PEOPLE'S ADAPTATION PLAN

Narayanganj City Corporation

Developed By: **Practical Action**

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In **partnership** with Canada

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ABOUT PRACTICAL ACTION

Practical Action, an international development organization with a long-standing commitment to community-centered development, has been an instrumental actor in addressing these issues globally and within Bangladesh since 1990. Established in 1966 as the Intermediate Technology Development Group, Practical Action emphasizes appropriate technology and innovation to reduce poverty and enhance climate resilience. Their work in urban contexts includes scalable solutions aimed at waste management, flood resilience, and inclusive urban planning strategies that promote equitable and sustainable urban environment.

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FOREWORDS

Ad. Md. Sakhawat Hossain Khan
Administrator
Narayanganj City Corporation

Photo of Administrator, NCC

The People's Adaptation Plan for Narayanganj City Corporation represents a significant milestone in our collective efforts to build a climate-resilient, inclusive, and sustainable urban future for our city. Developed through a participatory and evidence-based process, this plan reflects the voices, priorities, and lived experiences of our communities, particularly those most vulnerable to climate risks.

Narayanganj, as one of Bangladesh's rapidly growing urban centers, is increasingly exposed to climate-induced challenges such as waterlogging, heat stress, and environmental degradation. Addressing these challenges requires not only robust infrastructure investments but also integrated, community-informed planning approaches. This Plan provides a practical roadmap to guide such efforts, grounded in local realities and supported by scientific analysis.

The plan is well aligned with national and international frameworks, including the National Adaptation Plan (NAP 2023–2050), the Nationally Determined Contributions (NDC) and Climate Change Gender Action Plan (ccGAP). It also reflects global commitments under the the Paris Agreement, Sendai Framework and Sustainable Development Goals (SDGs).

Importantly, the People's Adaptation Plan offers a strong foundation for integrating climate resilience into the city's planning and investment processes. It provides actionable priorities that can be incorporated into ongoing and future urban development initiatives, including large-scale infrastructure investments supported by development partners such as the Asian Development Bank (ADB) and others. By embedding these priorities into our planning frameworks, we can ensure that investments are not only technically sound but also socially inclusive and climate-resilient.

On behalf of Narayanganj City Corporation, I would like to express our sincere appreciation to Practical Action, Global Center on Adaptation (GCA), Global Affairs Canada, all stakeholders, community representatives, and technical teams who contributed to the development of this plan.

We look forward to translating this plan into action through coordinated efforts, sustained partnerships, and continued engagement with communities. Together, we can advance towards a resilient Narayanganj that safeguards its people, infrastructure, and environment against the growing impacts of climate change.

Rita Lohani
Country Representative – Bangladesh
Global Center on Adaptation

CR-BD, GCA Photo

Ishrat Shabnam
Country Director – Bangladesh
Practical Action

CR-BD, GCA Photo

The People's Adaptation Plan (PAP) for Narayanganj City Corporation is a testament to the power of locally led, inclusive, and evidence-based climate action. At Practical Action, we strongly believe that sustainable and effective climate solutions must be rooted in the knowledge, priorities, and leadership of local communities, especially those most vulnerable to climate impacts.

Urban areas in Bangladesh, including Narayanganj, are facing increasing climate risks such as flooding, waterlogging, and urban heat stress. These risks disproportionately affect low-income communities, who often have limited access to basic services and adaptive resources. This Plan directly responds to these challenges by placing vulnerable communities at the center of planning and by promoting approaches that are both context-specific and scalable.

The plan integrates key principles of Locally Led Adaptation (LLA), ensuring that communities actively participate in identifying risks and prioritizing solutions. It also emphasizes the use of Nature-based Solutions (NbS) alongside infrastructure interventions, promoting sustainable and cost-effective approaches to urban resilience. Furthermore, the plan incorporates Gender Equality and Social Inclusion (GESI) considerations, recognizing the differentiated impacts of climate change on women and marginalized groups and ensuring that their voices are reflected in decision-making processes.

This initiative is well aligned with Bangladesh's national climate and development priorities, including the National Adaptation Plan (NAP 2023–2050), the Nationally Determined Contributions (NDC), and the Climate Change Gender Action Plan (ccGAP).

We would like to express our sincere gratitude to Narayanganj City Corporation for their leadership and collaboration throughout this process. We also acknowledge the valuable contributions of community members, local stakeholders, and partner organizations. Special thanks are extended to Global Affairs Canada (GAC) and the Global Center on Adaptation (GCA) for their financial and technical support, which made this initiative possible.

Moving forward, Practical Action remains committed to supporting the implementation of this plan and to scaling up inclusive and locally driven climate solutions across urban Bangladesh. We believe that this People's Adaptation Plan can serve as a model for other cities, demonstrating how community-led approaches can strengthen urban resilience and drive transformative change.

EXECUTIVE SUMMARY

Narayanganj City Corporation (NCC), located adjacent to the capital Dhaka along major river systems, is one of Bangladesh's oldest industrial and commercial centres. It hosts 55% of the country's knitwear factories and 33% of its textile mills. Over the past decade, rapid urbanisation has significantly expanded the city's low-income communities (LICs), with 66 informal settlements identified within NCC boundaries, housing large numbers of vulnerable residents including women, children, the elderly, and persons with disabilities.

The city is highly exposed to climate hazards — particularly waterlogging, urban heat stress, extreme rainfall, and water scarcity — that disproportionately affect LIC residents who have limited access to essential infrastructure and services. In response, the Asian Development Bank (ADB) is preparing a US$155-million Narayanganj Green and Resilient Urban Development Project (NGURDP). To ensure LIC communities' voices are reflected in three forthcoming masterplans (Urban Action Plan, Solid Waste Management Masterplan, and Sewerage Masterplan), the Global Center on Adaptation (GCA), funded by Global Affairs Canada, partnered with Practical Action Bangladesh to develop People's Adaptation Plans (PAPs) for priority wards within NCC.

The PAP development exercise combined rigorous technical assessment with deep community engagement. A Climate Vulnerability and Risk Assessment (CVRA) was conducted using multi-temporal remote sensing datasets, GIS overlays, and Multi-Criteria Decision Analysis (MCDA). Remote sensing indicators — including Urban Heat Island (UHI) extent, Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Built-up Index (NDBI), population density, road density, and waste accumulation data — were used to generate ward-level and LIC-level composite risk profiles for all 27 wards and 66 LICs of NCC.

Risk findings show that all nine community clusters within NCC record very low resilience scores — ranging from 20 to 30 out of 100 — for both urban flooding and heatwave hazards. Ward-level risk mapping revealed concentrations of high-risk areas in densely populated, low-elevation wards with limited green cover and poor drainage infrastructure. Of the 66 LICs assessed, 16 were identified as very high risk and selected for detailed participatory PAP development and costed priority action planning.

Community engagement followed a Gender Equality and Social Inclusion (GESI)-sensitive approach. LIC-level participatory workshops involved around 20 representatives per community, with balanced male-female participation. Pioneering Women's Adaptation Labs were introduced to ensure women's climate vulnerabilities and adaptation priorities are explicitly captured. PAPs were subsequently validated in community fine-tuning workshops (January 2026) and a multi-stakeholder validation workshop with NCC officials and partners (February 2026).

Five thematic adaptation areas were identified through the community engagement process: Safe Water; Improved Sanitation; Managed Waste; Climate-Resilient Infrastructure and Settlements; and Waterlogging and Heat Wave management. Community-proposed adaptation solutions have been compiled, prioritised, and costed across all 16 high-risk LICs. The estimated total cost of priority interventions is BDT 301,291,578, structured across four implementation phases: (1) Critical Health and Sanitation Infrastructure; (2) Roads, Drainage, and Shelter Improvements; (3) Energy, Cooling, and Greening Interventions; and (4) Recreational, Educational, and Community Facilities.

Climate scenario modelling (SSP1-2.6 to SSP5-8.5) for 2040 and 2060 indicates a continued intensification of urban heat islands and expansion of waterlogging-prone areas under all emissions trajectories, underscoring the urgency of early adaptation investment. The PAP also integrates Nature-based Solutions (NbS) opportunities — including urban water management improvements, green cover enhancement, and community-managed cooling corridors — as cost-effective, long-term resilience measures.

This PAP document serves as a strategic, evidence-based instrument for NCC and its partners to ensure that adaptation priorities of the urban poor are reflected in masterplan formulation, IFI project investment decisions, and long-term urban development programming. It is designed to be used alongside the detailed technical annexes covering GIS mapping, enumeration survey data, community dialogue notes, costed technical assessment sheets, and human interest case studies.

ACRONYMS

Abbreviation		Full Form
ADB	:	Asian Development Bank
AII	:	Aggregate Infrastructure Index
CEI	:	Community Engagement Index
CRCAP	:	Climate Resilient City Action Plan
CRMC	:	Climate Resilience Measurement for Communities
CVRA	:	Climate Vulnerability and Risk Assessment
DRM	:	Disaster Risk Management
FGD	:	Focus Group Discussion
GCA	:	Global Center on Adaptation
GESI	:	Gender Equality and Social Inclusion
GIS	:	Geographic Information System
HAP	:	Heat Action Plan
HEV	:	Hazard–Exposure–Vulnerability
IFI	:	International Financial Institutions
KII	:	Key Informant Interview
LAPA	:	Local Adaptation Plan of Action
LIC	:	Low-Income Community
LST	:	Land Surface Temperature
MCDA / MCDM	:	Multi-Criteria Decision Analysis / Making
MoEFCC	:	Ministry of Environment, Forest and Climate Change
NAP	:	National Adaptation Plan

Abbreviation		Full Form
NbS	:	Nature-based Solutions
NCC	:	Narayanganj City Corporation
NDBI	:	Normalized Difference Built-up Index
NDVI	:	Normalized Difference Vegetation Index
NDWI	:	Normalized Difference Water Index
NGURDP	:	Narayanganj Green and Resilient Urban Development Project
O&M	:	Operation and Maintenance
PAP	:	People's Adaptation Plan
SDG	:	Sustainable Development Goal
SEVI	:	Socio-Economic Vulnerability Index
SSP	:	Shared Socioeconomic Pathways
STS	:	Secondary Transfer Station
UHI	:	Urban Heat Island
ZCRA	:	Zurich Climate Resilience Alliance

GLOSSARY OF TERMS

Term	Definition	Reference
Adaptive Capacity	The ability of systems, communities, or individuals to adjust to climate change and moderate potential damages.	IPCC, 2014
Climate Change	Long-term shifts in temperature and weather patterns, primarily caused by human activities.	UNFCCC, 2011
Climate Hazard	A climate-related physical event such as flooding or heatwaves that may cause harm.	IPCC, 2014
Climate Modelling	The use of mathematical models to simulate climate systems and future conditions.	IPCC, 2021
Climate Projection	A simulation of future climate conditions under a specific scenario.	IPCC, 2014
Climate Resilience	The capacity to anticipate, absorb, and recover from climate impacts.	IPCC, 2022
Climate Resilience Measurement for Communities (CRMC)	A tool for assessing community resilience across multiple dimensions.	Zurich Climate Resilience Alliance
Climate Risk	The potential for adverse impacts from climate hazards interacting with exposure and vulnerability.	IPCC, 2014
Climate Scenario	A plausible description of future climate conditions based on emissions and development pathways.	IPCC, 2021
Climate Vulnerability and Risk Assessment (CVRA)	A process to evaluate climate risks by analyzing hazard, exposure, and vulnerability.	UNDRR, 2019
Disaster Risk Management (DRM)	Strategies and practices to reduce disaster risks through preparedness and response.	UNDRR, 2017
Exposure	The presence of people and assets in hazard-prone areas.	IPCC, 2014
Global Climate Models (GCMs)	Models that simulate climate systems at a global scale.	IPCC, 2021
Hazard–Exposure–Vulnerability (HEV) Framework	A framework defining risk as a function of hazard, exposure, and vulnerability.	IPCC, 2014
Heat Stress	Adverse impacts caused by prolonged exposure to high temperatures.	WHO, 2018
Land Surface Temperature (LST)	Surface temperature measured using satellite data.	NASA, 2020

Term	Definition	Reference
Locally Led Adaptation (LLA)	An approach where local communities lead adaptation planning.	IIED, 2021
Low-Income Communities (LICs)	Settlements with limited services and high climate vulnerability.	World Bank, 2020
Nature-based Solutions (NbS)	Actions using ecosystems to address climate and societal challenges.	IUCN, 2020
Regional Climate Models (RCMs)	Climate models providing higher-resolution regional projections.	IPCC, 2021
Remote Sensing	Collection of environmental data using satellite or aerial sensors.	NASA, 2020
Resilience	The ability to withstand and recover from shocks and stresses.	IPCC, 2022
Scenario Analysis	A method to evaluate possible future conditions under different assumptions.	UNDRR, 2019
Sensitivity	The degree to which a system is affected by climate change.	IPCC, 2014
Shared Socioeconomic Pathways (SSPs)	Scenarios describing alternative socio-economic futures for climate analysis.	IPCC, 2021
SSP1-2.6	A low-emission scenario reflecting sustainable development pathways.	IPCC, 2021
SSP2-4.5	A moderate-emission scenario reflecting intermediate trends.	IPCC, 2021
SSP5-8.5	A high-emission scenario driven by fossil-fuel-intensive growth.	IPCC, 2021
Urban Heat Island (UHI)	A phenomenon where urban areas are warmer than surrounding rural areas.	EPA, 2021
Vulnerability	The propensity to be adversely affected by climate hazards.	IPCC, 2014

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CHAPTER ONE

1. INTRODUCTION

1.1. Study Context

Narayanganj, located near major rivers and adjacent to the capital Dhaka, is one of the oldest industrial and trade centers in Bangladesh, particularly for textile industries. Manufacturing dominates the city's economy, with 55% of Bangladesh's knitwear factories and 33% of textile mills located in the city. In the last decade, the city has experienced rapid urbanization and population growth, resulting in a substantial increase in responsibility for municipal services. However, the city suffers from deteriorating urban services, including in key sectors, such as water supply and waste management. Climate change and disaster risks will further accelerate these pressures. The city is frequently subjected to droughts, heatwaves, extreme rainfall, and multi day rainfall events leading to shortages in water supply and often overwhelmed drainage systems. Increases in temperature over time represent chronic risks, leading to increasing demand for water supply. These challenges disproportionately impact low-income communities, particularly those residing in the city's many informal settlements who often lack access to basic services and risk infrastructure, making them highly vulnerable to the impacts of climate change.

The city of Narayanganj (**Figure 1**) lacks a long-term masterplan, like many other cities in Bangladesh, resulting in piecemeal solutions and projects instead of integrated city wide programs to address the needs and climate vulnerability of the poor. The Asian Development Bank (ADB) is currently preparing a US$155-million Narayanganj Green and Resilient Urban Development Project (NGURDP), which aims to provide sustainable, climate resilient and inclusive urban infrastructure services in Narayanganj City Corporation (NCC). These include investments in infrastructure for safe drinking water supply, drainage, and urban roads; and improved capacity of NCC and local communities. The project will also support the preparation of three masterplans for improved municipal services in NCC: i) an Urban Action Plan, ii) a Solid Waste Management Masterplan, and iii) a Sewerage Masterplan. The ADB recognizes that to ensure sustainable urban development, it is imperative that the special needs and circumstances of low-income communities, particularly those residing in informal settlements, are accounted for in the formulation of urban masterplans, and in investments under the project.

The ADB has therefore requested the Global Center on Adaptation's (GCA) to support formulating People's Adaptation Plans (PAPs) to inform prospective project investments and outputs, including the three masterplans for NCC. To ensure low-income and informal settlement communities are included in planning and investment, the ADB has engaged the GCA to develop PAPs. With funding from Global Affairs Canada, the GCA is partnering with Practical Action in

Bangladesh to support the NCC in preparing PAPs for priority wards (as Low-Income Communities or LICs) of the NCC.

The study under which PAPs are prepared titled *Climate Vulnerability and Risk Assessment, And GIS Mapping for People's Adaptation Planning in Narayanganj City Corporation (NCC)*. It aims to strengthen NCC's Climate Resilient City Action Plan by generating evidence-based climate risk insights and community-informed strategies for vulnerable low-income settlements. It mapped and profiled at-risk areas, assessed climate vulnerability, documented community experiences, and built local capacity to guide practical, prioritized resilience and adaptation investments.

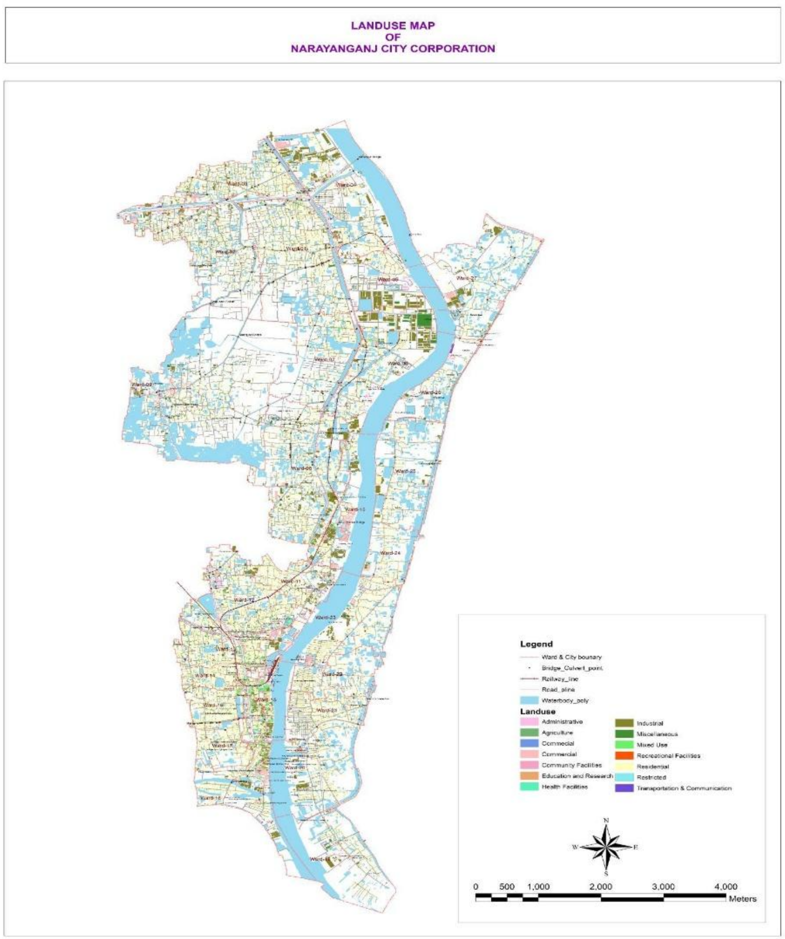

Figure 1: ***Landuse map of Narayanganj City Corporation (NCC).***

1.2. Purpose of People's Adaptation Plans (PAPs)

The main purpose of formulating People's Adaptation Plans (PAPs) for NCC was to ensure that climate-related priorities of the poor are reflected in the ADB project investments and outputs, including the three masterplans, namely an Urban Action Plan, a Solid Waste Management Masterplan, and a Sewerage Masterplan. To do that first a number of LIC-level PAPs were formulated in a participatory manner. The PAP development exercise also pioneered 'Women's Adaptation Labs' as part of the planning process to identify the key climate vulnerability challenges of women residents of the LICs, to assess their urgent needs, and to register locally appropriate and affordable adaptation solutions to meet those demands. The outputs of these Labs were subsequently incorporated in the LIC-level PAPs. This document synthesises and compiles all these PAPs in a comprehensive single document to be ready used by the NCC and ADB and other stakeholders involved in betterment of people's lives and livelihoods.

To fulfil its purpose, the PAP preparation exercise undertook several major activities. It conducted a comprehensive current and future climate vulnerability risk assessment for priority wards within NCC. It supported selected highly climate vulnerable communities (i.e., LICs) in Narayanganj to develop their own LIC-level PAPs. Along with that it facilitated Women's Adaptation Labs for women to develop locally contextualized and cost-effective adaptation solutions in consultation with technical experts. Subsequently, the exercise supported the NCC to uptake the PAPs to ensure adaptation approaches and solutions identified are integrated within the three city masterplans to be prepared under the international financial institutions (IFI) project. Finally, it supported the community to develop a list of priority-costed solutions, to inform investments under the IFI project.

Building on this comprehensive PAP development exercise, a number of outcomes are expected. First, the whole process was expected to ensure that the climate-related priorities of the poor in Narayanganj, in particular women, are included in the above mentioned masterplans. Second, this would inform investments in community-level infrastructure under the ongoing and anticipated projects (e.g., NGURDP project). Third, it would support community ownership, and operation and maintenance (O&M) of infrastructure installed by these projects. Fourth, the PAP development would ensure consideration of Nature-based Solutions (NbS) interventions in the masterplans (e.g., as part of participatory Heat Action Plans), along with consideration of the role of poor communities in long-term O&M for upkeep and sustainability of NbS. Fifth, it would support consideration of longer-term climate threats (e.g., migration and water stress) in the forthcoming masterplans. Finally, the PAP development exercise would support green jobs for the members of the LICs to build economic resilience to climate change.

1.3. Methodology of Participatory Exercise

1.3.1. Risk assessment of Wards and LICs

The Climate Vulnerability and Risk Assessment (CVRA) uses multi-temporal datasets, combining long-term climate baselines, recent socio-economic and infrastructure data, and future climate projections (2050 and 2100). This supports assessment of both present vulnerabilities and future risks. The analysis for the NCC applied remote sensing–based indicators including Urban Heat Island (UHI), Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Built-up Index (NDBI), road density, population density, ecosystem services, waterlogging zones, and waste accumulation hotspots. These indicators quantified hazard intensity, exposure, and environmental stress. This section gives a short introduction to the steps used for risk assessment and investment planning. Detailed methodology can be found in the report titled *Climate Vulnerability and Risk Assessment, and GIS Mapping for People's Adaptation Planning in Narayanganj City Corporation (NCC)* (**Annex 1**).

Ward-Level Risk Assessment and Mapping In the current exercise, the ward-level risk assessment integrated spatial indicators, climate modeling, infrastructure data, and community inputs using Multi-Criteria Decision Analysis (MCDA). Indicators were standardized and weighted to generate ward-specific risk profiles and maps, identifying priority hotspots for intervention. By integrating the different factors found from the ward-level assessment, the study integrated those in assessing settlement-level risk (or LIC-level risk). Risk assessment and mapping integrated insights from secondary data sources using satellite images and analyzed them using remote sensing. Data from the NCC regarding this assessment also played an important role. The list of variables used for this assessment is given in **Table 1.1**.

The ward-level analysis provided a broad overview of hazard distribution, settlement-level assessment ensuring that the micro-scale dynamics of exposure, sensitivity, and adaptive capacity were systematically evaluated. At the LIC-level, on the other hand, the risk assessment and mapping process aims to capture the highly localized vulnerabilities faced by the LICs and other at-risk groups of the NCC.

The risk assessment follows established models of hazard–exposure–vulnerability (HEV) interactions, in line with frameworks adopted by IPCC (2014) and UNDRR (2019). Settlement-level risk (R) has been computed using a composite index approach, where $R = f(H,E,V)$

Table 1.1: Variables used in risk assessment to estimate the exposure, sensitivity and adaptive capacity of the wards and the LICs of NCC.

Variable	Dimension*	Remarks
UHI (Urban Heat Island area/intensity)	Exposure	Captured the hazard intensity of heat affecting a ward. Larger/stronger UHI means more frequent/longer hot conditions.

Variable	Dimension*	Remarks
Waterlogging	Exposure	Direct manifestation of the flood hazard (standing water/inundation extent).
NDWI (water index)	Exposure	In dense cities, higher NDWI often signals surface water/ponding or proximity to water bodies, greater flood exposure.
Population density	Exposure	More people potentially exposed to any hazard; also complicates evacuation and service coverage.
NDBI (built-up index)	Sensitivity	More impervious/built surfaces, higher heat retention, lower infiltration, and faster runoff; settlements become more damage-prone to heat & flood.
Waste accumulation (% of STS)	Sensitivity	Rains, exacerbates waterlogging; increases public-health burdens during heat/flood events.
NDVI (vegetation/green cover)	Adaptive Capacity	Vegetation provides cooling, shading, infiltration and erosion control, it reduces heat/flood impacts.
Road density	Adaptive Capacity	Better access/evacuation, emergency response, and service delivery. (roads add impervious area)

* The Dimension column represents different aspects of Risk, namely Exposure, Sensitivity, and Adaptive Capacity.

Settlement-Level Risk Assessment and Mapping

Building on the ward-level results, settlement or LIC-level assessment captured micro-scale vulnerabilities using a Hazard–Exposure–Vulnerability framework aligned with IPCC and UNDRR guidance. Composite Climate Risk Indices were generated using GIS overlays and participatory data to rank all existing LICs and identify priority LICs.

Settlement Profiling

All LICs were screened using composite vulnerability indicators, followed by scoring, ranking, and field validation. A statistically representative household sample was selected for detailed profiling.

Data Analysis and Indices

Quantitative analysis applied established indices, including Aggregate Infrastructure Index (AII), Socio-Economic Vulnerability Index (SEVI), Community Engagement Index (CEI), and an aggregated Informal Settlement Index. These indices integrate survey, spatial, climate, and participatory data to rank the LICs.

1.3.2. Resilience analysis of the communities

The exercise applied the Climate Resilience Measurement for Communities (CRMC) tool developed by the Zurich Climate Resilience Alliance (ZCRA) (https://zcralliance.org/crmc/) to systematically assess resilience across key livelihood capitals and climate risk dimensions. Although resilience depends on context and is hazard specific, the CRMC adopts a community-level approach to measure resilience for specific risks, while also addressing underlying vulnerabilities through general, hazard-specific, and hazard-unique resilience components. Consistent with the CRMC principle of measuring resilience at the community level, the total 27 wards of NCC were identified as nine communities each having three wards (**Table 1.2**).

Table 1.2: The clustering of 27 wards of NCC into nine communities for resilience analysis by using the Climate Resilience Measurement for Communities (CMRC) tool.

