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URBAN LOW EMISSION DEVELOPMENT STRATEGIES

CLIMATE RESILIENT CITY ACTION PLAN NARAYANGANJ BANGLADESH

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BACKGROUND

1.1 Introduction

Since the beginning of this century, the global and national discourse on sustainable development and subsequently climate resilient development has been significantly shaping the development paradigm in cities, especially in developing countries.

The adoption of several international agreements such as Paris Agreement, 2030 Agenda for Sustainable Development and the UN-Habitat's 2016 New Urban Agenda, etc. marks a turning point where the role of local governments in the global climate action has been recognized as well as encouraged.

Local governments are central to efforts of tackling the issue of climate change, which has been acknowledged by major agendas such as sustainable development goals (SDGs) and the Paris Agreement. Cities can lead climate action by framing strategies and programmes, integrating such actions into ongoing urban development, and forging the partnerships necessary for effective climate responses.

Globally, cities are at the frontline of climate emergency, responsible for up to 70% of global GHG emissions, 80% of global GDP and constituting 55% of the global population. With two-thirds of the global population expected to live in cities by 2050, it becomes imperative that cities will have to transform themselves into climate resilient and liveable places for people to live and work. The Intergovernmental Panel on Climate Change (IPCC) 2018 special report on warming of 1.5 °C (SR1.5) highlighted the need for coordinated actions by all the actors, including sub-national and non-state as a crucial framework for achieving the 1.5 °C goal.

The global COVID -19 pandemic has led to a reconsideration of how people in cities live, work, and connect. It has also highlighted the risks of living in cities, and how they can become drivers of economic growth as well as hubs for sustainability. Without a doubt, the urban development policies and actions taken in next few years will be decisive in accomplishment of global climate & sustainability efforts.

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Bangladesh is experiencing one of the highest urban population growth rates in the world. The UN projects that the urban population will grow from 48 million in 2011 to 84 million in 2030 in Bangladesh. Since its independence in 1971, Bangladesh's urban population has grown at a yearly average rate of 6%, and the country's urban population has expanded six-fold. In 2017, almost 35% of Bangladesh's 165 million population lived in metropolitan areas. More over 60% of the urban population lived in the five largest metropolitan regions, which include Dhaka (18.9 million), Chittagong (7.4 million), Khulna (2.0 million), Sylhet (1.0 million), and Rajshahi (0.85 million). Given the inevitable urban growth in the country, developing liveable and sustainable cities is critical for future growth of Bangladesh.

The rapid urbanization in Narayanganj city is also accompanied by a number of key challenges, including insufficient urban planning and management, as well as a lack of coordination among agencies, higher energy consumption and incr eased greenhouse gas (GHG) emissions, insufficient solid waste and sewerage management, resulting in environmental issues such as pollution, etc. With climate change these challenges and resulting impacts are most likely to be exacerbated.

As climate change disproportionally affects poor and vulnerable populations, it is therefore not only an environmental issue, but also inextricably linked to challenges currently being addressed through Sustainable Development Goals (SDGs).

In this regard, development & implementation of the Climate Resilient City Action Plan for Narayanganj will not only address systemic risks and pursue transformation over the longer term, it will also support meet immediate needs for the creation of sustainable jobs, the improvement of urban service delivery and the alleviation of poverty.

The development of a climate action plan will help Narayanganj to understand and effectively respond to climate change Impacts. Through, implementation of the actions suggested in the plan, the city will not only contribute towards national targets under the Paris Agreement and the SDGs but also position the city to attract international finance for a green economic recovery following the COVID-19 pandemic. Lastly, it will ensure that the benefits of climate action are equitably distributed amongst its citizens.

Overall, the CRCAP approach is to create an enabling ecosystem for mainstreaming climate action through creation of necessary institutional mechanisms, technical capabilities and communication channels between stakeholders for horizontal and vertical integration. This would facilitate achieving climate compatible urban development that contributes to Bangladesh's NDCs and also ensures achievement of Sustainable Development Goals (SDGs).

1.2 Approach

Narayanganj is a fast-urbanizing city of Bangladesh, located on the banks of the River Shitalakshya and the River Buriganga, close to the capital of Dhaka. It is an industrial centre famous for its jute mills and textiles and a prominent river port. Given its proximity to Dhaka, Narayanganj is a key contributor and driver of the regional economy and employment.

The Narayanganj City Corporation (NCC) is a relatively recently formed city corporation. It was upgraded in 2011 when Narayanganj city was established by unifying the three former municipalities of Narayanganj, Shiddhirganj and Kadamrasul. NCC has pursued efforts to promote and integrate sustainability and low carbon considerations in the city's infrastructure and urban services. Most of the city's industrial units are primarily located on the two banks of the River Shitalakshya and River Buriganga River and provide a number of employment opportunities in the city. Narayanganj's industrial and economic opportunities are essential to its growth, but have also resulted in increasing population, unplanned development, and negative environmental impacts. Providing efficient municipal services has become a challenge for the NCC, which is being further exacerbated due to the impacts of climate change. The city does not have the

necessary infrastructure to deliver piped water supply to all its citizens at present and is heavily reliant on groundwater, with pollution of its water resources a major concern. A centralized sewer network and wastewater treatment facilities are also absent, with the stormwater drains carrying domestic sewage and incidences of water logging recurrent during the monsoon. A large-scale waste-to-energy plan to help generate energy from Narayanganj's solid waste is being constructed. The waste management system needs to be strengthened in order to ensure that solid waste is collected and processed efficiently at this large facility.

Climate change is one of the greatest risks facing the world in the 21st century. The effects are more pronounced in cities like Narayanganj characterized by high urbanization, economic growth and resource insecurity. Moreover, these effects have been exacerbated by another human risk, the Covid-19 pandemic. This presents a dichotomy of emergencies that offers Narayanganj an opportunity to build back, greener and better.

ICLEI South Asia, in partnership with UN Habitat is supporting the NCC in implementation of the Urban Low Emissions Development Strategy (Urban LEDS) Phase II, to transition the city to a low emission, resilient, green, and inclusive urban economy. The Urban LEDS project is being implemented in more than 60 cities in eight countries: Brazil, India, Indonesia, South Africa, Bangladesh, Colombia, Lao PDR and Rwanda. In Bangladesh two model cities, Narayanganj and Rajshahi, and four satellite cities, Singra, Sirajganj, Faridpur and Mongla Port, are a part the Urban LEDS programme. The ClimateResilientCities is the guiding methodology used for the Urban LEDS project cities in planning for Low Emission Development (LED) strategies.

The Climate Resilient City Action Plan (CRCAP) for Narayanganj is a step towards Narayanganj's long term vision of integrating comprehensive and resilient approaches in its development objectives, planning & processes. Haphazard urbanisation, high urban sprawl, increased infrastructure demand, & fast-growing energy demand are contributing to environmental and urban service degradation in Narayanganj. There is an urgent need for decisive actions on urban governance, technology, data and innovation in the city. Narayanganj's CRCAP provides a comprehensive assessment of urban issues, GHG emission from urban activities & services, impacts of climate change on urban infrastructure, and suggests potential strategies and actions to increase urban climate resilience.

Bangladesh's urban population has grown at a yearly average rate of 6%, and the country's urban population has expanded six-fold. In 2017, almost 35% of Bangladesh's 165 million population lived in metropolitan areas

1.3 Methodology

Defining Climate resilience: It is defined as the capacity for a socio-ecological system to: (1) absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and (2) adapt, reorganize, and evolve into more desirable configurations that improve sustainability of the system, leaving it better prepared for future climate change impacts (Folke, 2006). Therefore, planning for urban resilience should take into consideration the activities that release GHGs and propose actions that not only help to reduce the sources of emissions but also help the city to adapt to the challenges of climate change, such as sea level rise, temperature changes, precipitation changes or extreme events.

The Climate Resilient City Action Plan (CRCAP) for Narayanganj has been developed using the ClimateResilientCities Methodology. This Methodology is tailor made for Local Governments, providing step by step guidance for the development of a Climate Resilient City Action Plan that addresses both, climate change adaptation and climate change mitigation. This process is based on the premise that climate resilience refers to both climate change mitigation and adaptation, and linkages therein.

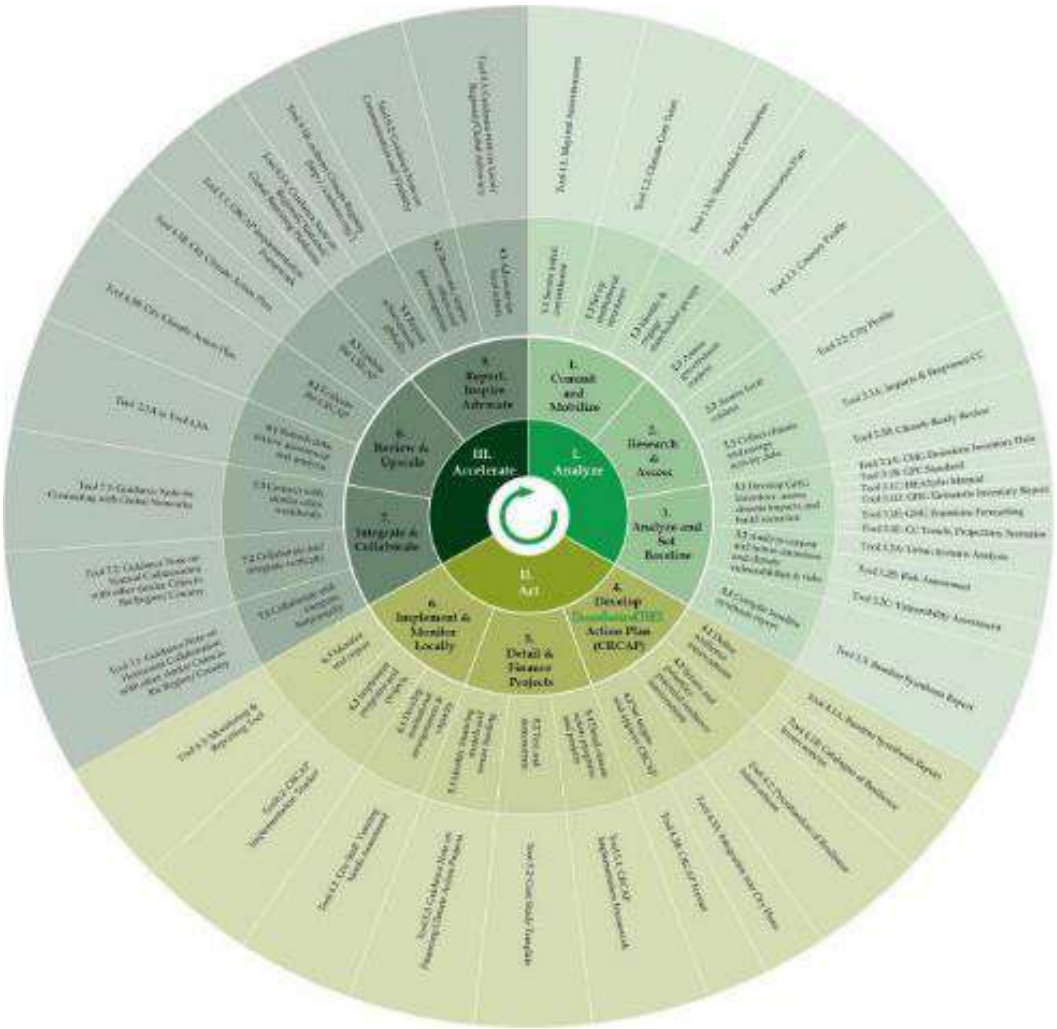
The process equips local governments to estimate the GHG intensity of city activities, assess the climate risks of various systems in the city in the context of urbanization and vulnerability, identify actions to address existing and forecasted climate fragility and develop an implementation and monitoring plan, which will not only help the city to adapt to existing and impending climate change impacts, but will also steer the city's focus to climate change mitigation measures as well.

This process builds on ICLEI's Cities for Climate Protection (CCP) Campaign, ICLEI's flagship mitigation program, the GreenClimateCities (GCC) program and ICLEI's adaptation tool-kit, the ICLEI Asian Cities Climate Change Resilience Network (ACCCRN) Process or IAP toolkit.

1.3.1 Overview of Climate Resilient Cities Methodology

The ClimateResilientCities methodology was followed to develop to the Climate Resilient City Action Plan for Narayanganj. The ClimateResilientCities Action Plan Process is a 9-step process in 3 phases: Analyse Act and Accelerate - each unfolding into three steps - outlining how climate fragility can be assessed and climate resilient options (to achieve low emissions development and climate adaptive development) can be identified and integrated into urban development policies, plans and processes. It consists of a wide range of tools and guidance notes to support Local Governments to deliver effective Local Climate Action. Figure 1 below shows the steps and various tools used in the Methodology.

Figure 1: ClimateResilientCities Methodology



Following section details the different steps undertaken to prepare the 'first' CRCAP for Narayanganj City.

Step: 1 – Commit and mobilize

Narayanganj city further reinforced its commitment to undertake climate action by signing up to the Global Covenant of Mayors (GCoM) in November, 2020

1.1 Secure initial commitment – It is very important to ensure senior political and local government buy-in to kick-start the process for climate resilient development in the community and provide clear leadership. As political, executive and administrative support are required for successful planning and implementation of climate action plans. Narayanganj city confirmed their intent to undertake CRCAP preparation through a signing a MoU. The city further reinforced its commitment to undertake climate action by signing up to the Global Covenant of Mayors (GCoM) on November 19, 2020 (see Annexure 2).

1.2 Set up institutional structures - The city-level Climate Core Committee was formalized and notified by the Narayanganj City Corporation on 9th May, 2019 comprising of 8 nominated officers and officials from various relevant departments of the Corporation, chaired by the Chief Executive Officer (See Annexure 1). The Core Committee was involved in evaluating climate adaptation and vulnerability aspects, developing resilience strategies to address these issues, and help during the implementation of a related pilot project in Narayanganj city. Climate Core Committee was involved in all steps of preparing the CRCAP and supporting internal institutional capacity building to effectively fulfil the long-term climate resilience.

1.3 Identify and engage stakeholder groups - The Climate Action Planning Process requires support from other stakeholders in the city such as parastatal agencies, local NGOs, community leaders, vulnerable group representatives, academia/ universities and private sector organizations, to appropriately share responsibilities and ensure co-ownership. A city-level Stakeholder Committee was formed and notified by the Narayanganj City Corporation on 9th May, 2019, comprising of 32 members chaired by the Chief Executive Officer. The 'Stakeholder's Committee' includes key decision-makers and administrators from Narayanganj City Corporation as well as representatives from RAJUK, Dhaka WASA, Bangladesh Road Transport Authority (BRTA) (Narayanganj), Department of Environment (Narayanganj), Roads and Highways Department, Bangladesh Inland Water Transport Authority, Dhaka Power Distribution Company, Titas Gas Transmission & Distribution Company, and national and international NGOs representative working in the city. This stakeholder group was part of frequent consultations during the preparation & finalisation of GHG inventory, Climate Risk and Vulnerability Assessment & CRCAP along with the Climate Core Committee.

Step: 2 - Research and Assess

2.2 Assess local context - It is very important to assess local policies, on-going projects and economic, social and environmental contexts at the local level, which would impact climate resilient development in the city. Local issues with respect to the environment and urban development (socio-economic status, demography, municipal services, energy consumption (electricity and fuel) within the city limit) are also identified and discussed with Climate Core Committee. A baseline assessment of the urban systems was conducted for assessment of climate change impacts and influences urban development activities, and to identify the kind of support required by the Narayanganj City Corporation to address such impacts. Based on information collected, a city profile was developed for an assessment of climate vulnerable urban systems and carbon intensive activities (See section 2.7)

Step: 3 - Analyse and set baseline

3.1 Develop GHG inventory, assess climate impacts and build scenarios –

- Baseline data (supply and demand-side) was collected for stationary fuel and

electricity consumption by all community and government sectors. It also involved engaging with NCC and other external agencies which have the required information (utilities). City officials and other stakeholders were engaged to validate the data and enhance its robustness to be used for GHG inventory preparation.

- Subsequently, a GHG emissions inventory was developed to determine sources of GHG emissions for the whole community and for Narayanganj City Corporation's operations using the HEAT+ online software tool and internationally accepted methodologies viz. the Global Protocol for Community-scale Emissions (GPC) (See section 3).
- The Community inventory includes emissions from community/city-wide activities within the Narayanganj City Corporation jurisdiction, including emissions from the local government's activities and energy use. This includes emissions from sources and/or activities from stationary units (residential, commercial/institutional facilities, industrial and constructions, agricultural), mobile transportation units, waste. This analysis provided a strong basis to develop technically sound and yet ambitious climate resilience interventions.
- Furthermore, energy consumption forecasting was prepared for medium term (till 2030) and long term (for 2050) planning. Energy consumption from municipal services was forecasted based on population projections, economic and growth assumptions, and municipal service delivery based on existing and future city planning. Based on a forecasting of the energy consumption, the corresponding GHG emissions are calculated.

3.2 Identify fragile urban systems, climate vulnerabilities and risks

Core and secondary urban systems were studied to identify fragile urban systems and to examine the impact of climate change on these fragile urban systems (See section 4). For each fragile urban system, key vulnerable areas (geographical areas) and the vulnerable population for each system were assessed and identified. Both the qualitative information gathered from stakeholder group through SLD and quantitative information from the city was assessed to assess climate vulnerability. Risk & adaptive capacities of the urban systems are also assessed after extensive consultations with the Climate Core Committee and Stakeholder Committee.

Various mitigation and adaptation interventions have been identified for Narayanganj based on GHG emission inventory and urban system analysis in line with existing city planning.

Step: 4 - Develop Climate Resilient Cities Action Plan

4.1 Define resilience interventions

Various mitigation and adaptation interventions have been identified for Narayanganj based on GHG emission inventory and urban system analysis in line with existing city planning. Mitigation and adaptation potential for each intervention along with financial aspect and implementation mode have been identified in line with ongoing projects and future planning of Narayanganj City Corporation (See section 5).

4.2 Screen and prioritize potential resilience interventions

Prioritization of Resilience Interventions has been done based on feasibility and impact assessment.

4.3 Set targets and approve CRCAP

- The resilience interventions have been linked to existing/ongoing/planned initiatives within the city to assess possibilities of leveraging existing funding opportunities to implement the action plan. Targets are set to move towards outcomes under climate action plan, which can relate to GHG "avoidance" or "reduction" and/or achievement of adaptation measures and also to socio-economic indicators.
- A formal Council approval offers an opportunity for political review, recommendations and adoption of the Action Plan.

02
CITY PROFILE

Narayanganj is Bangladesh's most prominent river port. Known as the 'Dundee of East', Narayanganj is the leading economic and industrial hub of the country. The city is famous for its jute mills and textiles. Its strategic location, pro-business environment, and rapid industrialization over the years has attracted both local and foreign investors as well as the migrant workforce from neighbouring districts, which has resulted in the city's rapid urbanization. Most of the industrial units are primarily located on the two banks of the River Shitalakshya and the eastern bank of River Buriganga and provide a number of employment opportunities in the city.

Narayanganj city spans a total area of 72.43 sq. km. Owing to rapid urbanization and industrialization in recent years, Narayanganj city was upgraded to a City Corporation in 2011, unifying three former municipalities namely Narayanganj, Shiddhirganj and Kadamrasul. This process was aimed to better manage the city's urban services and stimulate growth.

2.1 Location

Geologically, Narayanganj city lies on the edge of the Madhupur Tract and the Holocene floodplain deposits from the aquifers. The city is located at 17 km southeast from Capital Dhaka and lies between latitudes 23°33' and 23°57' North and longitudes 90°26' and 90°45' East. Situated on the banks of the River Shitalakshya, beside the confluence of the rivers Shitalakshya and Buriganga, Narayanganj has mixed topography. The present urbanized areas and the levees of the Shitalakshya, the Buriganga, and the Old Brahmaputra rivers are at a comparatively higher elevation as compared to the rest of the city. The city is bound by the Syedpur- Madabpur road to its east, Sonargaon sub-district and Dhaka-Chittagong highway in the north-east, Dhaka district on west and Munshiganj district in the south.

2.2 Connectivity

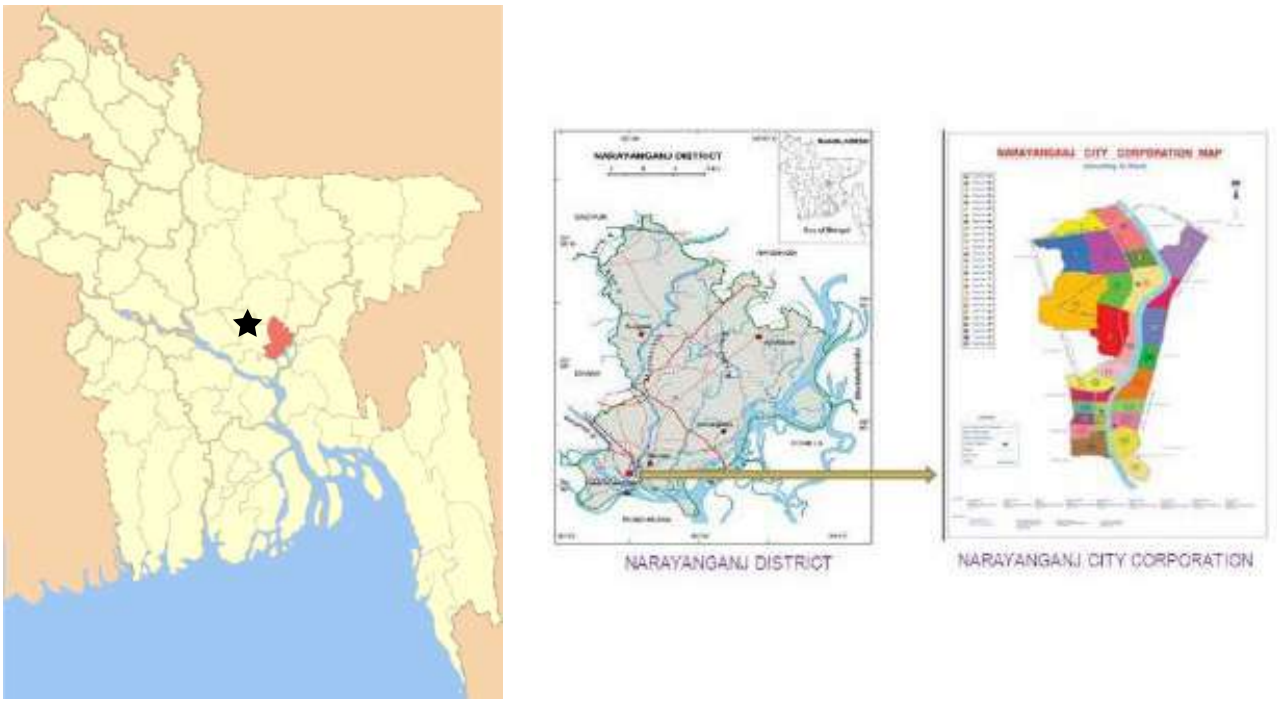
By Air:

There is no airport located in Narayanganj. The nearest Airport is Hazrat Shahjalal International Airport, located 34 km away in the capital Dhaka. The airport operates a number of domestic and international flights every day. The airport is accessible through the Dhaka – Narayanganj Road (R111), which connects Narayanganj and Dhaka through national highway 1.

Railway:

A 17 km meter-gauge track connects Narayanganj Railway Station with Kamalapur Railway Station and extends to Mymensingh district. More than thirty thousand people travel by train every day. To meet the increasing demand, The government has undertaken a plan to construct a 16 km underground Mass Rapid Transit Line -4 from Kamalapur to Narayanganj by 2030.

Figure 2: Location Map of Narayanganj City



Road: Narayanganj is well connected with adjacent cities by National and Regional highways. Being located at the centre of the country, a number of national and regional highways pass through the city. National Highway (N 1) connects Dhaka and Narayanganj with the South-East region. Dhaka – Chattogram Highway (N1) passes through the northern part of the City Corporation area and carry the majority of the motorized traffic to and from the city. Regional Highway R110, that is the Demra – Narayanganj road is connected to the Dhaka – Chattogram highway and is one of the major primary roads that run parallel to the River Shitalakshya. Dhaka – Narayanganj Road (R111) is the spine road that connects NCC with Dhaka through N1.

Within the city limits, the length of the internal road network spans about 609 km. Out of the total road network, the majority of roads are of Cement Concrete (CC) type followed by Roller Compacted Concrete (RCC) and Herring-Bone-Bond (HBB), respectively (see Table 1).

Table 1: Length of Different Types of Roads in Narayanganj City

Road Type	Length (Km)
Roller Compacted Concrete (RCC)	210.51
Cement Concrete (CC)	316.15
Herring-Bone-Bond (HBB)	82.77
Total	**609.43**

(Source: NCC Area Action Plan, 2016)

Waterway: As it is flanked by rivers, Narayanganj is well connected with the port cities of neighbouring Asian countries such as Myanmar (Rangoon and Akyab) and India (Kolkata, Assam, and Kachar), through waterways. This makes it easy for the city to export and import goods and services. The Narayanganj river port is one the oldest and busiest port in the country.

Figure 3: **Road and Rail Network of Narayanganj City**

(Source: NCC Area Action Plan, 2016)

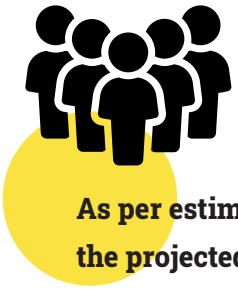
2.3 Demography

The population of Narayanganj city stands at 709,336 as per the Census, 2011, with a population density of 15,021 persons/sq. km. According to BBS 2011, the number of males exceeds that of females with 51.48% of the total population being male (106 males per 100 females). Bengalis and Muslims are the major population groups in the city. According to BBS 2011, 91.19% of the total population follow Islam, while 8.71% of the total population are Hindus. The decadal growth of population in the city has increased from 10.7% in 1961–1974 to 49.9% in 2001–2011 with an annual average growth rate of 4.7%, which is three times higher than the national growth rate of 1.2%. One of the primary reason for the rapid growth in the city population can be attributed to the rapid industrialization which has attracted a large labour force from the adjacent districts. Table 2 shows the population across three major zones of the city (Kadamrasul, Narayanganj, and Siddhirganj) as of 2011. Ward-wise population figures are provided in Annexure 5.

Table 2: Zone-wise and Population of Narayanganj City Corporation, 2011

Zone/Area	Total Population	Male Population	Female Population
Kadamrasul	166,246	84,262	82,029
Narayanganj	286,330	148,214	138,116
Siddirganj	256,760	132,698	110,764
Grand Total	**709,336**	**365,174**	**330,909**

(Source: Bangladesh Bureau of Statistics, 2011)



As per estimates, the projected population of Narayanganj city is expected to be almost 3 million in 2051.

According to the Bangladesh Bureau of Statistics 2011, urbanization rate of Narayanganj was 33.54% against the national urbanization rate of 23.30%. As a result, the population growth rate of Narayanganj has rapidly increased to 3.05% in 2011[1], from 2.16% in 2001. As per the estimates of City Population[2] , the projected population of Narayanganj city is expected to be almost 3 million in 2051.

2.4 Land Use

The rapid industrialization over the years has resulted in urban sprawl in Narayanganj. Urbanization in the city has placed significant pressure on the land and the existing architectural structures and land-use control mechanisms. The city now has a limited portion of land available to initiate new development plans with the majority of land being under residential and mixed-use. Given this situation, the city has recently developed an Area Action Plan (AAP) to develop a new land-use control mechanism.

The land use pattern in the Area Action Plan of NCC has been divided into fifteen broad categories. These categories are administrative, agriculture, commercial, community facilities, education and research, health facilities, industrial, miscellaneous, mixed-use, open space, recreational facilities, residential, restricted, transportation and communication and water body. In terms of land distribution and land-use, around 30.65% of the total city area is used for residential purposes, followed by water bodies which occupy a considerable 23.40% of the land space. Being a historic industrial city, NCC has been subjected to haphazard development, which has resulted in mixed-use of land spaces available in the city. Presently, almost 20% of the land area is used for mixed development. Industries occupy 14% of the area mostly along the River Shitalakshya River, while commercial entities occupy 11.74% of the land space. Government and non-government organizations occupy 4.51% land and open space (mostly vacant land) covers 5.05% of the city's area. Open green spaces are seemingly non-existent in the city, as most of these lands have been gradually utilized for business purposes or encroached by slum-dwellers. This land-use pattern for housing and industries has resulted in the reduction of agricultural activities as well as the social spaces.

1 Ministry of Housing and Public Works, 2014: Social Assessment and Social Management Framework Report
2 http://www.citypopulation.info/php/bangladesh-admin.php?adm1id=67

Figure 4: Land Use Distribution in Narayanganj

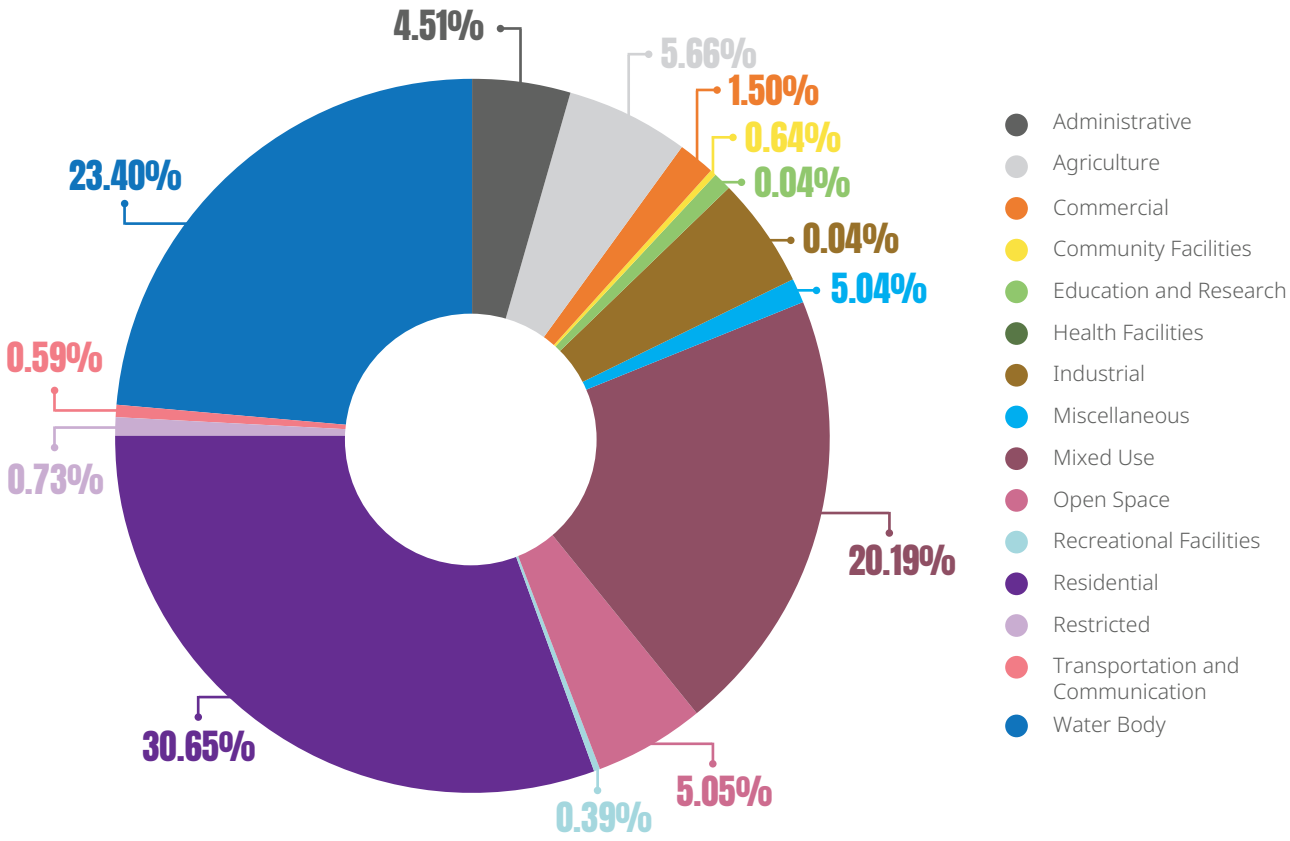
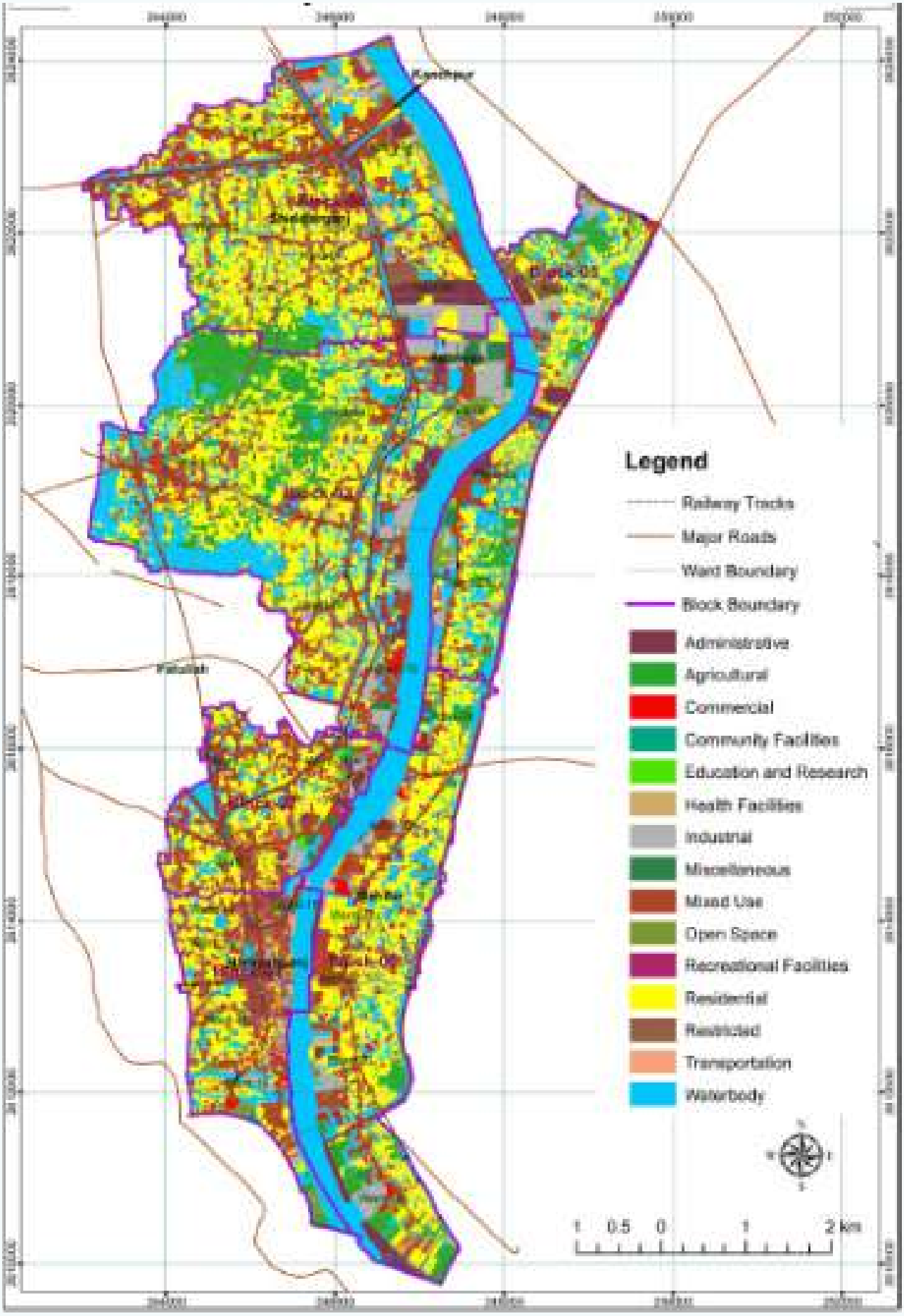


Figure 5: Land Use Pattern of Narayanganj



(Source: NCC Area Action Plan, 2016)

2.5 Economic Activities

Narayanganj is one of the major industrial centres in Bangladesh. The city was once renowned for its jute industries, which declined over the decades. However, around 55% of Bangladesh's total exported knitwear is still produced in Narayanganj. The city houses a number of textile and garment industries, that are labour intensive and thereby generate employment opportunities. The other major trades and businesses include oilseed trade, processing plant, and cement manufacturing. Details of major economic activities and share of the population involved (as of 2013) are highlighted in Table-3.

Table 3: Sector-specific Employment in Narayanganj

Major Economic Activities	Total Person Engaged	Percentage
Manufacturing	536,919	62.3%
Wholesale and Retail Trade, repair of motor vehicles	184,866	21.5%
Other Service Activities	48,162	5.6%
Accommodation and Food Service Activities	31,301	3.6%
Education	17,862	2.1%
Transportation and Storage	10,158	1.2%
Other Economic Activities	32,524	3.8%

(Source: Bangladesh Bureau of Statistics, 2013)

Around 55% of Bangladesh's total exported knitwear is produced in Narayanganj

In 2016, the city had more than three thousand industrial units. These industries are categorized into three board categories namely, Green, Red and Orange based on their impact on the environment (in increasing order of impact from Green to Red). Around 43.37% of the industries were listed under Orange category, which includes dairy farms, food and beverage industries, poultries, grinding and husking mill, handloom mills, garments mills, ship breaking, plastic and rubber industries, manufacturing and printing, automobile repairing works, leather production, salt production, PVC items, brickfield, lime, jute mill etc. About 10% of the industries were listed in Red category. This includes fertilizer industries, chemical industries, cement, oil factory, iron and steel mill, natural gas, tire and tube industry, paper mill etc. The remaining 8.88% were listed under Green category which includes assembling, goods re-packing, jute, cotton and artificial fibre industries etc.

2.6 Local Government Bodies

Narayanganj is administered by two governing bodies, the NCC and Rajdhani Unnayan Kartripakkha (RAJUK). NCC, formed in 2011, administers 27 wards spread over three former municipalities/zones (Narayanganj Sadar, Siddirganj and Kadamrasul), covering a total area of 72.43 sq. km.

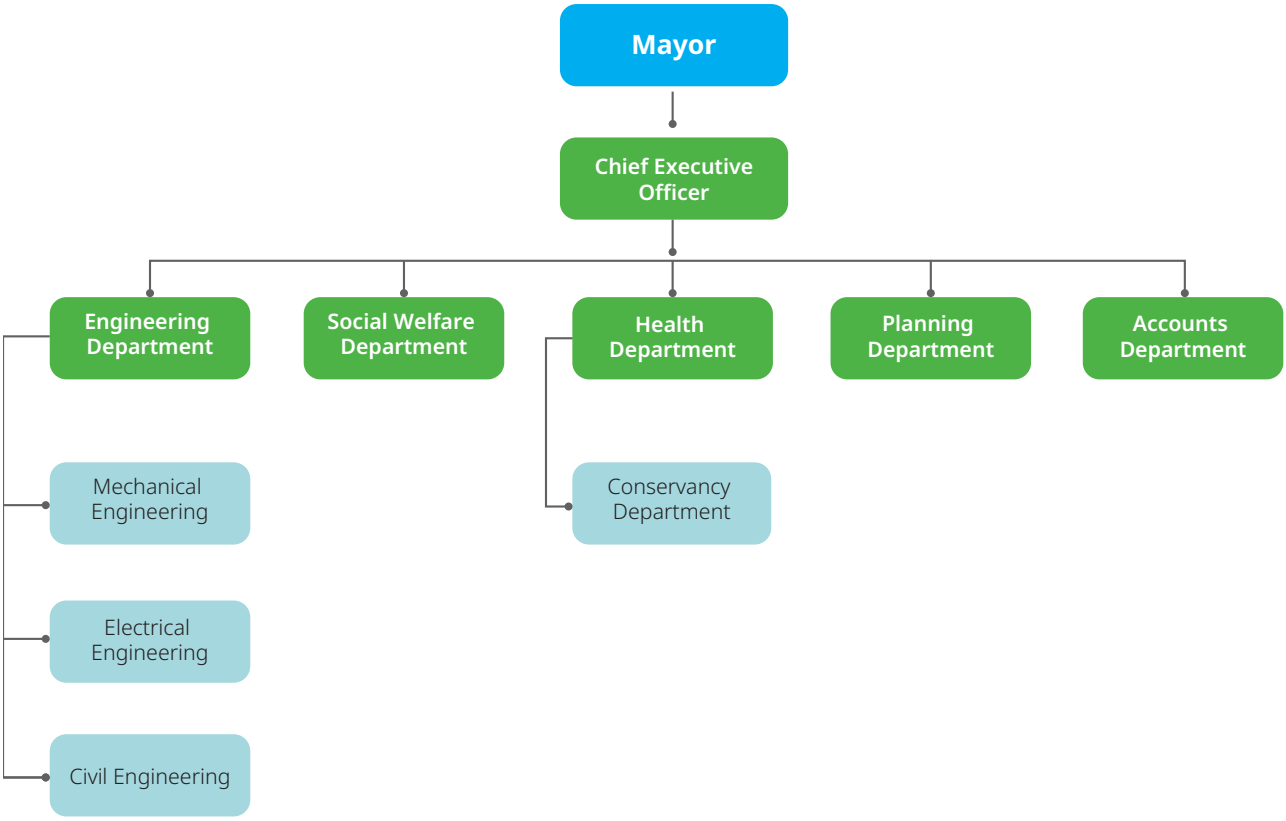
RAJUK administers a total area of 1,528 sq. km consisting of Dhaka City Corporation and areas under 14 metropolitan centres, including Narayanganj, Siddhirganj, Bandar, Kadamrasul, Sonargaon, Fatulla, Araihazar, Keraniganj, Savar, Gazipur and Tongi municipality. Being the metropolitan planning authority, RAJUK is responsible for preparing the Master Plan and development policies addressing spatial planning and urban infrastructure for Narayanganj city.

