Heat Action Plan (HAP)

Narayanganj City Corporation (NCC), Bangladesh

September, 2025

Photo credit: ICLEI South Asia

CLARE CLIMATE ADAPTATION & RESILIENCE

UK International Development
Partnership | Progress | Prosperity

IDRC · CRDI
Canada

ICLEI Local Governments for Sustainability SOUTH ASIA

Heat Action Plan (HAP), Narayanganj City Corporation (NCC), Bangladesh

This document is prepared by:

ICLEI – Local Governments for Sustainability, South Asia

Contributing Team Members:

Lead Authors:

1. Dipak Bhowmick, Technical Lead, ICLEI South Asia
2. Md. Jubaer Rashid, Country Representative, ICLEI South Asia

Mapping Support:

1. Vasavi Yarram, Senior Project Officer, ICLEI South Asia

Approved by:

Administrator of NCC in the monthly meeting dated 22nd September, 2025

Citation:
Bhowmick, Dipak, and Md. Jubaer Rashid. Heat Action Plan for Narayanganj City. *ICLEI South Asia and Narayanganj City Corporation, 2025.*

Contact:

ICLEI South Asia Secretariat

C-3, Lower Ground Floor
Green Park Extension
New Delhi - 110016, India
Email: iclei-southasia@iclei.org
Tel. +91 – 11 – 4974 7200; Fax +91 - 11 - 4974 7201

Bangladesh Country Office

House 12 (Flat 2B), Road 20, Nikunja 2, Khilkhet
Dhaka 129, Bangladesh
Email: iclei-bangladesh@iclei.org
Tel: +880 1881 - 363333

Acknowledgement

This Heat Action Plan (HAP) for Narayanganj City has been developed through the collaborative efforts of multiple stakeholders, united by a shared commitment to building climate resilience and safeguarding vulnerable communities from the growing threat of extreme heat.

We extend our deepest gratitude to the Narayanganj City Corporation (NCC) for their leadership, guidance, and unwavering support throughout the development of this plan. Special appreciation is due to the Honourable Administrator, A H M Kamruzzaman; Chief Executive Officer, Mohammad Zakir Hussain; Secretary, Md. Nur Kutubul Alam; Chief Engineer, Md. Abdul Aziz; Executive Engineers, Md. Asgor Hossain and A S M Moshiur Rahman; Chief Social Welfare and Slum Development Officer, K M Faridul Miraj; and Medical Officer, Nafia Islam. Their valuable inputs during consultations and review sessions were instrumental in shaping the plan.

We would like to especially acknowledge the contributions of Md. Moinul Islam, Urban Planner of NCC, whose continuous guidance and support have been central to the preparation of this HAP.

We are also grateful to the project team and our colleagues at SouthSouthNorth (SSN) for their technical assistance, review and constructive feedback, which strengthened key sections of the report and ensured that the strategies proposed are both context-specific and actionable.

Our sincere thanks also go to community volunteers, along with representatives from public and private institutions in Narayanganj, who generously shared their on-ground experiences and practical knowledge during the consultation workshop. Their participation has ensured that this plan reflects the needs and realities of the people it is designed to protect.

Forewords

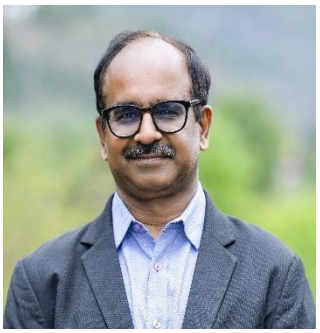
Dr. Abu Nasar Mohammad Abdullah,
Administrator, Narayanganj City Corporation (NCC)

It is with great pride that I present the Heat Action Plan (HAP) for Narayanganj City Corporation. This landmark initiative demonstrates our city's proactive commitment to addressing the growing threats posed by extreme heat and climate change.

Narayanganj, one of Bangladesh's most vibrant industrial and commercial centers, has been experiencing increasing effects of urban heat stress in recent years. Rising temperatures, dense built-up areas, limited open and green spaces, and higher energy use have amplified the urban heat island effect, threatening the health, livelihoods, and productivity of our residents. Vulnerable groups, such as outdoor workers, the elderly, children, and low-income communities, are hit hardest, as they have limited ability to adapt to extreme heat.

The Heat Action Plan provides a comprehensive framework to address these issues. It includes immediate measures such as early warning systems, heat health communication protocols, and community outreach, as well as long-term strategies that incorporate climate resilience into our city's urban planning, infrastructure, and development priorities. The Plan stresses cross-sector cooperation, data-driven decision making, and public awareness, making heat preparedness an essential part of Narayanganj's governance. In the long term, this Plan will benefit the city in many ways. By integrating heat resilience into local planning and budgeting, we can create cooler public spaces, adopt sustainable building practices, increase tree coverage, and promote reflective and green infrastructure. These initiatives will not only save lives and protect livelihoods but also improve overall urban living, public health, and economic productivity.

The experience and capacities developed through this effort will strengthen our ability to respond effectively to future climate challenges, making Narayanganj a model for other cities across Bangladesh. Moving forward, Narayanganj City Corporation will lead the implementation and institutionalization of this Plan through collaboration with relevant government agencies, development partners, and community organizations. We are dedicated to embedding heat resilience into city policies, emergency response systems, and urban planning frameworks. Our goal is to transform Narayanganj into a city that is not only economically vibrant but also safe, inclusive, and resilient to climate impacts for future generations. I sincerely thank ICLEI South Asia for their crucial technical support and all local officials, experts, and stakeholders who shared their insights and efforts in developing this Plan. The Heat Action Plan for Narayanganj City Corporation stands as a testament to our joint commitment to protecting our people, preserving our environment, and building a resilient urban future.



Emani Kumar
Deputy Secretary General,
ICLEI – Local Governments for Sustainability
Executive Director, ICLEI South Asia

The Narayanganj City Corporation Heat Action Plan (HAP) marks a significant milestone and a timely initiative in Bangladesh's journey toward building climate-resilient and people-centered cities. The increasing threat of extreme heat, one of the most urgent and widespread impacts of climate change, is especially alarming in rapidly urbanizing cities such as Narayanganj. This HAP represents an innovative local effort to understand, anticipate, and address these growing risks.

As one of the country's leading industrial and economic hubs, Narayanganj faces unique challenges from the combined pressures of dense urban development, limited green infrastructure, and rising temperatures. These factors contribute to increased heat stress, which directly threatens public health, urban productivity, and overall quality of life. Therefore, implementing this HAP will be an essential step toward shifting from reactive crisis management to proactive, evidence-based adaptation planning.

ICLEI South Asia is proud to have supported Narayanganj City Corporation (NCC) in developing this plan through a participatory and data-driven process. The HAP offers an integrated framework that combines early warning systems, public awareness campaigns, urban sector preparedness, and long-term urban design strategies to reduce exposure and vulnerability. It highlights the importance of multi-level governance, inter-departmental coordination, and active community involvement, all of which are principles at the core of ICLEI's mission to promote sustainable urban development.

In the long term, implementing this HAP will not only increase the city's resilience to extreme heat but also generate co-benefits, such as improved air quality, greener public spaces, and more inclusive urban infrastructure. By integrating heat resilience into local policies, land-use planning, and investment priorities, Narayanganj can demonstrate its leadership and inspire other Bangladeshi and South Asian cities to take similar action. This initiative also complements national strategies such as the Bangladesh National Adaptation Plan (2023–2050) and the Delta Plan 2100, reinforcing the country's broader climate resilience goals.

ICLEI South Asia remains committed to supporting city governments in building institutional capacity, integrating climate risk management into urban planning, and advancing the global agenda for sustainable, climate-resilient development.

I thank NCC for their ongoing leadership, dedication, and vision in championing this important initiative. We look forward to a long-lasting, productive partnership between ICLEI South Asia and NCC.

Abbreviations

AAP	: Action Area Plan
ADP	: Annual Development Programme
ADPC	: Asian Disaster Preparedness Plan
BCCSAP	: Bangladesh Climate Change Strategy and Action Plan
BCCTF	: Bangladesh Climate Change Trust Fund
BDP	: Bangladesh Delta Plan
BMD	: Bangladesh Meteorological Department
BSCIC	: Bangladesh Small and Cottage Industries Corporation
BUET	: Bangladesh University of Engineering and Technology
CDKN	: Climate and Development Knowledge Network
CDC	: Community Development Committee
CEO	: Chief Executive Officer
CRCAP	: Climate Resilient City Action Plan
CRVA	: Climate Risk and Vulnerability Assessment
CSR	: Corporate Social Responsibilities
CVI	: Climate Vulnerability Index
DGHS	: Directorate General of Health Services
DIFE	: Department of Inspection for Factories and Establishments
DND	: Dhaka-Narayanganj-Demra
DoE	: Department of Environment
DPHE	: Department of Public Health Engineering
DPDC	: Dhaka Power Distribution Company Ltd.
EPZ	: Export Processing Zone
FSCD	: Fire Service and Civil Defense
GHG	: Greenhouse Gas
GIZ	: Deutsche Gesellschaft für Internationale Zusammenarbeit
GoB	: Government of Bangladesh
HAP	: Heat Action Plan
ICLEI	: International Council for Local Environmental Initiatives
ICT	: Information and Communication Technology
IEC	: Information, Education and Communication
IWFM	: Institute of Water and Flood Management
LDCF	: Least Developed Countries Fund
LGED	: Local Government Engineering Department
LST	: Land Surface Temperature
MoEFCC	: Ministry of Environment, Forest and Climate Change
MODIS	: Moderate Resolution Imaging Spectroradiometer
MoLGRC	: Ministry of Local Government, Rural Development and Cooperatives
MoHFW	: Ministry of Health and Family Welfare
MoU	: Memorandum of Understanding
MHCP	: Multi-Hazard Contingency Plan
MtCO2e	: Metric Tons of Carbon Dioxide Equivalent
NAP	: National Adaptation Plan
NCC	: Narayanganj City Corporation
NDBI	: Naturalistic Developmental Behavioral Interventions
NDC	: Nationally Determined Contributions
NDRCC	: National Disaster Response Coordination Centre

NDVI	: Normalized Difference Vegetation Index
NDWI	: Normalized Difference Water Index
NGO	: Non-Government Organisation
NOAA	: National Oceanic and Atmospheric Administration
NWS	: National Weather Service
ORS	: Oral Rehydration Solutions
PM	: Particulate Matter
RAJUK	: Rajdhani Unnayan Kartripakkha
SDGs	: Sustainable Development Goals
SLD	: Shared Learning Dialogues
SMS	: Short Message Service
TAP	: Transformative Action Programme
UHI	: Urban Heat Island
Urban LEDS	: Urban Low Emission Development Strategies
UNDP	: United Nations Development Programme
USD	: United States Dollar
WBGT	: Wet-Bulb Globe Temperature
WHO	: World Health Organisation

Glossary of Terms

Term	Definition
Active Cooling	A heat-reducing mechanism that is typically implemented in electronic devices and indoor buildings to ensure proper heat transfer and circulation from within.
Adaptation (to Heat/Climate Change)	Adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. (UNFCCC)
Climate Change	A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/ or the variability of its properties and that persists for an extended period, typically decades or longer. (AR6, IPCC) A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods (UNFCCC)
Climate Resilient Infrastructure	That infrastructure will help to protect lives and livelihoods, reduce direct losses as a result of extreme weather events, and play a key role in meeting the mitigation targets of the Paris Agreement, as well as to meet national development aspirations. (UNDP)
Cooling Centre	An air-conditioned public or private space to temporarily deal with the adverse health effects of extreme heat weather conditions, like the ones caused by heat waves (Wikipedia)
Community-Based Adaptation (CBA)	A participatory approach that puts local people front and centre in climate and development action. (IIED)
Disaster Risk Reduction (DRR)	Preventing new disasters and reducing existing ones, as well as managing residual risk, all contribute to strengthening resilience and achieving sustainable development. (UNDRR)
Early Warning System (EWS)	An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events. (UNDRR)
Extreme Heat Event	A period of abnormally hot weather, often defined with reference to a relative temperature threshold, lasting from two days to months, (IPCC) A period where local excess heat accumulates over a sequence of unusually hot days and nights (WMO)
Green Infrastructure	The interconnected set of natural and constructed ecological systems, green spaces and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street-level design interventions that incorporate vegetation. (IPCC)
Health Co-Benefits	When implementing mitigation and adaptation policies, social or economic hurdles may arise. However, studies are increasingly showing that the implementation of climate policies leads to both cost savings and improvement in health. Mitigation of climate change in various sectors, including housing, transportation and energy, has many co-benefits that lead to substantial health gains and reduced health risks. (WHO)

Term	Definition
Heat Alert/ Warning	A heat warning, as defined by Environment Canada, means daytime and nighttime temperatures or humidex values are expected to be higher than the average high temperature for 2 or more days in a row.
Heat Index	An index that combines air temperature and relative humidity, in shaded areas, to posit a human-perceived equivalent temperature, as how hot it would feel if the humidity were some other value in the shade.
Heat Resilience	The capacity of systems to withstand, adapt to, and recover from heat stress, promoting sustainability.
Heat Stress	When the body overheats and can't cool itself to its normal body temperature (37 degrees Celsius). Heat stress occurs when the body is unable to remove excess heat, resulting in adding stress to the body. (National Guideline on Heat-Related Illness)
Heat Threshold	The effects of heat begin to provoke excess mortality attributable to heat.
Heat-Related Illness (HRIs)	Illnesses caused by exposure to high temperatures include heat cramps, fainting, heat exhaustion, heatstroke, and death.
Heatwave	A period of abnormally hot weather. Heatwaves and warm spells have various and, in some cases, overlapping definitions. (IPCC).
Low-Income Settlement	A residential area where the majority of inhabitants have limited financial resources and live in substandard or informal housing, often lacking secure tenure, access to basic services (such as clean water, sanitation, electricity), and adequate infrastructure.
Mitigation (of Climate Change)	Efforts to reduce emissions and enhance sinks are referred to as "mitigation". (UNFCCC)
Occupational Heat Exposure	The condition in which workers are exposed to high temperatures and/or humid environments during the course of their work, increasing the risk of heat-related illnesses, reduced productivity, and even fatalities.
Passive Cooling	Designing buildings to stay cool naturally, minimising or eliminating the need for energy-intensive air conditioning.
Preparedness	The knowledge and capacities developed by governments, response and recovery organisations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. (UNDRR)
Public Awareness Campaign	The development of increased public awareness about hazards and the understanding of disaster risks are vital elements in any comprehensive strategy for disaster reduction. Public awareness should be conducted through all possible means, including in schools, in particular through the media and other official, public, professional and commercial means, at all levels of society. (ADPC)
Public Health Emergency	The programme aims at improving national capability to prepare, prevent, detect and respond to public health emergencies. (WHO)
Public Health Emergency Preparedness	The capability of public health systems, communities, and individuals to prevent, protect against, quickly respond to, and recover from health emergencies – particularly those that pose widespread risks to population health, such as heatwaves, pandemics, or disease outbreaks.
Thermal Comfort	A state of mind that expresses satisfaction with the surrounding thermal environment, where a person feels neither too hot nor too cold.
Urban Heat Island (UHI)	An area within an urban area characterised by ambient temperatures higher than those of the surrounding area because of the absorption of solar energy by materials like asphalt. (IPCC)

Term	Definition
Vulnerable Groups	Populations that are disproportionately at risk of harm from disasters, climate change, and public health emergencies due to specific social, physical, economic, or environmental conditions. These groups may include individuals who are marginalised or face systemic disadvantages based on age, gender and sexual identity, race, ethnicity, culture, religion, disability, socio-economic status, geographical location, or migration status. (WHO)

Executive Summary

Narayanganj, located just southeast of Dhaka, is one of Bangladesh's most important industrial and commercial hubs. Its strategic location and rapid pace of urbanisation have transformed it into a centre of textile production, manufacturing, and trade. However, this progress has come with significant environmental costs, particularly in the form of growing exposure to extreme heat. The city's dense population, high concentration of industries, traffic congestion, and inadequate green-blue networks and open spaces have intensified the urban heat island effect. In recent years, Narayanganj has recorded more frequent and prolonged periods of extreme temperatures, pushing the limits of its infrastructure, public health systems, and communities. These conditions underscore the urgent need for a comprehensive and coordinated response to protect lives and livelihoods. The Heat Action Plan (HAP) of Narayanganj City Corporation (NCC) has been developed to provide such a framework, setting out both immediate and long-term strategies for building resilience against extreme heat.

The primary aim of the HAP is to reduce heat-related mortality and illness, particularly among vulnerable groups, while also strengthening the capacity of institutions and communities to anticipate, respond to, and recover from periods of excessive heat. The vision is "*By adopting the Heat Action Plan (HAP), Narayanganj aims to create a heat-resilient city where heat stress impacts are minimised through proactive measures, such as developing cooling centers, shaded spaces, and enhanced green infrastructure. This plan will also work with the CRCAP by strengthening the city's public health systems, improving disaster risk reduction efforts, and fostering community engagement to build a sustainable, adaptive urban environment*".

The plan aligns with national strategies, such as the Bangladesh National Adaptation Plan 2023-2050 and the Bangladesh Delta Plan 2100, contributing to the country's broader climate resilience goals. Its objectives include the establishment of early warning and communication systems, preparedness within urban public facilities, awareness building across communities, and the integration of heat adaptation into urban planning and development. By focusing on both immediate life-saving interventions and long-term resilience-building measures, the plan seeks to create a city that is better prepared to withstand and mitigate rising temperatures in the long run.

The development of the HAP for Narayanganj followed a structured and participatory methodology (Heat Resilience Toolkit, developed by ICLEI South Asia) that combined evidence, stakeholder input, policy alignment, and geospatial analysis. It began with inception meetings and stakeholder mapping to ensure broad participation and ownership, followed by a review of national and local policies to align the plan with existing frameworks. Secondary data on climate, environment, and demographics were analysed to produce LST, NDVI, NDWI, and NDBI maps alongside primary data collected through community surveys across all 27 wards, providing insights into lived experiences and vulnerabilities. This informed hotspot and vulnerability mapping, as well as a gap assessment that highlighted deficiencies in coordination, awareness, infrastructure, and health systems. City-specific heat thresholds were then defined to trigger timely responses, and strategies were formulated for short, medium, and long-term interventions, ranging from early warning systems and cooling infrastructure to community awareness and institutional strengthening. Draft strategies were validated through Shared Learning Dialogues (SLDs), fostering consensus and co-creation, before being finalised into an action plan for approval by NCC, ensuring a coordinated approach to heat risk reduction across sectors.

The evidence gathered during the preparation of the HAP reveals that heat stress is not uniform across the city but concentrated in particular wards and communities. Among the three administrative zones,

Narayanganj zone (Wards 10, 11, 12, 13, 14, 15, 16, 17, 18) is highly vulnerable, while Siddhirganj and Kadam Rasul zones show moderate vulnerabilities. Only Wards 9, 19, 24, and 25 show relatively low vulnerability, comprising less than 5% of the total population. Informal settlements, where residents live in poorly ventilated housing with limited access to clean water and electricity, are disproportionately affected. Outdoor workers such as rickshaw pullers, construction labourers, and factory employees face prolonged exposure to high temperatures, often without adequate protection. Children, elderly people, pregnant women, and individuals with chronic health conditions are also at elevated risk of heat-related illness. In addition to human vulnerability, the city's fragile urban systems, water supply, sanitation, transport infrastructure, and waste management are under increasing pressure during heat events, leading to compounding risks. These realities highlight the necessity of tailored interventions that address both the environmental drivers of heat and the social conditions that amplify its impacts.

The HAP outlines a strategic framework centred on prevention, preparedness, and resilience. A key pillar of the plan is the establishment of an early warning system for heatwaves. Linked with the Bangladesh Meteorological Department (BMD), this system will provide timely forecasts and alerts to city residents, enabling them to take protective measures before temperatures reach dangerous thresholds. Communication channels will include mobile phone messaging, community announcements, and engagement through schools, workplaces, religious centres, and local organisations. This system is intended to bridge the gap between climate information and actionable guidance for the people of Narayanganj.

The second major component of the plan focuses on strengthening the city's health systems. Hospitals, clinics, and community health centres will be equipped with protocols to identify, treat, and manage heat-related illnesses. Training programmes for doctors, nurses, and frontline workers will ensure timely recognition of symptoms such as dehydration, heat exhaustion, and heat stroke. Supplies such as oral rehydration salts, intravenous fluids, and cooling equipment will be stockpiled in anticipation of peak summer months. In parallel, outreach efforts will educate communities on basic first aid and hydration practices, so that families and neighbours are prepared to respond quickly when emergencies occur.

Beyond immediate preparedness, the plan recognises the importance of reducing structural drivers of heat vulnerability through long-term urban planning. Narayanganj has lost significant water bodies while built-up areas have increased without proper zoning, a trend that has worsened the city's heat stress. The HAP therefore emphasises the restoration and expansion of the blue-green network, the protection of water bodies, and the incorporation of cooling infrastructure such as shaded public spaces and community cooling centres. Urban design regulations encouraging heat-reflective roofing materials and better ventilation in buildings will play a central role in moderating temperatures at the neighbourhood scale. These interventions, combined with improved air quality monitoring and management, are expected to deliver co-benefits for health, environment, and quality of life.

The implementation of this HAP will depend on strong institutional coordination. Narayanganj City Corporation will lead the overall process, supported by health authorities, disaster management agencies, civil society organisations, urban community volunteers, and the private sector. The garment industries, construction sector, and transport operators, which employ large numbers of outdoor workers, need to be engaged to ensure that workplace safety standards address the risks of extreme heat. Partnerships with local NGOs and Community-based Organisations (CBOs) are essential in extending awareness and resources to the most marginalised groups. The plan also highlights the importance of collaboration with national agencies and international partners to secure the technical and financial support required for sustained action.

The expected outcomes of this HAP are both immediate and long-term. In the short term, residents of Narayanganj will benefit from timely warnings, better access to cooling facilities, and improved preparedness within the health system. Vulnerable populations will be prioritised for targeted support, reducing the number of heat-related deaths and illnesses during summer and pre-monsoon months. In the longer term, investments in green and blue infrastructure, climate-sensitive urban planning, and institutional strengthening will create a more liveable and resilient city. By embedding heat resilience into development planning, Narayanganj will also contribute to Bangladesh's commitments under global climate adaptation frameworks.

Effective implementation, regular monitoring, and periodic updates will be essential to ensure the success of this HAP. To this end, an institutional structure has been proposed, with the NCC at the helm, supported by designated focal points within relevant departments, including health, disaster management, urban planning, environment, and public works. The structure also emphasises coordination with external agencies, including national government bodies, meteorological services, civil society organisations, community groups, and the private sector, to ensure timely data sharing, resource mobilisation, and integrated action. Close collaboration across departments and stakeholders is critical not only for implementing interventions but also for achieving the intended outputs, and strengthened institutional resilience.

Table of Contents

List of Tables

List of Figures

List of Maps

1. Introduction

1.1. Background

Narayanganj City, located just 17 km southeast of Dhaka, is one of Bangladesh's most prominent industrial hubs. The city lies between latitudes 23°33′ and 23°57′ north and longitudes 90°26′ and 90°45′ east, along the banks of the Shitalakshya River. Narayanganj's strategic location and proximity to the capital have made it a key centre for commerce, textile production, and manufacturing.

The Narayanganj City Corporation (NCC) was formally established in 2011 through the amalgamation of three former municipalities – Narayanganj Sadar, Siddhirganj, and Kadamrasul – under the Local Government (City Corporation) Rules, 2010. With easy access to nearby markets, raw materials, and a skilled workforce, Narayanganj has grown into a thriving industrial centre with over 2,200 factories, mainly located along the Shitalakshya and Buri-Ganga rivers. Historically known as "The Dundee of the East" for its once-booming jute industry, the city continues to attract investment and labour, driving rapid population and infrastructure growth.

Narayanganj falls within the subtropical monsoon climate zone, characterised by hot, humid summers and relatively dry, mild winters. The summer season lasts from mid-April to mid-June, followed by the monsoon period extending into mid-October. Nearly 70–85% of the annual rainfall occurs during the monsoon, with July experiencing the highest precipitation (average 374 mm), while December remains the driest (5 mm on average). The average summer temperature in Narayanganj is approximately 29.4°C, with maximum temperatures often exceeding 34.7°C. Winters last from mid-December to mid-February, with January temperatures dropping as low as 13.4°C. These climatic patterns are becoming increasingly erratic and intense, exacerbated by global climate change, leading to more frequent and prolonged periods of heat.

Rapid and often unplanned urbanisation has significantly transformed Narayanganj's landscape. The dense network of roads, concrete buildings, and industrial installations has reduced natural cooling mechanisms and contributed to the formation of urban heat islands. Limited green spaces, rising energy consumption, and expansion of built-up areas further intensify heat, particularly in densely populated and industrial zones. The city has an estimated population of over 2 million residents spread across approximately 72.43 square kilometres, resulting in high population density and increased pressure on infrastructure and public services. Environmental degradation, deforestation, air and water pollution, and inadequate solid waste management exacerbate these challenges, making urban populations increasingly vulnerable to heat.

The impacts of heat are not evenly distributed. Marginalised and low-income communities residing in informal settlements are disproportionately affected due to poor housing conditions, limited access to clean water, and unreliable electricity. Children, the elderly, pregnant women, and outdoor workers – particularly in the informal and industrial sectors – face heightened risks of heat-related illnesses, including heat exhaustion, heat stroke, and dehydration. Public health systems in Narayanganj are often overstretched and under-resourced, limiting their capacity to respond effectively to climate-induced health emergencies. Addressing these vulnerabilities requires integrating climate adaptation measures into regular urban planning and development activities.

Bangladesh is globally recognised as one of the most climate-vulnerable countries, and cities like Narayanganj exemplify this vulnerability through pressures on water supply, solid waste management, air and water quality, transport systems, and public health. The effects of climate change – rising temperatures, prolonged heat, and shifting rainfall patterns – are further intensified by rapid urban

growth, poor planning, and institutional fragmentation. Recognising these challenges, a Climate Resilient City Action Plan (CRCAP) was prepared for NCC in 2021 through a comprehensive Climate Risk and Vulnerability Assessment (CRVA), laying the groundwork for integrating climate resilience into urban development, infrastructure, and public service delivery.

Given the convergence of climatic stress, urban pressure, and socio-economic vulnerability, there is a compelling need for a comprehensive Heat Action Plan (HAP) for Narayanganj City. This plan seeks to build resilience against the growing threat of heat by implementing preventive and responsive strategies aimed at protecting public health, strengthening infrastructure, and safeguarding livelihoods. Key areas of focus include reducing heat-related health risks through early warning systems and health system preparedness; protecting vulnerable populations by ensuring access to cooling centres, shaded areas, and safe water sources; and promoting sustainable urban planning that integrates green infrastructure and heat-reflective materials. In addition, the HAP emphasises raising public awareness, enhancing institutional capacity across government and industry stakeholders, and fostering data-driven decision-making and multisectoral coordination for effective long-term heat management. This initiative aligns with both national and global priorities on climate adaptation, sustainable urban development, and public health resilience, forming part of a broader strategy to address the escalating urban impacts of climate change in Bangladesh.

1.2. Objectives

To build a heat-resilient city, the HAP focuses on strategic interventions to minimise public health risks, enhance emergency response, integrate adaptation into urban planning, and strengthen stakeholder capacity and collaboration. The specific objectives of this plan are:

1. **Identify** targeted interventions and programmes to minimise public health risks from heat
2. **Prioritise** protective measures for vulnerable groups
3. **Establish** institutional mechanisms to enhance implementation and improve the city's ability to respond effectively to heat emergencies, ensuring timely assistance to affected communities
4. **Integrate** heat adaptation strategies into urban planning to mitigate the urban heat island effect and strengthen citywide resilience
5. **Ensure access** to emergency support services to reduce heat-related impacts
6. **Enhance awareness**, capacity, and partnerships among stakeholders to improve understanding of heat risks and promote proactive adaptation measures

1.3. Vision

By adopting the Heat Action Plan (HAP), Narayanganj aims to create a heat-resilient city where heat stress impacts are minimised through proactive measures, such as developing cooling centers, shaded spaces, and enhanced green infrastructure. This plan will also work with the CRCAP by strengthening the city's public health systems, improving disaster risk reduction efforts, and fostering community engagement to build a sustainable, adaptive urban environment.

1.4. Existing Policies and Works

A comprehensive review of relevant national and local policies, plans, and strategic frameworks reveals strong alignment with the objectives of NCC's HAP. These policy instruments collectively emphasise the importance of climate resilience, urban adaptation, environmental sustainability, and the protection of vulnerable populations – core themes that the HAP seeks to operationalise at the

city level. From addressing urban heat stress through green and blue infrastructure to enhancing early warning systems and public health responses, the HAP integrates and localises broader policy directives. Moreover, local planning tools and assessments have provided critical data and strategic direction, enabling the HAP to prioritise interventions that are evidence-based, spatially targeted, and socially inclusive.

As part of this process, a set of relevant national and local policies was reviewed and listed to ensure coherence and alignment with existing frameworks. These policies serve as a foundation for shaping the HAP's strategic direction and for identifying institutional linkages critical for implementation.

Table 1: Relevant National and Local Policy Instruments Supporting HAP Development

Policies/Projects	Timeline	Relevancy with Heat Action Plan
National		
1. Bangladesh Delta Plan (BDP)	2100	Narayanganj's HAP aligns closely with the Bangladesh Delta Plan 2100 (BDP 2100) by directly addressing climate resilience in urban areas, focusing on heat stress mitigation through measures like cooling centers and heat-resilient infrastructure. It supports BDP 2100's integrated water resource management goal by restoring 26 canals and creating eco-parks along the Shitalakhya River to improve water flow and reduce urban heat island effects. The HAP addresses environmental sustainability, a key BDP 2100 target, by improving air quality monitoring and regulating emissions, critical in Narayanganj, where PM2.5 levels exceed WHO guidelines by four times, and 254 of 344 brick kilns operate illegally. It contributes to socio-economic goals by protecting vulnerable communities from heat-related illnesses and enhancing sustainable urban development, thereby supporting poverty reduction and inclusive growth. Overall, Narayanganj's HAP operationalises national climate strategies at the city level, reinforcing BDP 2100's vision for a resilient and prosperous delta region.
2. National Adaptation Plan (NAP)	2023-50	The HAP aligns with Bangladesh's National Adaptation Plan (NAP) 2023–2050 by addressing urban heat stress, identified in the NAP as a significant hazard in densely populated cities like Narayanganj.

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		It contributes to NAP's urban climate resilience goals by promoting green infrastructure and restoring 26 canals, supporting the NAP target of maintaining 25% green areas in urban zones. The HAP enhances infrastructure resilience through blue-green initiatives like eco-parks and riverfront restoration, reflecting the NAP's emphasis on climate-smart drainage and water management systems. It supports vulnerable populations - including the elderly, children, and low-income groups - through targeted health and resilience measures, directly echoing NAP's priority on social inclusion. The city's air quality monitoring system and public display of real-time data address NAP's call for improved urban air quality and climate-health integration. Developed in partnership with ICLEI South Asia, the HAP models NAP's directive for city-level climate action plans, contributing to Bangladesh's commitments under the Paris Agreement.
3. 8th Five-Year Plan	2020-25	**Urban Climate Resilience**: The 8FYP emphasises integrating environmental and climate change considerations into the growth strategy, paving the way for a green and climate-resilient development path. Narayanganj's HAP contributes to this by implementing measures to mitigate urban heat stress, including the development of green infrastructure and the restoration of water bodies. **Infrastructure Development**: The plan outlines the need for climate-smart infrastructure to support sustainable urbanisation. Narayanganj's initiatives to restore 26 canals and develop eco-parks along the Shitalakhya River align with this objective, aiming to enhance water flow, reduce urban flooding, and mitigate heat island effects.
4. Nationally Determined Contributions (NDCs), Bangladesh (Updated)	2021	**Urban Adaptation and Climate Resilience**: The NDC emphasises enhancing adaptive capacity and resilience in urban areas, particularly for vulnerable populations. Narayanganj's HAP addresses this by implementing measures to mitigate urban heat stress, such as developing

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		green infrastructure and restoring water bodies, thereby protecting the health and well-being of residents. **Emission Reduction Targets**: Bangladesh's updated NDC aims to unconditionally reduce greenhouse gas emissions by 27.56 $MtCO_2e$ (6.73%) and 61.9 $MtCO_2e$ (15.12%) conditionally by 2030 compared to business-as-usual scenarios. Narayanganj's Climate Resilient City Action Plan (2022-2027) contributes to these targets by proposing actions with an annual GHG emission mitigation potential of 12.6% by 2026-27 over the 2018-2019 baseline. **Integration of Local and National Climate Strategies**: The NDC underscores the importance of integrating local-level climate actions into national strategies. Narayanganj's HAP, developed with support from ICLEI South Asia, serves as a model for such integration, demonstrating how city-level initiatives can contribute to national climate goals and the commitments under the Paris Agreement.

Policies/Projects	Timeline	Relevancy with Heat Action Plan
5. National Climate Finance Mechanism - Bangladesh Climate Change Trust Fund (BCCTF)		**Urban Climate Resilience**: The BCCTF has financed over 850 projects with an investment of approximately USD 490 million, focusing on climate-resilient infrastructure and urban adaptation initiatives. Narayanganj's HAP, which includes measures like restoring water bodies and developing green spaces, complements these efforts by enhancing the city's resilience to extreme heat events. **Adaptation to Extreme Heat**: While specific BCCT funded projects in Narayanganj are not detailed in the available sources, the fund's emphasis on urban adaptation provides a framework that supports initiatives like the HAP, which aims to mitigate the impacts of rising temperatures on urban populations. **Integration with National Climate Strategies**: The BCCTF operates under the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), which outlines thematic areas such as food security, health, and infrastructure. Narayanganj's HAP aligns with these themes by addressing public health concerns related to heatwaves and improving urban infrastructure to better cope with climate-induced stresses. **Support for Vulnerable Populations**: Both the BCCTF and Narayanganj's HAP prioritise the protection of vulnerable groups, including the elderly, children, and low-income communities, by implementing targeted interventions to reduce heat-related health risks.
6. Bangladesh National Conservation Strategy (NCS)	2021-36	The Bangladesh National Conservation Strategy (NCS) 2021 – 2036 aligns with the HAP by focusing on sustainable urban development, ecosystem conservation, and climate resilience. The NCS encourages the integration of green infrastructure, including urban forests and wetlands, into city planning to mitigate urban heat island effects and enhance biodiversity. It also highlights the significance of preserving natural water bodies and promoting nature-based solutions to address climate-related challenges. These strategic priorities support the objectives of the HAP, which seeks to reduce heat-related

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		vulnerabilities through the implementation of green spaces, improved urban planning, and community awareness programs. By aligning with the NCS, Narayanganj's HAP contributes to national aims of environmental conservation and climate adaptation, promoting a comprehensive approach to urban resilience.
7. The Bangladesh Health-National Adaptation Plan (HNAP)	2018	The Bangladesh Health-National Adaptation Plan (HNAP) provides a strategic framework for addressing climate-induced health risks associated with extreme heat events, aligning with the development of Narayanganj's HAP. HNAP emphasises the need for climate-resilient health systems through components such as vulnerability assessments, integrated risk monitoring, early warning systems, and emergency preparedness, which are integral to the HAP's objectives. By enhancing the capacity of healthcare infrastructure and workforce, HNAP supports the HAP's goal of protecting vulnerable populations, including the elderly, children, and low-income groups, from heat-related health issues. In addition, HNAP promotes community-based health adaptation and public awareness campaigns, which are crucial for the effective implementation of heat mitigation strategies in Narayanganj. This alignment promotes a cohesive approach to managing heat-related health risks, strengthening both national and local efforts to enhance climate resilience.
Local		
1. Climate Resilient City Action Plan (CRCAP)	2021-26	Narayanganj's HAP is directly aligned with its CRCAP, serving as a targeted implementation of the broader climate resilience strategies outlined in the CRCAP. The CRCAP, developed under the Urban-LEDS II project with support from ICLEI South Asia, identified heat stress as a significant and escalating risk for the city due to climate change. In response, the HAP was formulated to address this specific challenge, focusing on mitigating heat-related impacts on vulnerable populations such as the elderly, children, and low-income communities.

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		The HAP builds upon the CRCAP's comprehensive vulnerability assessments and urban systems analyses, translating strategic objectives into actionable measures like establishing early warning systems, enhancing green infrastructure, and improving urban planning to reduce heat islands. This alignment ensures that the HAP not only addresses immediate heat-related concerns but also contributes to the city's long-term vision of sustainable, low-carbon, and climate-resilient urban development as envisioned in the CRCAP.
2. Climate Risk and Vulnerability Assessment (CRVA)	2019-24	**Identification of Vulnerable Areas**: The CRVA pinpointed specific wards, such as Wards 01, 09, 12, 13, 15, 20, 23, and 24, as hotspots for climate vulnerability, particularly concerning sanitation, water quality, and solid waste management. This granular mapping informed the HAP's targeted interventions in these high-risk zones. **Urban Systems Analysis**: The assessment highlighted five fragile urban systems – air quality, water, sanitation and wastewater, solid waste, and transport- susceptible to climate-induced stresses like increased temperatures and decreased rainfall. The HAP incorporates measures to bolster these systems against heat-related impacts. **Stakeholder Engagement**: The CRVA process involved Shared Learning Dialogues (SLDs) with local stakeholders, fostering a participatory approach that ensured the HAP's strategies are community-informed and context-specific. **Integration into Broader Climate Strategies**: Insights from the CRVA were instrumental in shaping Narayanganj's CRCAP, which encompasses the HAP as a critical component addressing extreme heat events.
3. Narayanganj City Corporation Action Area Plan (AAP)	2016	**Infrastructure Development**: The AAP emphasises enhancing municipal services, including improving drainage systems and road networks along the Shitalakshya River. These are critical for reducing urban heat islands and facilitating efficient heat mitigation strategies.