Ward numbers and corresponding communities		Ward numbers and corresponding communities		Ward numbers and corresponding communities	
1, 2, 3	Community 1	4, 5, 6	Community 2	7, 8, 9	Community 3
10, 11, 12	Community 4	13,14,15	Community 5	16,17,18	Community 6
19, 20, 21	Community 7	22, 23, 24	Community 8	25, 26, 27	Community 9

The resilience analysis used a mixed-method design within the CRMC framework to capture a comprehensive picture of community resilience. Quantitative data were collected through household surveys, with a sample of 1,565 households drawn at a 95% confidence interval from a total population of 255,648 residents, assuming an average household size of 3.7. Qualitative data were collected through 37 Focus Group Discussions (FGDs), 15 Key Informant Interviews (KIIs), secondary sources' information and community context questions, allowing the study to integrate both measurable indicators and the lived realities of the community members. To strengthen accuracy and ownership, the findings were validated through a workshop with the community members and local government representatives of the NCC.

Resilience scores were calculated through a stepwise CRMC-consistent process. General sources assessed underlying vulnerabilities and critical systems and were graded only once. Hazard-specific sources measured similar concepts that vary slightly by hazard and were graded separately for each hazard, while hazard-unique sources captured elements specific to a particular hazard and were graded only for that hazard. Each source grade was first converted into a numerical score. Capital-level scores were then computed by averaging all sources within each capital. Finally, the overall resilience score was derived by averaging the five capital scores (i.e., human, financial, physical, financial, natural and social capitals), producing a composite measure of resilience across vulnerability, adaptive capacity and recovery potential. This integrated approach ensured a balanced understanding grounded in both quantitative evidence and qualitative insight. The detailed methodology of resilience analysis can be found in **Annex 2**.

1.3.3. Participatory adaptation planning and validation process

LIC-level PAP development

After the final selection of a LIC based on its very high risk index, participatory adaptation plan development was initiated ensuring meaningful inclusion by prioritizing gender balance (GESI) and youth representation. For a LIC, the around 20 representative community members were brought in a workshop in a suitable location in NCC, with a balanced representation of men and women, including youth and different professional groups. This participatory session aimed at informing the development of actionable plans aimed at enhancing urban service delivery within the jurisdiction of NCC by following standard principles of co-creation and co-development, where applicable. With that view, the planning process started with an orientation on the project context, key climate and environmental risks, and the critical importance of inclusive, and locally led adaptation. It was followed by a participatory adaptation planning exercise, where LIC representatives identified their existing community resources; major problems related to toilet/sanitation, water access, heat stress, and infrastructure; and brainstormed possible solutions to improve the situation. Finally, they collectively prioritize the adaptation solutions deemed most necessary and urgent for their community through a ranking exercise. Details of these LIC-based adaptation action plans can be found in **Annex 3**.

PAP validation

A total of three LIC-level PAP fine-tuning workshops were held in Narayanganj city on 15, 18, and 21 January 2026. In each workshop, around 7 people from each ward participated, including the ward secretary, and 4 male and 4 female representatives.

On 3 February 2026, a validation workshop with NCC officials and other stakeholders of the NCC was held at the NCC office. A total of 22 people participated in that event consisting of different LIC and ward representatives, staff members of different government agencies, and NCC officials. In that validation event, the whole process of risk assessment, LIC prioritisation, and PAPs development at LIC-level were presented by the Practical Action Team. It was followed by a presentation of priority adaptation actions of 15 LICs. The participants discussed and validated the prioritisation of the action points.

1.3.4. Costed priority actions

A structured, evidence-based, and participatory approach was followed to prepare costed priority action for 16 high-risk LICs of NCC. This approach combined desk review, field-based investigation, and stakeholder engagement, ensuring that both technical evidence and community perspectives were reflected. Emphasis was placed on settlement-level assessment to capture localised service gaps, climate risks, and operational constraints, while maintaining consistency across all LICs for comparability. It was also aligned with NCC systems, institutional roles, and budgeting processes to support realistic implementation and sustainability.

Based on the LIC-level adaptation plans (**Section 7.4**), a comprehensive list of potential interventions were identified according to their level of urgency, implementation complexity, and investment requirements, such as i) Quick Wins, ii) Short-Term Improvements, and iii) Medium-Term Solutions. A multi-criteria scoring matrix was used to evaluate each proposed intervention against a set of predefined criteria (**Table 1.3**). The prioritization framework ensured that the selected interventions provided the greatest benefits in terms of risk reduction, service improvement, and community impact while remaining technically and financially feasible.

Table 1.3: Criteria-wise prioritization process of LIC-level interventions and scoring matrix.

Criterion	Key Considerations
Risk Reduction Impact	Extent to which the intervention contributes to reducing flooding, waterlogging, sanitation risks, and disruption of essential services in vulnerable communities.
Beneficiary Reach	Number of beneficiaries and the degree to which vulnerable populations benefit from the intervention.
Feasibility	Technical readiness, availability of space or land, institutional capacity, and practicality of implementation within the municipal context.
Cost and Sustainability	Capital investment requirements (CAPEX), affordability, and implications for long-term operation and maintenance.
Inclusion and Safety	Degree to which the intervention improves safety, accessibility, and usability for women, children, elderly people, and other vulnerable groups.
Time to Benefit	The expected timeframe within which the intervention would generate visible improvements in service delivery and community well-being.

For each prioritised intervention, concept-level technical inputs and cost estimates were prepared to support planning and budgeting decisions. First, conceptual design layouts were prepared for each proposed infrastructure interventions, based on which preliminary quantity estimates (BOQ) were done. Total cost estimate for an intervention was based on appropriate unit rates obtained from government schedules and relevant market references. The costing assumptions and reference sources were duly documented. The costing information was compiled and summarised in different formats (e.g., by LICs, by service sectors, and by intervention categories) to facilitate decision-making and resource planning. Details of costed priority actions can be found in **Annex 4**.

CHAPTER TWO

2. SITUATIONAL ANALYSIS OF NCC

2.1. Current Situation and Climate Change

Narayanganj City Corporation (NCC) stands at the crossroads of rapid urbanization, which, despite bringing diverse economic opportunities, has also introduced significant socio-environmental challenges. The city's accelerated urban expansion has led to a substantial concentration of informal settlements, where residents often face inadequate access to essential services such as clean water, sanitation, and effective waste management. These deficiencies critically undermine the living standards and health of these communities, particularly those residing in low-income areas.

The vulnerability of Narayanganj's residents is worsened by the increasing impacts of climate change. The city is witnessing a rise in the frequency and intensity of floods, heatwaves, urban pollution, and water scarcity incidents. Such climate-induced stresses disproportionately affect marginalized populations who possess limited adaptive capacity and resources. Addressing these multifaceted challenges demands a robust, data-driven understanding of the local risks, enabling evidence-based planning and targeted interventions.

Demography and Settlement Patterns

NCC is home to a diverse population with varying socio-economic conditions. The city hosts 66 urban slums and low-income communities (LICs) that accommodate a substantial portion of vulnerable residents, including informal laborers, women, children, the elderly, and persons with disabilities. These settlements typically have dense housing patterns, limited access to basic services, and inadequate infrastructure, making them particularly sensitive to climate-related hazards. The population pattern in NCC is clearly polarized, with a small cluster of very dense core wards and a larger ring of more moderately populated areas.

Socio-Economic Profile

The city's economy is diverse, with formal and informal sectors coexisting. Many residents of the LICs are engaged in small-scale trade, manufacturing, mills, daily labor, waste and sanitation work, and service-oriented occupations. Despite the economic activity, the urban poor experience limited access to essential services, including potable water, sanitation, healthcare, and education. Household structures are often temporary or semi-permanent, constructed with low-cost materials, and highly susceptible to damage from floods, storms, and extreme heat.

Environmental and Climate Context

Narayanganj is increasingly affected by climate change and urban pressures. The city experiences extreme rainfall events, heatwaves, water scarcity, and poor drainage conditions, which can further exacerbate flooding and waterlogging, particularly given the city's low elevation of around 5 m above mean sea level and the likelihood that some settlements in river-adjacent pockets sit at lower ground levels. Urban expansion has led to environmental degradation, encroachment on natural water bodies, and increased solid waste accumulation, creating compounded climate risks. The informal settlements, in particular, face high exposure to both slow-onset events (e.g., water scarcity, urban heat islands) and sudden shocks (e.g., floods, heavy rainfall).

Infrastructure and Services

The existing infrastructure in low-income areas of NCC remains inadequate. The city has a mix of formal roads, drainage networks, water supply systems, educational and healthcare facilities, but their coverage in slum areas is limited. Informal settlements often rely on ad hoc water supply sources, makeshift sanitation systems, and temporary shelters, heightening their vulnerability to climate-related disruptions.

2.2. Prevailing Development Plans for NCC

2.2.1. Narayanganj Climate Resilient City Action Plan (CRCAP)

The Narayanganj CRCAP, developed under ICLEI's Urban-LEDS II initiative, prioritizes integrated vulnerability assessments, climate hazard mapping, and socially inclusive adaptation interventions across sectors, such as waterlogging, waste, heat stress, and sanitation. Its framework emphasizes ward-level diagnostics and evidence-based actions but often relies on secondary or aggregated datasets, leaving gaps in fine-scale inclusion of LICs. With rapid urbanization and increasing climate risks, Narayanganj faces challenges, such as insufficient urban planning, inadequate waste management, and rising environmental pollution, all exacerbated by climate change. This plan aims to address these systemic risks by promoting sustainable and climate-compatible urban development that aligns with national and international commitments like the Paris Agreement and the Sustainable Development Goals (SDGs). By fostering institutional coordination, building technical capacity, and enhancing stakeholder communication, the CRCAP seeks to create an enabling environment for effective climate action. It will support Narayanganj not only in mitigating and adapting to climate impacts but also in advancing inclusive growth, poverty alleviation, and green economic recovery, ensuring that climate benefits reach all segments of the population.

This plan provides valuable insights and strategic guidance for the Climate Vulnerability and Risk Assessment, and GIS Mapping for PAP study under NCC. Further, the present study directly complemented CRCAP's mandate by employing high-resolution tools, drone surveys, remote sensing indices (NDVI, NDWI, LST, and NDBI), and settlement-level Multi-Criteria Decision Making (MCDM), to map vulnerabilities in all LICs and 27 wards. It will help ensure that local adaptation measures are grounded in existing climate resilience frameworks, promote alignment with ongoing city-level actions, and enhance the effectiveness of mapping and vulnerability assessments by integrating comprehensive data and institutional perspectives.

Furthermore, the present study introduced scenario-based climate modelling (SSP2, SSP3, and SSP4) and the Climate Resilience Measurement for Communities (CRMC) tool, bridging an existing policy gap in the CRCAP by providing foresight-driven risk assessment. While the CRCAP sets adaptation priorities, it does not operationalize downscaled climate scenarios or resilience capitals (human, social, financial, physical, and natural) at the settlement/LIC scale. By aligning the CRMC indicators with CRCAP monitoring metrics and overlaying social vulnerability with hazard exposure (i.e., heat, flooding, and waste hotspots), the current study strengthened NCC's evidence base for climate-resilient investment screening under the forthcoming Narayanganj Green and Resilient Urban Development Project (NGURDP). This integration not only validates the present study's relevance to city-level planning, but also ensures its outputs feed directly into national priorities, namely under the Bangladesh Delta Plan 2100, the National Adaptation Plan (NAP) (2023-2050), and the SDG 11.

2.2.2. Heat Action Plan and Climate Resilient Service Planning for NCC

Narayanganj, a key industrial and commercial hub near Dhaka, faces increasing vulnerability to extreme heat due to rapid urbanization, high population density, concentrated industrial activities, traffic congestion, and insufficient green and blue infrastructure. These conditions have amplified the urban heat island effect, putting pressure on public health systems and infrastructure, and disproportionately affecting vulnerable groups, such as residents of informal settlements (LICs), outdoor workers, the elderly, and children. The Heat Action Plan (HAP) developed by NCC addresses these challenges through a multi-faceted approach, including the establishment of early warning systems linked with the Bangladesh Meteorological Department, strengthening healthcare facilities with training and resources to manage heat-related illnesses, and community outreach to raise awareness about heat risks and first aid. Long-term recommendations emphasize restoring and expanding blue-green networks, creating shaded public spaces and cooling centers, promoting heat-reflective building materials, and improving urban planning to reduce heat stress. The plan highlights the importance of institutional coordination among government agencies, civil society, private sector, and community organizations. The HAP is crucial for the present study to leverage its evidence-based findings and strategies, ensuring that heat resilience is effectively integrated into the wider climate adaptation framework for Narayanganj.

2.2.3. From National Adaptation Plan (2023–2050) to Local Adaptation Plans of Action (LAPA)

The Bangladesh NAP sets out a long-term pathway for climate-resilient development and makes a clear case that adaptation has to be implemented through coordinated institutions and sustained financing. The plan also highlights that climate-relevant public spending has increased over time, signalling that adaptation is not only a policy priority, but also a growing investment agenda within national budgeting processes (MoEFCC, 2022).

This is where the Local Adaptation Plan of Action (LAPA) becomes especially important. LAPA is the practical bridge between national direction and what actually gets delivered on the ground. It helps translate broad national priorities into local decisions by identifying location-specific climate risks, setting realistic adaptation actions, and positioning them within local government planning and budgeting cycles. The LAPA guidelines explicitly frame this as a downscaling of the NAP to the upazila level, with a focus on integrating adaptation into local development planning over the next planning period (United Nations in Bangladesh, 2024).

From an investment perspective, LAPA strengthens implementation because it turns “needs” into “bankable priorities.” When local risks and solutions are clearly defined and agreed with communities and local institutions, it becomes easier to sequence interventions, justify resource allocation, and mobilize external finance alongside domestic funding. In cities and peri-urban areas where rapid growth, migration-linked livelihoods, and climate exposure intersect, this matters even more, because local plans can target the specific service and infrastructure gaps that climate hazards repeatedly stress, and do so in a way that aligns with the national adaptation framework and financing logic. The PAP prepared under this study went one step forward by contributing to LAPA preparation by identifying LIC-level adaptation actions.

CHAPTER THREE

3. CLIMATE CHANGE IMPACT AND STATE OF ADAPTATION

The LICs in NCC primarily face two major climate-related challenges: urban waterlogging and heatwaves. These risks arise from a combination of natural factors, such as geography and weather patterns, and human-related causes including inadequate infrastructure, rapid urban growth, and environmental degradation. Together, they create difficult living conditions that affect health, safety, and livelihoods. This section synthesizes findings from community-level case studies, FGDs, and Participatory Rapid Appraisal (PRA) exercises conducted across selected LICs. These qualitative surveys were designed to collect detailed information on local climate risks, existing adaptive capacities, and community-led investment priorities. The consolidated findings presented here reflect shared experiences, recurring challenges, and locally identified solutions, providing a community-grounded understanding of climate vulnerability in Narayanganj's low-income settlements. The summary of all information presented here is captured in **Table 3.1**.

Table 3.1: Sectoral impacts of climate change, community adaptive measures, and current gaps in the actions in LICs of NCC.

Key Climate Risk	Specific Impacts	Community Adaptation Strategies	Prevailing Gaps
Waterlogging	Frequent and prolonged flooding	Manual removal of floodwater with pots, mugs, buckets; collective community efforts to remove stagnant water	Labor-intensive, short-term relief
	Poor drainage infrastructure	Regular drain cleaning and maintenance by residents	Drain cleaning undermined by poor infrastructure and ongoing waste dumping
	Blocked drains due to waste	Community drain cleaning; collaboration with municipal authorities and NGOs	Lack of equipment, limited access to pumps and technical capacity
	Water contamination and health risks	Temporary household adaptations such as covering roofs with cloth or leaves	Temporary measures do not address root causes

Key Climate Risk	Specific Impacts	Community Adaptation Strategies	Prevailing Gaps
	Rapid unplanned urban growth	Community engagement with authorities for drainage improvements	Some communities passive, relying on natural drainage without action
			Lack of integration with formal drainage and waste management
Heatwaves and Heat Stress	Poor housing materials trapping heat	Roof cooling by sprinkling water on tin roofs; temporary shading with cloth or leaves	Temporary cooling methods offer only short-term relief
	High population density and limited open space	Informal community cooperation and resource sharing	Reluctance to reduce housing density or allocate space for green areas
	Air pollution and dust concentration	Engagement with municipal authorities to address drainage and waste issues	Weak community influence over infrastructure problems
	Irregular water supply during dry seasons	Community initiatives to improve water access (deep tube wells, pumps); household ventilation and shading improvements	Water scarcity limits cooling and hydration options
	Blocked drains and illegal waste dumping worsening heat	Community engagement with municipal authorities	Some residents take no action, enduring heat without adaptations

3.1. Climate Hazards Affecting the Community

1.1.1 Waterlogging

Waterlogging happens when rainfall exceeds the capacity of drainage systems or when drainage channels become blocked, causing water to accumulate in residential areas. In many LICs of NCC, poorly planned or insufficient drainage infrastructure cannot manage heavy or prolonged rainfall, resulting in frequent and long-lasting flooding (**Figure 3.1**). The problem is made worse by low-lying land and the lack of proper stormwater management.

Figure 3.1: Rainwater intrusion into homes of an LIC.

Blocked drains and canals often fill with uncollected solid waste and sediment, reducing the flow of water and increasing the severity and duration of flooding. This stagnant water damages homes, especially those made from fragile materials, and contaminates water sources as floodwaters mix with sewage and waste. These unsanitary conditions promote the spread of waterborne diseases and create breeding grounds for mosquitoes and other disease carriers.

Rapid and unregulated settlement expansion without adequate infrastructure is a key reason for drainage problems. The lack of regular maintenance and waste collection services also adds to the issue. As a result, waterlogging remains a persistent problem that disrupts movement, limits access to services, and lowers quality of life.

3.1.2. Heat Stress

Heatwaves are a serious challenge, especially in densely populated LICs where homes made from tin roofs and thin walls absorb and trap heat, causing very high indoor temperatures. The absence of trees and green spaces reduces natural cooling and increases the urban heat island effect.

Air pollution from nearby industries, unpaved roads, and open waste dumping areas adds to the problem (**Figure 3.2**). Dust and fine particles become more concentrated during hot and dry periods, worsening air quality. This increases the risk of respiratory problems and adds to the physical stress caused by extreme heat. Considering the lack of proper waste management containment facilities, heatwaves also promote biodegradation leading to pathogens and odor transmission to the surrounding environment,

Figure 3.2: Heatwaves cause degradation of waste.

Water scarcity during dry seasons limits people's ability to cope with heat. Irregular or insufficient water supply reduces opportunities for drinking, cooling, and maintaining hygiene. This increases the risk of heat-related illnesses and worsens living conditions. The combination of extreme heat, poor air quality, and limited water access creates very difficult environments for these communities.

3.2. Community Actions to Reduce Climate Hazard Impacts

3.2.1. Waterlogging

People of Narayanganj's LICs have developed various local coping strategies to manage the persistent challenges posed by urban waterlogging. These community-driven practices reflect both immediate responses to flooding and longer-term efforts to improve drainage and reduce health risks.

Manual removal of floodwater A common immediate response to indoor flooding is the manual removal of water using pots, mugs, or buckets. Many households in slums like

Guhobari and Haji Goli engage in this labor-intensive activity during and after heavy rains to reduce water accumulation inside their homes. In some areas, residents also coordinate collective efforts to remove stagnant water from communal spaces, helping to limit prolonged flooding.

Drain cleaning and maintenance

Although NCC is formally responsible for the cleaning and regular maintenance of drainage infrastructure, service delivery remains irregular, LICs are frequently underserved in practice. Residents actively participate in cleaning and maintaining local drainage channels to improve water flow and reduce blockages. Informal community groups in places, such as Bihari Camp (Balur Math and Sunil Para) and Risi Para organize regular drain clearing, removing accumulated waste and debris that worsen waterlogging. In some settlements, such as Ispahani Jela Para and Shanti Nagar, communities collaborate with municipal authorities or NGOs to support drainage improvement efforts, demonstrating a proactive approach to managing flood risks.

Use of mechanical pumps and community coordination

In areas where waterlogging is severe and persistent, such as Kelanpur Mouchak, some communities have adopted use of pumps or motors to accelerate the removal of standing water. These interventions require coordination and shared responsibility among residents to operate and maintain the equipment effectively.

Temporary household-level adaptations

Alongside drainage and water removal efforts, households implement temporary measures to minimize water intrusion and indoor discomfort. These include covering roofs with cloth or leaves to reduce heat and water penetration, a practice observed in Guhobari and Bihari Camp. Additionally, some communities have constructed or maintained toilets and drainage systems through community-led or supported projects, such as those in Bag Baria Colony, aiming to improve living conditions despite ongoing infrastructure challenges.

3.2.2. Heat Stress

Residents in Narayanganj's LICs face severe heat stress, especially in poorly constructed homes made with tin roofs and thin walls that trap heat indoors. To cope with extreme temperatures, many households have developed practical and low-cost adaptation strategies.

Roof cooling and temporary shading

A widespread practice to reduce indoor heat involves sprinkling water on tin roofs to cool the surface. This method is commonly used in slums, such as Guhobari, Haji Goli, and Bihari Camp, where residents also place cloth or tree leaves over roofs to provide temporary shade and reduce heat absorption. These simple measures help lower indoor temperatures during the hottest parts of the day.

Community cooperation and informal support networks

In some communities, informal cooperation plays a role in managing heat stress. For example, residents in WAPDA Slum and Siddhirganj South Rail Slum rely on collective support to share resources and information, although specific coping methods may vary. The communities come together to do emergency tasks, such as temporary drain clean before monsoon season. Additionally, communities collectively put covers over the tin sheds to reduce heat inside houses. Such collaboration can be vital in times of extreme heat, especially when access to water or other cooling resources is limited.

Addressing water scarcity

Water scarcity during dry seasons poses an additional challenge in coping with heatwaves. Irregular and insufficient water supply reduces opportunities for residents to cool their homes or hydrate adequately. In Omarpur West Para, community initiatives supported by organizations (e.g., BRAC) include the installation of deep tube wells and submersible pumps to improve access to water during critical periods.

Household-level adaptations and infrastructure engagement

Households also adopt other low-cost adaptations, such as using temporary shading materials and ventilating homes to improve airflow. In some areas, community representatives actively engage with municipal authorities to address structural issues related to heat, such as blocked drains that worsen heat effects and illegal waste dumping that affects overall environmental quality, as seen in Babulpara and other settlements.

3.3. Gaps in Community Adaptation Practices

3.3.1. Waterlogging

Despite various efforts by residents in Narayanganj's low-income settlements to cope with waterlogging, significant challenges remain. Many of the current adaptation measures are limited in scope, unevenly implemented, or unable to address the root causes of flooding. These shortcomings highlight the need for more comprehensive and coordinated approaches to improve resilience.

Labor-intensive and temporary measures

Manual removal of floodwater is common, but physically demanding and only offers short-term relief, especially during prolonged flooding.

Limited access to equipment and coordination

Use of pumps and motors is rare due to lack of resources and the need for organized community management.

Weak drainage infrastructure and waste issues

Drain cleaning helps, but is often ineffective because poor infrastructure and ongoing waste dumping quickly cause blockages again.

Passive responses in some communities

Some LICs do little or nothing to manage waterlogging, relying on floodwaters to recede naturally, increasing their vulnerability.

Lack of integration and support

Community efforts often lack sustained support and connection with formal city drainage and waste management, limiting their overall impact.

3.3.2. Heat Stress

Residents in Narayanganj's LICs have developed various strategies to cope with extreme heat. While there is a clear desire for solutions, many are reluctant to give up valuable living space for open areas or tree plantations that could reduce heat. Despite understanding that high population density worsens heat stress, space constraints and immediate housing needs limit such adaptations. Additionally, some community members do little to mitigate heat and simply endure the conditions. These social and spatial challenges, along with limited resources and infrastructure issues, hinder effective and sustainable coping.

Temporary and limited solutions

Roof cooling with water and shading reduce heat temporarily, but do not solve underlying housing problems that trap heat indoors.

Uneven community support and passive responses

Some communities cooperate to manage heat stress, but many lack organized support. Others take no action and just bear the heat, increasing their vulnerability.

Water scarcity

Irregular water supply limits options for cooling and hydration, worsening heat impacts. Efforts to improve water access are still limited.

Infrastructure and engagement gaps

Blocked drains and poor waste management contribute to heat stress, but community control over these issues is often weak and inconsistent.

CHAPTER FOUR

4. COMMUNITY CLIMATE VULNERABILITY AND RISK ASSESSMENTS

4.1. Hazard Pattern Analysis

In the following sections intensity of hazards (high temperature and waterlogging), and spatial hazard mapping using GIS are documented. Detailed data and analysis can be found in the report titled *Climate Vulnerability and Risk Assessment, and GIS Mapping for People's Adaptation Planning in Narayanganj City Corporation (NCC)* (**Annex 1**).

4.1.1. Urban heat island (UHI)

Figure 4.1 captures the area extent of land surface temperature and urban heat island (UHI) intensity classes across all wards of NCC. For this study, 2024 was selected as the baseline year because the hottest month (April) recorded the highest average temperature in the past five years, with an average of 33 °C and a maximum of 41 °C.