NCC Council consists of elected members including a Mayor and 27 Councillors. The Council also consists of nine reserved councillors. The Chief Executive Officer (CEO) is the administrative head and is responsible for the functioning of NCC including tax collection, estates maintenance, projects, among other things. The corporation has multiple sector-specific departments that are responsible for day-to-day functioning. The Mayor and Councillors are responsible for all the policy decisions, whereas the administrative

decisions rest with the CEO. The Corporation is chaired by the Mayor and a total of 147 employees work under 6 departments- Engineering (Mechanical Engineering, Electrical Engineering, Civil Engineering), Conservancy, Accounts, Social Welfare, Health and Planning.

The NCC provides and maintains services including water purification and supply, sewage treatment and disposal, garbage disposal and street cleanliness, solid waste management, construction and maintenance of roads and streets, street lighting, maintenance of parks and open spaces, cemeteries and crematoriums, registration of births and deaths, conservation of heritage sites, disease control including immunization, and functioning of NCC owned public schools. The current organogram of NCC is provided in Figure 6.

Figure 6: Organogram of Narayanganj City Corporation



2.7 Major Urban Sectors

It is essential to establish sectoral baselines and assess status of urban services delivery, in order to enable the preparation of a well-informed climate action plan and identify sectoral climate resilience strategies, appropriately contextualized to the local potential and gaps. This overall urban profile assessment involved data collection (service level information for key urban sectors) & consultation with city authorities. The profile gives a practical snapshot of sector performance, including infrastructure and service delivery gap. Apart from infrastructure information, the section also documents and presents sectoral policies, plans, and ongoing & planned projects or initiatives by the city. This urban infrastructure and gap analysis feeds into the GHG emission inventory forecasting and climate vulnerability assessment.

Water Supply

Present Scenario

Water Supply and Treatment

The Dhaka Water Supply and Sewerage Authority (DWASA) was responsible for water treatment and supply in the NCC area until October 31, 2019. The responsibility has now been handed over to the City Corporation with DWASA providing technical and policy support. The existing water supply in the city relies heavily on groundwater, with groundwater tube-wells sourcing about 78% of urban water demand from aquifers[3]. As per available records, thirty-one deep tube-wells were installed by DWASA in the city, of which twenty-two are currently operational. In addition, the DWASA has installed thirty-two street hydrants, eight overhead water tanks, and two surface water treatment plants with a design capacity of 55 MLD[4]. However, the water treatment plants are presently not operating to their full capacity. The Godnail Surface Water Treatment Plant, located on the western bank of River Shitalakshya River, has a design capacity of 45 MLD but is currently treating about 10 to 12 MLD of water, thereby operating at 26% of its design capacity. Similarly, the Sonakada Surface Water Treatment Plant, located on the eastern bank of River Shitalakshya, is only treating about 2 MLD of water.

About half of the city's population is served through a piped water network. The city faces shortage of treated water supply, given the seasonal variations in its surface water resources and water scarcity experienced in non-monsoon months along with water treatment plants operating at sub-optimal capacity. Considering the current scenario, shortage of treated water can be expected to increase with population growth and rising water demand going forward. Total water supplied by Dhaka WASA through the two water treatment plants and tube-wells amounted to around 92.2 MLD water in year 2018-19. Based on a projected population of 891,932 persons in 2018-19, per capita water production is estimated to be about 207 litres per capita per day (lpcd), of which 145 lpcd is estimated to be supplied at the household level, considering physical losses and non-revenue water (about 30%).

NCC has implemented several projects to improve water supply in Narayanganj. When Narayanganj was a municipality, 11 submersible deep tube-wells were set up throughout the city under the Urban Governance and Infrastructure Improvement Project (UGIIP). In recent years, through the financial support from Urban Partnerships for Poverty Reduction Project (UPPRP), NCC has setup another 183 submersible deep tube-wells and six tube-wells at different locations, especially in areas housing low-income population. At present, the NCC maintains these water supply facilities through its municipal budget and spends nearly BDT 20 lakh every year on their maintenance[5].

Over dependency on groundwater from natural aquifers to meet the growing water demand is a concern for the city. Households that are unserved by the piped water network (50%) rely on individual household-level tube-wells to extract groundwater. NCC issues permits for installing household-level tube-wells. However, unregulated installation of tube-wells and groundwater abstraction is prevalent, leading to depletion of groundwater levels and increased health risks. With data on the total number of household-level private tube wells in operation not recorded at present, NCC is in the process of registering such unregulated tube-wells and preparing a database of total tube-wells in the city. Putting in place measures and policy changes for sustainable use of the available water resources hence is crucial and requires immediate attention.

The existing water supply in the city relies heavily on groundwater, with groundwater tube-wells sourcing about 78% of urban water demand from aquifers

3 DWASA Water Supply Master Plan
4 https://www.newagebd.net/article/89429/dwasa-hands-over-narayanganj-supply-to-ncc
5 State of Cities: Re-thinking Urban Governance in Narayanganj; Institute of Governance Studies, BRAC University

Water Distribution

Piped water distribution network exists in the city's Narayanganj Sadar and Kadamrasul zones. Piped water supply in the Siddirganj zone is largely absent, with only ward no. 8 partly connected to the water network. The city's piped water distribution system suffers from ageing infrastructure. At present, water supply coverage stands at about 50%, with about 27,000 holdings/properties are served through the piped network that spans 72 km. To ensure 100% service coverage, Dhaka WASA was planning to develop a 50-year master plan for Narayanganj. However, given that water supply services have been handed over by DWASA to NCC, preparation of this Master Plan is on hold at present.

Illegal water connections and pilferage are also a major concern and impact revenue generation as well as the quality of the supplied water. The extent of non-revenue water (NRW) in the city is reported to be about 30%[6]. The extent of metering of water connections is 100%, while efficiency in collection of water charges is about 81% with a net revenue collection of BDT 72.7 million in 2018-19.

Table 4: Service Level Information – Water Supply

Indicator	Status
Coverage of water supply connections	49.98%
Per capita supply	145 lpcd (estimated)
Existing Water Supply	92.2 MLD
Extent of Metering of Water Connection	100%
Efficiency in collection of water supply - related charges	81.05

Issues Identified

Service Coverage:

Only half of the total households are connected to the water supply system. Ensuring water supply to all the residents requires additional infrastructure in terms of water treatment plants, water pumps and distribution network. The city's water supply system is vulnerable to decreasing rainfall, which will likely curtail the groundwater levels and also impact surface water resources.

Water Pollution:

Most of the surface water sources are highly polluted by the untreated industrial effluents, which has also contaminated ground water. Water is supplied by treating highly polluted water from the River Shitalakshya. Given the pollution in the surface water sources, many households use water supplied through piped network for non-drinking purposes. Flooding occurs during high intensity rainfall and results in contamination of water supply, thereby leading to risks of severe health issues.

Depleting groundwater resources:

High dependency on groundwater, with residents relying largely on tube-wells for drinking water. Indiscriminate withdrawal of water through deep tube-wells has reduced the groundwater level. Impervious surfaces have increased significantly, thereby inhibiting ground water recharge.

6 The World Bank (2014): Benchmarking to Improve Urban Water Supply Delivery in Bangladesh. https://www.ib-net.org/docs/Bangladesh_Report.pdf#https://www.ib-net.org/docs/Bangladesh_Report.pdf

Stipulated Projects

- UNDP is providing and installing deep tube-wells in low-income communities under the Livelihood Improvement of Urban Poor Communities Project (LIUPCP), which extends from 2018 to 2023.
- The ADB is supporting NCC in water supply improvements under the Urban Infrastructure Improvement Preparatory Facility project, through two phases:
  - Phase I (2019-2022): Conduct of technical feasibility study to identify the existing water demand, network design and appropriate water tariff and judicious use of water, with a budget of BDT 718 Million
  - Phase II (2022 onwards): Implementation (including operation and maintenance activities) based on technical feasibility and assessments in phase I, with a budget of BDT 8,500 Million

Solid Waste

Present Scenario

Solid Waste Generation

The conservancy department of NCC is responsible for collecting, transporting and managing the city's municipal solid waste (MSW). Being an industrial town, significant quantum of industrial waste is also generated within the city. The daily average solid waste generation in the city is estimated to be around 400 tonnes per day (TPD) in 2018-19, out of which 350 TPD of waste is collected from secondary waste transfer stations. MSW generation has shown a consistent rise since 2013-14 see (Annexure 5, Table 32).

According to NCC, the residential, commercial and industrial sectors contribute to about 70%, 20% and 10% of total waste collected. Narayanganj's MSW primarily consists of food, vegetables, polythene, paper, wood and textiles. Among these, food and vegetable waste are the major components (around 74%), followed by paper and industrial wastes.

According to NCC, the residential, commercial and industrial sectors contribute to about 70%, 20% and 10% of total waste collected. Narayanganj's MSW primarily consists of food, vegetables, polythene, paper, wood and textiles

Solid Waste Collection and Disposal

Waste collection in Narayanganj is undertaken in two ways:

1. **Public-private partnership:** Some NGOs like BRAC support NCC for collection and transportation of domestic MSW from some wards including ward nos. 1, 11, 14, 15, 16 and 17. Medical waste is collected, transported and managed separately by Prism Bangladesh.

2. **By NCC:** NCC has established secondary waste transfer stations across the city's wards . The collected MSW is initially transferred to these stations and then transported to the dumping sites. The Conservancy department of NCC employs over 185 vehicles for the collection and transportation of household, commercial and industrial wastes from transfer stations to the dumping sites.

At present, the waste collection efficiency in NCC is around 87.5 percent. NCC achieved collection coverage in 25 of the city's 27 wards, as of early 2020. However, some households still do not have access to the formal waste management system. Door-to-door collection is still absent in some wards, while in a few wards even primary MSW collection systems are unavailable and dwellers in these areas dump waste directly into the ponds or canals[7]. A separate organized collection mechanism for medical and industrial wastes is lacking.

7 STATE OF CITIES: Re-thinking Urban Governance in Narayanganj.

The waste collected from the transfer stations is transported to dumping. At present, most of the MSW collected is transported for dumping at three existing open dumpsites, located in wards 6 & 19 and at Saidpur. Two new waste disposal sites are being developed at Pancahabati and Jalkuri. The existing dumpsites are shallow and wet and lack adequate systems for scientific disposal and appropriate maintenance. Uncollected MSW is left unattended or is dumped along riverside/canals. The absence of adequate facilities and systems for scientific processing, treatment and disposal of MSW has resulted in environmental impacts on land and groundwater, posing health risks to the community.

NCC has commenced a project to construct a waste to energy plant of 500 TPD to address the absence of MSW processing and treatment facilities

Solid Waste Treatment

An anaerobic composting facility has been established at Panchabati for organic waste treatment. The plant has been constructed by Department of Environment (DoE) and is currently being managed by Megha Organic Bangladesh Ltd. The plant has a design capacity to compost 35 TPD of organic waste. Currently, about 20 tonnes of organic waste is composted into fertilizer every day at this composting site. NCC is also planning to produce fuel from plastic wastes , with studies successfully conducted on this technology at the Panchabati site.

NCC has commenced a project to construct a waste to energy plant of 500 TPD to address the absence of MSW processing and treatment facilities. This project, which will generate power from incineration of MSW, is being implemented with the support of Power Development Board (PDB) through a public private partnership (PPP) model.

Table 5: Service Level Information – Solid Waste

Indicator	Status
Coverage of solid waste collection	87.5%
Scientific disposal of through treatment plants	0%
Extent of segregation of municipal solid waste	0%
Waste Collection Vehicles	185

Issues Identified

Waste Collection

Although NCC has made notable strides in expanding coverage of door-to-door collection of waste, approximately 10-15 per cent of the total generated waste is still not collected. Uncollected waste is dumped in open drains, open spaces, local ponds, canals and rivers. This blocks the drains and leads to waterlogging and flooding during monsoons.

Waste Segregation

Household-level waste segregation is still not practised in the city. This poses challenges in utilizing MSW in treatment and processing facilities such as composting and waste to energy plants. The city thus needs to adopt and implement a city-wide waste segregation strategy, in line with the national 3R strategy.

Public Awareness

Studies show that a significant number of citizens and slum-dwellers dump waste in drains and local water bodies, which has resulted in environmental pollution and health risks. Hence, awareness generation regarding the proper disposal of solid waste should be a priority for the city.

Stipulated Projects

- PDB has signed an MoU with NCC to utilize 500 metric tonnes of MSW to produce electricity, with implementation taking place through PPP mode (Build, Own, Operate basis). The total approved cost is BDT 345,913 million (through GOB funds) including a) Landfill and preparation b) purchasing electricity from the contracted company (budget of BDT 16,654 million). The contracted company will invest capital and implement the project, and generate revenue by selling the electricity to PDB
- Preparation of a MSW Action Plan has commenced recently. The Plan is expected to be completed by mid-2022.

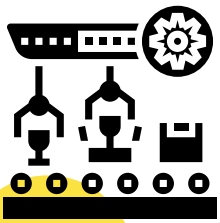
Wastewater and Sanitation

Present Scenario

Wastewater System

NCC is currently responsible for management of wastewater, having taken over the responsibility from Dhaka WASA in end-November 2019. At present, Narayanganj lacks a centralized sewerage system. Thus, the majority of citizens use on-site sanitation technologies. A centralized domestic wastewater treatment facilities are also absent. Thereby, almost two-thirds of the generated wastewater is directly discharged into local water bodies and rivers, through natural drains and canals, without the required primary treatment. This has resulted in serious environmental and health risks.

There is no recorded information on the amount of wastewater generated in the city. Based on the city's water supply consumption, wastewater generation is estimated to stand at about 51.6 MLD in 2018-19. Studies show that almost 80% of industries in Dhaka-Narayanganj-Demra (DND) area do not have necessary effluent treatment plants in place. Textile and dyeing industries are the major effluent generators, as they use a large volumes of water in their operations. Being a textile hub, Narayanganj generates a large number of effluents and sewage sludge every day, which are discharged into surrounding channels, agricultural fields, irrigation channels, surface water and river bodies without any treatment[8]. As a result, surface water in Narayanganj is highly polluted. The BOD values of the effluents vary from 415 to 770 mg/L and the average value is 574 mg/L, which is 14 to 18 times higher than DoE's environmental standard. The COD values of the effluents vary from 860 to 1560 mg/L and the average value was found 815 mg/L, which is around 4 to 9 times higher than the DoE standard[9].



Studies show that almost 80% of industries in Dhaka-Narayanganj-Demra (DND) area do not have necessary effluent treatment plants in place. Textile and dyeing industries are the major effluent generators, as they use a large volume of water in their operations

Sanitation

Most of the households in the city use in-situ septic or fully lined tanks (90%), and around 10% use toilets connected to lined tanks or pits. Out of the households that use septic tanks, 45% of the septic tanks are connected to open drain or storm sewer, 15% of the septic tanks are connected to soak pits located in areas of low risk of groundwater pollution, and 15% of the septic tanks are connected to an unknown discharge point. Most of the households rely on lined tanks or pits, and discharge directly to the drain[10].

8 City profile: Narayanganj, Bangladesh. Abu Hanifa Md. Noman, Md Aslam Mia, Hasanul Banna, Md. Sohel Rana, A.S.A. Ferdous Alam, Chan Sok Gee, Che Ruhana Isa, A.C. Er. Available at: https://www.researchgate.net/publication/303551141_City_profile_Narayanganj_Bangladesh

9 Impact of the Effluents of Textile Dyeing Industries on the Surface Water Quality inside D.N.D Embankment, Narayanganj; Mahfuza S. Sultana et al.

10 WaterAid Bangladesh (2018): SLD Lite Report - Narayanganj, Table 1 and page 3. Available at https://www.susana.org/_resources/documents/default/3-3562-7-1552914540.pdf

Table 6: Service Level Information – Wastewater

Indicator	Status
Waste Water Generation	51.6 MLD
Coverage of sewerage network and collection	0%
Treatment capacity (wastewater)	0%

Issues Identified

- Absence of a centralized sewerage system is resulting in the direct discharge of domestic and industrial effluents into the surface water sources, with 90% of households reliant on septic tanks.
- The city is experiencing frequent waterlogging due to encroachment and narrowing down of the canals, and obstruction in surface runoff. Drainage network needs to be refurbished and augmented.
- Direct untreated discharge from industries and domestic sewage sludge slurry is exacerbating water pollution in surface water resources such as River Shitalakshya and Baburail Canal.

Stipulated Projects

- UNDP is providing and installing septic tanks for low-income communities under the Livelihood Improvement of Urban Poor Communities Project (LIUPCP).

At present, a brick drainage system of 206.5 km in length exists in the city. The Baburail Canal is the primary natural drainage system for stormwater runoff and wastewater discharge in the city

Storm Water Drainage

Present Scenario

NCC is responsible for the construction and maintenance of storm drains. Narayanganj's storm drainage system comprises of open street-side drains, piped network, canals and ponds. The drainage system is gravity-based, hence there are no pumps and sluice gates installed for facilitating water flow through the channels[11]. At present, a brick drainage brick drainage system of 206.5 km in length exists in the city. The Baburail Canal is the primary natural drainage system for stormwater runoff and wastewater discharge in the city. A railway line/track and Bangabandhu road divides the Baburail Canal into two sections. The Canal is connected to River Shitalakshya on the east side and the River Dhaleswari on the west side. Currently, the western side of the Canal lies disconnected from the River Shitalakshya River due to disposal of soil and landfilling, and the eastern side has been gradually encroached upon and narrowed down to a drain[12]. This has resulted in frequent incidences of water-logging and urban flooding in recent times.

Issues Identified

- The existing drainage network is inadequate and needs to be refurbished and augmented.
- Encroachment and disposal of solid waste has led to narrowing of drainage channels and obstruction in surface runoff, thereby reducing carrying capacity. This is resulting in increased vulnerability to increased and/or high intensity rainfall, with waterlogging experience at many locations during monsoons.

11 Urban Flooding of Greater Dhaka in a Changing Climate: Building Local resilience to Disaster Risk. World Bank Group.
12 Municipal Governance and Services Project (MGSP), World Bank

Stipulated Projects

- JICA is implementing City Governance Project (CGP) with an objective of constructing 38 km of additional stormwater drainage network.
- Drainage Master Plan is being prepared for Narayanganj with the support from ADB under Urban Infrastructure Improvement Preparatory Facility (TAPP project) (2019-2022)

Transport

Present Scenario

NCC is responsible for construction and management of transport infrastructure and systems in the city. NCC undertakes construction and maintenance of roads, bridges and culverts in Narayanganj, working closely with the Govt. of Bangladesh's Local Government Engineering Department (LGED). Vehicle registration falls under the purview of Bangladesh Road Transport Authority (BRTA). Bangladesh Railway operates and manages rail transportation and Bangladesh Inland and Water Transport Authority (BIWTA) is responsible for monitoring water transport across the rivers.

Motorized Vehicles: The city's registered vehicle population amounts to a relatively low number (7,997 in total). However, a much larger number of vehicles ply on the city roads, most of which are registered in the neighbouring capital city of Dhaka. There is no public transit system within the city and people are dependent on cycle rickshaws, auto-rickshaws, and CNG three-wheelers. While auto-rickshaws are a popular transport mode for short distance trips, the unregistered rickshaws are almost three or four times higher than the registered rickshaws and are responsible for traffic congestion.

Being an industrial centre, a large number of freight vehicles and trucks move through Narayanganj. While the number of freight vehicles using the city's roads are not recorded, NCC states that these trucks lead to significant pressure on and damage to the road infrastructure. In addition to the private vehicles, NCC owns a fleet of 46 vehicles that are used for delivery of urban and administrative services.

Table 7: Registered Vehicle Population in Narayanganj City

Freight Vehicle	69
Passenger Vehicle	6,450
Two Wheeler	1,051
Tractor	340
Service Vehicle	87
Total	7,997

Non-Motorized Vehicles: Non-motorized vehicles also play a significant role in Narayanganj. Studies show that approximately 19,000 trips are generated by non-motorized vehicles (cycle-rickshaws) every day, to and from the city's main rail junction, serving around 30,000 passengers.

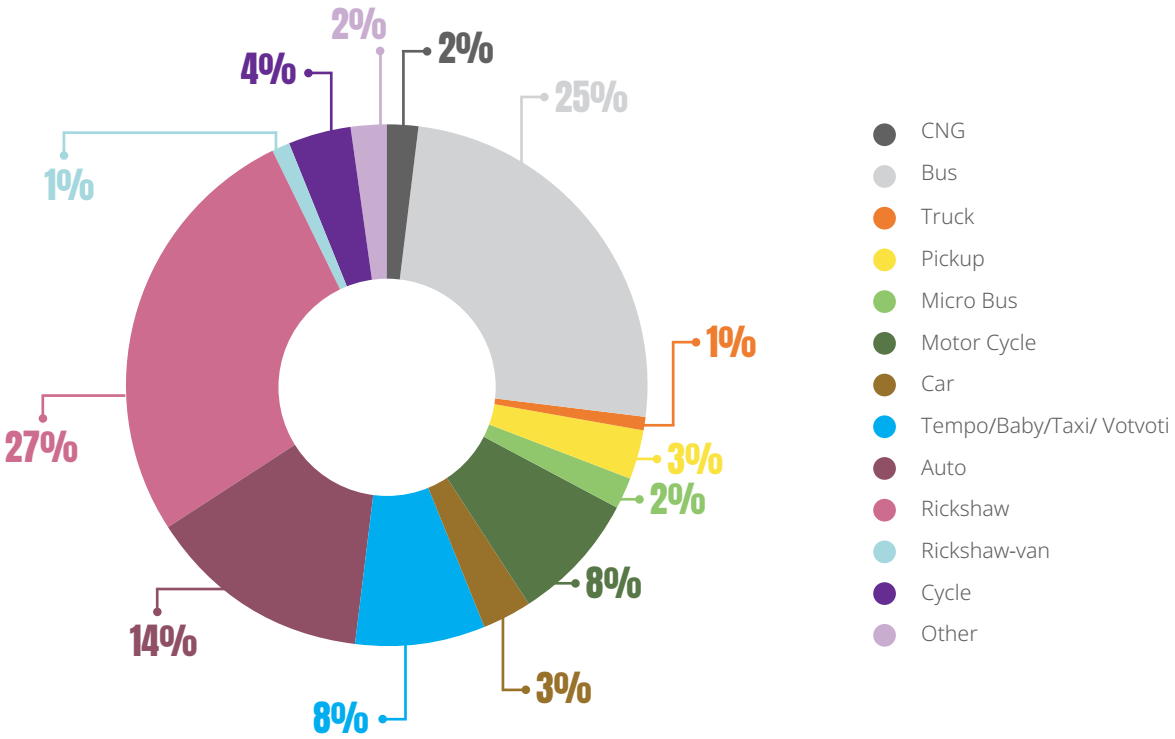
Bus Services: A public bus system is not present in the city. Private buses play an important role in transit of commuters and passengers in Narayanganj. Most of these buses commute between Narayanganj and Dhaka. At present, there are seven private bus operators and one government-owned operator in Narayanganj. According to the Dhaka

The city's registered vehicle population amounts to a relatively low number (7,997 in total). However, a much larger number of vehicles ply on the city roads, most of which are registered in the neighbouring capital city of Dhaka

Transport Coordination Authority (DTCA), five of the private operators have 205 buses in total and undertake about 1,025 trips per day to and from Narayanganj and play more than 30,000 passengers.

Mode of Travel and Travel purpose: A Traffic and Transportation survey carried out in 2016 showed that cycle rickshaw is the most prevalent mode of transport, with around 27 percent of citizens using these as their primary mode of travel. Motorized intermediate public transport options such as auto-rickshaw and shared vehicles (votvoti, taxi) account for over 20% of the city's mode share. Buses contribute to 25% of modal share but also mostly cater to inter-district travel and thereby to trips undertaken beyond the city limits. Two-wheelers and private cars account for 8% and 3% of the mode share respectively. In 2016, it was observed that almost 54% of citizens undertake travel on a daily basis for different purposes. About 78% of the trips are generated within Narayanganj city, and nearly 20% trips are generated for outside the Narayanganj city area.

Figure 7: Travel Mode Share in Narayanganj



(Source: Traffic and Transportation Survey, 2016)

Parking facilities: Designated parking facilities and areas are absent in the city, leading to citizens parking their vehicles on the roads which results in the reduction of carriageway's width and adding to traffic congestion. There are about more than fifty shopping complexes that have no parking facilities.

Waterways: Two major rivers, Shitalakshya and Buriganga, play a significant role in freight transport to and from Narayanganj. Raw materials as well finished/manufactured products from apparel industries are transported from the seaports to other cities through these rivers. River Shitalakshya also plays an important role in public transport, with boats predominantly used for transportation between the Bandar and Narayanganj areas, located on the eastern and western banks of the river, in the absence of direct road connectivity between these two areas. As a result, approximately 200,000 people use the engine-powered boats for travelling between the two areas daily.

Issues Identified

- The city lacks a public transport system and thereby relies on private vehicles and intermediate public transport modes. There is a need to introduce public transport between Netaiganj and the DC office as well as on Chittagong road and Panchabati, as these routes attract the majority of the city's traffic.
- Travel demand and trip generation is increasing considerably with the rising population. Capacity and width of existing road infrastructure is limited to accommodate this resulting additional traffic.
- A detailed city-scale transportation study and mobility plan to improve the transport system and integrate low carbon mobility options is absent at present .
- Motorized and non-motorized vehicles use the same roads and lead to traffic congestion. In the absence of public transport, high volume of motorized vehicles leads to traffic congestion at locations such as Chasara and Kachpur intersections during peak hours. Non-motorized transport such as rickshaw, van and push carts are prevalent at locations such as rail gate no 1 & 2 and Chasara intersection, leading to congestion.
- There is a need to address freight vehicles in the transport planning and management, given the significant freight movement within the city and its fringe areas.
- Road conditions and infrastructure not designed to enable efficient NMT and bicycling. Bicycle lanes are absent. Pedestrian ways are not separated from motorways, threatening the safety of the pedestrians.
- As Narayanganj is situated on the banks of the River Shitalakshya, the overall socio-economic conditions of the area are significantly influenced by the prospective use of waterways. Unplanned and undeveloped use of waterways has adversely impacted the water transport services. There is no road connectivity between Bandar and Narayanganj areas (eastern and western parts across the river). Engine powered boats are prevalent between these two parts. These boats are leading to pollution in the River Shitalakshya.

In the absence of public transport, high volume of motorized vehicles leads to traffic congestion at locations such as Chasara and Kachpur intersections during peak hours.

Stipulated Projects

- Conduct and preparation of comprehensive Transportation Study and Plan by Dhaka Transport Coordination Authority (DTCA) has been approved and is planned.
- Government of Bangladesh (GoB) is constructing a bridge over the River Shitalakshya, with a length of 1309 m and 2.13 km approach road, to connect the Bandar and Narayanganj areas that are located across the eastern and western river banks.
- JICA is constructing a 26 km road and 7 bridges and culverts under City Governance Project (CGP).
- GoB has initiated a project to upgrade the Dhaka – Narayanganj railway line to dual-gauge[13].
- To meet the increasing traffic demand, construction of a 16 km underground Mass Rapid Transit Line -4 from Kamalapur to Narayanganj by 2030[14] is planned.
- Preliminary stage planning is underway for a mass-transit system, with a Light Rapid Transport (LRT) of 10 km length and 20 stations to transport 130,000 passengers being explored.
- Initial stage studies are underway to introduce Electric train service in the city with 23 km service line through two separate routes[15].

13 http://m.theindependentbd.com/printversion/details/198995
14 The New Age: http://www.newagebd.net/article/63179/16-km-kamalapur-narayanganj-underground-train-by-2030
15 https://www.thedailystar.net/business/news/narayanganj-get-electric-train-service-1663513

Building, Energy and Urban Green Spaces

Present Scenario

Buildings Sector

Urban Planning is the city is overseen by RAJUK and NCC jointly. NCC is in charge of granting approvals and permissions for new buildings and development. The city's building stock has grown significantly in the last decade, especially post 2011 when NCC was upgraded to a municipal corporation. As of 2011, there were 54,012 residential buildings in Narayanganj which occupied 40.7% of total land space. Commercial and industrial areas occupied 11.74% and 14% of the total land area respectively in 2011[16]. In 2016, the residential buildings nearly doubled with 103,811 residential holdings in the city[17]. This is mainly due to expansion in the city area after Narayanganj was upgraded to a city corporation from a municipality.

As of 2011, there were 54,012 residential buildings in Narayanganj which occupied 40.7% of total land space. Commercial and industrial areas occupied 11.74% and of the total land area respectively in 2011.

Being an industrial town Narayanganj houses 2,180 light, 355 medium and 67 large industries within the city boundary. Most of the large and medium industries are located in wards 4, 5, 6, 8, and 10. According to the Area Action Plan of NCC, despite such an increase in the number of residential and industrial properties, their land use percentage has decreased, with residential sector occupying 30.6% of land space and industrial sector occupying a mere 5% of land space. This trend can be attributed to the increase in mixed-use establishments in the city, which now occupy 20% of the land space27. Only 23.7% of the buildings in NCC have permanent (or pucca) structures (RCC and brick), whereas 36.8% are partially permanent (semi-pucca; Brick with tin roof) and 39.5% buildings are temporary (tin and indigenous materials)27. Narayanganj has experienced haphazard urban development in recent years, with existing land-use control mechanisms unable to regulate this development pattern.

Electricity

Dhaka Power Distribution Company Limited (DPDC) and Rural Electrification Board (REB) are the power distribution utilities responsible for delivery of electricity supply within the city. DPDC is responsible for electricity supply in Siddirganj and Narayanganj areas, whereas REB is responsible for electricity supply in Kadamrasul area.

The city's total electricity consumption in 2018-19 amounted to 951 million kWh. The main consumer of grid electricity was the industrial sector with a share of about 48.5% in city-wide consumption. Residential buildings accounted for 39% of the electricity, with commercial and institutional buildings & facilities using 12.5% of the city's electricity. About 98.73% of households within the city corporation area have electricity connections. Unauthorized electricity connections are observed in unregulated slums situated on public lands, as they do not have legal rights to apply for electricity connection.

Street Lighting

Streetlight operation and maintenance is managed by the NCC. As of 2020, streetlighting coverage spanned to about 89 km of road length. As per the latest information available in 2020, there are about 7,306 operational streetlights in total within the city. Of these, 1,217 are fluorescent tube lights (FTL), 1,475 are compact fluorescent lamps (CFL) and 4,614 are light emitting diode (LED) lights[18]. The total annual electricity consumption for public streetlighting stood at around 1.5 million units in 2018-19, translating to an annual electricity bill of BDT 14.5 million[19]. Areas away from the city centre and near the periphery do not have streetlights at present. NCC is expanding streetlight coverage, with LED streetlights being installed in unserved areas.

16 Bangladesh Bureau of Statistics, 2011
17 Narayanganj City Corporation Action Area Plan 2016
18 As per the information received from NCC.
19 As per the information received from NCC.

Urban Green Spaces

The haphazard industrial development and urban sprawl in Narayanganj have affected the availability of open green spaces. Open green spaces are seemingly non-existent in the city, as most of these lands have been gradually transformed into profitable business set-ups or have been gradually encroached by slum-dwellers[20]. At present, the city only has two parks and open spaces along with 13 playgrounds. The Baburail canal restoration and beautification project, completed in 2020, helped to establish additional recreational space near the canal.

Issues Identified

- Electricity consumption is rising rapidly in residential and commercial buildings. However, there is a lack of awareness on technology and benefits of energy efficiency and renewable energy measures that can help address rising energy demand.
- Adoption of green and sustainable building design and construction practices is absent in new buildings. The building bye-laws and local policies do not promote uptake of renewable energy and energy efficiency.
- Energy efficiency equipment ecosystem and market is not fully matured, with availability, distribution networks and local capacity for the same highly limited locally.
- Streetlight coverage is lacking in a number of areas, especially in areas away from the city centre or core and nearer to the periphery. While LED streetlights are being installed in a few uncovered areas, long-term agreements with vendors of LED lamps for post-installation operation and maintenance are absent. The existing street lighting infrastructure needs to properly designed and upgraded to provide the requisite levels of illumination and service in line with national public lighting standards.
- Extent of open green spaces in the city is very low considering the city's population. Most open spaces have been encroached and utilized for commercial development and low-income settlements.

The haphazard industrial development and urban sprawl in Narayanganj have affected the availability of open green spaces.

Stipulated Projects

- Both DPDC and REB plan to transmit all the existing and future power distribution lines through underground T&D network.
- NCC plans to expand streetlight coverage throughout the city, with use of LED streetlights prioritized in such infrastructure expansion.

20 NCC Area Action Plan 2016.

03

BASELINE GHG EMISSION INVENTORY

Narayanganj's baseline inventory has been prepared based on energy consumption and municipal operation data for the period 2014-15 to 2018-19. The GHG emissions inventory has been prepared following the Global Protocol for Community Scale GHG Emissions (GPC) created collaboratively by World Resources Institute (WRI), C40 Cities Climate Leadership Group and ICLEI - Local Governments for Sustainability. In particular, it complies with the BASIC level reporting which covers Scope 1 and Scope 2 emissions from stationery and transportation energy sources, as well as Scope 1 and Scope 3 emissions from waste.

The GHG emissions inventory consists of two analyses, one for the emissions within the community determined by the geographical boundaries of the city's municipal jurisdiction and the other for urban services provided by the NCC.

1

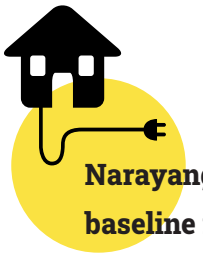
Community level inventory

is a useful tool to establish baseline status of GHG emissions and develop mitigation actions for the entire city community. It includes emissions from community activities that occur within the municipal government's jurisdiction, which includes emissions due to activities in residential buildings, commercial/institutional facilities, industrial units and processes, agriculture, forestry and land use, and mobile transportation units.

2

Local Government inventory

includes emissions from all local operations that NCC owns or controls. The various energy end-uses and emission sources considered for this inventory include municipal buildings and facilities such as street lighting, traffic lighting, water, waste, sewerage and municipal vehicle fleet. Based on the inventory data for the baseline year, the municipal government can develop innovative approaches to provide sustainable urban services and can demonstrate leadership in pursuing emission mitigation efforts that illustrate the possibilities of different mitigation actions to the community.



Narayanganj's baseline inventory has been prepared based on energy consumption and municipal operation data for the period 2014-15 to 2018-19.

A city's GHG inventory is not the sum of GHG emissions from its community level activities and operations carried out by the local government to provide basic urban services. Usually, a major part of the emissions due to the municipal government's operations is a subset of the community level emissions. Often the community inventory data already accounts for the data pertaining to municipal government operations. Due care should be taken to avoid double accounting of emissions. For example, the electricity consumption in municipal facilities for water supply, sewage treatment, and street lighting may already be accounted in the community-wide electricity consumption data based on relevant customer/end-user categories as prescribed under the electricity distribution and tariff arrangements. Adding the electricity consumption data from such facilities, obtained from the respective departments within the city government, to the community-wide data again will result in double accounting of the emissions. Such overlaps can be prevented through careful handling of data.

However, it is necessary to acknowledge that analysing community-level emissions presents its own challenges as the natural flow of energy and materials is typically most accurate at the national level. Reducing the spatial area of analysis, from national to sub-national and local levels, results in a less accurate reflection of the material and energy flows. Community level GHG emissions accounting requires a combination of national and local area information to model the emissions. This report identifies the main energy carriers and the intensive GHG emitting sectors that contribute to the local carbon footprint and air pollution within the geographical boundary of NCC.

3.1 Methodology for GHG Emissions Inventory

The GHGs considered in the GHG emission inventory are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), gases which account for nearly 99% of global GHG emissions.

The GHG emissions inventory has been reported in terms of emissions of each individual GHG and the total carbon dioxide equivalent (CO_2e) emission. To arrive at the CO_2e, the global warming potential (GWP) of each gas for a 100-year timeline is factored. The GWP reflects the climate change impact, in terms of the warming effect on the atmosphere, for each GHG with reference to CO_2. The GWP values based on the IPCC's Fourth Assessment Report (2007) are presented in the table below.

Table 8: 100-Year GWPs of the GHGs with respect to CO_2

Gas	Lifetime (years)	GWP for 100 years
CH_4	12	25
N_2O	114	298

The GHGs considered in the GHG emissions inventory are carbon dioxide (CO_2), methane (CH_4) and nitrogen oxide (N_2O), gases that account for nearly 99% of global GHG emissions.

To arrive at the CO_2e, the global warming potential (GWP) of each gas for a 100- year timeline is factored.

Emissions Factors

For estimating the GHG emissions from the various activities or sources in a region, it is not feasible to carry out a direct physical measurement of GHGs emitted. The common methodology for estimating GHG emissions is by using the principle of emission factor and the relevant activity data to estimate the emissions.

$$GHG_A = EF_A \times D_A$$

Where,

GHG_A = GHG emissions resulting from activity A

EF_A = emission factor for activity A

D_A = data for activity A

The emission factor for a particular activity is dependent on the energy use and the direct emissions of GHGs resulting from the activity. As the emission factors are dependent on the energy use and the direct GHG emissions, they tend to vary over locations or even for different technologies. For example, the emission factor per kWh of electricity used would vary over countries or regions due to the varying energy mix, characteristics of fuel used and the efficiency of electricity generation. The emission factor per km travelled would vary depending on the fuel characteristics, the engine characteristics for the vehicle, the driving and traffic patterns prevalent. For accurately estimating a GHG emissions inventory, it is important to use the emission factor best suited to the location.

For this particular exercise, relevant emission factors as available in HEAT+ tool have been used to arrive at GHG emissions from activities in the region. HEAT+ contains numerous country specific emission factors and energy densities for a wide range of fuels, combustion technologies and waste types. HEAT+ uses these values to calculate the GHG emissions resulting from electricity usage, fuel consumption and waste decomposition.

3.1.1 Harmonized Emission Analysis Tool plus (HEAT+)

ICLEI's Harmonized Emission Analysis Tool plus (HEAT+) is an online emissions accounting software package that helps local governments to account for GHG emissions and develop a comprehensive energy and carbon inventory of their respective cities. The tool helps them in making informed climate action decisions and was used to assist with the accounting of Narayanganj's GHG emissions inventory. The HEAT+ tool incorporates

the latest technical findings (IPCC, 2006) and incorporates international reporting requirements and standards outlined in the GPC. HEAT+ is GPC compliant, and also includes a local government module to reflect GHG emissions limited to municipal operations.

HEAT+ helps Local Governments to:

1. create emissions inventory of GHGs as well as air pollutants such as nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic compounds, and particulate matter;
2. forecast growth of these emissions for a future year;
3. evaluate policies and measures to reduce emissions of these pollutants; and
4. prepare action plans to reduce emissions.

HEAT+ tool supports cities in the implementation of ICLEI's Climate Action methodologies, including the ClimateResilientCities methodology as well as the Green Climate Cities. Decision makers from other levels of governments as well as from the private sector and NGOs will also find the tool useful. With an easy to navigate interface, numerous built-in reports, extensive IPCC and country-specific emissions coefficient data sets, HEAT+ provides a robust software environment for everything right from preparing city specific GHG emissions inventories to evaluating the benefits of individual policies and measures for developing comprehensive action plans.

3.1.2 Data Sources and Collection

The baseline year for this study was the financial year of 2017-18 (i.e. April 2017-March 2018). Relevant data for the analysis and estimation was collected for a five-year period preceding the baseline year i.e. from 2014-15 onwards. A full GHG inventory includes emissions from energy, waste, agriculture, forestry, and land-use change. However, due to limited resources and data constraints, the direct emissions from agriculture, land-use change and forestry sectors were not included.

ICLEI South Asia and NCC staff members engaged through meetings and letters with a number of municipal, local and sub-national stakeholders to source the relevant energy consumption data focusing on the primary emission sources within the municipal area. Supply and demand-side data was collected and analysed. The various sources of energy and other relevant data used in the report are elaborated in Table 8.