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		Urban Planning and Land Use: By outlining specific land use policies and zoning regulations, the AAP facilitates the incorporation of green spaces and urban forestry, essential components of the HAP aimed at lowering ambient temperatures and improving air quality. **Population and Demographic Considerations**: The AAP provides detailed demographic data, including population density and distribution, enabling the HAP to identify and prioritise vulnerable communities most susceptible to heat-related health issues. **Integration with Climate Resilience Initiatives**: The AAP's focus on sustainable urban development complements the CRCAP objectives, ensuring that the HAP is integrated into broader efforts to enhance the city's resilience to climate change.
4. Multi-Hazard Contingency Plan	2018	The Multi-Hazard Contingency Plan (MHCP) of NCC serves as a foundational framework that aligns closely with the development of the HAP, ensuring a comprehensive approach to disaster preparedness and response. The MHCP, developed with technical assistance from the Asian Disaster Preparedness Center (ADPC) and support from Save the Children International, emphasises strengthening city-level first responder agencies, establishing effective coordination mechanisms, and enhancing the city's capacity to manage various hazards, including those exacerbated by climate change. Given that extreme heat events are becoming more frequent and severe due to global warming, the HAP builds upon the MHCP's objectives by specifically addressing heat-related risks. It incorporates strategies such as early warning systems, public awareness campaigns, and targeted interventions for vulnerable populations, complementing the MHCP's broader disaster management goals. This alignment ensures that Narayanganj's approach to urban resilience is holistic, integrating general and specific hazard preparedness

Policies/Projects	Timeline	Relevancy with Heat Action Plan
		measures to safeguard the health and well-being of its residents.

1.5. Methodology

The development of the HAP is grounded in the findings of the comprehensive CRVA conducted for Narayanganj in 2020. The CRVA highlighted a consistent rise in annual temperatures across the NCC area, resulting in significant environmental and public health challenges. These include increased demand on water supply, intensified pressure on limited groundwater resources, higher concentrations of pollutants in surface and groundwater sources, and elevated risks of waterborne and heat-related illnesses among residents. Rapid industrialization and urban expansion have further exacerbated urban heat, contributing to elevated air pollution, the loss of water bodies, and increased exposure of communities to heat stress.

The methodology for the HAP integrates these findings with spatial analysis, stakeholder consultations, and evidence-based assessments to identify heat-vulnerable zones, critical urban systems at risk, and population groups most exposed to heat. This approach ensures that proposed interventions are targeted, locally relevant, and designed to enhance both immediate preparedness and long-term resilience across the city.

The CRVA also identified that multiple urban systems are highly fragile under heat-related climate stress:

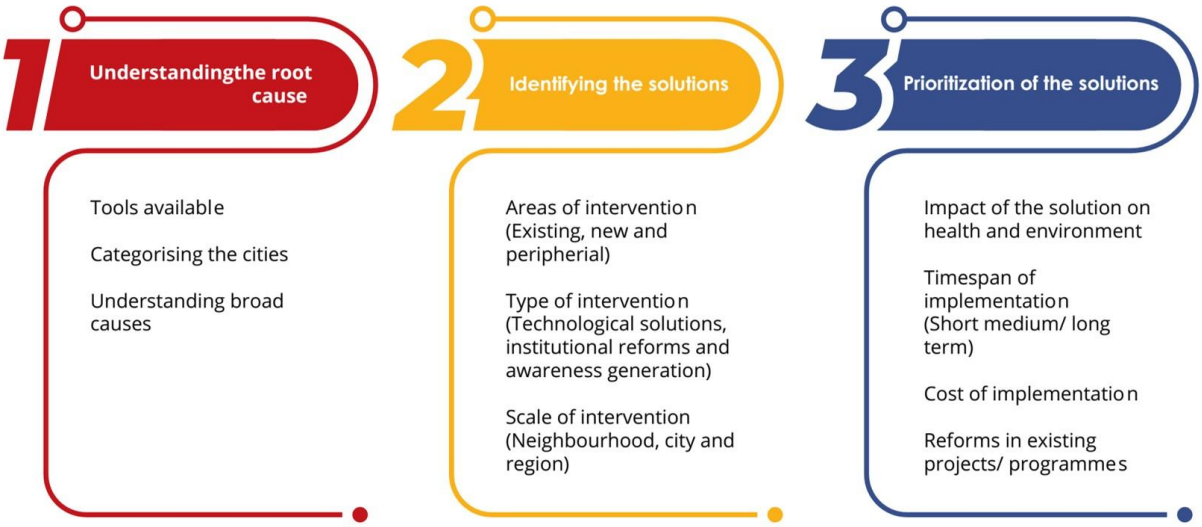
- Air quality is at high risk, as higher temperatures increase atmospheric stagnation and accelerate photochemical reactions, worsening smog and respiratory health risks. Dust and particulate matter from roads, vehicles, and industrial activities are less dispersed during hot periods.
- Water supply and quality is at high risk, as higher temperatures increase ground water scarcity, evaporation and water temperatures, concentrating pollutants and promoting pathogen growth in both surface and groundwater. This intensifies the risk of waterborne diseases.
- Sanitation and wastewater systems are at high risk, as higher temperatures increase microbial activity in untreated wastewater, intensifying odors and pathogen spread. Heat also reduces the effectiveness of sanitation systems, increasing the risk of diarrheal and vector-borne diseases.
- Transport infrastructure faces high risk, as prolonged high temperatures soften asphalt and degrade road surfaces, increasing maintenance needs. Commuters and workers are exposed to prolonged sun and elevated air pollution in congested areas.
- Solid waste management is at high risk, as higher temperatures accelerate the decomposition of organic waste, generating foul odors, attracting disease vectors, and creating micro-heat islands. Waste accumulation during hot periods can compound health risks.

Most notably, the assessment emphasised that heat stress disproportionately impacts vulnerable populations in Narayanganj – such as low-income groups, outdoor workers, elderly residents, and children - worsening their exposure and limiting their adaptive capacity.

In response to these findings, NCC has prioritised the development of a comprehensive Heat Action Plan, aimed at enhancing climate resilience by introducing urban heat mitigation strategies that safeguard vulnerable communities. The plan is aligned with the National Adaptation Plan (NAP) 2023–

2050, which identifies extreme heat as a major climate threat to public health and the national economy.

To guide this process, NCC has adopted City Heat Resilience Toolkit, a structured and participatory methodology developed under the Climate and Development Knowledge Network's (CDKN) Knowledge Accelerator Project. This toolkit provides an integrated approach for assessing vulnerabilities, formulating evidence-based heat action plans, and implementing nature-based and adaptive solutions, such as urban greening and reflective infrastructure. Emphasising inclusive governance and stakeholder engagement, the methodology supports cities in embedding climate resilience into urban planning to safeguard communities, reduce economic disruptions, and improve environmental sustainability.



Source: City Heat Resilience Toolkit

Figure 1: City Heat Resilience Planning Process

The toolkit considers a three-step method for achieving heat resilience in cities. These steps and the relevant readings, references, and case studies provide a package to manage heat stress. The steps are as follows:

Step 1: Understanding The Root Causes of Heat Stress: This step involves identifying the factors contributing to heat stress in Narayanganj through a heat vulnerability assessment, combining analytical tools and contextual research. Spatial and temporal analyses, including Land Surface Temperature (LST) mapping and urban heat pattern assessment, are conducted alongside evaluation of vegetation and water bodies using indices such as NDVI, NDBI, and NDWI. Ward-wise heat variability analyses further highlight areas experiencing higher heat exposure. These assessments are complemented by secondary research on national heat stress trends to understand broader climatic and environmental influences. From this analysis, three major causes of heat stress in the city have been identified: (i) the expansion of impervious surfaces and built-up areas, which restrict natural airflow, intensifying urban heat; (ii) heat generated from human activities such as industrial operations, transportation, and air conditioning; and (iii) insufficient green cover and water bodies, which limits natural cooling, evapotranspiration, and heat absorption.

Step 2: Identifying the Solutions: This step outlines the key considerations for developing a set of potential solutions to address heat stress in Narayanganj. Solutions are assessed across three dimensions: area, type, and scale. Areas of intervention cover the entire city as well as specific heat-

impacted hotspots or wards. Types of intervention include heat stress reduction measures, governance and data management structures, and awareness-building programmes designed to enhance skills for heat resilience. The scale of interventions is considered at the neighbourhood, city, and regional levels. Potential solutions include early warning systems, pre-event preparedness measures, and emergency actions tailored to different stages of heat alerts. Sustainable heat-resilient strategies are planned across short-term (0 - 1 year), medium-term (1 - 3 years), and long-term (3+ years) horizons, incorporating both structural and non-structural actions adapted to local conditions.

Step 3: Prioritisation of Solutions: After identifying the key heat-related issues and potential interventions, prioritisation was carried out using multiple criteria. These include the intervention's impact on vulnerable groups, such as the elderly, children, outdoor workers, and low-income communities – the timeframe for implementation, cost and resource efficiency, scalability, and alignment with existing programmes or policies. Interventions were also evaluated based on their potential to address citywide heat challenges and hotspot areas effectively. The prioritised solutions are then compiled into a comprehensive action table, outlining the implementation area, type of intervention, heat issues addressed, tentative costs, implementing agencies, potential funding sources, and key performance indicators. This structured approach ensures efficient allocation of resources, strategic sequencing of interventions, and the simultaneous implementation of short, medium, and long-term actions to reduce heat-related risks in Narayanganj.

To operationalise the City Heat Resilience Toolkit and tailor it to the local context of Narayanganj, the following step-wise methodology was followed in developing NCC's HAP:

1.	Inception and Stakeholder Mapping
2.	Literature Review and Policy Mapping
3.	Secondary Data Analysis
4.	Primary Data Collection
5.	Hotspot and Vulnerability Mapping
6.	Gap Assessment
7.	Heat Threshold Determination
8.	Strategy Development
9.	Validation and Shared Learning Dialogues (SLD)
10.	Finalisation of HAP

Source: ICLEI South Asia

Figure 2: Step-wise Methodology for HAP Development in NCC

Inception and Stakeholder Mapping: The process began with a series of inception meetings and consultations to establish a shared understanding of the objectives and scope of the HAP. Key stakeholders were identified, including representatives from city authorities, health departments,

disaster management agencies, academia, community-based organisations, and climate experts. This mapping exercise ensured broad-based participation, fostered early ownership of the plan, and helped define roles and responsibilities for each group.

Literature Review and Policy Mapping: A detailed review was conducted of relevant national and local policies, climate strategies, development plans, and scientific literature. The aim was to ensure alignment of the HAP with existing legal and policy frameworks such as the National Adaptation Plan (NAP) 2023–2050 and to identify overlaps, gaps, and entry points for urban heat resilience strategies. This helped in grounding the HAP in both evidence and policy relevance.

Secondary Data Analysis: Climatic, environmental, and socio-demographic data were collected and analysed to understand heat stress patterns in Narayanganj. This included trends in LST, population density, land use changes, and infrastructure distribution. The analysis provided a historical and spatial understanding of heat-related risks, supporting the identification of priority areas and vulnerable groups.

Primary Data Collection: To complement secondary data, primary data was collected through a ward-level community survey across all 27 wards of the city. Using structured questionnaires via Google Forms, residents shared their experiences with extreme heat, health impacts, existing coping mechanisms, and access to services. This grassroots perspective was crucial in identifying context-specific vulnerabilities and adaptive capacities.

Hotspot and Vulnerability Mapping: Using a combination of secondary and primary data, geographic heat hotspots and socially vulnerable zones were mapped. Factors such as high LST, dense built-up areas, low green coverage, poor housing conditions, and concentration of outdoor workers were considered. This mapping enabled targeted strategy development for the most at-risk populations and areas.

Gap Assessment: An assessment was carried out to identify systemic gaps in responding to heat stress and to understand the institutional readiness and financial capacities for effective action. These gaps included deficiencies in institutional coordination, absence of early warning protocols, lack of public awareness, limited infrastructure for cooling, inadequate health response mechanisms, and constraints in funding and resource allocation. The gap analysis informed the priority areas for intervention in the HAP.

Heat Threshold Determination: Heat thresholds for Narayanganj have been established using climatological data, occupational exposure risks, social vulnerability indicators, and citizen feedback, with epidemiological tools like Distributed Lag Non-Linear Models (DLNMs) assessing delayed health impacts. Composite heat stress indices such as the Heat Index (HI) and Wet Bulb Globe Temperature (WBGT) capture real-world exposure, particularly in densely populated, industrial, and informal settlement areas.

Strategy Development: Based on the findings, a comprehensive set of interventions to be formulated under short, medium, and long-term timeframes. These include improvements in forecasting and warning systems, climate-resilient infrastructure (e.g., cool roofs, tree planting), urban planning measures (e.g., zoning regulations), community awareness campaigns, and institutional capacity building.

Validation and Shared Learning Dialogue (SLD): Draft strategies and findings to be shared with stakeholders and the public through SLDs. These inclusive, participatory workshops enabled the team

to validate data, gather feedback, and co-create solutions. The dialogues also helped build consensus on priority actions and enhanced stakeholder commitment.

Finalisation of HAP: Incorporating inputs from the SLDs and expert reviews, the final HAP to be developed with a detailed action matrix. The finalised HAP will be presented for approval at the NCC council meetings. Once endorsed, the plan will serve as a guiding document for coordinated heat risk reduction across sectors.

2. Heat Stress Analysis for Narayanganj

2.1. Understanding Heat Stress in Narayanganj

To understand the heat stress in Narayanganj, city topography, temperature and precipitation variations, humidity profile, climate vulnerable hotspots, past heat waves, and the Urban Heat Island (UHI) effect have been analysed. Each of these factors plays a critical role in shaping the city's exposure and sensitivity to extreme heat. The topography of Narayanganj influences local microclimates and drainage patterns, while climatic trends related to temperature, rainfall, and humidity determine the overall heat burden. Mapping vulnerable hotspots helps identify areas and populations at greatest risk, and understanding the history of past heat waves sheds light on patterns and impacts. Furthermore, the UHI effect – exacerbated by rapid urbanisation and lack of green infrastructure – intensifies ambient temperatures in built-up areas.

2.1.1. City Topography and Environmental Features

Narayanganj City, located in central Bangladesh within the Greater Dhaka region, exhibits a distinct topography shaped by its riverine geography and alluvial plains.

Elevation: The city's elevation ranges from -4 meters (-13 feet) in low-lying areas near riverbanks and floodplains to a maximum of 22 meters (72 feet) in urbanised or slightly upland zones. The average elevation is approximately 6 meters (20 feet) above sea level. This results in a total altitude range of 26 meters, reflecting a predominantly flat to gently undulating terrain[1].

Geographic Features: Narayanganj, located at the confluence of the Shitalakshya and Dhaleswari Rivers, tributaries of the Meghna River, is part of a dynamic floodplain ecosystem shaped by sediment deposits and seasonal flooding. The region within the Ganges-Brahmaputra-Meghna Delta consists of predominantly flat alluvial plains with minor elevation variations influenced by river meanders. Much of the district is classified as a meander floodplain, experiencing frequent rainwater-induced flooding. Meanwhile, areas near major rivers, particularly the Shitalakshya, receive fresh silt deposits during the monsoon season[2].

Flood Risk and Hydrology: Narayanganj's low-lying terrain includes approximately 48.56 km² (18.75 sq mi) of water-dominated areas, making it highly susceptible to waterlogging and flood risks. The city's tropical savanna climate intensifies seasonal flooding, as heavy monsoon rains frequently overwhelm drainage systems. While the Dhaka-Narayanganj-Demra (DND) embankment protects

[1] https://en-gb.topographic-map.com/map-fz59kl/Narayangonj-district/
[2] Water supply and management department, NCC

against river flooding in certain areas, urban drainage challenges persist, contributing to recurrent water management issues[3].

Urban and Industrial Impact: Rapid industrialisation, including jute mills and shipyards, along with urbanisation, has significantly altered Narayanganj's natural topography, with wetland encroachment and the filling of water bodies reducing natural flood buffers. The city's low elevation further heightens its vulnerability to sea-level rise and riverbank erosion, particularly in Siddhirganj and Bandar zones[4].

Soil and Vegetation: Narayanganj's alluvial soils, rich in silt and clay, are well-suited for agriculture but tend to retain water, contributing to flooding risks. Urbanisation has significantly reduced natural vegetation, though riverbanks and rural areas still support mangroves and wetland-adapted grasses. Industrial pollution has led to declining fish populations in rivers like the Shitalakshya, though migratory birds occasionally inhabit the region's remaining wetland areas.

2.1.2. Climate Profile

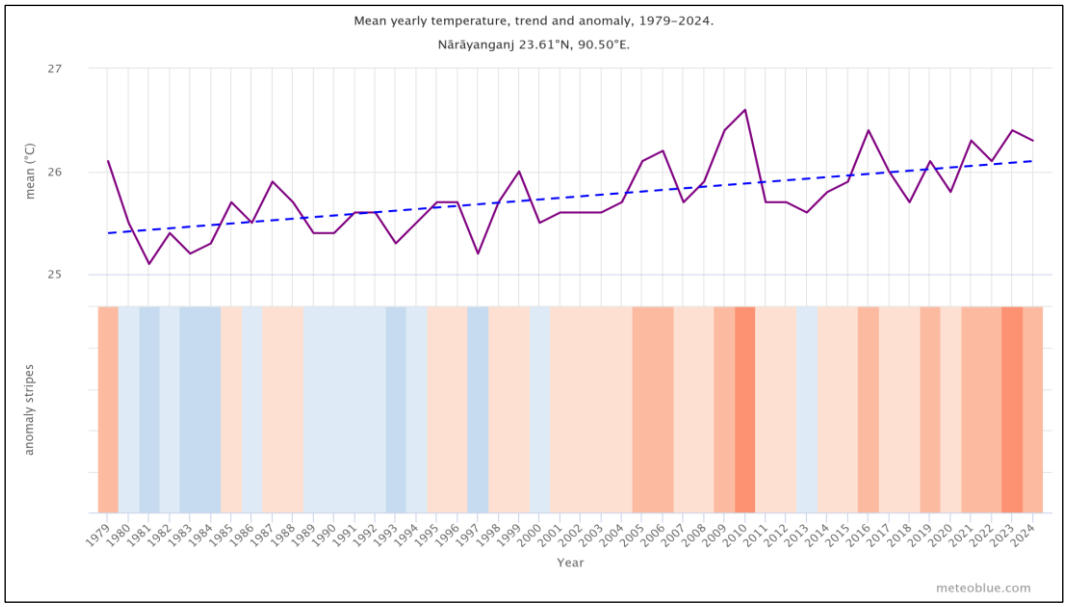
The climate data presented here – including historical simulations and recent trends – provide critical insights into how the local climate is evolving. Rising average temperatures, shifting precipitation patterns, and increasing frequency of extreme heat and rainfall events all influence the risks faced by the city's residents, infrastructure, and ecosystems. These changes affect not only the intensity and occurrence of heat stress but also water availability, urban flooding, and overall environmental health. By closely examining temperature anomalies, rainfall variability, and daily extremes, planners and decision-makers can prioritise interventions in heat action planning and disaster risk reduction, tailoring responses to the specific climatic realities of Narayanganj. Such evidence-based understanding ensures that adaptation efforts are timely, targeted, and effective in safeguarding public health and urban resilience.

Temperature

The following figures illustrate these trends in detail: mean annual temperature and its climate change trend; annual precipitation variations; monthly temperature and precipitation anomalies compared to historical averages; as well as monthly extremes in daily maximum and minimum temperatures, and the frequency of hot days, cold nights, and precipitation events.

[3] Bashar, K. (2024). Scope of Induced Recharge to River Bank Aquifers in Bangladesh. In: Saha, D., Villholth, K.G., Shamrukh, M. (eds) Managed Groundwater Recharge and Rainwater Harvesting. Water Resources Development and Management. Springer, Singapore. https://doi.org/10.1007/978-981-99-8757-3_18

[4] https://www.britannica.com/place/Narayanganj

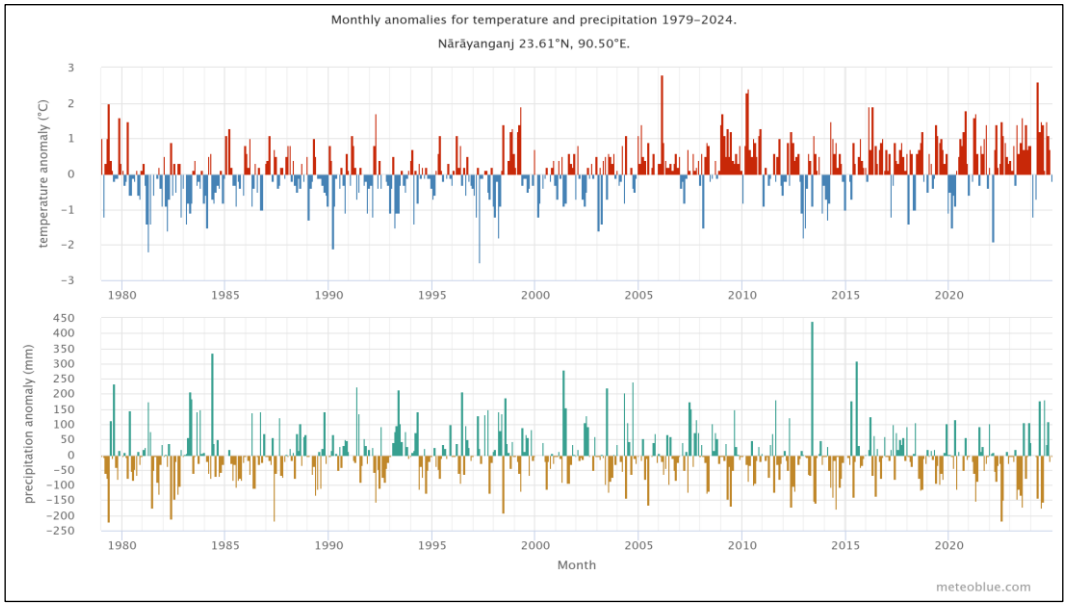


Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 3: Mean Yearly Temperature, Trend and Anomaly, 1979-2024

The graph (Figure 3) above estimates the mean annual temperature for Narayanganj and its surrounding region. The dashed blue line represents the linear climate change trend, illustrating how the average temperature has evolved over time. If the trend line rises from left to right, it indicates that temperatures in Narayanganj are steadily increasing due to the impacts of climate change. A horizontal trend line would suggest no significant change, while a declining trend would indicate cooler conditions over time.

In the lower part of the graph (Figure 3), the warming stripes visually represent the temperature for each year, with blue indicating colder years and red indicating warmer years. This visual tool highlights the growing frequency of hotter years in Narayanganj. Understanding these temperature trends is critical in guiding the urgency and prioritisation of heat resilience interventions in Narayanganj.

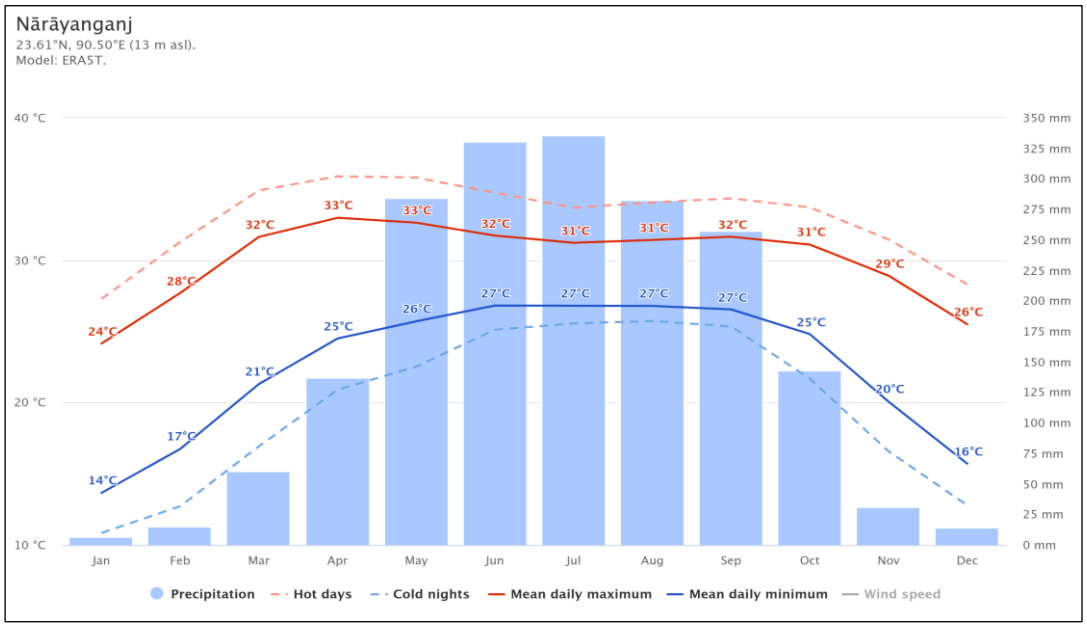


Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 4: Monthly Anomalies for Temperature and Precipitation, 1979-2024

The top graph (Figure 4) presents the temperature anomaly for each month from 1979 to the present, indicating how much the temperature deviated from the 30-year climate mean (1980 - 2020). Red months represent periods when temperatures exceed the historical average, while blue months reflect cooler temperatures. Over time, an increasing number of warmer months is visible, highlighting the trend of rising temperatures associated with global warming and climate change. This shift is significant for Narayanganj, underscoring the growing risk of extreme heat events.

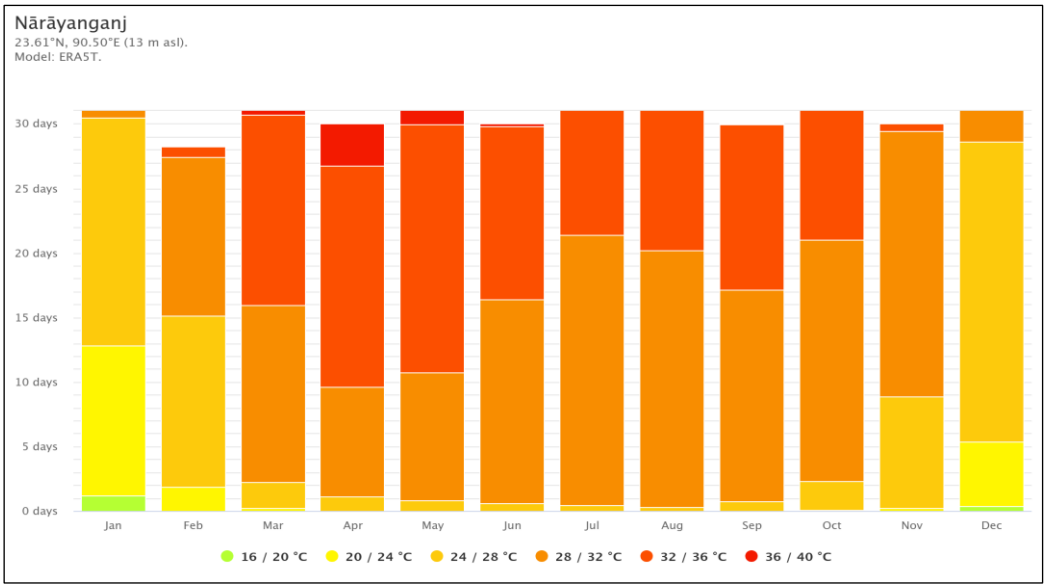
The lower graph (Figure 4) shows the precipitation anomaly for each month over the same period. This data reveals whether each month received more or less rainfall than the 30-year climate mean (1980 - 2020). Green months indicate wetter conditions, while brown months signify drier periods. Monitoring these trends is crucial for understanding how changing precipitation patterns may exacerbate the impacts of heat stress, especially in terms of water availability, urban heat island effects, and flood risks.



Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 5: Mean Daily Maximum and Minimum Temperatures, and Average Hottest and Cold Days

The "mean daily maximum" (solid red line) (Figure 5) represents the highest average temperature recorded each month for Narayanganj. Similarly, the "mean daily minimum" (solid blue line) illustrates the average of the lowest monthly temperatures. The "hot days" and "cold nights" (dashed red and blue lines) show the monthly averages of the hottest day and the coldest night over the past 30 years.



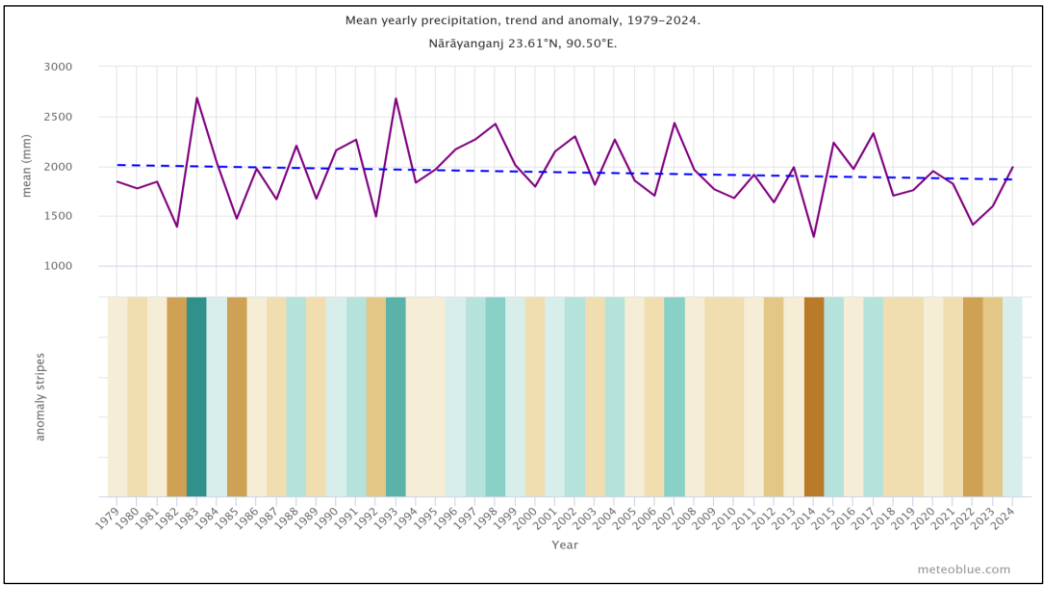
Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 6: Days with Maximum Temperatures

The maximum temperature diagram (Figure 6) for Narayanganj displays how many monthly days reach certain temperatures.

Precipitation

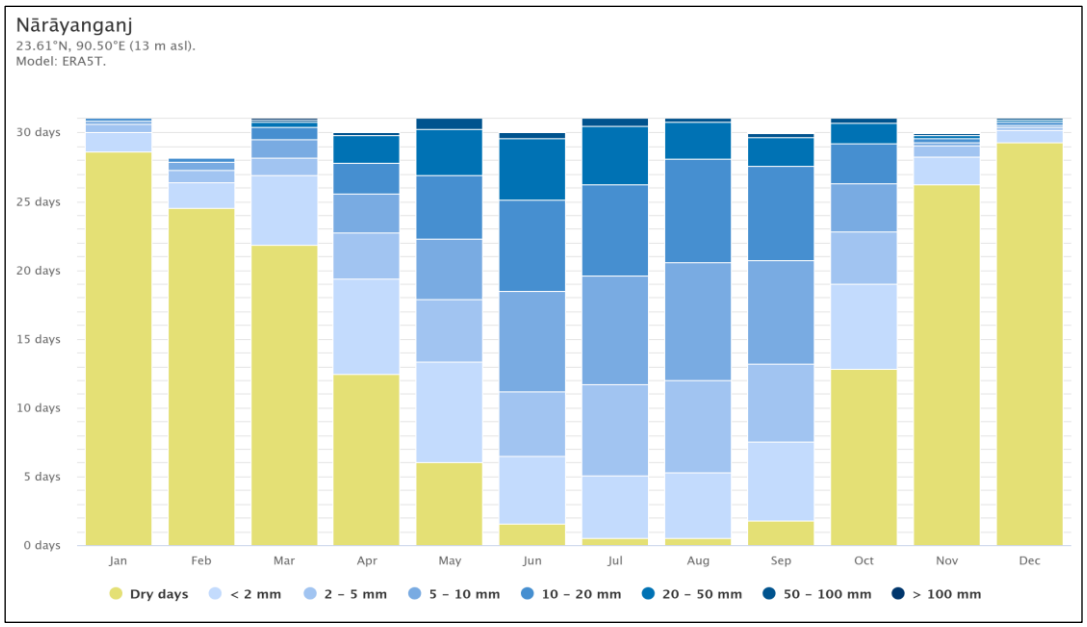
The graph (Figure 7) below estimates the total annual precipitation mean for Narayanganj and its surrounding region. The dashed blue line represents the linear climate change trend, highlighting how precipitation patterns have evolved. If the trend line rises from left to right, it suggests that Narayanganj is experiencing increased rainfall due to climate change, leading to wetter conditions. A horizontal trend line would indicate no apparent shift in precipitation, while a declining trend would signal drier conditions over time.



Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 7: Mean Yearly Precipitation, Trend and Anomaly, 1979-2024

In the lower part of the graph (Figure 7), the precipitation stripes visually illustrate the annual variations in precipitation, with green indicating wetter years and brown indicating drier years. These trends are essential for understanding the broader climate context in Narayanganj, as changes in precipitation patterns can exacerbate the challenges of heat stress.



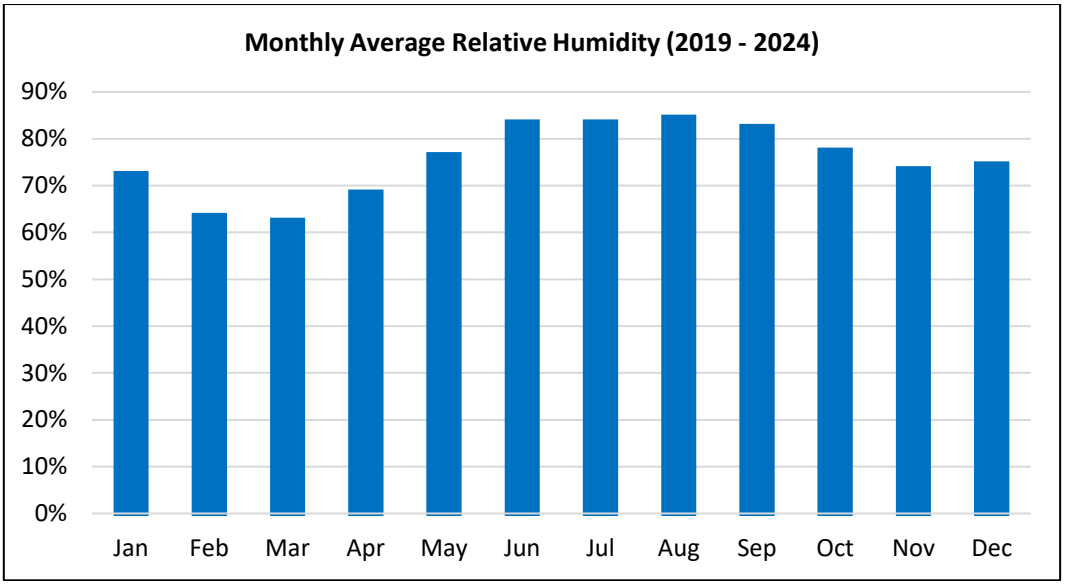
Source: Simulated historical climate and weather data for Nārāyanganj - meteoblue

Figure 8: Days with Precipitation

The precipitation diagram (Figure 8) for Narayanganj shows how many days per month specific precipitation amounts are reached.

Humidity

The relative humidity in Narayanganj (Figure 9) displays distinct seasonal variation throughout the year. Humidity is lowest during the pre-monsoon months of February and March (around 62 - 63%) and begins to rise in April as the monsoon season approaches. The highest humidity levels are observed between June and August (reaching up to 84%), coinciding with the peak monsoon period. Afterward, humidity remains high in September and October before declining slightly during the winter months.



Source: https://www.nearweather.com/location/1185155, BMD

Figure 9: Monthly Relative Humidity (2019-2024)

The winter and early spring months (November to January) experience moderately high humidity levels (around 72 - 74%), offering relatively comfortable atmospheric conditions.

Seasonal humidity patterns can be illustrated in two distinct periods:

1. **Dry Season (November – April):** During this period, average humidity ranges from 62% to 74%, providing relatively comfortable and less oppressive conditions.
2. **Monsoon Season (May – October):** Humidity significantly increases, ranging between 76% and 84%, often creating heavy and uncomfortable atmospheric conditions.