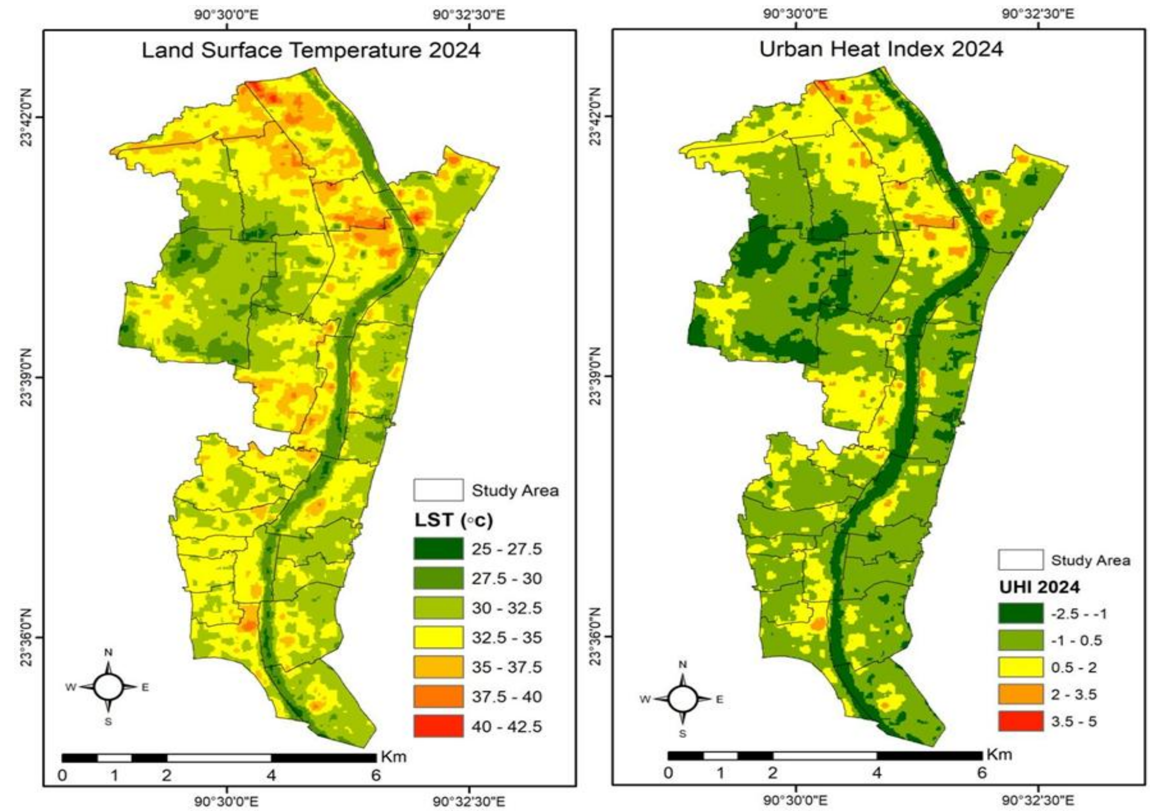

Figure 4.1: Land Surface Temperature and urban heat island (UHI) maps of NCC.

Across the city, the lowest intensity class (0.5–2) dominates the UHI footprint. Wards 1, 3, 4, 6, and 8 had the largest areas in this class (all above approximately 1 km²), suggesting broad zones of mildly elevated temperatures within these wards. Several other wards, such as 2, 5, 10, 18, 19, 20, 23, 25, and 27 also exhibited notable coverage in this lowest class, while smaller wards (e.g., 7, 14, 16, 21, 24, and 26) showed only limited UHI-affected area.

The intermediate intensity class (2 - 3.5) is more spatially constrained and concentrated in a smaller set of wards. The largest extent in this class again occurred in Ward 04 (0.307 km²), followed by Wards 5, 6, 27 and 1, indicating that these wards contained more pronounced UHI "hotspots" within their built-up fabric. Moderate UHI were also present, though at smaller scales, in Wards 8, 9, 10, 11, 13, 15, 18, 19, 20, 23, and 25. In contrast, a group of wards (namely, 2, 7, 12, 14, 16, 17, 21, 22, 24, and 26) had no area in this higher class, pointing to comparatively weaker UHI expression there.

4.1.2. Waterlogging

Waterlogging is a priority hazard for Narayanganj since it sits in a low-lying riverine setting along the Shitalakhya River and near other connected river systems, where heavy monsoon rainfall can quickly overwhelm drainage and leave standing water in streets and low pockets. When drains are constrained by siltation, solid waste blockage, or limited outfall capacity during high river levels, water takes longer to recede, which disrupts mobility, daily income, waste collection, and sanitation conditions, particularly in densely settled areas. The waterlogging results show that most of NCC falls under the low to very low waterlogging risk classes, but a few wards stand out as clear hotspots of concern (**Figure 4.2**).

The most critical situation appears in Ward 9, which had the largest extent of very high and high waterlogging (about 0.98 km^2 combined) and more than 1.38 km^2 when the medium class was included. Ward 12 also showed substantial susceptibility, with around 0.50 km^2 in very high–high and 0.60 km^2 in very high–medium waterlogging zones. Wards 1, 2, and 18 formed a second tier of concern, each with noticeable areas under very high and high waterlogging, indicating repeated or prolonged inundation risk during heavy rainfall or flood events. Localized but smaller very-high pockets also occurred in Wards 3, 4, 5, and 11. By contrast, many wards (e.g., 6, 10, 14, 15, 17, 19, 20, 21, 22, 23, 24, and 25) had no mapped very high or high waterlogging at all, with the vast majority of their area classified as low or very low risk. These wards currently enjoy relatively better drainage performance and fewer chronic waterlogging problems.

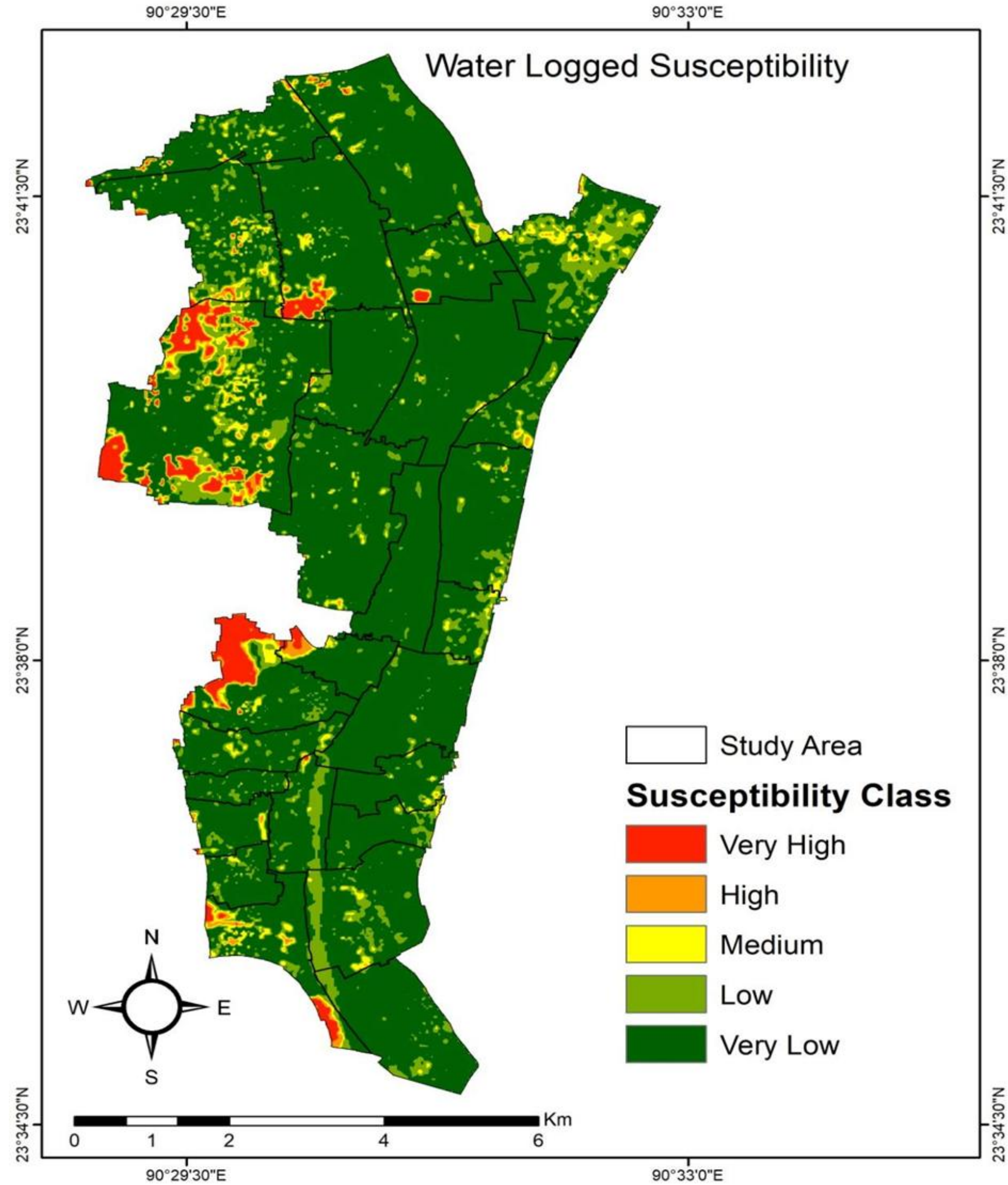

Figure 4.2: Waterlogging susceptibility of the wards of NCC.

In practical terms, Wards 9 and 12 should be top priorities for drainage improvement, canal/khals rehabilitation, and road-side stormwater upgrades, followed by targeted interventions in Wards 1, 2, and 18. For the lower-risk wards, the focus should be on protecting existing drainage channels and permeable surfaces so that today's "very low" and "low" conditions can be maintained as urbanization intensifies.

4.2. Estimation of Vulnerability

In addition to hazard mapping (UHI intensity and waterlogging tendency), several other variables (namely, NDBI, NDVI, NDWI, road density, population density, and waste accumulation) were estimated for all 27 wards of NCC. These were subsequently used to calculate ward-wise vulnerability scores. Detailed methodology, data and analysis can be found in the report titled *Climate Vulnerability and Risk Assessment, and GIS Mapping for People's Adaptation Planning in Narayanganj City Corporation (NCC)* (**Annex 1**).

4.2.1. Normalized Difference Vegetation Index (NDVI)

Ward-wise vegetation cover statistics derived from NDVI classification for NCC. For each ward, the total number of pixels, vegetated pixels, proportion of vegetation (%), and corresponding vegetated area (m²) are reported, providing a clear picture of how green space is distributed across the city. The distribution of vegetation cover across all wards of NCC based on NDVI analysis is mapped in **Figure 4.3**. These highlight the proportion of vegetated pixels and corresponding vegetated area in square meters. It illustrates clear variation between wards, with some exhibiting very low green cover (3-7%) and others showing significantly higher vegetation levels exceeding 50%.

Wards 3 and 15 exhibited the weakest vegetation signal, with only about 3% of their area classified as vegetated (46,800–34,200 m²). Other wards with very limited vegetation included Wards 5, 6, 12, 14, 16, and 17, where vegetation occupied roughly 7-16% of the area. These wards represented the more intensely built-up or environmentally stressed parts of NCC, with relatively sparse green cover and, consequently, a higher likelihood of heat stress and poorer environmental quality. A second group of wards showed moderate vegetation cover, typically between 19% and 25% (e.g., Wards 2, 8, 11, 18, 21, and 22), with vegetated areas ranging 190,800 m² - 813,600 m². These wards combined built-up land with a noticeable, though not dominant, presence of vegetation. In particular, Wards 8 and 22 stood out in this group for having relatively high vegetated areas and percentages, suggesting a more balanced land-use pattern and better local microclimate conditions than the most vegetation-poor wards.

The highest levels of vegetation cover were concentrated in a smaller set of wards. Wards 7, 9, 19, 20, 24, 25, 26, and 27 showed vegetation fractions from 37% up to 58%. Ward 26 (58%), Ward 27 (55%), and Ward 07 (51%) record the largest relative shares of vegetation, while Wards 9 and 19 provided some of the largest absolute vegetated areas (over 2.8 million m² and 1.0 million m², respectively). These wards function as key green zones within NCC, likely contributing significantly to cooler local temperatures, better air quality, and overall ecological resilience.

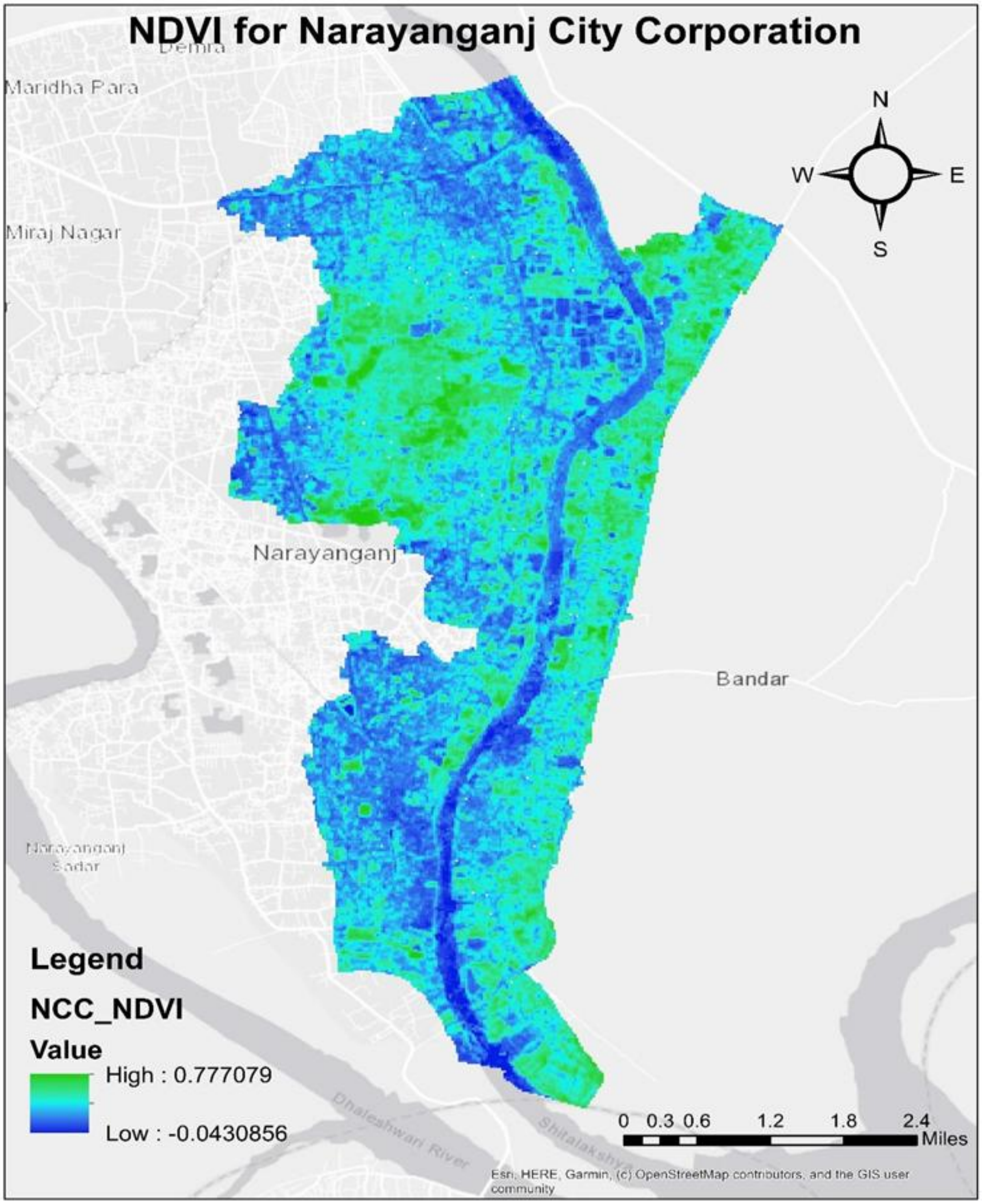

Figure 4.3: Normalized Difference Vegetation Index (NDVI) of NCC.

4.2.2. Normalized Difference Built up Index (NDBI)

Figure 4.4 presents the extent of built-up areas across NCC wards using NDBI analysis, showing the proportion of built-up pixels and the corresponding built-up area in square meters. It highlights wards with very high built-up intensity, often above 70%, as well as wards with comparatively lower levels of urban development.

The NDBI results show a very clear concentration of dense built-up in the central part of NCC. Wards 3, 12, 13, 14, 16, and 17 had more than 65% of their area mapped as built-up, with Wards 14 and 03 exceeding 77-79% coverage. Large, highly urbanized blocks also appeared in Wards 1, 2, and 15, where built-up surfaces accounted for more than half of the ward area. These wards were likely to experience stronger urban heat island effects, higher surface runoff, and lower ecological resilience, and therefore should be prioritized for cooling interventions (tree planting, pocket parks, and reflective surfaces) and improved drainage. Towards the other end of the gradient, Wards 7, 9, 19, 20, 24, 25, 26, and 27 showed substantially lower built-up fractions (roughly 19–27%). Although these wards were not free from development, they retained comparatively larger shares of non-built surface water, vegetation, or vacant land which could still be protected, enhanced, or guided through more controlled growth. Strategically, these lower-NDBI wards represented key opportunities for conserving green-blue infrastructure and steering future expansion in a more climate-sensitive way.

Overall, the NDBI pattern highlights where Narayanganj was already highly sealed and vulnerable, and where there was still room to balance development with environmental quality. High NDBI wards demand immediate mitigation, while low and moderate NDBI wards offer space for more sustainable, planned urban growth.

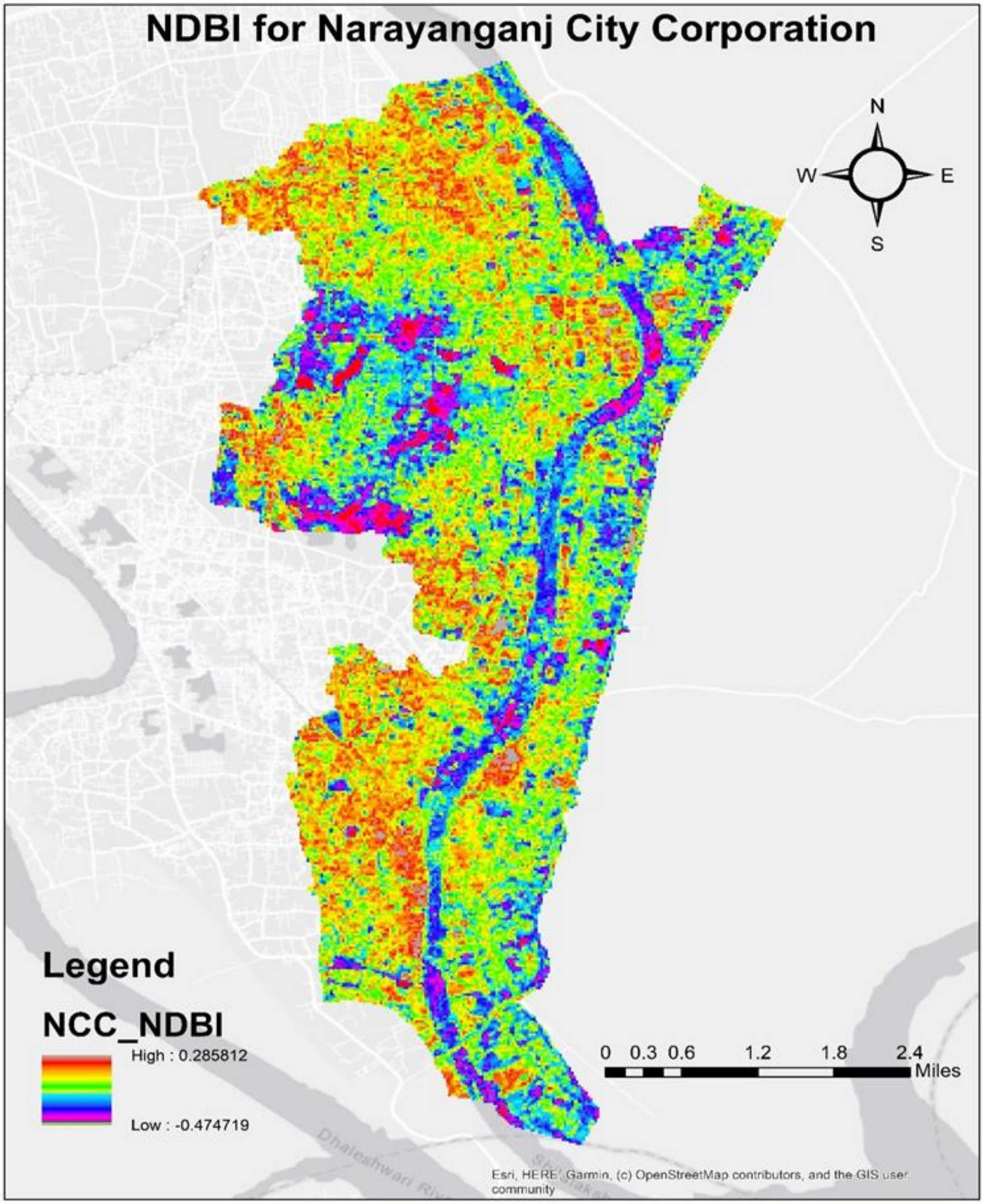

Figure 4.4: Normalized Difference Built up Index (NDBI) for NCC.

4.2.3. Normalized Difference Water Index (NDWI)

Figure 4.5 presents ward-wise surface water extent as NDWI across NCC. For each ward, the total number of pixels, water pixels, percentage of water cover, and corresponding water area (m^2) are reported, providing a detailed picture of how surface water bodies are distributed across the city.

At the lower end of water availability, Wards 7 and 26 showed the smallest proportional water cover (3–3.5% of their area). Slightly higher but still limited surface water was observed in Wards 17, 22, 24, and 25, where water occupies roughly 5–8% of the ward area. These wards can be interpreted as more strongly dominated by built-up or dry land surfaces, with relatively few open water bodies such as ponds, canals or wetlands. A second group of wards (e.g., Wards 1, 2, 8, 9, 11, 18, 19, 20, 21, and 27) exhibited moderate water presence, typically between about 9% and 20% of the ward area. Among these, Wards 2 and 9 stood out both in terms of percentage and absolute water area (over 968,000 m^2 and 430,200 m^2, respectively). These moderately watered wards play an important role in maintaining local humidity, supporting drainage, and contributing to urban living systems.

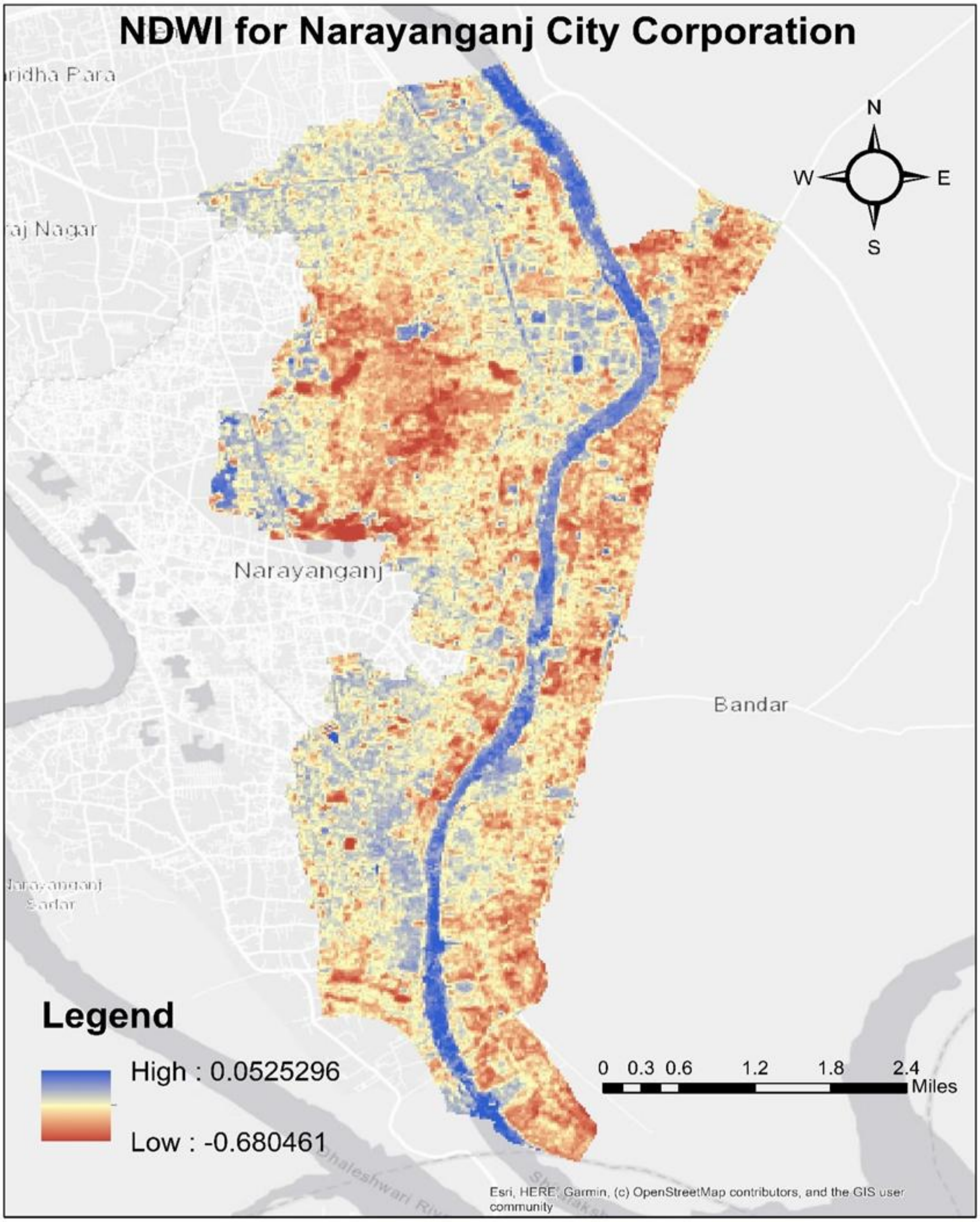

Figure 4.5: Normalized Difference Water Index (NDWI) of NCC.

4.2.4. Road Density

Table 4.1 shows the estimated road density for each ward in NCC, presenting ward area, total road length, and the resulting road density expressed in kilometers of road per square kilometer.

Table 4.1: Ward-wise road density in an ascending order.