Table 9: Sources of Activity Data for GHG Emission Estimation

Fuel Type	Sector	Source of Data
Electricity	Residential	Dhaka Power Distribution Company (DPDC) and Rural Electrification Board (REB)
	Commercial/Institutional	DPDC and REB
	Manufacturing Industry and Construction	DPDC and REB
	Municipal Buildings; Water Supply; Street Lighting	NCC
Diesel and Octane	Community Transport	Padma, Meghna, and Jamuna Oil Company Limited
	Municipal Buildings and Vehicles	Narayanganj City Corporation
LPG	Residential	JMI Group
	Commercial/Institutional	JMI Group
PNG	Residential; Commercial/Institutional; Manufacturing Industry and Construction	Titas Gas Transmission and Distribution Company
CNG	Community Transport	Titas Gas Transmission and Distribution Company
Solid Waste Management		NCC
Wastewater		Secondary Research and Estimations

3.2 GHG Emissions Inventory Report

3.2.1 Narayanganj City Energy Consumption and GHG Emission (2018-19)

Table 10: Key Indicators – Economy-wide Energy Consumption and GHG Emissions

1 Total Energy Use[21] **9,638,828 GJ**	2 Total GHG Emission **1.06 million tonnes of CO_2e**
3 Per Capita Energy Use **10.81 GJ**	4 Per Capita GHG emissions **1.19 Tonnes of CO_2e**

Community Scale Energy Consumption and GHG Emissions

Figure 8: Sector-wise share of Energy Use, 2018-19

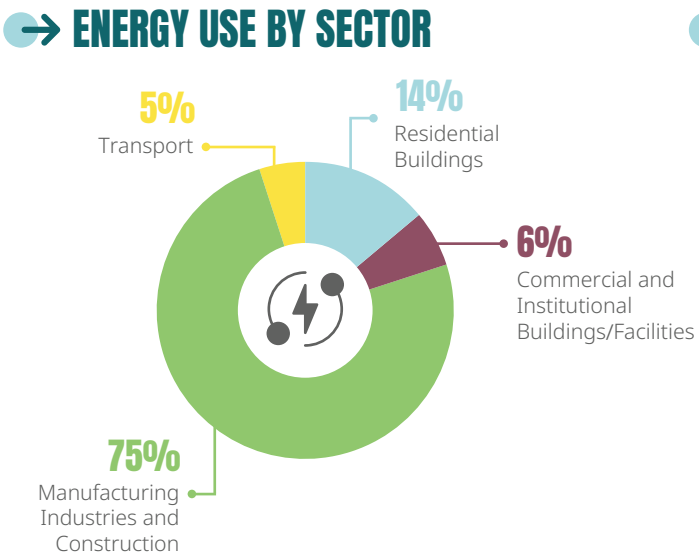


Figure 9: Sector-wise GHG Emissions , 2018-19

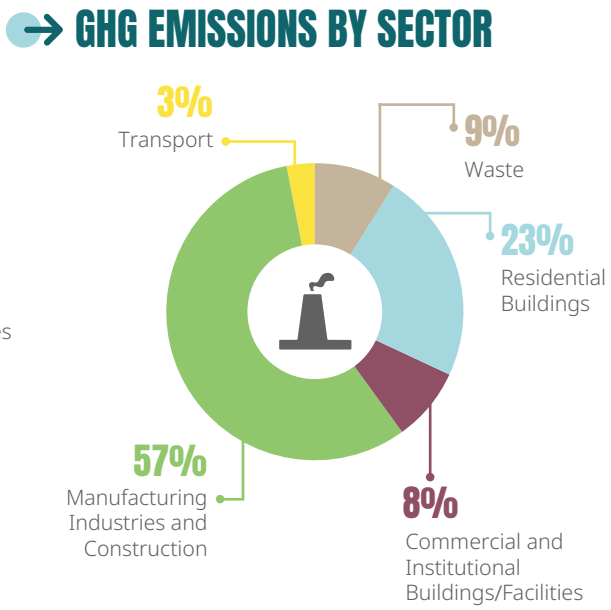


Table 11: Sector-wise Energy Consumption and GHG Emissions in 2018-19

Sector	Energy Use (GJ)	GHG Emissions (tCO_2e)
Residential Buildings	1,378,311	242,847
Commercial and Institutional Buildings/ Facilities	590,187	86,161
Manufacturing Industries and Construction	7,214,724	610,675
Transport	455,607	29,449
Waste	----	92,277
Total	**9,638,828**	**1,061,409**

21 Includes direct energy use (from combustion of fuels such as kerosene, LPG, petrol, diesel) and indirect energy use (due to consumption of grid electricity)

Figure 10: Trend of Energy Consumption from 2014-15 to 2018-19

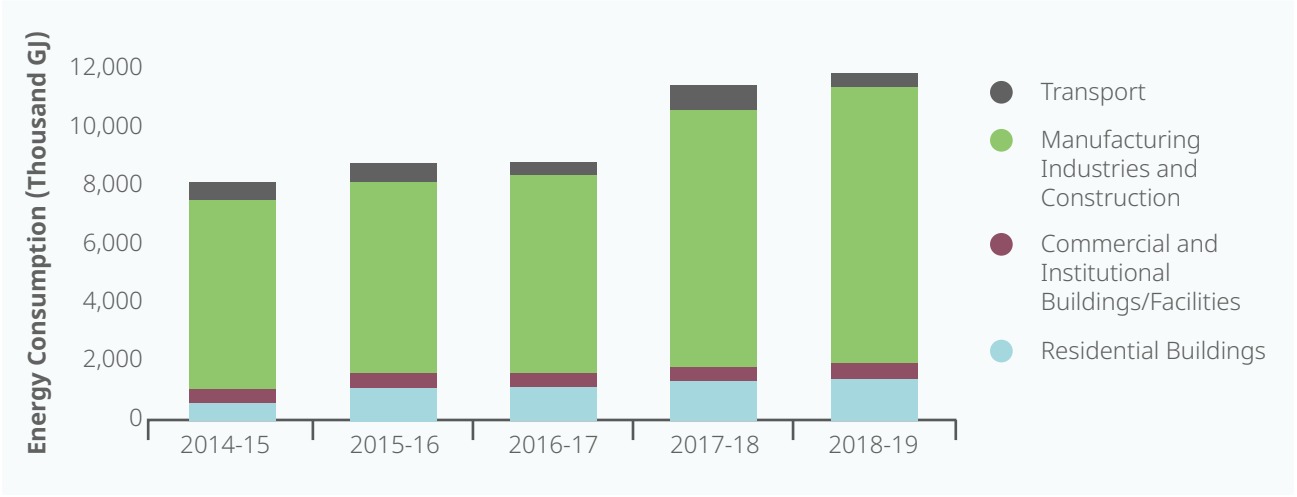
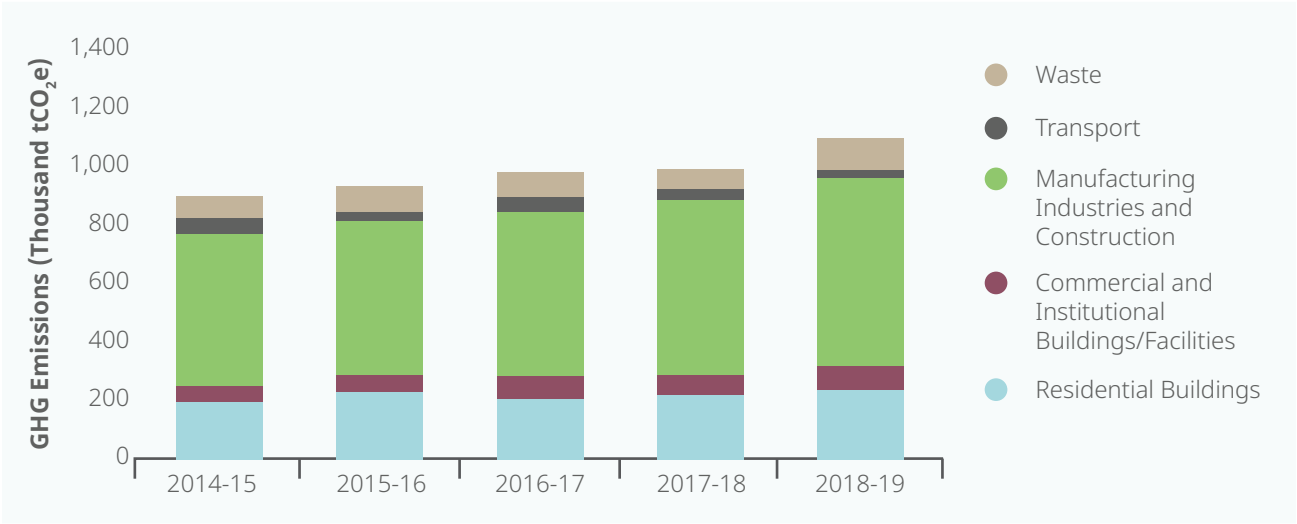


Figure 11: Trend of GHG Emissions from 2014-15 to 2018-19



- Largest Energy consumers: Manufacturing Industries and Construction (75%); Residential Buildings (14%); Commercial and Institutional Buildings/Facilities (6%)
- Trend of Energy use: Rise of 22.09% since 2014-15 (at a CAGR of 4.1%)
- Largest GHG emitters: Manufacturing Industries and Construction (57%); Residential Buildings (23%); Waste (9%); Commercial and Institutional Buildings/Facilities (8%);
- Trend of GHG Emissions: Rise of 28.35% since 2014-15 (at a CAGR of 5.1%)

3.2.2 Snapshot of Energy Use and Resultant GHG Emissions by Energy Source

Figure 12: Share of Energy Consumption by Energy Source/Fuel in 2018-19

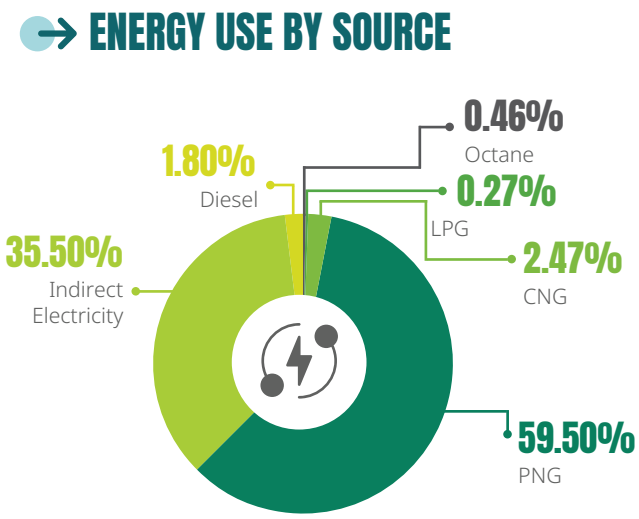


Figure 13: Share of GHG Emissions by Energy Source/ Fuel in 2018-19

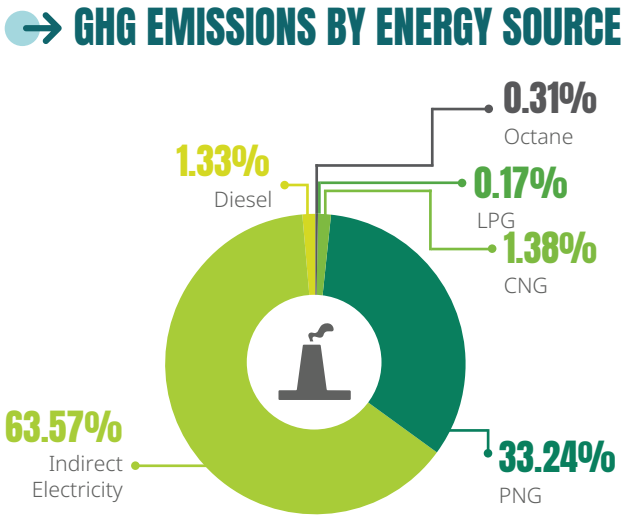


Table 12: Energy Consumption and GHG Emissions by Energy Source in 2018-19

Fuel/Energy Source	Energy Use (GJ)	GHG Emission (tCO_2e)
Diesel	173,745	12,919
Octane	43,890	3,052
LPG	25,548	1,613
CNG	237,972	13,387
PNG	5,735,477	322,075
Electricity	3,422,196	615,995
Total	**9,638,828**	**969,041**

- Prominent Energy sources: PNG (59.50%); Electricity (35.50%)
- Largest GHG emitting Energy sources: Electricity (63.57%); PNG (33.24%)

3.2.3 Sectoral Electricity Consumption and Resulting Indirect GHG Emissions

Figure 14: Sector-wise Electricity Consumption in 2018-19

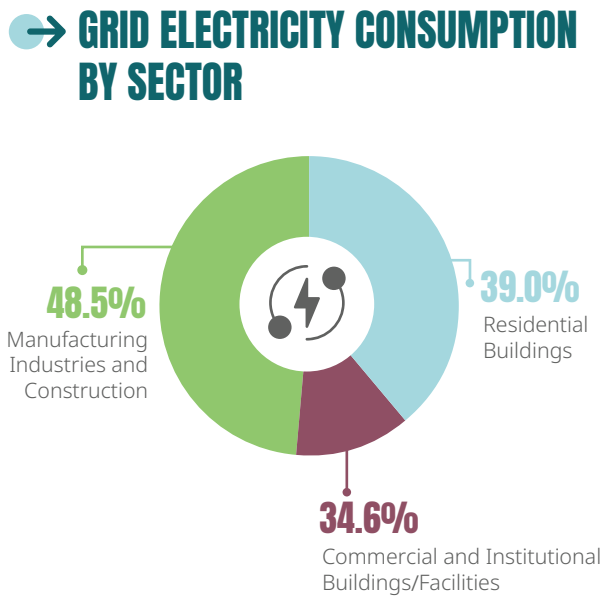


Figure 15: Sector-wise GHG Emissions from Electricity Consumption in 2018-19

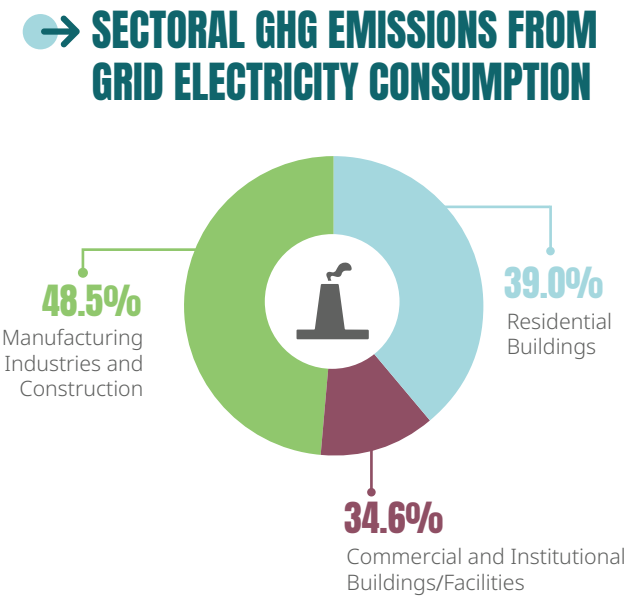


Figure 16: Trend of Grid Electricity Consumption

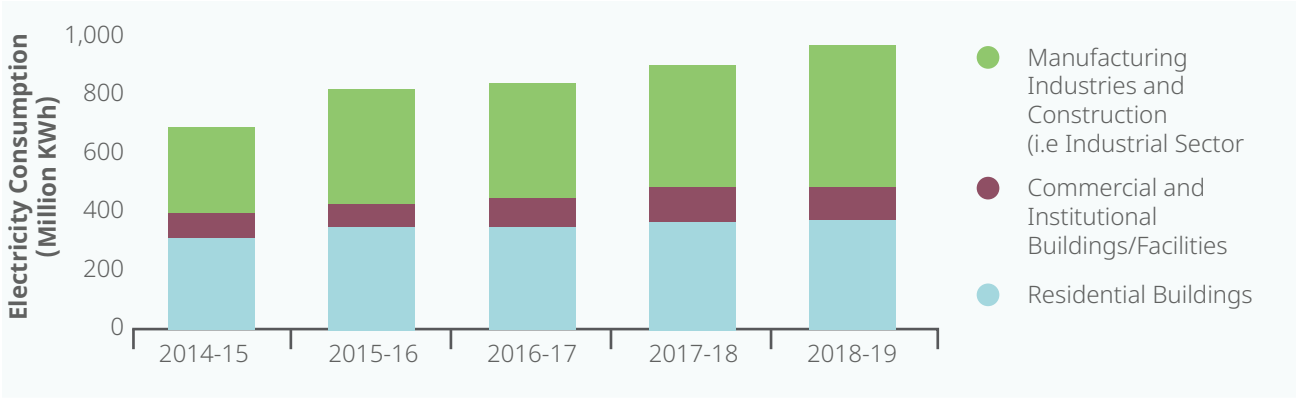
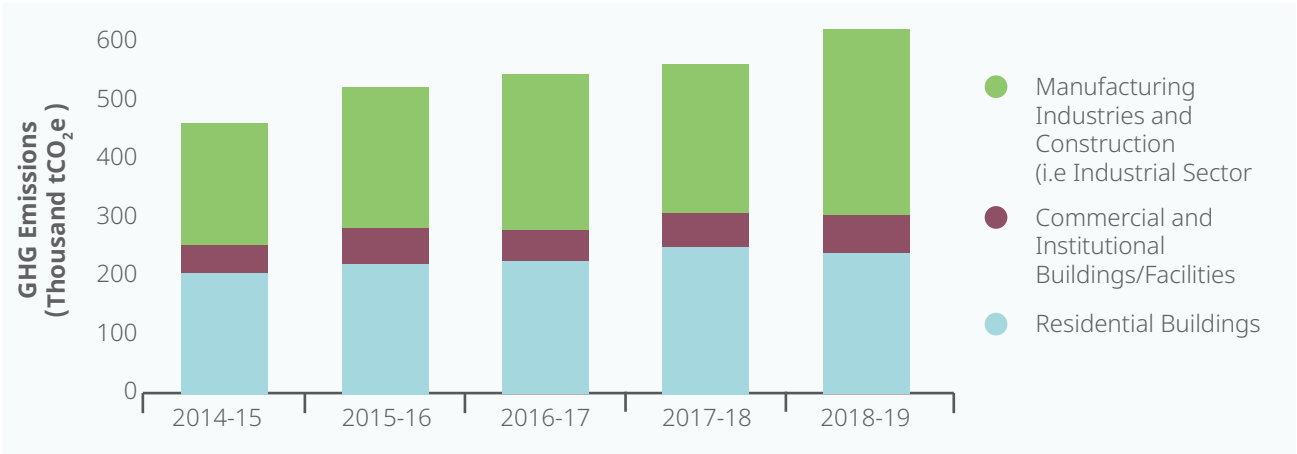


Figure 17: Trend of GHG Emissions from Grid Electricity Consumption



- Total Electricity consumption in 2018-19: 951 million kWh
- Electricity consumption per capita: 1,066 kWh

- Total GHG emission from electricity consumption in 2017: 18: 615,995 tonnes of CO_2e
- Largest Electricity consumers and GHG emitters: Manufacturing Industries and Construction (48.5%); Residential Buildings (39%); Commercial and Institutional Buildings/Facilities (12.5%)

3.2.4 Direct Emissions from Stationary Combustion

Residential Buildings Sector

Figure 18: Share of stationary fuels in Energy Use in Residential sector

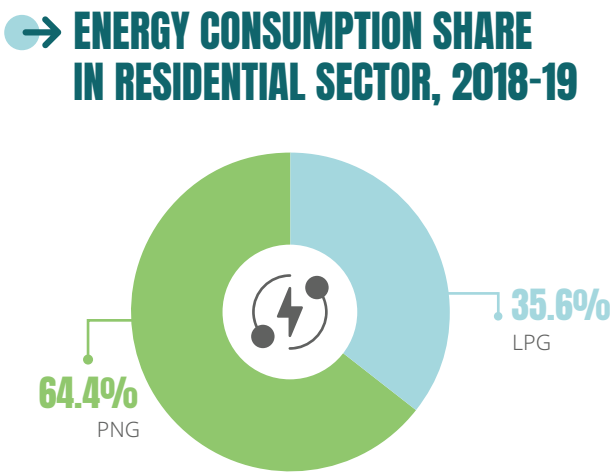
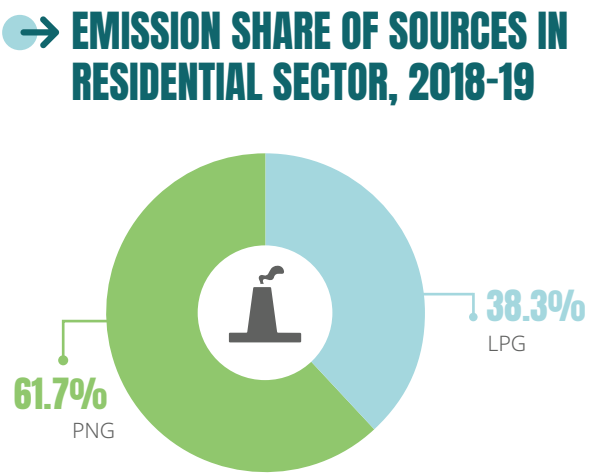


Figure 19: Share of stationary fuels in GHG Emissions in Residential sector



- Total Energy Use from stationary fuel consumption in the sector: 43,251 GJ
- Energy Use Trend: rise of 42.33% (at a CAGR of 7.3%)
- Trend of LPG Consumption: rise of 135.51% (at a CAGR of 18.7%)
- Trend of PNG consumption: rise of 16.83% (at a CAGR of 3.2%)
- Total GHG emissions from stationary fuel consumption in the sector: 2,536 t CO_2e
- Largest GHG emitting Fuel: PNG (61.7%)
- Trend of GHG Emissions: rise of 44.76% (at a CAGR of 7.7%)

Commercial and Institutional Buildings & Facilities

Figure 20: Share of stationary fuels in Energy Use in Commercial sector

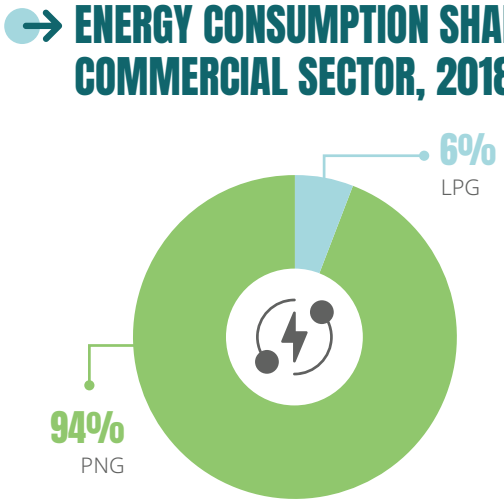
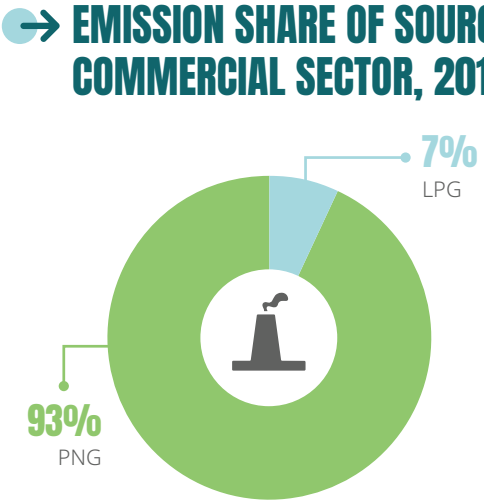


Figure 21: Share of stationary fuels in GHG Emissions in Commercial sector



- 5Total Energy Use from stationary fuel consumption in the sector: 162,651 GJ
- Energy Use Trend: rise of 14.15% (at a CAGR of 2.7%)
- Trend of LPG Consumption: rise of 133.70% (at a CAGR of 18.5%)
- Trend of PNG consumption: rise of 10.38% (at a CAGR of 2.0%)
- Total GHG emissions from stationary fuel consumption in the sector: 9,205 tCO_2e
- Largest GHG emitting Fuel: PNG (93%)
- Trend of GHG Emissions: rise of 14.6% (at a CAGR of 2.8%)

Manufacturing Industries and Construction Sector

Figure 22: Trend of Energy Use from Stationary Fuel Consumption in Industrial Sector

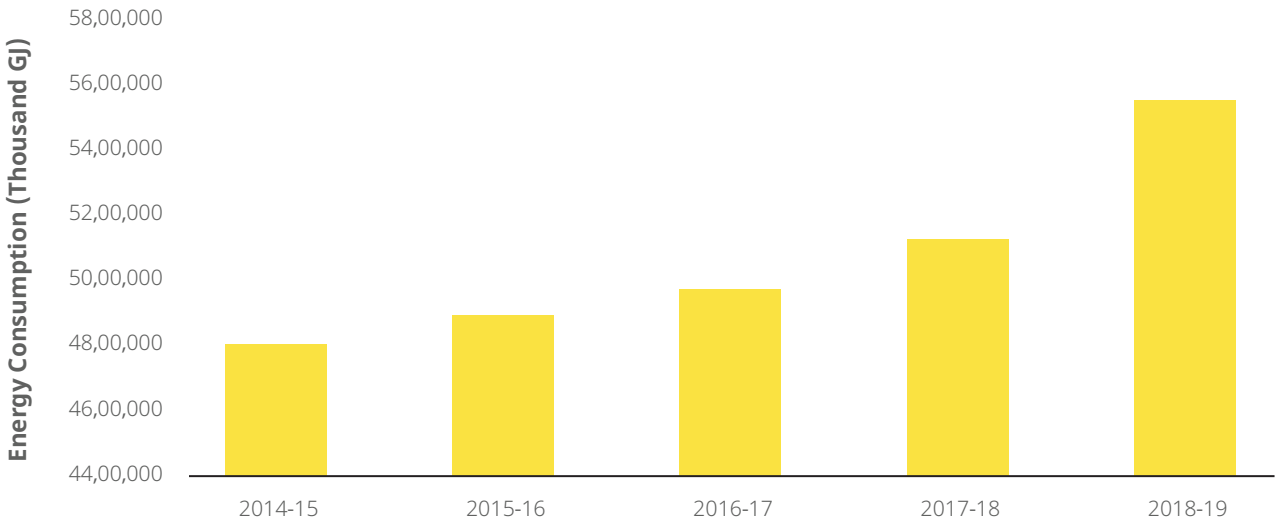
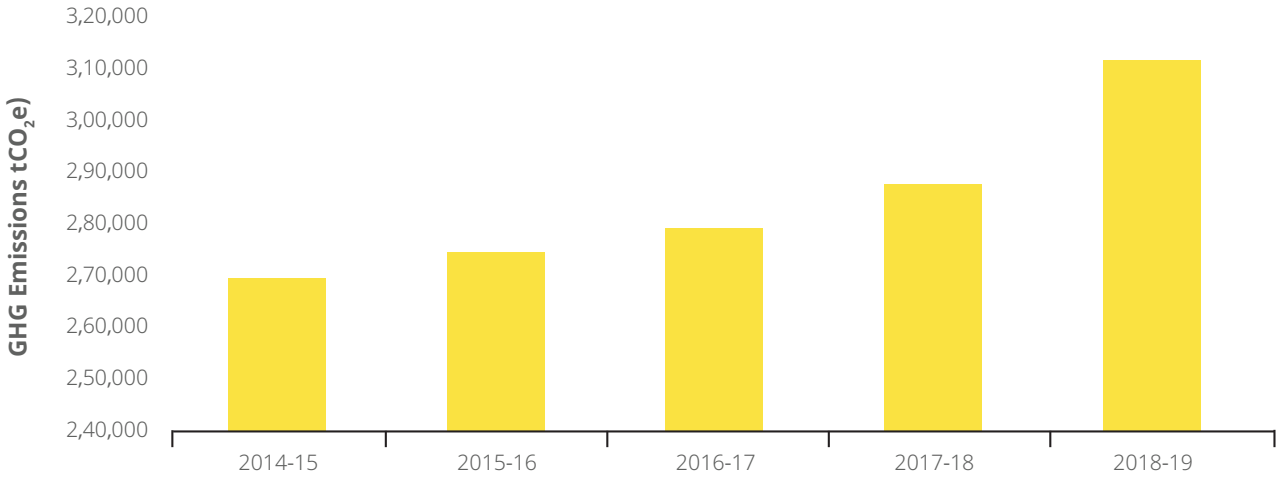


Figure 23: Trend of GHG Emissions from Stationary Fuel Consumption in Industrial Sector



- Total Energy Use from stationary fuel consumption in the sector: 5,555,124 GJ
- Energy Use Trend: rise of 15.62% (at a CAGR of 2.9%)
- Total GHG emissions from stationary fuel consumption in the sector: 311,946 tCO_2e
- Trend of GHG Emissions: rise of 15.62% (at a CAGR of 2.9%)

3.2.5 Fuel Use in Transport Sector & Resultant Direct Emissions

On-Road Transport

Figure 24: Share of Energy Consumption by Fuel in On-road Transport

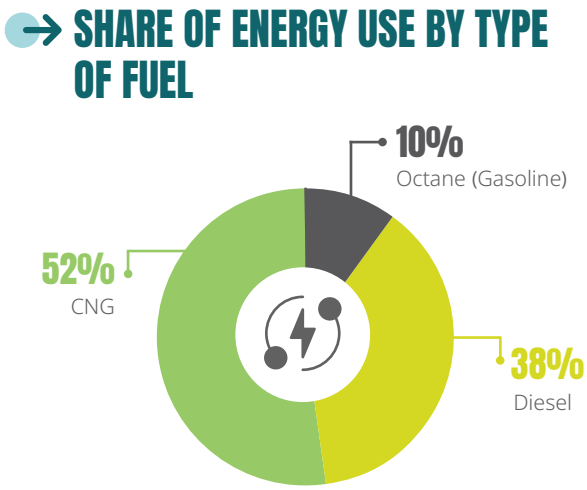


Figure 25: Share of GHG emissions by Fuel in On-road Transport

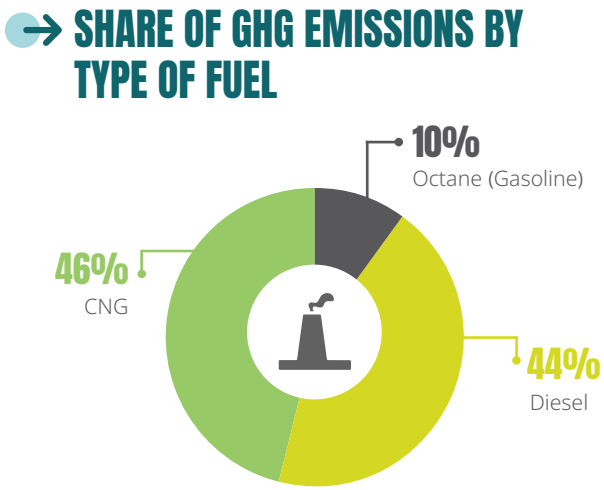


Figure 26: Trend of Energy Consumption in Road Transport

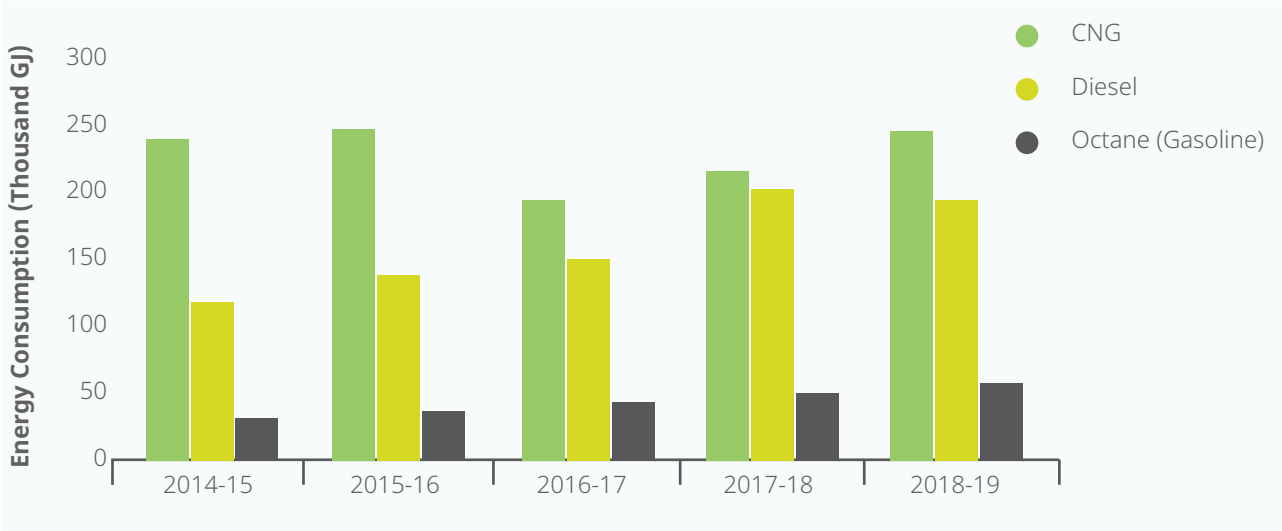
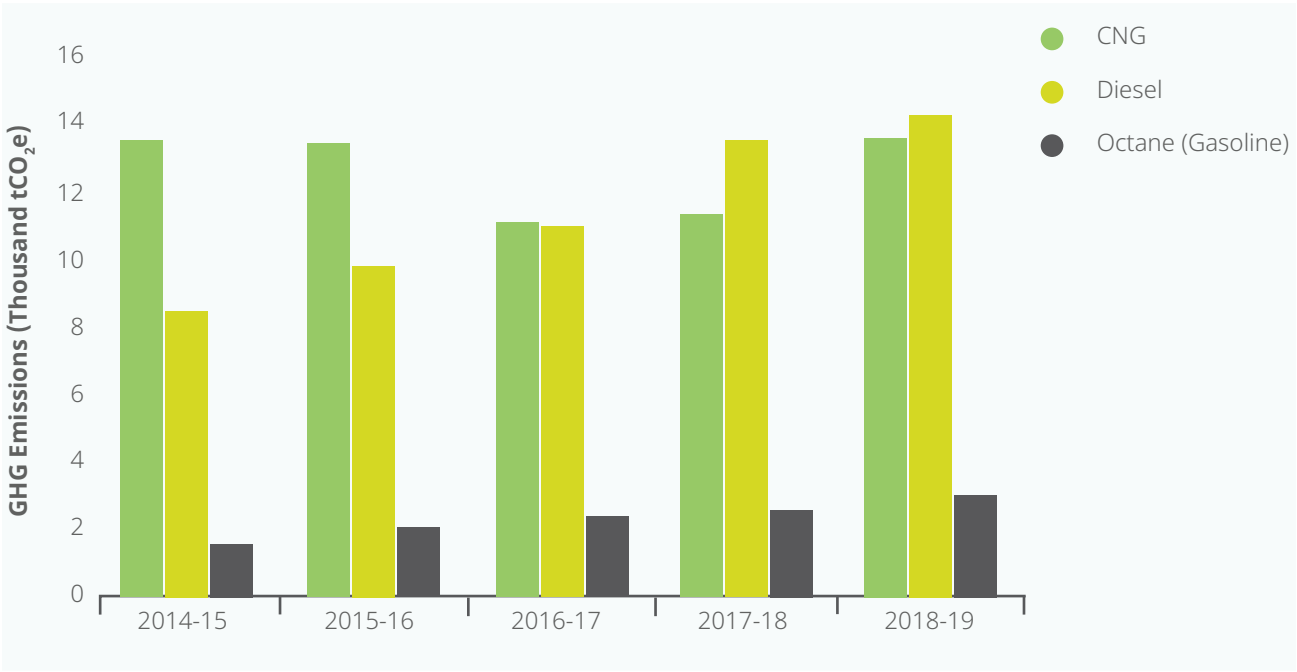


Figure 27: Trend of GHG Emissions from Road Transport



- Total Energy Consumption in On-Road Transport in 2018-19: 455,607 GJ
- Total GHG emission from Road Transport in 2018 -19: 29,357 tonnes of CO_2e
- Trend of emission increase since 2014-15: Diesel (rise of 56%), Octane (83%)

Rail Transport

Table 13: GHG Emissions from Rail Transport

Year	2014-15	2015-16	2016-17	2017-18	2018-19
Total Rail Emission (tCO_2e)	76	80	83	87	91

3.2.6 Waste Emissions

Solid Waste

Figure 28: Trend of Annual Solid Waste Processing and Disposal in Narayanganj

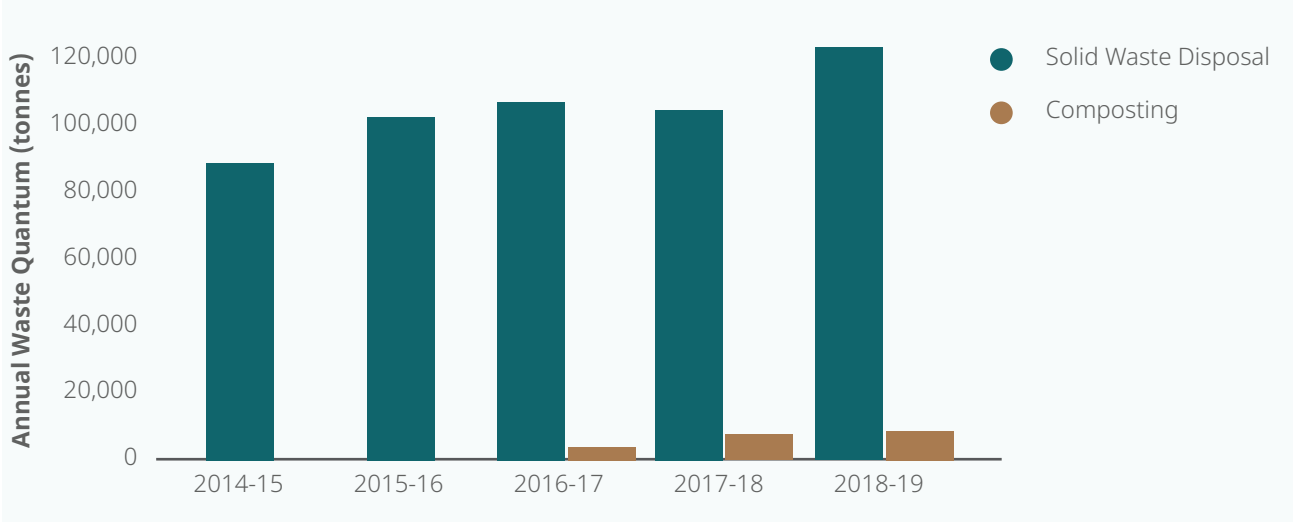
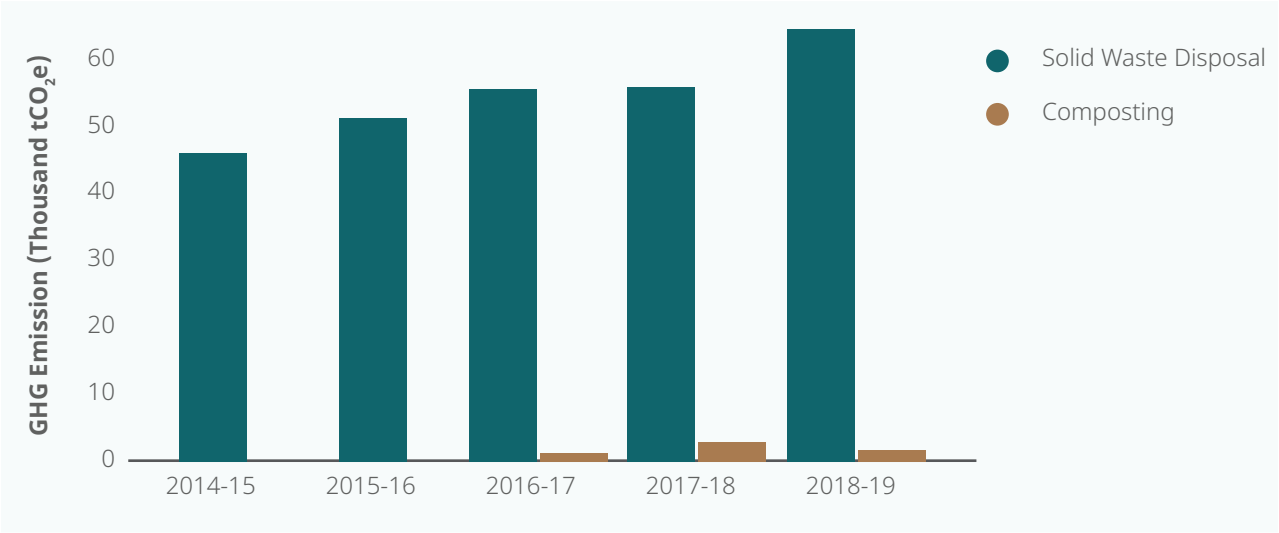


Figure 29: Trend of GHG Emissions from Solid Waste Disposal and Processing



- Annual Waste Collection in 2018-19: 128,663 Tonnes (i.e. 350 TPD of 400 TPD generated)
- Total GHG Emission from solid waste to landfill in 2018-19: 65,259 tonnes of CO_2e
- Total GHG Emission from waste composted in 2018-19: 1,252 tonnes of CO_2e
- Trend of Emissions from Solid Waste to landfill: Rise of 44.57% since 2014-15

Domestic Wastewater

Table 14: GHG Emissions from Domestic Wastewater Discharge and Treatment

Treatment/ discharge pathway or system	GHG Emission from Domestic Wastewater (in tCO_2e)				
	2014-15	2015-16	2016-17	2017-18	2018-19
Uncollected wastewater discharged to water bodies	3,838	4,665	5,078	5,322	5,445
Septic Systems	3,838	4,665	5,078	5,322	5,445
Latrines - Uncollected	512	622	677	710	726
Domestic N_2O Emissions	12,427	12,840	13,265	13,701	14,151
Total	**20,615**	**22,792**	**24,098**	**25,055**	**25,767**

- Total emission from wastewater treatment/discharge in 2018-19: 25,767 tonnes of CO_2e
- Trend of emissions since 2014-15: Uncollected wastewater discharged into water bodies (rise of 41.87%); Septic systems (41.87%)
- Trend of emissions from domestic N_2O emissions: rise of 13.87% since 2014-15

3.3 Narayanganj City Local Government: Energy Consumption and GHG Emissions (2018-19)

Table 15: Energy Consumption and GHG Emissions in Municipal Operations

Total Energy Use[22]	Total GHG emissions
13,872 GJ	2,049 tCO_2e

Snapshot of Energy Use and Resultant GHG Emissions

Figure 30: Share of Energy Consumption by Municipal End-use

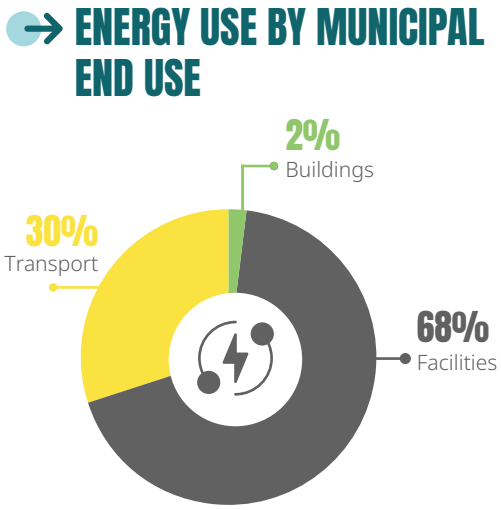


Figure 31: Share of GHG Emissions by Municipal End- Use

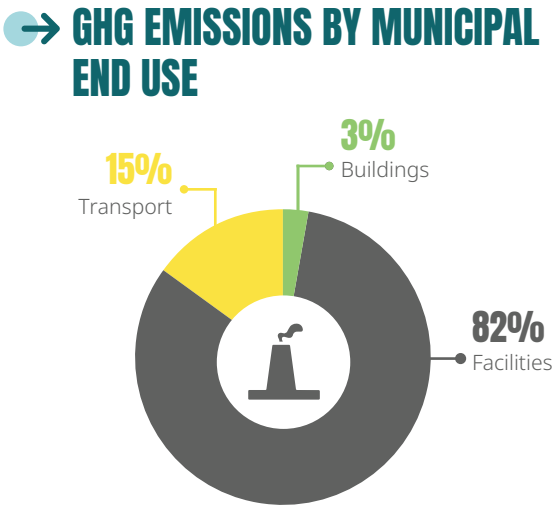


Table 16: Break-up of Energy Consumption and GHG Emissions in Municipal Operations

Sector	Energy Use (GJ)	GHG emission (tCO_2e)
Local Government Buildings	303	54
Facilities (Waste Water Treatment, Water Supply and Street Lighting)	9,378	1,688
Municipal Vehicles	4,192	306

- Largest Energy consumers: Facilities (68%); Transport (30%)
- Trend of Energy use: Rise of 132.79% since 2014-15 (at a CAGR of 18.4%)
- Largest GHG emitters: Facilities (82%); Transport (15%)
- Trend of GHG Emission: Rise of 127.85% since 2014-15 (at a CAGR of 17.9%)

3.4 Energy and GHG Emissions Projection

The Climate Resilient City Action Plan is prepared for 5 years, with a long-term vision for a 20-to-30-year timeline that is determined by the local authority. Energy consumption and GHG emissions are projected by using Tool 3.1E: GHG Emissions Forecasting of the ClimateResilientCITIES methodology. Projections have been undertaken for medium term (yearly from 2018-19 to 2026-27) and long-term scenario (every 5 years from 2027-28 to 2050-51).

