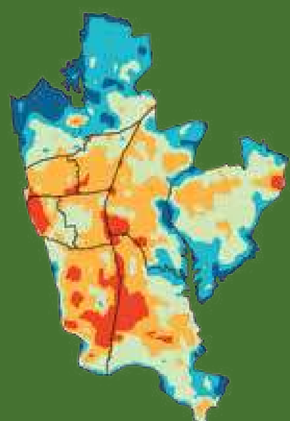

CLIMATE ACTION PLAN

Savar Municipality, Savar
Bangladesh
2024

german
cooperation
DEUTSCHE ZUSAMMENARBEIT

BORDA
SOUTH ASIA

WASTE CONCERN

CLIMATE ACTION PLAN

Savar Municipality, Savar, Bangladesh

ACKNOWLEDGEMENT

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
CAP	Common Agricultural Policy
CAP	Climate Action Plan
CBO	Community-Based Organization
CDC	Community Development Committee
CEO	Chief Executive Officer
CHRS	Center for Hydrometeorology and Remote Sensing
CR	Climate Resilience
CRU	Climatic Research Unit
DMC	Disaster Management Committee
DPHE	Department of Public Health Engineering
DRBP	Dhaka River Basin Project
FSTP	Fecal Sludge Treatment Plant
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HBB	Herring Bone Bond
HIGS	Hazard, Infrastructure, Governance, Socio-Economic
KL	Kiloliter
Km	Kilometer
LGED	Local Government Engineering Department
LIC	Low-Income Community
LIUPCP	Livelihoods Improvement for Urban Poor Communities Project
LST	Land Surface Temperature
MDMC	Municipal Disaster Management Committee
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NUPRP	National Urban Poverty Reduction Program
PDB	Power Development Board
PNO	Paura Nirbahi Officer
RCC	Reinforced Cement Concrete
REB	Rural Electrification Board
SC	Standing Committee
SDG	Sustainable Development Goal
Sq. Km.	Square Kilometer
SWM	Solid Waste Management
TLCC	Town Level Coordination Committee
UDD	Urban Development Directorate
UNDP	United Nations Development Programme
UPSM	Urban Poor Settlement Mapping
USGS	United States Geological Survey
WASH	Water, Sanitation, and Hygiene
WC	Ward Committee
WL	Waterlogging
WVI	Ward Vulnerability Index
WW	Waste Water

GLOSSARY

Adaptation: The process of preparing for and adjusting to the impacts of climate change to withstand its effects. It is a key pillar of climate action, alongside mitigation.

Bottom-up approach: An approach to planning that starts by engaging local residents to understand their needs, demands, and perceptions, ensuring that strategies are inclusive and reflect community priorities.

Canal: Khal or river channel

Carbon Credit: A financial instrument representing a reduction in greenhouse gas emissions. Projects that reduce emissions, like a Material Recovery Facility, can potentially earn carbon credits as part of global circular economy trends.

Climate Action Plan (CAP): A strategic document for municipalities that provides a structured, evidence-based framework for local climate action.

Climate Financing: The mobilization of funds for projects aimed at climate change mitigation and adaptation, such as the development of low-carbon city infrastructure.

Climate Resilience Plan: A strategic plan that outlines actions and interventions to help a community or system prepare for, withstand, and recover from climate-related shocks and stresses. The Climate Action Plan (CAP) serves this function at the municipal level.

Coldwaves: A climatic hazard characterized by unexpected drops in temperature, particularly during winter.

Detail Project Report (DPR): A comprehensive document outlining the plan for a specific project identified within the Climate Action Plan.

Flood Risk: The likelihood of an area being inundated by water, assessed using factors like topography, land elevation, rainfall intensity, and proximity to water bodies.

Floodplains: Low-lying areas of land adjacent to a river that are subject to flooding.

Heatwaves: A climate hazard defined by prolonged periods of extreme heat. In urban areas, their impact is often intensified by the "urban heat island effect."

HIGS Framework: A methodology used for climate vulnerability assessments at the ward level, which analyzes four key dimensions: Hazards, Infrastructure, Governance, and Socio-economic indicators.

IPCC Guidelines 2006: A specific methodology provided by the Intergovernmental Panel on Climate Change (IPCC) for calculating and inventorying greenhouse gas (GHG) emissions.

Kancha/Jhupri: Terms for non-permanent housing structures common in low-income communities. Kancha houses are typically made of materials like mud, bamboo, or thatch, while jhupri refers to a slum shack or hut.