Ward No	Area (km^2)	Road Length (km)	Road Density (km/km^2)
Ward-19	1.91	12.54	6.57
Ward-27	2.38	17.88	7.51
Ward-25	1.84	15.09	8.20
Ward-10	1.61	13.32	8.27
Ward-20	2.06	18.23	8.85
Ward-06	2.82	27.38	9.71
Ward-04	3.06	29.85	9.75
Ward-23	1.93	18.83	9.76
Ward-09	5.63	56.99	10.12
Ward-24	0.72	7.35	10.21
Ward-26	0.90	9.39	10.43
Ward-18	1.42	16.61	11.70
Ward-15	1.00	12.19	12.19
Ward-05	1.25	16.72	13.38
Ward-07	1.63	23.57	14.46
Ward-08	3.04	45.69	15.03
Ward-17	0.61	9.98	16.36
Ward-22	0.90	14.77	16.41
Ward-16	0.63	11.81	18.75
Ward-01	2.93	55.08	18.80
Ward-11	0.78	14.86	19.05
Ward-14	0.46	8.81	19.15
Ward-12	1.84	35.73	19.42
Ward-02	2.43	47.97	19.74
Ward-13	1.10	23.05	20.95
Ward-03	1.50	32.9	21.93
Ward-21	0.82	20.93	25.52

The road density pattern in Narayanganj City Corporation shows a clear contrast between more peripheral, less connected wards and highly accessible but heavily congested inner wards. At the lower end, Wards 19, 27, 25, 10, 20, 06, 04 and 23 record road densities below about 10 km/km². These wards have comparatively fewer roads per unit area, indicating more open space, larger urban blocks, or still-developing networks. In the mid-range, wards like 09, 24, 26, 18, 15, 05, 07 and 08 (around 10–15 km/km²) represent a more balanced road network, where accessibility is reasonably good without yet reaching the extremes of network saturation. The highest road densities are concentrated in Wards 17, 22, 16, 01, 11, 14, 12, 02, 13, 03 and especially Ward 21, which reaches 25.52 km/km². These wards form the most intensely connected and likely the most urbanized core of Narayanganj.

Overall, the road density distribution provides a strong basis for differentiating mobility, land-use, and environmental strategies across the wards of Narayanganj.

4.2.5. Population density

The population pattern in NCC is polarized, since a small cluster of very dense core wards and a larger ring of more moderately populated areas. The ward-wise population is shown in **Table 4.2**.

Table 4.2: Population density of different wards of NCC in a descending order.

1.1.1.1 Ward No.	Area (km2)	Population (Census 2022)*	Population (% of total population)	Pop Density (per km2)
14	0.46	31390	3	68,239
16	0.63	32128	3	50,997
22	0.9	45840	5	50,933
17	0.61	29155	3	47,795
3	1.5	71219	7	47,479
13	1.1	46137	5	41,943
11	0.78	31978	3	40,997
21	0.82	28785	3	35,104
1	2.93	96223	10	32,841
24	0.72	22375	2	31,076
7	1.63	41319	4	25,349
18	1.42	34614	4	24,376
12	1.84	43060	4	23,402
2	2.43	52655	5	21,669
8	3.04	64884	7	21,343
5	1.25	24111	2	19,289

1.1.1.1 Ward No.	Area (km2)	Population (Census 2022)*	Population (% of total population)	Pop Density (per km2)
23	1.93	35575	4	18,433
15	1	16866	2	16,866
4	3.06	45422	5	14,844
10	1.61	23365	2	14,512
6	2.82	31797	3	11,276
20	2.06	19801	2	9,612
26	0.9	8033	1	8,926
19	1.91	15423	2	8,075
27	2.38	19128	2	8,037
25	1.84	14292	1	7,768
9	5.63	42376	4	7,527

*BBS (2023). Population and Housing Census 2022. Bangladesh Bureau of Statistics. Government of the Republic of Bangladesh.

At the top of the hierarchy, Ward 14 stands out as the most crowded part of the city followed by Wards 3, 16, 17, and 22 (above 47,000 persons/km²). Although these wards occupy relatively small areas, they accommodate a disproportionate share of residents, indicating intense pressure on housing, utilities, roads and social services. A second tier of high-density wards including 1, 7, 11, 13, 21, and 24 (densities 25,000-42,000 persons/km²). Together they host a significant portion of the city's population (often 3–7% per ward), forming a continuous urban fabric around the densest core. Further out, densities decline noticeably. Wards 2, 5, 8, 12, 15, 18, and 23 sit in the mid-range (16,000–24,000 persons/km²), while Wards 4, 6, 9, 10, 19, 20, 25, 26, and 27, and are much smaller (less than 15,000 persons/km²). These lower-density wards still contribute meaningful population totals.

4.2.6. Waste Accumulation

The **Table 4.3** shows how secondary transfer stations (STS) for solid waste are distributed across the wards of NCC, highlighting a clear picture of areas.

Table 4.3: Calculation of waste accumulation in a descending order by secondary transfer stations (STS) percentage.

Ward No	Number of STS Spot	STS within Ward (Percentage of Total STS Count)	Area Name
Ward-08	14	7	Shiddhirganj
Ward-23	14	7	

Ward No	Number of STS Spot	STS within Ward (Percentage of Total STS Count)	Area Name
Ward-09	13	6	
Ward-03	11	5	
Ward-13	11	5	
Ward-20	11	5	
Ward-10	10	5	
Ward-15	10	5	
Ward-24	10	5	
Ward-06	9	4	Narayanganj
Ward-11	8	4	
Ward-21	8	4	
Ward-01	7	3	
Ward-07	7	3	
Ward-19	7	3	
Ward-04	6	3	
Ward-05	6	3	
Ward-16	6	3	
Ward-17	6	3	Kadamrasul
Ward-22	6	3	
Ward-12	5	2	
Ward-25	5	2	
Ward-02	4	2	
Ward-18	4	2	
Ward-14	2	1	
Ward-27	2	1	
Ward-26	1	0	

The highest concentration of waste accumulation points was found in Wards 8 and 23, each with 14 STS spots (about 7% of the total), followed by Ward 9 with 13 spots (6%). Wards 3, 13 and 20 each hosted 11 STS (5%), and Wards 10, 15 and 24 had 10 spots apiece. These wards formed the core of the collection system and appeared to be relatively well covered in terms of intermediate waste storage and transfer facilities. Shiddhirganj (e.g., Ward 8) clearly functioned as a key cluster for waste management infrastructure. In contrast, several wards had only a small number of STS. Wards 14 and 27 had just 2 spots (1%). Wards 2, 12, 18 and 25 had 4 or 5 STS (2%), which is modest given their role in the urban system. These wards were more likely to face problems, such as longer waste hauling distances, informal dumping, and irregular collection coverage if not supported by stronger service arrangements.

4.2.7. Calculation of vulnerability scores

To assess vulnerability levels across all wards of NCC, a multi-criteria scoring framework was developed using key environmental, infrastructural, and socioeconomic indicators. Each ward was evaluated based on NDBI, NDVI, NDWI, UHI intensity, road density, population density, waterlogging tendency, and waste accumulation. Scores assigned to each parameter were aggregated to generate an overall vulnerability score, enabling a comparative understanding of ward-level conditions. The detailed scoring is shown in **Table 4.4**

Table 4.4: Scoring of evaluation criteria to estimate overall vulnerability.

Ward No	NDBI	Score	NDVI	Score	NDWI	Score	UHI	Score	Rd Density	Score	Pop Density	Score	Waterlogging	Score	Waste Accumulation	Score	Overall Score
01	*1.6398*	*10*	*0.4014*	*9*	*0.6831*	*3*	*2.8367*	*9*	*18.80*	*4*	*32840.61*	*5*	*2.0*	*4*	*3%*	*5*	*49*
02	*1.5336*	*9*	*0.4968*	*9*	*0.4302*	*4*	*0.0000*	*1*	*19.74*	*4*	*21668.72*	*3*	*2.6*	*4*	*2%*	*4*	*38*
03	*1.3455*	*8*	*0.0468*	*10*	*0.5562*	*4*	*2.1739*	*8*	*21.93*	*3*	*47479.33*	*7*	*2.1*	*4*	*5%*	*7*	*51*
04	*1.3158*	*8*	*0.45*	*9*	*1.3851*	*1*	*10.0343*	*10*	*9.75*	*8*	*14843.79*	*2*	*1.1*	*2*	*3%*	*5*	*45*
05	*1.2906*	*8*	*0.2142*	*9*	*0.4131*	*5*	*17.4825*	*10*	*13.38*	*7*	*19288.80*	*3*	*0.7*	*2*	*3%*	*5*	*49*
06	*1.2492*	*8*	*0.3087*	*9*	*1.1169*	*1*	*4.9689*	*10*	*9.71*	*9*	*11275.53*	*2*	*0.0*	*1*	*4%*	*6*	*46*
07	*1.2033*	*7*	*0.9126*	*7*	*0.0639*	*9*	*0.0000*	*1*	*14.46*	*6*	*25349.08*	*4*	*0.7*	*2*	*3%*	*5*	*41*
08	*1.1592*	*7*	*0.8136*	*7*	*0.3015*	*6*	*1.6695*	*7*	*15.03*	*6*	*21343.42*	*3*	*0.4*	*2*	*7%*	*10*	*48*
09	*0.8271*	*5*	*2.8143*	*1*	*0.9684*	*2*	*0.0311*	*5*	*10.12*	*8*	*7526.82*	*1*	*5.3*	*8*	*6%*	*9*	*39*
10	*0.7686*	*5*	*0.2745*	*9*	*0.7065*	*2*	*2.2876*	*8*	*8.27*	*9*	*14512.42*	*2*	*0.0*	*1*	*5%*	*7*	*43*
11	*0.7443*	*5*	*0.1719*	*10*	*0.0837*	*9*	*2.0247*	*8*	*19.05*	*4*	*40997.44*	*6*	*6.5*	*10*	*4%*	*6*	*58*
12	*0.6462*	*4*	*0.2124*	*9*	*0.5643*	*3*	*0.0000*	*1*	*19.42*	*4*	*23402.17*	*3*	*5.0*	*8*	*2%*	*4*	*36*

Ward No	NDBI	Score	NDVI	Score	NDWI	Score	UHI	Score	Rd Density	Score	Pop Density	Score	Waterlogging	Score	Waste Accumulation	Score	Overall Score
13	0.5841	4	0.1692	10	0.4257	5	0.2373	6	20.95	3	41942.73	6	0.9	2	5%	7	43
14	0.5418	3	0.045	10	0.189	7	0.0000	1	19.15	4	68239.13	10	0.0	1	1%	2	38
15	0.5409	3	0.0342	10	0.5985	3	0.1742	5	12.19	7	16866.00	2	0.3	1	5%	7	38
16	0.4815	3	0.0468	10	0.1701	8	0.0000	1	18.75	4	50996.83	7	1.8	3	3%	5	41
17	0.4635	3	0.0693	10	0.0504	10	0.0000	1	16.36	5	47795.08	7	0.2	1	3%	5	42
18	0.4401	3	0.3132	9	0.3195	6	4.0223	9	11.70	8	24376.06	4	6.8	10	2%	4	53
19	0.423	3	1.0008	7	0.4176	5	0.7418	6	6.57	10	8074.87	1	0.0	1	3%	5	38
20	0.4158	3	0.828	7	0.4131	5	0.0426	5	8.85	9	9612.14	1	0.2	1	5%	7	38
21	0.3969	2	0.1908	9	0.0846	8	0.0000	1	25.52	1	35103.66	5	0.1	1	4%	6	33
22	0.3933	2	0.2493	9	0.0819	9	0.0000	1	16.41	5	50933.33	7	0.4	2	3%	5	40
23	0.3933	2	0.3258	9	0.6867	2	0.7263	6	9.76	8	18432.64	3	0.1	1	7%	10	41
24	0.3654	2	0.3537	9	0.0522	10	0.0000	1	10.21	8	31076.39	5	0.3	1	5%	7	43
25	0.3609	2	0.9018	7	0.1008	8	1.3790	7	8.20	9	7767.39	1	0.0	1	2%	4	39

Ward No	NDBI	Score	NDVI	Score	NDWI	Score	UHI	Score	Rd Density	Score	Pop Density	Score	Waterlogging	Score	Waste Accumulation	Score	Overall Score
26	0.2403	1	0.5733	8	0.0297	10	0.0000	1	10.43	8	8925.56	1	1.0	2	0%	1	32
27	0.162	1	1.4382	5	0.2799	7	4.9538	9	7.51	10	8036.97	1	0.9	2	1%	2	37

In this framework, Ward 26 (score 32) and Ward 21 (score 33) emerged as the best-performing wards, followed closely by Ward 12 (36) and Ward 27 (37). These wards tended to combine relatively moderate built-up intensity with more favorable levels of vegetation, water presence, and lower exposure to urban heat, while also avoiding extremes in road and population density, waterlogging, and waste accumulation. In practical terms, they represented comparatively balanced urban environments where physical development and environmental support systems were still in a more sustainable state.

Wards with higher scores pointed towards greater pressure. Ward 11 (score 58) stood out as the most stressed ward, followed by other poor performers, such as Ward 18 (53), Ward 3 (51), and Wards 1 and 5 (49). In these wards, the combined indicators high built-up levels, limited vegetation and water, stronger UHI expression, intense road and population densities, more problematic waterlogging, and higher waste concentration accumulate into a clearly unfavorable condition. These areas are more likely to experience heat discomfort, drainage problems, congestion, and a general decline in environmental quality and livability.

4.3. Ward-level Risk Classification

To categorize the relative climate and environmental risk across NCC, wards were classified using a quantile-based scoring approach. Based on the overall vulnerability scores, wards were grouped into three categories: High risk (score interval: >43.00), Moderate risk (>38.67 and ≤43.00), and Low Risk (≤38.67), corresponding to the upper, middle, and lower tertiles. This classification helps identify priority areas requiring targeted interventions. The resulting ward classifications are presented on **Table 4.5**.

Table 4.5: Ward-wise risk classification in a descending order of the evaluation score.

Ward	Score	Class
Ward-11	58	High
Ward-18	53	
Ward-03	51	
Ward-01	49	
Ward-05	49	
Ward-08	48	
Ward-06	46	
Ward-04	45	
Ward-24	43	Moderate
Ward-13	43	
Ward-10	43	
Ward-17	42	
Ward-23	41	
Ward-16	41	
Ward-07	41	
Ward-22	40	
Ward-25	39	

Ward	Score	Class
Ward-09	39	
Ward-20	38	Low
Ward-14	38	
Ward-19	38	
Ward-15	38	
Ward-02	38	
Ward-27	37	
Ward-12	36	
Ward-21	33	
Ward-26	32	

Precisely, based on the scoring classification, ward wise risk assessment was conducted. The output shows scoring results with the variables, which were taken into consideration during this assessment. So, overall assessment has depicted the condition of the wards within NCC that could potentially take into consideration for a better sustainable environment. The Risk Assessment Map is given in **Figure 4.6**.

An important finding of the vulnerability assessment is that Wards 10, 12, and 15 were classified within the low-risk category despite being located in the core urban area. This outcome is primarily driven by spatial and environmental characteristics rather than an absence of urban stress. In Wards 10 and 15, a substantial portion of their boundaries is occupied by the Shitalakhya River, which significantly influences multiple indicators used in the assessment. The presence of the river increased NDWI values, reduced overall built-up coverage (NDBI), lowered population density, and resulted in comparatively lower UHI intensity over water pixels. Collectively, these effects contribute to a lower composite vulnerability score. While excluding river areas from the analysis could be argued, such an approach would be methodologically subjective and potentially misleading. The river plays a critical role in shaping local microclimate conditions and urban thermal regulation, and any arbitrary reduction or omission of its spatial extent would undermine the scientific consistency of the assessment. Therefore, retaining the river within the analytical framework provides a more objective and defensible representation of actual environmental conditions. Ward 12, on the other hand, exhibited a similar low-risk classification for different reasons, including the presence of dispersed pocket green and blue spaces and a comparatively lower resident population, which together reduceed exposure and sensitivity scores.

It is important to note that the vulnerability scores are relative and comparative in nature. A low-risk classification does not imply that a ward is free from environmental or climate-related challenges; rather, it indicates lower relative vulnerability compared to other wards. The results should therefore be interpreted as a prioritization tool to guide targeted investments and interventions, rather than as an absolute measure of ward-level sustainability or resilience.

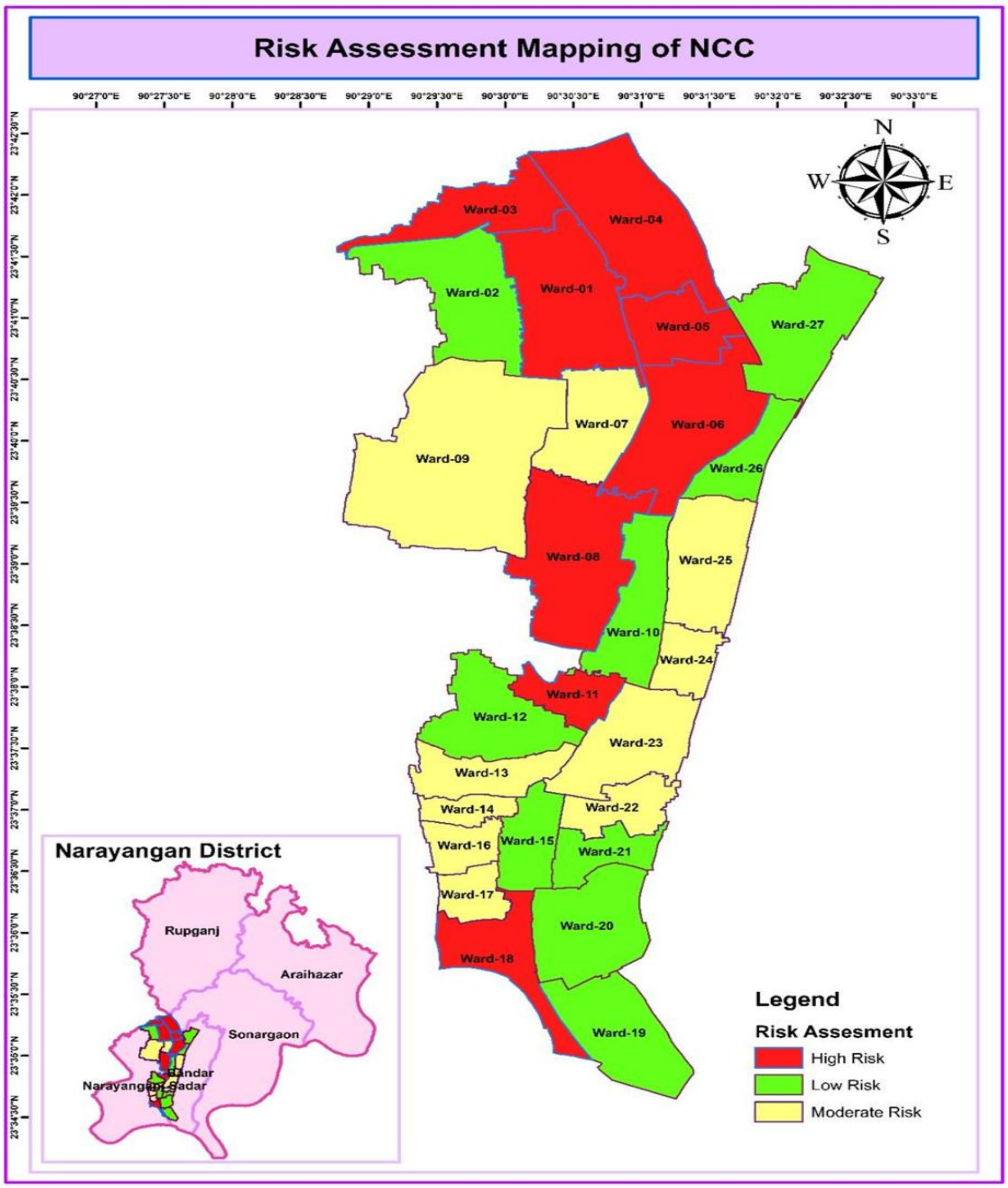

Figure 4.6: Ward-wise risk assessment map of NCC.

4.4. LIC-level Risk Assessment

4.4.1. Process of community risk assessment

For the community risk assessment, specific LICs were first identified across NCC to ensure that the most vulnerable populations were included in the analysis. These LICs were then assessed for their exposure and sensitivity to key climate-related risks, such as flooding, waterlogging, heat stress, poor drainage, and environmental health challenges. This process provided a detailed understanding of settlement-level vulnerabilities, supporting more targeted and equitable resilience planning. The locations of the LICs are shown in **Figure 4.7**.

The process began with the NCC's list of 92 informal urban settlements, slums or LICs, which was supplemented with information provided by local contacts and community leaders familiar with the settlements. A reconnaissance survey was conducted at every listed site; with the involvement of NCC operational staff and community focal persons, the locations, access, and active status of the sites were confirmed, resulting in a verified set of 66 LICs. For these 66 LICs, systematic drone surveys were carried out (**Section 4.4.2**), producing orthophotos and base maps. Settlement boundaries were delineated collaboratively with residents and nominated community leaders, the team validated and refined the settlement boundaries through a simple participatory mapping process. Printed base maps and satellite images were used during group sessions, where participants drew the extents of the settlement, marked key landmarks, access routes, drains, water points, and frequently waterlogged spots, and explained how boundaries shift in practice. The team then walked the perimeter with community guides to ground-truth these inputs and recorded key points with GPS-enabled phones, after which the mapped boundaries were digitized and cross-checked with the original imagery to ensure the final map reflected local knowledge rather than only image interpretation.

Following the completion of mapping, all 66 LICs were revisited by field teams for structured observations of services and conditions. Based on these visits and community engagement, 16 LICs exhibiting the poorest and most deteriorated conditions were identified for detailed risk analysis. A professional observation checklist was used to capture five thematic criteria, which were coded on an ordinal scale. Using the CRMC/IPCC framework, checklist scores were transformed into three composite pillars: Exposure and Sensitivity (both normalized as "badness," where higher scores indicate greater risk) and Adaptive Capacity (normalized as "goodness," where higher scores indicate better capacity). Criteria were weighted, then aggregated into pillar indices. Vulnerability was calculated as Sensitivity multiplied by (1 − Adaptive Capacity), and overall risk was computed as Exposure multiplied by Vulnerability. This process produced a comparable risk score for each of the 15 LICs (out of 16, where one couldn't be included due to some unavoidable circumstances), grounded in both observational evidence and community-validated mapping. The resulting ranked list highlights the most vulnerable settlements and provides a transparent, reproducible basis for further planning and intervention.

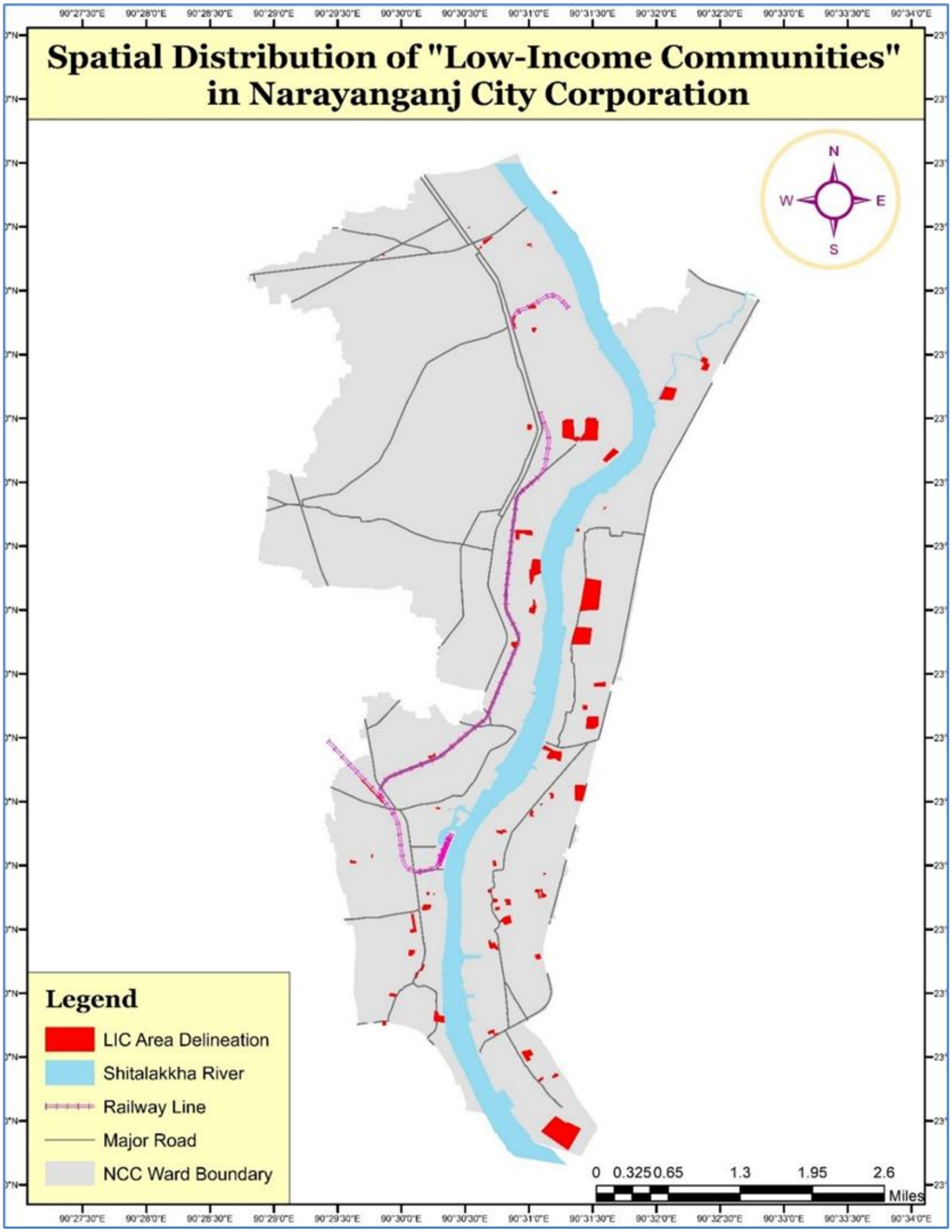

Figure 4.7: Locations of LICs within NCC.