Stationary fuel and electricity consumptions have been projected by using Geometric mean of historic data (2014-15 to 2018-19) for community sectors. Energy consumption from utility services/ facilities (i.e., water supply, drainage and solid waste management) has been projected for future estimates of service demand. The service demand (i.e. MLD

22 Includes direct energy use due to consumption of grid electricity for waste water treatment, street lighting, water supply and lighting in government buildings and consumption of fuels by government vehicles for transportation.

of water supply, TPD of waste generated and disposed) has been estimated based on population growth[23] and future plans on service delivery and infrastructure expansion of the NCC. Based on a forecast of the energy consumption, the corresponding GHG emissions are calculated using the HEAT+ software.

Table 17: Assumptions for Forecasting and Projections of Key Urban Services

Sector	Assumption
Water Supply	Based on existing city planning, below assumptions have been taken into consideration. ◆ From the baseline data in 2018-19, 92.2 MLD of water supply has been used as basis to estimate per capita water supply (145 lpcd), which has been considered to be consistent until 2025-26. Non-revenue water (NRW) of 30% has been factored in to arrive at figures of per capita water supply[24]. ◆ NRW is assumed to reduce to 20% by 2026-27 based on ongoing and proposed interventions to address water leakages and network improvement. Given the reduced leakages, per capita water supply is correspondingly assumed to stand at 130 lpcd in 2026-27. ◆ It is assumed that the water supply service will be improved to operate at desired benchmarks (15% NRW and delivering 125 lpcd of supply) by 2031. Service delivery is assumed to continue operating thereafter at these benchmarks for the projections until 2050. ◆ Quantum of total water supply has been forecasted until 2050 using corresponding figures of NRW and per capita water supply. ◆ Energy consumption and GHG emission for BAU scenario have been correspondingly estimated considering baseline energy consumption in 2018-19 and projected figures of future water demand.
Wastewater	◆ 80% of total water supply is assumed to be discharged as wastewater from households. In the absence of city-level data on future wastewater generation, this assumption has been used to estimate projected quantum of wastewater generation (MLD of wastewater) ◆ Centralised sewer network and treatment system is absent in the city. Based on existing baseline and plans, , it is assumed in the projections that the city will be able to start implementing sewer connections by 2026 and 10% of network coverage is assumed by 2026. 20% of the city area is assumed to be covered by 2031 and 65% is assumed to be covered with sewer network by 2050. ◆ In the absence of sewer network, share of households using septic tanks has been assumed to reach 18% by 2026-27 and further increase to 28% by 2050 to supplement the sewer network, as compared to 15% in the baseline year of 2018-19.
Solid Waste Management	◆ In the absence of data on future municipal solid waste generation and disposal, per capita waste generation has been used as a basis for the projections. Per capita waste generation is assumed to increase at annual growth rate of 1.33% from 2018 to 2030 and at 1.47% per year from 2031 to 2050[25]. ◆ Waste composition is assumed to be consistent across the years, given the lack of reliable published information on projected composition[26].
Streetlighting	◆ Street lighting coverage is limited to central areas of the city and is lacking particularly in peripheral areas at present. NCC is installing street lighting at such locations. Thereby, in the projections it is assumed that streetlighting infrastructure expands by 5% per year upto 2030 and then at 1% per year thereafter.

23 Population projection has been carried out by taking average of population projection by arithmetical increase method, geometrical increase method and incremental increase method

24 The World Bank (2014): Benchmarking to Improve Urban Water Supply Delivery in Bangladesh. Available at https://www.ib-net.org/docs/Bangladesh_Report.pdf#https://www.ib-net.org/docs/Bangladesh_Report.pdf

25 "Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. 2018. What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050. Urban Development;. Washington, DC: World Bank. © World Bank. Information from Appendix A. Available at https://openknowledge.worldbank.org/handle/10986/30317

26 Waste composition information sourced from UNCRD & IGES, 2017. State of the 3Rs in Asia and the Pacific- Country Chapter – The People's Republic of Bangladesh, Table C-7, pg. 21. Available at: https://www.uncrd.or.jp/content/documents/5685[Nov%202017]%20Bangladesh.pdf

Projected city-wide energy consumption as per business-as-usual (BAU) scenario for year 2050-51 is 92,619,610 GJ, which is nearly 10 times higher as compared to the baseline of 9,638,828 GJ in year 2018-19. In the business-as-usual (BAU) scenario, GHG emission is correspondingly projected to increase to 10.73 million tCO_2e, which is over 10 times higher as compared to baseline of 1.06 million tCO_2e in year 2017-18. This substantial increase in the energy consumption and corresponding GHG emission by 2050 clearly signifies the urgent need for a Climate Resilient City Action Plan for Narayanganj city. Projected energy consumption and GHG emission trend has been shown in Figure 32 and Figure 33 respectively.

Looking at the forecasting trend over the action plan period (i.e. until 2026-27), total energy consumption is projected to increase by 1.54 times over the baseline. GHG emissions are projected to similarly increase by 1.64 times the base year emissions. Sector-wise contribution of energy consumption and GHG emissions in 2026-27 is largely similar to that in the baseline year. Energy consumption in Transport and Residential buildings will continue to drive Narayanganj's GHG emissions, accounting for 80% of emissions in 2026-27.

Transport and commercial buildings, primarily attributed to population increase and economic growth (enabling residents to have individual vehicles) are seen to have the highest rate of increase in energy use and GHG emissions, from 2018-19 to 2026-27 and beyond. Electricity from the grid will be the primary energy source for the city in the business-as-usual scenario, accounting for 42% of its energy use, which is higher than its share of 35.5% in the baseline. Thereby, it is important to address rising electricity consumption in the city's building stock through adoption of energy efficiency and integration of renewable energy. Adoption of public transport systems, use of cleaner fuels and E-mobility, and promotion of non-motorized transit are key strategies to bring down energy use and GHG emissions in the Transport sector.

Figure 32: Projection of Sectoral Energy Consumption from 2018-19 to 2050-51

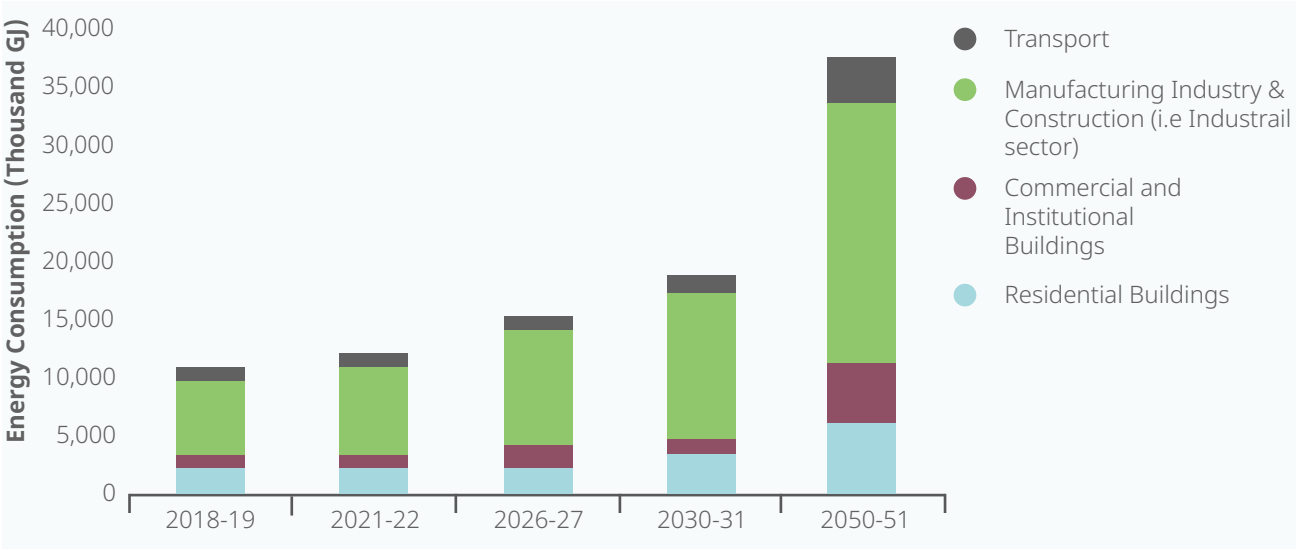


Figure 33: Projection of Sectoral GHG Emissions from 2018-19 to 2050-51

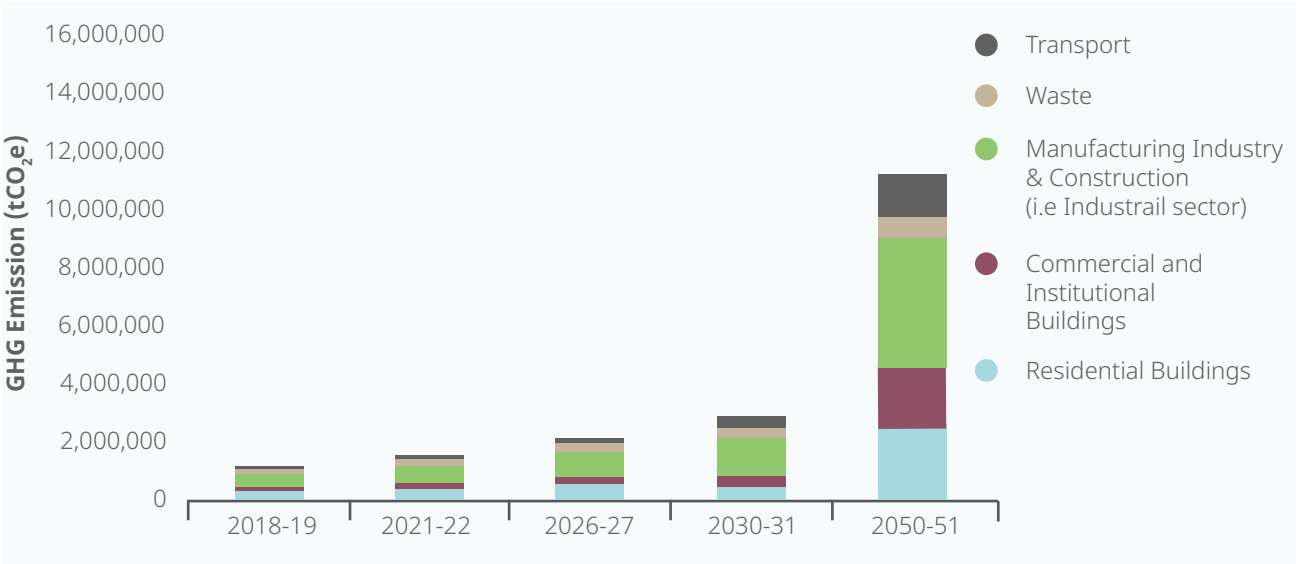


Table 18: Projection of Energy Consumption in the Medium-Term and Long-Term

Sectors	Energy Source	Baseline Energy Consumption (GJ)	Projected Energy Consumption (GJ) (Medium term)			Project Energy Consumption (GJ) (Long-term)	
		2018-19	2021-22	2026-27	2030-31	2040-41	2050-51
Residential Buildings	Electricity	1,335,060	1,601,161	2,167,664	2,762,088	5,062,343	9,278,240
	LPG	15,376	29,231	85,281	200,843	1,709,494	14,550,510
	PNG	27,875	31,324	38,048	44,452	65,584	96,761
Commercial and Institutional Buildings	Electricity	427,536	546,490	822,743	1,141,326	2,586,866	5,863,247
	LPG	10,172	19,226	55,552	129,823	1,083,871	9,049,075
	PNG	152,479	164,202	185,776	205,059	262,485	335,991
Manufacturing Industry & Construction (i.e. Industrial sector)	Electricity	1,659,600	2,129,330	3,225,834	4,497,397	10,321,894	23,689,590
	PNG	5,555,124	6,194,130	7,426,622	8,586,973	12,344,174	17,745,327
Transport	Petrol	43,890	69,138	147,450	270,262	1,229,243	5,591,004
	Diesel	173,745	242,785	424,041	662,454	2,020,814	6,164,482
	CNG	237,972	239,553	242,210	244,358	249,810	255,383
Total	-	**9,638,828**	**11,266,570**	**14,821,220**	**18,745,036**	**36,936,576**	**92,619,610**

Table 19: Projection of GHG emissions in the Medium-Term and Long-Term

Sectors	Energy Source	Baseline GHG emission (tCO2e)	Projected GHG emission (tCO2e) (Medium term)			Projected GHG emission (tCO2e) (Long-term)	
		2018-19	2021-22	2026-27	2030-31	2040-41	2050-51
Residential Buildings	Electricity	240,311	288,209	390,180	497,176	911,222	1,670,083
	LPG	971	1,846	5,386	12,684	107,963	918,935
	PNG	1,565	1,759	2,137	2,496	3,683	5,434
Commercial and Institutional Buildings	Electricity	76,956	98,368	148,094	205,439	465,636	1,055,385
	LPG	642	1,214	3,508	8,199	68,452	571,493
	PNG	8,562	9,221	10,432	11,515	14,740	18,868
Manufacturing Industry & Construction (i.e.	Electricity	298,728	383,279	580,650	809,531	1,857,941	4,264,126
	PNG	311,947	347,830	417,040	482,200	693,185	996,485
Waste	Solid Waste to Landfill	65,259	75,330	92,435	112,070	183,354	301,311
	Biological treatment	1,252	1,252	2,191	2,191	2,191	2,191
	Wastewater	25,766	29,391	35,543	46,137	81,926	70,641
Transport	Petrol	3,052	4,807	10,252	18,791	85,468	388,736
	Diesel	12,919	18,052	31,529	49,256	150,255	458,353
	CNG	13,387	13,476	13,626	13,746	14,053	14,367
	Rail	91	104	129	154	229	342
Total	-	**1,061,409**	**1,274,139**	**1,743,131**	**2,271,586**	**4,640,297**	**10,736,747**

04

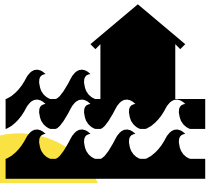
CLIMATE RISK AND VULNERABILITY ASSESSMENT

4.1 Past Hazards and Climatic Events

Narayanganj has experienced severe adverse effects of climate change in the recent years due to its riverine and geographical location. The major climate change impacts that Narayanganj faces are i) Drainage congestion (Flood) and ii) Heat stress[27]. The city experiences hot and humid summers, short and mild winters, and heavy rains during the monsoon season[28].

According to a study, Narayanganj has moderate risk in terms of multiple hazards with a cumulative score of 18.9. Based on geographic location and historical data, Narayanganj is mostly at the risk of earthquake and tornado[29].

Several low-lying areas of Narayanganj suffer from frequent and long-lasting waterlogging due to the encroachment of canals (natural drains), which is exacerbated by heavy rainfall during monsoon. Almost all of Narayanganj lies in a meander flood plain and is located in a 56.79 sq. km area within Dhaka-Narayanganj-Demra that is mostly vulnerable to waterlogging and flood. To alleviate the situation, the government had launched Dhaka-Narayanganj-Demra (DND) Area Flood Control, Discharge and Irrigation Project in 1962-1968 period. This project installed 4 pumps and one pumping station, constructed 31.25 km of embankment, excavated 55.20 km of Irrigation canal, 45.90 km of Discharge canal and established 216 Water Control Infrastructures. But in the 1998, the water in Shitalakkhya Shitalakshya River was flowing at the level of 6.93 m and 7.23 m in Buriganga River. As a result, the embankment was breached by the most severe flood in history, and many low-lying areas were inundated for 15-20 days. A study indicates that 47% of total DND area was inundated. Out of that, flood depth was less than 1m in 21% of total area, and 1-2m in 15% of total area. The highest depth was recorded 6.67m in rest of the inundated area. Total 250,000 people within DND area was affected by this devastating flood[30].



Almost all of Narayanganj lies in a meander flood plain and is located in a 56.79 sq. km area within Dhaka-Narayanganj-Demra that is mostly vulnerable to waterlogging and flood

In August 2016, the GoB has approved 558.2 crore budget for "DND Area Drainage Improvement Project (Phase II)", which commenced in July 2016 and concluded in June 2020. This project sought to install 2 pumps and 3 pumping plants, re-excavate 93.98 km canal and develop the embankment of 93.98 km[31].

Table 20: Past Climatic Events in Narayanganj

Year	Climatic Event	Impact	Action Taken
1976	Nor'westers and Tornado	No record of damage[32].	-
2008	River bank erosion	Bandar and Araihazar area was damaged by the event[33].	-
2010	River bank erosion	Bandar area was damaged by the event[34].	-
2011	River bank erosion	Bandar area was damaged by the event[35].	-
2011	Earthquake	Magnitude of 6.4 and 4.9. No report of damage[36].	-

27 Adaptation options for managing water related extreme events under climate change regime: Bangladesh perspectives; Ahmed, A. U. (2005).
28 City Profile: Narayanganj; A.H.M. Noman et al.
29 District-wise multi-hazard zoning of Bangladesh; Uttama Barua
30 Flood Hazard Mapping of Dhaka-Narayanganj-Demra (DND) Project Using Geo-Informatics Tools; Md. Aminul Islam
31 Bangladesh Water Development Board
32 Disasters in Bangladesh: Mitigation and Management; M Hasinur Rahman
33 BBS District Statistics 2011 - Narayanganj
34 BBS District Statistics 2011 - Narayanganj
35 BBS District Statistics 2011 - Narayanganj
36 Bangladesh: Disaster Report 2011

Year	Climatic Event	Impact	Action Taken
2011	Flood	The residential areas of Narayanganj and other places such as Don Chamber, Khanpur, Missionpara, Amlapara, President Road, Galachipa, Jalutala, Masdair, Iqbal Road, Ukipara, Nawanati, Bhuiarbag, Baburail, Dewvog, Nitaiganj, Tarakpoti and Tanbazar were waterlogged due to the heavy downpour on August 8, 9 and 10, 2011. In some areas there was knee deep water. The people of Jamtoli were marooned. The low-lying area in DND embankment was inundated. Several millions of people were marooned. Lack of proper drainage system was the main cause of water-logging[37].	-
2011	Lightning	1 child died on May[38].	-
2011	Nor'wester	15 students were injured in Sadekul Ulum Madeni Madrasa of Keshoppur Hatkhola of Narayanganj; the tin of the roof fell down on them when they were sleeping at night[39].	-
2013	Cold Wave	A cold wave lasted for 7 days in the January with a minimum temperature of 10-12°C.	The GoB allotted BDT 150,000 for blanket for NCC during this event[40].
2015	Waterlogging	Dhaka-Narayanganj-Demra embankment area was submerged under waist-height water for several days.	-
2016	Lightning	2 Killed and 1 injured in Char Kishorganj union of Sonargaon upazila[41].	-
2017	Waterlogging	Shanarpara, Dogair, Rahim Market, Adamjee, Pagla and Fatullah area was submerged under ankle to knee height water for two months, from July – September.	Development of Drainage System of DND has started a project of four year with a budget of BDT 558.2 Crore to solve this problem[42].

4.2 Climate Scenario in the City

According to the Köppen-Geiger climate classification, Narayanganj has a tropical wet and dry climate[43]. The summer season is hot and dry and lasts from mid-April to mid-June. Monsoon commences in early to min-May and lasts till mid-October. Around 70-85% of yearly precipitation occurs within this period[44]. Annual rainfall averages 2004 mm in Narayanganj. The average temperature during summer is 29.4°C with a maximum of 34.7°C. In the calendar, the winter season spreads from mid-December to mid-February and the minimum temperature is recorded 13.4°C during January. December is the driest month of the year and the precipitation is maximum during July with an average rainfall of 374 mm[45].

37 Bangladesh: Disaster Report 2011
38 Bangladesh: Disaster Report 2011
39 Bangladesh: Disaster Report 2011
40 Bangladesh: Disaster Report 2013
41 Disaster Incidences in Bangladesh in March 2016; Nirapad
42 The Daily Star: https://www.thedailystar.net/city/marooned-waterlogging-1458106
43 https://en.climate-data.org/asia/bangladesh/dhaka-division/narayanganj-33722/
44 http://en.banglapedia.org/index.php?title=Season
45 https://en.climate-data.org/asia/bangladesh/dhaka-division/narayanganj-33722/

4.2.1 Past Climate Trends

The nearest station of Bangladesh Meteorological Department (BMD) for Narayanganj is in Dhaka. Thereby, past climate trends for Narayanganj are assessed considering the data for Dhaka. According to the data of BMD, the figures below show the temperature trend of the period 1980-2012. Each graphs shows an upward trend for annual maximum temperature, annual minimum temperature and annual average temperature. A study analysed the temperature data from 1995-2016 and also concluded an increasing trend. The study projected that the monthly minimum temperature will increase by up to 6.8°C and the minimum temperature in the winter will increase by up to 13°C in the next 100 years[46].

Figure 34: Trend of Annual Maximum Temperature for Narayanganj

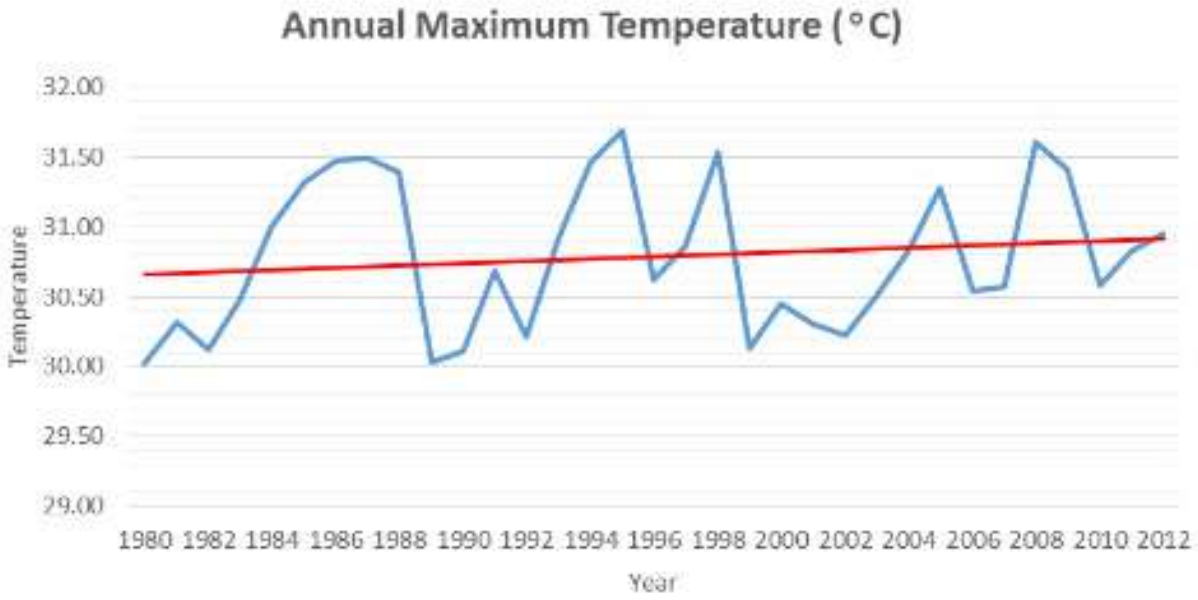
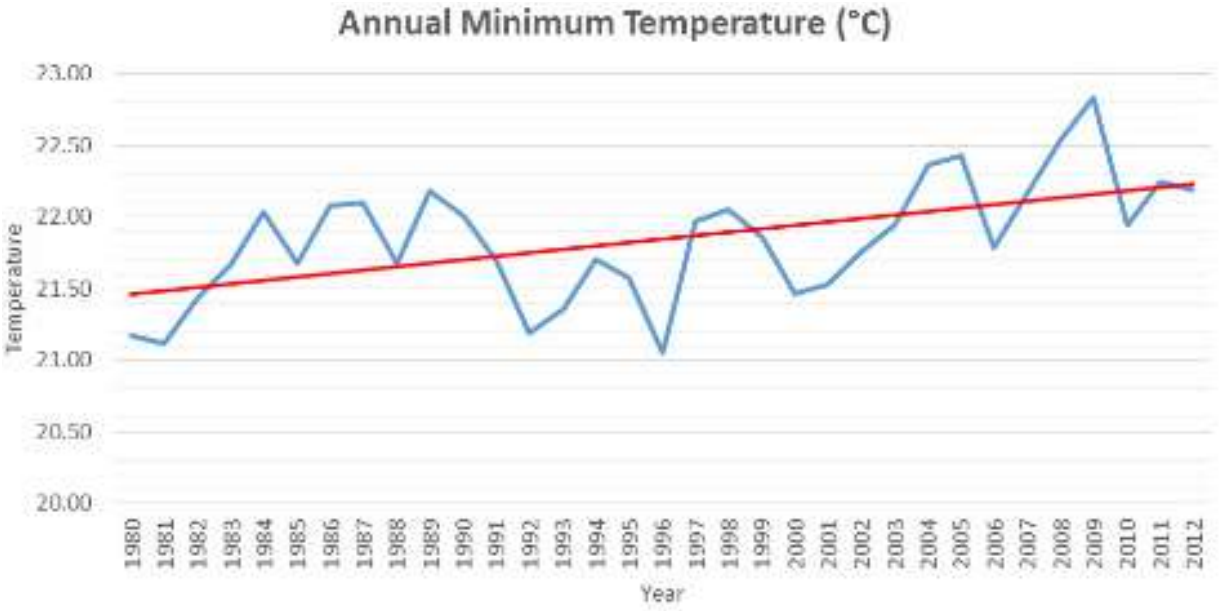
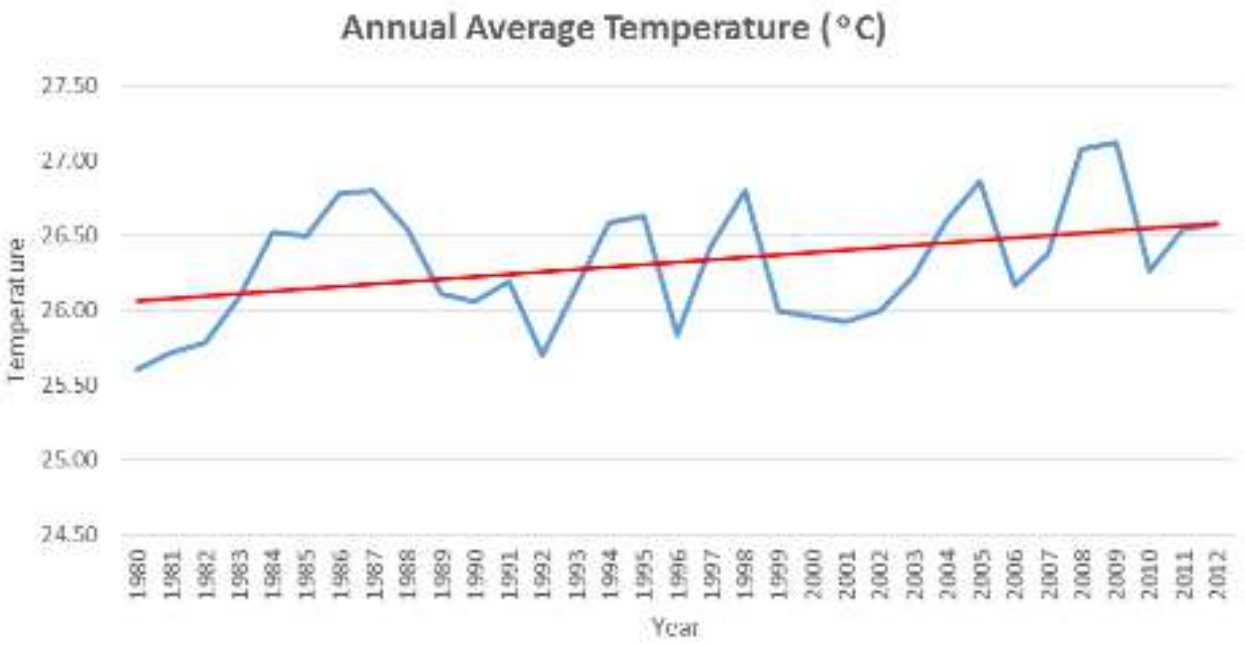


Figure 35: Trend of Annual Minimum Temperature for Narayanganj



46 An analysis of the temperature change of Dhaka city; Hossain Mohiuddin et.al.

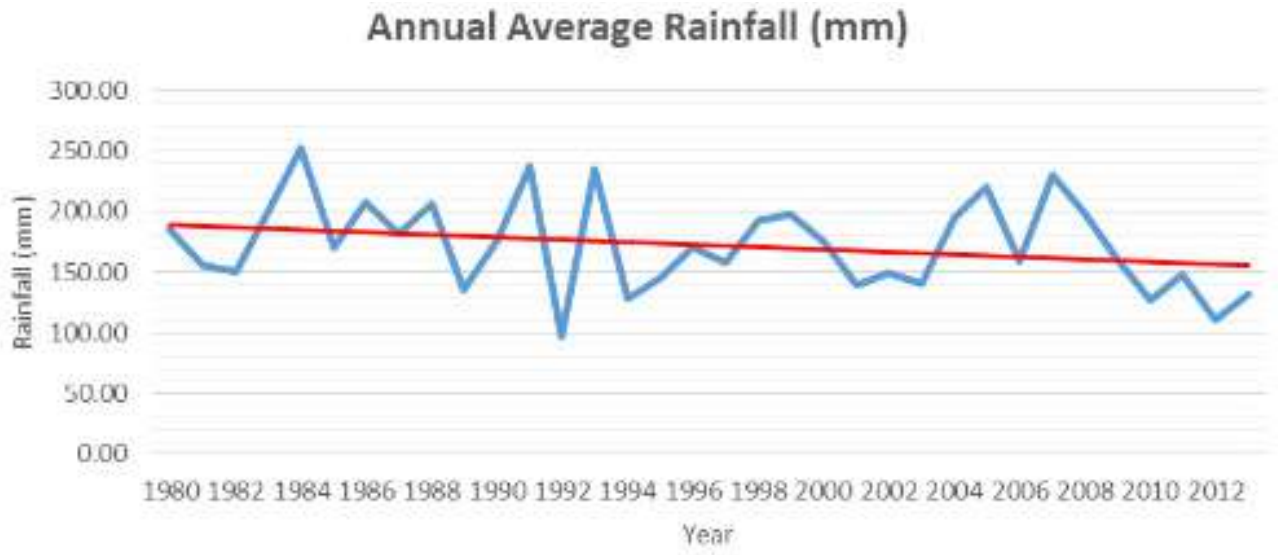
Figure 36: Trend of Annual Average Temperature for Narayanganj



The annual precipitation data of Dhaka over a 33-year period, from 1980-2013, shows a downward trend. Rainfall during monsoon displays a slightly increasing trend over the years. But the total rainfall or precipitation in other seasons is observed to decrease significantly.

On the other hand, a study on annual daily rainfall in Dhaka indicates an increase at the rate of 4.54 mm per year for the last 57 years. However, post 2000 (i.e. from 2000 to 2009), the increase rate is much higher, at 55.90 mm per year[47]. Another study on the regional temperature and rainfall trend shows no significant change in the trend of rainfall for Dhaka city[48].

Figure 37: Trend of Annual Average Rainfall for Narayanganj



47 Variability of annual daily maximum rainfall of Dhaka, Bangladesh; Faisal Ahammed et al.

48 Regional Variation of Temperature and Rainfall in Bangladesh: Estimation of Trend; Abdur Rahman et al.

Figure 38: Trend of Total Rainfall in Summer (March-May) for Narayanganj

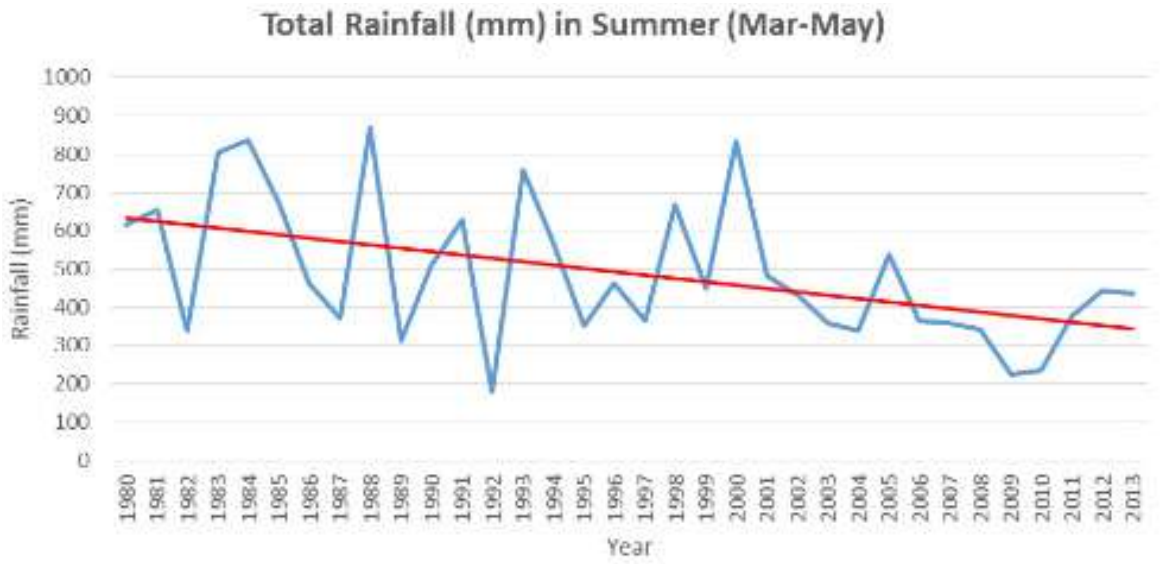


Figure 39: Trend of Total Rainfall in Monsoon (June – August) for Narayanganj

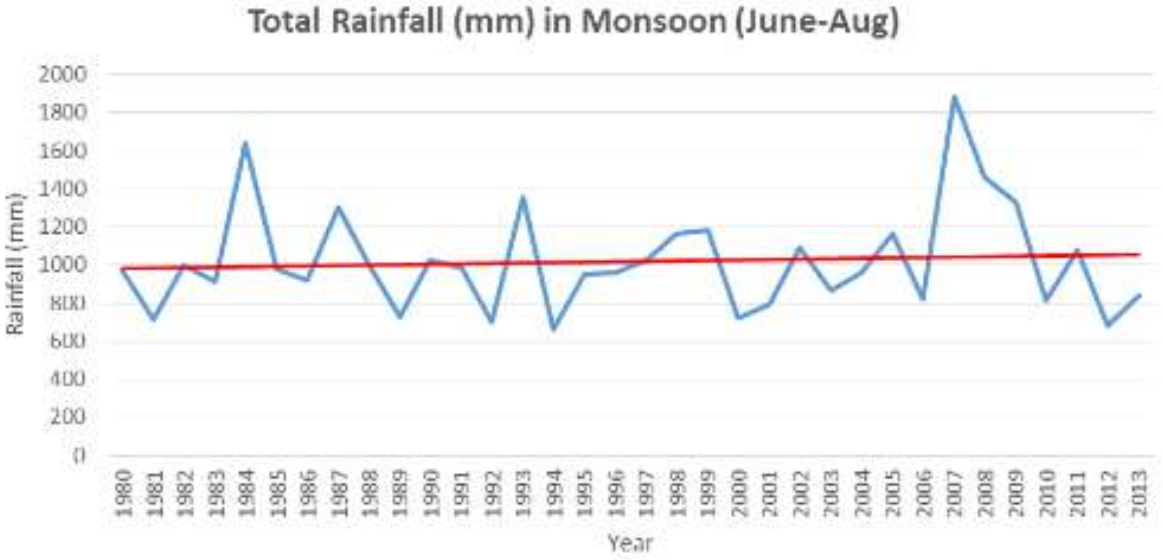


Figure 40: Trend of Total Rainfall in Autumn (September-October) for Narayanganj

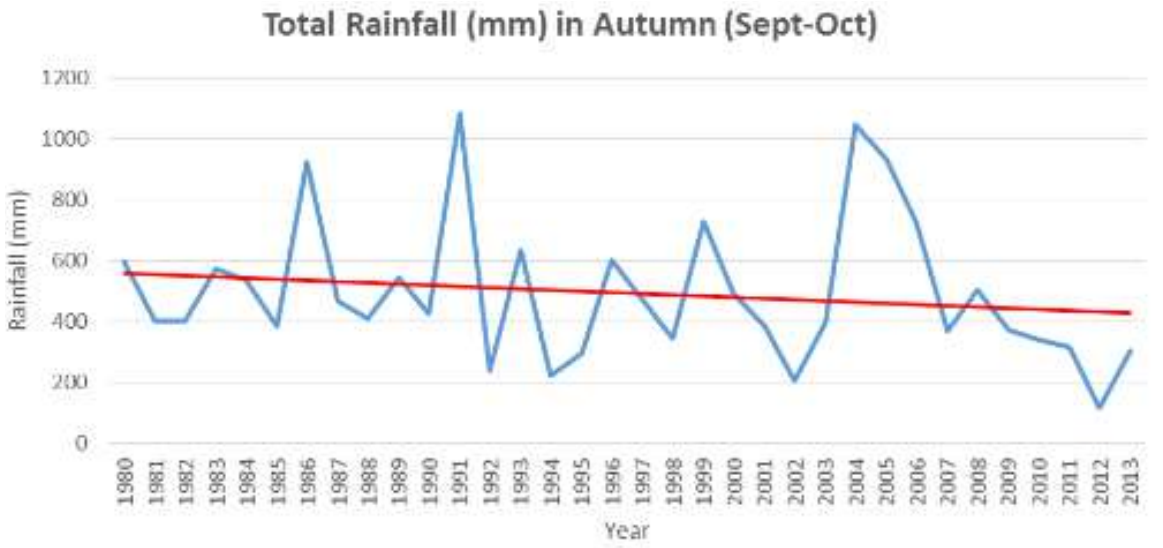
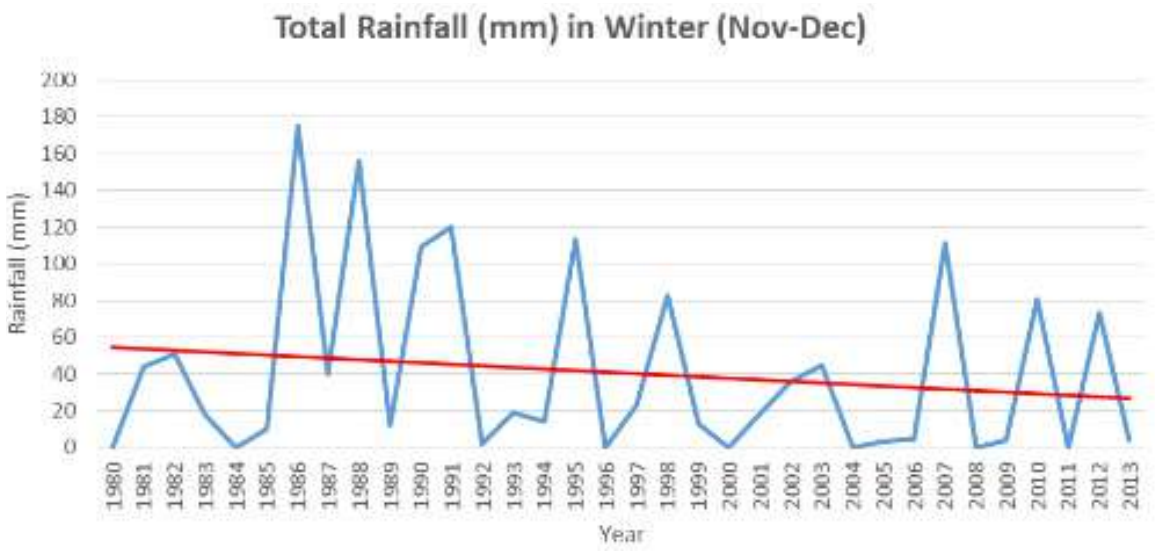


Figure 41: Trend of Total Rainfall in Winter (November-December) for Narayanganj



4.3 Climate Change Projection and Climate Scenario Statement

There is no specific literature available detailing climatic projections for various regions in Bangladesh. National-level climate projections from the National Plan for Disaster Management (2010-2015) published by the Government of Bangladesh and the Vulnerability, Risk Reduction and Adaptation to Climate Change, Climate Risk and Adaptation Country Profile (2011), published by World Bank are referred in this section. The National Plan for Disaster Management used the regional climate model PRECIS to estimate future climate projections for Bangladesh.

Table 21: Climate Scenario Statement

Changing Climate Conditions	Assessment	Climate Scenario Summary Statement
Precipitation Change	National Assessment[49]	Pre-monsoon rainfall will decrease while monsoon and post-monsoon rainfall will increase. From 2051 onwards, annual average rainfall and monsoon rainfall will follow a higher increasing trend.
	National Assessment[50]	There will be an increase in the amount of run-off, and rainfall intensity.
Temperature Change	National Assessment[51]	The monthly average maximum temperature will increase during the monsoon period and will decrease in other periods. The monthly average minimum temperature will increase in all periods and the annual maximum and minimum temperature will follow an increasing trend.
	National Assessment[52]	Mean temperatures across Bangladesh are projected to increase between 1.4°C and 2.4°C by 2050 and 2100, respectively.