Land Cover Classification: A process that uses satellite imagery to map and analyze how different types of land surfaces (e.g., vegetation, water bodies, built-up areas) change over time.

Land Surface Temperature (LST): The temperature of the ground's surface, which can be measured using satellite data. LST maps are used to identify areas exposed to extreme heat and to understand the effects of urban heat islands.

Littering: The improper disposal of waste in open spaces, drains, or water bodies.

Material Recovery Facility (MRF): A specialized facility designed to receive, sort, and process inorganic and recyclable waste materials for recycling or resale, thereby improving overall waste management efficiency.

Mitigation: A primary component of climate action focused on reducing the impact of climate change to limit the severity of future climate change.

Non-WASH System: Urban infrastructure and services that are not part of the WASH (Water, Sanitation, and Hygiene) sector. This includes critical systems like housing, transportation, and electricity & communication.

Overlay Analysis: A geographic information system (GIS) technique where multiple data maps (e.g., land surface temperature, rainfall, and flood risk) are superimposed on one another to identify "hotspot" areas.

Plastic Credit: A financial instrument, similar to a carbon credit, designed to support projects that manage and reduce plastic waste, aligning with global circular economy goals.

Pourasabha or pourashava: Local governing body, municipality or municipal corporation of a city or town in Bangladesh

Pre-monsoon: The season immediately preceding the main monsoon rainy season, often referred to as spring.

Rainwater Harvesting: The practice of collecting and storing rainwater for future use, which serves as a key strategy for managing groundwater resources.

Recyclable: Able to be collected, separated, and processed to be used as raw material in the manufacture of a new product

Recycling: The process by which waste materials are transformed into new products in such a manner that the original products may lose their identity

Shared Toilet: A communal toilet facility used by multiple households, often implemented in densely populated low-income communities or slums to improve sanitation and hygiene.

Solid waste management: Systematic control of generation, storage, collection, transport, separation, processing, recycling, recovery, and final disposal of solid waste

Stormwater Drainage: The urban infrastructure system, including street gutters and storm drains, is designed to manage runoff from heavy rainfall, prevent water accumulation, and minimize flood risks.

Urbanization: The process of population growth and expansion of cities, often involving the conversion of agricultural land for urban use.

Vulnerability Assessment: A systematic process to identify which geographic areas, communities, or systems are most susceptible to the impacts of climate hazards.

Ward: An administrative and electoral division of a municipality. In the provided documents, vulnerability assessments and climate action planning are conducted at the ward level.

WASH System: An acronym for Water, Sanitation, and Hygiene. It refers to the essential urban services that ensure public and environmental health, including water supply, sanitation and wastewater management, stormwater drainage, and solid waste management.

Vangari dokan (scrap shop) or bhangari: Small shops that buy and sell recyclable waste and old and scrap items.

UNIT CONVERSION

1 ha = 2.471 acres

1 Gg CO_2e = 1,000 tonnes CO_2e

1 kL = 1 m^3 = 1,000 L

1 kWh = 1000 watt-hours (Wh)

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1. INTRODUCTION: DEFINING THE CRISIS

1.1 Global Context: A Shared Climate Emergency

Climate change has emerged as one of the most pressing global challenges of the 21st century, posing profound threats to ecosystems, economies, and human well-being worldwide. Driven by extensive land-use changes and human-induced greenhouse gas emissions, the Earth's climate system is undergoing unprecedented transformations. These disruptions are manifesting through rising temperatures, shifting rainfall patterns, more frequent and intense extreme weather events, and accelerating sea-level rise, which intensify vulnerabilities and place immense pressure on both natural and human systems. The Intergovernmental Panel on Climate Change (IPCC) has unequivocally stated that global warming has already reached 1.1 °C above pre-industrial levels and is likely to exceed 1.5 °C in the near term unless immediate and sustained reductions in emissions are achieved (IPCC, 2023).

The effects of this warming are already widespread and intensifying, impacting all aspects of the Earth system. The last decade, 2015-2024, was the warmest on record, with 2024 being the hottest year since recordkeeping began in 1880. This rise in temperature is causing more frequent and severe extreme weather events, including intense heatwaves, heavy rainfall, thunderstorms and prolonged droughts. According to the IPCC, with just a 1.1°C of warming so far, approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to these impacts, particularly in regions across Africa, South Asia, and Central and South America. Similarly, the planet's oceans have absorbed over 90% of the additional heat, resulting in rising sea levels due to thermal expansion and the melting of ice sheets.