4.4.2. Area delineation by drone survey

Drone surveys were conducted to accurately delineate the boundaries of low-income communities and surrounding areas. High-resolution aerial imagery captured during these flights provided detailed orthophotos and base maps, enabling precise mapping of settlement extents, infrastructure, and environmental features. This method ensured up-to-date, reliable spatial data to support further analysis and planning.

4.4.3. 4LIC-level risk estimation and classification

At the settlement level, the risk assessment and mapping process aims to capture the highly localized vulnerabilities faced by LICs and other at-risk groups in NCC. While ward-level analysis provides a broad overview of hazard distribution, settlement-level assessment ensures that the micro-scale dynamics of exposure, sensitivity, and adaptive capacity are systematically evaluated.

The settlement-level risk assessment and mapping in Narayanganj integrated multiple layers of physical, socio-economic, and environmental information to generate a comprehensive understanding of vulnerabilities in LICs. A core component of this approach was community-led vulnerability assessment, where residents identified and prioritized the risks they face, explained how and when impacts occur, and mapped the people, places, and services most affected. These lived-experience inputs were then triangulated with the physical and socio-economic datasets to confirm hotspots, understand underlying drivers of risk, and ensure the final vulnerability profiles reflected local realities rather than only secondary data. This phase used CRMC tools, which provide a structured and scientifically robust approach to spatially analyze risks and to identify priority zones for intervention.

Based on physical observations, expert understanding of the contextual conditions, and community perspectives, a list of 24 different types of criteria was deployed (**Table 4.6**). These criteria were evaluated using a Likert scale to capture the varying degrees element (Very Low Risk: 1, Low Risk: 2, Moderate Risk: 3, High Risk: 4, Very High Risk: 5). This approach allowed for a standardized and consistent assessment across different indicators. Accordingly, the LIC-level risk assessment was conducted using a multidimensional framework based on four essential components: Hazard, Exposure, Sensitivity, and Adaptive Capacity, following widely accepted climate-risk methodologies. Hazard scores reflect the intensity of waterlogging and heat-wave risks affecting each settlement. Exposure captures the population, housing, and essential services that are situated in hazard-prone conditions. Sensitivity assesses how underlying socio-environmental vulnerabilities, such as housing quality, sanitation, drainage, and health conditions, amplify the impact of hazards. Adaptive Capacity measures the community's ability to cope with, respond to, including access to services, infrastructure conditions, and resilience measures. The risk assessment follows established models of Hazard–Exposure–Vulnerability (HEV) interactions, in line with frameworks adopted by IPCC (2014) and UNDRR (2019). LIC-level risk was computed using a composite index approach, where Risk Index= (Hazard X Exposure X Vulnerability) / Adaptive Capacity.

Table 4.6: The checklist of criteria/variables scored against a Likert scale to assess LIC-level risk.

1	Housing Condition	9	Drainage Condition	17	Toilet Condition
2	Waterlogging Condition	10	Drainage Type	18	Toilet Type
3	Home Destruction Condition	11	Water Accessibility	19	Electricity Supply
4	Water Availability Condition	12	Drinking Water System	20	Health Facility Proximity
5	Health Condition	13	Drinking Water Source	21	Emergency Services
6	Housing Density	14	Condition of Drinking Water Source	22	Road Condition
7	Solid Waste Management	15	Housing Type	23	Open Space
8	Solid Waste System	16	Sanitation Facility	24	Water Storage

The scores of each LICs are captured shown in **Table 4.7**.

Table 4.7: Risk indicator assessment of 66 LICs within NCC.

LIC Name	Hazard	Exposure	Sensitivity	Adaptive Capacity	Lack of Adaptive Capacity	Vulnerability
Harijan Sweeper Colony Slum	5.00	5.00	4.89	4.60	1.40	3.14
Reeshi Para Slum (W 17)	5.00	5.00	5.00	4.80	1.20	3.10
Bihari Camp Slum	5.00	5.00	4.89	4.70	1.30	3.09
Guha Bari Slum	5.00	5.00	4.89	4.70	1.30	3.09
South Rally Bagan Slum	5.00	5.00	4.78	4.70	1.30	3.04
Reeshi Para Slum (W 21)	5.00	4.80	4.89	4.60	1.40	3.14
BJC Workers' Colony Slum	5.00	5.00	4.78	4.80	1.20	2.99
Bihari Colony Slum	5.00	4.80	4.89	4.70	1.30	3.09
Dockyard Sweeper Colony Slum	4.67	5.00	4.89	4.70	1.30	3.09
Dutta Para Bou Bazar Slum	4.67	5.00	4.89	4.70	1.30	3.09
Siddhirganj North Railway Line Slum	4.67	4.80	4.89	4.60	1.40	3.14
Siddhirganj South Railway Line Slum	4.67	4.60	4.78	4.30	1.70	3.24
Ibrahim Colony Slum	4.67	4.80	4.89	4.70	1.30	3.09
Chittaranjan Cotton Mill Slum	4.67	4.80	4.89	4.70	1.30	3.09
Bajna Para Slum	4.67	4.80	4.89	4.70	1.30	3.09
New Gymkhana Slum	3.67	4.00	3.67	3.00	3.00	3.33
Tan Bazar Harijan City Colony Slum	3.67	3.80	3.56	3.00	3.00	3.28

LIC Name	Hazard	Exposure	Sensitivity	Adaptive Capacity	Lack of Adaptive Capacity	Vulnerability
Chhoial Barighat Slum	3.67	3.80	3.56	3.10	2.90	3.23
Bangladesh Para Slum	3.67	3.80	3.44	3.00	3.00	3.22
Jele Para (Fishermen's) Slum	3.67	3.80	3.44	3.00	3.00	3.22
Dhakeshwari Oil Ghat Slum	3.67	3.80	3.44	3.00	3.00	3.22
Mouchak Bus Stand	3.67	3.60	3.44	3.00	3.00	3.22
Kanchpur Bridge	3.67	3.60	3.33	3.00	3.00	3.17
Shantinagar Slum	3.67	3.60	3.22	3.00	3.00	3.11
C & B Slum	3.67	3.60	3.22	3.00	3.00	3.11
WAPDA Colony Slum	3.33	3.80	3.44	3.00	3.00	3.22
Sukum Potti Slum	3.33	3.60	3.33	3.00	3.00	3.17
Alamin Nagar Slum	3.33	3.60	3.33	3.00	3.00	3.17
Dr Hira's House Slum	3.33	3.60	3.22	3.00	3.00	3.11
Rasulbagh Rail Line Slum	3.33	3.60	3.22	3.00	3.00	3.11
Talla Rail Line Slum	3.33	3.60	3.22	3.00	3.00	3.11
Isdair Rail Line Slum	3.33	3.60	3.11	3.00	3.00	3.06
Chashara Rail Station Slum	3.33	3.60	3.11	3.00	3.00	3.06
Kumudini Welfare Trust Slum	3.33	3.60	3.11	3.00	3.00	3.06
North Rally Bagan Slum	3.33	3.60	3.11	3.00	3.00	3.06
Omarpur Slum	3.33	3.60	3.00	3.00	3.00	3.00
Mohabbat Ali Slum	3.33	3.60	3.00	3.00	3.00	3.00
Zaman Saheb's House Slum	3.33	3.60	3.00	3.00	3.00	3.00

LIC Name	Hazard	Exposure	Sensitivity	Adaptive Capacity	Lack of Adaptive Capacity	Vulnerability
Naya Para Slum (1)	3.00	3.00	3.00	3.00	3.00	3.00
Naya Para Slum (2)	3.00	3.00	3.00	3.00	3.00	3.00
Khaja Company Slum	3.00	3.00	3.00	3.00	3.00	3.00
Star Marine Technology Slum	3.00	3.00	3.00	3.00	3.00	3.00
Haji Mostak’s House Slum	3.00	3.00	3.00	3.00	3.00	3.00
Hajipur Slum	3.00	3.00	3.00	3.00	3.00	3.00
Madanganj Bus Stand Slum	2.67	2.80	2.89	2.50	3.50	3.19
Babu Mia’s House Slum	2.67	2.80	2.67	2.30	3.70	3.18
Hakim Munshi’s House Slum	2.33	2.80	2.56	2.20	3.80	3.18
Shantinagar Slum	2.33	2.80	2.56	2.20	3.80	3.18
Nowadah Slum	2.33	2.60	2.44	2.10	3.90	3.17
Choura Para Slum	2.33	2.60	2.33	2.10	3.90	3.12
Ekrampur Water Tank Slum	2.00	2.20	2.22	2.40	3.60	2.91
Sweeper Colony Slum	2.00	2.20	2.22	2.40	3.60	2.91
Four-Storey (Char Tola) Slum	2.00	2.20	2.00	2.20	3.80	2.90
Phalan’s Slum	2.00	2.00	2.00	2.00	4.00	3.00
Machhua Para Slum	2.00	2.00	2.00	2.00	4.00	3.00
Bagbari Slum	2.00	2.00	2.00	2.00	4.00	3.00
Amirabad Slum	2.00	2.00	2.00	2.00	4.00	3.00
Kaitakhali Slum	2.00	2.00	2.00	2.00	4.00	3.00
Thakur Bari Slum	2.00	2.00	2.00	2.00	4.00	3.00

LIC Name	Hazard	Exposure	Sensitivity	Adaptive Capacity	Lack of Adaptive Capacity	Vulnerability
Najimuddin's Slum	2.00	2.00	2.00	2.00	4.00	3.00
Babu Para (Ar Ghati Slum)	2.00	2.00	2.00	2.00	4.00	3.00
Satya Narayan's Slum	2.00	2.00	2.00	2.00	4.00	3.00
Rally Bagan Slum	2.00	2.00	2.00	2.00	4.00	3.00
South Lakkhan Khola Slum	2.00	2.00	2.11	2.30	3.70	2.91
Char Shumil Para Slum	2.00	2.00	2.00	2.20	3.80	2.90
Chapatli Slum	2.00	1.20	1.22	2.00	4.00	2.61
Kuri Para Colony Slum	2.00	2.00	1.00	2.00	4.00	2.50

The risk scores of all 66 LICs were then classified into high, moderate, and low risk categories to provide a comparative overview of climate-related vulnerability across all assessed LICs. Table 4.8 presents the resulting risk index and corresponding classification for each settlement.

Table 4.8: Risk classification of 66 LICs of NCC.

LIC	Risk index	Classification
Harijan Sweeper Colony Slum	100	High Risk
Reeshi Para Slum (W 17)	99.52	High Risk
Bihari Camp Slum	99.39	High Risk
Guha Bari Slum	99.39	High Risk
South Rally Bagan Slum	98.02	High Risk
Reeshi Para Slum (W 21)	97.53	High Risk
BJC Workers’ Colony Slum	96.79	High Risk
Bihari Colony Slum	96.34	High Risk
Dockyard Sweeper Colony Slum	94.32	High Risk
Dutta Para Bou Bazar Slum	94.32	High Risk
Siddhirganj North Railway Line Slum	92.58	High Risk
Siddhirganj South Railway Line Slum	91.69	High Risk
Ibrahim Colony Slum	91.48	High Risk
Chittaranjan Cotton Mill Slum	91.48	High Risk
Bajna Para Slum	91.48	High Risk
New Gymkhana Slum	71.42	High Risk
Tan Bazar Harijan City Colony Slum	68.26	Moderate Risk
Chhoial Barighat Slum	67.57	Moderate Risk
Bangladesh Para Slum	67.49	Moderate Risk
Jele Para (Fishermen’s) Slum	67.49	Moderate Risk
Dhakeshwari Oil Ghat Slum	67.49	Moderate Risk
Mouchak Bus Stand	64.94	Moderate Risk
Kanchpur Bridge	64.18	Moderate Risk

LIC	Risk index	Classification
Shantinagar Slum 1	63.36	Moderate Risk
C & B Slum	63.36	Moderate Risk
WAPDA Colony Slum	63.04	Moderate Risk
Sukum Potti Slum	59.87	Moderate Risk
Alamin Nagar Slum	59.87	Moderate Risk
Star Marine Technology Slum	58.97	Moderate Risk
Rasulbagh Rail Line Slum	58.97	Moderate Risk
Thakur Bari Slum	58.97	Moderate Risk
Isdair Rail Line Slum	58.08	Moderate Risk
Chashara Rail Station Slum	58.08	Moderate Risk
Kumudini Welfare Trust Slum	58.08	Moderate Risk
North Rally Bagan Slum	58.08	Moderate Risk
Omarpur Slum	57.18	Moderate Risk
Mohabbat Ali Slum	57.18	Moderate Risk
Zaman Saheb's House Slum	57.18	Moderate Risk
Naya Para Slum (1)	47.47	Moderate Risk
Naya Para Slum (2)	47.47	Moderate Risk
Khaja Company Slum	47.47	Moderate Risk
Dr Hira's House Slum	47.47	Moderate Risk
Haji Mostak's House Slum	47.47	Moderate Risk
Hajipur Slum	47.47	Moderate Risk
Madanganj Bus Stand Slum	44.41	Moderate Risk
Ekrampur Water Tank Slum	44.3	Moderate Risk
Hakim Munshi's House Slum	41.41	Moderate Risk
Shantinagar Slum 2	41.41	Moderate Risk
Rally Bagan Slum	40.52	Moderate Risk
Choura Para Slum	40.22	Low Risk
Babu Mia's House Slum	34.96	Low Risk
Sweeper Colony Slum	34.96	Low Risk
Phalan's Slum	35.18	Low Risk

LIC	Risk index	Classification
Machhua Para Slum	35.18	Low Risk
Bagbari Slum	35.18	Low Risk
Amirabad Slum	35.18	Low Risk
Kaitakhali Slum	35.18	Low Risk
Talla Rail Line Slum	35.18	Low Risk
Najimuddin’s Slum	35.18	Low Risk
Babu Para (Ar Ghati Slum)	35.18	Low Risk
Satya Narayan’s Slum	35.18	Low Risk
Nowadah Slum	35.18	Low Risk
South Lakkhan Khola Slum	34.81	Low Risk
Char Shumil Para Slum	34.79	Low Risk
Chapatli Slum	30.21	Low Risk
Kuri Para Colony Slum	30.17	Low Risk

The risk assessment of the LICs revealed overall vulnerability when evaluated through the combined effects of hazard exposure, community sensitivity, and adaptive capacity. The majority of settlements located in dense urban cores, such as Harijan Sweeper Colony, Reeshi Para, and Bihari Camp fall within the High-Risk category (scores above 71), reflecting severe exposure to waterlogging and heat stress, poor housing conditions, and limited coping capacity. A large cluster of LICs (scored 41-70) are classified as Moderate Risk, indicating moderate levels of environmental stress, but significant socio-infrastructural vulnerabilities that heighten risk during climatic events. The Low-Risk settlements (scored 30-40) demonstrate comparatively better physical conditions, lower hazard exposure, and relatively stronger adaptive capacity, though they still remain susceptible to localized shocks. This classification enables targeted prioritization of interventions, ensuring that the most vulnerable communities receive immediate resilience and infrastructure support. Through this classification, 16 most vulnerable LICs were identified to develop LIC-level PAPs.

4.5. Climate Modelling and Scenario Development

This chapter presents projections for Urban Heat Island (UHI) intensity and waterlogging vulnerability for the study area in the years 2040 and 2060. The analysis covers three Shared Socioeconomic Pathways (SSPs): the low-emission mitigation scenario SSP1-2.6, the intermediate scenario SSP2-4.5, and the high-emission scenario SSP5-8.5. Projections are generated using a Markov Chain modeling approach implemented through the MOLUSCE tool, driven by bias-corrected ensemble temperature and climate data from multiple models (ACCESS, CanESM, IPSL, and Miroc6), all referenced to a 2024 baseline.

4.5.1. Projected UHI Extent for 2040 and 2060

SSP1-2.6 Scenario

Under the SSP1-2.6 scenario, urban heat island (UHI) conditions are projected to remain largely stable compared to the 2024 baseline. This scenario serves as the foundation for implementing targeted cooling interventions in identified hotspot wards and densely populated low-income community clusters. By 2040, the growth of the highest intensity UHI category (3.5–5) is expected to slow significantly due to measures such as street trees, pocket greenery, micro-parks, vegetative buffers, green roofs, and vertical gardens in space-constrained areas. Looking ahead to 2060, these cooling gains are anticipated to be maintained and reinforced by scaling these nature-based solutions through routine urban planning and maintenance, thereby preventing further expansion of extreme heat zones beyond the projected business-as-usual scenario. Overall, SSP1-2.6 emphasizes sustained, proactive management to keep UHI impacts relatively constant over time (**Figure 4.8**).

SSP2-4.5 Scenario

Under the SSP2-4.5 scenario, global society follows historical trends with moderate climate action, resulting in a radiative forcing of 4.5W/m2 by 2100 (**Figure 4.8**). The model projects a moderate increase in both the extent and intensity of the UHI effect in the study area by 2040 and 2060 presented in **Table 4.9**.

Table 4.9: Urban Heat Island (UHI) Index of years 2040 and 2060 under SSP2-4.5 scenario.

Ward	0.5–2			2–3.5			3.5–5		
	2024	2040	2060	2024	2040	2060	2024	2040	2060
Ward-01	46.91	55.62	49.3	2.84	9.11	12.6	0.00	0.59	1.10
Ward-02	28.40	42.27	40.2	0.00	2.95	4.08	0.00	0.00	0.00
Ward-03	78.79	80.05	71.2	2.17	14.71	20.4	0.00	0.23	0.41
Ward-04	49.06	53.95	40.3	10.03	14.47	20.0	0.89	4.59	8.20
Ward-05	55.66	58.75	42.1	17.48	19.97	27.6	0.14	5.79	10.40
Ward-06	36.24	50.70	43.4	4.97	8.67	12.0	0.00	1.77	3.20
Ward-07	8.24	21.53	21.53	0.00	0.00	0.00	0.00	0.00	0.00
Ward-08	42.86	54.27	49.9	1.67	7.18	9.93	0.00	0.28	0.50

Ward	0.5–2			2–3.5			3.5–5		
	2024	2040	2060	2024	2040	2060	2024	2040	2060
Ward-09	9.46	18.13	17.8	0.03	0.44	0.61	0.00	0.00	0.00
Ward-10	35.68	48.03	44.1	2.29	6.08	8.41	0.00	0.27	0.48
Ward-11	46.23	61.76	56.3	2.02	9.78	13.5	0.00	0.00	0.00
Ward-12	29.01	56.01	55.2	0.00	0.99	1.37	0.00	0.00	0.00
Ward-13	14.40	47.85	46.0	0.24	2.35	3.25	0.00	0.00	0.00
Ward-14	29.96	84.86	84.86	0.00	0.00	0.00	0.00	0.00	0.00
Ward-15	32.84	56.58	55.4	0.17	1.72	2.38	0.00	0.00	0.00
Ward-16	16.34	70.80	70.4	0.00	0.14	0.19	0.00	0.00	0.00
Ward-17	28.47	61.20	60.8	0.00	0.14	0.19	0.00	0.00	0.00
Ward-18	32.43	48.99	43.0	4.02	5.98	8.27	0.00	1.22	2.19
Ward-19	9.64	17.36	16.6	0.74	0.91	1.26	0.00	0.14	0.25
Ward-20	13.24	28.85	28.0	0.04	1.12	1.55	0.00	0.00	0.00
Ward-21	1.39	16.67	16.67	0.00	0.00	0.00	0.00	0.00	0.00
Ward-22	0.00	5.74	5.74	0.00	0.00	0.00	0.00	0.00	0.00
Ward-23	15.21	32.81	31.0	0.73	2.29	3.17	0.00	0.04	0.07
Ward-24	6.30	12.00	11.3	0.00	0.95	1.31	0.00	0.00	0.00
Ward-25	14.98	28.32	26.7	1.38	1.93	2.67	0.00	0.47	0.84
Ward-26	8.60	19.87	19.0	0.00	0.96	1.33	0.00	0.00	0.00
Ward-27	22.92	31.62	25.6	4.95	6.13	8.47	0.26	2.22	3.98

The ward-wise UHI projections for 2024–2060 indicate a clear shift toward higher heat intensity rather than uniform spatial expansion. While the moderate UHI category (0.5–2) increases substantially by 2040 across most wards, it stabilizes or slightly declines by 2060, suggesting that many areas transition into higher-intensity classes over time. In contrast, the high UHI category (2–3.5) shows a consistent increase, and the very high category (3.5–5), largely absent in 2024, becomes increasingly prominent by 2060. This trend reflects the cumulative effects of urban densification and land-use change, where moderate heat zones are progressively transformed into persistent and extreme urban heat islands.

The most pronounced intensification is concentrated in dense, built-up wards, particularly Ward-04, Ward-05, Ward-06, Ward-03, and Ward-11. Ward-04 and Ward-05 exhibit the largest growth in the very high UHI class by 2060, indicating the emergence of severe heat pockets in core urban areas. Conversely, wards such as Ward-14, Ward-16, Ward-17, Ward-21, and Ward-22 remain dominated by the lowest intensity class throughout the projection period, likely due to lower development intensity and the presence of open or blue–green spaces. Overall, the findings demonstrate that future UHI risk in Narayanganj will be driven more by intensification in specific urban cores than by widespread citywide warming, emphasizing the need for targeted heat mitigation measures in the most affected wards.

SSP5-8.5 Scenario The SSP5-8.5 scenario represents a future characterized by energy-intensive economic growth, reliance on fossil fuels, and minimal climate policy, leading to the highest projected radiative forcing of 8.5 W/m2 by 2100 (**Figure 4.8**). This path projects a significantly more alarming intensification of the UHI effect by 2040 and then 2060 due to both increased global warming and continued urban development. The model projects a moderate increase in both the extent and intensity of the UHI effect in the study area for 2040 and 2060 presented in **Table 4.10**.

Table 4.10: Urban Heat Island (UHI) Index of years 2040 and 2060 under SSP5-8.5 scenario.

Ward	0.5–2			2–3.5			3.5–5		
	2024	2040	2060	2024	2040	2060	2024	2040	2060
Ward-01	46.91	49.77	51.20	2.84	8.90	12.31	0.00	0.44	0.79
Ward-02	28.40	39.03	43.44	0.00	4.34	6.00	0.00	0.00	0.00
Ward-03	78.79	69.55	65.53	2.17	15.86	21.94	0.00	0.23	0.41
Ward-04	49.06	46.72	45.25	10.03	13.23	18.30	0.89	3.97	7.12
Ward-05	55.66	50.76	48.82	17.48	13.57	18.77	0.14	6.34	11.37
Ward-06	36.24	45.31	48.09	4.97	7.73	10.69	0.00	1.31	2.35
Ward-07	8.24	21.42	26.33	0.00	0.05	0.07	0.00	0.00	0.00
Ward-08	42.86	49.45	52.63	1.67	7.32	10.12	0.00	0.26	0.47
Ward-09	9.46	17.26	20.09	0.03	0.73	1.01	0.00	0.00	0.00
Ward-10	35.68	42.38	45.20	2.29	6.18	8.55	0.00	0.11	0.20
Ward-11	46.23	58.68	63.56	2.02	9.01	12.46	0.00	0.00	0.00
Ward-12	29.01	55.06	60.46	0.00	1.32	1.83	0.00	0.00	0.00
Ward-13	14.40	45.97	51.44	0.24	2.66	3.68	0.00	0.00	0.00
Ward-14	29.96	84.86	87.41	0.00	0.00	0.00	0.00	0.00	0.00
Ward-15	32.84	54.86	58.63	0.17	2.24	3.10	0.00	0.00	0.00
Ward-16	16.34	70.80	75.57	0.00	0.14	0.19	0.00	0.00	0.00
Ward-17	28.47	59.06	63.51	0.00	1.28	1.77	0.00	0.00	0.00

Ward	0.5–2			2–3.5			3.5–5		
	2024	2040	2060	2024	2040	2060	2024	2040	2060
Ward-18	32.43	45.45	49.20	4.02	4.70	6.50	0.00	1.34	2.40
Ward-19	9.64	16.31	18.59	0.74	0.68	0.94	0.00	0.09	0.16
Ward-20	13.24	27.27	30.63	0.04	1.46	2.02	0.00	0.00	0.00
Ward-21	1.39	16.77	20.23	0.00	0.00	0.00	0.00	0.00	0.00
Ward-22	0.00	5.74	6.91	0.00	0.00	0.00	0.00	0.00	0.00
Ward-23	15.21	31.56	35.46	0.73	1.97	2.72	0.00	0.04	0.07
Ward-24	6.30	11.76	13.11	0.00	0.71	0.98	0.00	0.00	0.00
Ward-25	14.98	26.95	30.26	1.38	1.88	2.60	0.00	0.24	0.43
Ward-26	8.60	19.29	21.68	0.00	1.05	1.45	0.00	0.00	0.00
Ward-27	22.92	28.74	31.21	4.95	5.98	8.27	0.26	1.86	3.34

The data shows a general increase in higher intensity UHI categories (2–3.5 and 3.5–5) over time, indicating worsening heat stress across Narayanganj wards. While the moderate category (0.5–2) tends to decrease or stabilize in many wards, the high (2–3.5) and very high (3.5–5) UHI percentages rise notably by 2060. For example, Ward-04's very high category grows from 0.89% in 2024 to 7.12% in 2060, and Ward-05's rises from 0.14% to 11.37%. This trend reflects urban densification and intensification of heat islands in core urban areas.

Certain wards such as Ward-14 and Ward-16 maintain a dominant moderate UHI presence with little to no increase in the very high category, likely due to greater vegetation or open spaces. However, highly urbanized wards like Ward-04, Ward-05, Ward-11, and Ward-03 exhibit steep increases in both high and very high UHI categories, highlighting them as critical zones for heat mitigation efforts. This pattern suggests that future heat risk in Narayanganj will be driven by intensification of UHI in specific dense wards, rather than a uniform spread across the city.

The projections across the SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios reveal distinct trajectories for the urban heat island (UHI) effect in Narayanganj through 2060. Under SSP1-2.6, UHI conditions remain relatively stable, emphasizing the effectiveness of targeted cooling interventions such as street trees, pocket greenery, and green roofs in limiting the growth of extreme heat zones. This scenario highlights proactive management to maintain current heat levels and prevent expansion of high-intensity heat islands.

