather, especially acute heatwave events, puts enormous stress on the energy systems of urban areas. In Rajshahi, power cuts increase during peak summer months (May–July). Increasing heat due to climate change will only put more stress on the energy system. Long-term, encouraging building design that decreases heat outside of

12 Mowla, Q. (2010) 'Green Roof Concept for Eco-Sustainability in the Context of Urban Dhaka'. Available at: https://www.academia.edu/6084128/Green_Roof_Concept_for_Eco_Sustainability_in_the_Context_of_Urban_Dhaka (Accessed: 27 January 2022).
13 ibid.
14 Gunawardena, K.R., Wells, M.J. and Kershaw, T. (2017) 'Utilising green and bluespace to mitigate urban heat island intensity', Science of The Total Environment, 584–585, pp. 1040–1055. doi:10.1016/j.scitotenv.2017.01.158.
15 Lin, Y. et al. (2020) 'Water as an urban heat sink: Blue infrastructure alleviates urban heat island effect in mega-city agglomeration', Journal of Cleaner Production, 262, p. 121411. doi:10.1016/j.jclepro.2020.121411.
16 He, B.-J. et al. (2019) 'Co-benefits approach: Opportunities for implementing sponge city and urban heat island mitigation', Land Use Policy, 86, pp. 147–157. doi:10.1016/j.landusepol.2019.05.003.
17 Lamichhane, D., & Thapa, H. B. (2012). Participatory urban forestry in Nepal: Gaps and ways forward. Urban Forestry & Urban Greening, 11(2), 105–111. https://doi.org/10.1016/j.ufug.2011.07.008

air conditioning systems will reduce strain on the system. These include previously mentioned cool roof designs, providing corridors for breezes in the city and increasing green and blue infrastructure. Some service interruptions could be prevented if the District Authority works with water and electric providers to avoid scheduling maintenance or other routine service disruptions during heatwave alerts.[18]

### *Long-term heat education*

While short-term awareness campaigns are effective for addressing individual heatwaves, more resilience can be built by developing long-term plans for heat education. Integrating signs of heat-related illnesses into training for municipal workers, particularly those who work outside or who interact with the public, will increase their ability to respond to heatwaves. The city authority and education system can also provide education about the causes of heat stress and ways to keep cool in schools, so youth understand what to look for in older relatives and how to protect themselves. Targeted social media campaigns to educate youth and other members of the public on heat island effect and heat stress have been successful in other cities across South Asia, particularly if they engage national and local influencers in encouraging youth to look out for their vulnerable relatives.[19]

Finally, tapping into existing educational resources can help build the RCC's capacity to react to future stresses. Partnering with the University of Rajshahi or Rajshahi University of Engineering & Technology (RUET) to develop heat stress maps and heat-health data for the city can better inform future actions while giving students valuable experience in increasing climate resilience.

## Conclusion

Dangerously hot weather, particularly in cities, is one of the most harmful impacts of climate change, and the frequency and severity of heatwaves will only increase in coming decades. Cities such as Rajshahi need to be prepared to address heat stress with both immediate and long-term strategies to keep populations safe. Thankfully, Rajshahi has several existing branches of government and disaster preparedness plans that can provide organisation and a foundation on which to enact these strategies. Coordination between the BMD, RCC, disaster management committee, District Authority, and Rajshahi Town Development Authority, will be key in ensuring a response to increasing temperatures that protects the most vulnerable in the city and relieves pressure on energy and healthcare systems during heatwaves. Early alert systems and raising awareness can help people to take actions to protect themselves, while long-term education campaigns will help people learn to take care of their most vulnerable relatives and neighbours. Meanwhile, bolstering the city's natural cooling infrastructure and planning the city around a hotter future will mean the city becomes more resilient to future heatwaves. Taking steps to address the city's resilience will help to lessen future suffering and economic impacts from heatwaves and provide many concurrent health and well-being benefits for the residents of Rajshahi.

18 Ghanekar, A. *et al.* (2021) 'City Heat Resilience Toolkit'. Toolkit for Indian Cities.
19 Ghanekar, A. *et al.* (2021) 'City Heat Resilience Toolkit'. Toolkit for Indian Cities.

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