The increasing intensity and frequency of climate extremes have led to severe human and economic losses. Between 2000 and 2019, over 475,000 people died worldwide as a direct consequence of more than 11,000 extreme weather events, with total economic losses exceeding US$2.5 trillion (Germanwatch, 2021). In 2022 alone, weather and climate-related disasters caused an estimated US$313 billion in global economic losses (Munich Re, 2023). These impacts are not evenly distributed: low- and middle-income countries, despite contributing the least to global greenhouse gas emissions, bear a disproportionate share of the damages and are the least equipped to respond.

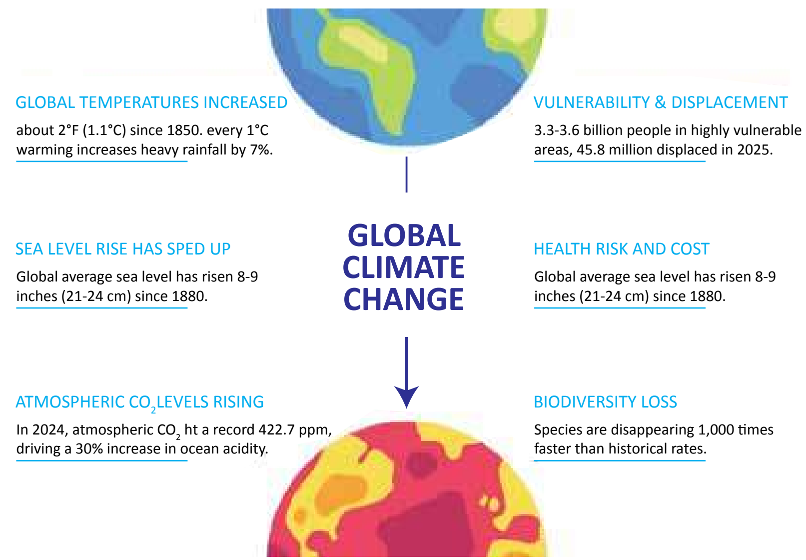


Figure 1: *Impact of Global Climate Change*

Recognizing the scale and urgency of the crisis, the international community has adopted several frameworks and commitments:

- **Paris Agreement (2015):** Committing countries to limit global temperature rise to well below 2 °C, and preferably to 1.5 °C.
- **Sendai Framework for Disaster Risk Reduction (2015–2030):** Promoting resilience-building and risk reduction across sectors.
- **Sustainable Development Goals (SDGs, 2015):** Mainstreaming climate action (Goal 13) across all development goals.
- **New Urban Agenda (2016):** Provides a global framework to promote sustainable, inclusive, and resilient urban development aligned with SDG 11.

Mitigation, reducing emissions, and adaptation —preparing societies to withstand impacts —are all critical pillars of global climate action. Urban areas, home to over 56% of the world's population and responsible for more than 70% of global CO_2 emissions, are increasingly recognized as key actors in achieving global targets (UN DESA, 2022; UN-Habitat, 2020). Cities and municipalities have become frontlines for innovative climate solutions, from green infrastructure to renewable energy transitions and resilient urban development.

1.2 National Context: Bangladesh's Rising Climate Risks

Bangladesh, located on the world's largest delta formed by the Ganges-Brahmaputra-Meghna river system, is one of the most climate-vulnerable countries globally. Its low elevation, high population density, and reliance on climate-sensitive sectors such as agriculture and fisheries make it highly susceptible to both slow-onset climate impacts and extreme events. Bangladesh ranked the 7th most affected country globally on the Global Climate Risk Index 2021 for the period 2000–2019 (Germanwatch, 2021).

1.2.1 Observed Impacts and Emerging Threats

Bangladesh is experiencing an escalation of extreme heat, with the country's maximum temperature increasing by 1.1°C, and the heat index—or "feels like" temperature—rising even more dramatically by 4.5°C (World Bank, 2025). This warming trend has intensified urban heat stress, particularly in urban areas, aggravating health risks and energy demand (Rahman et al., 2022).

Flooding remains the most frequent and damaging hazard. The 2020 monsoon floods, the longest in recent decades, affected 5.4 million people and inundated 37% of the country's area, disrupting livelihoods and infrastructure (UN OCHA, 2020). Moreover, intense rainfall events have increased by 12% since the 1980s, leading to recurrent urban waterlogging in major cities (BMD, 2022).