In contrast, SSP2-4.5 and SSP5-8.5 scenarios depict increasing heat stress, with more pronounced growth in the high (2–3.5) and very high (3.5–5) UHI categories over time. SSP2-4.5 shows a moderate increase in heat intensity, while SSP5-8.5, driven by greater urbanization and minimal climate action, forecasts the most severe intensification, especially in dense urban wards like Ward-04, Ward-05, Ward-11, and Ward-03. Notably, wards with more green or open spaces (e.g., Ward-14, Ward-16) maintain lower heat intensities across scenarios. Overall, the findings underscore that future UHI risks will be concentrated in core urban areas, necessitating targeted heat mitigation strategies tailored to ward-specific vulnerabilities and development patterns. The contrast between the three scenarios in 2040.

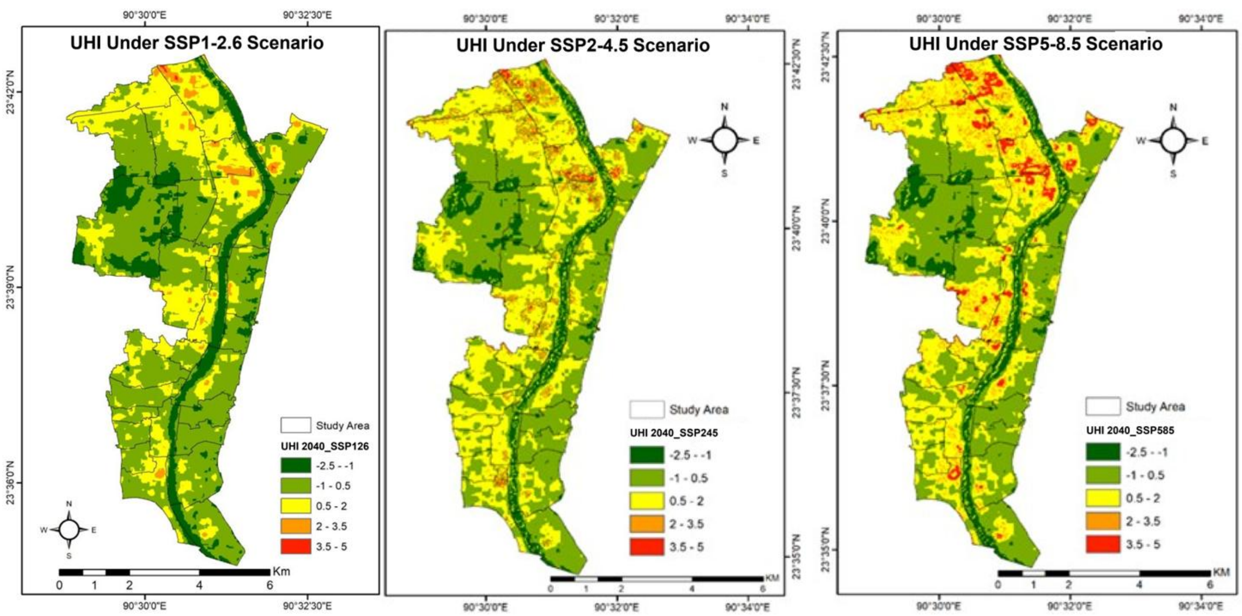

Figure 4.8: Urban Heat Island Index of NCC under SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios.

4.5.2. Projected Waterlogging Extent for 2040 and 2060

SSP1-2.6 Scenario

Under the SSP1-2.6 scenario, the 2024 baseline conditions are retained as the reference point to identify priority hotspot wards and low-income community clusters where climate disruption and service deficits are most pronounced. This baseline supports targeted, equity-focused investments rather than large-scale reactive interventions.

By 2040, the expected trajectory under SSP1-2.6 is a moderated growth of waterlogging and heat stress compared to higher-emission pathways (**Figure 4.9**). Expansion of the “High” exposure category is anticipated to be largely contained through early and coordinated implementation of nature-based and community-led measures, including green and participatory drainage systems, bioswales, retention and infiltration features, routine drain maintenance, and restoration of canals and natural drainage corridors. These actions align closely with Tier 1 investment priorities and emphasize prevention over crisis response.

Looking toward 2050–2060, SSP1-2.6 assumes consolidation of these gains through institutionalized climate-sensitive urban planning. Long-term protection and rehabilitation of wetlands and waterways, integration of green stormwater management into building and planning regulations, and formalized participatory operation and maintenance frameworks are expected to sustain reduced exposure levels. Overall, this pathway reflects a transition toward stable, manageable climate risk, where incremental improvements in urban form and governance prevent the escalation of extreme waterlogging and heat stress across NCC.

SSP2-4.5 Scenario

Under the SSP2-4.5 scenario, the city implements moderate climate and development policies (**Figure 4.9**). While the global climate impact is less severe than in SSP5-8.5, the combined effect of changing precipitation patterns and continued urban growth leads to a notable increase in flood risk. The total waterlogging area is projected to increase by nearly 19% by 2040 presented in **Table 4.11**.

Table 4.11: Projected waterlogged area of years 2040 and 2060 under SSP2-4.5 scenario.

Ward	High			Very High		
	2024	2040	2060	2024	2040	2060
Ward-01	2.000	3.348	4.020	4.000	1.223	1.470
Ward-02	2.600	0.983	1.180	1.300	0.491	0.590
Ward-03	2.100	0.454	0.540	1.300	0.511	0.610
Ward-04	1.100	3.555	4.270	0.300	1.055	1.270
Ward-05	0.700	0.880	1.060	2.100	2.573	3.090
Ward-06	0.000	0.756	0.910	0.100	0.061	0.070
Ward-07	0.700	0.052	0.060	0.100	0.000	0.000
Ward-08	0.400	0.532	0.640	0.000	0.392	0.470
Ward-09	5.300	6.294	7.550	12.100	2.269	2.720

Ward	High			Very High		
	2024	2040	2060	2024	2040	2060
Ward-10	0.000	0.212	0.250	0.000	0.053	0.060
Ward-11	6.500	5.998	7.200	5.100	5.016	6.020
Ward-12	5.000	13.776	16.530	22.500	10.390	12.470
Ward-13	0.900	0.770	0.920	0.200	0.154	0.180
Ward-14	0.000	0.000	0.000	0.000	0.000	0.000
Ward-15	0.300	0.085	0.100	0.300	0.000	0.000
Ward-16	1.800	1.493	1.790	0.400	0.950	1.140
Ward-17	0.200	0.000	0.000	0.000	0.000	0.000
Ward-18	6.800	5.719	6.860	7.400	4.937	5.920
Ward-19	0.000	1.118	1.340	0.000	0.045	0.050
Ward-20	0.200	1.859	2.230	0.000	0.165	0.200
Ward-21	0.100	1.877	2.250	0.000	0.730	0.880
Ward-22	0.400	1.899	2.280	0.000	0.950	1.140
Ward-23	0.100	0.972	1.170	0.000	0.044	0.050
Ward-24	0.300	4.455	5.350	0.000	1.290	1.550
Ward-25	0.000	4.705	5.650	0.100	3.413	4.100
Ward-26	1.000	3.406	4.090	0.000	1.514	1.820

Ward	High			Very High		
	2024	2040	2060	2024	2040	2060
Ward-27	0.900	5.794	6.950	0.000	1.323	1.590

The analysis shows a substantial expansion of waterlogging risk across most wards by 2040, with further intensification by 2060, particularly in the High category. This reflects a widening spatial spread of serious waterlogging conditions. Core urban wards such as Ward-12, Ward-09, Ward-11, Ward-18, and Ward-27 consistently emerge as dominant hotspots. Ward-12 demonstrates the most severe escalation, with High waterlogging increasing from 5.0% in 2024 to 13.78% in 2040 and 16.53% in 2060, while Very High waterlogging, although lower than the base year, remains critically elevated at 12.47% by 2060, indicating persistent and chronic flooding risk.

A clear pattern is observed in the redistribution between severity classes. Between 2024 and 2040, several wards show a decline in the Very High category alongside a strong increase in the High category, followed by renewed growth in both categories by 2060. This indicates that while the most extreme waterlogging may become less spatially concentrated in the near term, moderate to severe waterlogging expands across a much larger urban area, increasing exposure for a broader population. Wards with limited baseline risk, including Ward-19, Ward-21, Ward-22, Ward-24, and Ward-25, exhibit sharp proportional increases by 2040 and 2060, identifying them as emerging hotspots rather than historically affected areas.

Overall, the findings confirm that waterlogging is evolving from a localized extreme hazard into a city-wide chronic stress. The High waterlogging category is the primary driver of future risk growth. It should be emphasized that lower percentages in some wards do not indicate acceptable conditions, as the results are comparative and intended for prioritization. Without significant scaling of drainage capacity, retention, and infiltration measures, the 2060 projections suggest increasing pressure on urban infrastructure and growing equity concerns, particularly in wards experiencing rapid increases from low baseline exposure.

SSP5-8.5 Scenario Under the high-emissions SSP5-8.5 scenario (**Figure 4.9**), the city experiences greater climate-driven impacts, particularly more intense rainfall, coupled with high resource consumption and rapid, potentially unplanned, urban development (**Table 4.12**).

Table 4.12: Projected Waterlogged area of year 2040 and 2060 under SSP5-8.5 scenario.

Ward	High			Very High		
	2024	2040	2060	2024	2040	2060
Ward-01	2.000	3.319	3.983	4.000	1.077	1.239
Ward-02	2.600	0.842	1.010	1.300	0.491	0.565
Ward-03	2.100	0.511	0.613	1.300	0.511	0.588
Ward-04	1.100	2.749	3.299	0.300	0.722	0.830
Ward-05	0.700	0.880	1.056	2.100	2.573	2.959
Ward-06	0.000	0.756	0.907	0.100	0.060	0.069
Ward-07	0.700	0.052	0.062	0.100	0.000	0.000
Ward-08	0.400	0.504	0.605	0.000	0.364	0.419
Ward-09	5.300	5.991	7.189	12.100	2.133	2.453
Ward-10	0.000	0.212	0.254	0.000	0.000	0.000
Ward-11	6.500	5.889	7.067	5.100	5.016	5.768
Ward-12	5.000	13.729	16.475	22.500	10.390	11.949
Ward-13	0.900	0.616	0.739	0.200	0.231	0.266
Ward-14	0.000	0.000	0.000	0.000	0.000	0.000
Ward-15	0.300	0.000	0.000	0.300	0.000	0.000
Ward-16	1.800	1.493	1.792	0.400	0.950	1.093
Ward-17	0.200	0.000	0.000	0.000	0.000	0.000
Ward-18	6.800	5.599	6.719	7.400	4.877	5.609
Ward-19	0.000	0.939	1.127	0.000	0.045	0.052
Ward-20	0.200	1.611	1.933	0.000	0.124	0.143
Ward-21	0.100	1.564	1.877	0.000	0.730	0.840
Ward-22	0.400	1.899	2.279	0.000	0.950	1.093
Ward-23	0.100	0.795	0.954	0.000	0.044	0.051
Ward-24	0.300	4.689	5.627	0.000	1.407	1.618
Ward-25	0.000	3.736	4.483	0.100	3.183	3.660
Ward-26	1.000	3.500	4.200	0.000	1.325	1.524
Ward-27	0.900	5.436	6.523	0.000	1.431	1.646

The ward-wise assessment shows a consistent increase in waterlogging exposure between 2024 and 2060, with the most significant growth occurring in the High waterlogging category. By 2040, several wards that already experience drainage stress, notably Ward-12, Ward-24, Ward-27, Ward-11, Ward-18, and Ward-09, show substantial expansion of High-risk areas, and this trend intensifies further by 2060. Importantly, wards with minimal waterlogging in 2024, such as Ward-19, Ward-20, Ward-21, and Ward-22, also register steady increases over time, indicating a spatial spread of waterlogging risk beyond established hotspots. This pattern suggests that drainage systems are becoming increasingly inadequate to manage growing runoff volumes associated with urban densification and climate stress.

In contrast, the Very High waterlogging category remains more spatially concentrated but continues to pose critical localized risks. Ward-12 consistently emerges as the most severe hotspot across all years, while Ward-09, Ward-18, Ward-11, and Ward-25 also retain notable Very High exposure despite some reduction between 2024 and 2040. The re-intensification of Very High exposure by 2060 in several wards indicates that, without sustained and scaled interventions, extreme waterlogging conditions are likely to persist or re-emerge in structurally vulnerable areas. Overall, the findings indicate a transition from isolated extreme flooding toward a broader, city-wide challenge dominated by recurrent high-severity waterlogging, underscoring the need for early, ward-specific drainage and retention interventions.

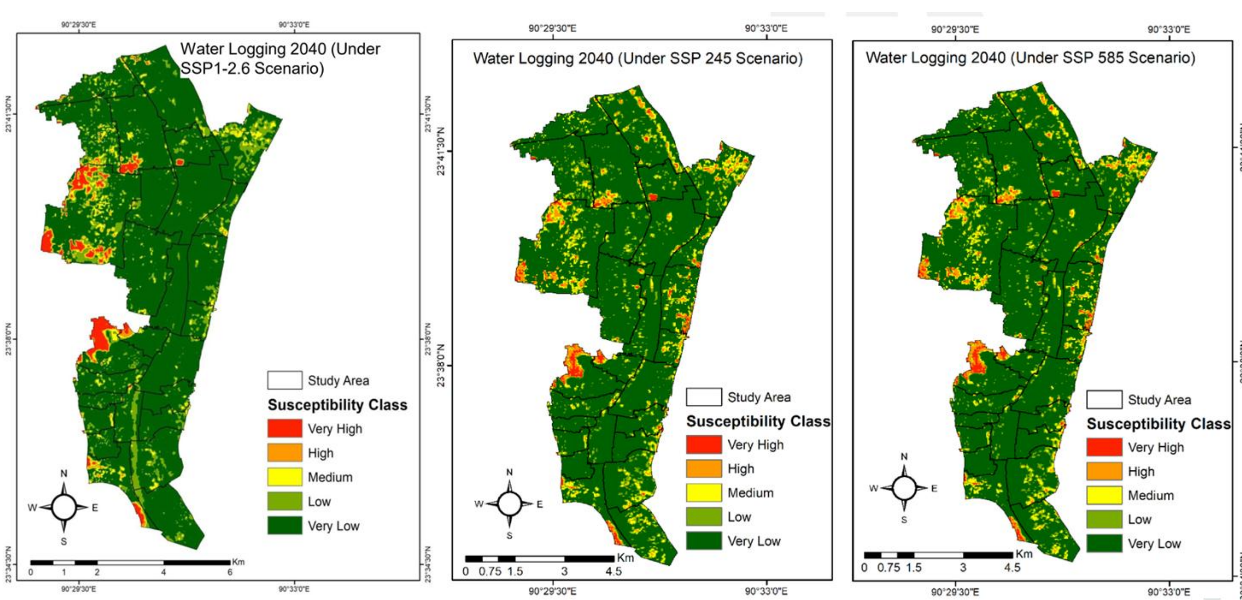

Figure 4.9: Waterlogged areas of NCC in 2040 under SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios.

CHAPTER FIVE

5. CLIMATE RESILIENCE MEASUREMENT FOR COMMUNITIES

This section briefly describes the scores from the Climate Resilience Measurement for Communities (CRMC) tool, which was measured for nine communities clustered across 27 wards of NCC (Table 1.2). Details of the analysis can be found in Annex 2.

5.1. Community Resilience Scores

Resilience scores are assessed for two hazards: **waterlogging (flood)** and **heatwave**. The assessment uses the **5C–4R framework**, which evaluates resilience through **five livelihood capitals** (human, social, physical, financial, natural) and **4R systems of resilience** (robustness, redundancy, resourcefulness, rapidity) to measure a community's capacity to develop, withstand shocks, and respond effectively. Each capital contains a set of generic and discrete sources of resilience. Across the 5Cs, there are some sources of resilience that assess aspects of the community's resilience that apply regardless of the hazard. For each hazard included, there is an additional set of sources that explore resilience specifically to that hazard.

A community can score a maximum of 100, which indicates its highest possible resilience, against any specific sources. Based on estimated scores, a community can be graded A, B, C, or D against any specific source (Table 5.1). The **grades (A–D)** assigned to each community are combined in several ways to support analysis. These aggregations, or **"lenses,"** allow resilience to be examined from different perspectives, including the **5C** and the **4R**. Additional lenses include the **seven thematic areas** used to organize questions (such as healthcare, education, and livelihoods), the **five stages of the Disaster Risk Management (DRM) cycle**-i) preparedness, ii) response, iii) recovery, iv) prospective risk reduction, and v) corrective risk reduction; seven **city resilience index** components, namely i) flexible, ii) inclusive, iii) integrated, iv) redundant, v) reflective, vi) resourceful, and vii) robust among others.

Table 5.1: Grades and respective cores of community resilience against different sources of resilience.

Grades	Scores	Significance
A	100	Best practice for managing the risk
B	66	Good industry standard, no immediate need for improvement

Grades	Scores	Significance
C	33	Deficiencies with room for improvement
D	0	Significantly below standard, potential for imminent loss

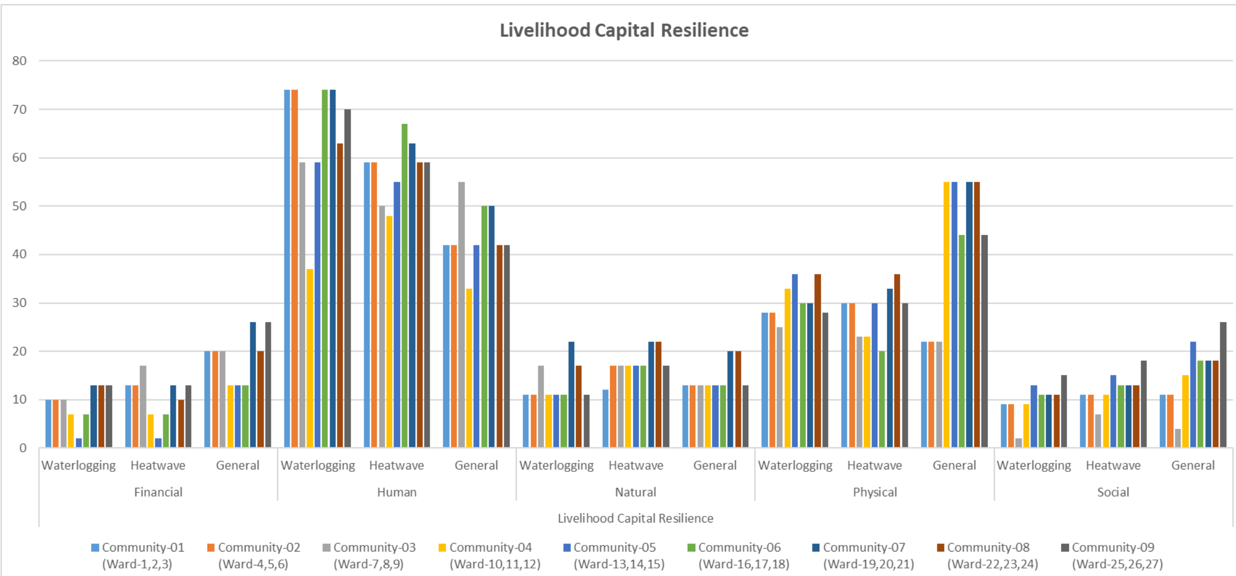

Figure 5.1: Resilience scores of nine communities of NCC based on five livelihood capitals mapped against hazards.

5.1.1. Livelihoods Capital-based Resilience

Figure 5.1 captures the resilience of nine communities of NCC against five livelihood capitals. Human capital constituted the highest scores (Grade B) followed by physical capital. Other three capitals, namely financial, natural and social, scored lowest (Grade D), suggesting very low contribution in defining community resilience of these communities. In turn, overall resilience scores of these communities were low (**Section 5.2**).

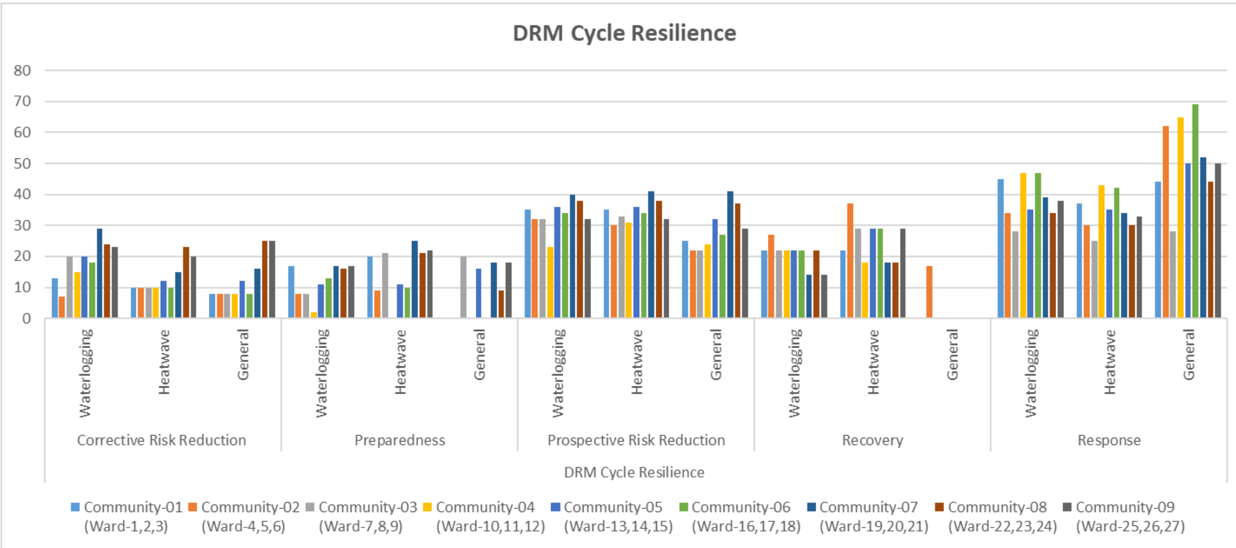

Figure 5.2: Resilience scores of nine communities of NCC based on five stages of disaster risk management (DRM) cycle mapped against hazards.

5.1.2. Resilience along the DRM Cycle

Figure 5.2 shows the resilience of nine communities of NCC against five stages of DRM cycle. Here, Response after a disaster received the highest scores (50% scores fell into Grade B), followed by Prospective risk reduction and Recovery. Low scores against corrective risk reduction and preparedness stages indicate inherent weaker readiness against both hazards. Consequently, the overall individual resilience scores of all nine communities were low (Section 5.2).

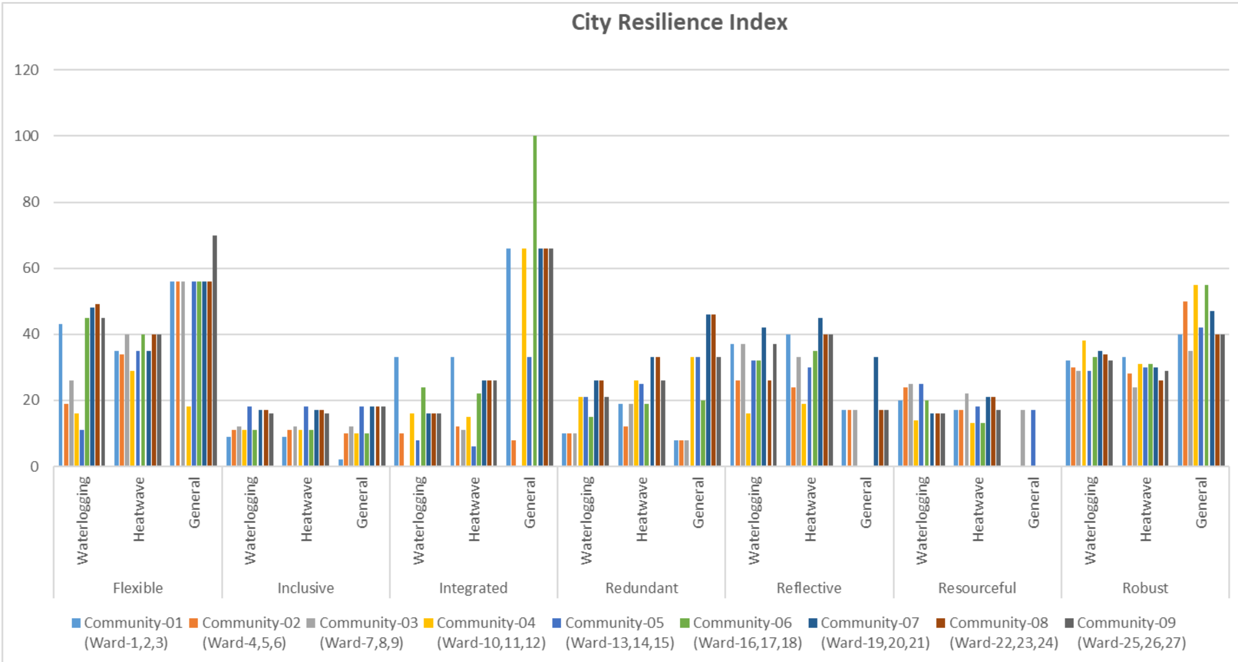

Figure 5.3: City Resilience Indexes of nine communities of NCC based on seven resilience components mapped against hazards. General refers to the overall hazard context.

5.1.3. City Resilience Index

City Resilience Indexe of nine communities of NCC are presented in **Figure 5.3**. Here, the Flexible, Reflective, and Robust resilience components scored high (most communities fell into Grade B), followed by the Integrated component. While Redundant scored modestly, Inclusive and Resourceful resilience components scored very poorly. As a result, the overall resilience score of the individual community was low (**Section 5.2**).

5.2. Overall Resilience Scores of the Communities

Figure 5.4 presents the overall score of each of nine communities against two hazards (waterlogging and heatwaves). The following sub-sections explain the sources of low resilience.