2.1.3. Climate Vulnerable Hotspots from NCC's CRCAP

Based on the CRVA, several neighborhoods within NCC have been identified as climate-vulnerable hotspots where heat-related impacts are particularly acute. These vulnerabilities stem from rising temperatures, decreased precipitation, and the compounded effects of rapid urbanisation and industrial activity.

Table 2: Climate Vulnerable Hotspots in Narayanganj

Parameter	Existing Vulnerability	Relation to Heat Sensitivity
Air Quality	High dust and particulate matter from road dust, vehicle emissions, and industrial processes (cement factories, cotton mills, garment industries, Export Processing Zones-EPZ). High-vulnerability wards include 12, 18, 19 – 27, 15 – 17, and 6.	Higher temperatures reduce atmospheric dispersion of pollutants, leading to stagnation and higher concentrations of particulate matter. Heat also accelerates photochemical reactions, increasing smog formation and exacerbating respiratory health risks for residents in these wards.
Water Supply and Quality	Severe contamination in Bandar region (Wards 19 – 27), Siddirganj, DND area, and parts of Wards 6, 8, 10, 13 due to industrial/domestic effluents and excessive groundwater use.	Rising temperatures increase water demand, placing additional stress on already limited groundwater resources. Higher heat elevates water temperatures and concentrates pollutants in surface and groundwater sources, while warmer conditions promote pathogen growth, increasing the risk of waterborne diseases. Groundwater scarcity combined with heat-driven demand can restrict the availability of safe drinking water, intensifying pressure on the city's water supply system.
Sanitation and Wastewater	Poor systems in DND area (Wards 1 – 3, 7 – 9), Bihari Colony (Ward 6), Shantinagar (Ward 23), Ward 20, and areas without soak wells like Nurbagh (Ward 18) and Rasulbagh (Ward 27).	Higher temperatures increase microbial activity in untreated wastewater, intensifying odors and pathogen proliferation. Heat stress can reduce the effectiveness of existing sanitation systems, increasing public health risks, especially in dense settlements and informal areas.
Solid Waste Management	Medium vulnerability in Mission Para (Ward 12) and Paikpara (Ward 17), where poor disposal and sudden rains cause drain blockages and waterlogging.	High heat accelerates decomposition of organic waste, increasing foul odors and pest infestations. Waste piles on hot days attract disease vectors and can create local heat pockets (micro-heat islands). Combined with blocked drains, even short heavy rains can lead to high-risk health conditions.
Transportation	Extreme vulnerability in Signboard –Chasara corridor (Wards 1, 2, 9, 11 –13), high traffic Wards 8 – 10, 14 – 16, 18, and BB Road/rail crossings (Wards 14 – 15) with 3 – 4 hours of average daily congestion.	Prolonged heat softens asphalt and other road materials, increasing maintenance needs and causing surface damage. Commuters and workers are exposed to extended periods under direct sun, elevating heat stress. Heat-intensified smog further reduces air quality, compounding health and mobility risks.

2.1.4. Past Heat Waves

Past heat waves have been analysed and documented here (Table 3) to understanding the frequency, intensity, and impacts of extreme heat in Narayanganj. Such records help identify vulnerable populations, sectors, and regions that are disproportionately affected, and reveal patterns that can inform future preparedness and response strategies. By learning from previous occurrences, policymakers and planners can develop targeted heat action plans to mitigate health risks, manage resource shortages, and reduce economic losses – particularly in critical areas like health, agriculture, education, and infrastructure. Moreover, detailed documentation supports community awareness and strengthens institutional capacity to handle upcoming heat emergencies more effectively. The following table highlights some of the significant heat wave events in recent years, outlining their impacts on people and key sectors in Narayanganj and its surrounding regions.

Table 3: Past Heat Waves in Narayanganj

Year	Type of Impacts	Impacted Areas	Impacted People
2024 (21-24 April)	• **Health:** Significant increase in heat-related illnesses, including heatstroke, dehydration, and respiratory issues. Hospitals, such as Mugda Medical College and Hospital, reported a surge in patients, particularly among children and the elderly[5]. • **Education:** Closure of all government primary schools until April 27, affecting over 33 million children nationwide[6]. • **Agriculture:** Severe damage to crops like chilies, pulses, sunflowers, almonds, and rice, leading to anticipated yield reductions[7]. • **Water Scarcity:** Depletion of water reservoirs causes shortages in drinking water and affects daily activities.	NCC and the surrounding regions	• Children, the elderly, and individuals with pre-existing health conditions. • Farmers have faced crop failures and livestock losses. • Urban residents have experienced water shortages and health risks.
2023 (June-July)	• **Health:** Rise in cases of heat exhaustion and heatstroke. Hospitals observed an influx of patients with heat-related ailments • **Education:** Closure of primary schools due to extreme temperatures.	NCC and the surrounding regions	• Children, the elderly, and individuals with pre-existing health conditions. • Farmers have faced crop

[5] https://www.dhakatribune.com/bangladesh/348941/extreme-weather-bangladesh-bears-brunt-of-severe
[6] https://www.unicef.org/bangladesh/en/press-releases/children-are-high-risk-amid-countrywide-heatwave-bangladesh
[7] https://www.downtoearth.org.in/climate-change/unusual-heat-scorches-bangladesh-as-april-s-consecutive-heatwave-breaks-76-year-record-96034

Year	Type of Impacts	Impacted Areas	Impacted People
	• **Energy:** Frequent power cuts resulting from increased electricity demand and fuel shortages, leading to the shutdown of several power plants. • **Agriculture:** Adverse effects on rice and fruit production, with estimates suggesting up to a 40% reduction in rice yields[8].		failures and livestock losses. • Urban residents have experienced water shortages and health risks.
2022 (19-20 July)	• Health: Increased instances of heat-related illnesses, including dehydration and heatstroke. • Energy: Strain on the power grid due to heightened use of cooling systems, potentially leading to power outages. • Water Scarcity: Elevated demand for water resources stresses existing supply systems.	NCC and the surrounding regions	• Urban residents, particularly those in densely populated neighborhoods. • Individuals with limited access to cooling and water resources.

2.2. Heat Vulnerability Assessment

2.2.1. Spatiotemporal Analysis of Land Surface Temperature (LST) and Urban Heat Patterns

To further understand the urban heat exposure in Narayanganj, an in-depth analysis of LST was conducted using both Landsat 8 Thermal Infrared Sensor (30 m resolution) and MODIS MOD11A1 LST products (1 km resolution). This dual-satellite approach enabled high-resolution urban heat island mapping alongside seasonal and interannual trend detection, covering a comprehensive nine-year period from 2015 to 2024.

The analysis applied radiometric calibration and atmospheric correction through the Single-Channel algorithm (Landsat) and Generalised Split-Window algorithm (MODIS), validated against ground station data. This revealed extreme heat events, including peak LSTs during:

- March 2020 (42.3°C)
- March – May 2021 (up to 43.1°C)
- March 2022 (41.8°C)
- April – May 2023 (43.6°C)
- September 2023 (unseasonal 40.2°C), and
- April 2024 (42.9°C)

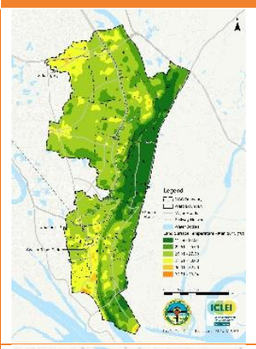
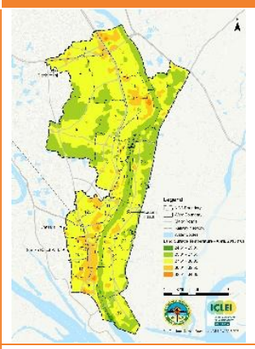
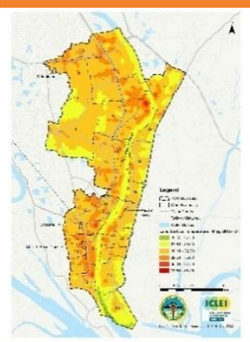
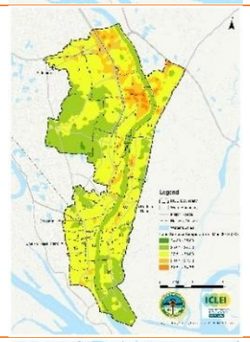
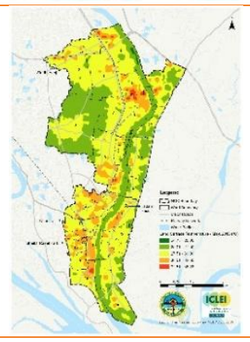
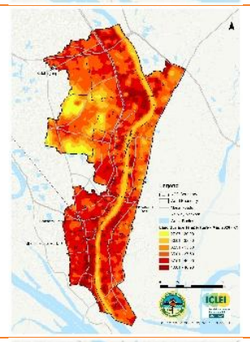
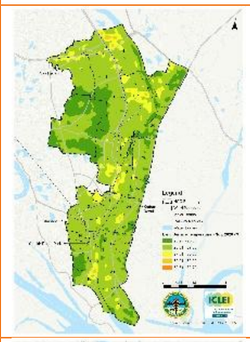
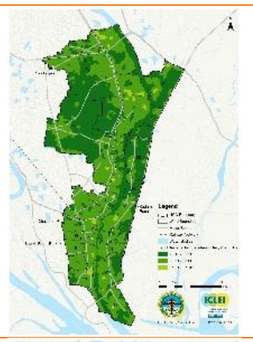
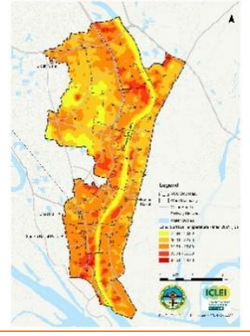
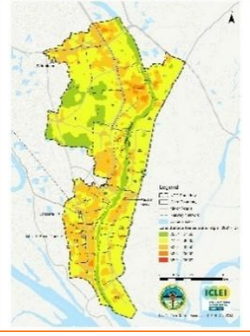
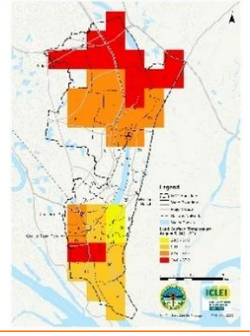
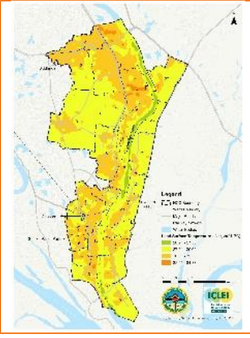
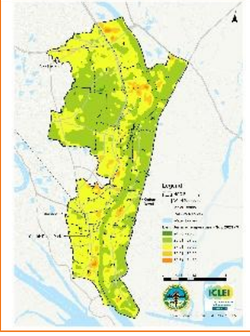
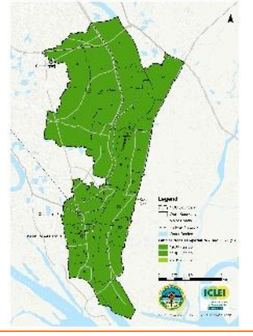
These periods closely aligned with official heatwave alerts from the Bangladesh Meteorological Department and featured urban core LST anomalies of 5 – 7°C above the decadal average.

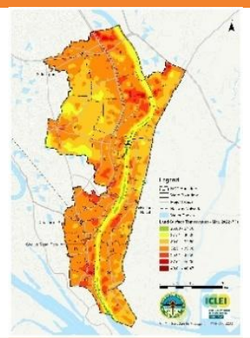
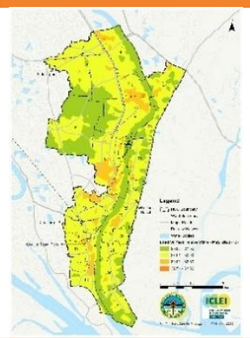
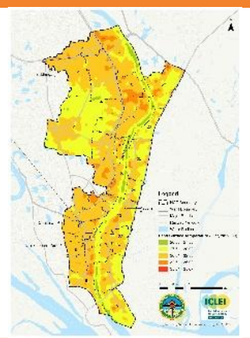
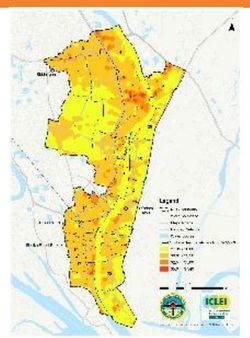
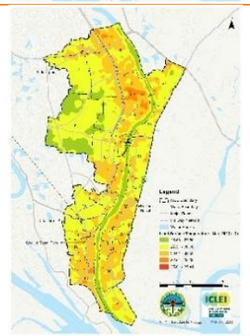
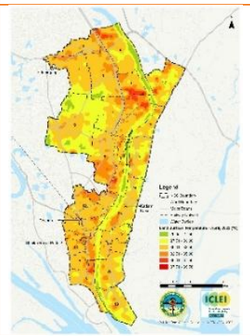
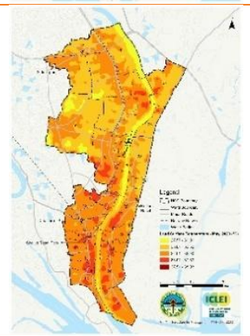
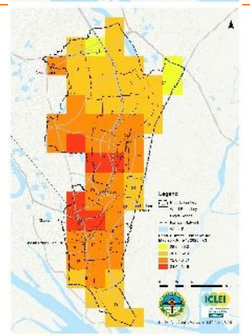
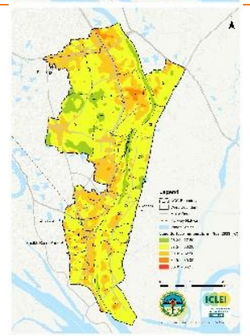
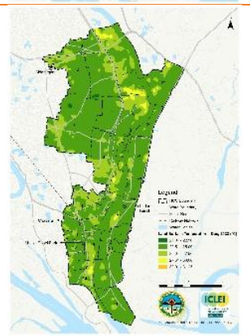
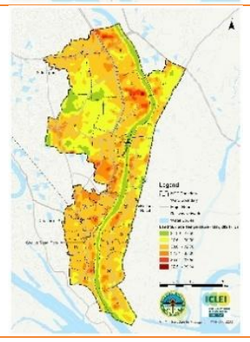
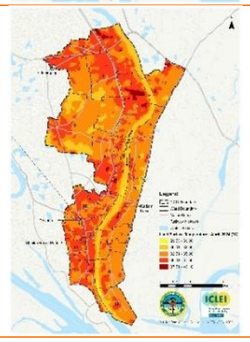
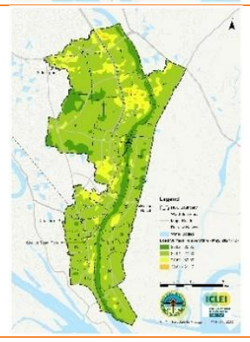
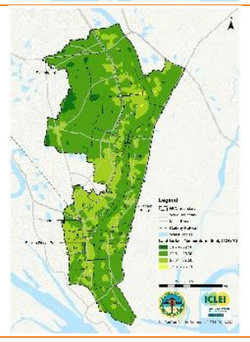
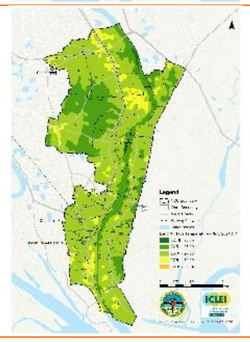
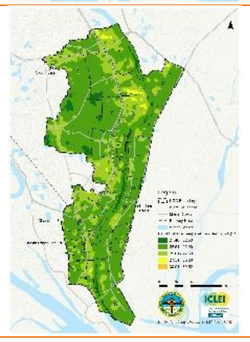
[8] https://en.wikipedia.org/wiki/2023_Asia_heat_wave

The following LST maps (Map 1) illustrate stark urban-rural gradients, with industrial zones (e.g., Narayanganj Export Processing Zone) and dense informal settlements emerging as persistent thermal hotspots. In contrast, riverfronts and green parks exhibited lower surface temperatures – by 3–5°C – due to evaporative cooling. These patterns affirm the UHI effect and indicate that areas with limited vegetation and high built-up density are most vulnerable to extreme heat.

The presence of recurring heatwaves during pre-monsoon months (March – May) aligns with regional climate trends. However, the anomalous spike in September 2023 suggests a shifting heat profile potentially tied to delayed monsoons or rapid land-use changes. These findings offer critical evidence for shaping localised early warning systems and targeting high-risk zones with adaptation measures such as urban greening and cooling shelters.

Map 1: Spatiotemporal Variation of Land Surface Temperature (2015–2024)

Year	March	April	May	September	November	December
2015						
2018						
2020						
2020						
2021						

Year	March	April	May	September	November	December
2022						
2023						
2024						

Source: USGS, ICLEI South Asia

Summary of LST Spatiotemporal Trends (2015 – 2024):

The spatiotemporal analysis of LST in Narayanganj from 2015 to 2024 across key months (March, April, May, September, November, December) reveals a notable warming trend, with increasing LST levels during pre-monsoon and post-monsoon periods, particularly in April and May. The temperature changes appear more concentrated in urbanised and industrially dense zones.

March – May (Pre-monsoon)

- 2015 – 2018: Moderate LST values, with peri-urban green cover showing relatively cooler patches.
- 2020 – 2023: Substantial rise in LST, particularly in core wards (Wards 3, 4, 5, 6 7, 10. 11, 12, 13, 14, 15, 16, 17, 18, 22, and 23), indicating increased urban heat island (UHI) effects.
- 2024: Highest recorded LSTs, with Wards 1, 3, 4, 5, 6, 11 – 18, and 23 exceeding 38°C in some locations.

September (Monsoon end)

- Lesser variation across years; however, 2023 – 2024 data show reduced post-monsoon cooling, likely due to persistent urban heating and lower vegetation regeneration.

November – December (Winter transition)

- Typically, lower LSTs across all years, but December 2023 – 2024 shows warmer wintertime LSTs than previous years, pointing to changing seasonal thermal behaviour.

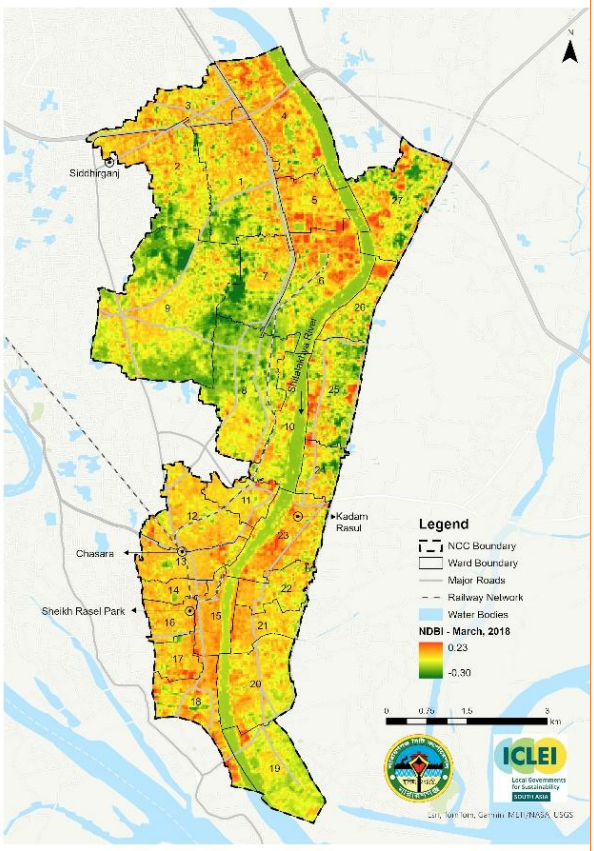
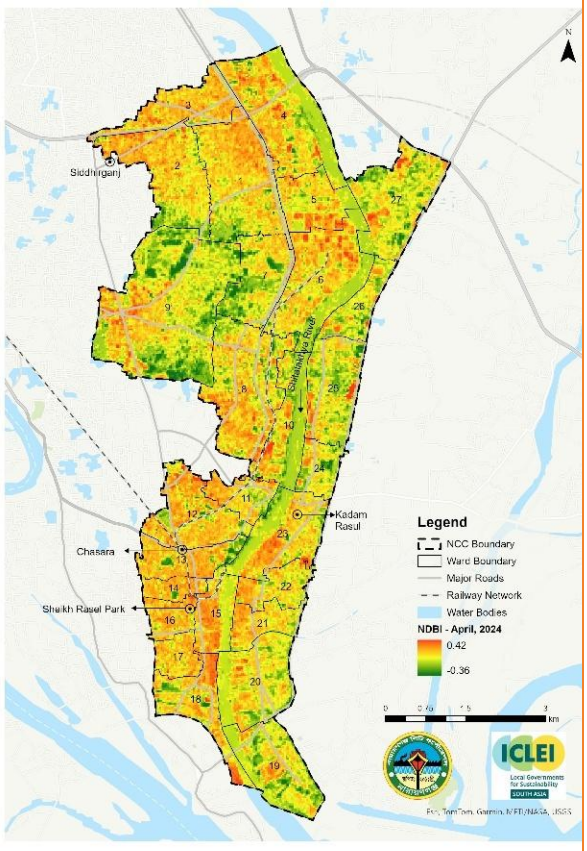
2.2.2. Changes in Vegetation Cover and Water Bodies

Rapid urbanisation has significantly transformed Narayanganj city's natural landscape, replacing green and blue spaces with impervious built-up areas. This transformation is quantitatively assessed through remote sensing indices such as the Normalised Difference Built-up Index (NDBI), Normalised Difference Vegetation Index (NDVI), and Normalized Difference Water Index (NDWI). NDBI highlights the extent of built-up expansion, while NDVI measures the density and health of vegetation, and NDWI detects the presence of water bodies. Comparative analysis of these indices from 2018 to 2024 reveals a sharp increase in built-up surfaces and a corresponding change in vegetation cover and surface water, both parameters are important for moderating urban temperatures. The loss of natural water bodies contributes significantly to the intensification of the Urban Heat Island (UHI) effect and heightens the city’s vulnerability to heat stress. The extent of these changes, as described in Section 2.2.1, is illustrated through the comparative NDBI and NDVI maps provided below (Maps 2, 3, 4).

The years 2018 and 2024 were selected for this assessment to capture the changes in Narayanganj’s urban landscape and environmental conditions over a significant period aligned with key climate action milestones. Between 2018 and 2021, Narayanganj developed its CRCAP and conducted a comprehensive CRVA, establishing a baseline understanding of the city’s climate vulnerabilities and adaptive capacities. By comparing data from 2018 with that of 2024, six years later, this analysis evaluates the effectiveness of interventions, monitors ongoing urban development, and identifies emerging trends in built-up expansion, vegetation cover, and water bodies. This timeframe enables a meaningful examination of how climate risks – particularly heat stress – have evolved following the implementation of strategic climate resilience efforts.

The extent of built-up expansion in Narayanganj has been assessed using the NDBI, a remote sensing tool that helps identify and quantify built-up areas in satellite imagery. NDBI is calculated using the reflectance values from the Near-Infrared (NIR) and Shortwave Infrared (SWIR) bands. Its values range from -1 to 1, with higher values indicating a greater concentration of built-up surfaces. The comparison between NDBI maps from 2018 and 2024, as illustrated in Map 2, highlights a significant increase in built-up areas across the city, underscoring the rapid pace of urban expansion and its contribution to rising heat stress.

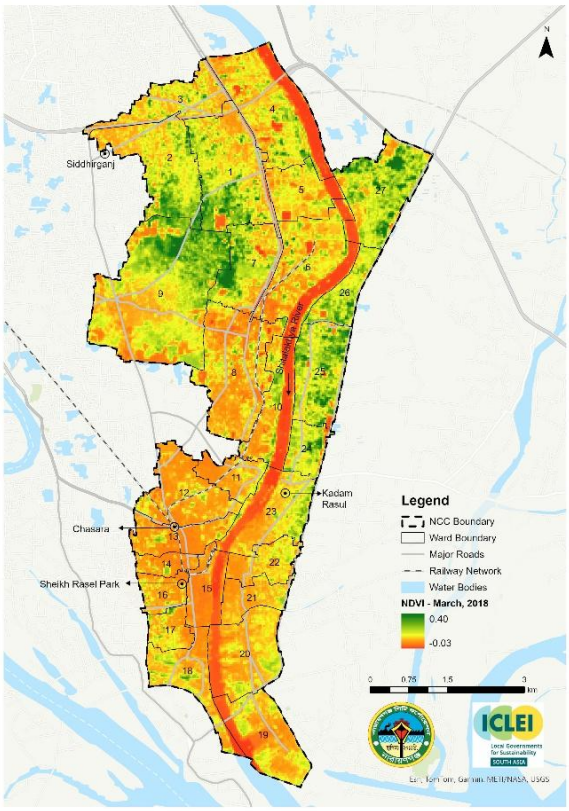
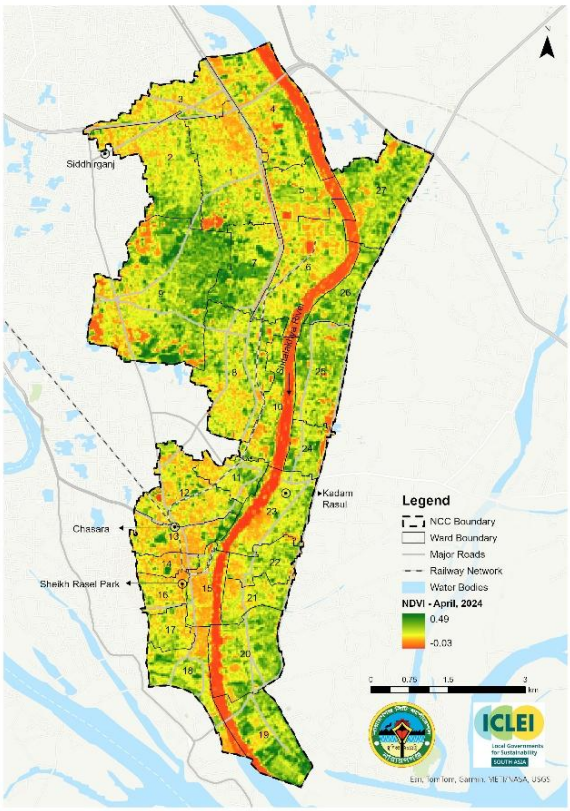
Map 2: Comparative NDBI Map of Narayanganj (2018 vs. 2024)

NDBI (2018)	NDBI (2024)
	

Source: USGS, ICLEI South Asia

The change in vegetation cover in Narayanganj has been assessed using the NDVI, a widely used remote sensing metric for evaluating vegetation health and density. NDVI is calculated by measuring the difference between the reflectance of near-infrared (NIR) and red light from vegetation, using satellite imagery. The index ranges from -1 to +1, where negative values (close to -1) typically indicate water bodies or non-vegetated surfaces such as rock, sand, or built-up areas, while positive values (close to +1) reflect healthy, dense vegetation. The comparative NDVI maps from 2018 and 2024, as illustrated in Map 3, show an 11% increase in green cover; however, this gain appears insufficient to counterbalance the ongoing expansion of concrete structures, the reduction of natural water bodies, and the resulting rise in continuous heat exposure, particularly in certain areas of the city.

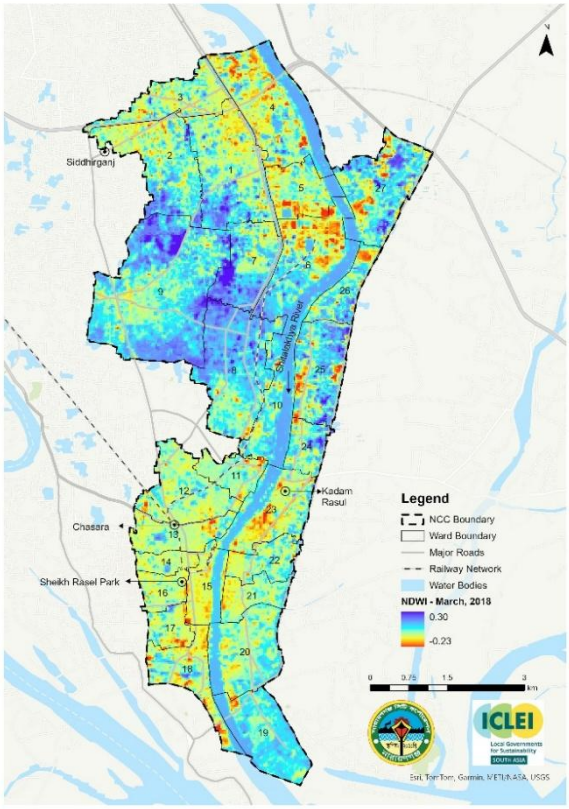
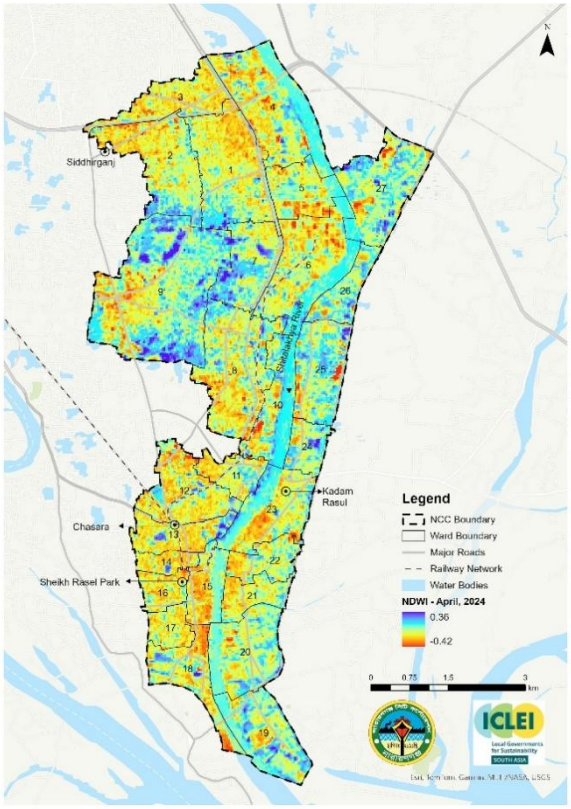
Map 3: Comparative NDVI Map of Narayanganj (2018 vs. 2024)

NDVI (2018)	NDVI (2024)
	

Source: USGS, ICLEI South Asia

The presence and extent of water bodies in Narayanganj have been assessed using the NDWI, a remote sensing tool designed to identify and monitor surface water. NDWI is calculated using the green and near-infrared (NIR) bands from satellite imagery, where higher values indicate greater water content. This index is particularly useful for distinguishing water from vegetation and other land features, making it valuable for applications such as drought monitoring, flood detection, and water resource management. The typical NDWI formula is (Green - NIR) / (Green + NIR), where water bodies generally exhibit higher values (usually above 0.5) due to their light absorption and reflection characteristics. The comparative NDWI maps from 2018 and 2024, as illustrated in Map 4, indicate a clear reduction in water bodies, further contributing to Narayanganj's increased vulnerability to heat stress. Around 17% water bodies have been reduced from 2018 to 2024.

Map 4: Comparative NDWI Map of Narayanganj (2018 vs. 2024)

NDWI (2018)	NDWI (2024)
	

Source: USGS, ICLEI South Asia

Summary of NDVI, NDBI, and NDWI:

The ward-wise spatial vulnerability analysis of Narayanganj highlights the intricate interplay between urban growth, vegetation dynamics, and the degradation of natural cooling systems, all of which influence the city's exposure to heat stress. The Normalised Difference Vegetation Index (NDVI) comparison from 2018 to 2024 reveals an overall increase in greenery, particularly in Wards 2, 7, 9, 11, 18, 19, 20, 24, 25, 26, and 27, indicating some progress in urban greening initiatives. Importantly, no ward experienced a decline in vegetation, suggesting a city-wide effort towards enhancing green cover.

However, despite this gain, the Normalised Difference Built-up Index (NDBI) shows a significant increase in built-up areas across all wards, particularly in Wards 3, 4, 5, and 22 – densely populated zones where new construction and impervious surfaces have intensified the urban heat island effect.

In contrast, the Normalised Difference Water Index (NDWI) highlights a substantial reduction in surface water bodies in Wards 1, 2, 7, 9, 21, and 22. At the same time, only minor increases are observed in Wards 11, 12, 19, and 20, reflecting continued pressure on natural hydrological buffers. These spatial patterns suggest that while greening has improved in several peripheral and semi-urban areas, core urban wards with increased construction activity remain highly vulnerable to heat stress due to inadequate green space and diminishing water resources.

To address this, ward-specific adaptation strategies should focus on protecting and expanding green infrastructure, rejuvenating waterbodies – especially in the most affected wards —promoting heat-reflective building materials, and regulating urban expansion with a focus on sustainable and climate-resilient planning, particularly in Wards 3, 4, 5, 10, 11, 12, 13, 15, 16, and 21.

2.2.3. Urban Heat Island Effect

Narayanganj is experiencing the urban heat island (UHI) effect, where city temperatures are 2 – 4°C higher than those in surrounding rural areas, especially during summer and heatwaves. This phenomenon is primarily driven by unplanned urbanisation, rapid industrial growth, and inadequate land use management. Over the past decade, dense clusters of concrete structures, paved roads, and metal-roofed factories have replaced green spaces and agricultural land, notably in areas such as Fatulla, Siddhirganj, and Bandar. These heat-retaining surfaces absorb warmth during the day and release it slowly at night, contributing to elevated urban temperatures. The significant reduction of trees and water bodies, including encroachment on the banks of the Shitalakshya River, has further limited the city's natural cooling capacity.

Poor ventilation in many tin-roofed homes within low-income and informal settlements exacerbates indoor heat exposure. The UHI effect is linked to growing public health concerns, including increased cases of heatstroke, dehydration, and fatigue – particularly among outdoor workers, children, and the elderly. In addition, electricity demand rises due to higher use of fans and air conditioning, causing frequent power outages. Productivity in the garment and logistics sectors is also impacted as workers face challenging conditions in the heat.

2.2.4. Ward Wise Heat Variability and Hotspots

The ward-wise heat vulnerability assessment in Narayanganj combined satellite-derived LST data with built-up and vegetation indices (NDBI and NDVI), surface water extent (NDWI), and socio-economic factors. Using high-resolution Landsat 8 and MODIS imagery from 2015 to 2024, spatial and temporal heat patterns were identified alongside urban land cover and water body changes. Demographic and infrastructure data – including population density, housing conditions, and access to services—were incorporated to evaluate adaptive capacity. A composite vulnerability score, reflecting exposure (heat intensity and built environment), sensitivity (natural cooling elements), and adaptive capacity, categorised wards into Most Vulnerable, Moderately Vulnerable, and Less Vulnerable groups. Persistent heat hotspots were identified in industrial zones and densely populated informal settlements with limited vegetation and water bodies, highlighting areas of elevated heat stress and reduced resilience. This comprehensive approach supports targeted climate adaptation and resource allocation planning in Narayanganj.

Wards with consistently higher LST readings, elevated built-up density, reduced green cover, and limited water bodies were classified as highly vulnerable due to increased heat exposure and diminished natural buffering. Socio-economic factors such as high population density, prevalence of informal settlements, and industrial activity – particularly garment and dyeing factories—were also considered, as they influence both heat exposure and residents' coping capacity.

Wards 3, 4, and 5 emerge as the most vulnerable, experiencing intense urban heat island effects driven by high population density, poor infrastructure, and minimal vegetation. Wards 6 and 8 similarly show high vulnerability due to their compact urban form, industrial concentration, and socio-economic challenges. In addition, Wards 10 to 18 and 23 demonstrate considerable vulnerability, as these central wards face a combination of heat-amplifying factors like dense construction and insufficient adaptive infrastructure. Despite relatively lower population density, these wards struggle with low

tree cover, limited public services, and inadequate climate-resilient infrastructure, reducing adaptive capacity.

In contrast, peripheral Wards such as 9, 19, 24, and 25, characterised by increased green space, fewer built-up areas, and less industrial pressure, are comparatively less vulnerable to heat stress.

This overall spatial pattern underscores the urgent need for targeted interventions in the most at-risk wards, especially those experiencing both high heat exposure and limited coping capacity.