Similarly, Cyclone Amphan (2020) affected 2.6 million people and resulted in losses exceeding US$130 million, underscoring the increasing severity of coastal disasters (World Bank, 2021).

Salinity intrusion poses another growing threat, as sea-level rise and reduced river flow have increased soil and water salinity in coastal districts, affecting agriculture and safe drinking water for nearly 20 million people (World Bank, 2018).

Climate change is also accelerating rural–urban migration. Every year, hundreds of thousands of people migrate to urban centers due to river erosion, crop failure, and cyclones. By 2050, up to 13.3 million Bangladeshis could become internal climate migrants (World Bank, 2018).

According to the Country Climate and Development Report for Bangladesh by the World Bank

- Average tropical cyclones cost Bangladesh about $1 billion annually.
- By 2050, one-third of agricultural GDP may be lost due to climate variability and extreme events – a devastating figure as the agriculture sector represents around half of employment in the country.
- 13.3 million people may become internal migrants in the next 30 years due to climate impacts on agriculture, water scarcity, and rising sea levels, with higher impacts on women.
- In case of a severe flooding, GDP could fall by as much as 9 percent.
- The costs of environmental degradation and natural disasters are predicted to rise over time, compounded by higher heat, humidity, and health impacts.

Bangladesh will require at least $12.5 billion, approximately 3 percent of its GDP, in the medium term for climate action (World Bank, 2022).

1.2.2 Urban Vulnerabilities

In 2023, Bangladesh's urban population accounted for 40.47% of the total population, growing at an annual rate of 3.12%, and is projected to reach 50% by 2050, reflecting a rapid pace of urbanization (World Bank, 2024). While urban centers drive economic growth, they are increasingly becoming hotspots of climate risk. Rapid and often unplanned urbanization has heightened exposure to multiple hazards. Urban flooding is becoming more frequent and severe due to intense rainfall events, inadequate drainage systems, and encroachment on natural water bodies (World Bank, 2021). Densely built-up areas with limited vegetation amplify the urban heat island effect, increasing heat stress and energy demand (Dasgupta et al., 2019). Unplanned infrastructure expansion leaves critical services vulnerable to extreme weather, while poor sanitation and stagnant water contribute to growing health risks from vector- and water-borne diseases, such as dengue, cholera, and diarrhea, which are expected to worsen with changing climate patterns (WHO, 2020). These intersecting pressures make urban centers particularly susceptible to climate impacts, threatening lives, livelihoods, and essential urban systems.

1.3 National Strategies and Policy Responses to Climate Change

The Government of Bangladesh has taken proactive steps to address climate change through a comprehensive policy and planning framework, including the following shown in Table 1:

Table 1: Key features of local-level climate action planning in the Regulatory Frameworks of Bangladesh

National Documents	Key features of local-level climate action planning
National Adaptation Plan of Bangladesh (2023-2050)	• Development of climate action plans for urban and peri-urban areas with an investment budget of BDT 4 billion, prioritizing resilience of vulnerable populations, including the urban poor and climate migrants. • Implementation of risk management measures for thunderstorms and lightning in high-risk areas. • Promotion of climate-resilient, inclusive (gender-, age-, and disability-sensitive) WASH technologies and facilities. • Enhancement of urban access to water, sanitation, and hygiene services to reduce exposure to flooding and waterborne diseases during extreme weather events.
Bangladesh's Third Nationally Determined Contribution (NDC 3.0) 2025	• Integration of climate mitigation into city development plans, strengthening local government capacity for low-carbon urban planning, and aligning zoning, building codes, and infrastructure with emission reduction goals. • Implementation of integrated solid waste and fecal sludge management at the city level (establishment of 26 integrated landfills and resource recovery facilities and 6 sewage treatment plants) • Sustainable waste management practices, including source segregation, composting/anaerobic digestion, landfill gas capture, e-waste management; • workforce training, job creation through repair, reuse, and recycling hubs; and formalization of waste pickers with PPE, contracts, and health coverage.