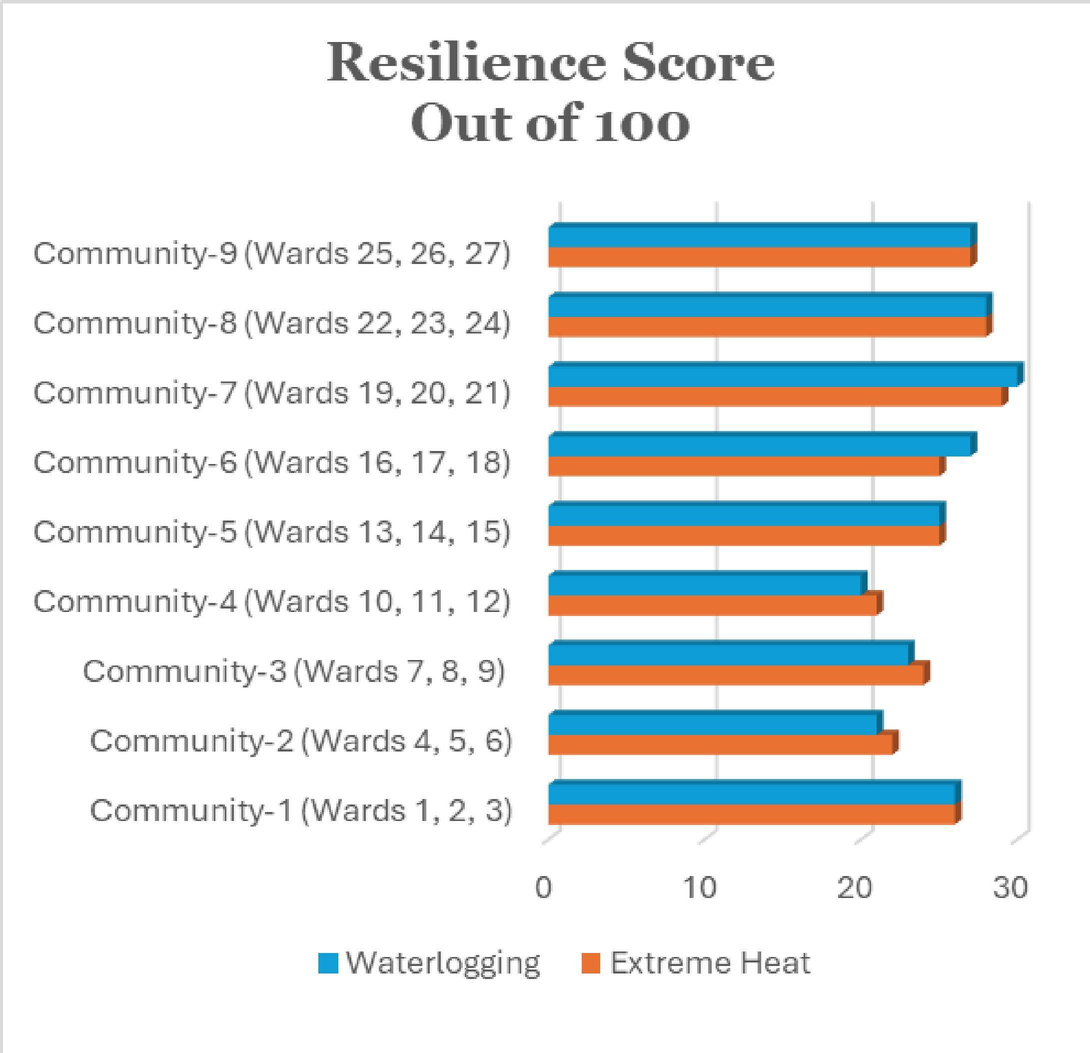

Figure 5.4: Overall resilience scores of nine communities, consisting of 27 wards of NCC. Since all scored less than 33, all communities showed lots of deficiencies in resilience and there is a lot of room for improvement.

Community-1 (Wards 1, 2, 3) The overall resilience score of this community is very low, at 26 (out of 100) for both urban flooding and heatwaves, indicating a limited ability to anticipate, withstand, respond to, and recover from climate induced shocks. This suggests that existing systems, resources, and capacities are insufficient to manage both sudden events such as flooding and slow onset stresses like heatwaves.

Community-2 (Wards 4, 5, 6) The community resilience results for wards 4, 5 and 6 of NCC remain low and closely aligned across hazards, with scores of 21 for floods, 22 for heatwaves and general resilience. These low values reflect limited capacity of the community to prepare for, absorb and recover from climate-related shocks.

Community-3 (Wards 7, 8, 9) The overall community resilience scores are very low, at 23 for urban flooding and 24 for heatwave, indicating extremely weak preparedness and limited capacity to cope with climate induced disasters.

Community-4 (Wards 10, 11, 12) The overall resilience scores for urban flooding and heatwaves are very low, at 20 and 21 respectively, indicating a high priority for targeted development and resilience strengthening interventions in ward 10,11 and 12 of NCC.

Community-5 (Wards 13, 14, 15) This community records low resilience for both hazards, with a score of 25, indicating limited capacity of community people and local government and requiring a pressing need for strengthening targeted resilience building activities in ward 13,14 and 15 of NCC.

Community-6 (Wards 16, 17, 18) The overall resilience for heatwave and urban flooding are very low, with a score of 25 and 27 respectively, emphasizing the importance of improving targeted measures in this community.

Community-7 (Wards 19, 20, 21) The overall resilience scores for urban flooding and heatwaves are very low, at 30 and 29 respectively, indicating that this community performs slightly better than others, though resilience levels remain relatively low, requiring a high priority for targeted development and resilience strengthening interventions in ward 19, 20 and 21 of NCC.

Community-8 (Wards 22, 23, 24) The overall resilience scores for urban flooding and heatwaves are very low, 28 for each indicating a high priority for targeted development and resilience strengthening interventions in these wards.

Community-9 (Wards 25, 26, 27) The overall resilience scores for urban flooding and heatwaves are very low, 27 for each indicating a high priority for targeted development and resilience strengthening interventions in ward 25, 26 and 27 of NCC.

CHAPTER SIX

6. PEOPLE'S ADAPTATION PLANS

6.1. Community Vision Statement and Strategic Objective

Vision:

A resilient and inclusive urban future for Narayanganj City Corporation where the voices and priorities of vulnerable communities guide climate-responsive planning, ensuring equitable access to safe water, sanitation, waste and sewerage management, nature-based solutions, and resilient infrastructure that effectively address heat stress and waterlogging.

Strategic Objectives

- **Strengthen Community-Led Climate Planning**
  Ensure that the voices, knowledge, and priorities of low-income and climate-vulnerable communities are central to urban climate adaptation planning and decision-making processes.
- **Improve Climate-Resilient Urban Services**
  Promote equitable and climate-resilient delivery of essential urban services, including water supply, sanitation, solid waste management, and sewerage systems.
- **Promote Nature-Based and Structural Adaptation Solutions**
  Support the implementation of nature-based solutions and climate-resilient infrastructure to reduce risks from heat stress, flooding, and waterlogging.
- **Institutionalize the People's Adaptation Plan**
  Facilitate the integration of the People's Adaptation Plan into city-level development plans, policies, and investment priorities of Narayanganj City Corporation.
- **Strengthen Multi-Stakeholder Collaboration**
  Encourage collaboration among communities, local government institutions, civil society organizations, and development partners to collectively implement climate adaptation actions.

6.2. Planning Approach and Principles

The PAP development process for all LICs was guided by four specific guiding principles as described below.

6.2.1. Locally Led Adaptation (LLA)

The exercise actively considered the philosophy of eight LLA principles. Inclusive climate risk analysis, collective understanding of the problem, planning activity, and wider stakeholder engagement all indicate an intention to communicate and undertake locally led actions.

6.2.2. Nature-based Solutions (NbS)

Nature-based Solutions (NbS), utilizes locally available resources to promote sustainable and context-appropriate interventions by benefiting both human beings and biodiversity. In this connection, the Compendium on Nature-Based Solutions for Urban Resilience in Bangladesh, published by IUCN Bangladesh and the GCA in March 2025, has been considered as a guiding document.

6.2.3. Gender Equality and Social Inclusion (GESI)

Complementing with LLA principles, GESI was embedded in the planning exercise through dedicated Women's Adaptation Labs (WALs) to ensure women's specific adaptation needs and solutions are identified and integrated into the adaptation plans.

6.2.4. Solution-oriented and pro-poor planning

This approach focuses on generating practical and costed adaptation solutions from and for LICs and informal settlements, ensuring their priorities guide city masterplans and investments.

6.3. Thematic Areas of Adaptation

The participatory exercises in all priority LICs identified four major thematic areas to take adaptation actions, as described below.

6.3.1. Safe Water

Climate-resilient access, affordability, and quality of water services remain critical challenges in Narayanganj's low-income communities (LICs). Communities report frequent water scarcity during the dry season, contamination from flooding/waterlogging, damaged tube wells and reliance on unsafe sources. Participatory planning (PRA/FGDs) identified priorities including repair of damaged tube wells, plus installation of community water points and free drinking water filters. City Corporation and Local Project Implementation Committees lead implementation, with training for committee members on maintenance and safe water practices. Awareness-raising on safe drinking water targets multiple villages, while nature-based elements like retention ponds and canal restoration support recharge and quality. These measures aim for inclusive, affordable, climate-resilient services, with strong emphasis on gender/youth inclusion in planning and oversight.

6.3.2. Improved Sanitation

Safe, inclusive, and climate-resilient sanitation systems are severely compromised in LICs due to damaged or absent toilets, clogged drains, flooding intrusion, and health risks from open defecation or poor facilities. Community exercises highlighted needs for new community toilet sheds, repair of damaged toilets, provision of slabs/pans, and sanitary latrine materials. Drainage repair and water tanks for toilet use address flooding and hygiene gaps, while low-cost hygiene kits (including medicine, chlorine, bleaching powder) and hygiene material units tackle disease prevention. City Corporation, committees, beneficiaries, NGO's and ward councillors collaborate on implementation, with community supervision-management established for sustainability. Training and awareness ensure inclusive access (e.g., women, youth, persons with disability, elderly), aligning with WASH strengthening for health and resilience.

6.3.3. Managed Waste

Improved collection, disposal, recycling, and drainage protection are urgent to reduce waterlogging, pollution, and health hazards in dense LICs. Unmanaged waste clogs drains, exacerbates flooding, contaminates water, and amplifies heat-related biodegradation; communities and KIIs note insufficient transfer stations, manpower, and enforcement. Priorities include designated waste management points, better collection systems, regular drain clearance (e.g., multiple units), and community-led removal collaborations. Integration with nature-based solutions protects drainage while enabling recycling. NCC, committees, and NGOs coordinate with awareness and low-cost tools; participatory prioritization ranks these highly for reducing exposure and co-benefits (health, environment).

6.3.4. Climate-Resilient Infrastructure and Settlement

Safer housing, reduced exposure, and incremental upgrading address fragile tin-roofed/semi-permanent structures vulnerable to flooding, heat stress, storms, and poor ventilation in LICs. Communities face water intrusion into homes, indoor overheating, insecure tenure, and lack of green cover/drainage; drone/GIS mapping shows high built-up density and low vegetation in priority wards. Recommendations focus on reflective/green roofing, elevated floors, climate-resilient materials, incremental housing upgrades, and nature-based cooling corridors. Community-centered planning integrates safer housing with drainage, WASH, and green infrastructure. NCC, ward committees, CBOs/NGOs, and residents co-design/maintain solutions with targeted pro-poor financing, emphasizing gender balance, youth representation, and Locally Led Adaptation principles for long-term resilience.

6.3.5. Waterlogging and Heat Wave

Due to its rapid industrialization and largely unplanned urban expansion, the city is increasingly vulnerable to heat and waterlogging. Urban residents are experiencing several impacts from irregular rainfall, rising temperatures and an increasing number of extreme hot days. Community members have expressed strong expectations for proactive measures to reduce these impacts.

They emphasized the need to promote Nature-based Solutions (NbS), including the restoration of natural canals and ponds, the development of open and green public spaces, and the improvement of urban ecosystems. Additionally, communities highlighted the importance of strengthening emergency response mechanisms through the health units of the City Corporation and ensuring adequate indoor and outdoor cooling and protection facilities.

6.4. Community-Proposed Adaptation Solutions

The following sections summarise the priority adaptation actions identified by 15 LICs in their respective PAPs. Each of the sections represents one thematic area of adaptation (**Section 6.3**).

6.4.1. Safe Water

i) Installation of submersible water supply, ii) Improved water supply (through water pipeline/ tube well/ tap/ toilet-based water supply), and iii) Usable water tank required along with cleaning existing water tanks and pond came up as the top three adaptation interventions in most of LICs (**Table 6.1**).

- Siddhirganj North Railway Line Slum, BJC Workers' Colony Slum, Bajna Para Slum and Bihari Camp Slum placed strong demand for submersible water supply.
- South Rally Bagan Slum and Chittaranjan Cotton Mill Slum required improved water supply.
- Siddhirganj South Railway Line Slum and Reeshi Para Slum (W 17) needed well-maintained water tanks.

Table 6.1: Priority adaptation actions under safe water thematic area. Numbers in the table represent the number of LIC members voted for the respective intervention during the PAP development session.

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
1	Submersible water supply	6	10	12	11	1	2	16	7	4	19	1		15	11
2	Electricity connection for community	1	5				2				2			1	
3	Water pipeline/ tube well/ tap/ toilet-based water supply	1		2		15		4		2	1		15	1	1
4	Water tank required and cleaning of water tanks and pond clean	2	7		1	1	3			2		15			1
5	Arrangement for rainwater	1	3	1		1				2		1			

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
	harvesting / use of filter														
6	Electricity supply and security			2											1
7	Awareness required (meeting, courtyard meeting, training)										4				

6.4.2. Improved Sanitation and Toilet

Here the top three adaptation interventions for most of LICs were i) Installation of community tube well and septic tank, ii) Installation of specific toilets for women, persons with disability, and pregnant women, and iii) Ensuring arrangement for waste disposal (**Table 6.2**).

- Guha Bari Slum, Bajna Para Slum and BJC Workers' Colony Slum placed demand for community septic tanks.
- Guha Bari Slum and South Rally Bagan Slum underscored the need for specific toilets for different groups of people.
- Guha Bari Slum and Reeshi Para Slum (W 21) required a better waste disposal system.

Table 6.2: Priority adaptation actions under improved sanitation thematic area. Numbers in the table represent the number of LIC members voted for the respective intervention during the PAP development session.

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
1	Community tube well and septic tank required	5	4	5	14	5	8	10	5	3	4			13	8
2	Water motor required								6			4			
3	Water and electricity supply	1	4	5	5		3	4	2	2		4	8		3
4	Toilet for Women, PWD and Pregnant	5	4	6	14	13		4	2		3		1	2	
5	Arrangement for waste disposal must be ensured	3	2	4	14	3	8	4			4	4		1	

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
6	Arrangement of streetlight	1				1					1	1			
7	Access/road to toilet and repair of toilet	4					1						5		
8	Awareness required (meeting, courtyard meeting, training)			2	2			2						1	2

6.4.3. Waste Management

The top three adaptation interventions of this theme for most of LICs were i) For waste and garbage disposal, assign a designated place/ dustbin arrangement/ adequate waste management/pond cleaning, ii) For waste management, need worker/ truck/ van/ equipment, and iii) Repair/ cleaning existing drain and road/ construct new drain/ bridge (**Table 6.3**).

- Guha Bari Slum, Siddhirganj North Railway Line Slum and BJC Workers' Colony Slum demanded for better waste and garbage disposal.
- South Rally Bagan Slum, Siddhirganj South Railway Line Slum, and Reeshi Para Slum (W 21) highlighted the need for enhanced human resource and equipment supply for waste management.
- Chittaranjan Cotton Mill Slum, BJC Workers' Colony Slum and Siddhirganj North Railway Line Slum focused on repairing and maintenance of existing drainage systems.

Table 6.3: Priority adaptation actions under managed waste thematic area. Numbers in the table represent the number of LIC members voted for the respective intervention during the PAP development session.

Sl.	Action Needed	Harijan Sweeper Colony Slum (Ward 4)	Reeshi Para Slum (W 17) (Ward 17)	Bihari Camp Slum (Ward 6)	Guha Bari Slum (Ward 14)	South Rally Bagan Slum (Ward 15)	Reeshi Para Slum (W 21) (Ward 21)	BJC Workers' Colony Slum (Ward 10)	Bihari Colony Slum Balur math (Ward 6)	Dockyard Sweeper Colony Slum (Ward 26)	Siddhirganj North Railway Line Slum (Ward 4)	Siddhirganj South Railway Line Slum (Ward 5)	Chittaranjan Cotton Mill Slum (Ward 10)	Bajna Para Slum (Ward 14)	New Gymkhana Slum (Ward 15)
1	For waste and garbage disposal, a designated place / dustbin arrangement / adequate waste management/pond cleaning	2	6	12	19	2	2	15	5	2	16	11	11	8	11
2	For waste management need worker/ truck/ van/equipment	9	7	7	4	22	17	2		13	1	21	2	6	7

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
3	Prepare compost and fertilizer using waste and garbage			4		2	1	8	2	15	2	3	8		4
4	Awareness required (meeting, courtyard meeting, training)	1		3						2	2	2		2	3

6.4.4. Infrastructure

Here the top three adaptation interventions for most of LICs were i) Building new houses/ toilets/Boundary/market/ field, ii) Arrangement of family level Gas/water supply/ tube well, and iii) Primary school/Library/Clinic/Hospital (**Table 6.4**).

- Siddhirganj South Railway Line Slum put strong demand for new house/ toilet/Boundary/market/ field.
- BJC Workers' Colony Slum and Siddhirganj North Railway Line Slum demanded for arrangement of family level Gas/water supply/ tube well.
- Rishipara slum and Siddhirganj south Railway Line Slum put demand for Primary school/Library/Clinic/Hospital.

Table 6.4: Priority adaptation actions under infrastructure thematic area. Numbers in the table represent the number of LIC members voted for the respective intervention during the PAP development session.

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum	Bihari Camp Slum	Guha Bari Slum	South Rally	Reeshi Para Slum	BJC Workers' Colony Slum	Bihari Colony Slum	Dockyard Sweeper Colony	Siddhirganj North Railway	Siddhirganj South Railway	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
1	Need New house/ toilet/Boundary/market/ field	6	2		1		4	4	4	6	4	19			
2	Repair of House/Drain/road/ streetlight	2	13		4	8	5	4		3	4	5	9	12	1
3	Training for women's income source										4	4			
4	Arrangement of family level Gas/water supply/ tube well	2						16	4	5	16		7		11
5	Primary school/Library/Clinic/Hospital	2	9	19	3	2	9	4	4	2	7	12		1	

Sl.	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum	BJC Workers' Colony Slum	Bihari Colony Slum	Dockyard Sweeper Colony	Siddhirganj North Railway	Siddhirganj South Railway	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
6	Community waste management /disposal/ vehicle/worker/equipment's			4				4		1	4	5	1 1		1
7	Mosque/ temple/ Dead body bath place/place for religious activities	3								3				7	
8	Playing field and Community center	5		4			5		3	6					

6.4.5. Heatstress and waterlogging

Here the top three adaptation interventions for most of LICs were i) Drain and road repair / cleaning / new drain/bridge, ii) Ensure a designated place for waste and garbage / use dustbins/ Mosquito Control, and iii) During excessive temperature, arrange shed/green park/cooling center/water supply/work/tree plantation/eco park (**Table 6.5**).

- BJC Workers' Colony Slum, Siddhirganj North Railway Line Slum, and Chittaranjan Cotton Mill Slum demanded for drain and road repair / cleaning / new drain/bridge.
- Reeshi Para Slum (Ward 21), Bihari Colony Slum Balur math, and Siddhirganj South Railway Line Slum put strong demand for During excessive temperature, arrange shed/green park/cooling center/water supply/work/tree plantation/eco park.
- Siddhirganj South Railway Line Slum, and New Gymkhana Slum demanded for ensuring a designated place for waste and garbage / use dustbins/ Mosquito Control.

Table 6.5: Priority adaptation actions under Heat stress and waterlogging thematic area. Numbers in the table represent the number of LIC members voted for the respective intervention during the PAP development session.

Sl	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
1	Drain and road repair / cleaning / new drain/bridge	2	6	7	7	2		18	2	4	15	2	19	13	
2	Govt. Pond cleaning and landfill				5			10		2		1		3	
3	Ensure a designated place for waste and garbage / use dustbins/		3	4	1				7		6	14		4	11

Sl	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
	Mosquito Control														
4	During excessive temperature, arrange shed/green park/cooling center/water supply/work /tree plantation/eco park	14	4	9	10	11	16		22	11	12	15		3	
5	During excessive heat, change	2	4	4	4	2	1			2		4	1		

Sl	Action Needed	Ward 4	Ward 17	Ward 6	Ward 14	Ward 15	Ward 21	Ward 10	Ward 6	Ward 26	Ward 4	Ward 5	Ward 10	Ward 14	Ward 15
		Harijan Sweeper Colony Slum	Reeshi Para Slum (W 17)	Bihari Camp Slum	Guha Bari Slum	South Rally Bagan Slum	Reeshi Para Slum (W 21)	BJC Workers' Colony Slum	Bihari Colony Slum Balur math	Dockyard Sweeper Colony Slum	Siddhirganj North Railway Line Slum	Siddhirganj South Railway Line Slum	Chittaranjan Cotton Mill Slum	Bajna Para Slum	New Gymkhana Slum
	in working hours														
6	Electricity supply must be kept running or alternative arrangements must be made	2				2	1			1		1			
7	Awareness required (meeting, courtyard meeting, training)							3		3			10		3

6.5. Alignment of LIC PAPs with NCC Masterplans and IFI Investments

Table 7.6 maps out how the adaptation actions identified by 16 LICs in a participatory manner are addressed in three existing masterplans of NCC to improve civic services. These plans are the Urban Action Plan, the Sewerage Master Plan, and the Solid Waste Management Plan. Among these the Urban Action Plan showed strong alignment, followed by the Solid Waste Management Plan and then the Sewerage Master Plan.

Table 6.6. The adaptation actions identified by 16 LICs are mapped against three masterplans for NCC.

Thematic Area	Adaptation Actions	Alignment with Master Plans of NCC		
		Urban Action Plan	*Sewerage Master Plan*	*Solid Waste Management Plan*
Safe Water	Submersible water supply	X		
	Electricity connection for community	X		
	Water pipeline/ tube well/ tap/ toilet-based water supply	X		
	Water tank required and cleaning of water tanks and pond clean	X		
	Arrangement for rainwater harvesting / use of filter	X		
	Electricity supply and security	X		
	Awareness required (meeting, courtyard meeting, training)	X		
Improved Sanitation and Toilet	Community tube well and septic tank required		X	
	Water motor required	X	X	
	Water and electricity supply	X	X	
	Toilet for Women, PWD and Pregnant	X	X	

Thematic Area	Adaptation Actions	Alignment with Master Plans of NCC		
		Urban Action Plan	***Sewerage Master Plan***	***Solid Waste Management Plan***
	Arrangement for waste disposal must be ensured		X	X
	Arrangement of streetlight	X		
	Access road to toilet and repair of toilet	X		
	Awareness required (meeting, courtyard meeting, training)	X	X	
Waste Management	For waste and garbage disposal, a designated place / dustbin arrangement / adequate waste management/pond cleaning			X
	For waste management need worker/ truck/ van/ equipment			X
	Prepare compost and fertilizer using waste and garbage	X		X
	Awareness required (meeting, courtyard meeting, training)	X		X
Infrastructure	Need New house/ toilet/ boundary/ market/ field	X		
	Repair of house/ drain/ road/ streetlight	X		
	Training for women’s income source	X		
	Arrangement of family level Gas/water supply/ tube well	X		
	Primary school/ Library/ Clinic/ Hospital	X		

Thematic Area	Adaptation Actions	Alignment with Master Plans of NCC		
		Urban Action Plan	***Sewerage Master Plan***	***Solid Waste Management Plan***
	Community waste management/ disposal/ vehicle/ worker/ equipment's			X
	Mosque/ temple/ Dead body bath place/place for religious activities	X		
	Playing field and Community center	X		
Heatstress and waterlogging	Drain and road repair/ cleaning / new drain/ bridge		X	X
	Govt. Pond cleaning and landfill	X		
	Ensure a designated place for waste and garbage / use dustbins/ Mosquito Control			X
	During excessive temperature, arrange shed/green park/ cooling center/ water supply/ work/ tree plantation/ eco park	X		
	During excessive heat, change in working hours	X		
	Electricity supply must be kept running or alternative arrangements must be made	X		
	Awareness required (meeting, courtyard meeting, training)	X		

6.6. Alignment of LIC PAPs with the National Adaptation Plan (NAP), the Third Nationally Determined Contribution (NDC 3.0) of Bangladesh and the Climate Change Gender Action Plan (ccGAP)

The National Adaptation Plan of Bangladesh 2023-2050 (NAP) is the most updated investment plan of the country to take its adaptation action forward. It envisions to build a climate-resilient nation through effective adaptation strategies and actions to nurture a resilient society and ecosystems, and at the same time stimulate sustainable economic growth. Its basic structure is built on six goals focusing on disaster management, resilient agriculture, climate-smart cities, nature-based solutions, good governance, and capacity-building & innovation.

The **Goal 3** of the NAP reads "Develop climate-smart cities for an improved urban environment and wellbeing". To contribute towards this goal, three **outcomes** are envisaged, namely, Outcome 1: Improved urban environment and resilient urban infrastructure; Outcome 2: Enhanced urban resilience and improved standard of living; and Outcome 3: Improved human health, livability and well-being. To achieve these outcomes, three overarching **adaptive strategies** are identified: S 3.1: Promote green and blue infrastructure for urban environmental management and conservation; S 3.2: Develop climate-smart cities to increase urban resilience; and S 3.3: Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities. To accomplish these different levels of results, the NAP has identified 12 major interventions under urban sector, which will need to be translated into one or more projects.