During stakeholder consultations undertaken as part of the Climate Risk and Vulnerability Assessment process, these projections were discussed in detail. Stakeholders observed that although temperature in the city seems to be increasing over the years, rainfall seems to be decreasing. This is also evident from the analysis of historic rainfall trends. The main climate risks are therefore identified as:

49 Government of Bangladesh. 2010. National Plan for Disaster Management, 2010 – 2015, Disaster Management Bureau, Disaster Management & Relief Division, Government of Bangladesh.

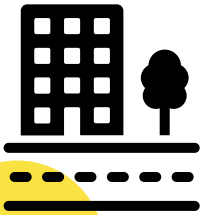
50 The World Bank Group. 2011. Vulnerability, Risk Reduction and Adaptation to Climate Change. Climate Risk and Adaptation Country Profile, Bangladesh. The World Bank Group, Global Facility for Disaster Reduction and Recovery, Climate Investment Funds. https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_BGD.pdf

51 Government of Bangladesh. 2010. National Plan for Disaster Management, 2010 – 2015, Disaster Management Bureau, Disaster Management & Relief Division, Government of Bangladesh.

52 The World Bank Group. 2011. Vulnerability, Risk Reduction and Adaptation to Climate Change. Climate Risk and Adaptation Country Profile, Bangladesh. The World Bank Group, Global Facility for Disaster Reduction and Recovery, Climate Investment Funds. https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_BGD.pdf

4.3.1 Climate Impact Assessment

Climate impact assessment of urban systems helps to evaluate their fragility with respect to the identified climate impacts. These urban systems include 'Core Systems' such as Water, Energy, and Transport which are essential for functioning of the city and 'Secondary Systems' such as Health, Education, and Sanitation which rely on the core systems. The urban system analysis identified five fragile urban systems for Narayanganj through extensive discussions with Narayanganj's Core Climate Team and Stakeholder Committee in Shared Learning dialogues (SLDs):



The urban system analysis identified five fragile urban systems for Narayanganj through extensive discussions with Narayanganj's Core Climate Team and Stakeholder Committee in Shared Learning dialogues (SLDs).

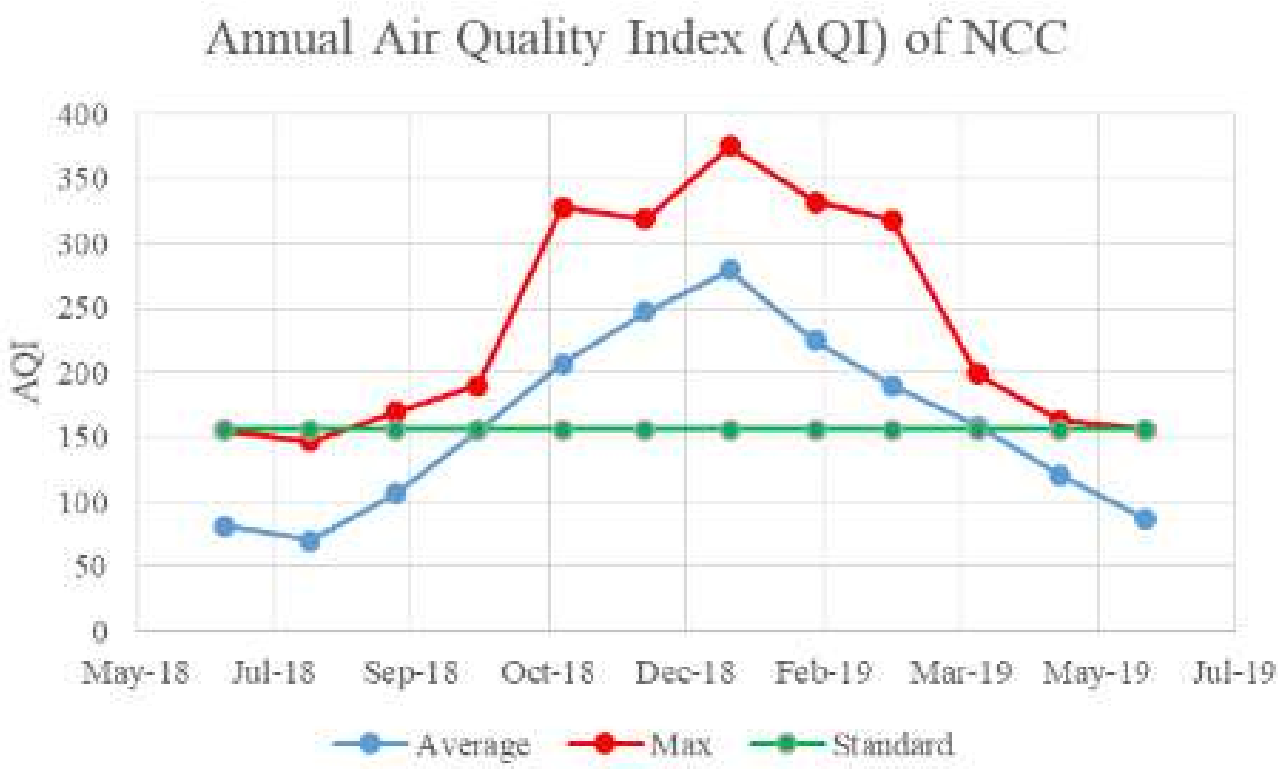
4.3.2 Urban Systems Analysis

4.3.2.1 Air Quality

Situation Analysis

Air quality is identified as one of the most vulnerable urban system in Narayanganj. Department of Environment (DoE) under the Ministry of Environment, Forest and Climate Change (MoEFCC) has installed a Continuous Air Monitoring Station (CAMS) in Narayanganj under Clean Air & Sustainable Environment (CASE) project supported by World Bank to monitor the city's ambient air quality. The CAMS monitors air pollutants including SO_2, NO_2, CO, PM10, and PM2.5 along with other meteorological parameters. The CASE project publishes monthly air quality reports based on the monthly average readings of each pollutant and estimates the Air Quality Index (AQI) based on PM2.5 concentration in the air.

Figure 42: Air Quality Index of Narayanganj



Annual AQI data indicates that the monthly average exceeds the national AQI standard of 156 in seven consecutive months, from September to March. Monthly maximum concentration of PM2.5 exceeds the national standard all across the year, except for July[53]. Air quality is considerably good during monsoon, yet unhealthy in terms of international standards.

Fragility Statement

The urban fragility statement for this system is "Being a primarily industrial city, air quality is poor, with dust and particulate matter as major pollutants from thermal power plants, cement plants, steel rolling mills, and textile mills. Lung diseases are common in slum areas".

Climate Fragility Statement

Dust and particulate matter are major pollutants in the city. Decreased precipitation can increase air pollution and lead to increased risk of lung diseases.

WASA supplied about 92.2 MLD of water to 27,000 residential units out of a total 54,012 residential units within the city area. Two treatment plants exist at Godnail and Sonakanda, with a total capacity of 55 MLD

4.3.2.2 Water

Situation Analysis

DWASA, NCC and Department of Public Health Engineering (DPHE) jointly manage water supply and sanitation in Narayanganj. Before handing over responsibility of Water Supply to NCC in October 2019, DWASA served the core area of Narayanganj and the Kadam Rasul area (Blocks-01, 02, 04, 05, 06) through piped supply. In 2018-19, DWASA operated 31 water pumping stations and 2 water treatment plants for provision of water supply to the city. WASA supplied about 92.2 MLD of water to 27,000 residential units out of a total 54,012 residential units within the city area. Two treatment plants exist at Godnail and Sonakanda, with a total capacity of 55 MLD. On 31st October 2019, Dhaka WASA handed over the responsibility to NCC. A total 31 deep tube-wells, 32 street hydrants, eight overhead water tanks and two water treatment plants with 160 employees were handed over to NCC.

53 http://case.doe.gov.bd/

Fragility Statement

The urban fragility statement for this system is "Water supplied from WASA plant is mainly used for non-drinking purposes, while residents rely largely on tube well water for drinking. Indiscriminate withdrawal of water through deep tube wells is lowering the ground water level".

Climate Fragility Statement

Climate Fragility Statement

Water sources used to supply drinking water are polluted from domestic and industrial effluents. High temperature and low rainfall can cause higher demand on water resources, and lead to greater abstraction of groundwater and depletion of water table. Lower rainfall can cause greater pollution of surface water.

4.3.2.3 Sanitation and Waste Water

Situation Analysis

At present, there is no centralized wastewater treatment facility in Narayanganj. As a result, household wastewater is discharged directly to the river and local water bodies without treatment. Although most households have on-site septic tanks, but the septage is released to the river and waterbodies without requisite treatment or disposal, when these tanks are full. A study shows that almost 80% industries in Dhaka-Narayanganj-Demra (DND) area have no effluent treatment plants. Due to irregular monitoring, these industries are releasing untreated or inadequately treated effluents into the River and canals. As a result, surface water in Narayanganj is highly polluted. The BOD value of the effluents varies from 415 to 770 mg/L and the average value is 573 mg/L, which is 14 to 18 times higher than the DoE standard. Again, the COD value of effluents varies from 860 to 1560 mg/L and the average value was found 815 mg/L, which is around 4 to 9 times higher than the DoE standard.[54]

At present, there is no centralized wastewater treatment facility in Narayanganj. As a result, household wastewater is discharged directly to the river and local water bodies without treatment.

Fragility Statement

The urban fragility statement for this system is "Lack of facilities to collect and treat wastewater is leading to release of effluents, both domestic and industrial, to the nearby river and polluting the river. Since the River water is also used for water supply in the city, it impacts health of the population".

Climate Fragility Statement

High temperature and lower rainfall can increase concentration of pollutants in water sources and cause health risks to the population.

4.3.2.4 Solid Waste

Situation Analysis

NCC's Conservancy Department is responsible for waste collection, transportation and management. In 2018-19, the city generated about 400 TPD of municipal waste. Industrial, commercial and residential wastes account for 10%, 20% and 70% of waste generation respectively. Efficiency of municipal waste collection lies between 80-90% as per NCC. Domestic waste is predominantly composed of food, vegetables, and fruits (more than 70% organics) along with polyethylene, paper and cloth. Waste is dumped in an unscientific manner at three dumpsites. The uncollected waste remains untreated and is dumped in open land, ponds, canals and River. NCC and PDB have commenced construction of a waste to energy plan to treat solid waste and produce energy.

54 Impact of the Effluents of Textile Dyeing Industries on the Surface Water Quality inside D.N.D Embankment, Narayanganj; Mahfuza S. Sultana et al.

Fragility Statement

The urban fragility statement for this system is "Lack of proper waste treatment and processing facilities is leading to open dumping of waste. Lack of segregation at source is leading to mixed waste that is difficult to process".

Climate Fragility Statement

High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.

4.3.2.5 Transport

Situation Analysis

Narayanganj city is well connected with the nearby cities by road, rail and waterways. The city's road network extends to 609 km. The roads in many parts experience large traffic load, especially due to overweight freight trucks. Poor quality of road construction along with heavy traffic load has resulted in loss of bitumen and led to damage of road surface and pot holes in many stretches.

Fragility Statement

The urban fragility statement for this system is "Damaged roads and high pollution levels because of lack of regulatory control over freight vehicles".

Climate Fragility Statement

Water logging can cause traffic congestion, leading to higher air pollution and emissions. Accessibility can be limited due to inadequate public transport and last mile connectivity. Water freight can lead to higher concentration of water pollutants in the river during low rainfall periods.

High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.

4.4 Risk Assessment

The climate risks associated with the fragilities of the systems were estimated through a risk assessment exercise conducted by the local Stakeholder Committee during the SLD. The fragile urban systems with the highest risks as per the assessment were investigated further.

The risk score for each climate fragility statement is defined as a combination of the likelihood of an event occurring and the consequences faced if the event occurred.

Table 22: Risk Assessment for the Identified Fragile Urban Systems

Urban Systems	Climate fragility statement	Risk Score	Risk Status
Air quality	Dust and particulate matter are major pollutants in the city. Decreased precipitation can increase air pollution and lead to increased risk of lung diseases.	16	High
Water	Water sources used to supply drinking water are polluted from domestic and industrial effluents. High temperature and low rainfall can cause higher demand on water resources, and lead to greater abstraction of groundwater and depletion of water table. Lower rainfall can cause greater pollution of surface water.	20	Extreme

Urban Systems	Climate fragility statement	Risk Score	Risk Status
Sanitation/ Wastewater	High temperature and lower rainfall can increase concentration of pollutants in water sources and cause health risks to the population.	16	High
Solid Waste	High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.	9	Medium
Transport	Water logging can cause traffic congestion, leading to higher air pollution and emissions. Accessibility can be limited due to inadequate public transport and last mile connectivity. Water freight can lead to higher concentration of water pollutants in the river during low rainfall periods.	20	Extreme

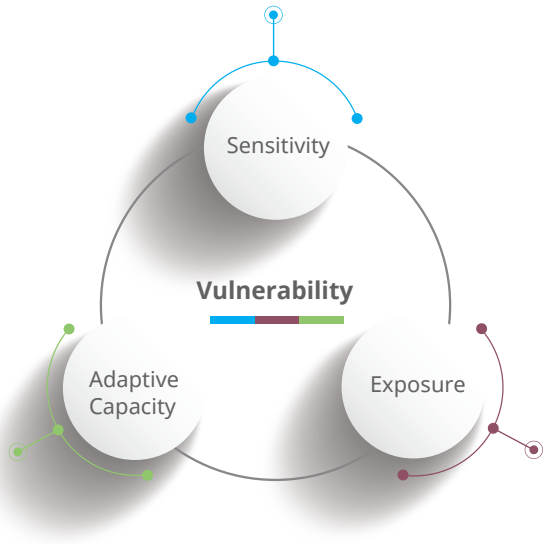
Based on this risk assessment, two fragile urban systems – water quality and transportation show extreme risk while air quality and sanitation and waste water show a high risk. All of these urban systems require urgent attention but water quality, transportation and air quality particularly should be prioritized as per inputs from local stakeholders.

4.5 VULNERABILITY ASSESSMENT

4.5.1 Overview

In order to build resilience there is a need to understand the extent of vulnerability of the city to climate change. This vulnerability depends upon the geographical location, demography, infrastructure, socio economic condition, and ecological condition of the city. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as a function of three parameters of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity[55].

Figure 43: Vulnerability Constituents



55 IPCC, 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Annex I., M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK.

The vulnerability assessment consists of identification of areas vulnerable to the identified climate risks and actors. This is done for all the prioritized climate fragility statements of the fragile urban systems and includes an analysis of the adaptive capacities of the actors and the urban systems themselves. Vulnerability assessment of Narayanganj city was carried out in consideration of the following elements:

1. **Identification of Vulnerable Places:** Areas that are highly vulnerable to the identified fragile urban systems of the city were identified and mapped to arrive at vulnerability hotspots affected by maximum number of fragile urban systems.

2. **Identification of Actors and their Adaptive Capacity:** In each of the vulnerable areas, the actors that play a critical role towards building urban resilience were identified and assessed in terms of their capacity to organize and respond to threat or disruption, access to resources necessary for response (manpower, technology, funds) and access to information necessary to develop effective plans and actions and to improve responses to disruptions. These determine the adaptive capacity/ resilience of the identified actors for a particular fragile system.

3. **Assessment of Adaptive Capacities of Fragile Urban Systems:** Adaptive capacity of urban systems is its capacity to absorb and respond to shocks that determines their resilience. The adaptive capacity was determined in the context of economy, technology/infrastructure, governance, social systems and ecosystems.

The sections below identify the vulnerable areas, vulnerable actors and adaptive capacity of the fragile urban systems using the Climate Fragility Statements developed in consultation with the local Stakeholder Committee/Group.

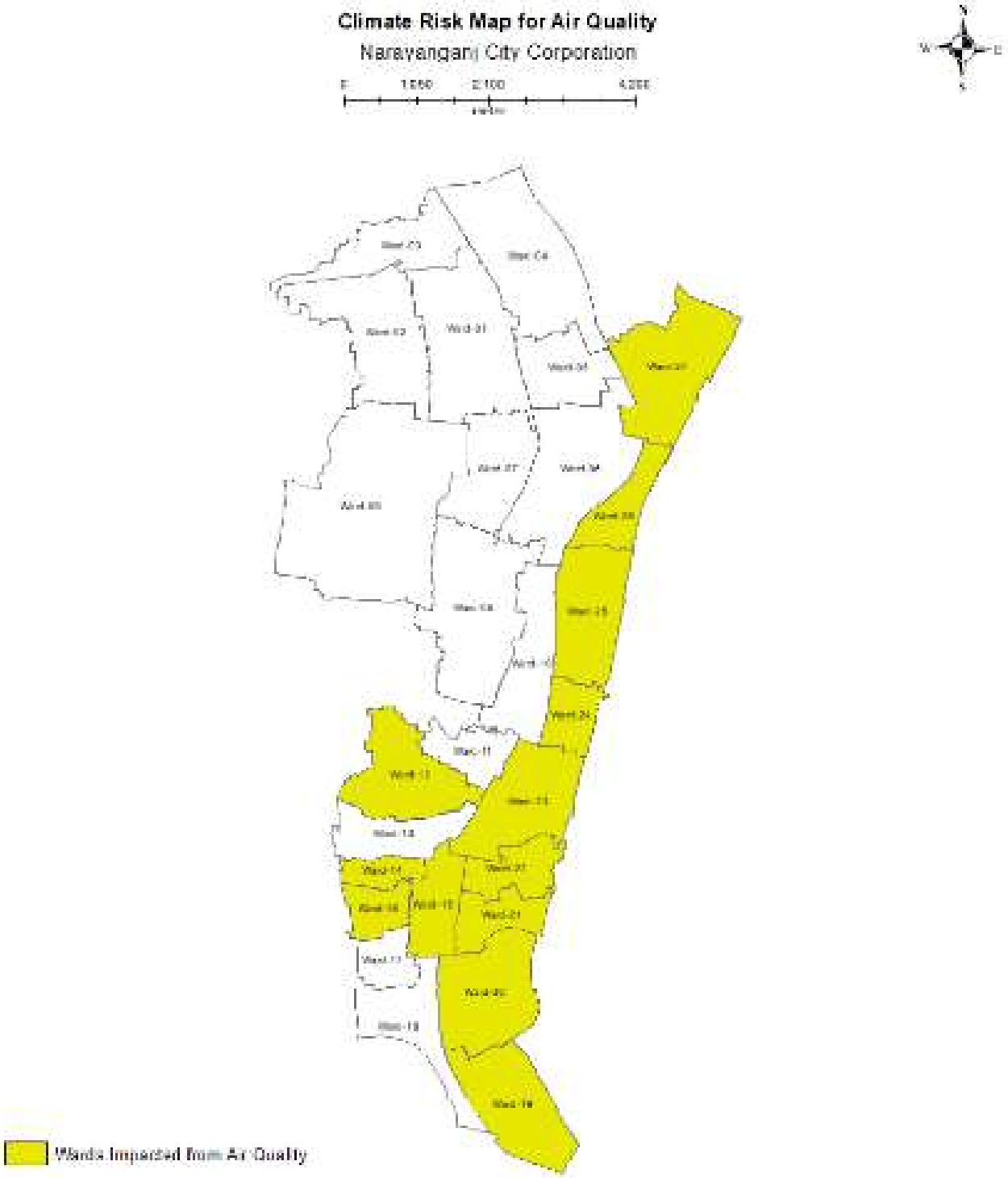
4.5.2 Identification of Vulnerable Places

4.5.2.1 Air Quality: Vulnerable Areas

Table 23: Climate Vulnerable Areas for Air Quality

Climate Vulnerability Statement	Areas/ Wards Most Vulnerable
Dust and particulate matter are major pollutants in the city. Decreased precipitation can increase air pollution and lead to increased risk of lung diseases.	◆ Chasara Intersection, Ward 12 – Road dust and vehicular smoke ◆ Ward 19, 20, 21, 22, 23, 24, 25, 26, 27 – Cement Factory ◆ Ward 15, 16, 17 – Garments ◆ Ward 25, 26, 27 – Cotton Mills ◆ Ward 06 – EPZ ◆ Nitaiganj, Ward 18 – Grain Dust

Figure 44: Climate Risk Map for Air Quality



4.5.2.2 Water: Vulnerable Areas

Table 24: Climate Vulnerable Areas for Water

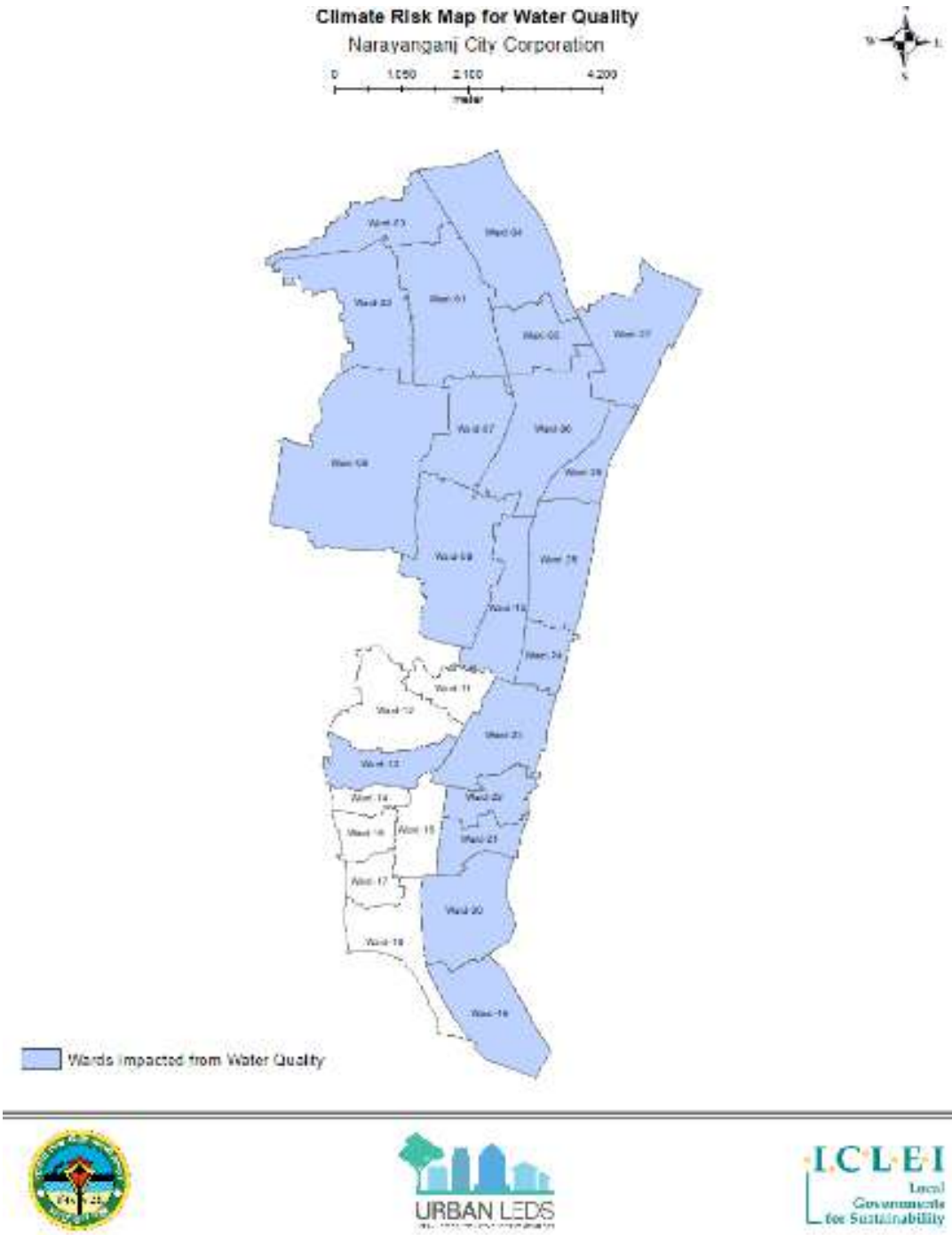
Climate Vulnerability Statement

Water sources used to supply drinking water are polluted from domestic and industrial effluents. High temperature and low rainfall can cause higher demand on water resources, and lead to greater abstraction of groundwater and depletion of water table. Lower rainfall can cause greater pollution of surface water.

Areas/ Wards Most Vulnerable

- Bandar Area, Ward 19, 20, 21, 22, 23, 24, 25, 26, 27
- Siddirganj
- DND Area
- Ward 06, 13 – EPZ and BISIC area
- Ward 08, 10 – Industrial Area

Figure 45: Climate Risk Map for Water



4.5.2.3 Sanitation and Wastewater: Vulnerable Areas

Table 25: Climate Vulnerable Areas for Sanitation and Wastewater

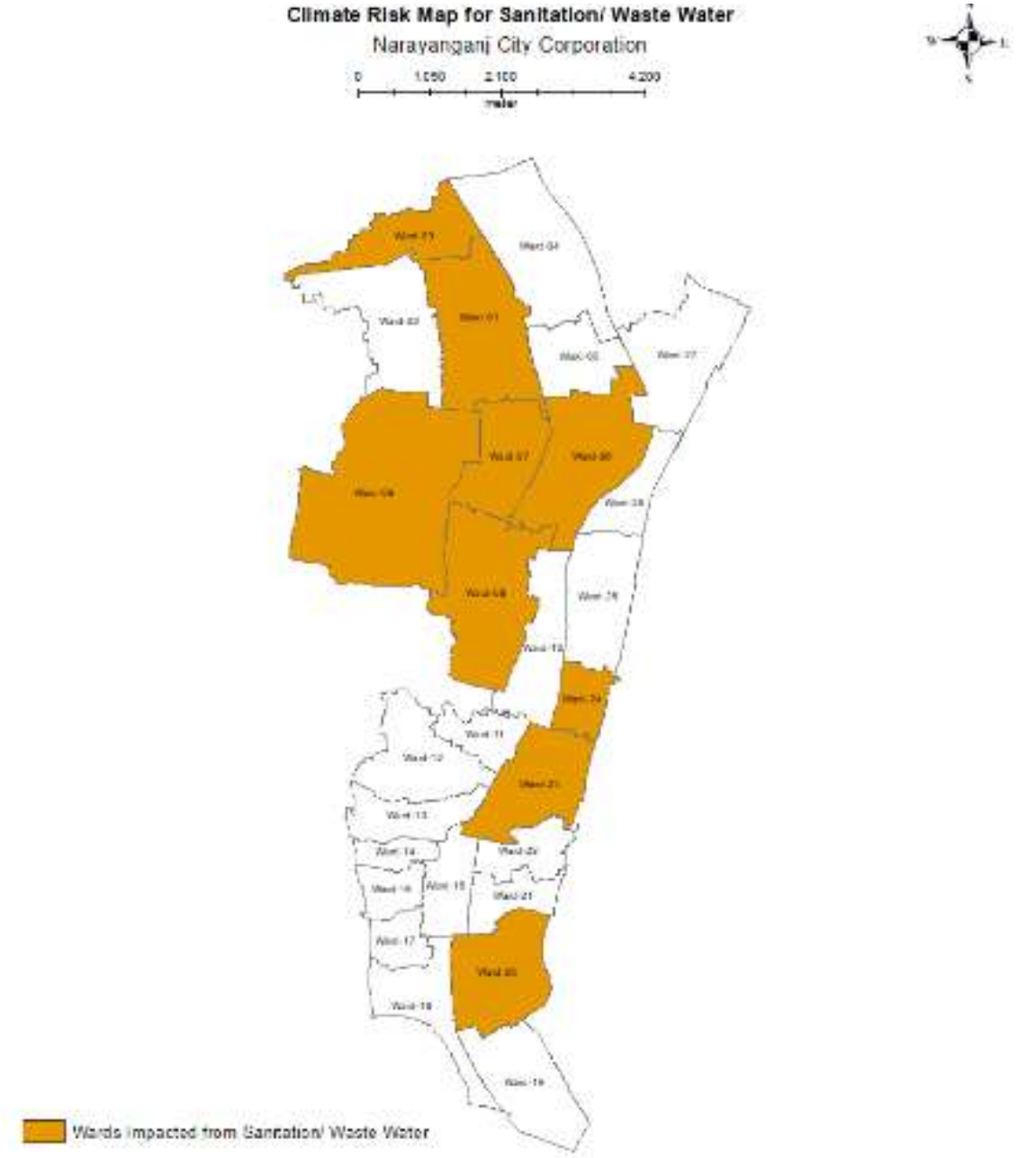
Climate Vulnerability Statement

High temperature and lower rainfall can increase concentration of pollutants in water sources and cause health risks to the population.

Areas/ Wards Most Vulnerable

- Bihari Colony, Ward 06; Shanti Nagar, Ward 23; Ward 20
- DND Area, Ward 01, 02, 03, 07, 08, 09 – Most Severe Area
- Nurbagh, Ward 18; Rasulbagh, Ward 27 – No Soak well

Figure 46: Climate Risk Map for Sanitation and Wastewater



4.5.2.4 Solid Waste: Vulnerable Areas

Table 26: Climate Vulnerable Areas for Solid Waste

Climate Vulnerability Statement

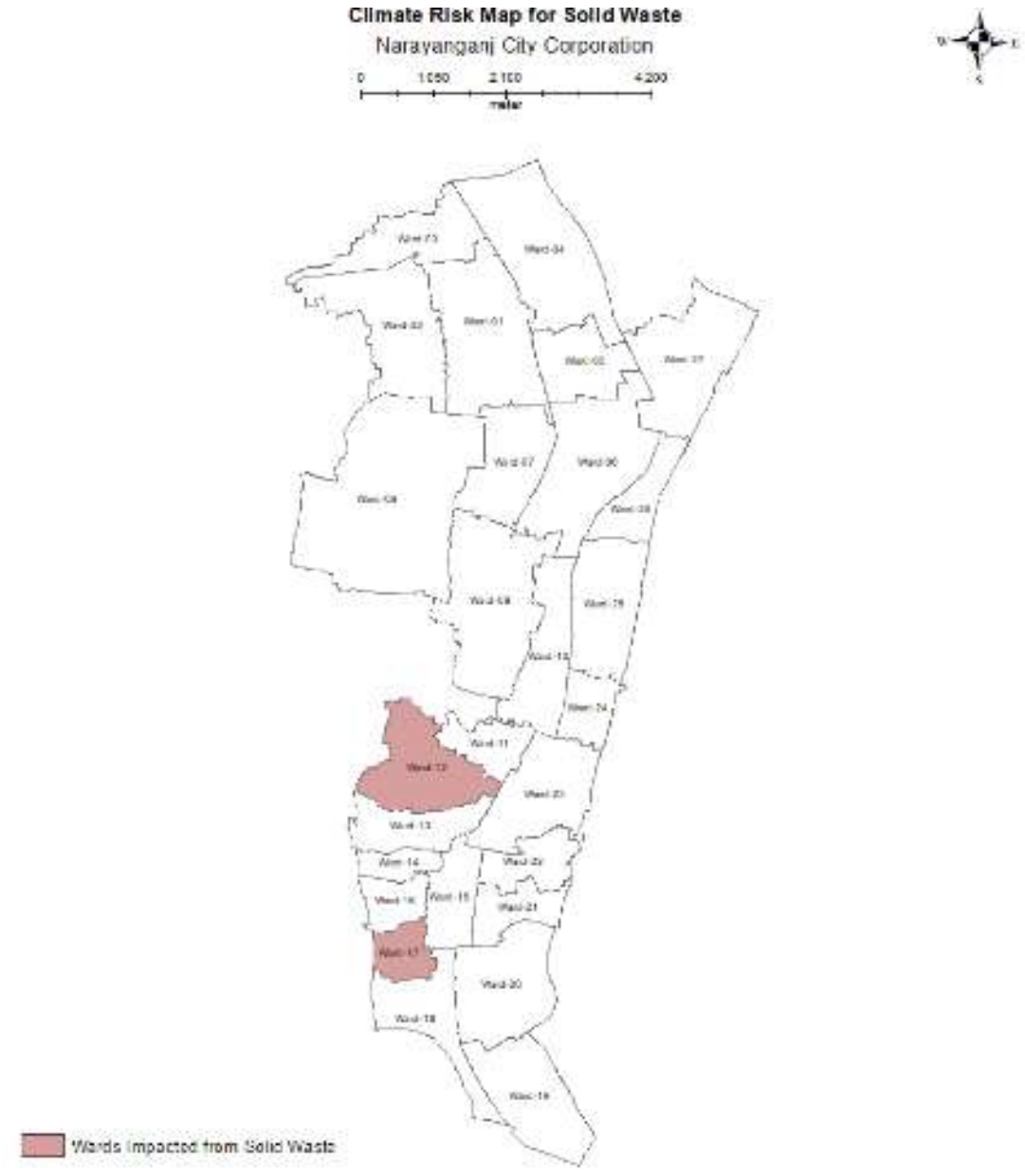
High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.

This can cause water logging and related health impacts.

Areas/ Wards Most Vulnerable

- Mission Para, Ward 12 – Construction Materials clogs the drain
- Paikpara, Ward 17

Figure 47: Climate Risk Map for Solid Waste



4.5.2.5 Transport: Vulnerable Areas

Table 27: Climate Vulnerable Areas for Transportation

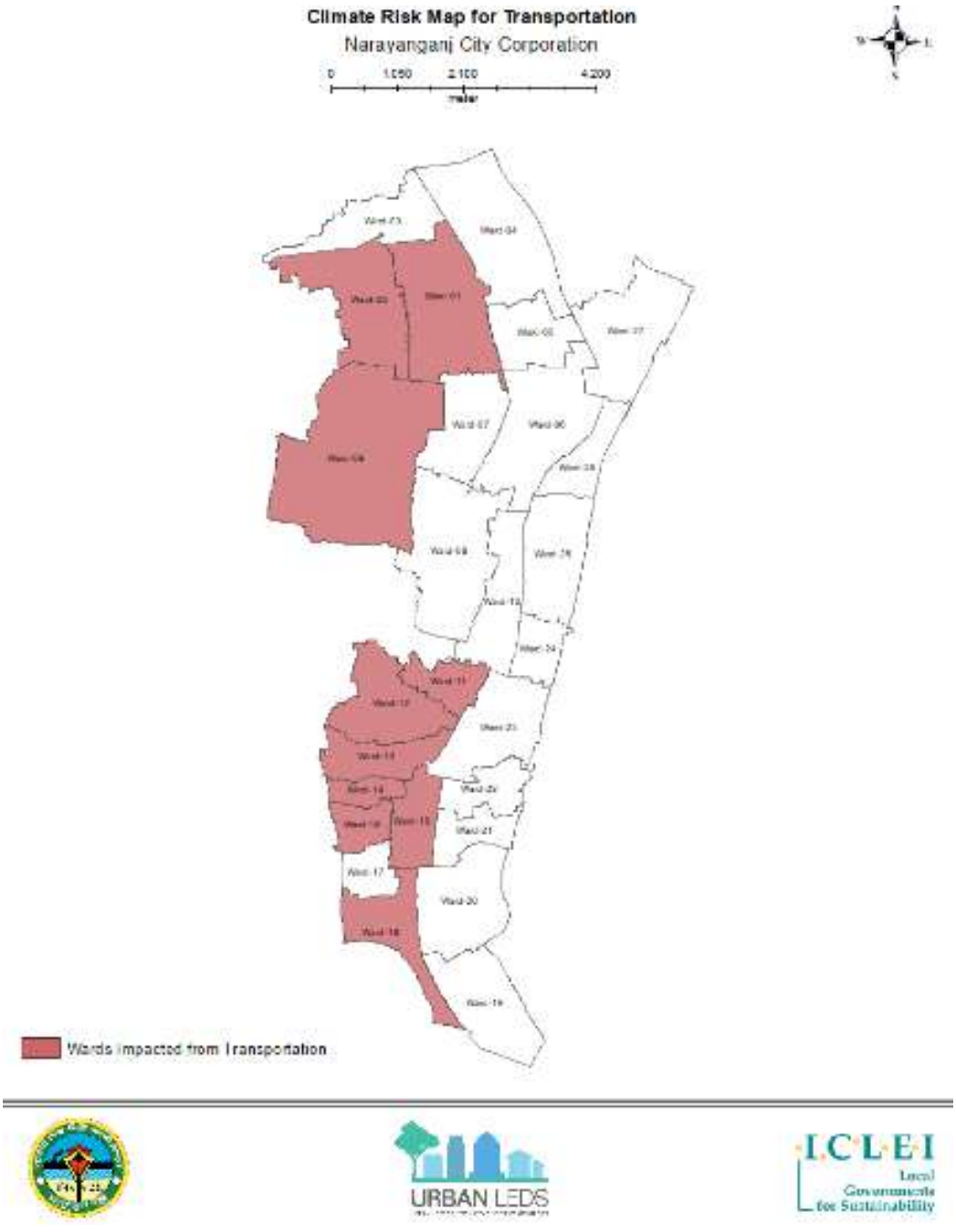
Climate Vulnerability Statement

Water logging can cause traffic congestion, leading to higher air pollution and emissions. Accessibility can be limited due to inadequate public transport and last mile connectivity. Water freight can lead to higher concentration of water pollutants in the river during low rainfall periods.

Areas/ Wards Most Vulnerable

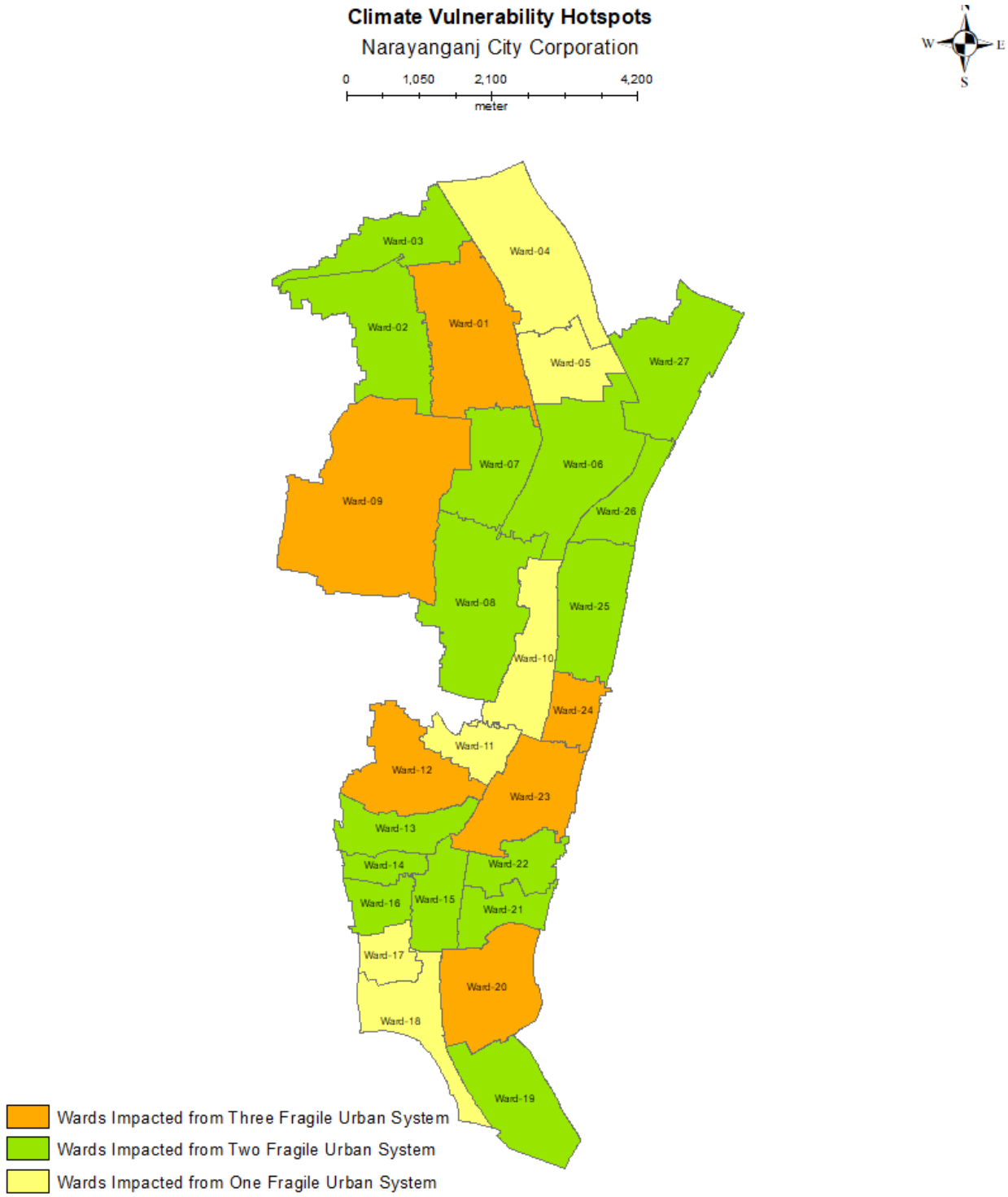
- Signboard to Chasara, Ward 01, 02, 09, 11, 12, 13
- Ward 08, 09, 10, 14, 15, 16, 18 – Heavy Vehicular Movement
- BB Road, Ward 14, 15 – Rail Crossing causes 3-4 hrs of congestion every day
- 1 No Rail Gate, Ward 15; 2 No Rail Gate, Ward 14, 15; Chasara Intersection, Ward 12, 13

Figure 48: Climate Risk Map for Transportation



Through this assessment, wards 1, 9, 12, 20, 23, and 24 are found to be vulnerable from three out of five fragile urban systems. Wards 2, 3, 6, 7, 8, 13, 14, 15, 16, 19, 21, 22, 25, 26, and 27 are vulnerable from two fragile urban systems and rest of the wards are vulnerable from one fragile urban system, making them least vulnerable compared to other wards.