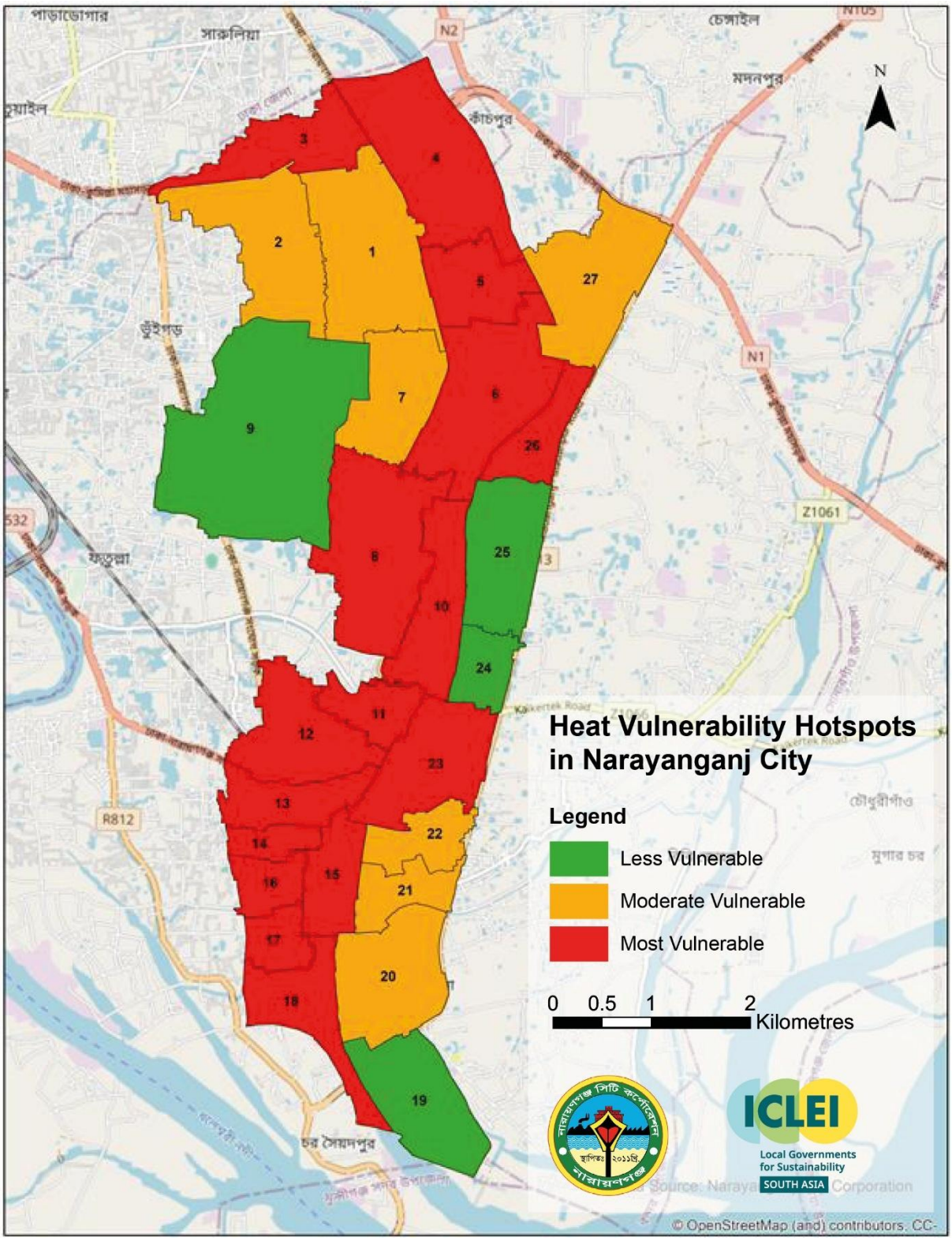
Heat Hotspots

Detailed mapping confirms that industrial zones such as the Narayanganj EPZ and densely populated informal settlements consistently register the highest land surface temperatures. These hotspots coincide with areas of intense built-up cover, scarce vegetation, and limited water bodies, exacerbating localised heat stress. Riverfront areas and urban parks exhibit comparatively cooler conditions due to evaporative cooling effects, emphasising the importance of preserving and expanding green and blue infrastructure to mitigate extreme heat exposure in vulnerable wards.

Table 4: Ward-Wise Vulnerability Summary

Status of Vulnerability	Wards	Percentage of population
Less Vulnerable	9, 19, 24, and 25	4.9%
Moderate Vulnerable	1, 2, 7, 20, 21, 22, and 27	15.7%
Most Vulnerable	3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 23	79.4%

Map 5: Heat Vulnerability Hotspots in Narayanganj City



Source: USGS, ICLEI South Asia

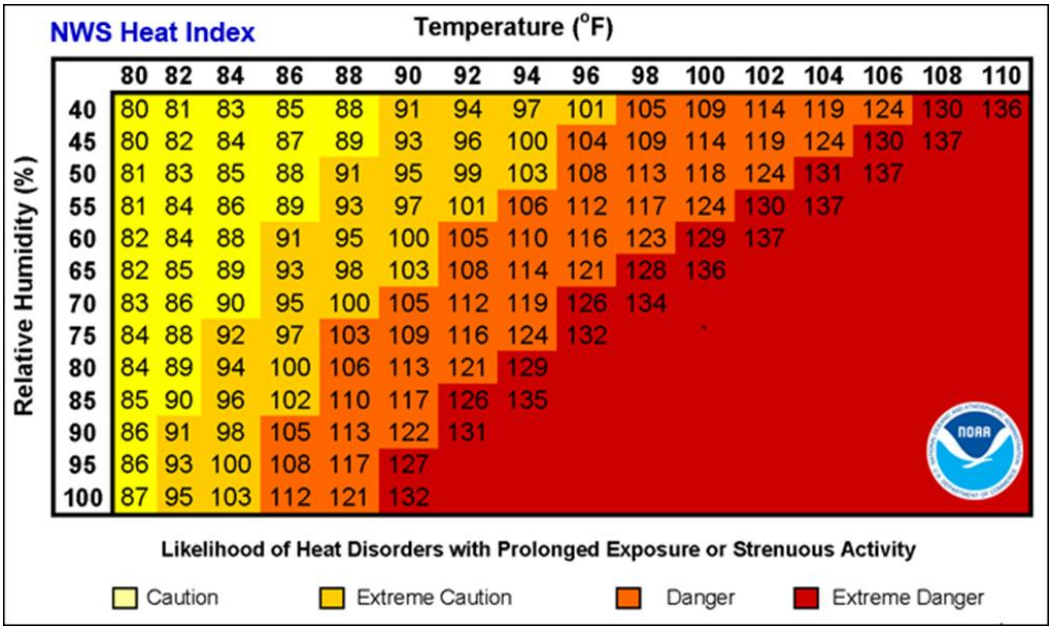
2.3. Heat Threshold for Narayanganj

Defining appropriate heat thresholds for Narayanganj involves integrating climatological data, occupational exposure risks, and social vulnerability indicators. As climate change intensifies extreme heat events, NCC must establish localised heat thresholds that can trigger early warning systems and adaptive measures to safeguard public health and labor productivity.

To determine critical temperature points, epidemiological tools like Distributed Lag Non-Linear Models (DLNMs) are often employed. These allow us to assess the delayed health impacts of rising temperatures – such as heat-related illnesses, hospitalisations, or mortality spikes, and identify thresholds at which interventions are most needed.

For cities like Narayanganj, densely populated, highly industrialised, and burdened with informal settlements – traditional temperature readings alone are insufficient. Instead, composite heat stress indices such as the Heat Index and Wet Bulb Globe Temperature (WBGT) are more appropriate. These indicators combine multiple variables (temperature, humidity, wind speed, solar radiation) to reflect actual human heat stress, particularly in outdoor or industrial settings.

The Heat Index chart (Figure 10) by the U.S. National Weather Service (NWS) serves as a critical tool for public health officials and city managers to issue heat warnings and guide behavior during heatwaves. For instance, a Heat Index of 40°C (104°F) or above often corresponds to conditions of "Danger" or "Extreme Danger," when heat-related illnesses like heatstroke become likely, especially with prolonged exposure.



Source: National Oceanic and Atmospheric Administration (NOAA)

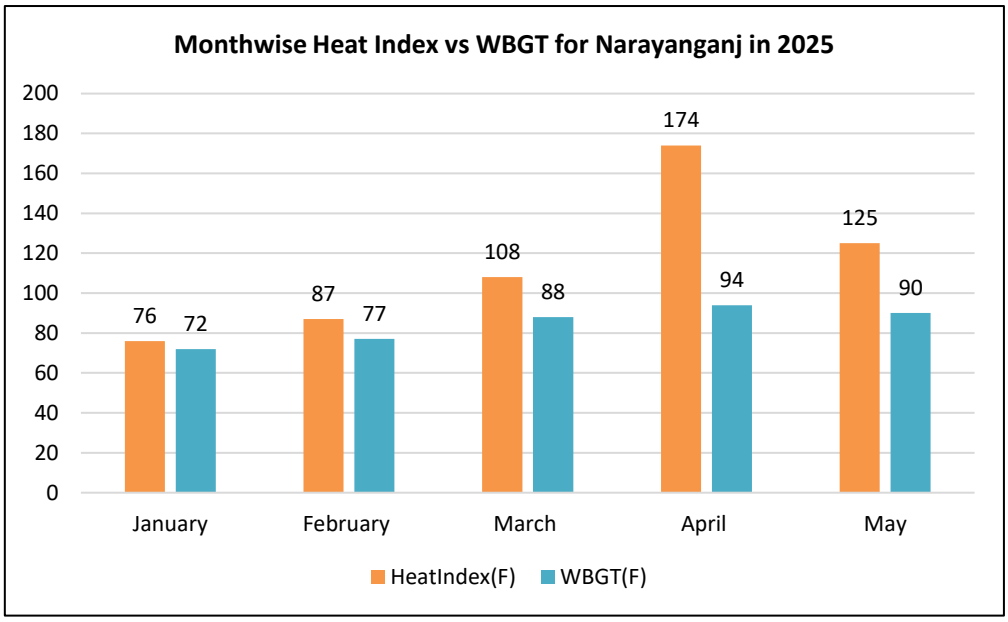
Figure 10: NWS Heat Index Chart Showing Levels of Heat Risk and Associated Health Warnings

Similarly, WBGT is widely used in occupational settings to determine permissible exposure limits and necessary rest-break cycles. Occupational WBGT thresholds exceeding 28 – 30°C are known to lead to significant physiological stress and productivity losses, particularly in sectors like garments, construction, and manufacturing.

The UHI effect significantly exacerbates local heat exposure. A spatial analysis of Narayanganj's LST from 2011 to 2019 shows an average increase of 1.86°C, driven by rapid urban expansion and loss of green infrastructure. This pattern underscores the urgent need for nature-based solutions, such as urban greening and water-sensitive planning, to regulate microclimates and reduce exposure[9].

Adding to this, climate projections from Cornell University's Global Labor Institute indicate a worrying rise in the number of days when Wet Bulb Temperatures exceed 30.5°C – a critical threshold for safe human labor. This pattern has already been observed between 2020 – 2024 in Bangladesh, compared to the 2005–2009 baseline. If this trajectory continues, a projected 2% reduction in national apparel export revenue could occur due to heat-related labor disruptions[10].

To understand the seasonal variations of heat stress in Narayanganj, it is important to examine how Heat Index and WBGT levels change throughout the year. This following figure (Figure 11) illustrates the month-wise trend of Heat Index and WBGT for Narayanganj in 2025. The data, generated using NOAA's Heat Forecast Tool[11], provides insights into variations in perceived heat stress throughout the year, helping assess seasonal exposure risks, especially for outdoor and industrial workers.



Source: National Oceanic and Atmospheric Administration (NOAA)

Figure 11: Monthly Comparison of Heat Index and WBGT for Narayanganj in 2025 Based on NOAA Heat Forecast Tool

The above figure will help in planning staggered interventions – such as worker scheduling, hydration stations, school closures, and heatwave shelters – by anticipating months of highest heat stress. Typically, April to June in Narayanganj shows overlapping spikes in both Heat Index and WBGT, indicating the period of maximum health vulnerability.

Narayanganj's vulnerability to extreme heat is compounded by its high population density, informal settlements, and labour-intensive industries. Many low-income groups lack access to cooling infrastructure, safe drinking water, and medical services, making heat risk a developmental and equity issue.

[9] https://doi.org/10.1016/j.envc.2022.100571
[10] https://www.reuters.com/business/extreme-heat-puts-garment-factory-workers-risk-study-shows-2024-12-08
[11] Heat Forecast Tools

Using spatial vulnerability mapping, urban "hot zones" can be identified by overlaying indicators such as surface temperature, household income, building materials, and occupation types. These data layers are essential to prioritise neighbourhoods for heat action interventions – such as shaded public spaces, rooftop gardens, and community cooling centres.

Real-time heat forecasting tools, combined with ground-level monitoring, allow local authorities to issue early warnings and implement preparedness measures. These tools must be embedded in institutional planning frameworks and synchronised with community outreach strategies.

To guide practical responses to escalating heat, the following table (Table 5) outlines WBGT thresholds, their health implications, and the necessary precautionary actions. Both Fahrenheit and Celsius units are included to facilitate local comprehension in Narayanganj.

Table 5: WBGT Thresholds, Associated Risks, and Recommended Actions for Narayanganj

WBGT (°C / °F)	Cautionary Level	Effects	Precautionary Actions
< 26.7°C / < 80°F	Safe	No action needed	No action needed
26.7 – 29.4°C / 80 – 85°F	Caution	Working or exercising in direct sunlight will stress the body after 45 minutes.	Taking at least 15 minutes of breaks each hour if working or exercising in direct sunlight
29.4 – 31.1°C / 85 – 88°F	Extreme Caution	Working or exercising in direct sunlight will stress the body after 30 minutes.	Taking at least 30 minutes of breaks each hour if working or exercising in direct sunlight.
31.1 – 32.2°C / 88 – 90°F	Danger	Working or exercising in direct sunlight will stress the body after 20 minutes.	Taking at least 40 minutes of breaks each hour if working or exercising in direct sunlight.
> 32.2°C / > 90°F	Extreme Danger	Working or exercising in direct sunlight will stress the body after 15 minutes.	Taking at least 45 minutes of breaks each hour if working or exercising in direct sunlight.

Source: National Oceanic and Atmospheric Administration (NOAA)

2.4. Community Impacts and Adaptive Responses

To understand the community impacts of heat stress, a comprehensive community-level survey was conducted in close collaboration with the 27 ward secretary offices across NCC. This structured questionnaire survey aimed to capture diverse local experiences, perceptions, and adaptive responses related to heat exposure. By actively engaging citizens, the survey sought to promote inclusive participation in the HAP development process.

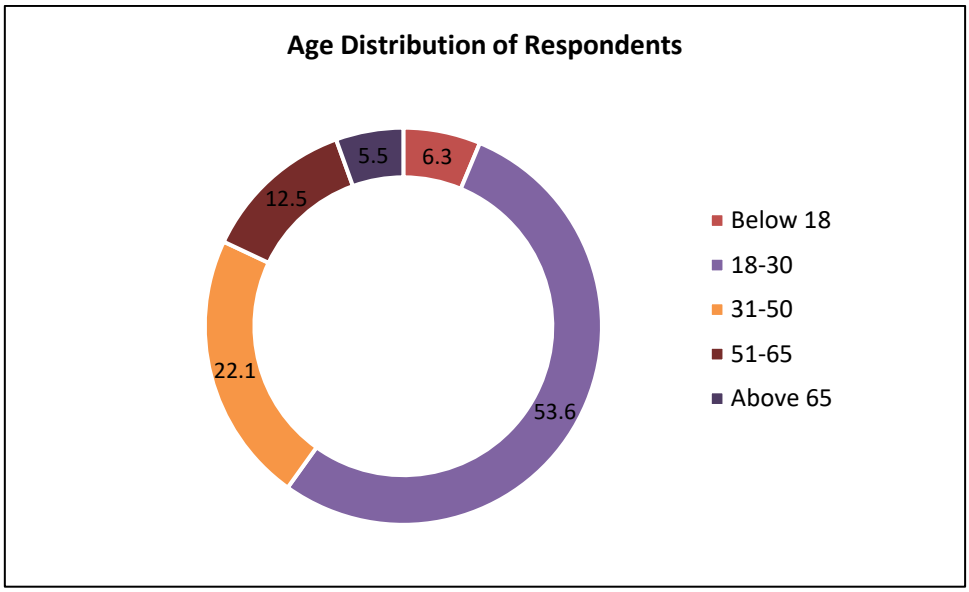
The survey collected detailed information on demographic profiles, heat-related health symptoms, coping mechanisms, household-level mitigation practices, perceived risks, existing preparedness levels, and community-prioritised interventions. A total of 600 individuals participated, with roughly 30 respondents randomly selected from each ward. Special emphasis was placed on ensuring

representation of vulnerable groups, including women, children, informal workers, elderly residents, and slum dwellers. Given that slum settlements are concentrated in only three wards – Wards 3, 15, and 22 – targeted engagement in these areas was crucial to address equity and inclusivity in heat resilience planning.

While the sample size provides valuable initial insights, practical constraints reduced effective responses to about 20 – 22 participants per ward. This limitation underscores the importance of conducting deeper, ward-specific consultations and more extensive data collection efforts. Moving forward, the design of decentralised and locally responsive Heat Action Plans will require additional resources, participatory sessions, and detailed analyses to ensure interventions effectively meet community needs. Below is a summary of the demographic overview of the respondents, including age distribution, gender ratio, and housing types.

2.4.1. Demographic Overview

Age Distribution: The age profile of respondents indicates that the majority (53.6%) fall within the 18 – 30 age group, followed by 22.1% aged 31 – 50. Notably, the most vulnerable age segments – those under 18 (6.3%) and over 65 (5.5%) – represent a smaller portion of the surveyed population. While the dominant demographic may be more physically resilient to heat, the presence of at-risk groups, particularly children and the elderly, underscores the importance of inclusive heat adaptation strategies. These groups are more susceptible to heat-related illnesses, necessitating targeted outreach, medical preparedness, and protective infrastructure to safeguard their health during extreme heat events.



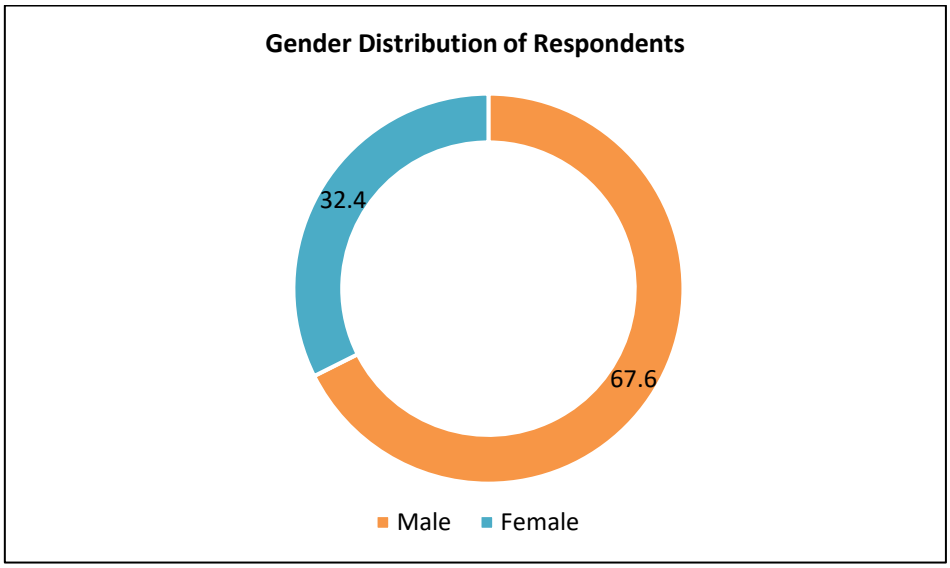
Source: Primary Survey, ICLEI South Asia

Figure 12: Age Distribution of Respondents

Gender Ratio: Survey results show a predominantly male respondent base (67.6%), with females accounting for 32.4% of participants. This gender disparity may reflect differences in occupational exposure, mobility, or engagement with public surveys.

The data also suggests potential gender-specific heat vulnerabilities: men, particularly those engaged in outdoor or industrial work, may face higher direct heat exposure, while women, especially in

informal or caregiving roles, may experience compounded risks due to limited access to cooling resources and healthcare.

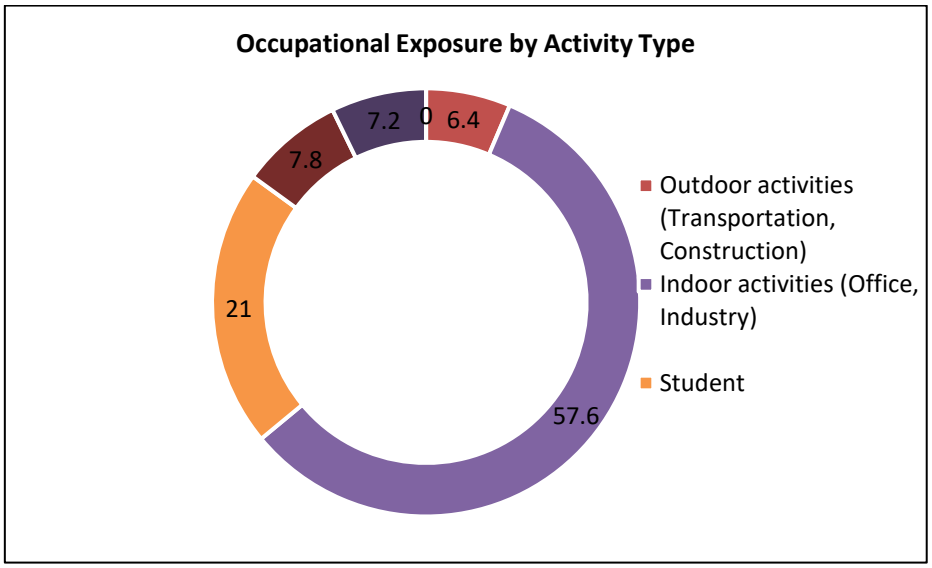


Source: Primary Survey, ICLEI South Asia

Figure 13: Gender Distribution of Respondents

2.4.2. Occupation and Housing

Occupational Exposure: Data indicates that 57.6% of respondents primarily engage in indoor activities, including work in homes or industrial settings. However, a significant portion is involved in outdoor occupations such as transportation and construction, which pose greater heat-related health risks due to direct and prolonged sun exposure. While indoor workers and students report experiencing heat stress, their exposure tends to be less intense compared to outdoor labourers. Nevertheless, poorly ventilated or non-air-conditioned indoor environments can lead to thermal discomfort and reduced productivity.

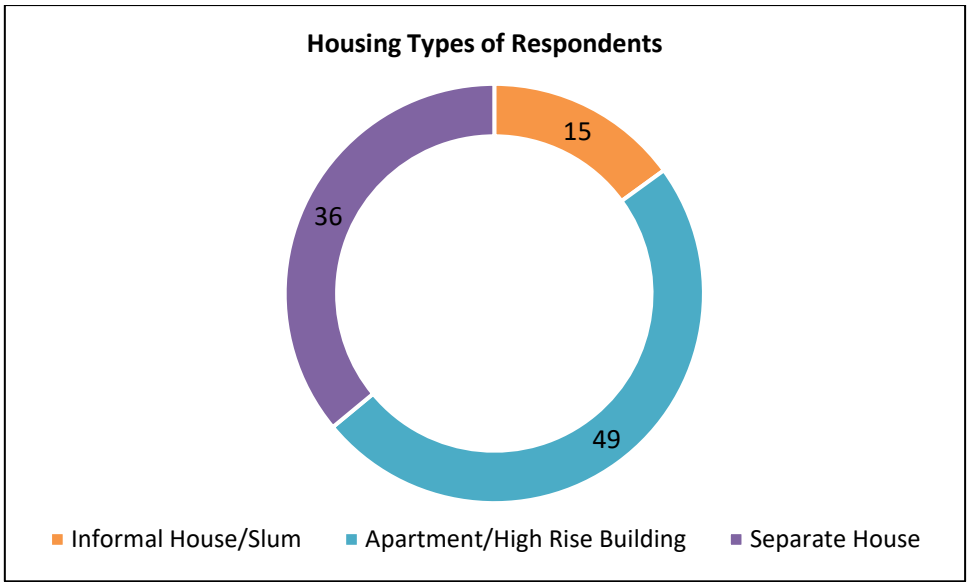


Source: Primary Survey, ICLEI South Asia

Figure 14: Occupational Exposure by Activity Type

Housing Types: Analysis reveals that 15% of respondents reside in informal houses or slums, typically lacking adequate cooling infrastructure such as fans, air conditioning, or proper ventilation. These conditions significantly amplify the impact of extreme heat, especially in overcrowded neighbourhoods.

A larger share, 49%, live in apartments or high-rise buildings, which, while offering better access to cooling appliances, can also trap and retain heat, especially in poorly ventilated structures. Separate houses, though offering potential for better airflow, may still be vulnerable due to high population density and lack of strict zoning regulations, contributing to heat retention and limited green cover.

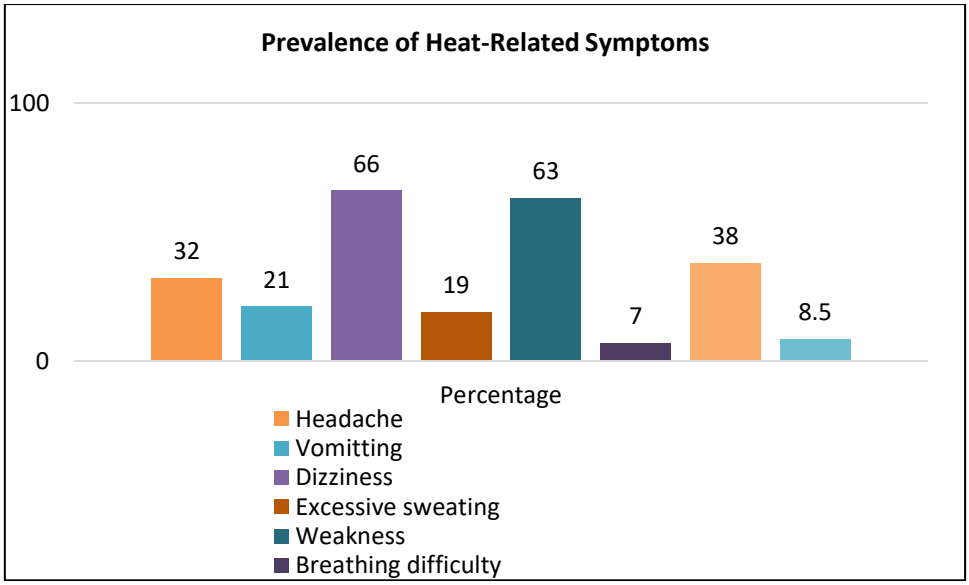


Source: Primary Survey, ICLEI South Asia

Figure 15: Housing Types of Respondents

2.4.3. Heat-Related Symptoms and Coping Measures

Symptoms Experienced: Survey responses indicate a high prevalence of heat-related symptoms, with dizziness (66%), weakness (63%), nausea (38%), and headache (32%) being the most commonly reported. These symptoms suggest widespread thermal discomfort and early-stage heat stress. More severe indicators, such as vomiting (21%) and breathing difficulties (7%), point to serious health risks, particularly among vulnerable groups or those with prolonged exposure. In addition, 19% reported excessive sweating, a marker of the body's thermoregulatory response. These findings highlight the urgent need for public awareness, early medical intervention, and preventive infrastructure during peak heat events.

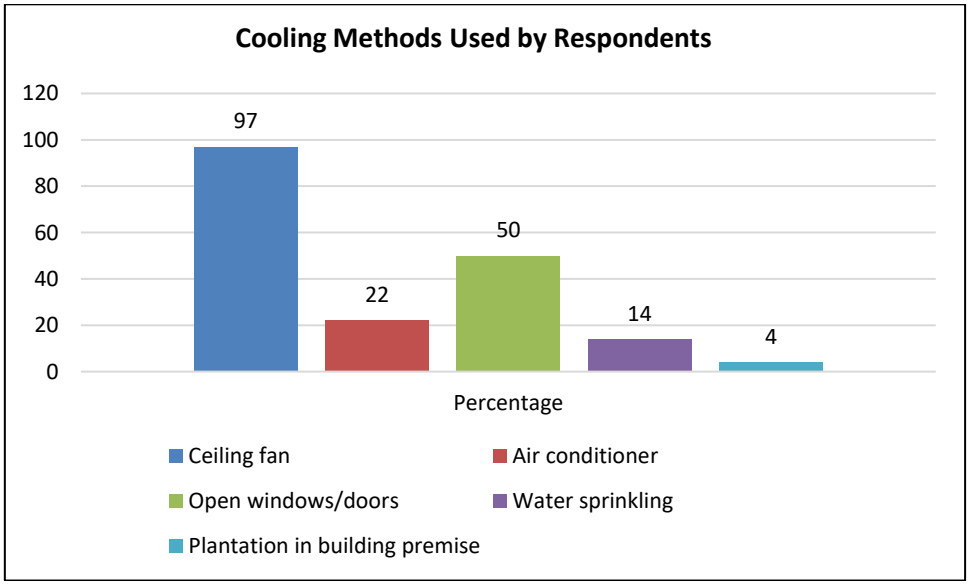


Source: Primary Survey, ICLEI South Asia

Figure 16: Prevalence of Heat-Related Symptoms

Cooling Measures: Ceiling fans are the most widely used cooling method (97%), reflecting accessibility and affordability. Only 22% have access to air conditioning, indicating limited mechanical cooling availability, especially in low-income households.

Notably, only 4% rely on plantation-based cooling (e.g., shade from trees or rooftop gardens), highlighting a gap in green infrastructure for sustainable passive cooling. Meanwhile, 50% use natural ventilation, and 14% employ water sprinkling as heat mitigation.

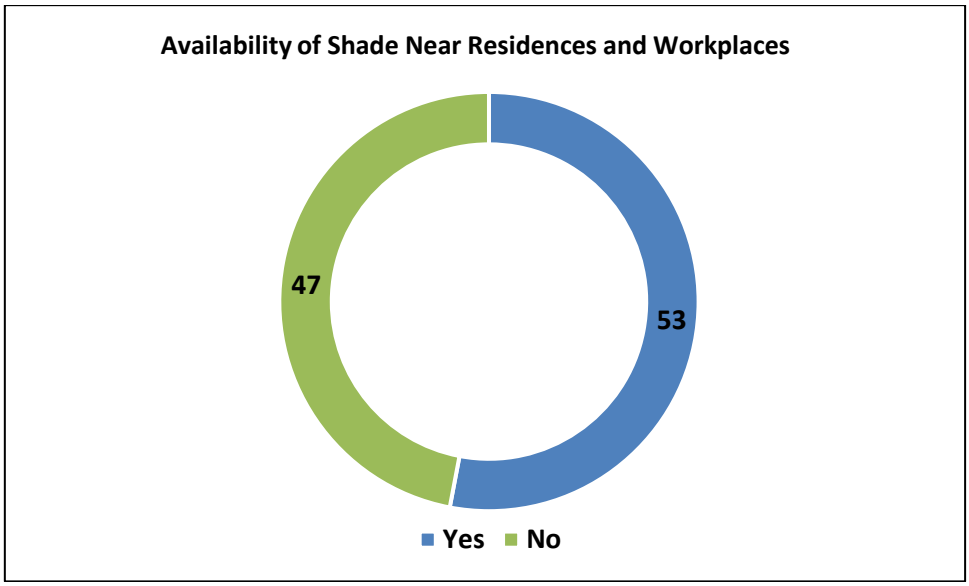


Source: Primary Survey, ICLEI South Asia

Figure 17: Cooling Methods Used by Respondents

2.4.4. Shading and Medication Use

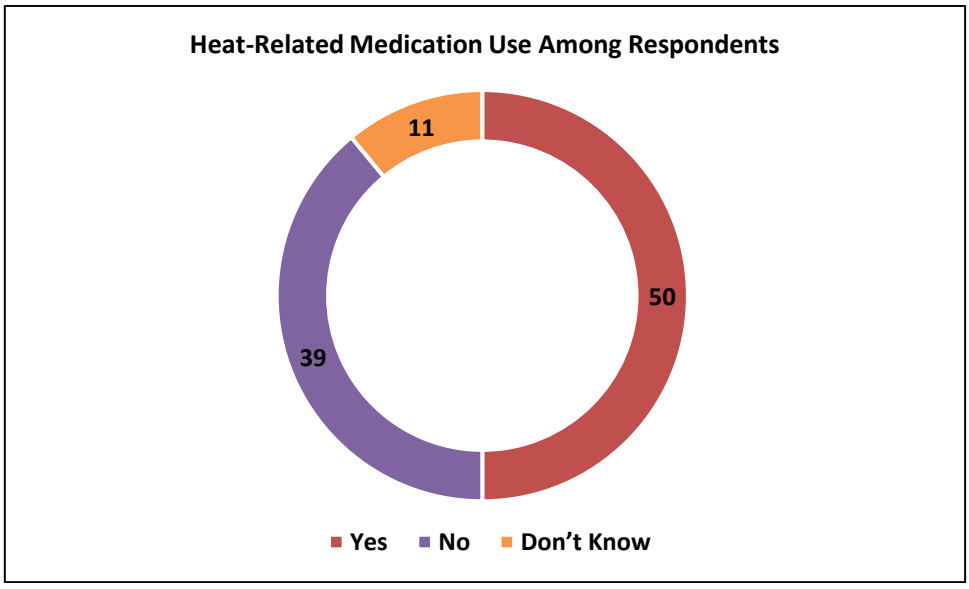
Shade Availability: 47% of respondents do not have shading near their homes or offices, increasing heat exposure. Conversely, 53% benefit from shade, helping mitigate heat risks. This nearly even split highlights a critical area for intervention to improve thermal comfort.



Source: Primary Survey, ICLEI South Asia

Figure 18: Availability of Shade Near Residences and Workplaces

Medication Due to Heat: 50% of respondents have taken medication for heat-related illnesses, indicating significant health impacts. Meanwhile, 11% are unsure if they have taken such medication, suggesting gaps in awareness of heat-related health issues. The remaining 39% reported no need for medication.

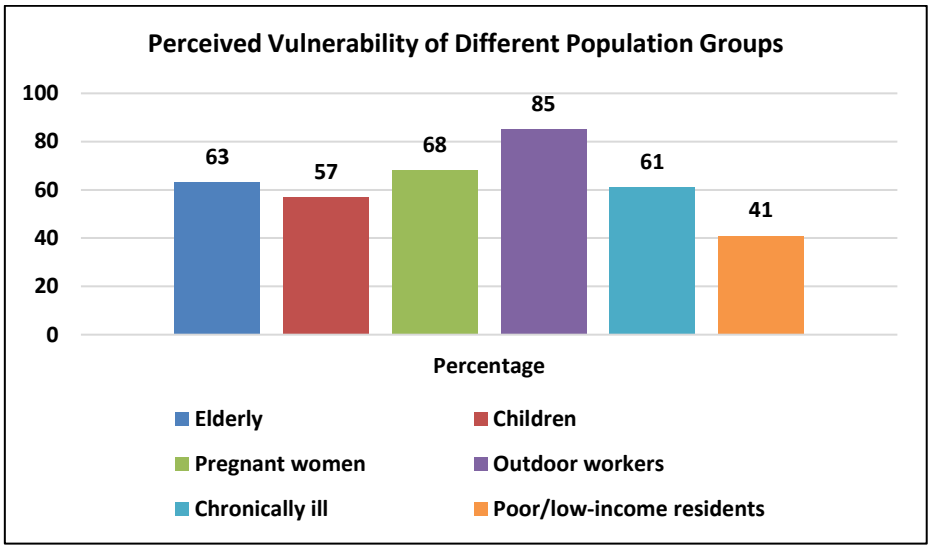


Source: Primary Survey, ICLEI South Asia

Figure 19: Heat-Related Medication Use Among Respondents

2.4.5. Community Vulnerability and Challenges

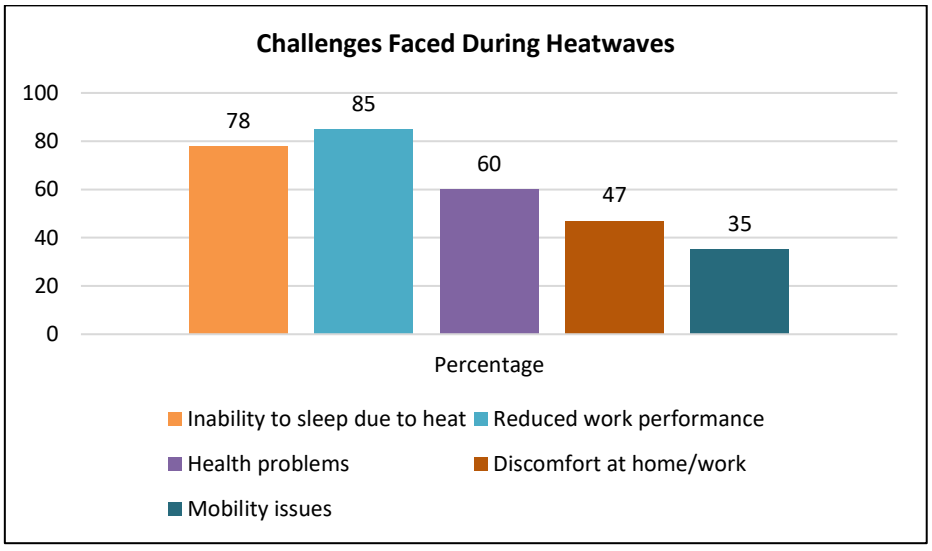
Most Vulnerable Groups: Outside workers (85%) are seen as the most vulnerable due to direct environmental and occupational exposure. Pregnant women (68%), the elderly (63%), and chronic disease patients (61%) also face heightened risks. Children (57%) are perceived as vulnerable but slightly less so, potentially due to protective social factors. Low-income residents (41%) face systemic vulnerabilities linked to poor housing and limited services.