Table 6.7 shows how the PAP actions for NCC outlined in **Section 6.4** are aligned with the urban NAP interventions at different strengths (i.e., strong, moderate, and weak). Strong alignment of many urban NAP interventions indicates that, the PAP development process has managed to rightly identify priority urban actions for the NCC. This will subsequently help NCC and other stakeholders working in NCC area to develop projects to implement the PAP as described in **Section 6.7**.

Further, the NAP envisages the development of necessary policies, improved governance and a structured framework for its smooth implementation. The NAP proposes developing a large number of plans to translate the NAP for the local, sectoral and cross-sectoral levels: the Local Adaptation Programme of Action (LAPA) (already done for 22 unions under the LoGIC project of UNDP by 2025), the Youth-Led Adaptation Plan (YLAP), the Chattogram Hill Tracts Climate Action Plan (CHTCAP), the Adaptation Plan for Persons with Disabilities, the City Climate Action Plan (City-CAP) (already done for a few cities), the Sector Adaptation Plan (e.g., for infrastructure and WASH), the National Adaptation Plan for Health (H-NAP) (launched in 2026), and the Climate Change Gender Action Plan (ccGAP) (updated in 2024). The PAP development process that was followed for NCC, therefore, contributes to the translation of the NAP for NCC. More specifically, the PAP development directly contribute to implement the NAP intervention "CRC4: Development of city climate action plans for major urban and peri-urban areas emphasizing the resilience of urban poor communities and climate migrants."

The Government of Bangladesh also updated and submitted its Third Nationally Determined Contribution (NDC 3.0) to the United Nations Framework Convention on Climate Change (UNFCCC), in September 2025. Through the latest NDC, the country pledges and outlines its greenhouse gas emission reduction targets for 2035. The document also includes adaptation actions and actions against climate change-induced loss and damage. The 65 adaptation targets listed in the NDC 3.0 are directly extracted from the NAP's total 113 interventions. These 65 interventions include seven urban interventions, which are identified from 12 urban NAP interventions, as described above. These priority interventions expected to be completed by 2035 are also highlighted in **Table 6.7**. It is to note that most of the urban NAP interventions, to which the PAP actions are showing strong alignment, are also included in the NDC 3.0.

Table 6.7: Alignment of the proposed PAP actions with 12 interventions of urban sector listed in the NAP (2023-2050). The urban NAP interventions prioritized in the NDC 3.0 are also identified in the far-right column.

NAP Interventions of the urban sector	Level of PAP actions' alignment with the NAP interventions			NAP interventions prioritized in the NDC 3.0
	Strongly	Moderately	Weakly	
CRC1: Improvement of natural and artificial stormwater drainage networks for reducing vulnerabilities to urban floods and drainage congestion	X			+
CRC2: Expansion and conservation of green and blue infrastructure for improvement of urban environments and drainage systems	X			+
CRC3: Stormwater management in cities through attenuating peak flow and allowing infiltration in line with the concept of low-impact development		X		
CRC4: Development of city climate action plans for major urban and peri-urban areas emphasizing the resilience of urban-poor communities and climate migrants	X			+
CRC5: Expand innovative climate-resilient, gender-, age- and disability-sensitive WASH	X			+

NAP Interventions of the urban sector	Level of PAP actions' alignment with the NAP interventions			NAP interventions prioritized in the NDC 3.0
	Strongly	Moderately	Weakly	
technologies and facilities for urban communities				
CRC6: Increase access to water supply, sanitation and hygiene services in cities for reducing exposure to flooding and waterborne diseases during or after extreme weather events	X			+
CRC7: Adopt integrated water management for urban and peri-urban areas		X		
CRC8: Carry out initiatives to improve the well-being of children and youth and reduce the effects of climate stress		X		
CRC9: Improvement of surveillance, early warning systems and monitoring of psychosocial impacts and mental health risks from extreme weather events			X	
CRC10: Extension of resilient and eco-friendly materials and engagement of the private sectors through incentives and tax rebates for climate-resilient infrastructure development in urban areas			X	
CRC11: Establishment of climate-resilient health-care facilities in urban areas			X	+
CRC12: Development of heatwave and disease outbreak advisory services for city dwellers			X	+

*CRC = Climate Resilient Cities, as identified in the NAP.

The Government of Bangladesh also updated its Climate Change Gender Action Plan (ccGAP) in 2024. Originally prepared in 2013 as a follow-up to the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), the ccGAP was revised and updated in partnership with UN Women and the Bangladesh Climate Change Trust (BCCT), with technical support from IUCN, aligning it with the NAP and the updated BCCSAP. The ccGAP defines the role of MoEFCC in initiating and facilitating efforts — both internally and with strategic partners — to mainstream gender in climate action and promote gender equality. It integrates gender considerations across four key pillars: food security, social protection and health; comprehensive disaster management; infrastructure; and mitigation and low carbon development.

The PAP development process for NCC is well-positioned to contribute to the implementation of the ccGAP at the city level. The PAP actions — particularly those addressing gender-, age- and disability-responsive WASH (CRC5), urban resilience for women and marginalized communities, and inclusive participation in adaptation planning — are directly aligned with the ccGAP's core objective of ensuring that diverse groups of stakeholders equally access, participate in, and benefit from climate change interventions. Establishing the NCC-APICC (Section 7.6) with inclusive representation from women, elderly, youth, and persons with disabilities will further support the translation of the ccGAP into locally led, gender-responsive urban adaptation practice.

6.7. Costed Priority Actions

6.7.1. Priority interventions across 16 LICs

Based on the methodology described in **Section 1.3.4**, a number of key interventions were prioritised to improve basic services, infrastructure, and overall living conditions and their costs were estimated. A detailed description of priority action plan for each of 16 LICs can be found in **Annex 4**, which also includes the detailed design of each infrastructural intervention. These proposed action plans provide a structured roadmap for implementing targeted improvements, enhancing resilience, and promoting sustainable urban development. **Table 6.7** summarises the action plan components. It outlines key service and infrastructure components, the number of slums requiring each intervention, and the specific slum locations targeted for implementation.

Table 6.8: Components of priority action plan for 16 LICs of NCC.

Priority action plan components	Number of LIC requiring an intervention	LIC names
Safe drinking water (tube wells / submersibles)	15	Bazna Para, Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Dattapara Boi-Bazar, Harijan Sweeper Colony, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), South Railway Bagan, Dockyard Sweeper Colony, Rishipara (Ward 17), Rishipara (Ward 21), Notun Jimkhana
Community toilets / sanitation facilities	15	Bazna Para, Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Dattapara Boi-Bazar, Harijan Sweeper Colony, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), South Railway Bagan, Dockyard Sweeper Colony,

Priority action plan components	Number of LIC requiring an intervention	LIC names
		Rishipara (Ward 17), Rishipara (Ward 21), Notun Jimkhana
Accessibility & gender/disabled-friendly toilets	7	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Harijan Sweeper Colony, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp
Drainage repair / flood management	10	Bazna Para, Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Dattapara Boi-Bazar, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Rishipara (Ward 17), Rishipara (Ward 21)
Road repair / maintenance	7	Bazna Para, Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Dattapara Boi-Bazar, Dockyard Sweeper Colony, Rishipara (Ward 17)
Waste collection & management (designated areas & vans)	13	Bazna Para, Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Dattapara Boi-Bazar, Harijan Sweeper Colony, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), South Railway Bagan, Dockyard Sweeper Colony, Rishipara (Ward 21)
Health service / emergency management (ambulance, centers)	8	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), Rishipara (Ward 21)
Housing / shelter improvement	9	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), Dockyard Sweeper Colony, South Railway Bagan
Recreational / play areas	5	Guhbari, BGC Labor Colony, Harijan Sweeper Colony, Bihari Colony (Balur Maath), South Railway Bagan
Fire / water / safety services	5	Guhbari, Bihari Colony (Balur Maath), Dockyard Sweeper Colony, Harijan Sweeper Colony, BGC Labor Colony
Awareness / training / community capacity building	6	Siddirganj North Railway Line, Siddirganj South Railway Line, Rishipara (Ward 17), Rishipara (Ward 21), Notun Jimkhana, Guhbari
Cooling / heat-mitigation measures	8	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), South Railway Bagan
Eco-parks / greening & tree plantation	5	Guhbari, BGC Labor Colony, Siddirganj North Railway Line, Bihari Colony (Balur Maath), South Railway Bagan
Education / libraries / schools	5	Guhbari, BGC Labor Colony, Siddirganj North Railway Line, Siddirganj South Railway Line, Rishipara (Ward 21)

Priority action plan components	Number of LIC requiring an intervention	LIC names
Electricity / solar / lighting	7	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Harijan Sweeper Colony, Bihari Colony (Balur Maath), South Railway Bagan, Dockyard Sweeper Colony
Sewerage / septic tanks / wastewater management	10	Guhbari, BGC Labor Colony, Chittaranjan Cotton Mill, Siddirganj North Railway Line, Siddirganj South Railway Line, Bihari Camp, Bihari Colony (Balur Maath), South Railway Bagan, Dockyard Sweeper Colony, Rishipara (Ward 21)

6.7.2. Cost estimation of priority interventions

The cost estimates for all priority infrastructure interventions were derived from detailed component-wise assessments, considering measurable quantities, standard unit rates, and preliminary technical designs. The total financial requirement for all planned interventions in 16 LICs is estimated to be BDT 301,291,578. **Table 6.8** presents estimated total costs for each LIC. Detailed breakdown for each intervention for each LIC can be found in **Annex 4**, which offers a clear reference point for budgeting, resource allocation, and investment planning. It also ensures transparency and consistency, and facilitates decision-making for implementing the priority actions.

Table 6.9: Cost estimation of priority actions to be implemented in 16 LICs.

Sl. No.	LICs	Number of infrastructure components needed	Amount (BDT)
1	Horizon Sweeper Colony	14	8,331,251
2	Rishi Para Slum (Ward 17)	10	8,093,090
3	Bihari Camp	17	26,583,070
4	Guhobari	13	25,632,299
5	South Rally Bagan Slum	10	28,284,327
6	Rishi Para Slum (Ward 21)	13	18,082,062
7	BJC Worker's Colony	24	70,216,063
8	Bihari Colony	16	19,612,536
9	Dockyard Sweeper Colony	12	17,503,246
10	Dutta Para Bou Bazar	7	5,287,727

Sl. No.	LICs	Number of infrastructure components needed	Amount (BDT)
11	Siddhirganj North Rail Line	9	10,632,727
12	Siddhirganj South Rail Line Slum	13	12,381,868
13	Ibrahim Colony	14	8,999,595
14	Chittaranjan Cotton Mill Slum	14	31,784,654
15	Bajna Para Slum	10	7,334,736
16	Gymkhana	7	2,532,327
Total			**301,291,578**

6.7.3. Implementation of the priority interventions

It is recommended that the priority actions should be implemented in four phases to balance urgency, cost, and feasibility within the five years (2026-2030) as listed below.

Phase 1: Critical Health and Sanitation Infrastructure. Here focus should be on safe drinking water supply, and installing sufficient community toilets, sewerage facility, and septic tanks.

Phase 2: Roads, Drainage, and Shelter Improvements. This should include repairing of roads and drainage networks within the LICs, and improvement of housing and shelters.

Phase 3: Energy, Cooling, and Greening Interventions. Here interventions cover electricity supply, installing solar lighting, initiatives to mitigate heat stress, and enhancing greening within and around LICs.

Phase 4: Recreational, Educational, and Community Facilities. Here, the focus should be given on playgrounds, libraries, educational spaces, and awareness training centers for the LIC communities.

The implementation of priority actions in each LIC must also follow some **guiding principles**. The implementation must be community-centered and follow a phase-wise prioritisation, as noted above. It should ensure sustainability and maintenance of the new infrastructure. Finally, these should be integrated into and aligned with the NCC's overall infrastructural planning.

All interventions should follow a multi-stakeholder approach to ensure that responsibilities are clearly defined, avoiding duplication and ensuring accountability (**Table 6.9**).

Table 6.10: Stakeholders' roles and responsibilities to implement priority actions in 16 LICs of NCC.

Stakeholder	Role in Implementation	Scope of Work
Narayanganj City Corporation (NCC)	Lead implementation of municipal infrastructure	Roads, drainage, flood management, water supply connections
Non-Governmental Organizations (NGOs)	Fund and supervise community-level structural interventions	Water points, sanitation, solar/electric lighting, greening, shelters, educational/recreational facilities
Community Members / LIC Residents	Participate in construction support, monitoring, and maintenance	Minor repairs, site supervision, upkeep of facilities, tree planting
Collaborative Partners (Private Sector / CSR Programs)	Optional co-financing and technical expertise	Supplementary energy or greening projects, specialized community infrastructure

A detailed monitoring and evaluation (M&E) framework to implement the priority actions can be found in **Annex 4**.

6.8. Opportunity for NbS in the PAPs

The United Nations defines Nature-based Solutions (NbS) as "Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits." NbS offers long-term, multiple benefits, are cost-effective, and easier to maintain. It is not that only ecosystem-based approaches or green solutions would act alone in a given context, nor that all hard, engineering or grey solutions should be replaced. Rather, we need to harness ecosystem services as much as possible while designing an NbS intervention. We need to remember that we should work with diverse ecosystems in NbS and move away from planting trees as the core Nbs action. Net biodiversity gain is crucial for NbS, that is why planting millions of 'single tree species' must not be called NbS. Full engagement and consent of Indigenous Peoples and local communities respecting their cultural & ecological rights are fundamental guiding principles of NbS. IUCN Global Standard for Nature-based Solutions (IUCN, 2020) offers an important framework to assess the quality of an NbS intervention if it is adhering to the standard. In a recent assessment of 20 Bangladeshi potential urban NbS intervention, the city park of NCC was identified as one of the best examples of NbS (IUCN Bangladesh and GCA, 2025).

In the context of LICs of NCC, NbS interventions can focus on working with natural systems to address waterlogging, heat stress, air quality, and water scarcity, while also improving environmental quality and livability and biodiversity benefits. The proposed approaches aim to complement existing community practices (**Section 3.2**) by introducing scalable, low-cost, and sustainable interventions that can be integrated into local planning frameworks and institutional processes.

6.8.1. Integrated Urban Water Management

Community-Based Participatory Drainage Planning

Effective drainage solutions require the involvement and ownership of the local community. Engaging residents of LICs in the planning, design, and maintenance of drainage improvements helps ensure that solutions are practical, culturally appropriate, and well-maintained. Participatory processes build local capacity, promote cooperation, and increase the sustainability of interventions.

To facilitate this NbS intervention, the NCC authority should establish support programs that provide technical assistance, training, and funding to LIC-based groups. These programs can facilitate collaborative projects where residents help co-design green drainage infrastructure, conduct regular cleaning, and monitor system performance, fostering a sense of stewardship and resilience.

Green Infrastructure for Stormwater Management

Green infrastructure provides sustainable alternatives to traditional drainage by promoting natural water infiltration and storage. Solutions like permeable pavements allow rainwater to seep through surfaces rather than run off, reducing flooding and replenishing groundwater. Rain gardens, bioswales, and constructed wetlands can be strategically placed in LICs to collect and treat stormwater while adding greenery to urban spaces.

Since space is limited in densely populated LICs, NCC must ensure that the green infrastructure is carefully designed to fit into existing urban layouts without reducing valuable living areas. Vertical gardens, green walls, and rooftop planting are innovative ways to incorporate these solutions where horizontal space is scarce, maximizing benefits without displacing residents.

Restore and Enhance Natural Drainage Systems

Natural drainage features (e.g., rivers, canals, wetlands, and retention basins) play a critical role in managing stormwater by absorbing and slowing runoff before it reaches the residential areas. In NCC’s low-income communities, many of these natural systems have been degraded or encroached upon due to rapid urban growth, exacerbating waterlogging. Prioritizing the restoration and conservation of these natural water bodies will help reduce flood risk, improve water quality, and support local biodiversity.

NCC authority should enact regulations that protect remaining wetlands, canals, and natural waterways from further encroachment and pollution. Incentives, such as community grants or technical support, can encourage residents and local organizations to actively participate in the rehabilitation and ongoing maintenance of these drainage systems.

6.8.2. Nature-Based Cooling and Heat Mitigation

Urban Greening and Tree Planting

Urban greening is a powerful and cost-effective way to combat heat stress by increasing shade and promoting evaporative cooling. In low-income communities where dense housing and tin roofs amplify heat, introducing more trees and small green spaces can significantly lower ambient and indoor temperatures. Policies should encourage the strategic planting of trees along streets, in communal areas, and wherever small open spaces exist.

To ensure sustainability and minimal maintenance, NCC should prioritize native, drought-resistant tree and plant species that are well-adapted to the local climate and can thrive in small spaces. This approach maximizes cooling benefits while minimizing water use and avoiding competition with housing space.

Green Roofs and Vertical Gardens

Green roofs and vertical gardens provide innovative ways to increase vegetation coverage in space-constrained LICs. By covering rooftops and walls with plants, residents can reduce heat absorption by buildings, lower indoor temperatures, and improve air quality by filtering dust and pollutants. These solutions can also contribute to better rainwater management by capturing and slowing runoff.

To support adoption, NCC and NGOs should offer subsidies, technical training, or affordable planting kits tailored for low-income households of LICs. Emphasis should be on easy-to-maintain, low-water-use plants that require minimal upkeep, making these technologies accessible and sustainable.

Air Quality Improvement through Vegetation Buffers

Many LICs are located near industrial zones or busy roads, exposing residents to high levels of dust and particulate matter (PM), which worsen during heatwaves. Vegetation buffers made up of trees and shrubs can act as natural filters, trapping dust particles and improving overall air quality while providing additional shade and cooling.When designing these vegetative buffers, NCC, NGOs and LICs should select species known for their ability to capture particulate pollution effectively and that can withstand the harsh urban environment, including poor soil conditions and exposure to pollutants. Proper maintenance plans should also be included to ensure the long-term health and effectiveness of these green barriers.

CHAPTER SEVEN

7. Implementation, and Operation & Maintenance (O&M) of the PAPs

The PAPs presented in **Section 7.4** capture the expectations of the members of highly vulnerable LICs of NCC, which have been prepared in a rigorously participatory manner and have been duly validated by multiple stakeholders in concern. Given the rule of business of the Government of Bangladesh, implementation of these actions lies exclusively with NCC as the representative of the government in five years (2026-2030). However, assistance from other government and non-government entities would add value to expedite the implementation since we live in a resource and expertise constrained environment. To ensure a collaborative implementation of the People's Adaptation Plan, three major pathways have been proposed below to guide actions on an urgent basis.

7.1. Internalising the PAPs in NCC's current portfolio

- As an immediate action, NCC needs to adopt the PAPs prepared by the LICs as its own. It should be easy to do so since all senior officials of the NCC have been aware of the PAP process and many of them have been closely involved in the preparation and validation of PAP activities.
- The formal adoption of PAPs by NCC should be followed by allocating funds to implement the PAP actions in the current FY2025-2026 through the ongoing projects. Such projects could both be funded by the Government of Bangladesh, as ADP-allocated projects of the LGD, and by the development partners (e.g., forthcoming ADB-funded Narayanganj Green and Resilient Urban Development Project (NGURDP)).
- Based on the PAPs, NCC should immediately formulate new ADP projects to tap funds for the forthcoming FY2026-2027.
- NCC should also regularly seek funds from the LGD for operation and maintenance (O&M) of the PAP and other actions implemented lately. It has been discussed in different forums that, in many contexts, funding in O&M is equally crucial to investing in new interventions. NCC needs to closely work with the LGD and Finance Division to ensure sufficient allocation for O&M.
- As a part of the internalisation, NCC should also encourage other agencies, such as NGOs, who want to support the LICs, to implement the priority actions already outlined in the PAPs. This will in turn expedite the actions at the LIC level, which would otherwise have to wait for preparing yet another participatory plan by the respective NGO.

7.2. Mainstreaming PAPs into larger, long-term planning instruments

- NCC needs to proactively incorporate PAPs into i) the existing urban service development (master)plans (e.g., Narayanganj Climate Resilient City Action Plan (CRCAP), Heat Action Plan, and Climate Resilient Service Planning), ii) plans those to be revised soon, and iii) plans to be prepared soon (e.g., ADB supported masterplans (a) an Urban Action Plan, (b) a Solid Waste Management Masterplan, and (c) a Sewerage Masterplan).
- Such an attempt will give multiple benefits. First, this will ensure that the most vulnerable people's needs and expectations are included in those long-term plans without investing additional resources and time for planning. This was the core motivation from GCA to undertake the present NCC-wide PAP exercise.
- Second, many of the actions proposed by the LIC members are short-term, indicating a dire need to cope with the existing climatic challenges. These are included in the PAP as those were proposed by the people, without any additional paraphrasing to fit them into formally adaptation definition. But, given that climate change is happening on the ground for these LICs, incorporating those action points into the masterplans will give the PAP a long-term basis through proper O&M of the interventions as mentioned above.

7.3. Ensuring participatory implementation of PAPs and collaborative O&M

- The PAPs have been a prime example of participatory planning. To complement this and sustain the collaborative arrangement, implementation of PAP should also be inclusive. NCC needs to ensure that LIC representatives, including women groups, youth, and CDC members, participate in the implementation of PAP actions in their respective localities.
- O&M of infrastructure is a crucial aspect of getting sustainable adaptation benefits. Local stakeholders mentioned above should also be involved in all O&M activities.
- These will not only ensure transparency and accountability of the interventions at the implementation and O&M stages, but also ensure people ownerships.

7.4. Nurturing a Nature-based Solutions (NbS) 'Community of Interest' in NCC

- NCC leadership has shown tremendous interest in NbS to make NCC more liveable. It should establish a 'Community of Interest' (CoI) by bringing together individuals and stakeholders strongly interested and committed in addressing the waterlogging and heat stress problems of NCC.
- This CoI will:
    - Conduct regular dialogues to keep the conversations on waterlogging and heat stress going to reduce the gaps among the stakeholders with different interests in the conditions.

    - Share government’s commitments to reduce climate risks through environment-friendly options to orient stakeholder with NbS interventions.
    - Present assessments, cases, analyses, and studies on the economic and non-economic impacts (losses and damages) of waterlogging and heat stress problems to get social, political, government and development partners’ support to resolve the problem.
    - Ensure concerted effort to implement NbS in the NCC.
- Unlike many infrastructural interventions, NbS interventions can give wider benefits which go beyond specific intervention sites (e.g., LICs). Such larger benefits could only be achieved and capitalised on if a CoI can work together.
- Such an attempt in the NCC may make other city corporations of Bangladesh to follow suit.

7.5. Maintaining a blended financing portfolio

The financing of priority interventions (**Section 7.6**) should draw from NCC, NGOs, community-based sources, and the private sector ensuring coverage of both structural and capacity-building components.

While different interventions can be implemented by more than one source, NCC investments should essentially go to roads and drainage construction and repairments, and flood mitigation. It should cover labour, equipment, construction materials, and technical supervision costs. **NGO and other partners can contribute to** water and sanitation facilities, housing upgrades, solar lighting, and greening interventions. Their investment should also include community training and awareness programmes. As mentioned above (**Section 7.8.3**), **communities’** In-kind support, such as volunteer labor, locally available materials, and maintenance services should be accounted for to build ownership and reduce overall implementation costs. Finally, **co-financing opportunities should be explored and availed of** through public-private partnerships for energy, recreation, or educational facilities. This should also include potential grant support from development agencies or CSR programmes.

7.6. Establishing an effective multistakeholder coordination committee at NCC for inclusive implementation of the PAP actions

The recommendations outlined above are only possible if a coordinated, inclusive effort is taken by bringing all relevant stakeholders on one platform. Since the PAP is essentially translation of the NAP in the form of a City Climate Action Plan, it should follow the core principle of NAP implementation. The NAP implementation is essentially based on the philosophy of locally led action, often formalised through the principles of Locally Led Adaptation (LLA) (**Section 6.2.1**).

Keeping that philosophy in mind, the Government of Bangladesh has recently prepared the 'National Framework and Action Plan for Locally Led Adaptation in Bangladesh' (2025). This comprehensive framework expects a vertical and horizontal coordinated effort among numerous government agencies and systems, including MoEFCC, LGD, Finance Division, sectoral ministries and departments, IMED, and GED; local people, local government institutions, and administrations at different levels (i.e., union, upazila, municipality, city corporation, and district); and non-government entities (e.g., local enterprises, CSOs, and NGOs). NCC must appreciate the need for establishing a committee to facilitate such a coordination to channel funds from the government, development partners, and private sector to implement the PAP actions. The funding modalities include interministerial fund transfers and funds from the central government, coming to the local level as subsidies, direct performance contracts, and agreements between the central and LG entities.

The NAP also envisages reforming the District Development Coordination Committees making it more climate-responsive and inclusive and effective for the NAP implementation. Inspired by that provision, NCC should establish a **NCC Adaptation Plan Implementation Coordination Committee (NCC-APICC)** to ensure locally led, gender-, age- and disability-responsive and socially inclusive PAP implementation. To do so, this committee should include representatives from NCC's different relevant departments/units, LICs, women, elderly, youth, persons with disabilities, ethnic communities and other marginalized groups, the private sector (including representative from Narayanganj Chamber of Commerce & Industry), CBOs, CSOs, and NGOs.

NCC should define the final composition and terms of reference of the NCC-APICC. But such a committee should essentially stocktake and monitor the implementation of the PAP actions/projects in its quarterly coordination meetings. It may also create sub-committees as needed to explore and channel funds, to expediate PAP implementation, to reduce overlapping, to mitigate social conflicts, and to track implementation progress.

ANNEXTURES

Annextures	Title	No. of Pages	Note
Annex 1	Climate Vulnerability and Risk Assessment, and GIS Mapping for People's Adaptation Planning in Narayanganj City Corporation (NCC)	202 Pages	All the Annextures are individual study/assessment attached separately
Annex 2	Climate Resilience Assessment for Communities (CRMC) Report	32 Pages	
Annex 3	Costed Priority Action Plan Report (Technical Assessment Sheets)	52 Pages	
Annex 4	LIC Level Adaptation Plan of Action (Sample: South Rally Bagan, Ward-15)	37 Pages	