National Documents	Key features of local-level climate action planning
Bangladesh Delta Plan 2100	• Recognizes urban areas as critical climate hotspots with an investment budget of USD 8 billion, particularly vulnerable to flooding, heat stress, and infrastructure strain due to rapid urbanization and climate change. • Appropriate action plan for removing waterlogging in urban areas • Categorization of wastes into e-waste, hospital wastes and others and separate effective waste management plans. • Community engagement and local knowledge in developing and implementing climate adaptation strategies, ensuring that interventions are context-specific and inclusive. • Strengthening local governance and institutional frameworks to effectively plan, implement, and monitor climate adaptation measures in urban settings.
Perspective Plan of Bangladesh 2021-2041	• Green areas in Dhaka and major cities to reach 5–12 m^2 per capita, 100 % of cities flood-free with proper drainage, and PM 2.5 reduced from 86 µg/m^3 to 10 µg/m^3. • Emphasis on sustainable city planning, decentralized governance, and integration of geo-spatial data (e.g., urban heat-mapping and land-use zoning). • Urban development must integrate environmental management and climate resilience to reduce urban heat, flooding, and pollution.
8th Five-Year Plan of Bangladesh (2021–2025)	• By 2030, cities should adopt integrated urban policies focusing on resource efficiency, mitigation and adaptation to climate change, and disaster resilience, aligned with the New Urban Agenda (NUA) and SDG-11. • Integrate climate change risk management into urban planning and governance. • Strengthen local institutions for urban climate and disaster risk management and build municipal–community partnerships to improve services and neighborhood resilience

1.4 Local Level Climate Action

Despite notable advances in national climate policies and strategic frameworks, a critical gap persists in local-level implementation, particularly within municipalities. As the core of urban settlements, municipalities are at the frontline of climate impacts—facing heightened risks from urban flooding, heat stress, infrastructure vulnerability, and public health threats. Yet, municipal institutions often have limited capacity, resources, and localized data to translate national priorities into actionable interventions on the ground.

A Municipal Climate Action Plan (MCAP) provides a structured mechanism to address this gap by enabling evidence-based, localized climate action. Through ward-level vulnerability assessments, municipalities can identify climate risk hotspots, set clear priorities, and design targeted interventions that address the most pressing needs. The MCAP will serve as both a strategic planning tool and a critical data source, supporting the integration of climate actions into master plans, local development plans, and municipal budgets.

Importantly, the MCAP will promote community engagement and local empowerment, ensuring that climate strategies are context-specific, inclusive, and supported by local stakeholders. By aligning municipal initiatives with national climate strategies, the MCAP will enhance institutional capacity, optimize resource allocation, and promote resilient, low-carbon urban development at the local level.