Figure 49: Climate Vulnerability Hotspots for Narayanganj City



4.5.3 Identification of Actors and their Adaptive Capacity

An analysis of the actors within the wards identified as vulnerable revealed that they had very poor levels of adaptive capacities. The NCC has high adaptive capacity since they have access to resources, information and ability to respond to stress. This is also true for government agencies like RAJUK, DoE or the non-government organisations. However, common citizens including daily labourers, women, children, elderly, and others due to either a lack of information and education, or a lack of financial resources lack the capacity to adequately respond to stress and therefore have low adaptive capacity. Table 11 shows the adaptive capacities of the actors for each fragile urban system.

Table 28: Analysis of the adaptive capacities of local actors identified

Fragile Urban System	Climate Fragility Statements	Area/ward most vulnerable	Actors	Level of Adaptive Capacity
Air quality	Dust and particulate matter are major pollutants in the city. Decreased precipitation can increase air pollution and lead to increased risk of lung diseases.	◆ 15 - Kitchen market; ◆ 12 - Chashara more; ◆ Bandar 19- 24, 14, 15, 16 – ◆ Garments; 25, 26, 27 - ◆ Cotton factory; 18- Nitaiganj	Residents	Medium
			Children	Low
			Elderly	Low
			Women	Low
			Slum dwellers	Medium
			Daily labours	Low
			Factory workers	Medium
			Industry owners	High
			NCC	High
			City Development Coordination Committee (CDCC)	High
			CSCC	High
			Policy makers	High
			DoE	High
			NGOs/CBOs	High
			School/College	Medium
			RAJUK	High
			Religious leaders	Medium
			Community leaders	Medium
			Media	High
			Garment industry	High
			Cotton industry	Medium

Fragile Urban System	Climate Fragility Statements	Area/ward most vulnerable	Actors	Level of Adaptive Capacity
Water quality	Water sources used to supply drinking water are polluted from domestic and industrial effluents. High temperature and low rainfall can cause higher demand on water resources, and lead to greater abstraction of groundwater and depletion of water table. Lower rainfall can cause greater pollution of surface water.	◆ Bandar - 19-27, Siddirganj; ◆ DND area ◆ Ward 13; ◆ Ward 6 – EPZ; ◆ Ward 10,8 - Garments industry abstracts water	Residents	Medium
			Children	Low
			Elderly	Low
			Women	Low
			Slum dwellers	Medium
			Industry owners	High
			Water Development Board	High
			NCC	High
			CDCC	High
			CSCC	High
			Policy makers	High
			DoE	High
			NGOs/CBOs	
			RAJUK	High
			School/Colleges	Medium
			Religious leaders	Medium
			Community leaders	Medium
			Media	High
			WASA	High
			Garment industry	High
Sanitation and waste water	High temperature and lower rainfall can increase concentration of pollutants in water sources and cause health risks to the population.	◆ 1, 3, 7, 8, 9 - DND area; ◆ 6 - Bihari Colony; ◆ 20, 23, 24- Selapara, Master para; ◆ 20 - Hazipur, Bagbari; ◆ 23 - Rasulbag, Shantinagar, Noorbag, Charshomil para	Residents	Medium
			Children	Low
			Elderly	Low
			Women	Low
			Slum dwellers	Medium
			Daily labours	Low
			Factory workers	Medium
			Water Development Board	High
			NCC	High
			CDCC	High
			CSCC	High
			Policy makers	High
			DoE	High
			NGOs	High
			CBOs	High
			School/Colleges	Medium
			Religious leaders	Medium
			Community leaders	Medium
			Media	High
			Industry owners	High

Fragile Urban System	Climate Fragility Statements	Area/ward most vulnerable	Actors	Level of Adaptive Capacity
Solid waste	High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.	◆ Mission Para, Ward 12 – Construction Materials clogs the drain ◆ Paikpara, Ward 17	Residents	Medium
			Children	Low
			Elderly	Low
			Women	Low
			Slum dwellers	Medium
			NCC	High
			CDCC	High
			CSCC	High
			Policy makers	High
			DoE	High
			NGOs	High
			CBOs	High
			School/Colleges	Medium
			Religious leaders	Medium
			Community leaders	Medium
			Media	High
Transport	Water logging can cause traffic congestion, leading to higher air pollution and emissions. Accessibility can be limited due to inadequate public transport and last mile connectivity. Water freight can lead to higher concentration of water pollutants in the river during low rainfall periods.	◆ Signboard to Chasara, Ward 01, 02, 09, 11, 12, 13 ◆ Ward 08, 09, 10, 14, 15, 16, 18 – Heavy Vehicular Movement ◆ BB Road, Ward 14, 15 – Rail Crossing causes 3-4 hrs of congestion every day ◆ 1 No Rail Gate, Ward 15; 2 No Rail Gate, Ward 14, 15; Chasara Intersection, Ward 12, 13	Residents	Medium
			Children	Low
			Elderly	Low
			Women	Low
			Roads and Highway Department	High
			Daily labours	Low
			Traffic police	High
			Rickshaw pullers	Low
			NCC	High
			CDCC	High
			CSCC	High
			Policy makers	High
			RAJUK	High
			NGOs	High
			CBOs	High
			BRTA	High
			Media	High

4.5.4 Adaptive Capacity of Fragile Urban Systems

The adaptive capacities of the five identified fragile urban systems were assessed during the SLDs against the five parameters - economy, technology, governance, societal and ecosystem services (Table 29). Several of the systems have medium economic adaptive capacity, since there is funding available for action, however, technological limitations in most of the systems indicate a need to look for and identify suitable means of climate action in these systems. Governance and societal adaptive capacity is also low in all fragile urban systems and needs supportive policy measures.

Table 29: Consolidated vulnerability analysis of Fragile Urban Systems identified for Narayanganj

Fragile Urban System	Climate Fragility Statements	Vulnerable Areas	Urban Actors		Adaptive Capacity of the System		
			Vulnerable	**Potential Supporting**	**Low**	**Medium**	**High**
Air quality	Dust and particulate matter are major pollutants in the city. Decreased precipitation can increase air pollution and lead to increased risk of lung diseases.	• 15 - Kitchen market; • 12 - Chashara more; • Bandar 19-24, 14, 15, 16 – • Garments; 25, 26, 27 - • Cotton factory; 18-Nitaiganj	– Residents – Children – Elderly – Women – Slum dwellers – Daily labours – Factory workers	– Industry owners – NCC – CDCC – CSCC – Policy makers – DoE – NGOs/CBOs – School/College – RAJUK – Religious leaders – Community leaders – Media – Garment industry – Cotton industry	– Technology – Governance – Societal – Ecosystem Services	– Economic	
Water quality	Water sources used to supply drinking water are polluted from domestic and industrial effluents. High temperature and low rainfall can cause higher demand on water resources, and lead to greater abstraction of groundwater and depletion of water table. Lower rainfall can cause greater pollution of surface water.	• Bandar - 19-27, Siddirganj; • DND area • Ward 13; • Ward 6 – EPZ; • Ward 10,8 - Garments industry abstracts water	– Residents – Children – Elderly – Women – Slum dwellers	– Industry owners – Water Development Board – NCC – CDCC – CSCC – Policy makers – DoE – NGOs/CBOs – RAJUK – Scholl/College – Religious leaders – Community leaders – Media – WASA – Garment industry	– Governance – Societal – Ecosystem Services	– Economic – Technology	
Sanitation and waste water	High temperature and lower rainfall can increase concentration of pollutants in water sources and cause health risks to the population.	• 1, 3, 7, 8, 9 - DND area; • 6 - Bihari Colony; • 20, 23, 24-Selapara, Master para; • 20 - Hazipur, Bagbari; • 23 - Rasulbag, Shantinagar, Noorbag, Charshomil para	– Residents – Children – Elderly – Women – Slum dwellers – Daily labours – Factory workers	– Water Development Board – NCC – CDCC – CSCC – Policy makers – DoE – NGOs/CBOs – School/College – Religious leaders – Community leaders – Media – Police – Industry owner	– Technology – Governance – Societal – Ecosystem Services	– Economic	

Fragile Urban System	Climate Fragility Statements	Vulnerable Areas	Urban Actors		Adaptive Capacity of the System		
			Vulnerable	**Potential Supporting**	**Low**	**Medium**	**High**
Solid waste	High intensity rainfall may lead to choking of drains that are blocked with solid waste that remains uncollected. This can cause water logging and related health impacts.	• Mission Para, Ward 12 – Construction Materials clogs the drain • Paikpara, Ward 17	– Residents – Children – Elderly – Women – Slum dweller	– NCC – CDCC – CSCC – Policy makers – DoE – NGOs/CBOs – School/College – Religious leaders – Community leaders – Media	– Societal – Ecosystem Services	– Economic – Technological – Governance	
Transport	Water logging can cause traffic congestion, leading to higher air pollution and emissions. Accessibility can be limited due to inadequate public transport and last mile connectivity. Water freight can lead to higher concentration of water pollutants in the river during low rainfall periods.	• Signboard to Chasara, Ward 01, 02, 09, 11, 12, 13 • Ward 08, 09, 10, 14, 15, 16, 18 – Heavy Vehicular Movement • BB Road, Ward 14, 15 – Rail Crossing causes 3-4 hrs of congestion every day • 1 No Rail Gate, Ward 15; • 2 No Rail Gate, Ward 14, 15; • Chasara Intersection, Ward 12, 13	Residents Children Elderly Women Rickshaw pullers Daily labours	– Roads and Highways Department – Traffic police – NCC – CDCC – CSCC – Policy makers – RAJUK – NGOs/CBOs – BRTA – Media	– Economic – Technological – Governance – Societal – Ecosystem Services		

05

CLIMATE RESILIENCE INTERVENTIONS

The CRCAP of Narayanganj includes climate resilience interventions across the Residential, Commercial, Institutional, Industrial and Municipal service sectors. Municipal services and infrastructure such as Water supply, Wastewater, Stormwater drainage, Solid waste, Transport, Street lighting, Biodiversity and Air quality are also addressed in the action plan. The resilience interventions included in the CRCAP are informed by the baseline sectoral GHG emissions and identified climate vulnerabilities.

Identified sectoral interventions are prioritized based on their resilience capacity, which is assessed in terms of their propensity to increase the redundancy, flexibility, and responsiveness to climate change impacts of the relevant systems as well as GHG reduction potential[56]. The interventions are then assessed for feasibility (technical, financial, and political) and their impact (short, medium or long term). As far as possible, the prioritized interventions are linked to existing city plans and schemes so as to ensure that the required interventions are integrated, with little or no additional resources, into existing departmental programs or projects. The interventions have been discussed with Narayanganj's Climate Core Committee.

The following Table summarizes the selected climate resilience interventions that constitute the CRCAP of Narayanganj. Additional information on the interventions for each sector is provided in section 5.2. This section includes sector specific information, including energy consumption and GHG emissions for the baseline as well as the projected BAU scenario, along with overall GHG emissions mitigation potential and possible energy savings from all interventions for the corresponding sector. The SDGs addressed by the proposed interventions for the sector are included to reflect overall contribution to sustainability.

For the interventions, the specific target location where the intervention should be sited (where relevant), scale of intervention, climate and other co-benefits, ballpark cost estimates, proposed implementation strategies, mode of implementation, entities that are primarily responsible for the implementation, and various schemes and programmes that can support the intervention, are also indicated in section 5.2. To assess the bankability of the interventions, a detailed techno-commercial assessment is required to determine NCC's ability to access budgetary resources as well as repay loans and generate revenue.

CRCAP duration: 5 years (2022-23 to 2026-27)

Mitigation Target: The Climate Resilient City Action Plan proposes actions with an annual GHG emission mitigation potential of 12.6% by 2026-27 over the 2018-2019 baseline.

Adaptation Goal: Narayanganj aims to become a healthy, liveable city sustainably providing basic urban services to all, while managing air quality and economic productivity by incorporating climate resilience in local decision-making processes.

The CRCAP of Narayanganj includes climate resilience interventions across the Residential, Commercial, Institutional, Industrial and Municipal service sectors.

56 See Annexure 3 for further explanation on the key criteria/parameters considered for assessing resilience potential

5.1 Summary of Key Strategies and Measures for Climate Resilience

The CRCAP for Narayanganj city comprises of 24 actions (structural) delineated across 9 thematic areas/sectors that provide a pathway for Narayanganj to enhance climate resilience and move towards a low carbon urban development pathway. These proposed interventions can deliver significant benefits in terms of reducing GHG emissions by lowering energy consumption, as well as reducing municipal expenditure on fuel and electricity.

These identified strategies will not only help reduce GHG emission and better manage local climate risks but will also support the city in its Sustainable Development Goal (SDG) aspirations. Solid Waste Management (61%), Residential Sector (33%), and Commercial & Institutional Sector (3%) are expected to provide most of the GHG emission reduction benefits (see Figure 50).

While these 24 structural actions have direct GHG emission reduction impacts, the CRCAP also recommends additional 'enabling strategies and actions' that enable and inform design and implementation of interventions or provide necessary policy support. Development of a city-wide Water Conservation Policy and preparation of a Low Carbon Transport Plan are examples of enabling actions.

Table 30 provides a summary of the key strategies and interventions for enhancing climate resilience of Narayanganj city. Figure 51 shows the GHG emission reduction scenario on implementation of the CRCAP and interventions therein as compared to the BAU emissions trajectory. Through implementation of ambitious but achievable actions proposed under the CRCAP, the city's GHG emission can be reduced by 12.6% by 2026-27, from the 2018-19 base year.

Table 30: Summary of Climate Resilient City Action Plan and Strategies for Narayanganj

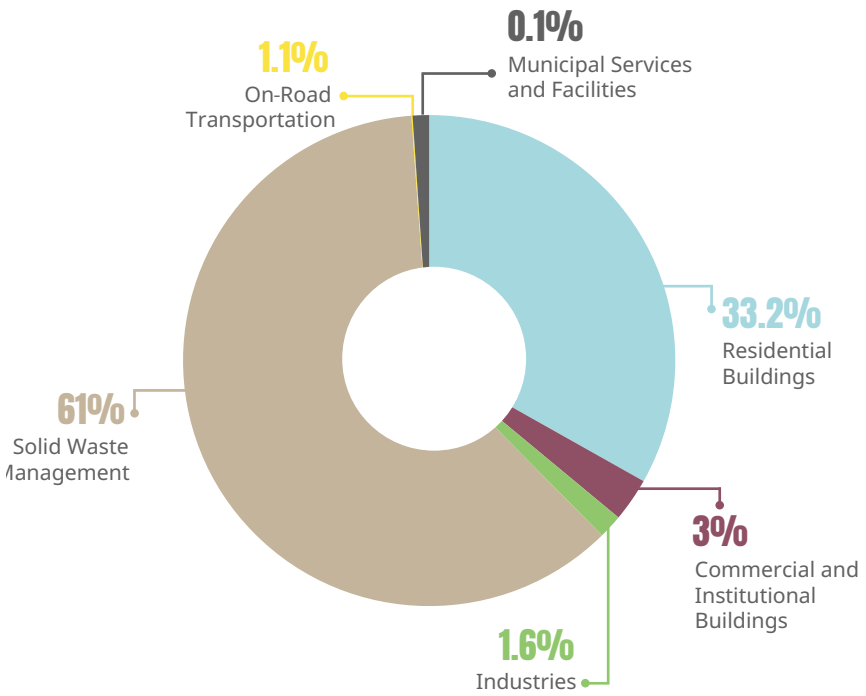
Sectors	Key Strategies	Mitigation Potential (tCO_2e)	Overall Climate Resilience Impact
 Solid Waste	**1 Structural strategies:** Implement waste to energy plant of 500 TPD **2 Enabling strategies:** Strengthen implementation of 3R Strategy	81,652	Higher resource efficiency, lower air & land pollution, & public health risks, reduced waste to landfill
 Buildings Residential	**1 Structural strategies:** Promote renewable energy (RE) (net-metered solar PV & Solar water heating systems) & energy efficiency (EE) adoption (efficient ceiling fans, LED lights, air conditioners) **2 Enabling strategies:** Pilot Green/Eco-building design, programme for rooftop gardening adoption	44,233	Reduced grid dependency, efficient thermal comfort & energy cost savings, heat mitigation, urban food security
 Commercial & institutional buildings	**1 Structural strategies:** Scale-up RE adoption (net metered solar PV & SWHS in hospital, hotels & institutions), EE adoption (LED lights, efficient fans and air conditioners) **2 Enabling strategies:** Policy mandates and incentives for RE & EE in buildings, inefficient appliance exchange programs	3,821	Reduced grid dependency, efficient thermal comfort & energy cost savings
 Industries	**1 Structural strategies:** EE adoption (LED lights, efficient ceiling fans), scale-up solar PV adoption	2,098	Reduced grid dependency, energy & cost savings
 Transport	**1 Structural strategies:** Promote and develop non-motorized transit facilities, introduce public transport through city bus **2 Enabling strategies:** Undertake Comprehensive Traffic Study and prepare Low Carbon Transport Plan	1,434	Reduced traffic congestion & GHG emission, improved air quality, better mobility and accessibility
 Water Supply	**1 Structural strategies:** Reduce physical water losses and non-revenue water, install solar PV system, promote rainwater harvesting **2 Enabling strategies:** Prepare city-level water conservation policy, introduce integrated water resource management, study and incentives to promote rainwater harvesting	94	Freshwater conservation; improved groundwater recharge; better water access; enhanced water availability, quality and security; reduced risk of waterlogging; lower public health risks

Sectors	Key Strategies	Mitigation Potential (tCO_2e)	Overall Climate Resilience Impact
Street Lighting	**1 Structural strategies:** Install smart and efficient street lighting control systems **2 Enabling strategies:** Technical study and energy audit for street lighting design	15	Energy & cost savings, improved visibility; improved reliability; longer life of infrastructure
Waste water and Drainage	**1 Structural strategies:** Pilot decentralized wastewater treatment systems (DeWATS) for households (250 kLD), promote and adopt non-potable reuse & recycling of grey water **2 Enabling strategies:** Drainage master plan, Policy and Plan for feacal sludge management, effective monitoring and auditing of industrial wastewater, centralized sewer system master plan, optimum operation of new sewage treatment plants	0.03	Improved water quality, enhanced sanitation, lower public health risks, improved resilience to high intensity rainfall, revival of local biodiversity
Urban Biodiversity and Green Space	**1 Structural strategies:** Improve and maintain urban green cover and green spaces, restoration of surface water bodies and biodiversity conservation **2 Enabling strategies:** Promote nature-based solutions for flood control, utilize air quality data for sustainable urban planning	-	Ecology and biodiversity conservation, urban heat mitigation, cleaner air and water, urban flood mitigation

Total → 133,346

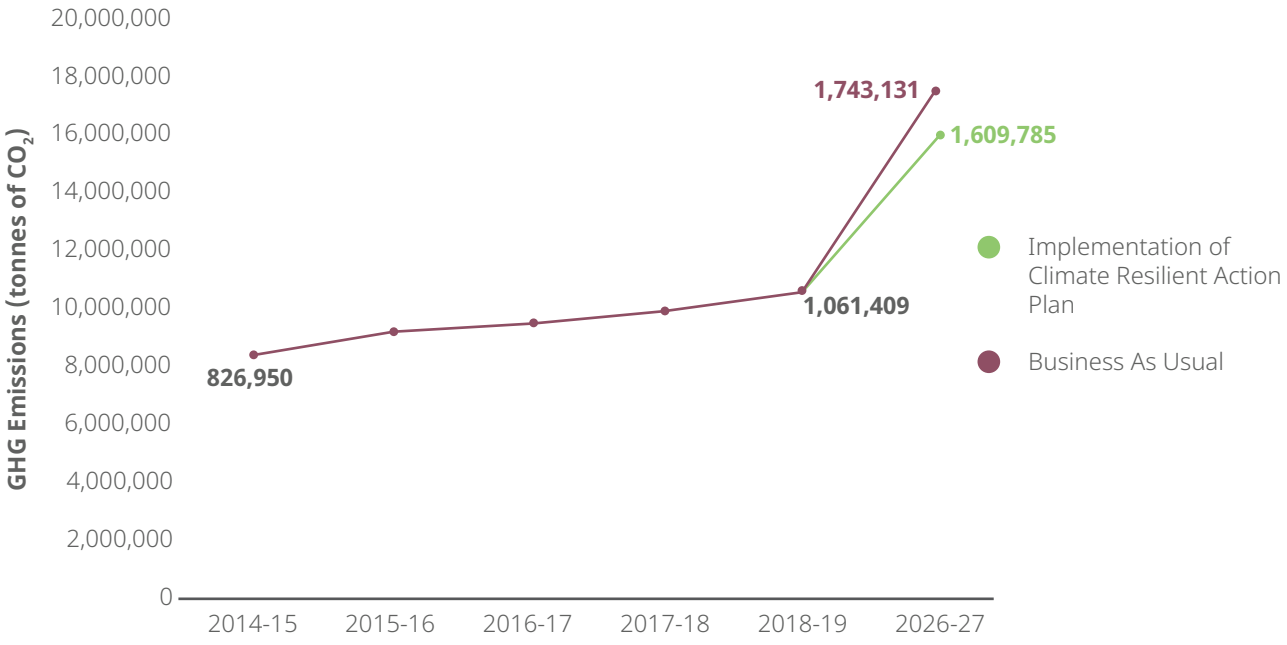
The following figures show the sector-wise GHG mitigation potential of the interventions and GHG emission reduction scenario post implementation of the CRCAP as compared to the BAU scenario.

Figure 50: Sectoral Share of Mitigation Potential



Note: Municipal services & facilities – includes water supply, wastewater and street lighting

Figure 51: GHG Emission Reduction Scenario on CRCAP implementation compared to BAU



5.2 Sectoral Climate Resilience Interventions for Narayanganj

5.2.1 Residential Buildings

2018-19
Energy consumption
1,350,436 GJ

2018-19
GHG emission
241,283 tCO_2e

Contributes to (2018-19)
39% of city's electricity consumption

Baseline analysis and issues

- Residential buildings have the second highest electricity consumption. Electricity consumption rising at nearly 5% per year and expected to rise further in the future with growing population and temperature increase
- Lack of awareness and thereby demand for energy efficiency and renewable energy solutions and benefits
- Absence of sustainable building design adoption in new buildings
- Need for effective implementation, financing and mechanisms/schemes for wider adoption of energy efficiency and renewable energy measures

Potential climate impacts and BAU scenario

- 2026-27 (projected): Energy consumption– 2,290,993 GJ
- 2026-27 (projected): GHG emission – 397,702 tCO_2e
- 62% increase in electricity consumption from 2018-19 to 2026-27

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual energy saving: 56 million kWh
- 2026-27: Annual GHG emission reduction: 44,233 tCO_2e (18% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 353,469 tCO_2e
- Reduced grid dependency, improved self-sufficiency from decentralized RE generation, thermal comfort at lower energy use
- Heat mitigation and food security
- Total cost of climate resilience interventions: BDT 1,529 million

SDGs

GOAL 3: Good Health & Well-being

GOAL 7: Affordable & Clean Energy

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Note:

- Status of each intervention is defined as: - Ongoing action: Already under implementation; Planned action: Being considered and planned for; New action: Proposed for the first time in the CRCAP
- Climate resilient potential of each intervention is defined as very high, high, medium or low considering the aspects of redundancy, flexibility, responsiveness, access to technology, implementation duration and GHG emissions reduction potential
- Duration of implementation: - Short term: 1-2 years; Mid-term: 2-4 years: Long-term: 5 to 10 years

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Promote use of solar water heaters (SWH) in place of conventional geysers in households	• Scale – 100 LPD SWH each in 20% of high-income and upper mid-income homes • Target wards such as 01, 02, 03, 12, 13, 14, 15, 16, 17, 18, 23, 24 and high-income residential areas like Chasara, Khanpur, Isdair, Masdair and Jamtola.	• Energy saving: 2.1 million kWh • GHG reduction: 1,336 tCO_2e • High Resilience Potential	77.5	**Implementing Entities** – NCC, citizens, technology providers, SREDA **Implementation mode** –Investment by consumers, supported by grants from international agencies, incentives from NCC (holding tax rebates) and mandates for large buildings. Aggregation of multiple projects facilitated by NCC to reduce capital costs	• New Action • Mid-term
Promote and facilitate installation of rooftop solar PV with net-metering	• Scale – 5 kW each in 5% of high-income and upper middle-income homes 10 kW each in 20 multi-storey buildings • Target wards like 01, 02, 03, 12, 13, 14, 15, 16, 17, 18, 23, 24 and areas like Chasara, Khanpur, Isdair, Masdair, Amlapara, Tanbazar and Jamtola.	• Energy saving: 0.89 million kWh • GHG reduction: 1,336 tCO_2e • Reduced grid dependency, improved self-sufficiency from decentralized RE generation • High Resilience Potential	49.0	**Implementing Entities** – NCC, local DISCOMs (DPDC/BREB), citizens, technology providers, SREDA **Implementation mode** –Net-metering Policy, 2019. Investment by consumers, supported by grants from international agencies, incentives from NCC (holding tax rebates). Aggregation of multiple projects facilitated by NCC to reduce capital costs	• New Action • Mid-term

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Adopt energy efficient lighting to replace conventional lighting	• Scale –a) 50% of incandescent lamps phased-out and replaced with CFLs and LED lamps b) 10% of existing CFLs replaced with LED lamps c) 35% of T-8 tube lights replaced with T5 & LED tube lights • Initiate in Chasara, Khanpur and Jamtola areas and expand to middle income homes	• Energy saving: 26.0 million kWh • GHG reduction: 24,967 tCO_2e • Medium Resilience Potential	128.2	**Implementing Entities** – NCC, citizens & residential associations, technology providers, SREDA **Implementation mode** – Purchase by consumers. Bulk procurement for consumers facilitated by SREDA and NCC to reduce costs.	• New Action • Short-term
Adopt energy efficient ceiling fans to replace conventional fans	• Scale –Conventional ceiling fans replaced in 25% of homes with Alternating current (AC) type efficient fans and super-efficient brushless type DC fans[57] • Initiate in high-income homes in Chasara, Khanpur and Jamtola areas and expand to middle income homes	• Energy saving: 20.2 million kWh • GHG reduction: 13,060 tCO_2e • Delivers thermal comfort with lower energy use to address rising temperature risk • Medium Resilience Potential	893.0		• New Action • Short-term
Adopt LED lights for common area lighting in multi-storey buildings	• Scale – 10% of all multi-storey buildings • Target wards like 01, 02, 03, 12, 13, 14, 15, 16, 17, 18, 23, 24 and especially in areas like Chasara, Khanpur, Isdair, Masdair, Amlapara, Tanbazar and Jamtola	• Energy saving: 0.1 million kWh • GHG reduction: 97 tCO_2e • Medium Resilience Potential	1.6		• New Action • Mid-term
Encourage use of energy efficient air conditioners	• Scale –Energy efficient ACs in 5% of high-income and upper middle-income homes[58] • Target wards such as 01, 02, 03, 12, 13, 14, 15, 16, 17, 18, 23, 24 and high-income residential areas like Chasara, Khanpur, Isdair, Masdair and Jamtola.	• Energy saving: 6.5 million kWh • GHG reduction: 4,192 tCO_2e • delivers thermal comfort with lower energy use to address rising temperature risk • Medium Resilience Potential	379.8	**Implementing Entities** – NCC, citizens, technology providers, SREDA **Implementation mode** – Purchase by consumers. Programs/mechanisms from product suppliers to support exchange of inefficient stock for new efficient appliances.	• New Action • Long-term

57 AC fans proposed for 20% of replacements and super-efficient brushless DC fans proposed for 5% of replacements
58 Purchasing capacity and penetration predominant in high-income and upper mid-income groups

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Pilot Green/ Eco-building design	• Pilot green/eco-building concept in new large residential buildings in Chasara, Khanpur and Jamtola area following SREDA's Building Energy Efficiency & Environment Rating (BEEER) standard (Draft), 2020	• Lower energy use and GHG emissions • Improved indoor thermal comfort, lower water & resource use • High Resilience Potential	Not estimated[59]	**Implementing Entities** – NCC, RAJUK, SREDA, Housing and Building Research Institute (HBRI), building developers & owners **Implementation mode** – Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds; part-investment by building developers; additional/ extra floor area (FAR) potentially offered to certified green buildings[60]	• New Action • Mid-term
Implement a programme to promote adoption of rooftop gardening	• May initially implement in residential buildings with sizeable rooftop space in areas such as Chasara, Khanpur and Jamtola and link with waste composting plant • NCC is encouraging residential building owners to adopt rooftop gardening by awarding 10% holding tax rebate	• Contributes to heat mitigation, urban food security • High resilience potential	Not estimated[61]	**Implementing Entities** – NCC, RAJUK, citizens **Implementation mode** – NCC can offer tax rebates (holding tax) through its municipal budget. Issuance of mandates/notification by NCC for homes to adopt rooftop gardening.	• Planned • Short-term

59 Cost is dependent on scale and specific measures to be included, hence not estimated here

60 SREDA (2020): Bangladesh Experience in Buildings Energy Efficiency - Building Energy Efficiency & Environment Rating (BEEER) System for Bangladesh

61 Cost is dependent on scale and activities, hence not estimated here

5.2.2 Commercial and Institutional Buildings

2018-19
Energy consumption
590,187 GJ

2018-19
GHG emission
86,161 tCO_2e

Sector with fastest growth in energy consumption:
6.2% per year

Baseline analysis and issues

- High growth in electricity consumption of 6.8% per year, driven by commercial development and expected to increase further with rising temperature
- Inadequate benchmark data on energy consumption from commercial & institutional buildings
- Limited information about the benefits of energy efficiency investments and technologies, lack of familiarity with energy efficient products, lack of awareness on benefits, and energy efficiency equipment and fixtures are absent in public procurement processes.
- Inadequate enforcement, standards and labelling. EE equipment ecosystem not fully matured, availability or product distribution networks or local capacity limited.

Potential climate impacts and BAU scenario

- 2026-27 (projected): Energy consumption– 1,064,071 GJ
- 2026-27 (projected): GHG emission – 162,024 tCO_2e
- Electricity consumption projected to rise annually by 13% annually from 2018-19 to 2026-27

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual energy saving: 5.9 million kWh
- 2026-27: Annual GHG emission reduction: 3,821 tCO_2e (4% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 158,213 tCO_2e
- Reduced grid dependency, improved self-sufficiency from decentralized RE generation, thermal comfort at lower energy use
- Total cost of climate resilience interventions: BDT 98 million

SDGs

GOAL 7: Affordable & Clean Energy

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Adopt energy efficient lighting and ceiling fans in commercial units, hospitals, educational and public buildings	• Scale – Conventional lights replaced with LED lamps and conventional ceiling fans replaced with energy efficient fans in a. 20% of commercial offices & shops and mixed-use buildings b. 20% public and institutional buildings c. 5 hospitals d. 15 schools and colleges • Initiate in commercial and institutional buildings located in wards 13, 14, 15, 16, 17, 18	• Energy saving: 5.3 million kWh • GHG reduction: • 3,421 tCO_2e • EE ceiling fans deliver thermal comfort with lower energy use to address rising temperature risk • Medium resilience potential	69.4	**Implementing Entities** –Business owners, institutional and public entities, NCC, technology providers, SREDA **Implementation mode** – Purchase by end-users (CAPEX). Bulk procurement for consumers facilitated by SREDA and NCC to reduce costs.	• New Action • Short-term
Use of energy efficient air conditioners in large public buildings	• Scale –Energy efficient ACs (inverter-based and 5 energy star-rated) installed for demonstration in 5 large public buildings • Target prominent and large public buildings of the NCC and other government departments such as RAB, BIWTA, District Court	• Energy saving: 0.08 million kWh • GHG reduction: • 53 tCO_2e • delivers thermal comfort with lower energy use to address rising temperature risk • Medium resilience potential	4.4	**Implementing Entities** – NCC, public institutions, technology providers, SREDA **Implementation mode** – Purchase by public sector/ institutions (CAPEX). Programs/ mechanisms from product suppliers to support exchange of inefficient stock for new efficient appliance.	• New Action • Long-term
Install solar water heating systems (SWHS) in hospitals, hotels and institutional campuses	• Scale – 2000 LPD each in premises of 10 buildings • Target buildings to include large hospitals, hotels, educational and public/institutional campuses with hot water demand	• Energy saving: 0.28 million kWh • GHG reduction: • 182 tCO_2e • High resilience potential	10.6	**Implementing Entities** – Business owners, institutional and public entities, NCC, technology providers, SREDA **Implementation mode** –CAPEX Investment by end-users, supported by grants from international agencies, incentives from NCC (holding tax rebates) and mandates for large buildings. Aggregation of multiple projects facilitated by NCC to reduce capital costs	• New Action • Mid-term

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Scale up installation of rooftop solar PV with net-metering in commercial units, hospitals, educational and public buildings	• Scale – a. 10 kW each in 15 public, educational and commercial buildings b. 10 kW each in 5 large hospitals • NCC has piloted two rooftop solar PV systems at the Public Healthcare Centre in Bandar and the Public Library. • This intervention be scaled up in prominent large-size public, institutional and hospital buildings such as NCC new administrative building, Osman Tower, RAB, BIWTA, District High Court, District Govt Library, Godnail High school, Morgen Girls School & College, Victoria Hospital, 300 bed public hospital.	• Energy saving: 0.26 million kWh • GHG reduction: • 166 tCO_2e • Reduced grid dependency, improved self-sufficiency from decentralized RE generation • High Resilience Potential	14.0	**Implementing Entities** – NCC, local DISCOMs (DPDC/BREB), business owners, institutional and public entities, technology providers, SREDA **Implementation mode** –Net-metering Policy, 2019. CAPEX Investment by end-users, supported by grants from international agencies, incentives from NCC (holding tax rebates). Aggregation of multiple projects facilitated by NCC to reduce capital costs	New Action Mid-term

5.2.3 Industries

2018-19
Energy consumption
7,214,724 GJ

2018-19
GHG emission
610,675 tCO_2e

Largest electricity consumer
48.5% of city's electricity use

Baseline analysis and issues

- Limited control of NCC over industrial entities and facilities, thereby inhibiting NCC's role in energy efficiency and renewable promotion
- Inadequate empirical benchmark data on energy consumption for lighting and ventilation in local industrial units
- Limited information about the benefits of energy efficiency investments and technologies, lack of familiarity with energy efficient products, lack of awareness on benefits, and a perceived risk when evaluating potential investments especially in micro-sized industrial units
- Inadequate enforcement, standards and labelling. EE equipment ecosystem not fully matured, availability or product distribution networks or local capacity limited.

Potential climate impact and BAU scenario

- 2026-27 (projected): Energy consumption–10,652,455 GJ
- 2026-27 (projected): GHG emission – 997,690 tCO_2e
- 63% increase in GHG emission from 2018-19 to 2026-27

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual energy saving: 3.2 million kWh
- 2026-27: Annual GHG emission reduction: 2,098 tCO_2e (<1% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 995,593 tCO_2e
- Reduced grid dependency, improved self-sufficiency from decentralized RE generation, thermal comfort at lower energy use
- Total cost of climate resilience interventions: BDT 91 million

SDGs

GOAL 7: Affordable & Clean Energy

GOAL 8: Decent Work & Economic Growth

GOAL 9: Industry, Innovation & Infrastructure

GOAL 11: Sustainable Cities and Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Replace conventional lights with LED lights in industrial units	• Scale – Conventional lights replaced with LED lamps in a. 10% of micro and small industries b. 25% of large garment and textile industries • 2,180 micro and small industries and 109 large textile units exist in total in the city. Measure can be implemented in wards 3, 6, 10 and 18, where most of the industries are concentrated.	• Energy saving: 1.28 million kWh • GHG reduction: • 830 tCO_2e • Medium resilience potential	6.7	**Implementing Entities** – Business/industry owners, BEPZA, industry associations[62], NCC, technology providers, SREDA **Implementation mode** – Purchase by end-users (CAPEX). Bulk procurement for consumers facilitated by BEPZA, industry associations and SREDA to reduce costs. Tax incentives from BEPZA / industrial authorities and NCC. Financial support may be sought through IDCOL's financing schemes targeted specifically for industries.	• New Action • Short-term
Replace conventional ceiling fans with energy efficient ceiling fans in industrial units	• Scale – Conventional lights replaced with LED lamps in c. 10% of micro and small industries d. 25% of large garment and textile industries • 2,180 micro and small industries and 109 large textile units exist in total in the city. Measure can be implemented in wards 3, 6, 10 and 18, where most of the industries are concentrated.	• Energy saving: 0.68 million kWh • GHG reduction: • 440 tCO_2e • Delivers thermal comfort with lower energy use to address rising temperature risk • Medium resilience potential	14.1		• New Action • Short-term
Scale-up deployment of net-metering based solar PV systems in industrial units	• Scale – 1000 kW of solar PV is installed in total across medium and heavy industries. • Narayanganj has 400 medium and heavy industries with ample roof space available. Measure can be targeted in wards 03, 06, 10 and 18 where most of the industries are located.	• Energy saving: 1.3 million kWh • GHG reduction: • 828 tCO_2e • Reduced grid dependency, improved self-sufficiency from decentralized RE generation • High resilience potential	70	**Implementing Entities** – Business/industry owners, Industry associations, NCC, local DISCOMs (DPDC/BREB), technology providers, SREDA **Implementation mode** – Net-metering Policy, 2019. Investment by end-users, supported by grants from international agencies. Financial support may be sought through IDCOL's financing schemes and RESCO model where third-party invests capital costs can be explored. Mandates and appropriate tax incentives from BEPZA / industrial authorities can support.	• New Action • Mid-term

62 BEPZA, Bangladesh Knitwear Manufacturers and Exporters Associaition (BKMEA), Bangladesh Garments Manufacturers and Exporters Association (BGMEA), Federation of Bangladesh Chambers of Commerce and Industry (FBCCI)

5.2.4 Water Supply

2018-19 Energy consumption **1.1 million kWh**

2018-19 GHG emission **713 tCO_2e**

Contributing to **41%** of municipal electricity consumption

2018-19 **92.2** MLD of water supply (production)

Baseline status

- Around half of the total population is served by piped water supply service
- High groundwater dependency (78% of water supply). Unregulated groundwater withdrawal through household tube wells and depleting water table.
- Most of the surface water sources are highly polluted, which has also contaminated ground water and led to increased health risk. Water is supplied by treating highly polluted water from Shitalakshya River
- Water scarcity in the non-monsoon months
- Water logging and flooding during high intensity rainfall and contamination of water supply, leading to health issues
- Reduced groundwater recharge due to increasing impervious surfaces

Existing and planned measures by NCC

- With the support of ADB under the Urban Infrastructure Improvement Preparatory Facility project
- Phase I (2019-2022): Conduct of technical feasibility study to identify the existing water demand, network design and appropriate water tariff and judicious use of water, with a budget of BDT 718 Million
- Phase II (2022 onwards): Implementation (including operation and maintenance activities) based on technical feasibility and assessments in phase I, with a budget of BDT 8,500 Million

Potential climate impacts and BAU scenario

- 2026-27 (projected): Electricity consumption– 1.55 million kWh
- 2026-27 (projected): GHG emission – 1,003 tCO_2e
- 40% increase in water demand from 2018-19 to 2026-27
- Climate Risk Status: Extreme | Extreme risk during high temperature and low rainfall
- Water scarcity in the non-monsoon months
- Exposure to contaminated groundwater and its depletion during increased water demand due to low rainfall and high temperature
- Flooding leading to contamination of surface water

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual energy saving: 0.15 Million kWh
- 2026-27: Annual GHG emission reduction: 94 tCO_2e (13% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 919 tCO_2e
- Freshwater conservation, improved groundwater recharge, better water access, enhanced water availability, quality and security, reduced risk of waterlogging, lower public health risks
- Total cost of climate resilience interventions: BDT 6 million[63]

SDGs

- GOAL 3: Good Health & Well-being
- GOAL 6: Clean Water & Sanitation
- GOAL 7: Affordable & Clean Energy
- GOAL 10: Reduced Inequalities
- GOAL 11: Sustainable Cities and Communities
- GOAL 12: Responsible Consumption & Production
- GOAL 13: Climate Action

63 Costs estimated for solar PV installation and to engage experts for study on rainwater harvesting

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Reduce physical water losses and non-revenue water through water audits, leak detection, network improvement	• Scale – Reduce water losses to 20% through water audits, leak detection, upgradation of pipeline network with ductile iron pipes	• Energy saving: 0.12 million kWh • GHG reduction: • 77.6 tCO_2e • Water conservation and resource security, reduced water contamination and public health risks • High resilience potential	Not estimated[64]	**Implementing Entities** – NCC, DWASA (technical support[65]), technical experts/private sector **Implementation mode –** Implementation of activities through the ongoing ADB funded project [Urban Infrastructure Improvement Preparatory Facility project (Phase I: Feasibility and technical design & Phase II: Implementation)]. Additional support through Municipal budget; GoB funds; potentially BCCTF. Technical inputs and support from the UNDP LIUPCP project that focuses on low-income areas.	• In-progress (through the ADB project) • Mid-term
Install solar PV systems at water supply plants	• Scale – Install 20 kWp of solar PV capacity at Godnail and Sonakada water treatment plants (rooftop or ground-mounted systems based on technical assessments by solar PV installers) • For all new facilities, include rooftop solar PV systems and energy efficient equipment (pumps, motors) during the planning and design stage	• Energy saving: 0.03 million kWh • GHG reduction: • 16.6 tCO_2e • Improved energy security and resilience of water supply • Very high resilience potential	2.0	**Implementing Entities** – NCC, local DISCOMs (DPDC/ BREB), SREDA, private sector/technology providers **Implementation mode** – Net-metering policy (revised), 2019. Municipal budget; GoB funds; potentially BCCTF	• New Action • Mid-term

64 Cost is dependent on scale and specific measures/interventions to be included, hence not estimated here.

65 DWASA has successfully implemented the Dhaka Environmentally Sustainable Water Supply Project with ADB to improve water supply services. More information is available at *https://www.adb.org/sites/default/files/publication/384631/dhaka-water-services.pdf*

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Introduce and promote rainwater harvesting (RWH) for groundwater recharge in residential, public/ institutional and industrial properties	• Undertake technical study to identify areas with high groundwater extraction rate and sites with RWH potential • Introduce RWH in existing as well as new large residential buildings and new apartments in future. Chasara, Khanpur and Jamtola areas have more than 100 large apartments (2000+ sq. ft in size) that can be targeted. • Institutional & public buildings such as Chasara – Rupali Bank, Sayam Plaza, Jaman Tower, Shudhijon Library, Titas Gas Transmission Building, • NCC Court Building, 300 bed Hospital, AC Land Office can be targeted • Industries in Adamzee EPZ and other locations • can be targeted	• Reduced energy consumption and GHG emissions • Lower freshwater consumption, improved groundwater recharge, increased self-sufficiency, reduced risk of frequent waterlogging[66] from high intensity rainfall • High resilience potential	4.0 (for technical study)	**Implementing Entities –** NCC, DWASA (technical support), RAJUK, private sector / technology provider, technical expert, citizens & residential associations, public & educational institutions, industries **Implementation mode** – Residents and building owners to invest. NCC can offer tax rebates to building owners & residents. Bangladesh Export Processing Zone Authority (BEPZA) can offer award incentives to industries. NCC and RAJUK can issue mandates for RWH installation in large buildings. NCC's support funded through Municipal budget; GoB funds; potentially BCCTF	• New action • Mid-term

66 If feasible locations fall within wards 01, 02, 03, 07, 08 and 09, they may be potentially suitable as these areas are also frequently affected by waterlogging

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Prepare city-level water conservation policy	• Develop a policy to help regulate and control surface water and groundwater use and pollution, reduce water wastage, support introduction of water meters	• Reduced energy consumption and GHG emissions • Freshwater conservation, improved groundwater resource, enhanced water availability and security • High resilience potential	Not estimated[67]	**Implementing Entities** – NCC, DWASA (technical support), technical experts, citizens, local NGOs, private sector and industries **Implementation mode –** Formation of a multi-stakeholder group to develop policy, implement and monitor its progress. NCC can issue a notification to support implementation. Funding through Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds	• New Action • Short-term
Initiate Integrated water resource management	Key activities – • Assess existing baseline scenario including source and demand analysis (water budgeting and assessing water balance) • Assess impact of climate change on water demand and supply infrastructure (including drought management) • Identify strategies for augmenting local water resources (groundwater recharge, rainwater harvesting, and wastewater reuse) • Identify interventions to reduce water wastage and increase reuse, recycle, minimize extraction and ensure recharge of groundwater	• Improved water resource management, equitable and improved water access, efficient water use, and improved resilience of water sector to climate change impacts • Very high resilience potential	Not estimated[68]	**Implementing Entities –** NCC, DWASA (technical support), technical experts/ private sector **Implementation mode –** NCC can issue a notification for adoption that will support establishment & strengthening of institutional mechanism and capacity. Funding through Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds	• New Action • Long-term

67 Policy development is considered as part of the municipal functions and hence cost not estimated here
68 Cost is dependent on scale and specific activities that are undertaken, hence not estimated here

5.2.5 Wastewater and Drainage

2018-19
GHG emission
25,766 tCO_2e

2018-19
51.6 MLD of waste water (estimated)

90% households use septic tanks

Baseline status

- Absence of a centralized sewerage system. 90% of households rely on septic tanks, of which majority discharge untreated wastewater directly into local water bodies and rivers, through storm and natural drains
- Highly polluted surface water sources, mainly Shitalakshya River and Baburail Canal, due to untreated effluent from industries (being a textile hub) and domestic sewage sludge
- Frequent water logging due to encroachment and narrowing down of the canals, and obstruction in surface runoff. Drainage network needs to be refurbished and augmented.