Source: Primary Survey, ICLEI South Asia

Figure 20: Perceived Vulnerability of Different Population Groups

Challenges During Heatwaves: Sleep disturbances (78%) and reduced work performance (85%) are widespread, impacting daily functioning. Health problems (60%) exacerbate fatigue and productivity loss, especially among vulnerable groups. Discomfort at home (47%) due to overcrowding and poor infrastructure further affects well-being, while mobility issues (35%) disproportionately impact the elderly and disabled. These factors combine to reduce overall resilience during heat events.

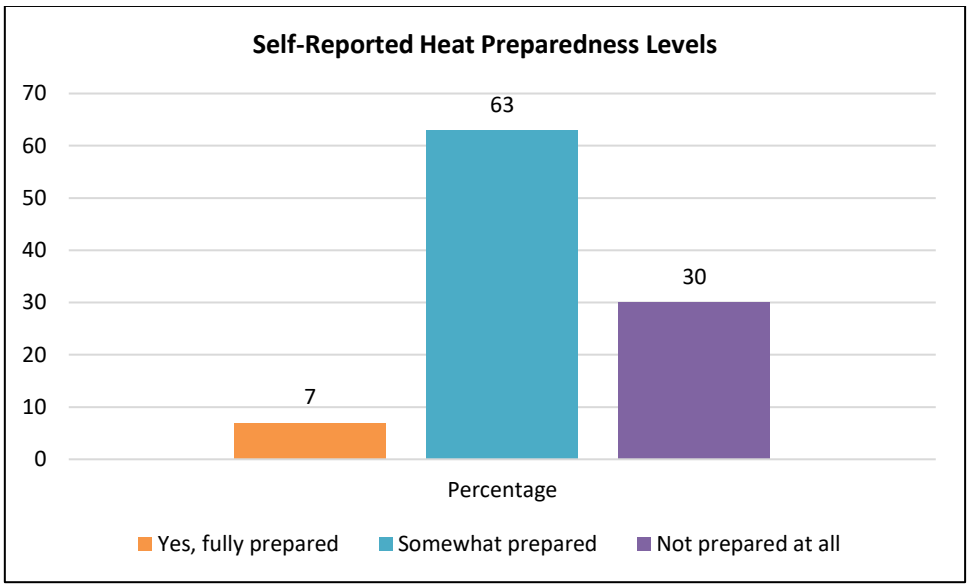


Source: Primary Survey, ICLEI South Asia

Figure 21: Challenges Faced During Heatwaves

2.4.6. Preparedness and Awareness

Preparedness Levels[12]: Only 7% feel fully prepared for extreme heat, revealing a critical resilience gap. While 63% feel somewhat prepared, this may overstate actual readiness, as many lack actionable plans or resources. Alarmingly, 30% admit to being unprepared, exposing them to serious risk.

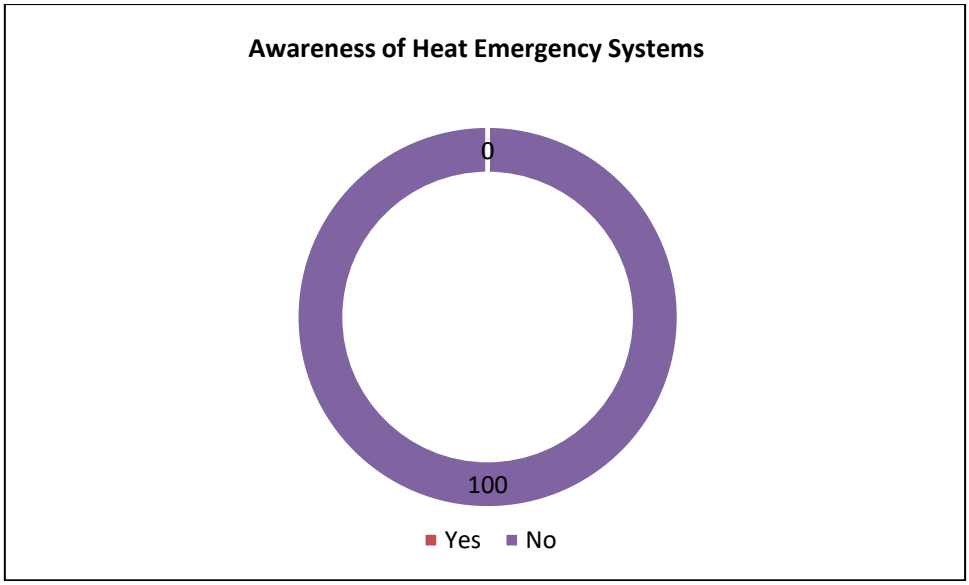


Source: Primary Survey, ICLEI South Asia

Figure 22: Self-Reported Heat Preparedness Levels

Emergency System Awareness: There is 0% awareness of heat emergency systems among respondents, indicating a breakdown in public communication. No existing city corporation schemes or early warning interventions were reported, underscoring the urgent need for localised outreach and education.

[12] **Fully Prepared**: Have cooling access, heat awareness, and a personal or household-level response plan.
Somewhat Prepared: Aware of heat risks and use basic coping strategies but lack proper plans or resources.
Not Prepared: Lacking both coping resources and knowledge, they are highly vulnerable to heat impacts.

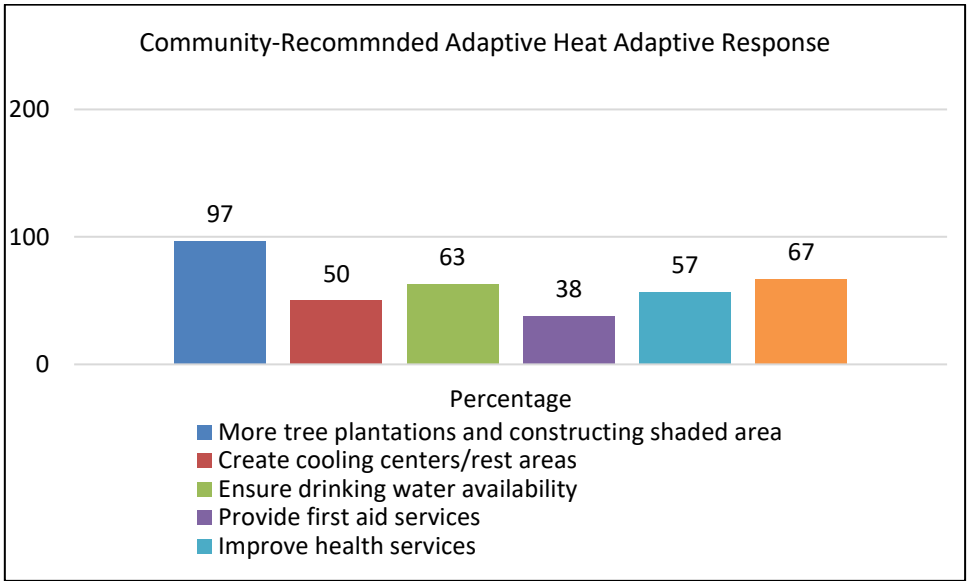


Source: Primary Survey, ICLEI South Asia

Figure 23: Awareness of Heat Emergency Systems

2.4.7. Community-Recommended Adaptive Responses to Heat

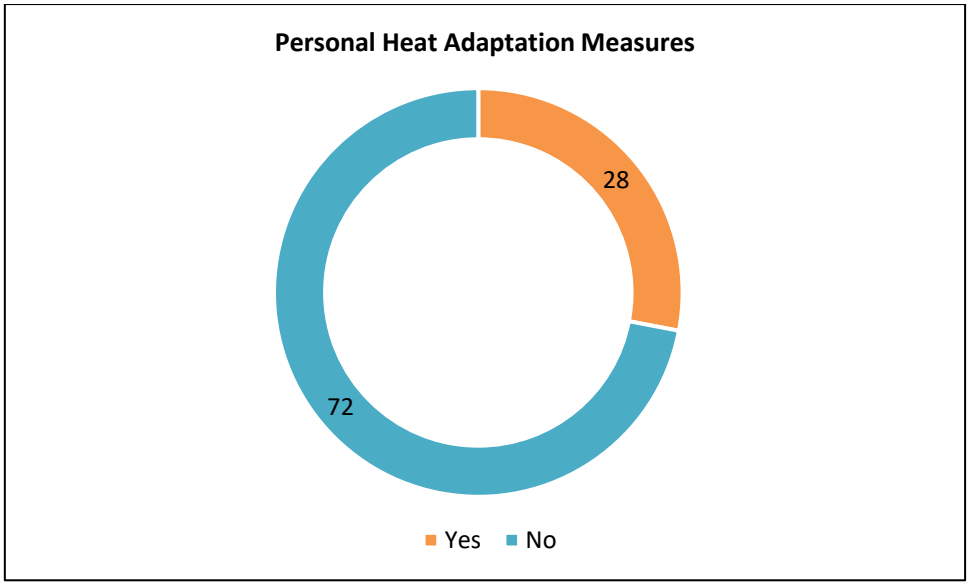
Community priorities emphasise urban greening and shading (97%), reflecting strong support for nature-based heat mitigation. Cooling centres (50%), drinking water access (63%), health services (57%), first aid (38%), and heat preparedness campaigns (67%) also rank highly. These responses highlight a community preference for preventative infrastructure coupled with education.



Source: Primary Survey, ICLEI South Asia

Figure 24: Community-Recommended Heat Adaptive Response

Despite growing risks, 72% take no proactive measures against extreme heat, revealing a disconnect between awareness and action. Only 28% engage in basic precautions such as hydration or shade use. Barriers likely include low emergency system awareness, economic constraints, and fatalism.



Source: Primary Survey, ICLEI South Asia

Figure 25: Personal Heat Adaptation Measures

Urban Greening and Tree Planting:

- Distribute at least one fruit-bearing tree to each household to encourage greenery and promote environmental awareness
- Mass tree plantation drives across the city, especially in heat-prone zones
- Encourage rooftop gardens and vertical greenery in high-rise buildings
- Plant large trees in every residential compound to enhance shade and cooling
- Introduce zoning regulations to ensure green space inclusion in all city sectors
- Engage youth and community volunteers in plantation and maintenance efforts
- Control unplanned urban construction and enforce green buffer requirements
- Penalise unnecessary tree cutting, especially when done to maximise rental space

Access to Clean Water:

- Ensure free access to safe drinking water, especially in public spaces and low-income areas.
- Install water dispensing units at bus stops and crowded places
- Improve uninterrupted water supply across residential and commercial areas
- Spray water on roads during heat waves to reduce surface temperature

Urban Heat Mitigation:

- Reduce the use of air conditioners where possible, as outdoor AC units contribute to heat emissions
- Designate public cooling centers or shaded rest areas for relief during extreme heat
- Encourage awareness campaigns on heat-health risks and mitigation strategies

Policy and Infrastructure:

- Regulate population density and construction intensity in congested zones
- Promote remote and online services for public institutions to reduce movement and exposure during heat waves

- Limit vehicular use and promote sustainable transportation to reduce heat and emissions
- Facilitate affordable housing for working-class communities, reducing exposure to extreme outdoor

3. Heat Action Plan

3.1. Early Warning and Heat Emergency Preparedness

With the rising frequency and intensity of extreme heat events, Narayanganj City must be equipped with a robust early warning and response system. This section outlines the strategic steps to be taken before and during heat emergencies to reduce health risks, protect vulnerable populations, and maintain essential services. The approach integrates pre-event preparedness, real-time emergency interventions, and post-event coordination, structured around three heat alert stages – *Normal, Alert, and Orange Warning*.

3.1.1. Pre-Event Preparedness (Normal Stage)

Focus: Prevention, awareness, readiness

1. **Development and Dissemination of Heat Awareness Materials:** Design targeted communication materials – leaflets, posters, community radio messages, and videos – in Bangla and local dialects to educate residents about heat risks, symptoms, and protective measures. Prioritise outreach to vulnerable groups such as slum residents, the elderly, pregnant women, and outdoor workers.
2. **Training for Health Workers, Ward Officials, and Urban Community Volunteers:** Organise regular orientation and simulation-based training for urban health staff, community health workers, ward-level disaster management teams, Community Development Committee (CDC) members and urban community volunteers to identify early signs of heat stress and respond efficiently.
3. **Community Mobilisation through Local Institutions:** Engage schools, mosques, temples, youth and cultural clubs as platforms to raise awareness and build a grassroots network for early warning dissemination and community watch during heat events.
4. **Risk Mapping of Vulnerable Zones and Populations:** Use participatory mapping and GIS tools to identified heat hotspots, poorly ventilated housing clusters, crowded commercial areas, and settlements with limited access to water and shade. Compile a database of vulnerable individuals for targeted support.
5. **Preparedness of Essential Services and Supplies:** Stockpile Oral Rehydration Solution (ORS), drinking water, umbrellas, and first-aid kits at ward offices and health centres. Prepare cooling facilities and mobile units to be quickly deployed when alerts are issued.

3.1.2. Heat Alert Stage (Above 40°C for 1 Day)

Focus: Early warning, rapid response

1. **Rapid and Inclusive Alert Dissemination:** Use BMD forecasts to issue clear heat alerts via SMS, local radio, community loudspeakers, digital boards, and social media. Engaging the ward secretary to reach vulnerable areas and are accessible to people with low adaptive capacity.
2. **Activation of Local Response Networks:** Deploy trained ward-level focal points (CDC cluster representatives), community health workers, and youth volunteers to check on vulnerable residents, distribute ORS, and disseminate alert messages door-to-door where needed.

3. **Set Up Hydration and First-Aid Points:** Install temporary hydration booths and first-aid stations in high-footfall areas such as markets, public buildings, and intersections, especially near slum communities and industrial zones.
4. **Field Monitoring and Workplace Safety Checks:** Inspect factories, construction sites, and transport hubs to verify implementation of basic protective measures like shaded rest areas, breaks during peak heat hours, and emergency kits for workers.
5. **Coordination Between City Departments:** Initiate cross-departmental coordination (health, engineering, urban planning, conservancy and public works) to monitor the evolving situation, issue daily updates, and coordinate logistics for relief deployment.

3.1.3. Orange Warning Stage (Above 40°C for 2+ Days)

Focus: Escalated response, relief measures, adaptive trials

1. **Public Health and Emergency Responses:** Upon a heat alert, hospitals and clinics should activate emergency protocols, ensuring 24/7 ambulance availability and stocking essential medical supplies like oral rehydration salts (ORS), IV fluids, and heatstroke medicines. Opening cooling centres in community halls, religious places, and schools, providing shaded and air-cooled environments. Special care must be taken for vulnerable groups, including the elderly, children, pregnant women, and those with pre-existing conditions. Mobile health units should be deployed in underserved or high-risk communities to provide immediate medical assistance and hydration support.
2. **Public Awareness and Communication:** Effective communication is critical during heat emergencies. Heat alerts and advisories must be widely disseminated through SMS, local radio, television, loudspeaker announcements, and social media platforms. Public messages should encourage staying indoors during peak hours (11:00 AM – 4:00 PM), drinking plenty of water, wearing loose-fitting and light-coloured clothing, and identifying symptoms of heat exhaustion and heatstroke. Information, Education, and Communication (IEC) materials must be visibly displayed at key public locations such as markets, transit hubs, schools, and health centres. Door-to-door campaigns should be conducted in low-income and high-risk neighbourhoods by trained volunteers to ensure the message reaches all sections of society.
3. **Urban Infrastructure and Worker Protection:** To mitigate the urban heat impact, the city corporation can initiate water sprinkling on roads, open grounds, and high-traffic public spaces during peak heat hours. Drinking water points must be set up in public places, especially in crowded and transit areas. Outdoor workers, including construction labourers, cleaners, traffic police, and street vendors, can be protected through the provision of heat-protective gear such as hats, scarves, and water bottles. Their working hours should be adjusted to cooler parts of the day, preferably early morning or late evening. Coordination with utility services is essential to prevent power cuts and ensure uninterrupted water supply during heatwave conditions.
4. **Institutional Coordination and Governance:** A multi-agency Heat Alert Response Team should be activated with stakeholders from health, engineering, utilities, and law enforcement. Daily coordination meetings will review measures and temperature trends. Real-time monitoring of heatwave indicators like temperature and hospital admissions will guide adjustments. Collaboration with NGOs and community leaders is essential for outreach and services. After the alert, a thorough assessment will evaluate response effectiveness and inform future strategies.

To implement this framework effectively, it is essential to clearly define who does what and when. Section 3.3 identifies the roles and responsibilities of relevant institutions and community actors across different heat emergency stages – normal, alert, and orange warning – ensuring all

stakeholders are prepared to act swiftly. Section 3.4 highlights the sources of early warning information, establishing how alerts will be triggered, communicated, and acted upon based on data from meteorological, health, and community sources.

3.2. Responsibilities for Emergency Response

The following table (Table 6) outlines the roles and responsibilities of various agencies and departments involved in the emergency response to heat stress and heat waves in Narayanganj. It categorises each stage of the heatwave event, specifying the required actions, responsible organisations, and contact details. By clearly defining the roles of key stakeholders, the table serves as an operational tool to ensure a coordinated and effective response to heat-related emergencies, ultimately minimising health risks and ensuring the population's well-being.

Table 6: Responsibility Framework for Emergency Response

Stage	Responsibility / Action Required	Responsible Agency / Department	Contact Person / Details
Normal (Pre-Heat Season / Awareness)	Develop and disseminate heat awareness materials (posters, leaflets, radio messages, digital content) targeted at slum communities, the elderly, children, and outdoor workers.	Health Department of NCC, CDCs, Urban Community Volunteers	Medical Officer, NCC
	Conduct training for frontline workers, health staff, and ward volunteers on heat illness identification, community alerts, and first aid.	Health Department of NCC, Department of Public Health and Engineering (DPHE), CDCs, Urban Community Volunteers, NGOs	Medical Officer, NCC
	Mobilise local institutions (schools, mosques, community centres) for heatwave awareness campaigns.	Social welfare and Slum Development Department of NCC, Educational Institutions	Chief Social Development Officer
	Identify heat hotspots and map vulnerable populations using GIS and local inputs.	Engineering Department (Urban Planning Cell)	Urban Planner, NCC
	Stockpile and position water tankers, ORS packets, and mobile health vans near identified risk zones.	Fire Service and Civil Defence (FSCD), NCC Engineering Department, CDCs, Urban Community Volunteers	Deputy Director, FSCD, Chief Engineer, NCC Names: Emails:
Alert (Above 40°C for 1 Day)	Disseminate heat alert using BMD forecast data via SMS, loudspeakers, community radio, cable news, and social media.	BMD, IT cell, NCC, Mobile Operators, Religious Institutions, School,	Regional Forecast Officer, BMD, Urban Planner, NCC

Stage	Responsibility / Action Required	Responsible Agency / Department	Contact Person / Details
		Urban Community Volunteers	
	Activate ward-level focal points, community-based volunteers, and Red Crescent youth teams for on-ground support.	Ward Councillors, Urban Community Volunteers, CDCs	Ward-level Volunteer Coordinator
	Distribute ORS packets and safe drinking water at key intersections, public transport points, and vulnerable communities.	Health Department (NCC), NGOs, Ward Councillors, Religious Institutions, School, Urban Community Volunteers	Medical Officer
	Conduct on-site visits to assess working conditions in factories, schools, and informal markets; ensure guidelines are followed.	Department of Inspection for Factories and Establishments (DIFE), Engineering Dept, NCC	Inspector, DIFE / Education Engineering
	Coordinate inter-agency field responses and ensure rapid deployment of mobile health services where needed.	NCC Emergency Cell, Health Department FSCD, Urban Community Volunteers	Emergency Response Focal Point, NCC
Orange Warning (Above 40°C for 2+ Days)	Issue public advisories to employers and implement flexible work shifts, especially for outdoor labourers (construction, traffic, cleaners).	DIFE, Cell, Department of Labour (GoB)	Representative from the Department of Labour
	Ensure shaded rest areas and temporary drinking water booths in high footfall areas such as bus stops, markets, and railway stations.	NCC Engineering Dept, Private Sector Corporate Social Responsibility (CSR) Partners, Bangladesh Red Crescent Society	Chief Engineer, NCC
	Open and manage cooling centres in schools, ward community halls, or large mosques; ensure fan, water, and medical supplies.	NCC, School Management Committees, Urban Community Volunteers, Bangladesh Red Crescent Society	Chief Slum and Community Development Officer, NCC
	Pilot heat-resilient infrastructure (cool roofs, shaded alleys, reflective paint) in 1–2 highly vulnerable wards.	NCC Urban Planning Cell, NGOs, and Academic Institutions	Urban Planner, NCC / Innovation Lead, NGO

3.3. Source of Early Warning Information

The following table provides a comprehensive overview of the key agencies and mechanisms responsible for issuing heatwave alerts and early warning information. It outlines the primary sources, such as meteorological departments, health organisations, and emergency response agencies, and their specific roles in monitoring and disseminating critical heat-related information. By ensuring timely and accurate communication, this table is designed to enhance preparedness and enable prompt action, particularly during periods of intense heat, to protect vulnerable populations in urban areas.

Table 7: Source of Early Warning Information

Source of Early Warning	Responsibility / Action Required	Responsible Agency / Department	Contact Person / Details
Bangladesh Meteorological Department (BMD)	Issue daily heat forecasts Provide early warnings for heatwaves.	BMD	Regional Forecast Officer
	Issue warnings on extreme temperature conditions and duration	BMD	Forecasting Officer
Emergency Alert System (SMS/Media)	Disseminate heatwave alerts through SMS, social media, TV, and radio	NCC, Print media, newspaper, TV and Radio Stations	Representatives from the concerned office
	Share heat alerts via loudspeakers in public spaces (e.g., markets, parks, streets)	NCC	Representatives from the concerned office
Narayanganj City Corporation (NCC)	Issue alerts for water availability and quality during heat stress periods	NCC	Representatives from the concerned office
	Monitor water supply and ensure quality in critical areas	NCC	Representatives from the concerned office
Slum and Social Welfare Department	Monitor and alert for vulnerable groups (e.g., elderly, children, disabled)	Slum and Social Welfare Department	Representatives from the concerned office
Local Hospital and Clinics	Provide health alerts on heat-related illnesses.	Public Health Department, DGHS, NCC	Representatives from the concerned office
	Share information on the availability of medical	Public Health Department, DGHS, NCC	Representatives from the concerned office

Source of Early Warning	Responsibility / Action Required	Responsible Agency / Department	Contact Person / Details
	services for heat-related emergencies		
Local Observations (Community Reports)	Report early signs of heat stress and unusual weather patterns	Ward Councilors, Ward Secretary, Urban Community Volunteer	Representatives from the concerned office
	Locally/Community-led intervention, showcasing innovative practice/approach in monthly meetings	Ward Councilors, Ward Secretary, Urban Community Volunteer	Representatives from the concerned office.

3.4. Heat Resilient Strategies for Sustainable Adaptation

While short and medium-term actions are essential for addressing immediate and seasonal heat risks, achieving long-term resilience to rising urban temperatures requires a forward-looking strategy. This section presents interventions designed to tackle the root causes of heat vulnerability in Narayanganj through sustained urban transformation, institutional strengthening, and the integration of climate resilience into planning, governance, and infrastructure development over a five-year horizon and beyond.

The prioritisation must occur based on the vulnerability of wards identified in the spatiotemporal analysis section. Designated ward councillors and the secretary will present the identified issues during monthly meetings before the onset of the heatwave season, and necessary interventions will be determined and approved at that time. The NCC is already advancing several new urban development projects, and these suggested interventions will be integrated as part of a comprehensive work package. Furthermore, NCC has submitted its revised organogram to the ministry, seeking approval for a dedicated environment and disaster management department. Once this is approved, it will play a crucial role in implementing the proposed interventions effectively. The framework adopts a phased approach, combining both structural measures (e.g., physical infrastructure, spatial planning, and urban design) and non-structural measures (e.g., policy reform, public awareness, service delivery, and institutional coordination). It outlines short-, medium-, and long-term actions tailored to reduce heat-related risks and build a climate-resilient future for NCC.

3.4.1. Short-Term Actions (0 – 1 Year)

Focus: Immediate life-saving interventions, public awareness, and mobilising basic services during peak heat seasons.

Non-Structural Strategies:

1. **Develop and disseminate heat awareness and risk communication materials:** Create IEC materials in Bengali and English, including posters, infographics, radio jingles, and short videos, emphasising hydration, rest, shade, and recognising heat stress symptoms. Disseminate in slums, rickshaw stands, and marketplaces.
2. **Use local media, SMS alerts, and loudspeakers for timely dissemination of heat warnings:** Sign Memorandum of Understandings (MoUs) with telecom providers for emergency heatwave alerts. Mobilise ward offices to coordinate with mosques, temples, and local radio stations to deliver alerts using megaphones during peak hours.

3. **Initiate distribution of ORS and safe drinking water:** Pre-position ORS sachets and bottled water at pharmacies, schools, and local shops in heat-prone areas. Engage youth volunteers and community-based organisations for distribution during red alert days.
4. **Train frontline health workers and mobilise community volunteer networks:** Conduct 2-day crash courses on basic first aid for heat exhaustion for NCC health staff, Red Crescent volunteers, and urban community volunteers. Equip them with response kits and heat emergency protocols.
5. **Engage religious and educational institutions to aid in community alerting:** Collaborate with local religious leaders and school authorities to announce daily heat alerts, distribute flyers, and share behavioural guidelines in prayer sessions, assemblies, and parent-teacher meetings.
6. **Conduct household visits and street campaigns in informal settlements:** Mobilise trained volunteers for door-to-door awareness in low-income neighbourhoods, distributing ORS and flyers, and identifying at-risk individuals (e.g., elderly, pregnant women).
7. **Promote temporary shift in working hours for outdoor workers:** Issue advisories recommending revised working hours (early morning/evening shifts) for construction workers, waste pickers, and vendors during red alert days.
8. **Activate temporary misting stations in crowded zones:** Install low-cost misting sprays in market areas, transport hubs, and rickshaw terminals using municipal water connections and hosepipe systems.
9. **Set up ward-level rapid response helplines:** Activate a dedicated call line for citizens to report heat-related symptoms or request medical support. Route calls to health centres or community volunteers for immediate follow-up.
10. **Launch social media campaign using influencers and youth groups:** Use Facebook, and YouTube, X (former Twitter) to disseminate short, engaging messages on staying safe during heatwaves. Engage local influencers and student networks to boost visibility.

Structural Strategies:

1. **Identify, map, and monitor heat risk zones and vulnerable populations:** Conduct rapid mapping exercises using satellite imagery, GIS tools, and community consultations to identify heat-prone areas and create a vulnerability database at ward level.
2. **Establish cooling centres in accessible public buildings:** Retrofit ward offices, schools, and community halls with fans, water coolers, and shaded areas. Publicise locations via SMS alerts and signage.
3. **Deploy mobile health units and water tankers to support at-risk populations:** Use rented vans to deliver first aid and water in slums and labour-concentrated areas during extreme heat days. Equip vans with loudspeakers to deliver warnings.
4. **Install temporary shade structures in open work and rest areas:** Set up tarpaulin or bamboo structures at traffic intersections, outdoor workplaces, and public toilets to provide relief during peak sun hours.
5. **Provide fans and ventilation systems to high-density health facilities:** Identify priority hospitals and clinics for immediate ventilation upgrades and temporary cooling aids to prevent indoor heat stress for patients and staff.
6. **Reopen and maintain public water taps and fountains:** Rehabilitate defunct public taps, install new water points in slum areas and marketplaces, and ensure regular water supply through coordination with WASA or local suppliers.
7. **Install reflective surfaces on selected public roofs:** Use light-coloured reflective paint on rooftops of municipal buildings to reduce heat absorption and trial the impact on indoor temperatures.

8. **Ensure uninterrupted power supply in health facilities:** Coordinate with power utility providers to prioritise health posts and cooling centres for continuous power during heatwave emergencies.
9. **Stock emergency heat kits in health centres and ward offices:** Include ORS, ice packs, rehydration tabs, glucose, and instructions for heat stress management to be used by staff and distributed to affected persons.
10. **Reinforce municipal waste collection to prevent heat-related sanitation hazards:** Intensify cleaning and waste collection to prevent the accumulation of waste during heatwaves, reducing secondary risks from odour and vector-borne diseases.

3.4.2. Short-Term Non-Structural (ST-NS) Actions (0 – 1 Year): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Issue to be addressed	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
ST-NS1	Develop and disseminate heat awareness and risk communication materials	Slums, marketplaces, public areas	Non-Structural (IEC / Communication)	Lack of public awareness, heat stress recognition	15 lakhs	NCC Health Department / Local NGOs	Development Partners, I/NGOs	No. of materials distributed; No. of people reached
ST-NS2	Use local media, SMS alerts, and loudspeakers for heat warnings	City-wide	Non-Structural (Early Warning)	Delayed community heat alerts	10 lakhs	NCC, Disaster Management Committee (DMC)/ BMD / Telecom providers	Telecom companies, Ministry of Local Government	No. of alerts issued; Coverage (% of population)
ST-NS3	Initiate distribution of ORS and safe drinking water	Heat-prone areas (schools, shops)	Non-Structural (Health Service)	Dehydration, heat stroke risks	20 lakhs	NCC Health Department / NGOs / Youth Volunteers	NGOs, Philanthropic organisation	No. of ORS kits distributed; No. of hydration points
ST-NS4	Train frontline health workers and mobilise community volunteers	Ward level	Non-Structural (Capacity Building)	Poor heat illness response capacity	12 lakhs	NCC Health Department / Urban Community Volunteers	Development Partners, I/NGOs	No. of people trained; No. of wards covered
ST-NS5	Engage religious and educational institutions in community alerting	Schools, religious centres	Non-Structural (Community Engagement)	Low community alertness and behavioural change	8 lakhs	NCC Social Development / Schools / Religious Institutions	Development Partners, I/NGOs, Community Foundations	No. of institutions engaged; No. of outreach sessions

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Issue to be addressed	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
ST-NS6	Conduct household visits and street campaigns in informal settlements	Low-income neighbourhoods	Non-Structural (Outreach)	Vulnerable groups (unaware or unsupported)	10 lakhs	NCC Social Development / NGOs / Volunteers	NGOs, Ministry of Local Government (MoLGRD)	No. of households reached; % of target covered
ST-NS7	Promote temporary shift in working hours for outdoor workers	Construction sites, markets	Non-Structural (Policy Advisory)	Heat exposure during peak hours	5 lakhs	NCC / DIFE, Department of Labour / Employers / Unions	Labour Ministry, Private Sector	No. of businesses adopting shift; Worker feedback
ST-NS8	Activate temporary misting stations in crowded zones	Markets, transport hubs	Non-Structural (Heat Relief)	Heat exposure in crowded public areas	25 lakhs	NCC Engineering Department	NCC, CSR initiatives	No. of misting points; Daily usage counts
ST-NS9	Set up ward-level rapid response helplines	City wards	Non-Structural (Emergency Response)	Delayed medical assistance	5 lakhs	NCC Health Department/ Volunteers	MoLGRD, Donors	No. of helpline calls; Avg. response time
ST-NS10	Launch social media campaigns using influencers and youth groups	City-wide	Non-Structural (Communication)	Public awareness and behavioural change	5 lakhs	NCC Communications / Youth Groups	Social Media Platforms, NGOs	Reach (impressions); Engagement rate

3.4.3. Short-Term Structural (ST-S) Actions (0 – 1 Year): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
ST-S1	Identify, map, and monitor heat risk zones and vulnerable populations	City wards	Structural (GIS Mapping)	Lack of targeted response due to poor risk knowledge	20 lakhs	NCC Urban Planning Department / GIS Unit	Development Partners, I/NGOs, MoLGRD	Risk maps produced; % of wards mapped
ST-S2	Establish cooling centres in accessible public buildings	Ward offices, schools, halls	Structural (Infrastructure)	Urban heat exposure, lack of safe cooling spaces	2 crore	NCC Engineering Department / NCC Education Department	Climate Adaptation Fund, NCC	No. of cooling centres; Daily users
ST-S3	Deploy mobile health units and water tankers to at-risk populations	Slums, labour-concentrated areas	Structural (Mobile Services)	Immediate medical support and hydration	50 lakhs	NCC Health Dept / Fire Service and Civil Défense (FSCD)/ NGOs	Development Partners, I/NGOs, WHO, MoLGRD	No. of units deployed; No. of beneficiaries
ST-S4	Install temporary shade structures in open work and rest areas	Traffic points, outdoor workplaces	Structural (Shade Infrastructure)	Exposure during peak sun hours	30 lakhs	NCC Engineering Department/ DIFE, Department of Labour /	MoLGRD, CSR	No. of structures; Worker satisfaction
ST-S5	Provide fans and ventilation systems to high-density health facilities	Hospitals, clinics	Structural (Facility Upgrade)	Indoor heat stress for patients and staff	40 lakhs	NCC Health Department / NCC Electrical Department	Health Ministry, Donors	No. of facilities upgraded; Patient satisfaction
ST-S6	Reopen and maintain public	Slums, marketplaces	Structural (Water Infrastructure)	Access to water for hydration	50 lakhs	NCC Water Supply Department/	NCC, MoLGRD	No. of taps reopened;

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
	water taps and fountains					Engineering Department		Functional uptime (%)
ST-S7	Install reflective surfaces on selected public roofs	Municipal buildings	Structural (Urban Cooling)	Heat absorption by buildings	30 lakhs	NCC Engineering Department	MoLGRD, NCC	No. of buildings retrofitted; Temp. reduction (°C)
ST-S8	Ensure uninterrupted power supply in health facilities	Health posts, cooling centres	Structural (Energy Infrastructure)	Power outages impacting cooling	20 lakhs	Dhaka Power Distribution Company Ltd. (DPDC) / NCC Health Department	DPDC, NCC	Downtime reduction (%); No. of facilities covered

3.4.4. Medium-Term Actions (1 – 3 Years)

Focus: Institutionalisation of heat preparedness systems, policy integration, and pilot interventions to reduce urban heat risk.

Non-Structural Strategies:

1. **Appoint a dedicated Heat Officer within NCC:** Institutionalise a permanent role within the Disaster Management Cell responsible for heat action coordination, inter-agency engagement, and implementation tracking.
2. **Establish a Heat Action Task Force for cross-departmental coordination:** Create a cross-sectoral platform with representation from Health, Environment, Education, Fire Service, Meteorology, NGOs, and community leaders to regularly review heat preparedness and response.
3. **Develop standardised heat emergency response protocols:** Establish thresholds (yellow, orange, red) linked to response actions such as activation of cooling centres, SMS alerts, and deployment of mobile units. Integrate protocols into city's DRM framework.
4. **Introduce citywide heat early warning dissemination protocols:** Design a tiered communication chain from BMD forecasts to NCC alerts to community dissemination through SMS, FM, and ward-level public announcement systems.
5. **Conduct periodic drills and simulations in wards:** Simulate heatwave response scenarios involving health workers, community leaders, and volunteers to test effectiveness of SOPs and identify response gaps.
6. **Integrate heat awareness into school curricula and disaster education:** Incorporate modules on heat safety, hydration, and early symptoms of heat illness in primary and secondary school programmes.
7. **Build capacity of city officials and service providers:** Conduct regular workshops for municipal engineers, health professionals, and field-level staff in partnership with public health institutions and urban planners.
8. **Establish a heat risk knowledge platform and database:** Create a centralised, open-access database with geo-tagged information on heat-related health cases, vulnerable populations, service gaps, and response actions.
9. **Launch city-wide campaigns targeting employers of outdoor workers:** Engage construction firms, rickshaw unions, and markets to raise awareness and promote protective practices like shaded breaks and hydration support.
10. **Develop a roster and rapid deployment system for community volunteers:** Maintain a trained volunteer pool in each ward for rapid mobilisation during extreme heat days, equipped with vests, basic kits, and communication tools.

Structural Strategies:

1. **Pilot nature-based cooling solutions in urban hotspots:** Identify pilot sites to test greening solutions—pocket parks, roadside trees, urban ponds, and rain gardens—with monitoring systems to track temperature reduction.
2. **Implement demonstration projects for cool roofs and reflective buildings:** Select government schools and clinics for demonstration of solar-reflective paint and insulation retrofits. Evaluate cost-effectiveness for city-wide scale-up.
3. **Introduce incentives for green infrastructure in private developments:** implement tax rebates or FAR (floor area ratio) incentives (Currently 10% rebate applicable for rooftop

gardening) for projects incorporating green roofs, shaded façades, and water-efficient landscaping.

4. **Mandate green building elements in revised building codes:** Amend NCC's building regulations to include energy-efficient materials, passive ventilation designs, and green coverage requirements.
5. **Develop heat vulnerability maps for land use planning:** Overlay heat data with socio-economic vulnerability to guide zoning and resource allocation decisions in detailed area planning.
6. **Promote pilot urban heat observatories with universities:** Set up temperature monitoring stations in partnership with academia to collect high-resolution data and support research-informed policy.
7. **Initiate urban corridor greening and shaded footpath pilot projects:** Identify priority walkways for pedestrian shade enhancement using trees, pergolas, and green canopies, especially near schools, hospitals, and markets.
8. **Expand municipal infrastructure for emergency response:** Invest in multi-use facilities that can be used as cooling centres during heatwaves and community halls during regular times.
9. **Design gender- and disability-sensitive cooling infrastructure:** Ensure all public infrastructure (e.g., water stations, rest points) are accessible to women, elderly, and persons with disabilities.
10. **Implement water-sensitive urban design (WSUD) pilots:** Use bioswales, infiltration trenches, and permeable pavements in pilot areas to improve microclimates and reduce heat through moisture retention.