Existing and planned measures by NCC

- NCC will prepare Drainage Master Plan for Narayanganj with the support from ADB under Urban Infrastructure Improvement Preparatory Facility (TAPP project) (2019-2022)
- JICA under City Governance Project (CGP) is constructing 38 km of drainage system

Potential climate impacts and BAU scenario

- 2026-27 (projected): GHG emission – 35,543 tCO_2e
- Climate Risk Status: High | High risk during high temperature and low rainfall
- Frequent water logging due to inadequacy and conveyance of sewage in the drainage network
- Exposure to contaminated groundwater and its depletion from increased water demand during periods of low rainfall and high temperature

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual GHG emission reduction: 0.03 tCO_2e (<1% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 35,543 tCO_2e
- Improved surface and groundwater quality, enhanced sanitation, lower public health impacts, improved resilience to high intensity rainfall and waterlogging, revival of local biodiversity, ecosystem
- Total cost of climate resilience interventions: 23-26 BDT million

SDGs

GOAL 3: Good Health & Well-being

GOAL 6: Clean Water & Sanitation

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

GOAL 14: Life under Water

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Develop city-wide drainage master plan	• Develop a drainage master plan to improve condition of existing drainage network, design and construct new drains with capacity to respond to high intensity rainfall • Identify measures to minimize untreated wastewater discharge and clogging from solid waste in stormwater drains • Locations such as Bihari Colony, Ward 06; Shantinagar, Ward 23; Ward 20; DND Area, Wards 01, 02, 03, 07, 08, 09; Nurbagh, Ward 18; Rasulbagh, Ward 27 are susceptible to water logging	• Climate resilient drainage system, reduced risk of waterlogging and public health impacts • High resilience potential	7.0-8.0 (for master plan preparation)	**Implementing Entities** – NCC, RAJUK, technical experts/private sector **Implementation mode –** Development of drainage master plan with support from ADB under Urban Infrastructure Improvement Preparatory Facility (TAPP project) (2019-2022) has been approved. Municipal budget; GoB funds can supplement this fund.	• In-Progress • Mid-term
Prepare Policy and Plan for faecal sludge management (FSM)	• Undertake technical assessment to prepare a city-scale Policy and Plan for developing FSM system • The documents should address regulations to prevent untreated discharge, measures improve existing/establish new on-site sanitation systems (household and group-level), identify mechanisms for sludge transfer, establishment of treatment facilities and options for sludge end-use as fertilizer	• Reduced land, groundwater and surface water pollution, improved water resources quality, improved sanitation and reduced public health impacts • High resilience potential	2.0-3.0 (for FSM plan preparation)	**Implementing Entities –** NCC, RAJUK, technical experts/private sector **Implementation mode –** Implementation through a multi-stakeholder group to develop policy, implement and monitor its progress. NCC can issue a notification to support implementation. Funding through Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds	• New Action • Mid-term
Effective monitoring and auditing of wastewater discharged by industries	• Undertake effective monitoring and auditing of effluent discharge by industries to address water pollution. Encourage advanced effluent treatment and zero discharge technologies in large textile and garment industries. • Intervention can be implemented in wards 3, 6, 10 and 18 where industries are concentrated.	• Lower energy consumption and GHG emission for water treatment • Reduced ground and surface water contamination, revival of local biodiversity, ecosystem and water quality, positive impacts on public health • High resilience potential	Not estimated[69]	**Implementing Entities –** DoE, NCC, local industries **Implementation mode –** NCC can issue a notification to support implementation by DoE. NCC's support to DoE can be funded through Municipal budget; GoB funds; support from international technical agencies & funds	• Planned • Mid-term

69 Cost is dependent on scale, specific activities and other factors, hence not estimated here

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Pilot decentralized wastewater treatment systems (DeWATS) for households	• Scale – Implement DeWATS pilots of 250 kLD for sustainable wastewater treatment of 500+ households. • Chasara, Khanpur, Isdair, Masdair and Jamtola areas can be targeted. • Encourage adoption of anaerobic technology based DeWATS in large hospitals and public/ institutional campuses	• GHG reduction: • 0.03 tCO_2e • Reduced water pollution and public health risk, improved flexibility and redundancy of wastewater treatment, biogas production for energy generation • High resilience potential	9.0	**Implementing Entities –** NCC, DWASA (technical support), private sector/ technology providers, citizens, hospitals, public & educational institutions **Implementation mode –** Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds; part-investment by building owners & institutions	• New Action • Long-term
Promote grey water reuse & recycling for non-potable uses such as landscape irrigation, gardening, flushing	• Target large industries to implement pilot projects and scale-up use of dual plumbing and reuse of greywater (from bathrooms, kitchens & treated on-site) for non-drinking uses such as landscape irrigation, parks, gardening, flushing, road cleaning • Promote grey water reuse in large sized educational and public institutions, new multi-apartment complexes. • Potential institutional and public buildings in Jamtola, Amlapara, and Kalir bazar can be targeted such as Adarsha School, Narayanganj Ideal School and College, Narayanganj High School, Narayanganj Public College.	• Reduced energy consumption and GHG emission • Freshwater conservation, improved water quality, reduced pressure on water supply system and improved resilience • High resilience potential	Not estimated[70]	**Implementing Entities –** NCC, DWASA (technical support), local industries, private sector/technology providers, public & educational institutions **Implementation mode –** NCC to issue notification to support. Investment by industries. NCC support through Municipal budget; GoB funds; support from international technical agencies & funds	• New Action • Long-term
Prepare Master Plan to introduce sewerage system	• Develop a detailed Sewerage Master Plan to guide introduction of centralized sewer network and treatment system in a phased manner • Network development can be prioritized in core areas and locations with high water pollution, with network built in sync with treatment plan to ensure STPs operate at optimal capacity	• Improved ground and surface water quality, reduced risk to public health, lower risk and enhanced climate resilience to stormwater and waterlogging/ flooding • High resilience potential	5.0-6.0	**Implementing Entities –**NCC**,** DWASA (technical support), technical experts, private sector/technology providers **Implementation mode –** Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds	• New Action • Long-term

70 Cost is dependent on scale, specific activities and other factors, hence not estimated here

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Optimum operation and performance management of new sewage treatment plants	• Build new centralized sewage treatment plants (STPs) that have control systems for efficient operation and performance management • Ensure plant operators are trained to operate and maintain new STPs (typically aerobic technology based) in an optimal manner	• Reduced GHG emission generation due to 'well-managed' aerobic treatment systems[71] • Prevents stagnation of untreated wastewater and increasing the quantity of treated wastewater thereby improving service delivery • High resilience potential	Not estimated[72]	• **Implementing Entities –** NCC, DWASA (technical support), technical experts, private sector/technology providers **Implementation mode –** Training and O&M agreements included during procurement from technology providers. Municipal budget; GoB funds; potentially BCCTF; support from international technical agencies & funds	• New Action • Long-term

71 Aerobic treatment systems are a key contributor to CH_4 emissions from domestic wastewater Improved management of new and existing aerobic treatment-based plants has been proposed as an action to lower their emission generation potential. The MCF value (i.e. emission generation potential) for 'not well -managed aerobic systems' is 0.3 as against MCF value of 0 (and therefore no CH_4 emissions) for 'well -managed aerobic treatment systems'.

72 Cost is dependent on scale, specific intervention and other factors, hence not estimated here

5.2.6 Transport

2018-19

Energy consumption
455,607 GJ

2018-19

GHG emission
29,449 tCO_2e

Key transport modes share (excludes walking)

Private bus	Cycle rickshaw	Three-wheelers & IPT	Car
27%	27%	22%	3%

Two-wheeler	Bicycle
8%	4%

Baseline analysis and issues

- Rising travel demand and trips, with limited road width to accommodate additional traffic.
- Absence of public transport system. High dependency on private vehicles, cycle rickshaws and intermediate public transport modes (three-wheelers, auto-rickshaws) for mobility.
- Motorized and non-motorized vehicles use the same roads and create traffic congestion.
- High freight vehicle volume in the traffic, given the city's industrial nature
- Absence of a transportation and mobility study and plan.
- Road conditions and infrastructure not designed to enable efficient NMT and bicycling. Pedestrian ways are not separated from motorways, threatening the safety of the pedestrians.
- Unplanned and undeveloped use of waterways has adversely impacted the water transport services.
- No road connectivity between Bandar and Narayanganj (eastern and western parts across the river). Engine powered boats are prevalent between these two parts. These boats are polluting River Shitalakshya.

Existing and planned measures by NCC

- Conduct of a Comprehensive transportation study and preparation of a Plan by Dhaka Transport Coordination Authority (DTCA) is approved and is planned.

Potential climate impacts and BAU scenario

- 2026-27 (projected): Energy consumption – 813,701 GJ
- 2026-27 (projected): GHG emission – 55,536 tCO_2e
- 79% increase from 2018-19 to 2026-27
- Climate Risk Status: Extreme | Extreme risk during high temperature and low rainfall
- Water logging leading to traffic congestion, resulting in higher air pollution and GHG emissions.

Climate resilience potential of the sector

- 2026-27: Annual fuel saving: 160 kilolitres of petrol & 371 kilolitres of diesel
- 2026-27: Annual GHG emission reduction: 1,434 tCO_2e (5% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 54,102 tCO_2e
- Reduced traffic congestion, improved air quality, lower public health risk, better mobility and accessibility
- Total cost of climate resilience interventions: BDT 67-68 million

SDGs

GOAL 3: Good Health & Well-being

GOAL 9: Industry, Innovation & Infrastructure

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Undertake Comprehensive Traffic Study and prepare Low Carbon Transport Plan	• Initiate a city specific Comprehensive Traffic and Mobility study to identify traffic flows and mobility patterns along different routes of Narayanganj including freight vehicles • Low Carbon Transport Plan will provide strategic support and identify measures to reduce congestion, promote sustainable low carbon transport options including electric vehicles & E-rickshaws, waterways, freight, non-motorized transit	• Reduced fuel consumption and GHG emission • Reduced traffic congestion, improved air quality and public health, improved accessibility • High resilience potential	7.0 – 8.0	**Implementing Entities –** NCC, Dhaka Road Transport Authority (DTCA), Bangladesh Road Transport Authority (BRTA), technical experts/ private sector **Implementation mode –** Through DTCA's upcoming Transportation Study and Plan preparation. Supplementary support as needed through Municipal budget; GoB funds; support from international technical agencies & funds	• Planned • Mid-term
Promote and develop non-motorized transit facilities	• Undertake technical and infrastructure measures to create barrier-free and walkable public spaces and introduce facilities for bicycling to promote non-motorized transit • NMT infrastructure can be improved in city core areas such as Chasara, 1 & 2 rail gate that face congestion and have shorter trip lengths. Bicycling can be promoted in residential neighbourhoods.	• Fuel saving: 160 kilolitres of petrol & 230 kilolitres of diesel • GHG reduction: • 1,031 tCO_2e • Reduced traffic congestion, lower fuel consumption, improved local air quality and public health, improved pedestrian safety • High resilience potential	Not estimated [73]	**Implementing Entities –** NCC, BRTA, technical experts/ private sector **Implementation mode –** PPP mode through Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• New action • Long-term

73 Cost is dependent on scale, specific interventions and other factors, hence not estimated here

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Introduce public city bus service	• Introduce CNG mini-buses in phased manner based on technical assessments to offer reliable & sustainable public transport system • City bus to be integrated with intermediate transport options (autos, three-wheelers) to improve last-mile connectivity • Routes such as Chasara junction to Signboard & Katchpur can be targeted. About 30 mini-buses can be potentially introduced on this route based on traffic volumes & demand estimates.	• Fuel saving: 141 kilolitres of diesel (equivalent fuel saving) • GHG reduction: • 403 tCO_2e • Reduced traffic congestion, improved air quality and public health, improved accessibility, reduced dependency on intermediate public transport modes • High resilience potential	60.0	**Implementing Entities –** NCC, BRTA, private sector **Implementation mode –** PPP mode through Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• New action • Mid-term

5.2.7 Municipal Solid Waste Management

2018-19 GHG emission 92,277 tCO_2e

2018-19 400 TPD Solid waste generation

2018-19 87.5% Waste collection efficiency

2018-19 20 TPD Waste composted:

Baseline analysis and issues

- Municipal solid waste collection extends to 87.5% households
- Composting facility of 35 TPD capacity. However, lack of adequate waste treatment and processing facilities.
- Open disposal of MSW in an unscientific manner, leading to environmental and health risks. Absence of large-scale integrated facility with proper waste disposal. Two larger disposal sites at Pancahabati and Jalkuri are under development.
- Lack of household waste segregation inhibiting opportunities for waste treatment and processing. Need to strengthen awareness among low-income households and the community.
- Uncollected waste is dumped in open drains, open spaces, local ponds, canals and rivers. This blocks the drains and leads to waterlogging and flooding during monsoons.

Existing and planned measures by NCC

- Implementing waste to energy plant of 500 TPD to generate power, through a public private partnership (PPP) model with support of Power Development Board (PDB). The total approved cost is BDT 345,913 million (through GOB funds) including a) Landfill and preparation b) purchasing electricity from the contracted company (budget of BDT 16,654 million). The contracted company will invest capital and implement the project, and generate revenue by selling the electricity to PDB.
- Organic waste composting facility of 35 TPD is operational and generating fertilizer from the compost
- Producing diesel from processing plastic waste
- Development of a SWM Action Plan underway

Potential climate impact and BAU scenario

- 2026-27 (projected): GHG emission – 130,169 tCO_2e
- 41% increase in GHG emissions from 2018-19 to 2026-27
- Climate Risk Status: Medium | Extreme risk during high temperature and low rainfall
- Clogging of drains during high intensity rainfall due to waste dumped indiscriminately, resulting in water logging and related health impacts.
- Accelerated waste decomposition due to increased temperatures

Potential climate resilience impacts from identified interventions

- 2026-27: Annual GHG emission reduction: 81,652 tCO_2e (88% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 48,517 tCO_2e
- Higher resource efficiency, lower air & land pollution and public health risks, reduced waste going to landfill, improved resilience from decentralized systems
- Total cost of climate resilience interventions: BDT 5.0 million[74] (excludes sanctioned cost for waste-to-energy plant)
-

74 Represents approximate cost for activities to strengthen 3R Strategy. Costs for proposed waste-to-energy plan with PCB are already approved and includes establishment of infrastructure, and facilities as well as future electricity purchases from private operator.

SDGs

GOAL 3: Good Health & Well-being

GOAL 6: Clean Water & Sanitation

GOAL 7: Affordable & Clean Energy

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Benefits and co-benefits	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Strengthen Implementation of 3R (Reuse, Reduce, Recycle) Strategy	• Implement 3R practices at the city-scale to enable and support infrastructure planned for sustainable waste processing and management • Conduct awareness generation activities, implement 100% segregated door to door waste collection, promote and establish systems to scale-up recycle, reduce and reuse practices	• Reduced GHG emission from effective waste treatment and avoided disposal • Higher resource efficiency, lower local pollution and public health risks, improved resilience from decentralized systems • High resilience potential	5.0[75]	**Implementing Entities –** NCC, local NGOs, citizens **Implementation mode –** NCC can issue notification to support. Activity funded through Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds. 3R and its operationalization should be addressed through the SWM Action Plan currently under preparation.	• New action • Short- term
Implement waste to energy plant	• Scale –Implement incineration-based waste to energy plant of 500 TPD to process waste and generate power • Dry waste such as paper, wood, non-recyclable plastics, rags/textile, leather, rubber can be collected and processed in the waste to energy plant	• GHG reduction: 81,652 tCO_2e • Higher resource efficiency, lower local pollution and public health risks, reduced waste going to disposal, alternate power source, improved climate resilience • High resilience potential	Cost already approved/ Sanctioned for in-progress project[76]	**Implementing Entities –** NCC, Power Development Board (PDB), local NGOs, private sector/ technology providers, citizens **Implementation mode –** PPP mode through BOT model, with private operator financing construction and undertaking plant operation. GoB funds are already allocated for this in-progress project, for landfill development and for purchase of generated electricity from the private operator. Any additional technical support/ services needed can be sought from international technical agencies & funds.	• In-progress • Mid-term

75 Approximate estimate for Information, education, and communication (IEC) activities, waste characterisation study, and segregated door-to-door collection and processing through small-scale decentralised organic waste composting plant (1 unit) addressing 2-3 wards

76 BDT 345,913 million has been approved/ sanctioned for this in-progress project

5.2.8 Street Lighting

2018-19
Energy consumption
1.5 million kWh

2018-19
GHG emission
975 tCO_2e

Baseline analysis and issues

- Highest electricity consumption in municipal services and buildings
- About 7,300 operational streetlights.
- Streetlights not in place in areas away from the city centre and nearer to the periphery.
- Additional LED streetlights are being installed in a few uncovered areas. However, agreements with vendors of LED lamps for post-installation operation and maintenance are absent.
- No detailed surveys and energy audits in place for street lighting
- Need to enhance street lighting infrastructure to provide requisite illumination and service

Existing and planned measures by NCC

- Installation of LED street lighting in areas that lack streetlights

Potential climate impacts and BAU scenario

- 2026-27 (projected): Electricity consumption – 2.2 million kWh
- 2026-27 (projected): GHG emission –1,441 tCO_2e

Potential Climate Resilience impacts from identified interventions

- 2026-27: Annual energy saving: 0.02 Million kWh
- 2026-27: Annual GHG emission reduction: 15 tCO_2e (2% of 2018-19 baseline)
- 2026-27: Net GHG emission after implementation of interventions: 960 tCO_2e
- Improved visibility; improved service quality, reliability and life of streetlights
- Total cost of climate resilience interventions: BDT 6 million

SDGs

GOAL 7: Affordable & Clean Energy

GOAL 11: Sustainable Cities & Communities

GOAL 12: Responsible Consumption & Production

GOAL 13: Climate Action

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Potential Energy Saving	Climate Resilient Impact	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Undertake a technical study for design of energy efficient street lighting	• Undertake a detailed technical field survey and investment grade energy audit to ensure proper infrastructure design, upgradation and adoption of well illuminated LED street lighting as per national lighting standards • Study should include identification of primary specifications, delivery model and long-term post-installation maintenance agreements with vendors	Not estimated	• Reduced energy consumption and GHG emission • Improved visibility; improved service quality, reliability and life • High resilience potential	5.5	**Implementing Entities** – NCC, local DISCOMs (DPDC/BREB), technical experts/ private sector **Implementation mode** – Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• New action • Mid-term
Install energy efficient street lighting control systems (timer-based On/ Off controls, voltage regulation)	• Scale – Install Street light control systems of 6 kW size at five street lighting feeder panels/switching points for energy efficient operation (auto on/off, voltage regulation) • Identify appropriate locations to install control systems with technology providers	0.02 million kWh	• Energy saving: 0.02 million kWh • GHG reduction: 15 tCO_2e • Improved visibility; improved service quality, reliability and life • High resilience potential	0.45	**Implementing Entities** – NCC, local DISCOMs (DPDC/BREB), private sector/ technology providers **Implementation mode –** Municipal budget; GoB funds	• New action • Mid-term

5.2.9 Urban Biodiversity and Air Quality

Baseline analysis and issues

- Very limited open green spaces in the city. Most open spaces have been encroached and utilized for commercial development and low-income settlements.
- Water bodies and natural drains are highly polluted due to discharge of industrial effluents and untreated domestic sewage. Environmental degradation leading to negative impacts on biodiversity.
- Susceptible to water logging due inadequacy & clogging of drainage network, and encroachments in and around natural drainage channels, ponds, canals.
- Being an industrial city, high air pollution with annual daily PM10 concentration in Narayanganj of 210 µg/m^3 (national std □ 150 µg/m^3) and air quality index (AQI) corresponding to unhealthy air conditions.

Existing and planned measures by NCC

- NCC has piloted installation of three sensor-based stationary ambient air quality monitoring stations (AAQMS) under the Urban-LEDS II project to monitor air quality and create an evidence base for decision-making and actions on urban planning.

Potential climate impacts and BAU scenario

- Climate Risk Status (for Air Quality): High | High risk during high temperature and low rainfall
- Increased air pollutant concentration and public health impacts due to lower precipitation

Potential Climate Resilience impacts from identified interventions

- Ecology and biodiversity conservation, urban heat mitigation, cleaner air and water, urban flood mitigation

SDGs

GOAL 3: Good Health & Well-being

GOAL 6: Clean Water & Sanitation

GOAL 11: Sustainable Cities & Communities

GOAL 13: Climate Action

GOAL 15: Life on Land

Priority Climate Resilience Interventions

Resilience Interventions	Details of Intervention	Climate Resilient Impact	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Improve and maintain urban green cover and green spaces	• Improve and maintain green cover in city parks, gardens and open spaces • Identify and map patches along roads, rail, rivers devoid of trees and suitable for avenue tree plantation with native species • Reserve space for green belts/avenue plantation at micro level in residential, commercial & industrial areas and during planned road widening & infrastructure development	• Urban heat mitigation, ecology and biodiversity conservation • High resilience potential	Cost will depend on scale, specific activities and other factors	**Implementing Entities** – NCC, RAJUK, local NGOs, nurseries, private sector, citizens **Implementation mode** – Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• New action • Mid-term
Restoration of surface water bodies and biodiversity conservation	• Check encroachment and regulate illegal structures in the river bed and flood plain zone • Identify degraded patches of Shitalakshya River and Baburail Canal where pilot rejuvenation/restoration projects can be initiated • Identify and map river stretches, wetlands and green belts to increase connectivity and act as potential corridors for biodiversity	• Urban heat mitigation, biodiversity conservation, environmental protection, improved surface water resources • High resilience potential	Cost will depend on scale, specific activities and other factors	**Implementing Entities** – DoE, NCC, LGED, RAJUK, local NGOs, private sector, citizens **Implementation mode** – Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• In-progress[77] • Mid-term
Promote nature-based solutions for flood control	• Demarcate catchments leading to flood prone areas and undertake native species plantations to regulate surface water run off • Reduce hardscapes and unnecessary concretization in public spaces by laying green pavements.	• Flood mitigation, improved groundwater recharge, ecology conservation, reduced public health risk • High resilience potential	Cost will depend on scale, specific activities and other factors	**Implementing Entities** – NCC, Bangladesh Water Development Board (BWDB), RAJUK, local NGOs, nurseries, private sector, citizens **Implementation mode** – Municipal budget; GoB funds; BCCTF; support from international technical agencies & funds	• New action • Long-term

77 The 'Restoration and Beautification of Baburail Khal Subproject' for restitution of the city's Baburail Canal addressed this intervention partly. The sub-project was completed in 2020 under the Municipal Government and Services Project (MGSP) project commissioned by LGED and funded by International Development Association (IDA) of the World Bank Group

Resilience Interventions	Details of Intervention	Climate Resilient Impact	Indicative cost (Million BDT)	Implementation entities and mode	Status and Duration of Implementation
Use of air quality data for city planning, particularly spatial planning	• Monitor data from ambient air quality system installed at 3 locations with the support of Urban-LEDS II project to inform urban planning and decision-making • Air quality data can be utilized for Land-use/spatial planning decisions such as siting of industries and residential clusters, green cover and spaces, transport management to achieve improved air quality	• Clean air, sustainable urban planning, reduced public health risk • High resilience potential	To be undertaken by NCC technical and planning staff and hence cost is not included here	**Implementing Entities** – NCC, DoE, RAJUK **Implementation mode** – Municipal budget; GoB funds; technical support from experts and international agencies	• In-progress[78] • Short-term

78 Infrastructure in terms of the ambient air quality sensors have been installed through Urban-LEDS II project support. NCC plans to utilize the air quality data captured through the sensors for urban planning and management

07
WAY FORWARD

Developing the CRCAP has helped Narayanganj to position itself as a champion of sub-national or city-level climate action in Bangladesh. The CRCAP for Narayanganj was developed using the ClimateResilientCities Methodology.

As part of the Climate Action Planning process, a climate risk and vulnerability assessment identified two major impacts of climate change at the local scale in Narayanganj– i) increased temperature, and ii) decreased rainfall and changing rainfall patterns. The city's urban services and systems, that will be most severely impacted by climate impacts in include Water supply, Wastewater, Solid waste, Transport and Air quality. These fragile urban systems and their fragility have been identified through 'Shared Learning Dialogues' (SLDs), involving the city's Climate Core Committee and Stakeholder Committee. The ClimateResilientCities methodology also helped identify the broad climate risks to these fragile urban systems and helped in identifying the most vulnerable areas within the city and the most vulnerable actors in the city that will be impacted by them.

The first-ever city-wide GHG emissions inventory, prepared using the HEAT+ tool, helped Narayanganj to identify the sectors that are mainly responsible for GHG emissions within the city, both at the community level as well as the municipal level. The sectors responsible for the majority of emissions in the city, include Industries, Residential buildings and Waste. On the basis of the vulnerable urban systems, areas, and actors, and the GHG emissions information, resilience actions have been identified to help the city to reduce carbon emissions as well as successfully adapt to potential climate impacts in the future.

Through its CRCAP, Narayanganj has a guiding framework to appropriately steer its industrial and socio-economic growth to a low carbon urban development pathway and strengthen its resilience to climate change. The CRAP includes 24 actions ("**structural strategies**") across 9 areas/sectors, identified based on the baseline analysis of sectoral GHG emissions and climate vulnerabilities. These actions have been prioritized based on their potential to enhance climate resilience, through multi-criteria consideration, as well as feasibility of implementation ((technical, financial and political) and impact (short, medium or long term). Apart from the structural strategies, the CRCAP has also

The Climate Resilient City Action Plan proposes actions with an annual GHG emissions mitigation potential of 12.6% by 2026-27 over the 2018-19 baseline.

recognized the importance of developing and implementing plans, policies and programs which create enable framework for climate resilience. Therefore, the action plan also lists several "**enabling strategies**" that will guide and support city to plan, develop, implement & monitor sectoral actions in the future.

The Climate action plan process is based on the premise that institutionalization of climate action planning is key to developing a vision of a climate resilient city. The success of the plan lies in its institutional at the local level and implementation of the prioritized actions, which would also ensure mainstreaming environmental sustainability and climate sensitivity in city development. For effective implementation of the action plan, the identified actions have been linked to existing city plans, annual municipal budgets and funding opportunities through urban improvement schemes, as much as possible. This will ensure that the required interventions are integrated, with little or no additional resources, into existing departmental programs or projects. Solid waste management, and Residential, and Commercial & Institutional sectors are assessed to have the highest potential for GHG emission reduction.

An important aspect that emerged from the Climate Action Planning process in Narayanganj is the need to establish and improve data collection and monitoring systems across all key urban services and sectors. Updated information can enable robust issue identification and help deliver need-based policy formulation, target setting and monitoring. Putting in place mechanisms for regular reporting and monitoring of urban infrastructure and service delivery is essential. To strengthen its data systems for both city infrastructure and climate action planning, NCC can adopt half-yearly/annual reporting of urban services and infrastructure by all departments, through appropriately measurable indicators and benchmarks.

There is also a need for better coordination and communication between different government agencies/departments. As highlighted in section 2.7, responsibilities of many of the critical urban services and sectors such as Water Supply, Wastewater, Drainage, Transport and Electricity are distributed among different government agencies. Thereby, it is necessary for the different government bodies to coordinate their activities. Stricter implementation of regulatory provisions for municipal solid waste management and sewerage connections, septage management, conservation of water bodies, littering, encroachment of water bodies, and maintenance of green spaces within the city and traffic control could also help the municipal corporation to reduce the impacts of sudden disruption to services because of climate impacts and be more resource efficient.

Energy efficiency in residential & commercial buildings, industries, municipal buildings and service infrastructure, can help realize substantial reduction in the city's energy demand and GHG emissions. Most of these interventions also result in co-benefits. In case of municipal buildings, adoption of solar power can deliver cost savings and mitigation benefits to the city corporation while also serving as demonstration sites to encourage uptake of renewable energy measures across the community. Formulating and adopting municipal mandates and policies promoting energy efficiency can enable wider adoption.

In case of transportation, promoting non-motorised transportation (NMT) and clean public transport will go a long way in ensuring low carbon mobility and clean air in the city. Emission reduction in solid waste management and water supply have distinct co-benefits of improved public health as well as socio-economic benefits for the poor and vulnerable.

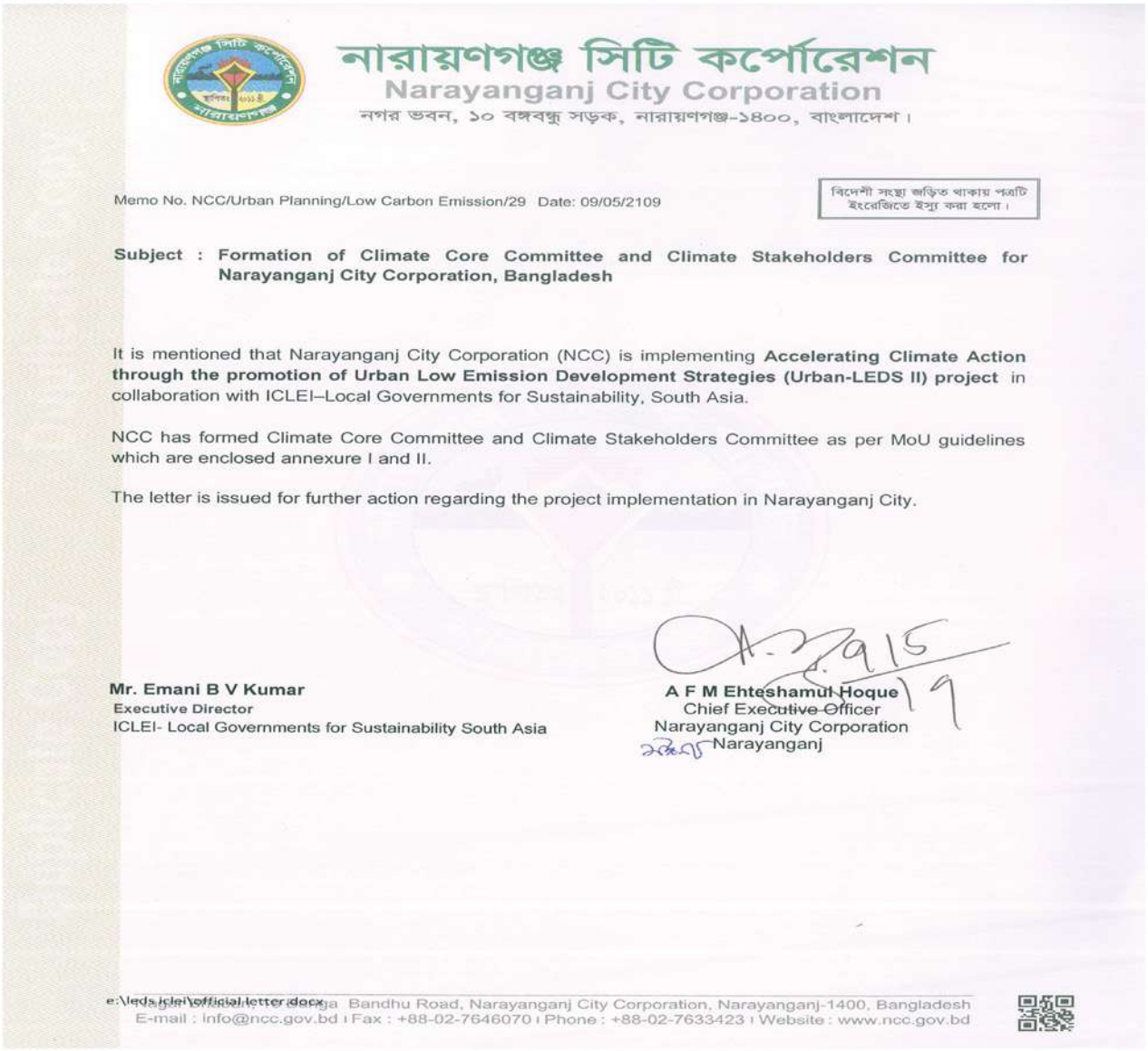
The Climate Resilient City Action Plan (2022-26) proposes actions with an annual GHG emissions mitigation potential of 12.6% by 2026-27 over the 2018-19 baseline. This target is consistent with the Bangladesh's Nationally Determined Contributions (NDCs) goals. *The CRCAP also underlines Narayanganj's commitment to become a healthy, liveable city sustainably providing basic urban services to all, while managing air quality and economic productivity by incorporating climate resilience in local decision-making processes.*

The scale of urban transformation required to achieve the goals of climate resilience can only be realised through strengthening multi-level governance to facilitate a city-wide response. Therefore, the CRCAP emphasises on cross-sectoral & multi-stakeholder actions which will have to be implemented in an inclusive and equitable manner. Additionally, successful implementation of the plan will require extensive public participation and open dialogues with all stakeholders including the youth, civil society, academia and research institutions, labour, business and all residents of Narayanganj.

The COVID-19 pandemic has served to highlight the potential severity of another global crisis - climate emergency: those most affected by the pandemic are predominantly the same groups who are also most vulnerable to climate change. Adoption and successful implementation of the CRCAP will ensure that this industrial hub achieves socio-economic goals and has a sustainable & climate resilient future that benefits all its people. The leadership shown by Narayanganj to identify and evaluate its climate vulnerability and drivers of GHG emissions, and to undertake evidence-based climate action planning, paves the way for other cities in the country to replicate these efforts and contribute to achievement of Bangladesh's NDC & SDG targets.

Annexures

Annexure 1: Core Climate Team and Stakeholder Committee for Narayanganj



নারায়ণগঞ্জ সিটি কর্পোরেশন
Narayanganj City Corporation
নগর ভবন, ১০ বঙ্গবন্ধু সড়ক, নারায়ণগঞ্জ-১৪০০, বাংলাদেশ।

Memo No. NCC/Urban Planning/Low Carbon Emission/29 Date: 09/05/2109

বিদেশী সংস্থা জড়িত থাকায় পত্রটি ইংরেজিতে ইস্যু করা হলো।

Subject : Formation of Climate Core Committee and Climate Stakeholders Committee for Narayanganj City Corporation, Bangladesh

It is mentioned that Narayanganj City Corporation (NCC) is implementing **Accelerating Climate Action through the promotion of Urban Low Emission Development Strategies (Urban-LEDS II) project** in collaboration with ICLEI–Local Governments for Sustainability, South Asia.

NCC has formed Climate Core Committee and Climate Stakeholders Committee as per MoU guidelines which are enclosed annexure I and II.

The letter is issued for further action regarding the project implementation in Narayanganj City.

Mr. Emani B V Kumar
Executive Director
ICLEI- Local Governments for Sustainability South Asia

A F M Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation
Narayanganj

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Bandhu Road, Narayanganj City Corporation, Narayanganj-1400, Bangladesh
E-mail : info@ncc.gov.bd ı Fax : +88-02-7646070 ı Phone : +88-02-7633423 ı Website : www.ncc.gov.bd

Annexure I: Climate Core Committee for Narayanganj City Corporation

Project: Accelerating Climate Action Through the Promotion of Urban Low Emission Development Strategies (Urban LEDS II)				
Sl. No	**Name**	**Organization**	**Designation**	**Contact Details**
01.	A. F. M. Ehteshamul Hoque (Chairperson)	Narayanganj City Corporation	Chief Executive Officer	ceo@ncc.gov.bd +880 1924 782900
02.	Md. Moinul Islam (Focal Person)	Narayanganj City Corporation	Urban Planner	townplanning@ncc.gov.bd +880 1913 910393
03.	Md. Asgor Hossain (Member)	Narayanganj City Corporation	Executive Engineer	asgor_babul@yahoo.com +880 1816 016924
04.	Dr. Sheikh Mostofa Ali (Member)	Narayanganj City Corporation	Medical Officer	dr.mostofaali81@gmail.com +880 1673 986947
05.	Md. Alamgir Heron (Member)	Narayanganj City Corporation	Conservancy Officer	conservancy@ncc.gov.bd +880 1924 460520
06.	Md. Rashed Mollah (Member)	Narayanganj City Corporation	Sub-Assistant Engineer (Mechanical)	rashedmollah21@gmail.com +880 1717174488
07.	Md. Rezaul Islam (Member)	Narayanganj City Corporation	Assistant Engineer (Electrical)	engr.raju_elec@yahoo.com +880 1675 289750
08.	Mr. Asit Baran Biswas (Member)	Narayanganj City Corporation	Ward 15 Councilor	councillorasit@gmail.com +88-01818458789

পরিকল্পনাবিদ মোঃ মঈনুল ইসলাম
নগর পরিকল্পনাবিদ
নারায়ণগঞ্জ সিটি কর্পোরেশন

A.F.M. Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation

Annexure II: Climate Stakeholder Committee for Narayanganj City Corporation

Project: Accelerating Climate Action through the Promotion of Urban Low Emission Development Strategies (Urban LEDS II)

Sl. No	Name	Organization	Designation	Contact Details
01.	Mr. A. F. M. Ehteshamul Hoque (Chairperson)	Narayanganj City Corporation	Chief Executive Officer	ceo@ncc.gov.bd +880 1924 782900
02.	Mr. Md. Moinul Islam (Focal Person)	Narayanganj City Corporation	Urban Planner	townplanning@ncc.gov.bd +880 1913 910393
03.	Mr. Md. Asgor Hossain (Member)	Narayanganj City Corporation	Executive Engineer	asgor_babul@yahoo.com +880 1816 016924
04.	Dr. Sheikh Mostofa Ali (Member)	Narayanganj City Corporation	Medical Officer	dr.mostofaali81@gmail.com +880 1673 986947
05.	Mr.Md. Alamgir Heron (Member)	Narayanganj City Corporation	Conservancy Officer	conservancy@ncc.gov.bd +880 1924 460520
06.	Mr.Md. Rashed Mollah (Member)	Narayanganj City Corporation	Sub-Assistant Engineer (Mechanical)	rashedmollah21@gmail.com +880 1717174488
07.	Mr.Md. Rezaul Islam (Member)	Narayanganj City Corporation	Assistant Engineer (Electrical)	engr.raju_elec@yahoo.com +880 1675 289750
08.	Mr.Md. Aliul Hossain (Member)	Roads and Highways Department, Narayanganj	Executive Engineer	eenary@rhd.gov.bd +880 1730 782606

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A.F.M. Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation

Sl. No	Name	Organization	Designation	Contact Details
09.	Eng. Md. Shah Alam (Member)	Education Engineering Department, Narayanganj	Executive Engineer	ee_nar@eedmoe.gov.bd +880 1711 165526
10.	Mr.Md. Moshiur Rahman (Member)	Dhaka Power Distribution Company, Narayanganj	Executive Engineer	xenfatulla@dpdc.org.bd
11.	Mr.Md. Abdullah All Arafin (Member)	Fire Service and Civil Defence, Narayanganj	Deputy Assistant Director	arafin.fscd@gmail.com +880 1710 746460
12.	Mr.Syed Aynul Huda Chowdhury (Member)	Bangladesh Road Transport Authority (BRTA), Narayanganj	Assistant Director	ad_narayanganj@brta.gov.bd +880 1966 622033
13.	Mr.Mir AbulHashem (Member)	Dhaka WASA, Narayanganj MODS	Executive Director	+880 1819 237170
14.	Eng. Md. MokbulAhammad (Member)	Titas Gas Transmission and Distribution Company, Narayanganj	Deputy General Manager	dgm.narayangonj@titasgas.org.bd +880 1939 921066
15.	Mr. Md. Sayeed Anwar (Member)	Department of Environment, Narayanganj	Deputy Director	+880 1712 562164
16.	Deputy General Manager (Member)	PalliBidyutSamiti (PBS) 1, Narayanganj		dgm_bandar@yahoo.com +880 1769 400216
17.	Mr.Md. Ashraful Islam (Member)	RajdhaniUnnayanKartripakkha (RAJUK)	Town Planner	dirpp@rajukdhaka.gov.bd +880 2 7160974
18.	Mr.Md. Anisur Rahman (Member)	Dhaka Transport Co-Ordination Authority (DTCA)	Traffic Engineer	tre@dtca.gov.bd +880 1711 890453

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নারায়ণগঞ্জ সিটি কর্পোরেশন

A.F.M. Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation

Sl. No	Name	Organization	Designation	Contact Details
19.	Assistant Director (Member)	Bangladesh Inland Water Transport Authority		
20.	Mr.Md. Nazrul Islam (Member)	Livelihood Improvement of urban Poor Communities Project (LIUPCP), Narayanganj	Town Manager	islam.nazrul@undp.org +880 1716 427237
21.	Mr.Md. Khaled Hossain (Member)	City Governance Project (CGP) LGED, Narayanganj	Junior Urban Planning Facilitator	planner.khaled.ncc@gmail.com +880 1819 461692
22.	Mr.Mohd. Mizanur Rahman (Member)	Megha Organic	Managing Director	meghagroupbd@gmail.com +880 1724 749113
23.	Mr. Md. Asaduzzaman Parish (Member)		Urban Planner	+880 1716 440440
24.	Mr. Nuruzzaman (Member)		Architect	+880 1819 284467
25.	Representative (Member)	Save the Children		
26.	Mr. Asad Rahman (Member)	BRAC		+880 1712 198019
27.	Representative (Female) (Member)	World Level Coordination Committee		
28.	Representative (Female) (Member)	World Level Coordination Committee		
29.	Representative (Female) (Member)	World Level Coordination Committee		

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A.F.M. Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation

Sl. No	Name	Organization	Designation	Contact Details
30.	Representative (Member)	Sustainable and Renewable Energy Development Authority (SREDA)		
31.	Representative (Member)	Bangladesh Climate Change Trust		
32.	Mr. Asit Baran Biswas (Member)	Narayanganj City Corporation	Councilor Ward 15	councillorasit@gmail.com +88-01818458789

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A.F.M. Ehteshamul Hoque
Chief Executive Officer
Narayanganj City Corporation

Annexure 2: Global Covenant of Mayors – Narayanganj Commitment

GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY

Global Covenant of Mayors for Climate & Energy
Commitment of
Narayanganj City Corporation
Narayanganj, 1400, Bangladesh

I, Dr. Salina Hayat Ivy, Mayor of Narayanganj City Corporation commit to the Global Covenant of Mayors for Climate & Energy (GCoM), joining thousands of other cities and local governments around the world currently engaged in climate leadership.