3.4.5. Medium-Term Non-Structural (MT-NS) Actions (1 – 3 Years): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
MT-NS1	Appoint a dedicated Heat Officer within NCC	City-wide (NCC HQ)	Non-Structural	Lack of institutional leadership, poor coordination	6-8 lakh/year	NCC Engineering Department	NCC own fund, MoLGRD, Development Partners, I/NGOs	Officer recruited and roles institutionalised within 6 months
MT-NS2	Establish a Heat Action Task Force	City-wide	Non-Structural	Weak inter-agency coordination, slow response	5 – 8 lakhs (setup), 3 lakh/year (ops)	NCC / DDM / Local NGOs	NCC, Ministry of Disaster Management	Task Force formed and meets quarterly
MT-NS3	Develop standardised heat emergency response protocols	City-wide	Non-Structural	Unclear response thresholds, delayed actions	10 lakhs (development + training)	NCC / DGHS / Fire Service	Health Ministry, Development Partners, I/NGOs	Protocols developed and adopted by all departments
MT-NS4	Introduce heat early warning dissemination protocols	City-wide + vulnerable wards	Non-Structural	Delayed public awareness, high exposure	20 – 25 lakhs (infrastructure + training)	NCC, BMD, Mobile Operators	Development Partners, I/NGOs, mobile operator CSR	Warning system operational with SMS reach to 10,000+ residents
MT-NS5	Conduct periodic drills and simulations	Selected wards	Non-Structural	Lack of preparedness, response gaps	5 lakhs/year	NCC / Ward Councillors / FSCD	Development Partners, I/NGOs	At least 10 wards conduct annual heat drills
MT-NS6	Integrate heat awareness into school curricula	Schools (Govt. and Private)	Non-Structural	Low child and teacher awareness	8 – 10 lakhs	NCC / Schools / NGOs	Development Partners,	Curriculum updated in 50%

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
							I/NGOs, MoEdu	of public schools
MT-NS7	Build capacity of city officials and service providers	City-wide	Non-Structural	Low institutional knowledge	15 lakhs/year	NCC / MoLGRD / DGHS	Development Partners, Donors, WHO, MoLGRD	200+ officials trained with >80% post-test score
MT-NS8	Establish a heat risk knowledge platform and database	City-wide	Non-Structural	Data gaps, poor monitoring	20 lakhs (design + 5 lakh/year ops)	NCC / Schools, Colleges / DoE	ICT Division, Development Partners, I/NGOs	Online platform launched and regularly updated
MT-NS9	Launch campaigns for employers of outdoor workers	Industrial zones, markets	Non-Structural	High vulnerability among workers	10 – 12 lakhs/year	NCC / DIFE, Department of Labour / NGOs	Factory CSR, ILO, GOB	50+ employers sensitised; posters in 100+ workplaces
MT-NS10	Develop volunteer deployment system	All wards	Non-Structural	Slow local mobilisation	12 – 15 lakhs (equipment, training)	NCC / Bangladesh Red Crescent Society / Urban Community Volunteers	Development Partners, I/NGOs, Ward Budgets	500+ volunteers trained and mobilised annually

3.4.6. Medium-Term Structural (MT-S) Actions (1 – 3 Years): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
MT-S1	Pilot nature-based cooling solutions	Heat hotspots (e.g., slums, market zones)	Structural	Urban heat islands, lack of green cover	30 – 50 lakhs/pilot	NCC / LGED / DoE / NGOs	Development Partners, I/NGOs	At least 3 pilot sites implemented and temperature reduction monitored for 12 months
MT-S2	Demonstrate cool roofs and reflective buildings	Govt. schools, clinics	Structural	Indoor overheating, health risks	10-12 lakhs/building	NCC / Ministry of Health and Family Welfare (MoHFW) / Local contractors	Development Partners, I/NGOs	10,000 m^2 of reflective surfaces completed; indoor temperature drops by 3 – 5°C
MT-S3	Incentivise green infrastructure in private development	New construction zones	Structural	Unregulated building heat traps	Policy-linked (rebates, incentives)	NCC / MoHPW	Real Estate CSR, NCC Policy Incentives	5+ private developments include green infrastructure under incentive scheme each financial year
MT-S4	Mandate green elements in building codes	City-wide	Structural (Regulatory)	Heat trapping from built forms	-	NCC / MoHPW / RAJUK	Development Partners,	Updated codes gazette and 25% of

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
							I/NGOs, MoLGRD	new buildings compliant within 2 years
MT-S5	Develop heat vulnerability maps	Urban Planning Cell	Structural (Planning Tool)	Unplanned development in heat-prone areas	25 lakhs	NCC Urban Planning Department	ICT Ministry, Development Partners	Digital maps integrated into NCC's planning tools; updated biennially
MT-S6	Promote heat observatories with universities	Pilot wards, academic campuses	Structural + Research	Lack of real-time climate data	15 – 20 lakhs	NCC / BMD	UGC, Research Grants, Development Partners, I/NGOs	3 observatories are functional; real-time data used in NCC's alert system
MT-S7	Urban corridor greening and shaded footpaths	Schools, hospitals, transport hubs	Structural	Heat exposure in walkable areas	50 – 70 lakhs/pilot zone	NCC / LGED / DoE	Development Partners, I/NGOs, GCF, MoLGRC	5+ km of shaded corridors; foot traffic increased by 10-20%
MT-S8	Expand emergency response infrastructure	High-density wards	Structural	Lack of cooling centres	1 – 1.5 crores/site	NCC / DDM / NGOs	Development Partners, I/NGOs	3 cooling centres operational; 10,000+ people served per season

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
MT-S9	Gender and disability-sensitive cooling infrastructure	All public infrastructure	Structural	Inequitable access to relief	Included in cooling infrastructure (S8)	NCC / Ministry of Social Welfare (MoSW) / NGOs	Development Partners, I/NGOs	100% of new centres meet accessibility standards; satisfaction surveys >60%
MT-S10	Implement WSUD pilots	Pilot areas with poor drainage	Structural (Green Infrastructure)	Lack of moisture retention, high surface heat	60 – 80 lakhs/pilot	NCC / LGED / DoE	Donors, Development Partners, I/NGOs	At least 2 WSUD systems functional with visible vegetation and soil cooling per financial year

3.4.7. Long-Term Actions (3+ Years)

Focus: Mainstreaming heat resilience into city planning, infrastructure development, and sustainable financing.

Non-Structural Strategies:

1. **Integrate Heat Action Plan (HAP) into Detailed Area Plan (DAP) and AAPs:** Advocate for HAP principles to be embedded into RAJUK and NCC's urban planning instruments, including zoning, setback regulations, and building design guidelines.
2. **Institutionalise sustainable financing mechanisms for heat resilience:** Establish a Climate Resilience Fund within NCC's budget. Mobilise funds through national adaptation programmes, international climate funds (GCF, Adaptation Fund), and PPPs.
3. **Develop inclusive urban policies addressing climate-induced migration:** Recognise and plan for influx of heat-affected migrants by promoting inclusive housing, health services, and livelihood support in city plans.
4. **Develop real-time heat monitoring and response dashboards:** Create a centralised digital dashboard to track heatwave alerts, response actions, health impacts, and community feedback for data-driven decision-making.
5. **Institutionalise partnerships with Red Crescent, NGOs, and public health actors:** Sign long-term MoUs with emergency response and health agencies to jointly plan and implement heat adaptation interventions.
6. **Mainstream heat risk into urban resilience and DRR frameworks:** Include heatwaves as a formal hazard in city-level risk assessments, disaster management plans, and climate resilience strategies.
7. **Establish NCC as a national model for urban heat resilience:** Position Narayanganj as a pioneering city by documenting learnings, publishing case studies, and sharing experience with peer cities.
8. **Incorporate climate-health linkages into city development strategies:** Integrate urban health surveillance, mental health services, and occupational health monitoring into development planning to address heat stress effects.
9. **Strengthen governance mechanisms for inter-agency climate coordination:** Create a standing committee on urban climate resilience to align NCC's climate actions with national frameworks and ensure departmental coordination.
10. **Promote innovation through research and technology incubation:** Partner with universities and start-ups to develop heat mitigation technologies, conduct behavioural studies, and trial sensor-based monitoring systems.

Structural Strategies:

1. **Expand urban forestation and develop green belts:** Undertake large-scale tree plantation drives along roads, canals, and industrial peripheries, coupled with long-term maintenance plans.
2. **Restore and conserve urban water bodies as cooling ecosystems:** Rehabilitate ponds, canals, and lakes across the city, remove encroachments, and maintain clean water to enable evaporative cooling benefits.
3. **Implement building-level energy efficiency retrofits city-wide:** Promote insulation, ventilation, solar shading, and cool roofing in public and private buildings with subsidies, technical support, and certification schemes.

4. **Mandate green infrastructure in all new large-scale developments:** Require major housing and commercial projects to include a minimum percentage of green cover, water features, and passive cooling design.
5. **Design a heat-resilient urban transport system:** Ensure bus stops, pedestrian zones, and NMT lanes are shaded, cooled, and well-ventilated. Consider using heat-resistant materials in road construction.
6. **Develop heat-resilient affordable housing schemes:** Build low-cost, thermally efficient housing using local materials, improved ventilation, and cool roofing for vulnerable communities.
7. **Adopt water-sensitive land use planning:** Integrate stormwater retention, blue-green corridors, and recharge zones into future land use plans to lower city temperature and improve urban ecology.
8. **Scale up citywide rooftop gardens and vertical greening:** Launch municipal programmes offering incentives for residential and commercial buildings to establish rooftop gardens, creepers, and green facades.
9. **Develop a citywide passive design guideline:** Publish and promote guidelines on passive design, including building orientation, shading devices, and natural ventilation suited to Narayanganj's climate.
10. **Invest in renewable energy for public facilities:** Install solar PV systems and solar water pumps in hospitals, community centres, and water stations to reduce dependency on grid power during heat emergencies.

3.4.8. Long-Term Non-Structural Actions (LT-NS) (3+ Years): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
LT-NS1	Integrate Heat Action Plan (HAP) into Detailed Area Plan (DAP) and AAPs	City-wide / Urban Planning	Non-Structural (Planning Integration)	Heat vulnerability in urban development	15 – 20 lakhs (policy integration + advocacy)	NCC Planning Dept / RAJUK	Development Partners, I/NGOs, MoLGRD	HAP integrated into 100% of planning docs
LT-NS2	Institutionalise sustainable financing mechanisms for heat resilience	NCC Budget, climate funds	Non-Structural (Financial Planning)	Funding gaps for heat adaptation	10 – 12 lakhs (fund setup and admin)	NCC Finance Department	Development Partners, I/NGOs, MoLGRD	Dedicated heat budget line operationalised annually
LT-NS3	Develop inclusive urban policies for climate-induced migration	City-wide	Non-Structural (Policy Reform)	Vulnerability of migrant populations	20 lakhs (policy research + drafting)	NCC Social Welfare Department / MoHFW	Development Partners, I/NGOs	Climate migration addressed in urban policy within 3 years
LT-NS4	Develop real-time heat monitoring and response dashboards	City-wide digital platform	Non-Structural (Technology/Info)	Delayed decision-making, lack of data	40 lakhs (system design + integration)	NCC ICT Unit / BMD / Health Dept	ICT Division, SDF, World Bank	Dashboard used by 5+ city depts; live updates every 2 hours during peak heat
LT-NS5	Institutionalise partnerships with Red Crescent, NGOs, health actors	City-wide coordination	Non-Structural (Partnership Building)	Fragmented response and capacity	5 – 8 lakhs/year (coordination costs)	NCC / Bangladesh Red Crescent Society / NGOs	Development Partners, I/NGOs	MoU signed with 5 key actors; 2 annual joint drills held

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
LT-NS6	Mainstream heat risk into urban resilience and DRR frameworks	City-wide	Non-Structural (DRR Integration)	Heatwave risks unaccounted in DRR	15 lakhs (policy alignment + training)	NCC / DMC / Department of Disaster Management (DMD)	Development Partners, I/NGOs	Heat explicitly included in 100% of DRR documents
LT-NS7	Establish NCC as a national model for urban heat resilience	City-wide / National level	Non-Structural (Knowledge Sharing)	Limited replication of best practices	10 lakhs (documentation + dissemination)	NCC / MoLGRD / Media	MoLGRC, Development Partners, I/NGOs	NCC featured in 3+ national knowledge products
LT-NS8	Incorporate climate-health linkages into city strategies	Health and Urban Planning Sectors	Non-Structural (Cross-sectoral Planning)	Health impacts of heat poorly addressed	25 lakhs (policy + training)	NCC Health Department / Urban Planning	Development Partners, I/NGOs, Health Ministry	Health data and climate plans linked; 2 joint actions/year
LT-NS9	Strengthen governance for inter-agency climate coordination	City-wide governance	Non-Structural (Governance Reform)	Weak departmental coordination	10 lakhs (committee setup + facilitation)	NCC Executive Office / MoEFCC	MoLGRC, Development Partners, I/NGOs	Climate Core Team meets quarterly with action tracking
LT-NS10	Promote innovation through research and tech incubation	City-wide / Academic partnerships	Non-Structural (Innovation Support)	Lack of new solutions for heat mitigation	30 lakhs/year	NCC / Schools, Colleges / Startups	Innovation Funds, Private Sector	2+ pilots supported/year; at least 1 scaled up

3.4.9. Long-Term Structural Actions (LT-S) (3+ Years): Indicative Cost, Potential Funding Sources, and KPIs

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
LT-S1	Expand urban forestation and develop green belts	Roads, canals, industrial peripheries	Structural (Large-scale greening)	Urban heat islands, lack of green cover	5 – 8 crores (multi-year)	NCC / Department of Forest / LGED	MoLGRC, Development Partners, I/NGOs	10,000+ trees planted; satellite greening index improved
LT-S2	Restore and conserve urban water bodies	Ponds, canals, lakes city-wide	Structural (Ecosystem restoration)	Cooling through evaporative effects	8 – 10 crores	NCC Water Department / DoE	MoLGRC, Development Partners, I/NGOs	3+ wetlands restored; 2°C local drop recorded
LT-S3	Implement building-level energy efficiency retrofits	Public and private buildings	Structural (Energy Efficiency)	Indoor overheating, energy use	2 – 4 crores (pilot phase)	NCC / MoHPW / Private Sector	Energy Efficiency Fund, Development Partners, I/NGOs	100 buildings retrofitted; energy savings ≥20%

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
LT-S4	Mandate green infrastructure in large developments	New housing, commercial zones	Structural (Regulatory)	Heat trapping from built environment	Policy linked, admin costs	NCC Planning Dept / MoHPW	NCC, National Govt., Donor Programmes	80% of large devs. Meet green criteria post-policy
LT-S5	Design heat-resilient urban transport systems	Bus stops, pedestrian zones, NMT lanes	Structural (Transport Infrastructure)	Heat exposure for commuters	5 crores+ (pilot corridors)	NCC Transport Department / Dhaka Transport Coordination Authority (DTCA)	Development Partners, I/NGOs	5 corridors shaded; ridership satisfaction >70%
LT-S6	Develop heat-resilient affordable housing	Vulnerable communities	Structural (Housing Development)	Vulnerable populations' heat exposure	5 crores (model housing units)	NCC / Ministry of Housing	Development Partners, I/NGOs, National Housing Fund	200+ units built with passive cooling and green cover
LT-S7	Adopt water-sensitive land use planning	Future land use plans	Structural (Planning Integration)	Urban heat via land mismanagement	20 lakhs (policy + GIS)	NCC Urban Planning Department	Development Partners, I/NGOs, Local Fund	100% new zoning includes WSUD principles

Project No.	Intervention / Project Name	Implementation Area	Type of Intervention	Heat Issues to be Reduced	Tentative Cost (BDT)	Implementing Agency (Lead / Support)	Potential Funding Sources	Key Performance Indicators (KPIs)
LT-S8	Scale up citywide rooftop gardens and vertical greening	Residential and commercial buildings	Structural (Urban greening)	Urban heat and poor air quality	1 – 2 crores/year incentives	NCC / Real Estate Developer Association	CSR Funds, NCC Incentives	5,000 m^2 added per year; 5% air quality improvement
LT-S9	Develop citywide passive design guidelines	Construction and planning sectors	Structural (Design Guidance)	Overheating due to poor design	15 lakhs (publication and outreach)	NCC Urban Planning Department	Development Partners, I/NGOs, Building Councils	Guidebook published; 10+ workshops held per financial year
LT-S10	Invest in renewable energy for public facilities	Hospitals, community centres, water stations	Structural (Renewables)	Grid dependency during heat emergencies	5 – 8 crores (solar PV + pumps)	NCC / Energy Dept	SREDA, DPDC, MoLGRC, Development Partners, I/NGOs	20% energy from solar in key sites; emissions reduced

3.4.10. Gender Sensitive Interventions (Community Guidelines)

Target Group	Household-level activities	Neighborhood/Community Activities	Collective Action and Advocacy
All groups	• Hydration: Drink safe water/ORS every hour during heat alerts. Teach children to recognise thirst. • Cooling: Use damp cloths on neck/wrists, take cool showers 2-3 times/day. Wet curtains at doors/windows. • Timing: Avoid outdoor work/cooking 11 AM-3 PM. Shifting chores to cooler hours.	• Shade Sharing: Plant fast-growing trees (neem, mango) in courtyards; set up shared community awnings. • Water Stations: Place jugs of drinking water + ORS in accessible community spots (mosques, shops, tea stalls). • Buddy System: Pair vulnerable individuals with neighbors for daily heatwave check-ins.	• Form Community Heat Committees with 50% women/PWD representatives to identify risks and coordinate responses. • Advocate for public cooling spaces and affordable water access in slums.
Women and girls	• Task Sharing: Rotate outdoor chores (water/ration collection) among household women to reduce exposure. • Pregnancy Care: Rest in coolest room; monitor for swelling/dizziness. Use handheld fans. • Safe Cooking: Cook early morning/late evening; use pressure cookers to reduce stove time.	• Women's Groups: Create self-help groups to sew cooling scarves (soaked in water), share childcare during heat emergencies. • Mobile Care: Organise rotating care for sick/elderly to reduce individual women's burden.	• Demand gender-segregated, well-lit cooling centers near homes. • Lobby for flexible work hours for home-based workers (garment, food processing) during heat waves.
Elderly and persons with disabilities (PWDs)	• Home Adaptation: Paint roofs white; use bamboo mats/reflective on walls. Keep medicines in a cool place. • Mobility: Use mobility aids early to avoid falls in the heat. • Keep phones charged for emergencies. • Cooling Kits: Stock towels, water spray,	• Doorstep Support: Volunteers deliver water, check on isolated elderly/PWDs twice a day during alerts. • Accessible Rest Points: Create shaded benches with handrails near homes/markets.	• Map barrier-free routes to the cooling centre. Train volunteers to assist PWDs during evacuations. • Push for subsidised home retrofits (insulation, ventilation)

Target Group	Household-level activities	Neighborhood/Community Activities	Collective Action and Advocacy
	battery fan, and emergency contacts.		for vulnerable households.
Children	• Play Safety: Restrict outdoor play during peak heat. Use indoor games (puzzles, storytelling). • Clothing: Dress in light cotton; use wide-brimmed hats. Teach "stop-play" signals (dizziness/nausea). • Hydration Reminders: Parents/guardians track water intake; add lemon/cucumber for flavor.	• Cool Play Zones: Set up shaded play areas with water sprinklers/misters in community courtyards. • Childcare Pools: Rotate supervision among parents to allow rest for working caregivers.	• Petition schools for heat-adjusted timings and mandatory shaded playgrounds. • Train adolescents as "Heat Helpers" to assist younger children.
Informal Workers (rickshaw pullers, street vendors, labourers)	• Self-Protection: Use an umbrella/hat, wrapping a wet cloth around the neck. Take 5-minute shade breaks hourly. • Hydration Packs: Carry two water bottles + ORS sachets. Avoid sugary drinks/alcohol. • Footwear: Wear breathable shoes to prevent burns from hot surfaces.	• Worker Groups: Pool funds to buy shared shade tents/cooling vests for worksites. • Community Alerts: Use WhatsApp groups to share real-time heat warnings and rest locations.	• Unionise to demand employer-provided shade/water at workplaces (construction, markets). • Campaign for heat hazard pay during extreme alerts.
Slum dwellers	• Ventilation: Create cross-breezes by opening opposite windows. Elevate beds for airflow. • Water Storage: Cover water containers to keep cool; add drops of bleach for safety if needed. • Fire Safety: Check electrical wiring; avoid overloading sockets for fans/coolers	• Community Cooling: Use hand-pumps/public taps to wet streets/roofs. Share fans during outages. • Slum Committees: Organise clean-ups to clear drains (reduce humidity) and fire hazards.	• Document heat impacts (e.g., health logs) to demand municipal cooling infrastructure. • Partner with NGOs for low-cost cool roof programmes (reflective paint, green mats).

4. Implementation

4.1. Current Institutional Setup

To propose a comprehensive institutional framework for implementing the HAP, the current institutional setup and readiness of NCC in addressing extreme heat risks and to identify critical areas for intervention, a comprehensive gap assessment was undertaken using a structured scoring framework. This framework interprets scores on a scale from 1 (Critical) to 5 (Very High), offering a clear indication of progress and highlighting the urgency of action required across multiple thematic areas (Table 8). Each score corresponds to a defined performance level – ranging from urgent action needed to comprehensive and effective performance – thereby enabling a systematic analysis of NCC's institutional strengths and weaknesses.

Table 8: Gap Assessment Score Interpretation

Score	Level	Status
1 – 1.9	Critical	Urgent action is required across all categories
2 – 2.9	Low	Significant improvements needed
3 – 3.9	Moderate	Progress is being made, but there are still gaps
4 – 4.9	High	Good performance with minor gaps
5	Very High	Comprehensive and effective across all categories

Table 9 illustrates the average assessment scores across key categories such as existing infrastructure, public awareness, financial readiness, and governance, providing a snapshot of the city's current state of preparedness. The assessment covers key components such as existing infrastructure, heat response systems, public awareness, policy and governance, financial readiness, institutional coordination, technical capacity, and environmental resilience. It was conducted in close consultation with NCC officials from relevant departments to ensure the analysis reflects ground-level realities and institutional perspectives.

Table 9: Gap Assessment Scores of NCC

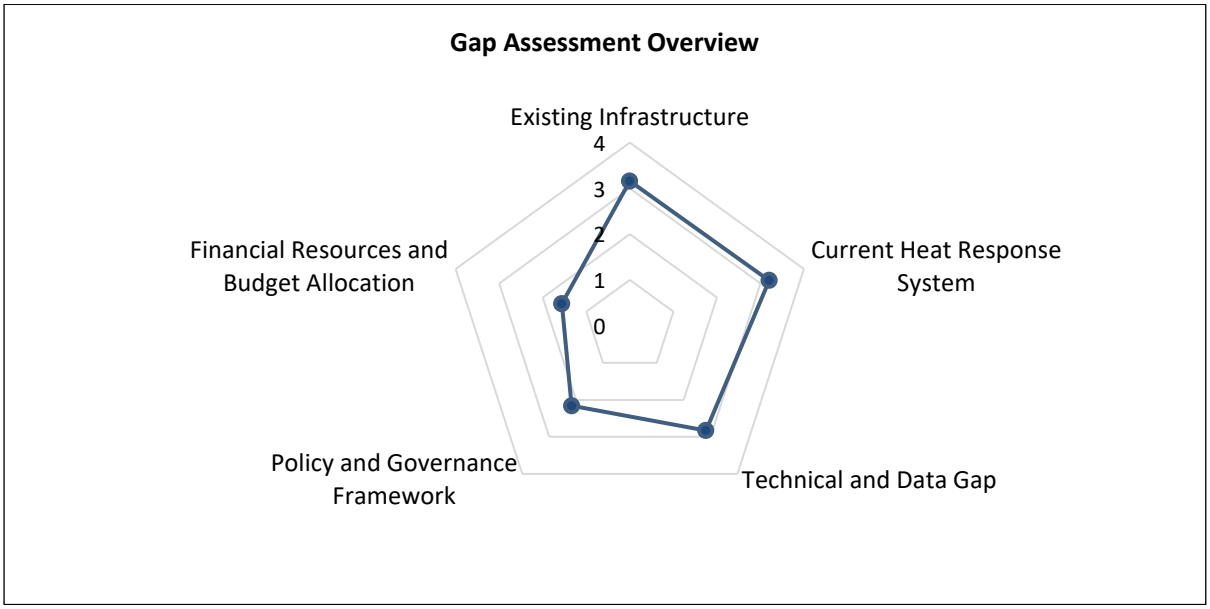
Assessment Category	Average Score	Level	Status
Existing Infrastructure	3.16	Moderate	Progress is being made, but there are still gaps
Current Heat Response System	3.2	Moderate	Progress is being made, but there are still gaps
Technical and Data Gap	2.83	Low	Significant improvements needed
Policy and Governance Framework	2.16	Low	Significant improvements needed
Financial Resources and Budget Allocation	1.56	Critical	Urgent action is required across all categories

Source: KII, ICLEI South Asia

The results reveal a mixed picture of moderate progress and critical challenges. Both existing infrastructure (average score: 3.16) and the current heat response system (3.2) fall within the

moderate category, indicating that while foundational systems are in place, significant gaps persist that require strengthening. Technical and data gap (2.83) and the policy and governance framework (2.16) scored low, highlighting the need for targeted outreach, capacity building, and policy reforms. Most notably, financial resources and budget allocation received a critical score of 1.56, underscoring an urgent need for dedicated funding mechanisms and investment to operationalise the HAP effectively.

The spider diagram (Figure 26) further visualises these scores across categories, providing a comparative overview of strengths and weaknesses in the city's current heat resilience landscape.



Source: KII, ICLEI South Asia

Figure 26: Gap Assessment Overview of NCC

In addition, the following tables detail the specific gaps identified across various domains:

Table 10: Policy and Governance Framework

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
City-Level Climate Planning	NCC operates under a traditional urban governance model, focused on service delivery (drainage, waste management, roads) with minimal climate integration.	No dedicated Climate Resilience or Environment Cell within NCC to coordinate climate adaptation, including heatwaves.	Engineering and Urban Planning Section of NCC
Policy Mandate	Bangladesh's National Adaptation Plan and BCCSAP (2009) highlight extreme heat, but they are national-level documents with	Lack of city-specific policy or bylaws that mandate the development or implementation of Heat Action Plans or urban heat resilience.	Local Government Division (LGD), Local Government Engineering Department (LGED)

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
	no specific urban or local operationalisation for secondary cities like Narayanganj.		
Disaster Risk Management Integration	The Government of Bangladesh (GoB) recently declared heat waves a disaster category, but DRR implementation remains focused on floods and cyclones.	Heatwaves are not fully integrated into NCC's risk reduction protocols or contingency planning.	Engineering and health department of NCC
Inter-agency Coordination	Agencies like the Bangladesh Meteorological Department (BMD), the Directorate General of Health Services (DGHS), and local health offices operate separately without a coordinated mechanism.	Absence of an institutional coordination mechanism for early warning dissemination, health response, and emergency preparedness for heatwaves.	NCC, BMD, DGHS, DPHE

Table 11: Technical and Data Gaps

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
Weather and Climate Data	BMD provides temperature forecasts at the district level (e.g., Dhaka Division), with limited real-time sub-district resolution. Narayanganj lacks automated weather stations (AWS) for hyper-local data.	No city-level, real-time data on temperature, relative humidity, or Heat Index (HI), limiting risk communication and warning accuracy.	BMD
Heat Vulnerability Assessment	There is no existing GIS-based assessment of vulnerable populations (e.g., slum dwellers, the elderly, and outdoor workers). More than 20% of Narayanganj's workforce are informal laborers, many of whom work outdoors.	Lack of spatial identification of high-risk areas and populations (schools, informal settlements, construction zones, garment factories).	Department of Environment (DoE), NCC

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
Health Surveillance Data	DGHS and NCC health records show that heatstroke and heat-related illness data are not systematically collected or categorised.	The absence of a health surveillance protocol for heat illness leads to underreporting and a lack of evidence for HAP justification.	DGHS, District Commissioner (DC) office, NCC
Impact Projection Tools	No modelling tools were used to project future urban heat scenarios in light of urban growth and climate change.	NCC lacks the technical capacity and partnerships to undertake predictive modelling or climate scenario planning for heat risks.	NCC

Table 12: Current Heat Response System

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
Municipal Human Resources	NCC currently does not employ any environmental planners or climate adaptation specialists. The health department is understaffed and has limited in-house training programs.	Limited institutional and staff capacity to prepare, manage, and operationalise a HAP.	NCC
Public Risk Perception and awareness	Community-level awareness of heatwave health risks is negligible. Field interviews indicate that residents view excessive heat as a discomfort, not a health hazard.	No city-level risk communication strategy or public awareness campaign about heatwave impacts or protective actions.	NCC
Training and Protocols	No Standard Operating Procedures (SOPs) or training modules exist for emergency response teams, school teachers, or health workers related to heat events.	Key frontline actors (clinics, paramedics, school authorities) lack the knowledge or resources to respond to heat emergencies.	NCC
Community Engagement	No heat preparedness messaging exists in schools, public transportation hubs, or community centers.	Structured community outreach or heatwave preparedness initiatives using local volunteers or ward-level structures are absent.	DC Office, NCC

Table 13: Existing Infrastructure

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
Urban Heat Island (UHI)	Narayanganj is densely built with industrial zones and a few open green areas. NDVI analysis shows less than 8% green cover in core urban wards. Surface temperature mapping (via Landsat) indicates 2-4°C higher land temperature in built-up areas than peri-urban zones.	No urban greening strategies, reflective roofing programs, or building guidelines to reduce UHI intensity.	Rajdhani Unnayan Kartripakkha (RAJUK), NCC
Rejuvenation of public water bodies and biodiversity conservation	Six major rivers surround Narayanganj, and within the city area, there are numerous canals, ponds, and public water bodies that need to be conserved to enhance local biodiversity and mitigate heat.	Illegal encroachment on canals and water bodies, along with improper adherence to zoning regulations, is a significant issue. In addition, industrial pollution poses serious environmental concerns.	DoE, Department of Fisheries, Department of Forestry
Cooling Infrastructure	Street vendors, rickshaw pullers, and traffic police work in exposed conditions without shade structures. The city lacks public water fountains or cooling shelters.	No provision for temporary cooling shelters, shaded bus stops, or heat-safe zones in marketplaces or transport nodes.	NCC
Building Design	Most low-income housing areas have poorly ventilated tin-roof structures, exacerbating indoor heat. Passive cooling design in buildings is not enforced.	Building permit processes do not incorporate thermal comfort guidelines or materials regulations to mitigate indoor heat risks.	RAJUK
Critical Service Infrastructure	Public hospitals and clinics lack backup cooling systems or heatwave response protocols.	Vulnerable infrastructure lacks climate-proofing against extreme heat, and there is no contingency planning for a surge in heat-related illnesses during peak summer.	DGHS

Table 14: Financial Resource and Budget Allocation

Aspect	Observations	Gaps Identified	Responsible Department/ Authority
Budget Allocation	NCC's Annual Development Program (ADP) 2023 – 24 does not specifically allocate funds for climate resilience or public health response to heatwaves.	Absence of a dedicated budget line for HAP development, early warning dissemination, or public cooling infrastructure.	NCC
Climate Finance Access	NCC has developed some small-scale national/international climate fund project proposals (e.g., Green Climate Fund (GCF), Least Developed Countries Fund (LDCF), ICLEI TAP grants, etc.).	Limited capacity to tap into external resources or technical assistance programs for sub-national climate adaptation.	NCC
Private Sector Involvement	Narayanganj houses over 2000 garment factories and industries, many of which contribute to heat emissions and house vulnerable workers.	Lack of private sector engagement in corporate responsibility for workplace cooling, tree plantation, or heat risk insurance.	Public Sector Associations
Strategic Partnerships	No formal collaboration with academic institutions (e.g., Bangladesh University of Engineering and Technology (BUET), Institute of Water and Flood Modelling (IWFM), Dhaka University) or civil society for knowledge sharing, research, or pilot interventions.	Weak institutional network to co-develop and monitor HAP interventions with evidence-based support.	NCC

These findings reveal critical institutional gaps that require strategic interventions. To further refine and develop effective strategies, additional stakeholder consultations were held with key representatives from relevant institutions. These consultations validated the identified gaps, uncovered root causes of heat-related challenges, and prioritised issues demanding urgent attention. Employing a problem tree methodology during these discussions allowed for a systematic analysis of the underlying causes and effects of heat vulnerability, which guided the formulation of targeted short-, medium-, and long-term strategies. The results of this participatory process have been thoroughly documented and integrated into the early warning and response framework for heat emergencies, encompassing pre-event preparedness, in-emergency actions, clearly defined emergency response responsibilities, and Measures for sustainable adaptation and resilience building. This approach ensures that the proposed interventions are evidence-based and grounded in the local context.

4.2. Proposed Institutional Setup for Implementing HAP

The successful implementation of the HAP requires strong coordination between internal departments and external agencies. A dedicated Core Team has been formed, comprising representatives from key departments. The Urban Planning Department of NCC has been designated as the lead implementing authority, overseeing coordination, integrating HAP strategies into city development plans, and monitoring the implementation progress. The Core Team will support the Urban Planning Department in operational execution, technical assessments, and stakeholder coordination. The hierarchical structure below (Table 15) illustrates the institutional setup for leading and managing the HAP.

Table 15: Institutional Roles and Responsibilities within NCC for HAP Implementation

NCC Departments	Role / Responsibility
Mayor / Administrator / Chief Executive Officer (CEO)	Provides political leadership, strategic guidance, and policy direction for the implementation of HAP.
Engineering Department, Urban Planning Section (Lead Department)	Overall lead and coordination of HAP implementation; integrates heat-resilient strategies in urban planning and development controls; monitors progress and reports to the Mayor / Administrator / CEO.
Core Team for HAP Implementation	Supports the Urban Planning Department in cross-departmental coordination, technical planning, emergency preparedness, and reporting. Ensures internal and external stakeholder alignment.
Health Department	Leads public health response to heat-related illnesses and awareness raising.
Engineering Department	Implements infrastructure-based adaptation like shaded areas, cool roofs, and ventilation improvements.
Conservancy Department	Supports greening interventions and monitoring of urban heat islands.
Social Welfare and Development Department	Disseminates information on heat alerts and coping strategies to the public, media, and stakeholders.
Accounts Department	Ensuring the smoothness of resource allocation for HAP activities.

The table (Table 16) below presents a structure outlining how NCC will coordinate and collaborate with external stakeholders across short, medium, and long-term phases. It defines the key functions of NCC's internal units and their engagement with external departments to ensure proactive, inclusive, and sustained heatwave management.

Table 16: Interdepartmental and External Coordination Framework for HAP Implementation

NCC Departments	Coordination Role	Key External Partners	Coordination Mechanism / Tools	Implementation Phase
Mayor / Administrator /	Overall leadership and political support	All line departments,	City-level coordination	All Phases

NCC Departments	Coordination Role	Key External Partners	Coordination Mechanism / Tools	Implementation Phase
Chief Executive Officer	for plan implementation	development partners	meetings, policy directives	
Health Department (NCC)	Manage heat-related illness response and community awareness	Hospitals, DGHS, NGOs	Health bulletins, mobile clinics, and public awareness drives	Short- to Medium-Term
Engineering Department	Integrate climate-resilient and heat-adaptive designs in design, planning and implementation	RAJUK, DoE, DPHE	Development control rules, zoning plans	Medium- to Long-Term
Public Relations/Communications Cell	Disseminate heat alerts and risk information to the public	Mobile operators, media houses	Mass SMS, TV/Radio announcements, social media	Short-Term
Engineering Department	Implement infrastructure interventions (cool roofs, shaded spaces)	LGED, NGOs, donors, development partners	Joint implementation projects, technical designs	Medium- to Long-Term
Water Supply and Sanitation Cell	Ensure water supply and hygiene during heatwaves	LGED, MoLGRC	Contingency water supply plans, water demand and supply management	Short- to Medium-Term
Waste Management Unit	Monitor urban heat islands, promote greenery and waste recycling	DoE	Urban greening schemes, temperature monitoring	Medium- to Long-Term
Social Welfare and Community Services	Support vulnerable groups (elderly, women, children)	Ministry of Social Welfare, NGOs	Community-based heat shelters, support networks	All Phases
ICT / Digital Services	Support data management and digital heat monitoring	ICT Division, BMD	Digital dashboard, real-time data tracking	Short- to Medium-Term
Accounts Department	Allocate and monitor funds for HAP activities	Donors, Ministry of Finance, Ministry of Planning, MoLGRC	Budget allocation frameworks	All Phases

5. Review and Update

The Heat Action Plan (HAP) for Narayanganj City Corporation (NCC) is designed as a five-year action plan, to be reviewed and revised after each five-year period to maintain its relevance, effectiveness, and alignment with evolving climate risks and community needs.

The review will evaluate the performance of existing interventions, analyse recent heatwave occurrences, assess health impacts, incorporate community feedback, and appraise institutional capacity. Findings from this assessment will guide updates to the plan, including the integration of the latest scientific data, enhancements to early warning systems, refinement of health advisories, and improvements in public awareness campaigns. Special emphasis will be placed on bolstering support for vulnerable populations and reinforcing inter-agency coordination mechanisms.

A yearly evaluation will be conducted to monitor the ongoing implementation and immediate effectiveness of interventions, while a mid-term evaluation will take place 2.5 years after each five-year review cycle to assess overall progress and identify necessary adjustments. All evaluation findings, review outcomes, updates, and progress reports will be documented and disseminated through the NCC website, ward-level meetings, and official publications to ensure transparency, accountability, and sustained community engagement.

A detailed Monitoring and Evaluation (M&E) framework, outlining specific indicators, responsibilities, timelines, and resource requirements for all HAP interventions, is provided in Annex 5 to facilitate systematic tracking and assessment.

6. Annexures

6.1. Annex 1: HAP Approval Letter

নারায়ণগঞ্জ সিটি কর্পোরেশন
Narayanganj City Corporation
নগর ভবন, ১০ বঙ্গবন্ধু সড়ক, নারায়ণগঞ্জ-১৪০০, বাংলাদেশ।
www.ncc.gov.bd

Memo No: Urban planning/Engr/heat action plan/16/2023-24/ 228 Date: 19/02/2025

Subject: Approval and Formation of Core Team for the Development of Heat Action Plan

This is to inform you that the "Heat Action Plan" is being prepared under the Climate Adaptation and Resilience (CLARE) project, funded by UK International Development and IDRC Canada and implemented by ICLEI-Local Governments for Sustainability (South Asia). The necessary actions for formulating the "Heat Action Plan" received approval during the second monthly meeting on 20 November, 2024.

A four-member core team has been formed to ensure the successful implementation of this project. The team will coordinate the initiative's planning, data collection, and execution and assist the ICLEI team when necessary.

Sl	Name	Designation	Committee designation
1.	Mr. Md. Abdul Aziz	Superintend Engineer Narayanganj City Corporation	Secretary
2.	Mr. A S M Moshiur Rahman	Executive Engineer Narayanganj City Corporation	Member
3.	Sub Assistant Director	Department of Environment Narayanganj	Member
4.	Mr. Md. Moinul Islam	Urban Planner Narayanganj City Corporation	Member Secretary

This letter is issued for your information.

19.02.25

Mr. Emani Kumar
Deputy Secretary General, ICLEI Global
Executive Director, ICLEI South Asia.

(Mohammad Zakir Hussain)
Chief Executive Officer
Narayanganj City Corporation
E-mail: ceo@ncc.gov.bd
Phone (Office) +8802 224433423

Copy:

1. Urban Planner, Planning & Design Division, Narayanganj City Corporation.
2. Md. Jubaer Rashid, Country Representative, ICLEI South Asia, Bangladesh.
3. Mr. Dipak Bhowmick, Technical Lead, ICLEI South Asia, Bangladesh.
4. Office Copy.

6.2. Annex 2: Community Survey Questionnaire

নারায়ণগঞ্জ সিটি কর্পোরেশন - তাপ কর্ম পরিকল্পনা সংক্রান্ত জরিপ

উদ্দেশ্য: এই জরিপের মাধ্যমে উষ্ণতা কীভাবে বাসিন্দাদের স্বাস্থ্য, দৈনন্দিন জীবন এবং সহায়তা প্রয়োজনীয়তার উপর প্রভাব ফেলে তা বোঝা যাবে। আপনার উত্তরগুলি তাপ-সম্পর্কিত ঝুঁকি কমানোর নীতিগুলো তৈরিতে সহায়তা করবে।

নির্দেশনা: অনুগ্রহ করে সমস্ত প্রশ্নের উত্তর দিন। আপনার তথ্য সম্পূর্ণ গোপন রাখা হবে।

প্রথম ধাপ: সাধারণ তথ্য

1. **বয়সের গ্রুপ:**
   ☐ ১৮-এর নিচে ☐ ১৮-৩০ ☐ ৩১-৫০ ☐ ৫১-৬৫ ☐ ৬৫+
2. **লিঙ্গ:**
   ☐ পুরুষ ☐ নারী ☐ অন্যান্য
3. **পেশা:**
   ☐ বাহিরে কাজ করি (যেমন: নির্মাণ, পরিবহন)
   ☐ ঘরের ভিতরে কাজ করি (যেমন: অফিস, কারখানা)
   ☐ শিক্ষার্থী
   ☐ গৃহিণী
   ☐ অবসরপ্রাপ্ত/বেকার
   ☐ অন্যান্য (উল্লেখ করুন): _____
4. **আপনার বসবাসের এলাকা:**
   ☐ বস্তি/অনানুষ্ঠানিক বসতি
   ☐ অ্যাপার্টমেন্ট/উচ্চ ভবন
   ☐ পৃথক বাড়ি
   ☐ অন্যান্য (উল্লেখ করুন): _____

দ্বিতীয় ধাপ ২: উষ্ণতা সংস্পর্শ ও প্রভাব

5. **তীব্র গরমে আপনি কোন উপসর্গ অনুভব করেন?** (প্রযোজ্য সকল অপশন চিহ্নিত করুন)
   ☐ মাথা ঘোরা ☐ মাথাব্যথা ☐ বমি বমি ভাব
   ☐ পানিশূন্যতা ☐ শ্বাসকষ্ট ☐ অবসাদ
   ☐ কোনো উপসর্গ অনুভব করি না
6. **তীব্র গরমে আপনার বাসা ঠাণ্ডা রাখার উপায় কী?**
   ☐ বৈদ্যুতিক ফ্যান ☐ এয়ার কন্ডিশনার ☐ জানালা খোলা রাখি
   ☐ পানি ছিটিয়ে দেই ☐ কিছুই করি না ☐ অন্যান্য: _____
7. **আপনার বাড়ি/কর্মস্থলের কাছে ছায়াযুক্ত বা শীতল স্থান আছে কি?**
   ☐ হ্যাঁ ☐ না
8. **আপনি বা আপনার পরিবারের কেউ কি গরমের কারণে চিকিৎসা সেবা নিতে বাধ্য হয়েছেন?**
   ☐ হ্যাঁ ☐ না

তৃতীয় ধাপ ৩: ঝুঁকি ও সহায়তার প্রয়োজনীয়তা

9. **আপনার মতে, কোন কোন গোষ্ঠী সবচেয়ে বেশি গরমে ঝুঁকিপূর্ণ?** (প্রযোজ্য সকল অপশন চিহ্নিত করুন)
   ☐ বৃদ্ধ ☐ শিশু ☐ গর্ভবতী নারী
   ☐ বাহিরে কাজ করা শ্রমিক ☐ অসুস্থ ব্যক্তি
   ☐ দরিদ্র/স্বল্প আয়ের পরিবার
10. **আপনি কি তীব্র গরমের জন্য প্রস্তুত মনে করেন?**
   ☐ হ্যাঁ, সম্পূর্ণ প্রস্তুত
   ☐ কিছুটা প্রস্তুত
   ☐ একদম প্রস্তুত নই
11. **তীব্র গরমের সময় আপনি কী কী সমস্যার সম্মুখীন হন?** (প্রযোজ্য সকল অপশন চিহ্নিত করুন)
   ☐ বিদ্যুতের বিল বৃদ্ধি
   ☐ ঘুমের সমস্যা
   ☐ স্বাস্থ্য সমস্যা
   ☐ কর্মস্থল/বিদ্যালয়ে অস্বস্তি
   ☐ পানির সংকট
   ☐ অন্যান্য: _____
12. **আপনার এলাকায় গরমের সতর্কবার্তা বা জরুরি প্রতিক্রিয়া ব্যবস্থা সম্পর্কে জানেন?**
   ☐ হ্যাঁ ☐ না
13. **তীব্র গরম মোকাবিলায় শহর কর্তৃপক্ষের কী ব্যবস্থা নেওয়া উচিত বলে মনে করেন?** (প্রযোজ্য সকল অপশন চিহ্নিত করুন)
   ☐ বেশি গাছ লাগানো ও ছায়াযুক্ত এলাকা তৈরি করা
   ☐ শীতল কেন্দ্র/পাবলিক বিশ্রাম স্থান তৈরি করা
   ☐ বিনামূল্যে পানীয় জলের ব্যবস্থা করা
   ☐ প্রাথমিক সতর্কতা ব্যবস্থা চালু করা
   ☐ স্বাস্থ্য সহায়তা কর্মসূচি
   ☐ সচেতনতা ক্যাম্পেইন

চতুর্থ ধাপ: চূড়ান্ত মতামত

14. **আপনি কি ব্যক্তিগতভাবে গরম কমানোর জন্য কোনো ব্যবস্থা গ্রহণ করেছেন?**
   ☐ হ্যাঁ (উল্লেখ করুন): _____
   ☐ না
15. **শহরে গরমজনিত ঝুঁকি কমাতে আপনার কোনো সুপারিশ আছে?**

_____

ধন্যবাদ! আপনার মতামত নারায়ণগঞ্জকে আরও নিরাপদ ও তাপ সহনশীল শহর হিসেবে গড়ে তুলতে সহায়ক হবে।

6.3. Annex 3: KII Questionnaire

Key Informant Interview (KII) Questionnaire

Project Title: Development of a Heat Action Plan (HAP) for Narayanganj City Corporation in Bangladesh

Interview Details

Date	**:**	
Interviewer	**:**	
Name of Respondent	**:**	
Designation	**:**	
Organization	**:**	
Location	**:**	
Duration of Interview	**:**	

Section 1: Project Brief and Informed Consent

Project Overview

The Heat Action Plan (HAP) for Narayanganj City aims to reduce heat-related risks, improve preparedness, and enhance resilience against rising temperatures and heatwaves. The plan focuses on assessing heat stress, identifying vulnerable populations, and developing strategies for urban planning, healthcare, early warning systems, and community engagement.

As part of this initiative, we are conducting Key Informant Interviews (KIIs) with local government officials, healthcare practitioners, and climate/urban planning experts. These interviews will help us to gather expert insights on heat risks, vulnerabilities, preparedness measures, and policy recommendations. Your expertise will help shape a robust and effective plan. This interview will take approximately **20-25 minutes**.

Informed Consent Statement

Before we begin, we would like to inform you that:

- Your participation is voluntary, and you may withdraw at any time
- The information shared will be used solely for research and policy development related to the Heat Action Plan
- Your responses will be anonymized unless you provide explicit permission to be cited
- The interview may be recorded for accuracy, with your consent

1. Do you consent to participate in this interview?

☐ Yes
☐ No

2. Do you consent to audio recording for documentation purposes?

☐ Yes
☐ No

Section 2: KII Questions (Generic)

1. **What is your area of professional expertise? (e.g. urban planning, climate resilience, public health, or other related fields)**

2. **Have you been involved in previous heat/health risk assessments, climate adaptation planning, or urban resilience projects?**

   ☐ Yes
   ☐ No
   ☐ Other (Please indicate) _____

3. **How familiar are you with heat-related issues in Narayanganj?**

   ☐ Very well informed – I take action for reducing heat impacts and encourage others to do the same.
   ☐ Well informed – I know that heat impacts must be mitigated, but it is a government response.
   ☐ Moderate – I hear about heat impacts in summer from media
   ☐ Less informed – I have not heard about the impacts of heat on health

4. **What sectors in Narayanganj are most affected by extreme heat? (Select all that apply)**

   ☐ Public health
   ☐ Labor and workforce
   ☐ Housing
   ☐ Transportation and mobility
   ☐ Energy and utilities
   ☐ Water supply
   ☐ Economy
   ☐ Environment and ecosystem
   ☐ Education
   ☐ Informal settlements
   ☐ Industry and commerce
   ☐ Others (Please indicate) _____

5. **What are the most vulnerable populations to extreme heat? (Select all that apply)**

   ☐ Outdoor workers
   ☐ Street vendors
   ☐ Slum dwellers
   ☐ Students
   ☐ Elderly population
   ☐ Children
   ☐ Low-income communities

- ☐ Pregnant women
- ☐ Persons with disabilities
- ☐ People with chronic health conditions
- ☐ Homeless population
- ☐ Women in informal settlements
- ☐ Migrant workers
- ☐ Others (Please indicate) _____

6. How would you rate the impact of urbanization on heat risk in Narayanganj?

- ☐ Very high
- ☐ High
- ☐ Moderate
- ☐ Low
- ☐ Very low

7. Over the past decade, Narayanganj has experienced significant temperature variations, with recorded highs reaching up to 40°C and lows dropping to approximately 20°C. Considering Narayanganj's historical temperature range, at what temperature threshold should heat warnings be issued?

- ☐ 32°C
- ☐ 35°C
- ☐ 38°C
- ☐ Other (Please specify): _____

8. What heat mitigation strategies should be prioritized at different times of the day?

Morning	☐ Public advisories	☐ Adjusted working hours	☐ Street cooling measures
	☐ Emergency medical response	☐ Cooling centers activation	☐ Water distribution
	☐ Public awareness campaigns	☐ Electricity load management	☐ Others (Please specify)
Afternoon	☐ Public advisories	☐ Adjusted working hours	☐ Street cooling measures
	☐ Emergency medical response	☐ Cooling centers activation	☐ Water distribution
	☐ Public awareness campaigns	☐ Electricity load management	☐ Others (Please specify)
Evening/Night	☐ Public advisories	☐ Adjusted working hours	☐ Street cooling measures
	☐ Emergency medical response	☐ Cooling centers activation	☐ Water distribution
	☐ Public awareness campaigns	☐ Electricity load management	☐ Others (Please specify)

9. How effective are existing heat-related policies in Narayanganj?

- ☐ Highly effective
- ☐ Effective
- ☐ Moderate
- ☐ Less effective

10. What are the significant gaps in institutional capacity for heat risk management? (Select all that apply)

- ☐ Lack of comprehensive Heat Action Plans
- ☐ Limited inter-agency coordination
- ☐ Weak data and research
- ☐ Poor early warning systems
- ☐ Lack of public awareness
- ☐ Insufficient healthcare preparedness
- ☐ Others (Please specify) _____

11. What key elements should be prioritized in Narayanganj's Heat Action Plan? (Select top 3)

- ☐ Early warning systems
- ☐ Public health preparedness
- ☐ Urban planning and infrastructure improvements
- ☐ Community awareness
- ☐ Workplace protections
- ☐ Emergency response coordination
- ☐ Long-term adaptation

Section 3: KII Questions (Expert Specific)

1. Local Government Officials Section (Focused on: Urban planning, policy, and governance)

- What policies or regulations currently address heat risks in Narayanganj?
- Is your department implementing measures for heat adaptation? If so, what challenges does your department face in implementing heat adaptation measures?
- How can inter-agency coordination be improved for better heat response? Which stakeholders should be involved? What could be their role in supporting your work?
- What financial or technical support is needed to enhance heat resilience?
- What governance mechanisms should be strengthened for better heat management?

2. Academia Section (Focused on: Research, data, and scientific understanding)

- What research has been conducted on heat risk and urban heat islands in Narayanganj? Is there any heat threshold specific to Narayanganj?
- What data sources are critical for assessing heat exposure levels?
- How can academia support data-driven policymaking for heat resilience?
- What role do universities play in training professionals for heat adaptation planning? Possible link to academia and medical professional and government agencies?
- What are the key knowledge gaps in heat resilience strategies that need further research?

3. Health Practitioners/Experts Section (Focused on: Public health preparedness and response)

- How prepared are local healthcare facilities for heat-related illnesses?
- What are the common health impacts of extreme heat observed in Narayanganj?
- How effective are existing public heat advisories and awareness campaigns?
- What interventions can be implemented to reduce heat-related morbidity and mortality?
- What additional resources or training are needed for healthcare professionals? Who can provide such training? Possible link to academia and medical professional and government agencies?

4. Climate Experts Section (Focused on: Climate trends, adaptation, and resilience)

- How has the frequency and intensity of extreme heat events changed in Narayanganj over time?
- What are the primary contributors to increasing heat risks in urban settings?
- How can nature-based solutions help mitigate urban heat islands? Where can it be applied in Narayanganj?
- What role does climate modeling play in forecasting heat risks and preparedness? Are there existing forecasts that the government can follow for planning purposes?
- What are the best practices in heat adaptation planning from other cities that can be applied in Narayanganj?

Section 4: Conclusion

1. Would you be willing to provide further inputs or review the Heat Action Plan?

☐ Yes
☐ No
☐ Only for specific sections (Please specify) _____

Thank You Note:

Thank you for your valuable insights. Your inputs will be crucial in shaping a comprehensive Heat Action Plan for Narayanganj City Corporation. We appreciate your time and expertise.

6.4. Annex 4: Gap Assessment Survey Questionnaire

1. Existing Infrastructure		
Category	**Current Status**	**Score**
Green Spaces and Shading	1 = No green spaces, severe heat issues, urgent action needed.	1
	2 = Some green areas, but inadequate coverage, major improvements required.	2
	3 = Basic systems exist, but coverage is uneven and needs enhancement.	3
	4 = Good implementation, minor gaps in certain zones.	4
	5 = Well-planned and effective green infrastructure, minimal or no gaps.	5
Cooling Centers	1 = No designated cooling centers, lack of heat relief facilities, high risk for vulnerable populations.	1
	2 = Few cooling centers exist, but they are insufficient in number, poorly equipped, or not accessible to all.	2
	3 = Some cooling centers are operational, but coverage is uneven, and awareness or accessibility is limited.	3
	4 = Well-implemented cooling centers with reasonable coverage, but minor gaps in outreach or facility upgrades.	4
	5 = Comprehensive network of cooling centers, well-maintained, easily accessible, and fully integrated into heat response plans.	5
Water Availability	1 = Severe water shortages, no designated drinking water stations, and high risk of dehydration during heat events.	1
	2 = Limited water access, some public water points exist but are insufficient, unreliable, or poorly maintained.	2
	3 = Basic water supply infrastructure in place, but coverage is uneven, and supply disruptions occur.	3
	4 = Reliable water access in most areas, functional drinking water stations, minor gaps in coverage or maintenance.	4
	5 = Well-planned, fully accessible water infrastructure with public drinking stations, strong supply resilience, and emergency backup systems.	5
Housing and Building Resilience	1 = Most buildings lack heat-resistant design, poor ventilation, high indoor heat retention, and no resilience measures in place.	1
	2 = Some buildings have basic cooling features, but most structures remain vulnerable, with limited insulation or heat-reflective materials.	2
	3 = Moderate adoption of heat-resilient designs, some new buildings follow climate-responsive principles, but older structures remain a concern.	3
	4 = Majority of buildings incorporate passive cooling, reflective roofing, or insulation, with only minor gaps in implementation.	4
	5 = Widespread integration of heat-resilient building designs, strong enforcement of climate-adaptive construction codes, and high energy efficiency in both new and retrofitted buildings.	5
Road and Pavement Heat Mitigation	1 = Predominantly dark, heat-absorbing surfaces with no heat mitigation measures, causing extreme surface temperatures and worsening urban heat island (UHI) effects.	1

1. Existing Infrastructure		
	2 = Some heat mitigation efforts (e.g., light-colored paint, tree-lined streets), but coverage is minimal, and most roads and pavements contribute to heat retention.	2
	3 = Moderate use of heat-reflective materials, tree canopies, and shaded walkways in select areas, but many roads still intensify heat exposure.	3
	4 = Widespread implementation of cool pavements, permeable surfaces, and tree-lined streets, with minor gaps in high-traffic or densely built-up areas.	4
	5 = Comprehensive adoption of heat-resilient road and pavement designs, including reflective materials, green corridors, and shaded pedestrian pathways, ensuring city-wide heat mitigation.	5
Average Score		

2. Current Heat Response System		
Category	**Current Status**	**Score**
Early warning systems	1 =No heat early warning system in place; residents receive no alerts or preparedness guidance before extreme heat events.	1
	2 = Basic warning system exists, but it lacks real-time data, proper dissemination channels, or public awareness, leading to limited effectiveness.	2
	3 = Functional early warning system with periodic heat alerts, but gaps remain in accessibility, coverage, or coordination with response agencies.	3
	4 = Well-developed early warning system with multi-channel dissemination (SMS, radio, public displays, etc.), but minor improvements needed in outreach or real-time updates.	4
	5 = Fully integrated, real-time heat early warning system with automated alerts, widespread public access, strong institutional coordination, and effective response mechanisms.	5
Emergency response capacity	1 = No structured emergency response for heat-related incidents; lack of trained personnel, medical support, or coordination during heatwaves.	1
	2 = Basic response system exists, but it is poorly coordinated, lacks resources, and has limited capacity to handle large-scale heat emergencies.	2
	3 = Moderate emergency response capacity with trained personnel and some medical facilities, but gaps in coordination, equipment, or public awareness persist.	3
	4 = Well-structured heat emergency response system with trained teams, medical facilities, and coordination across agencies, but minor improvements are needed in efficiency or coverage.	4
	5 = Highly effective, well-coordinated emergency response system with rapid deployment, medical preparedness, community engagement, and strong institutional support.	5
Coordination among agencies	1 = No coordination among agencies; fragmented efforts lead to ineffective heat response and lack of clear roles or responsibilities.	1

2. Current Heat Response System		
	2 = Some agencies are involved, but coordination is weak, with overlapping mandates, poor communication, and lack of joint planning	2
	3 = Moderate coordination exists through periodic meetings or shared responsibilities, but gaps remain in communication, resource-sharing, or implementation.	3
	4 = Well-established coordination mechanisms with clear roles, regular communication, and joint action plans, but minor gaps in efficiency or execution.	4
	5 = Strong, institutionalized coordination among all relevant agencies, ensuring seamless collaboration, resource mobilization, and an effective heat response strategy.	5
Healthcare System Preparedness	1 = No preparedness for heat-related illnesses; hospitals and clinics lack resources, trained staff, and emergency protocols.	1
	2 = Limited healthcare capacity with some medical facilities addressing heat stress, but no specialized protocols, training, or emergency response.	2
	3 = Moderate preparedness with designated heat response teams, some training for healthcare workers, and limited heat-related medical supplies.	3
	4 = Well-prepared healthcare system with trained personnel, dedicated cooling areas in hospitals, and accessible treatment options, but minor gaps remain.	4
	5 = Fully equipped and responsive healthcare system with widespread heat-related illness management, early intervention, public guidance, and strong institutional support.	5
Community Engagement and Support Networks	1 = No community awareness or engagement in heat response; vulnerable populations lack access to support networks.	1
	2 = Some awareness campaigns exist, but community involvement is low, and outreach efforts do not effectively reach at-risk groups.	2
	3 = Moderate engagement with periodic public outreach, volunteer networks, and partial community participation in heat response initiatives.	3
	4 = Strong community involvement, with active networks, trained volunteers, and targeted programs to support vulnerable populations.	4
	5 = Highly engaged and resilient communities with widespread participation in heat preparedness programs, strong social support networks, and inclusive response mechanisms.	5
Average Score		

3. Technical and Data Gap		
Category	**Current Status**	**Score**
General Awareness of Heat Risks	1 = Very low awareness; most people do not recognize heat-related illnesses or their symptoms.	1
	2 = Limited knowledge; some understand heat stress but lack awareness of its serious health impacts.	2

3. Technical and Data Gap		
	3 = Moderate knowledge; people are aware of common heat-related illnesses but lack detailed understanding of risks and prevention.	3
	4 = High awareness; most can identify heat risks, symptoms, and basic mitigation strategies.	4
	5 = Very high awareness; widespread understanding of heat risks, symptoms, and proper response actions across the population.	5
Access to Heat-Related Information	1 = No heat-related information is available to the public; no early warnings or advisories exist.	1
	2 = Some information exists, but access is limited, and few people receive early warnings.	2
	3 = Moderate access; heat warnings and advisories are available but not consistently distributed or understood.	3
	4 = High access; heat-related information is widely shared through various channels (TV, radio, social media), reaching most of the population.	4
	5 = Full access; reliable early warnings, advisories, and heat action plans are effectively communicated to all, including vulnerable groups.	5
Adoption of Preventive Measures	1 = No adoption of preventive measures; people do not take action to protect themselves from extreme heat.	1
	2 = Limited adoption; some individuals use cooling methods or stay hydrated, but the majority do not take necessary precautions.	2
	3 = Moderate adoption; many people use basic protective measures, but gaps remain in consistent practices.	3
	4 = High adoption; the majority follow preventive strategies like wearing appropriate clothing, staying hydrated, and using cooling spaces.	4
	5 = Widespread adoption; nearly all individuals actively use heat-prevention measures, with strong adherence across different social groups.	5
Data Availability	1 = No public engagement; no community campaigns or awareness programs exist.	1
	2 = Limited engagement; occasional awareness efforts occur, but public participation is minimal.	2
	3 = Moderate engagement; some community-led initiatives exist, and a portion of the population actively participates.	3
	4 = High engagement; public campaigns are frequent, well-received, and involve a large proportion of the community.	4
	5 = Very high engagement; widespread community involvement in heat awareness programs, with sustained participation and impact.	5
Targeted Outreach for Vulnerable Groups	1 = No targeted outreach; vulnerable groups are unaware of heat risks and have no access to specific support.	1

3. Technical and Data Gap		
	2 = Limited outreach; some efforts exist, but information does not effectively reach or address the needs of at-risk populations.	2
	3 = Moderate outreach; some programs are in place, but coverage is inconsistent, and many vulnerable individuals remain uninformed.	3
	4 = Strong outreach; well-structured programs effectively reach most at-risk groups, providing essential information and support.	4
	5 = Comprehensive outreach; highly effective, inclusive, and sustained efforts ensure that all vulnerable groups are well-informed and protected.	5
Average Score		

4. Policy and Governance Framework		
Category	**Current Status**	**Score**
Existence of Heat-Related Policies	No heat-specific policies or regulations exist.	1
	Limited policies addressing heat risks, but not comprehensive or enforced.	2
	Some policies in place, but gaps exist in implementation and enforcement.	3
	Strong policies with clear guidelines, though some areas still lack full implementation.	4
	Comprehensive heat action policies, with full enforcement and clear responsibility assigned to agencies.	5
Coordination Among Stakeholders	No coordination among relevant agencies, with disjointed efforts.	1
	Coordination exists on a limited scale, but with gaps in responsibility and communication.	2
	Coordination is somewhat established with defined roles, but gaps in communication persist.	3
	Strong coordination and roles defined, but with some minor overlaps or gaps.	4
	Excellent inter-agency coordination with clear roles, and effective communication among all stakeholders.	5
Heat Action Planning and Budgeting	No specific budget or funding for heat action planning.	1
	Small, insufficient budget with no clear allocation for heat-related activities.	2
	Adequate budget allocation for some activities, but not fully integrated into the overall governance framework.	3
	Significant funding allocated to heat action planning, but some gaps in resource distribution.	4
	Well-funded heat action plans with clear, sustainable financial resources and dedicated personnel.	5
Institutional Capacity and Training	No institutional capacity for heat action, and no dedicated training for relevant stakeholders.	1
	Limited institutional capacity, with few trained staff for heat response activities.	2
	Adequate institutional capacity with some staff trained in heat-related issues.	3

4. Policy and Governance Framework		
	Strong institutional capacity with regular training programs for key stakeholders on heat risk management.	4
	Highly skilled and well-trained institutional teams with robust capacity-building mechanisms in place.	5
Monitoring and Accountability	No system in place for monitoring heat risk policies or holding agencies accountable.	1
	Limited monitoring and accountability mechanisms with no formal process for tracking performance.	2
	Monitoring mechanisms exist, but are not fully operational or lack transparency.	3
	Monitoring and accountability systems are in place and largely operational, though some areas need improvement.	4
	Comprehensive monitoring and accountability systems in place with full transparency and regular evaluations.	5
Average Score		

5. Financial Resources and Budget Allocation		
Category	**Current Status**	**Score**
Availability of Budget	1 = No budget allocation for heat action plans or related activities.	1
	2 = Small, ad-hoc budget allocations, insufficient to address heat-related issues.	2
	3 = Adequate budget allocation for some heat-related activities, but not comprehensive.	3
	4 = Sufficient budget allocated to heat action plans, though some areas still face resource constraints.	4
	5 = Comprehensive and sustainable budget allocation with dedicated funding for all aspects of heat action planning.	5
Consistency in Funding	1 = No consistent funding for heat action programs; resources are sporadic and unpredictable.	1
	2 = Irregular funding with occasional resources allocated, but no long-term planning.	2
	3 = Moderate funding consistency, but gaps exist in terms of long-term funding stability.	3
	4 = Consistent funding allocated annually for heat action activities, though some areas may need more resources.	4
	5 = Stable, long-term funding sources with a clear commitment to financing heat action plans and resilience initiatives.	5
Resource Allocation for Vulnerable Groups	1 = No specific allocation for vulnerable populations (e.g., elderly, outdoor workers, low-income communities).	1
	2 = Limited allocation for vulnerable groups, but not sufficient for comprehensive outreach or protection.	2
	3 = Adequate allocation for vulnerable populations, though gaps remain in some areas.	3
	4 = Significant funding directed towards vulnerable groups, but minor improvements are needed in coverage.	4
	5 = Comprehensive and targeted funding for vulnerable populations with full coverage across all needs.	5

5. Financial Resources and Budget Allocation		
Multi-Stakeholder Funding Partnerships	1 = No funding partnerships with other organizations, agencies, or the private sector.	1
	2 = Some partnerships exist but lack coordination or effective resource-sharing mechanisms.	2
	3 = Moderate level of collaboration with external stakeholders for funding and resource-sharing.	3
	4 = Strong partnerships with clear agreements for funding and resources from multiple sectors.	4
	5 = Highly effective multi-stakeholder partnerships with robust resource mobilization and joint funding efforts.	5
Funding for Monitoring and Evaluation	1 = No dedicated budget for monitoring and evaluating heat action plans or programs.	1
	2 = Limited funds for monitoring and evaluation, with little to no impact assessment conducted.	2
	3 = Adequate budget allocated for monitoring and evaluation, but gaps exist in terms of implementation.	3
	4 = Sufficient resources allocated for regular monitoring and evaluation with some areas needing improvement.	4
	5 = Dedicated and sustainable funding for comprehensive monitoring, evaluation, and performance assessments.	5
Average Score		

6.5. Annex 5: M&E Framework

M&E Component	What to Monitor / Evaluate	Key Performance Indicators (KPIs) (Quantitative and Qualitative)	Data Sources	Frequency	Responsible Entity
Early Warning and Communication	Timely and accessible heatwave alerts to the public	• Percentage of wards receiving heat alerts within 12 hours of the forecast • Percentage of messages reached at the local level • Percentage of vulnerable households reached	BMD alerts, NCC communication records, and community feedback	Pre-season and during alerts	NCC Health Department, Ward Councilors
Public Awareness Campaigns	Effectiveness of awareness messages	• Percentage of awareness events held per ward- • Percentage of the target population aware of heat safety measures, including the Inclusion of women and elderly.	Event reports, social media analytics, and rapid perception surveys	Pre-season and post-event	NCC Health Department, Urban Planning Cell, Ward Councilors, Urban Community Volunteers, NGOs, CBOs
Cooling Centers and Water Points	Availability, accessibility, and usage	• Percentage of operational cooling centers per ward- • Average daily attendance during heat alert • Percentage of functioning public water points	NCC facilities records, site visits, and user logbooks	Weekly during the alert	NCC Engineering Department, Ward Offices
Health System Preparedness	Capacity of hospitals and clinics to treat heat-related illnesses	• Stock levels of ORS, IV fluids • Percentage of heat illness cases treated • Average response time of ambulances	Hospital records, DGHS data, health dept. stock registers	Weekly during the alert	Health Department, Hospital Admin

M&E Component	What to Monitor / Evaluate	Key Performance Indicators (KPIs) (Quantitative and Qualitative)	Data Sources	Frequency	Responsible Entity
Protection of Vulnerable Groups	Special measures for the elderly, children, pregnant women, slum dwellers, and informal workers	• Percentage of outdoor workers receiving protective gear • Percentage of home visits by health teams • Percentage of women/children reached by awareness drives	Volunteer reports, labor inspections, NGO records	During and post alert	Ward Committees, Department of Labor, Department of Women's Affairs
Urban Infrastructure Measures	Heat mitigation in public spaces	• Percentage of shaded bus stops and public areas • Percentage of roads sprayed during peak heat • Percentage of water refill stations operational	NCC engineering logs, site inspections	Monthly, during the peak season	NCC Engineering Department, Ward Councils
Policy and Governance Coordination	Inter-agency coordination during alerts	• Percentage of coordination meetings held • Presence of action plan activation log • Increase of stakeholder satisfaction with coordination (survey)	Meeting minutes, coordination reports	During and post alert	NCC Mayor's Office, Urban Planning Cell
Post-Event Review	Effectiveness of overall HAP implementation	• Reduction in heat-related mortality/morbidity compared to previous years- • Lessons learned documented • Recommendations adopted	Hospital data, community feedback sessions, review reports	End of heat season	NCC Health Department, NGOs, Urban Planning cell

6.6. Annex 6: Shared Learning Dialogue (SLD) Report

Report on Shared Learning Dialogue (SLD) On Developing a Heat Action Plan (HAP) for Narayanganj City Corporation

ICLEI South Asia
28 July 2025

Table of Contents

1. Introduction

The Shared Learning Dialogue (SLD) on the development of Narayanganj's Heat Action Plan (HAP) was held on 15 July 2025, from 10:30 AM to 2:30 PM (BST) at the 5th Floor Conference Room of the Narayanganj City Corporation (NCC). Organised under the CLARE–Research for Impact (R4I) Opportunity Fund, which is funded by UK International Development and Canada's International Development Research Centre (IDRC), the programme marked a significant step toward strengthening climate resilience and adaptive capacity in Narayanganj – a rapidly urbanising and industrial city in Bangladesh that is increasingly vulnerable to extreme heat stress and the Urban Heat Island (UHI) effect.

2. Objectives of the Workshop

The primary aim of the workshop was to build a shared understanding of the key challenges posed by urban heat in Narayanganj, identify vulnerable groups and priority areas, validate technical findings, and co-develop locally relevant solutions through participatory methods, particularly using the Problem Tree Analysis approach.

Specific objectives included:

1. To introduce the process of developing the first-ever Heat Action Plan (HAP) at the city level in Bangladesh
2. To present a technical overview of heat stress assessment, including past heatwaves, causes, community vulnerabilities, and institutional gaps
3. To review and discuss heat thresholds, emergency response roles, and the proposed implementation structure and financing mechanisms for the HAP
4. To gather feedback from city officials and stakeholders on the proposed components of the HAP
5. To facilitate interactive discussions and group exercises to identify short, medium, and long-term heat resilience actions
6. To define next steps for finalising and operationalising the HAP

3. Workshop Participants

The workshop was jointly organised by Narayanganj City Corporation (NCC) and ICLEI South Asia. The SLD offered research-based insights, data-driven analysis, and facilitation support throughout the event. Conducted in person, the session gathered a diverse group of stakeholders to promote a comprehensive understanding of the causes, impacts, and responses related to extreme heat at both community and urban levels. Special emphasis was placed on addressing gender-specific vulnerabilities and fostering an inclusive, context-sensitive planning approach.

A total of 48 participants represented a wide range of institutions and community groups, including officials from NCC, the Bangladesh Meteorological Department, UN-Habitat, RAJUK, Community Development Committees (CDCs), ICLEI South Asia's Bangladesh team, Urban Community Volunteers, and Nirman Upodeshta (an architectural firm). Members of the media from both national and local newspapers were also present. The dialogue ensured grassroots representation, including slum dwellers, elderly citizens, and other vulnerable populations. Notably, 15 out of the 48 participants were women, reflecting 32% female participation and demonstrating a commitment to gender-inclusive planning.

4. Session Overview

The workshop was divided into five broad sessions, which are as follows:

7. Welcome and Opening Remarks
8. Technical Presentation (Validation Round)
9. Interactive Technical Session: Strategy Development
10. Plenary Discussion and Group Reflection
11. Closing Remarks and Next Steps

The session began with welcome and opening remarks, followed by a technical presentation that provided a comprehensive overview of the HAP development methodology, heat stress trends, previous heatwaves, underlying causes, and community-level vulnerabilities. Key findings from the gap assessment of NCC were shared, along with proposed heat thresholds, institutional response mechanisms, implementation structures, and financing options. This segment helped participants validate the analytical foundation of the HAP.

An interactive technical session followed, where stakeholders engaged in breakout group discussions using a Problem Tree Analysis approach to identify and prioritise short (0 – 1 year), medium (1 – 3 years), and long-term (more than 3 years) actions. This collaborative exercise enabled the integration of diverse perspectives into strategy development. The plenary session facilitated reflection on group discussions, with key recommendations emerging for both immediate response planning and long-term heat resilience building. The dialogue concluded with closing remarks, summarising the next steps toward finalising the HAP and reinforcing the need for coordinated institutional commitment.

Session-wise outcomes are presented in the following section.

5. Welcome and Opening Remarks

The workshop was inaugurated and chaired by Mohammad Zakir Hussain, Chief Executive Officer of NCC. In his opening remarks, he set the tone for the session by underscoring the growing severity of global warming and the rising frequency of extreme heat events as pressing urban challenges. He pointed out that these are no longer future threats but current realities, particularly for rapidly urbanising cities like Narayanganj.