GCoM envisions a world where committed mayors and local governments – in alliance with partners – accelerate ambitious, measurable climate and energy initiatives that lead to an inclusive, just, low-emission and climate resilient future, helping to meet and exceed the Paris Agreement objectives.

Whatever the size or location, the mayors and local leaders committed to GCoM stand ready to take concrete measures with long-term impact to tackle the interconnected challenges of climate change mitigation and adaptation, as well as access to sustainable energy.

To implement this vision, we pledge to implement policies and undertake measures to (i) reduce / avoid[i] greenhouse gas (GHG) emissions, (ii) prepare for the impacts of climate change, (iii) increase access to sustainable energy, and (iv) track progress toward these objectives.

Specifically, within three years of this commitment[ii], we pledge to develop, adopt[iii], use and regularly report on the following:

- A community-scale GHG emission inventory, following the recommended guidance;
- An assessment of climate risks and vulnerabilities;
- Ambitious, measurable and time-bound target(s) to reduce/avoid GHG emissions;
- Ambitious climate change adaptation vision and goals, based on quantified scientific evidence when possible, to increase local resilience to climate change;
- An ambitious and just goal to improve access to secure, sustainable and affordable energy; and
- A formally adopted plan(s) addressing climate change mitigation / low emission development, climate resilience and adaptation, and access to sustainable energy.

The targets and action plans for mitigation / low emission development must be quantified and consistent with or exceed relevant national unconditional[iv] commitments defined through the UNFCCC (Intended) Nationally Determined Contribution (NDC). The targets and action plans should be in line with National Adaptation Plans, where these exist; and should be consistent with the principles around energy access and urban sustainability embodied in the Sustainable Development Goals (SDGs).

We will explore the allocation of adequate staff resources and institutional arrangements. This includes governance processes, municipal structures and budget allocations to deliver on this commitment and secure continuity.

www.globalcovenantofmayors.com

We acknowledge that there may be additional regional- or country-specific commitments or requirements that we commit to follow, and that may be agreed through our city networks or through our direct engagement with local partners of GCoM.

The Narayanganj City Corporation acknowledges that continued engagement in GCoM and associated Regional or National Covenants, as established, is contingent on complying with the above requirements within established timeframes.

Name and title of person signing this commitment

Narayanganj City Corporation,
Narayanganj, 1400, Bangladesh
http://www.ncc.gov.bd/
Dr. Salina Hayat Ivy
Email : mayor@ncc.gov.bd,
Phone No. : +880-27648430
02 million Inhabitants, 72.43 sq. kilometres
Bangladesh, http://www.ncc.gov.bd/

Salina Hyat
DR. SALINA HAYAT IVY
MAYOR
NARAYANGANJ CITY CORPORATION

Mandated by the Planner Md. Moinul Islam on 19 November 2020.

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[i] "Avoid emission" via low emission development
[ii] Flexibility is allowed to suit differentiated local circumstances and needs.
[iii] According to the city and local government's procedures
[iv] Many countries have submitted two sets of NDC targets: unconditional targets, to be implemented without any explicit external support; and conditional targets. The latter are more ambitious than unconditional targets and require external support for their fulfilment. The cities and local governments committing to the GCoM are required to commit at least to the equivalent of their country's unconditional targets, but are encouraged to be more ambitious where possible.

Annexure 3: Prioritization of Climate Resilience Interventions for Narayanganj

The prioritization exercise uses five key criteria/characteristics described below:

- Redundancy: A resilient system can function and achieve results through multiple paths or nodes when one fails and when performance is critical. In contrast, a "single best solution" is not resilient because if this single option fails, the system collapses. Back-up systems, or decentralized nodes for service delivery in a linked network, are preferable.
- Flexibility and diversity: Essential systems should be able to work under a variety of conditions; they should not be rigid or designed only for one specific situation. Any system will fail if overloaded beyond its capacity, but it should be designed to fail under stress in a safe and predictable way, rather than suddenly and catastrophically.
- Re-organization and responsiveness: Under extreme conditions, systems should be able to respond and change to meet unexpected shocks. This requires flexible organizations and access to different kinds of resources (information, skills, equipment, knowledge and experience). It also means a high level of coordination and flexible organizational structures capable of adjusting to new conditions.;
- Access to information: Resilient systems have mechanisms to learn from and build on experience, so that past mistakes are not repeated and lessons from other cities can be integrated into planning. This requires procedures for monitoring and evaluating performance under stress, and requires multiple sources of knowledge and documentation (strengthening "corporate memory")
- Energy saving and GHG emission mitigation potential: Resilient systems have potential to reduce energy consumption and mitigate GHG emission, which may be integrated into their regular planning. This requires procedures for periodic monitoring and evaluating performance, which requires multiple sources of knowledge and documentation.

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Residential Buildings						
Promote use of solar water heaters (SWH) in place of conventional geysers in households	Yes - Enables decentralization and reduced reliance on conventional energy through use of solar energy	Yes - Will operate dependent on availability of sunlight and designed to have 2-3 days of self-sufficiency. Can typically operate in combination with electric power to meet hot water demand during periods with low sunlight.	Yes - increased self-sufficiency at the household level.	Partial - Information on energy savings will be reflected in energy bills. However, monitoring mechanism will be needed to capture information to inform future planning. Results from deployment of solar water heating can help inform regulations on building design (heights and water distribution, rooftop utilization and design)	Yes	High
Promote and facilitate installation of rooftop solar PV with net-metering in independent homes in high-rise buildings	Yes - Enables decentralization and reduced reliance on grid energy supply through use of solar energy	Yes	Yes - increased self-sufficiency at the household level and improved energy resilience & security	Partial	Yes	High
Adopt energy efficient lighting to replace conventional lighting	Yes - low energy alternative to existing appliances/ equipment	-	Yes - Increased temperature can increase electricity demand during summer. Will help reduce power system stress by saving energy	No - Information on energy savings will be reflected in energy bills. However, information primarily dependent on consumer and strong monitoring mechanism needed to capture information that can inform future planning	Yes	Medium
Adopt LED lights for common area lighting in multi-storey buildings	Yes	-	Yes	No	Yes	Medium

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Adopt energy efficient ceiling fans to replace conventional fans	Yes	-	Yes - Increased temperature can increase demand for cooling and energy use during summer. This intervention will help reduce deliver thermal comfort with lower energy use and help reduce power system stress	No - Information on energy savings will be reflected in energy bills. However, information primarily dependent on consumer and strong monitoring mechanism needed to capture information that can inform future planning	Yes	Medium
Encourage use of energy efficient air conditioners	Yes	-	Yes	No	Yes	Medium
Pilot Green/Eco-building design	Yes	Yes - better indoor temperature and sustainable material can mitigate heat	Yes	-	Yes	High
Implement a programme to promote adoption of rooftop gardening	Yes - alternate food source	Yes	Yes	-	Yes	High
Commercial and Institutional Buildings						
Adopt energy efficient lighting and ceiling fans in commercial units, hospitals, educational and public buildings	Yes - low energy alternative to existing appliances/ equipment	-	Yes - Increased temperature can increase electricity demand during summer. EE fans will help reduce power system stress by saving energy	No - Information on energy savings will be reflected in energy bills. However, information primarily dependent on consumer and strong monitoring mechanism needed to capture information that can inform future planning	Yes	Medium
Use of energy efficient air conditioners in large public buildings	Yes	-	Yes	No	Yes	Medium

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Install SWHS in hospitals, hotels and institutional campuses	Yes - Enables decentralization and reduced reliance on conventional energy through use of solar energy	Yes - Will operate dependent on availability of sunlight and designed to have 2-3 days of self-sufficiency. Can typically operate in combination with electric power to meet hot water demand during periods with low sunlight.	Yes - increased self-sufficiency	Partial - Information on energy savings will be reflected in energy bills. However, monitoring mechanism will be needed to capture information to inform future planning. Results from deployment of solar water heating can help inform regulations on building design (heights and water distribution, rooftop utilization and design)	Yes	High
Scale up installation of rooftop solar PV with net-metering in commercial units, hospitals, educational and public buildings	Yes - Enables decentralization and reduced reliance on grid energy supply through use of solar energy	Yes	Yes - increased self-sufficiency at the household level and improved energy resilience & security	Partial	Yes	High
Industries						
Replace conventional lights with LED lights in industrial units	Yes	-	Yes	No	Yes	Medium
Replace conventional ceiling fans with energy efficient ceiling fans in industrial units	Yes	-	Yes	No	Yes	Medium
Scale-up deployment of net-metering based solar PV systems in industrial units	Yes	Yes	Yes	No	High	High

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Water Supply						
Reduce physical water losses and non-revenue water through water audits, leak detection, network improvement	Yes	No	Yes - Water demand will increase in the upcoming years. This intervention will improve water supply efficiency and reduce emission	Yes - Previously, Dhaka WASA had the technical expertise and access to information to implement this intervention. Now NCC is responsible for water supply and can get support and information from WASA and private sector experts. Intervention will support in planning for efficient future expansion of water supply service	Yes - Water loss will eventually reduce per unit energy consumption and emission	High
Install solar PV systems at water supply plants	Yes - Enables decentralization and reduced reliance on grid energy supply through use of solar energy	Yes	Yes - increased self-sufficiency and improved energy resilience & security	Yes- NCC can monitor results and use knowledge for future replication	Yes	Very High
Introduce and promote rainwater harvesting (RWH) for groundwater recharge in residential, public/ institutional and industrial properties	Yes - Currently, Narayanganj is dependent on surface and groundwater to meet water demand. Rain water harvesting will be act as supplementary decentralized source of water	Yes	Yes - Demand for supply water and ground water will increase in the future. RWH will reduce the pressure on water resources. Intervention can also help in ground water recharge and improve groundwater table.	No	Yes -Widespread adoption will significantly reduce energy consumption for surface and groundwater extraction and treatment	High
Prepare city-level water conservation policy	Yes - will help identify and implement alternative options	-	Yes - will improve water security and resilience	Yes - process will outline actions for future planning	Yes - Will lead to energy and GHG emission reduction	High

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Initiate integrated water resource management	Yes - Currently, neither surface nor ground water sources are managed, protected or preserved. Both surface and ground water are being polluted by uncontrolled discharge and disposal of waste water and solid waste. Initiating this measure will protect and preserve water sources from pollution and ensure better quality of supplied water	Yes - Supports efficient management of water resources, improves water access. Thereby enhances resilience of water services to climate change impacts	Yes - Higher temperature and decreased rainfall can impact water resource availability. Protecting, preserving and managing water resources will mitigate the impact	Yes - provides information for planning of supply and demand, efficient utilization and management of local water resources	Yes - Water resource efficiency and conservation will reduce energy use and GHG emissions for treatment and distribution of water resources	Very High
Wastewater and Drainage						
Develop city-wide drainage master plan	Yes - Current drainage system needs refurbishment. Developing a drainage masterplan will help in proper design of existing and upcoming drains, helping to reduce waterlogging and water pollution	Yes - Drainage masterplan will address future climate change impacts and design a system to mitigate these	Yes - Sudden and intense rainfall overflows into existing drains. Designing an adequate drainage system will help the city to adapt such scenarios	Yes – Will help in future planning, infrastructure development and related measures	--	High
Prepare Policy and Plan for fecal sludge management (FSM)	Yes	-	Yes	Yes	Yes	High
Effective monitoring and auditing of wastewater discharged by industries	Yes	-	Yes - Regular monitoring and auditing will lower water pollution. Increased temperature and decreased rainfall will have lower impact on water supply if the pollution is reduced	Yes - Regular monitoring along with DoE will provide access to data for better planning and decision-making	Yes	High

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Prepare Master Plan to introduce sewerage system	Yes - Currently, there's no sewer network in NCC. Will improve wastewater management and reduce water pollution	Yes	Yes – Dedicated sewer network will alleviate the problem of mixing of sewage and stormwater, making the system better respond better to high intensity rainfall	Yes	-	High
Pilot decentralized wastewater treatment systems (DeWATS) for households	Yes - Sewer network is absent. Decentralized treatment systems will provide an alternative solution and reduce untreated wastewater disposal	Yes- Reduced vector borne and other health hazards for vulnerable people due to sewage disposal in open drains	Yes - Decentralized treatment will improve condition of natural drains. Treated wastewater can generate biogas that can be utilized as an energy source	-	Yes - Energy savings from reduced wastewater quantity for pumping and GHG emission reduction from generation and use of biogas for energy	High
Promote grey water reuse & recycling for non-potable uses such as landscape irrigation, gardening, flushing	Yes -Reduced freshwater consumption and availability of wastewater through reuse and recycling for non-potable use	Yes - As grey and black water is collected separately, there is high potential of effective treatment of grey water on-site through low cost treatment solutions. This will reduce load and dependency on existing sewer network. Addresses water scarcity during less rain.	Yes - Conservation of freshwater can help strengthen resilience to water scarcity in summers or periods of low rainfall. Dual plumbing system has the potential to treat wastewater in a decentralized manner, and will reduce electricity us for pumping	-	Yes - Reduced energy consumption and GHG emission from pumping and distribution due to freshwater conservation and in-situ wastewater treatment	High
Optimum operation and performance management of new sewage treatment plants	-	Yes	Yes	Yes	Yes	High

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Municipal Solid Waste Management						
Strengthen Implementation of 3R (Reuse, Reduce, Recycle) Strategy	Yes – Will help improve decentralized management and processing of solid waste, enabling better redundancy	-	Yes - Decreased rainfall and high temperatures can impact waste processing efficiency. Measures to reduce waste generation, promote recycling and reuse will alleviate this problem	Yes	Yes	High
Implement waste to energy plant	Yes – Existing waste management facilities are inadequate. A waste to energy plant will help process and treat waste effectively, while also providing a new energy source.	-	Yes	Yes – Design and operationalizing the plant will help provide additional information, that can be used to improve efficiency and sustainability of solid waste management services	Yes – Reduced GHG emission due to avoided disposal of waste and energy generation from waste.	High
Street Lighting						
Undertake a technical study for design of energy efficient street lighting	Yes - Current design and infrastructure needs upgradation to ensure uniform illumination with lower energy use.	-	Yes	Yes – Will help in design and establishment of future street lighting infrastructure that provides adequate service delivery in an energy efficient manner	Yes -Will save energy and reduce GHG emission	High
Install energy efficient street lighting control systems	Yes – Current operation is manual and can help bring in automation/ remote control, thereby improving redundancy.	Yes - Automated system will efficiently turn on/off the lights and dim when necessary, responding better to weather or climate condition	Yes	-	Yes - This intervention will save energy and reduce GHG emission	High

Interventions	Redundancy	Flexibility	Responsiveness	Access to information	Energy saving and GHG emission mitigation potential	Overall Resilience Score
Transport						
Undertake Comprehensive Traffic Study and prepare Low Carbon Transport Plan	Yes – Will provide adequate mobility options/alternatives, improved access, reduced traffic congestion.	Yes	-	Yes	Yes	High
Promote and develop non-motorized transit facilities	Yes - Limited infrastructure suitable for walking and cycling. Will encourage and offer residents low/ no carbon options for short distance trips.	-	Yes - reduced fuel use, air pollution and emission	Yes	Yes – Low/ no energy option and will greatly reduce GHG emission	High
Introduce public city bus service	Yes – Reduced dependency on private vehicles and shared intermediate public transit vehicles. Improved mobility for all	Yes	Yes	-	Yes	High
Urban Biodiversity and Air Quality						
Improve and maintain urban green cover and green spaces	Yes	Yes	Yes	Yes	-	High
Restoration of surface water bodies and biodiversity conservation	Yes	Yes	Yes	Yes	-	High
Promote nature-based solutions for flood control	Yes	Yes	Yes	Yes	-	High
Use of Air Quality data for city planning, particularly spatial planning	Yes	Yes	Yes	Yes	-	High

Annexure 4: Feasibility Assessment of the Climate Resilience Interventions

Interventions	Feasibility of the intervention			Period of Impact
	Technical	Political	Financial	
Residential Buildings				
Promote use of solar water heaters (SWH) in place of conventional geysers in households	Medium - Technology is proven and available but awareness is limited. Improved awareness needed on net-metering mechanism	Low - Limited evidence of policy push to promote solar water heaters. Local government keen to promote solar energy but limited uptake among residential consumers and building owners	Medium- Intermediate capital cost and payback period as compared to solar PV.	Medium
Promote and facilitate installation of rooftop solar PV with net-metering in independent homes in high-rise buildings	Medium - Technology is proven and available but awareness is limited. Improved awareness needed on net-metering mechanism	Medium - GoB his promoting installing rooftop solar PV on new buildings. Policy and roadmap in place by SREDA. Local government is aware and keen to promote solar PV but there is a lack of willingness among residential consumers and building owners	Low - High capital cost, lower energy demand in individual homes inhibits viability, limited low-cost financing options	Medium term period
Adopt energy efficient lighting to replace conventional lighting	High - Type of lighting solutions proposed are well established and available. Technical know-how exists in the local government	Medium - Policy emphasis, and administrative & political willingness for adoption of solution in place. Awareness and willingness at household level, especially for LED lamps needs improvement. Better strategy can support in implementing the project.	High - Cost of intervention is not high, delivers immediate energy savings and has shorter payback period	Short term period
Adopt LED lights for common area lighting in multi-storey buildings	High - Type of lighting solutions proposed are well established and available. Technical know-how exists in the local government	Medium - Policy emphasis, and administrative & political willingness for adoption of solution in place. Awareness and willingness need improvement	Medium - Cost of intervention is not high, delivers immediate energy savings and has shorter payback period. Securing joint investment from multiple households for adopting solution for common utility lighting will need to be addressed	Mid-term period
Adopt energy efficient ceiling fans to replace conventional fans	High - Alternating current (AC) type efficient ceiling fans are available in the local market and these are primarily proposed. Super-efficient fans (brushless type DC fans) are not widely available and are proposed for 5% of replacements	Medium - Policy emphasis, and administrative & political willingness for adoption of solution in place. Awareness and willingness at household level needs improvement. Better strategy can support in implementing the project.	High - Cost of intervention is not very high, delivers immediate energy savings and has mid-term payback period	Short term period

Interventions	Feasibility of the intervention			Period of Impact
	Technical	Political	Financial	
Encourage use of energy efficient air conditioners	Medium - Efficient ACs are available in the market. Willingness may be low due to high capital cost but opportunity to influence new purchases. Low awareness is a barrier.	Low - Included in national energy efficiency policy initiatives. Lower priority due to higher capital cost. Purchasing capacity and penetration predominantly in high-income and upper mid-income groups.	Low - Capital cost of the appliance is high. Mechanisms to support exchange of inefficient stock and incentivize new purchases of efficient ACs are needed.	Long term
Pilot Green/Eco-building design	Medium - Technology/ concept is proven but awareness is limited	Medium - Policy emphasis, and administrative & political willingness exists. Awareness and willingness of end-users needs improvement	Low - No dedicated funds available	Mid-term period
Implement a programme to promote adoption of rooftop gardening	Medium - Not prevalent but knowledge can be accessed	High - NCC keen to promote and has a rebate in place	High - NCC provides a tax rebate; cost is not too high'	Short term period
Commercial and Institutional Buildings				
Adopt energy efficient lighting and ceiling fans in commercial units, hospitals, educational and public buildings	High - Type of lighting solutions proposed are well established and available. Technical know-how exists in the local government	Medium - Policy emphasis, and administrative & political willingness for adoption of solution in place. Awareness and willingness need improvement. Better strategy can support in implementing the project.	High - Cost of intervention is not high, delivers immediate energy savings and has shorter payback period	Short term period
Use of energy efficient air conditioners in large public buildings	Medium - Efficient ACs are available in the market. Willingness may be low due to high capital cost but opportunity to influence new purchases. Low awareness is a barrier.	Low - Included in national energy efficiency policy initiatives. Lower priority due to higher capital cost.	Low - Capital cost of the appliance is high. Mechanisms to support exchange of inefficient stock and incentivize new purchases of efficient ACs are needed.	Long term
Install SWHS in hospitals, hotels and institutional campuses	Medium - Technology is proven and available but awareness is limited. Improved awareness needed on net-metering mechanism	Low - Limited evidence of policy push to promote solar water heaters. Local government keen to promote solar energy but limited uptake among building owners	Medium-Intermediate capital cost and payback period as compared to solar PV.	Mid-term period
Scale up installation of rooftop solar PV with net-metering in commercial units, hospitals, educational and public buildings	High -Adoption of rooftop solar PV promoted in commercial and administrative buildings by GoB. NCC has pilot projects on solar PV in place and is familiar with the technology	Medium - Local government is aware and promoting building owners to install rooftop solar PV. But there's lack of willingness among building owners	Medium - High capital cost but viability may be better for commercial buildings	Medium term period

Interventions	Feasibility of the intervention			Period of Impact
	Technical	Political	Financial	
Industries				
Introduction of Rooftop Solar PV system in industrial buildings	High - Government has policy to encourage adoption of RE and installing rooftop solar PV in industrial buildings. NCC is also promoting to adopt RE in small scale	Low - GoB has policies but industry owners are unwilling to install solar PV. Larger industries are setting up their own power plant.	Medium - GoB has allowed loan for installing solar PV	Medium term period
Replacement of conventional lights with LED lights in micro & small industries	High	Medium	High - Cost is not too high and viability is better due to long working hours	Short-term
Replacement of conventional lights with LED lights in large garment & textile industries	High	Medium	High - Cost is not too high and viability is better due to long working hours	Short-term
Replacement of conventional fans with energy efficient fans in micro & small industries	High	Medium	High - Cost is not too high and viability is better due to long working hours	Short-term
Replacement of conventional fans with energy efficient fans in large garment & textile industries	High	Medium	High - Cost is not too high and viability is better due to long working hours	Short-term
Water Supply				
Reduce physical water losses and non-revenue water through water audits, leak detection, network improvement	Low - NCC was handed over the responsibility of water supply recently and has limited technical expertise. It will need to take support from Dhaka WASA or private agencies The responsibility of water supply and infrastructures have been handed over to NCC very recently. They are going to take support from ADB to execute their responsibility.	High - The mayor and other community leaders have high willingness and keen to execute actions to improve water supply and network	High - NCC has signed a BDT 820 crore project to expand service coverage and improve efficiency of water supply	Medium term period
Install solar PV systems at water supply plants	High - Technology is proven and available. NCC has implemented two demonstration projects on solar PV and can draw on the experience.	High - GoB is promoting renewable energy and adoption of energy efficient equipment. NCC is willing to follow government policies	Low - No funds under in-progress activities. City can allocate municipal budget as proposed system size is not too large.	Medium term period
Introduce and promote rainwater harvesting (RWH) for groundwater recharge in residential, public/ institutional and industrial properties	Medium - Rain water harvesting is a common practice in the coastal regions. Although not introduced at the city level yet, NCC can implement pilot projects and scale up with proper training.	Medium - Since this is already in practice in coastal region, administratively and politically it will be acceptable in Narayanganj. Awareness building and budget allocation will require some time.	Low - NCC has the financial capacity to implement small pilot projects. However, financing of RWH by consumers may be challenging	Mid-term period

Interventions	Feasibility of the intervention			Period of Impact
	Technical	Political	Financial	
Prepare city-level water conservation policy	Medium- Limited technical expertise. City can access information from other city policies, best practices	High - Political willingness to improve water supply and security through policy	High - Policy can be prepared with low costs	Short term period
Initiate Water resource management	Low - NCC has no prior experience and limited expertise on the topic. Support can be sought from Dhaka WASA and private agencies to implement this intervention	Medium - City has authority to protect, preserve and manage water resources. Consultations will be needed with business and industries, and also with residents	Low - This intervention will require significant financial resources. NCC does not have the capacity to finance this action and NCC doesn't have that capacity	Long term period
Wastewater and Drainage				
Develop city-wide drainage master plan	High - ADB will support city authority to prepare the drainage masterplan	High - The project is approved from ministry	High - Approved from ministry	Medium term period
Prepare Policy and Plan for fecal sludge management (FSM)	Medium - Other cities in Bangladesh are implementing initiatives	High - Ranks high on the agenda given lack of wastewater network	Low	Medium term period
Effective monitoring and auditing of wastewater discharged by industries	Medium - DoE has technical capacity for monitoring and auditing. NCC has offered to support DoE.	Low - Although DoE is responsible to monitor and regulate industrial pollution, it isn't done properly due to external pressure	Low - DoE and NCC has limited budget to conduct regular monitoring and audits	Medium term period
Prepare Master Plan to introduce sewerage system	Low - NCC doesn't have any sewerage system yet. The officials need training and technical support from external agencies to implement	Low - NCC is still working with drainage system and doesn't have any plan for sewerage system installation in recent years	Low - NCC will need financial support	Long term period
Promote grey water reuse & recycling for non-potable uses such as landscape irrigation, gardening, flushing	Low - Limited technical expertise on the topic within the city government. Access to required skills is limited due to limited deployment	Low - While there is an opportunity, especially given the industrial properties and need to address water pollution, no mandate/ regulation exists at present	Low	Long term period
Pilot decentralized wastewater treatment systems (DeWATS) for households	Low - NCC does not have experience and expertise in relation to adoption of decentralized treatment systems	Medium - In the absence of a sewer network, willingness from the city to adopt decentralized treatment solutions	Medium- Cost is in mid-range	Medium term period
Optimum operation and performance management of new sewage treatment plants	Low - NCC does not have expertise and will need training	Low	Medium	Long term period
Municipal Solid Waste Management				
Strengthen Implementation of 3R (Reuse, Reduce, Recycle) Strategy	Medium - NCC is gradually developing their technical strength in waste management	High - NCC is providing training to the responsible officials, organizing awareness building meetings and rallies	High - NCC has adequate budget and also taking support from private agencies	Short term period

Interventions	Feasibility of the intervention			Period of Impact
	Technical	Political	Financial	
Introduce bio-methanation facilities	Medium - NCC has experience of producing compost fertilizer at a small scale. With a little technical support from private agencies, they can implement the project	Medium - GoB has been promoting bio-methanation in rural areas for a long time. No city has taken this measure yet. But NCC is interested to take such projects	Low - NCC will need financial support. Also, they can handover the project to private agencies	Medium term period
Street Lighting				
Undertake a technical study for design of energy efficient street lighting	Medium - NCC has limited technical capacity in energy auditing. Will require external energy auditors to implement this intervention	Medium - NCC is already installing energy efficient lights and expanding street lighting. Conducting a study and audit might lead to change in the current design	Medium - Can use municipal budget and some part funding may be required	Medium term period
Install energy efficient street lighting control systems	Low - Low technical capacity of NCC, availability of technology	Medium - NCC willingness as energy bills will be reduced	Medium - Cost for suggested scale is not too high and can be funded by NCC	Medium term period
Transport				
Undertake Comprehensive Traffic Study and prepare Low Carbon Transport Plan	Low - NCC doesn't have the technical capacity to conduct traffic study and prepare a low carbon transport plan for the city	High - NCC has been looking for public or private agencies to prepare their transport plan	Low - Will require financial support to conduct this study	Medium term period
Promote and develop non-motorized transit facilities	Low - Technical support from external agencies is required to develop infrastructure. NCC can promote	Low - Most of the roads within the city are narrow. Introducing bicycle lane or footpath in them will be difficult. Also, people are more likely to take rickshaw	Low - Need financial support from GoB or private agencies	Long term period
Introduce public city bus service	Medium	High	Low - need support	Medium term period
Urban Biodiversity and Air Quality				
Improve and maintain urban green cover and green spaces	High- NCC has technical capacity for planning	Medium	Medium	Medium term period
Restoration of surface water bodies	Low - Technical capacity is low. Support will be needed	High - Water bodies restoration ranks high on NCC's agenda	Low- financial support needed	Medium term period
Promote nature-based solutions for flood control	Low - Technical capacity is low. Support will be needed	Medium	Medium	Medium term period
Use of Air Quality data for city planning, particularly spatial planning	Medium – Technology (sensors) have been installed. NCC can use its internal capacity to utilize the data captured	High – Air quality management is a priority issue for NCC	High- Municipal budget can support this planning action	Short term period

Annexure 5: Additional City Profile Data

Ward	Total Population	Male Population	Female Population
Kadamrasul Pourashava			
Ward – 01	11822	5977	5845
Ward – 02	17649	8777	8917
Ward – 03	22176	11380	10796
Ward – 04	30728	15633	15095
Ward – 05	30572	15553	15019
Ward – 06	20308	10029	10279
Ward – 07	12636	6431	6205
Ward – 08	6812	3462	3350
Ward – 09	13543	7020	6523
Total	**166246**	**84262**	**82029**
Narayanganj Pourashava			
Ward – 01	20489	10685	9804
Ward – 02	24550	12782	11768
Ward – 03	40187	20871	19316
Ward – 04	47079	24400	22679
Ward – 05	29431	15372	14059
Ward – 06	24096	12707	11389
Ward – 07	34496	17659	16837
Ward – 08	35518	18126	17392
Ward – 09	30484	15612	14872
Total	**286330**	**148214**	**138116**
Siddirganj Pourashava			
Ward – 01	36592	18961	17631
Ward – 02	25585	13180	12405
Ward – 03	35947	18931	17016
Ward – 04	23385	12240	11145
Ward – 05	18421	9334	9087
Ward – 06	25100	12878	12222
Ward – 07	21888	11165	10723
Ward – 08	42704	22169	20535
Ward – 09	27138	13840	13298
Total	**256760**	**132698**	**110764**
Grand Total	**709336**	**365174**	**330909**

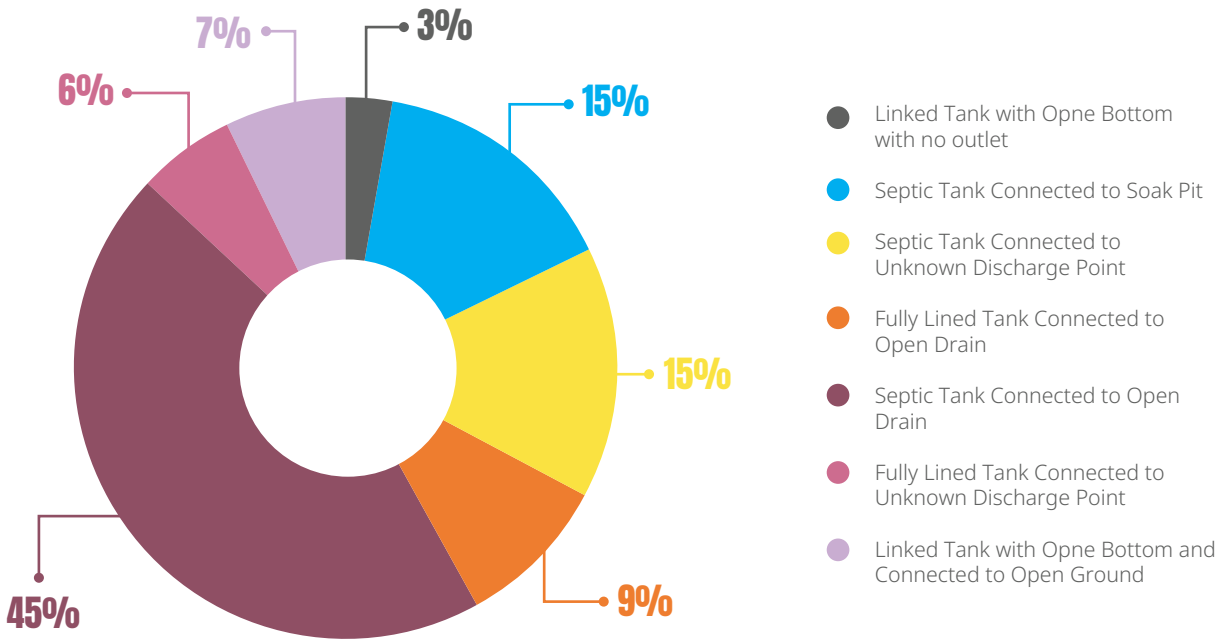
Details of Water Supply Pumping

Sl. No	Name of Pump	Operational Capacity (Litre per minute)	
		2018	2019
1	Paikpara Water Pump	3000	-
2	Nitaiganj Water Pump	4700	2700
3	Deobhog Water Pump	3600	-
4	Golachipa Water Pump	700	-
5	Masdair Water Pump	2600	2000
6	Khanpur Bank Colony Water Pump	3600	2000
7	Purbo Tolla Chairmanbari Water Pump	2300	3200
8	Pathantuli Water Pump	3000	2200
9	Sombaria Hat Water Pump	1800	2500
10	Nobiganj Water Pump	3000	
11	Bondor Water Pump	-	-
12	Arambag Water Pump (Old)	2500	1200
13	Arambag Water Pump (New)		2000
14	Paschim Tolla Water Pump	2700	2300
15	Modonganj Water Pump	3400	1000
16	Rupali R/A Water Pump	2400	1400
17	Choudhuri Para Water Pump	2400	-
18	Mahmud Nagar Water Pump	2400	-
19	Bhumi Palli Water Pump	2400	-
20	Arsim Gate Water Pump	2400	2200
21	Dhonkunda Water Pump	2400	1800
22	Uttar Lokkhon Khola Water Pump	2400	-
23	Killarpool Mazar Water Pump	2400	-
24	DC Banglo Water Pump	2400	3000
25	Kayempur Water Pump	-	2500
26	Shitalakshya Water Pump	-	-
27	Bage Jannat Water Pump	-	1300
28	SO Road	-	2500
29	Tantkhana Road	-	3000
30	Siraj-Ud-Doulla	-	2000
31	Bhuiyan Bhag Water Pump	-	1300

Year-wise Solid Waste Generation and Collection

Year	Daily Waste Generation (Tonnes)	Daily Waste Collection (Tonnes)
2018-2019	400	350
2017-2018	350	300
2016-2017	320	290
2015-2016	300	250
2014-2015	280	230
2013-2014	250	200

Figure 52: Types of septic tanks used by households in Narayanganj



Annexure 6: Key Recent Development Projects in Narayanganj

Sr, No	Project	Funding Agency	Cost	Status
		Water Sector		
01.		ADB	BDT 820 Crore	Approved
02.	Livelihood Improvement of Urban Poor Communities Project (LIUPCP)	UKAid and UNDP		Installed number of deep tubewells in urban slums and low-income communities
		Drainage and Waste Water		
03.	Municipal Governance and Services Project (MGSP)	World Bank and GoB	BDT 58 Crore	Constructed 15.5 km of drainage system between 2014-15 and 2016-17 fiscal year as a sub-project. Implementation of other project components is ongoing.[79]
04.	City Governance Project (CGP)	JICA	BDT 169 crore	Constructed 38 km drain since 2014 as a sub-project. Implementation of other project components is ongoing.[80]
05.	Drainage System Master plan for NCC	ADB	BDT 820 crore	A sub-project of the total package. The project is approved.
		Solid Waste		
06.	Implementation of a 5 MW Grid Connected Waste to Power Project on Build, Own & Operate (BOO) Basis at Jalkuri, Narayanganj, Bangladesh	Bid Winner		In progress[81]
07.	Solid Waste Management Master Plan for NCC			In Progress
		Sewerage and Sanitation		
08.	Municipal Governance and Services Project (MGSP)	World Bank and GoB	BDT 58 Crore	Restoration and beautification of 3.5km Baburail canal is a sub-project of the total package. Implementation of this component is ongoing.
09.	Livelihood Improvement of Urban Poor Communities Project (LIUPCP)	UKAid and UNDP		Installed septic tanks in low-income community latrines as a sub-project of the total package.
		Transportation		
10.	Upgrading Dhaka – Narayanganj rail line to dual-gauge		BDT 3.79 Billion	The project started in 2015 and was scheduled to be finished by 2019. Land acquisition phase is still going on and construction is yet to start.[82]
11.	Light Rapid Transit system in Narayanganj	Searching for a funding agency		Approved[83]
12.	16 km Kamalapur-Narayanganj underground rail network project			The project is proposed and targets to be finished by 2030[84]

79 https://ncc.portal.gov.bd/
80 https://ncc.portal.gov.bd/
81 https://www.dhakatribune.com/bangladesh/power-energy/2018/03/22/pdb-generate-power-narayanganj-garbage?
82 https://www.chinadaily.com.cn/business/2017-06/20/content_29812812.htm
83 http://www.pppo.gov.bd/projects-light-rapid-transit-system-for-narayanganj-city.php
84 http://www.newagebd.net/article/63179/16-km-kamalapur-narayanganj-underground-train-by-2030

Sr, No	Project	Funding Agency	Cost	Status
13.	Introduction of Electric Train System in Narayanganj	GoB and the Singapore Government		The project is approved. An MoU is signed between GoB and Singapore Government. Budget and timeline will be fixed after a feasibility study.[85]
14.	Construction of 3rd Shitalakshya Bridge	GoB and Saudi Funding Agency	BDT 5396.7 million	The construction is ongoing. A 1309 m bridge and 2.93 km approach road will be constructed. The project is scheduled to be finished by Dec 2021.[86]
15.	City Governance Project (CGP).	JICA	BDT 169 crore	The project is constructing 26 km road and 7 bridge and culvert as a sub-project.
16.	Municipal Governance and Services Project (MGSP)	World Bank	BDT 58 Crore	The project has constructed 1605-meter road, 3210 m walkway, and 9 Girder Bridges and 8 foot-bridges as a sub-project. Other components of the project are ongoing.
		Building and Energy		
17.	Uninterrupted power supply in Narayanganj	Gob and DPDC	BDT 2000 crore	The project timeline is 2019-2022. DPDC will improve its' power generation to ensure uninterrupted power supply in Dhaka and Narayanganj by 2030.[87]
18.	Introduction of Smart Grid in Narayanganj and Dhaka	GoB, French Agency for Development and European Union	BDT 1500 crore	To make the grid more efficient, reliable and secure, the project will develop network communication; automation control and new technologies and tools. Under the main project, two 132 kilo-volt sub-stations will be set up at Shyampur and Mohammadi Steel areas in Narayanganj. The project is scheduled to finish by Dec 2022.[88]

85 https://www.thedailystar.net/business/news/narayanganj-get-electric-train-service-1663513
86 http://103.48.18.161/admin/profiles/donation/rthd_9.pdf
87 https://www.thedailystar.net/city/news/tk-2000cr-project-non-stop-power-supply-dhaka-nganj-1689634
88 https://tbsnews.net/bangladesh/energy/smart-grid-smarten-dhakas-power-supply