He further noted that the recent appointment of a dedicated “Heat Officer” within the city administration should not be seen as a symbolic gesture. Rather, it is a critical and timely institutional measure aimed at ensuring focused leadership and coordination in tackling heat-related issues. Mr. Hussain also emphasised the importance of proactive planning and intervention before the onset of peak summer months, warning that delayed or reactive measures would not be sufficient to mitigate the growing risks posed by heatwaves.

Figure 1: Inaugural Address by the CEO of Narayanganj City Corporation

Following this, Md Moinul Islam, Urban Planner of NCC and the designated focal person for the Heat Action Plan from NCC, also shared his perspective. He:

1. Outlined the complex urban planning challenges faced by Narayanganj, particularly in the context of increasing climate-induced stressors.
2. Stressed the urgent need for cross-sectoral coordination and collaborative action among government agencies, communities, and stakeholders to effectively address the city's vulnerability to extreme heat.

Together, their remarks underscored the city's commitment to building institutional capacity, advancing preparedness, and fostering inclusive planning for heat resilience.

6. Technical Presentation (Validation Round)

The technical session was initiated by Md. Jubaer Rashid, Country Representative of ICLEI South Asia, provided a comprehensive overview of the HAP initiative under the CLARE programme. He emphasised the broader goals of the project, focusing on building climate resilience and adaptive capacity in rapidly growing secondary cities like Narayanganj. Jubaer Rashid highlighted the critical importance of adopting integrated and participatory planning approaches to ensure that local contexts and vulnerable groups are effectively addressed.

Figure 2: Technical Presentation by ICLEI South Asia Team

Following this, Dipak Bhowmick, Technical Lead at ICLEI South Asia, delivered an in-depth technical presentation covering key thematic areas essential for understanding and developing the HAP. His presentation included the following components:

1. **HAP Methodology:** Detailed explanation of the approach and sequential steps involved in developing Narayanganj's HAP, ensuring a structured and evidence-based process.
2. **Overview of Heat Stress in Narayanganj:** Scientific background on heat stress, including urban heat dynamics, temperature trends, and their implications for urban environments, based on the team's assessment.
3. **Past Heat Waves:** Analysis of historical heatwave events in Bangladesh, illustrating local impacts and lessons learned to guide future interventions.
4. **Causes of Heat Stress:** Identification of key contributing factors such as rapid urbanisation, reduction of green cover, changing energy consumption patterns, and land use alterations.
5. **Community Vulnerabilities:** Presentation of survey results highlighting vulnerable groups, including slum dwellers, women, the elderly, and outdoor workers, with an emphasis on the need for targeted measures.
6. **Gap Assessment of NCC:** Findings from the gap assessment highlighting institutional, infrastructural, and technical weaknesses within NCC that require strengthening to effectively manage heat risks.
7. **Heat Thresholds:** Identification of specific temperature thresholds for Narayanganj, subject to further validation, which trigger various levels of heat warnings and interventions such as Alert and Orange Warning stages.
8. **Emergency Response Roles:** Drafted roles and responsibilities assigned to different stakeholders during heat emergencies to facilitate coordinated action.

9. **HAP Implementation Structure:** Proposal of governance and coordination mechanisms designed to streamline decision-making and implementation.
10. **Financing Modes:** Presentation of ideas and strategies to mobilise sustainable financial resources supporting the HAP's activities and ensuring long-term viability.

This comprehensive technical session provided participants with a solid foundation to validate the project's approach and identify areas requiring further focus during the subsequent collaborative discussions.

7. Interactive Technical Session: Strategy Development

Following the comprehensive technical presentations, participants engaged in an interactive and collaborative group exercise using the Problem Tree Analysis method. This approach helped to systematically unpack the complex issue of urban heat stress in Narayanganj by identifying its core problem, root causes, effects, and potential strategic interventions.

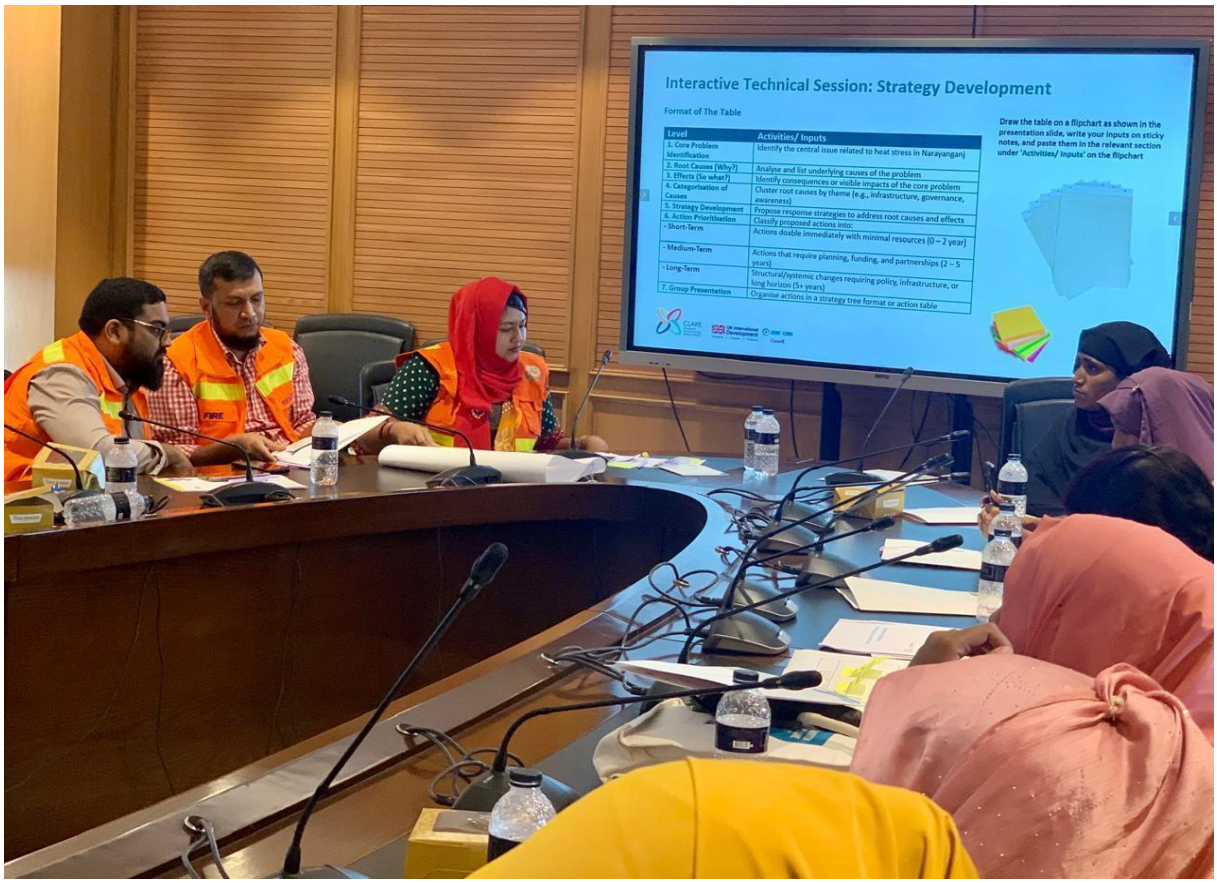


Figure 3: Technical Group (1) Works by Stakeholders

Figure 4: Technical Group (2) Works by Stakeholders

Figure 5: Technical Group (3) Works by Stakeholders

Figure 5: Technical Group (4) Works by Stakeholders

The session also served as a platform for validating the technical findings shared earlier and enriching them with additional insights and locally relevant strategies from diverse stakeholders. This collective effort ensured that the resulting HAP would be grounded in practical realities and tailored to the city's unique vulnerabilities and capacities.

Summary of Problem Tree Analysis:

Level	Activity/Output
1. Core Problem Identification	The central issue defined by the participants was the *Increased Heat Stress and UHI Effects in Narayanganj City.* This problem impacts several critical sectors, including: ● Public health (e.g., heat-related illnesses and fatalities) ● Labour productivity (particularly outdoor workers) ● Financial burdens on households and institutions ● Overall quality of urban living ● Uncontrolled migration driven by deteriorating living conditions
2. Root Causes (Why?)	The group identified six major categories of root causes contributing to the core problem: **Unregulated Urbanisation and Infrastructure Growth** 1. Rapid and often unplanned construction of high-rise buildings without thermal or climate-adaptive design

	2. Lack of integration of green (trees, parks) and blue (water bodies) infrastructure into urban planning 3. Weak enforcement of zoning laws and building regulations that could mitigate heat effects **Environmental Degradation** 4. Loss of biodiversity and open green spaces 5. Disappearance of natural water bodies, worsening heat retention 6. Expansion of paved, impervious surfaces that increase surface temperatures **Energy Dependency** 7. Growing use of air conditioners by affluent groups (~20% of population), driving up energy demand 8. Absence of energy-efficient building codes and policies 9. Rising carbon emissions from residential, transport, and industrial sectors exacerbate urban warming **Governance and Institutional Gaps** 10. No dedicated governance or monitoring team specifically focused on heat action planning and response 11. Lack of effective coordination between relevant government departments and agencies 12. Insufficient and unsustainable financing mechanisms for heat resilience initiatives **Community Vulnerability** 13. Poor and slum populations face heightened exposure with minimal coping capacity 14. Limited access to clean drinking water and healthcare services during heat waves 15. Low awareness levels and absence of reliable early warning systems **Policy and Planning Deficiencies** 16. Urban planning processes largely ignore climate adaptation and heat mitigation. 17. No existing city-level policies addressing energy efficiency or heat action. 18. Predominantly reactive, rather than proactive, responses to heat emergencies.
3. Effects (So what?)	Participants mapped the following impacts arising from increased heat stress:

	● Higher morbidity and mortality rates during extreme heat events ● Decreased labour productivity, particularly for outdoor workers and vulnerable groups ● Increased pressure on already strained public health infrastructure ● Energy shortages and escalating electricity costs are burdening residents and businesses ● Reduced overall urban livability, affecting residents' quality of life ● Migration outflows are driven by deteriorating environmental and living conditions
4. Strategy Interventions	The group developed a comprehensive set of interventions, structured in phased timelines:
Short-Term Actions (0 – 1 Year):	● Develop and disseminate heat awareness and risk communication materials targeted at vulnerable communities ● Identify, map, and monitor heat risk zones and vulnerable populations across the city ● Establish cooling centres in accessible public buildings such as schools and community halls ● Deploy mobile health units and water tankers to support at-risk populations ● Use local media, SMS alerts, and loudspeakers for the timely dissemination of heat warnings ● Initiate distribution of Oral Rehydration Salts (ORS) and safe drinking water during heatwaves ● Train frontline health workers and mobilise community volunteer networks for outreach ● Engage religious and educational institutions to aid in community alerting
Medium-Term Actions (1 – 3 Years):	● Officially appoint a dedicated Heat Officer within NCC to lead HAP efforts ● Establish a technical task force to coordinate heat management activities across departments ● Develop and standardise city-wide heat emergency response protocols ● Design and pilot nature-based solutions such as urban greening, rooftop gardens, and water-sensitive urban design ● Trial colour-coded buildings and promote the adoption of cool roof technologies ● Revise and enforce building codes to mandate heat-resilient designs ● Build institutional capacity and technical expertise through ongoing training and partnerships
Long-Term Actions (3+ Years):	● Fully integrate the HAP into Narayanganj's Action Area Plan and RAJUK's Detailed Area Plan (DAP) ● Expand urban forestation initiatives and restore degraded water bodies to mitigate heat island effects ● Institutionalise sustainable financing mechanisms to support climate resilience measures long term

	● Develop and implement city-wide urban energy efficiency policies ● Formulate urban development policies sensitive to migration dynamics and heat vulnerability ● Establish real-time monitoring, evaluation, and feedback systems to continuously assess HAP performance ● Maintain and strengthen partnerships with key agencies like the Red Cross, Department of Inspection for Factories and Establishments (DIFE), and Community Development Committees (CDC)

8. Plenary Discussion and Group Reflection

Following the technical sessions and group work, a plenary discussion was held to reflect on key insights and identify actionable recommendations for improving heat resilience in Narayanganj. Stakeholders from government, civil society, media, and development agencies shared their perspectives on institutional responsibilities, policy gaps, and immediate next steps. The discussion emphasised the need for sustained coordination, resource mobilisation, and adaptive planning across city systems.

Key Stakeholder Recommendations and Insights:

Md. Nuruzzaman, Architect, Nirman Upodeshta:

1. Urged the establishment of a dedicated technical team within NCC for the implementation of heat-related strategies
2. Stressed the importance of a robust monitoring mechanism post-implementation to track impact and adjust interventions
3. Called for sustainable financing mechanisms, including allocation from NCC's revenue sources
4. Recommended increasing street-level drinking water points, especially near transit areas and markets
5. Highlighted the issue of urban migration and suggested revisiting city-level policies to manage population pressure and ensure equitable contribution to city services

ASM Moshiur Rahman, Executive Engineer, NCC:

1. Emphasised the need to monitor the proliferation of high-rise buildings, particularly their role in exacerbating urban heat
2. Proposed the introduction of colour-coded buildings to reflect heat risk zones and promote heat-resilient designs
3. Encouraged energy efficiency measures and advocated for policy-driven solutions to reduce heat vulnerability

Asaduzzaman Paris, Urban Planner, UN-Habitat:

1. Recommended revisiting and refining the spider diagram indicators to ensure accurate assessment of sectoral heat vulnerability, particularly infrastructure scoring
2. Advocated for the integration of nature-based solutions and the promotion of energy-efficient building practices across the city

Afsana Moon, Journalist, Narayanganj Daily:

1. Emphasised ensuring continuous access to drinking water during peak summer months, suggesting the designation of specific water distribution points in key public areas

Additional Organisations Recommended for Inclusion in the Emergency Response Responsibility Framework:

During the stakeholder consultation, participants emphasised the importance of broadening the institutional base for effective emergency response under the Heat Action Plan. They recommended including additional local institutions, civil society groups, non-governmental organisations (NGOs), and community-based networks to enhance coordination, outreach, and service delivery during heat-related emergencies.

The following organisations and their indicative responsibilities were suggested for integration into the governance and response framework:

Stage	Responsibility / Action required	Suggested Responsible Agencies / Department
Normal (Pre-Heat Season)	Awareness campaigns, training sessions, early warning dissemination, risk mapping	CDC, Urban Community Volunteers
Alert (Above 38°C for 1 day)	Loudspeaker announcements, community mobilisation, ORS and water packet distribution	Religious institutions, schools, and local volunteers
Orange Warning (Above 40°C for 2+ days)	Activation of cooling centres, work flexibility, and provision of temporary shade structures	Bangladesh Red Crescent Society

To ensure the successful implementation of the HAP in Narayanganj, all stakeholders jointly emphasised the importance of strengthening governance through a robust implementation and monitoring framework with clearly defined institutional roles. They stressed that heat resilience must be systematically integrated into existing land use policies and urban planning processes to ensure long-term sustainability. Financial viability was also identified as a key priority, requiring the mobilisation of diverse funding sources – including public allocations, private sector investments, and donor support. Infrastructure development should focus on climate-responsive solutions such as shaded walkways, drinking water stations, and designated rest areas, particularly for outdoor workers and other vulnerable populations. Finally, fostering community ownership through awareness campaigns, targeted capacity-building programmes, and decentralised actions will be essential to promote inclusive and locally driven heat resilience efforts.

9. Closing Remarks and Next Steps

The SLD played a vital role in advancing the participatory planning process for the HAP in Narayanganj. In his concluding remarks, the CEO of NCC emphasised that proactive interventions, inclusive governance, and well-planned investments are key to enhancing the city's resilience to extreme heat, particularly for vulnerable communities. The ICLEI South Asia team stated that they will consolidate all inputs and outcomes from the SLD to develop a draft version of the HAP. Once the draft is finalised, it will be reviewed and validated at the NCC council meeting. Upon endorsement at the council level, the HAP will be formally adopted and ready for implementation. ICLEI South Asia is expected to submit the draft Heat Action Plan by August 2025.

10. Annexes

Annex 1: Agenda of SLD

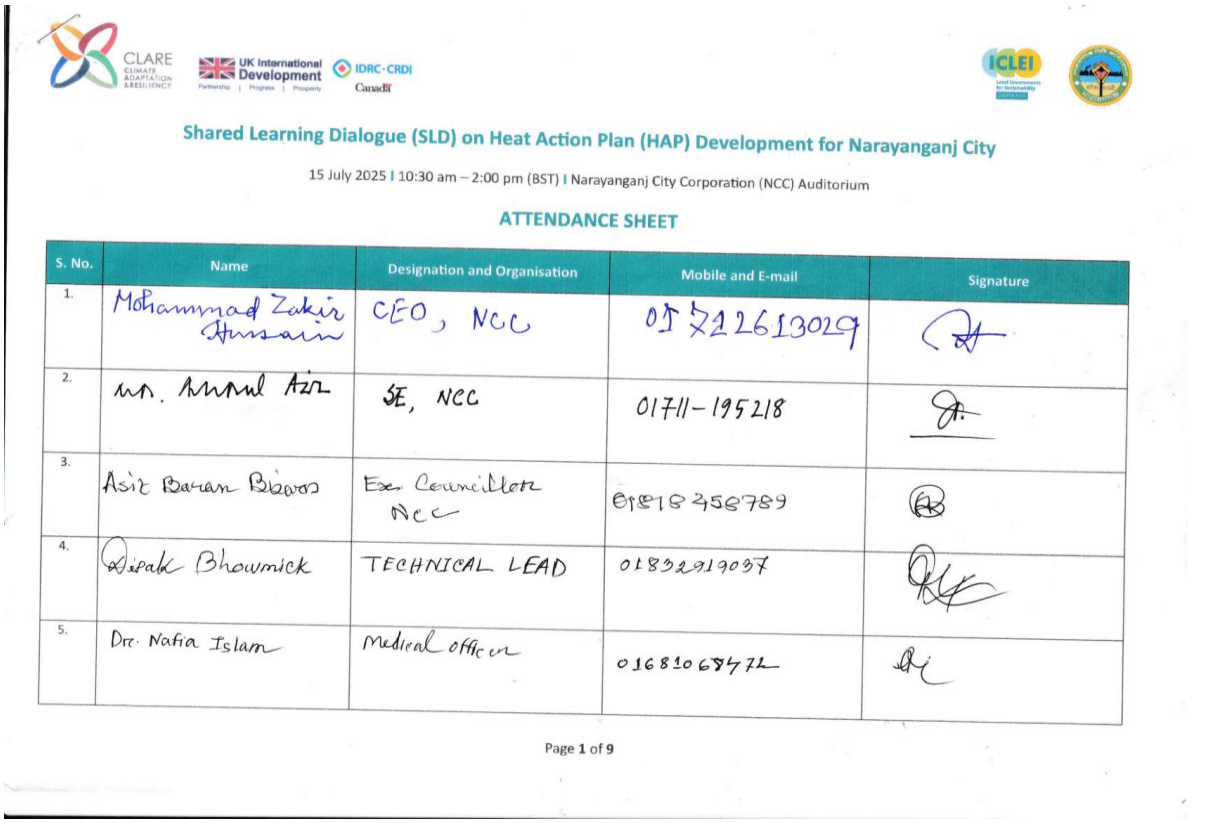
Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

Jointly organised by ICLEI South Asia and Narayanganj City Corporation (NCC)

Date: 15 July 2025
Time: 10:30 am – 2:00 pm (BST)
Place: Narayanganj City Corporation (NCC) Auditorium

Time	Session	Facilitator
10:30 am – 10:40 am	**Welcome and Opening Remarks**	NCC
10:40 am – 11:00 am	**Workshop Objectives and Agenda Overview**	ICLEI South Asia
11:00 am – 11:30 am	**Technical Presentation (Validation Round)**: • HAP Methodology • Overview of Heat Stress • Past Heat Waves • Causes of Heat Stress • Community Vulnerabilities • Gap Assessment of NCC • Heat Thresholds • Emergency Response Roles • HAP Implementation Structure • Financing Modes	ICLEI South Asia
11:30 am– 11:40 am	**Q&A and Feedback on Presentation**	Facilitated by ICLEI South Asia
11:40 am – 11:50 am	**Tea / Refreshment Break**	All
11:50 am – 1:30 pm	**Interactive Technical Session: Strategy Development** • Identify Short, Medium, Long-Term Actions using Problem Tree Analysis • Breakout group discussions	All, Facilitated by ICLEI South Asia
1:30 pm – 1:50 pm	**Plenary Reflections and Key Recommendations**	All
1:50 pm – 2:00 pm	**Closing Remarks and Next Steps**	NCC, ICLEI South Asia

Annex 2: Attendance Sheet



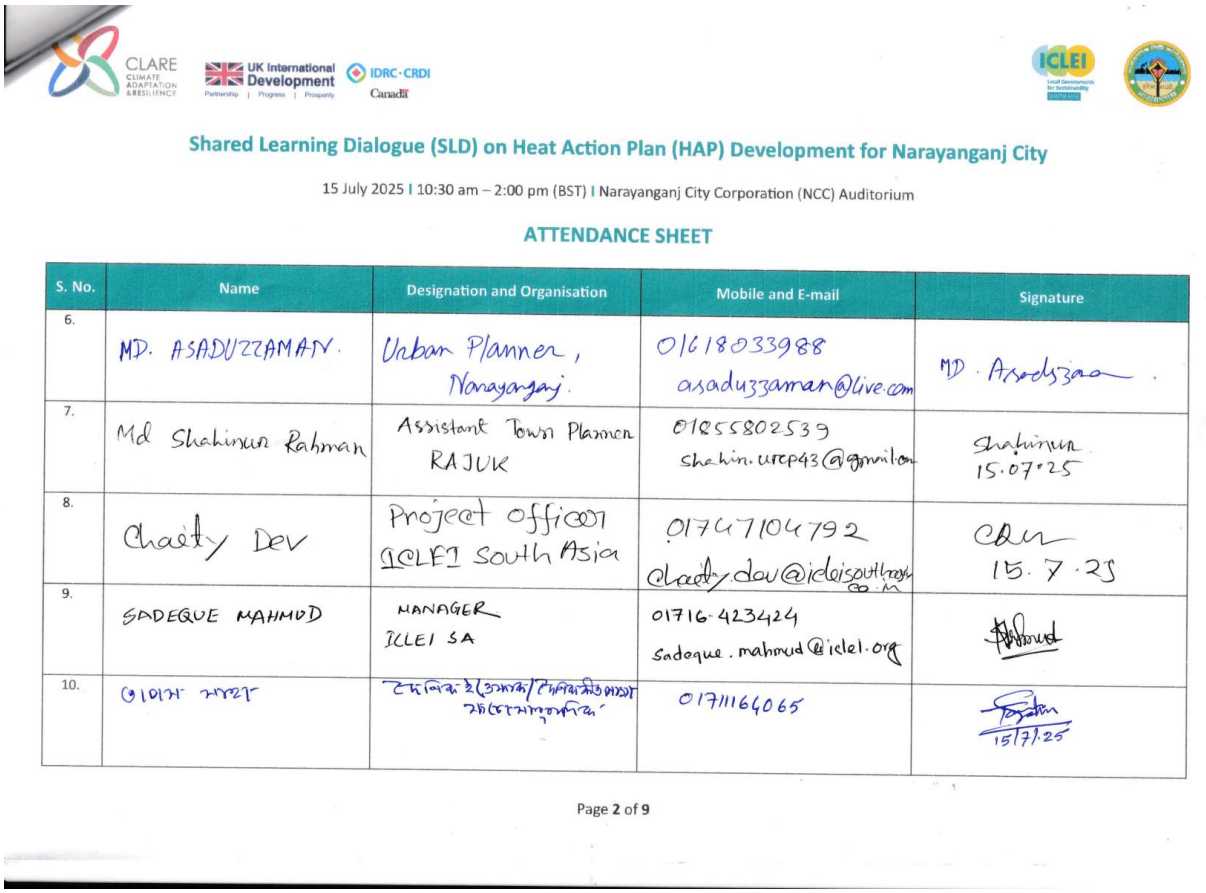
Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
1.	Mohammad Zakir Hussain	CEO, NCC	01[illegible]2613029	
2.	Md. Anwar Aziz	SE, NCC	01711-195218	
3.	Asit Baran Biswas	Ex Councillor NCC	01818 456789	
4.	Dipak Bhowmick	TECHNICAL LEAD	01832919037	
5.	Dr. Nafia Islam	Medical officer	01681068472	

Page 1 of 9



Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
6.	MD. ASADUZZAMAN.	Urban Planner, Narayanganj.	01618033988 asaduzzaman@live.com	MD. Asaduzzaman.
7.	Md Shahinur Rahman	Assistant Town Planner RAJUK	01855802539 shahin.urep43@gmail.com	Shahinur 15.07.25
8.	Chaity Dev	Project officer ICLEI South Asia	01747104792 chaity.dev@iclei-southasia.org	15.7.25
9.	SADEQUE MAHMUD	MANAGER ICLEI SA	01716-423424 sadeque.mahmud@iclei.org	
10.	[illegible]	[illegible]	01711164065	15/7/25

Page 2 of 9

CLARE CLIMATE ADAPTATION & RESILIENCE | UK International Development | IDRC·CRDI Canada | ICLEI

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
11.	[illegible]	[illegible]	01845208440	
12.	[illegible]	[illegible]	01636464455	
13.	[illegible]	[illegible]	01716294503	
14.	[illegible]	[illegible]	01717441364	
15.	Jannatul Faridousi	Urban Community Volunteer, Narayanganj City Corporation	0190784568	

CLARE CLIMATE ADAPTATION & RESILIENCE | UK International Development | IDRC·CRDI Canada | ICLEI

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
16.	[illegible]	CW. NCC	01715-713518	
17.	[illegible]	[illegible] CDC-সদস্য	01928084895	
18.	[illegible]	[illegible] CDC-সদস্য	01999713329	
19.	[illegible]	[illegible] CDC সদস্য	01812154802	
20.	[illegible]	CDC সদস্য	01746152313	

CLARE CLIMATE ADAPTATION & RESILIENCE | UK International Development Partnership | Progress | Prosperity | IDRC · CRDI Canada | ICLEI Local Governments for Sustainability

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
21.	Abdullah Mahammed Hashem	Assistant Engineer NCC	01841625632 mahammedhashem025@gmail.com	
22.	Abdullah Al Zobayer	Assistant Engineer N.C.C.	01521215941 aalzobayer96@gmail.com	
23.	A S M Mostiur Rahman	Executive Engineer NCC	01814353156 mostiurie@gmail.com	
24.	Mohammad Nuruzzaman	Principal Architect Nirman Upodeshta	01819284467 nuzaamaan@yahoo.com	
25.	Md. Rashedul Al Rafi	Computer operator (Urban community volunteer)	01567933678	

CLARE CLIMATE ADAPTATION & RESILIENCE | UK International Development Partnership | Progress | Prosperity | IDRC · CRDI Canada | ICLEI Local Governments for Sustainability

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
26.	পারভীন বেগম	CDC সদস্য	01586344120	পারভীন
27.	আবসির আক্তার	CDC সদস্য	01633402541	আবসির
28.	রেহানা	CHDF কর্মী	01938149155	
29.	নাসিমা সরদার শিমুল	ক্লাস্টার সভাপতি ২৬,২৪,২৫নং ওয়ার্ড NCC	01867021978	
30.	আয়াতুন নেসা রেখা	ক্লাস্টার সভাপতি ২১,২০,২১ ওয়ার্ড NCC	01735855586	

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

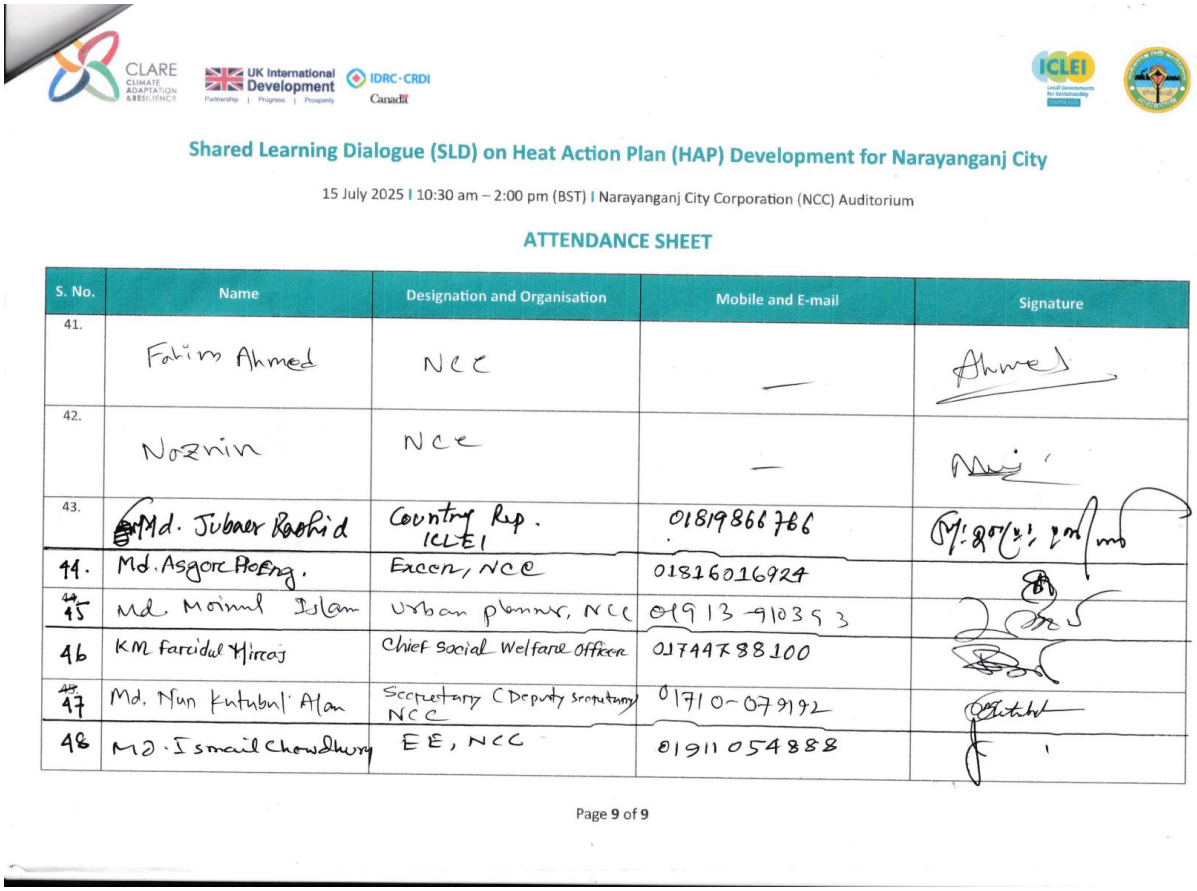
S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
31.	মো: সাব্বির	সেক্রেটারি SPGRC আদমজী বিহারী ক্যাম্প	01720947657	[illegible]
32.	মো: নাদিম	মেম্বার. SPGRC আদমজী বিহারী ক্যাম্প	01671580286	MD.NADIM
33.	মোঃ ইকবাল আলী	নির্বাহী প্রকৌশলী (সিভিল) নারায়ণগঞ্জ সিটি কর্পোরেশন	01718084833	[illegible]
34.	Edu	NCC	—	[illegible]
35.	Al Alamin	NCC	—	[illegible]

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
36.	[illegible]	CHDF সভাপতি NCC	01731962751	[illegible]
37.	[illegible]	NCC	—	[illegible]
38.	Sujon	NCC	—	[illegible]
39.	Apu	NCC	—	[illegible]
40.	Nahid	NCC	—	[illegible]



CLARE CLIMATE ADAPTATION & RESILIENCE | UK International Development | IDRC·CRDI Canada | ICLEI

Shared Learning Dialogue (SLD) on Heat Action Plan (HAP) Development for Narayanganj City

15 July 2025 I 10:30 am – 2:00 pm (BST) I Narayanganj City Corporation (NCC) Auditorium

ATTENDANCE SHEET

S. No.	Name	Designation and Organisation	Mobile and E-mail	Signature
41.	Fahim Ahmed	NCC	—	Ahmed
42.	Nozrin	NCC	—	
43.	Md. Jubaer Rashid	Country Rep. ICLEI	01819866766	
44.	Md. Asgor Hoeng.	Exen, NCC	01816016924	
45	Md. Moinul Islam	Urban planner, NCC	01913-910393	
46	KM Faridul Miraj	Chief Social Welfare Officer	01744788100	
47	Md. Nun Kutubul Alan	Secretary (Deputy Secretary) NCC	0171O-079192	
48	Md. Ismail Chowdhury	EE, NCC	01911054888	

Page 9 of 9

6.7. Annexe 7: Global Best Practices

City / Location	Context	Key Features	Why it's a Best Practice	Replicability
Ahmedabad, India (The Pioneering Model for the Global South)	Response to a 2010 heatwave that caused 1,300+ deaths in a dense, developing megacity.	• **Four-Pillar Approach:** Early Warning, Community Outreach, Capacity Building of Health Professionals, and Adaptive Measures. • **Simple Alert System:** Color-coded alerts (Yellow, Amber, Red) based on forecast temperatures. • **Focus on Vulnerable Groups:** Slum communities, outdoor workers, elderly. • **"Cool Roofs" Programme:** Pilot painting roofs with reflective white paint, reducing indoor temperatures by 2 – 5°C.	Evidence-based, low-cost, highly effective (estimated 1,190 lives saved annually), became the template for 100+ Indian cities and other countries.	Ideal for cities like Narayanganj with similar climatic, demographic, and infrastructural challenges.
France: National Heat Health Watch Warning System (HHWWS)	Developed after the catastrophic 2003 European heatwave causing over 70,000 deaths (nearly 15,000 in France).	• **National and Local Integration:** Météo-France issues warnings to regional health agencies, activating local emergency plans. • **Health-Based Triggers:** Biometeorological indices considering humidity and nighttime temperatures. • **Pre-Identified Vulnerable**	Sophisticated, data-driven, nationally coordinated system that successfully prevented mass mortality in subsequent heatwaves (e.g., 2019).	Best for countries with strong public health infrastructure and detailed health data.

City / Location	Context	Key Features	Why it's a Best Practice	Replicability
		• **Populations:** Registry for isolated, elderly, medically vulnerable individuals for direct check-ins during heatwaves.		
Philadelphia, USA (The Long-Running Urban Model)	One of the oldest and most comprehensive heat health programmes in the US, running for decades.	• **Tiered Response:** Heat Health Warning → Excessive Heat Warning with predefined actions. • **Robust Cooling Centre Network:** Libraries, community centres, pools with AC. • **Home Utility Assistance:** LIHEAP helps vulnerable residents afford AC. • **"Buddy System":** Community-based programme to check on at-risk neighbours.	Demonstrates long-term sustainability, deep community integration, strong focus on equity.	Relevant for cities with established social services looking to strengthen and formalize heat response.
Greece and Spain (The Public Engagement Model)	Raise public awareness and perception of risk, treating heatwaves with the same severity as hurricanes.	• **Categorization and Naming:** proMETEO Sevilla system categorizes heatwaves (Category 1, 2, 3) and assigns names (e.g., Heatwave Zoe). • **Behavioural Science:** Makes heat threat tangible and urgent for public and media.	Innovative approach to solving public complacency and ensuring protective actions are taken seriously.	Can be adopted by any city to enhance the impact of early warnings.
Kuwait and UAE (The Technological Model)	Adapting to some of the highest temperatures on the planet, where outdoor	• **Legislated Work Bans:** Outdoor work prohibited during hottest hours (12 PM – 4 PM, June – August).	Shows adaptation to extreme unavoidable heat using mandatory protections and	Key lessons for protecting outdoor workers in extreme heat contexts, especially in

City / Location	Context	Key Features	Why it's a Best Practice	Replicability
	work and life must continue.	• **Advanced Urban Design:** Reflective materials, shaded walkways ("sabbas"), wind towers for passive cooling. • **Climate-Controlled Environments:** AC indoor spaces (malls, walkways) for public respite.	technological solutions.	construction and agriculture.
Surat, India (The Public-Private Partnership Model)	Industrial city building upon Ahmedabad model, with strong focus on workforce.	• **Textile Industry Partnership:** Worked with factory owners to provide shaded rest areas, electrolyte solutions, adjusted work schedules. • **Vulnerability Mapping:** GIS mapping of high-risk areas (slums, industrial zones) for targeted interventions.	Demonstrates effective private sector engagement as a key partner in resilience, protecting a large portion of the vulnerable population.	Extremely relevant for Narayanganj, given its significant industrial base (textiles, shipbuilding); shows how to make a business case for heat resilience.

CLARE is a flagship research programme on climate adaptation and resilience, funded mostly (about 90%) by UK Aid through the Foreign Commonwealth and Development Office (FCDO), and co-funded by the International Development Research Centre (IDRC), Canada. CLARE is bridging critical gaps between science and action by championing Southern leadership to enable socially inclusive and sustainable action to build resilience to climate change and natural hazards. The views expressed herein do not necessarily represent those of the UK government, IDRC or its Board of Governors.

Learn more about CLARE: www.clareprogramme.org