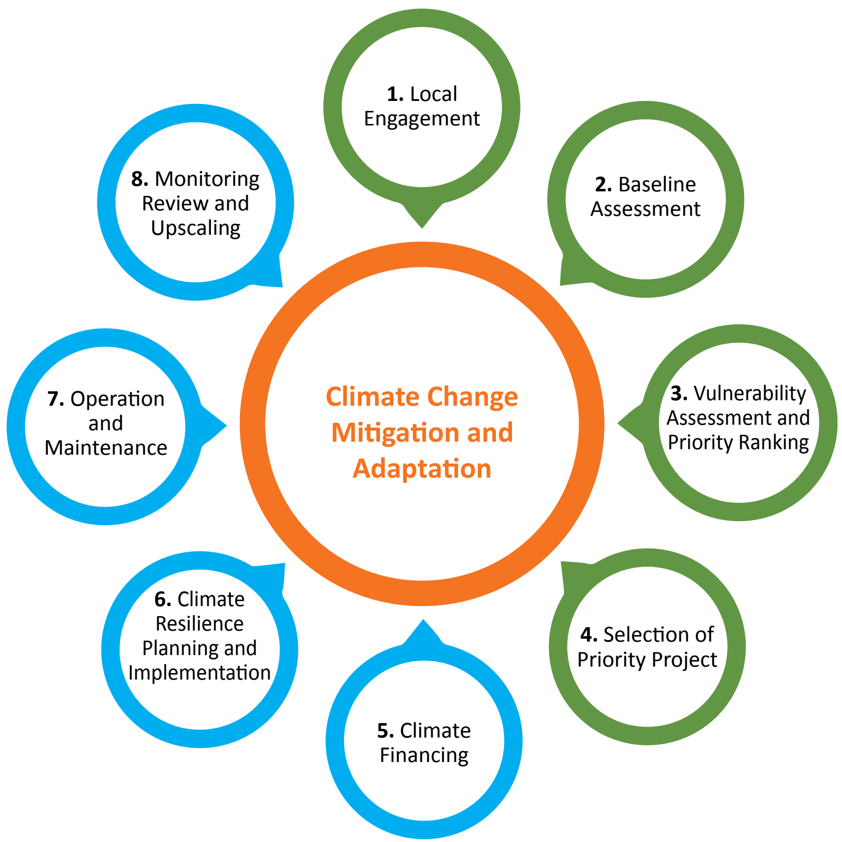


Figure 2: *Development of Local Level Climate Action Plan*

1.5 Preparation of Municipal Climate Action Plan

The preparation of the Climate Action Plan (CAP) for Savar Municipality followed a structured, participatory, and data-driven approach to ensure local relevance, inclusivity, and comprehensiveness. Active participation of municipal officials and local residents, including marginalized groups, was ensured throughout the process to capture diverse perspectives and community priorities, as shown in Figure 2. The first four segments(1-4), from local engagement to priority projects, represent the CAP preparation, while the subsequent segments (5-8) reflect its implementation.

Step 1: Orientation Meeting with Municipal Authority

The process commenced with an orientation meeting between the Savar Municipal Officials and Waste Concern to introduce the concept of the Climate Action Plan. The session highlighted climate impacts across national to local scales and stressed the importance of local action, community engagement, and inclusive planning. It also outlined the CAP's scope, objectives, and implementation approach, leading to strong municipal commitment and technical collaboration with Waste Concern.

Step 2: Data Collection

Data collection combined both secondary and primary sources to ensure comprehensive coverage of climatic, environmental, and socio-economic conditions.

- **Secondary Data:** Collected from institutional sources such as the Savar Paurashava Master Plan, UNDP, BBS, UDD, and Waste Concern. Additionally, Landsat satellite images were collected to analyze the spatiotemporal dynamics of land use and climate-induced extreme weather events.
- **Primary Data:** A town-level stakeholder consultation was conducted to initially understand Savar-specific climate change impacts and ensure the active participation of diverse stakeholders in the CAP preparation process. This was followed by a structured questionnaire survey targeting local residents to assess household-level exposure and perceptions of climate risks.

Step 3: Data Analysis

The collected datasets were analyzed at both ward and municipal levels to (i) understand the existing condition of the municipality, (ii) estimate greenhouse gas (GHG) emissions from municipal operations, and (iii) assess ward-wise climate vulnerability.

- **Vulnerability Assessment using Secondary Data**: Satellite imagery and GIS-based analysis were conducted to identify spatial variations in extreme climate events and land use changes contributing to local vulnerability. This helped compare climate exposure across wards and determine the areas at greatest risk.
- **Vulnerability Assessment using Primary Data**: Community perceptions were captured to complement the spatial analysis. The HIGS framework, covering Hazard, Infrastructure, Governance, and Socio-economic dimensions, was adopted and contextualized for Savar Municipality. Originally developed by Integrated Research and Action for Development (IRADe), the framework was scaled down to capture ward-level vulnerabilities, rather than a broader city-level approach.

Step 4: Prioritization of Vulnerable Wards and Urban Systems

Based on the vulnerability findings, wards and critical urban systems were prioritized according to their level of risk. This step guided the identification of where interventions are most needed and what actions should be prioritized, ensuring resources are directed toward the most vulnerable communities and sectors.

Step 5: Recommendations and CAP Implementation Pathway

Finally, recommendations have been developed incorporating community inputs and local insights. The CAP outlines actionable measures that translate national climate policies into local implementation strategies, focusing on both mitigation and adaptation. The plan provides a clear way forward for Savar Municipality to build climate resilience and integrate sustainable practices into municipal governance and service delivery.

1.6 Implication of Municipal Climate Action Plan

The Climate Action Plan (CAP) provides a clear, actionable roadmap for Savar Municipality to strengthen climate resilience and reduce vulnerability across all wards. By combining ward-level vulnerability assessments with community-driven insights, the CAP ensures that interventions are targeted, evidence-based, and locally relevant. It translates national climate policies into practical local actions, bridging policy with implementation.

The CAP also enhances municipal capacity for planning, governance, and monitoring, while fostering inclusive participation to ensure that the most vulnerable populations are protected. By guiding sustainable investments in infrastructure, disaster risk reduction, and urban services, the CAP positions Savar for climate-resilient growth and long-term urban sustainability. It establishes a framework for measurable outcomes, accountability, and adaptive management, setting a precedent for other municipalities to follow.

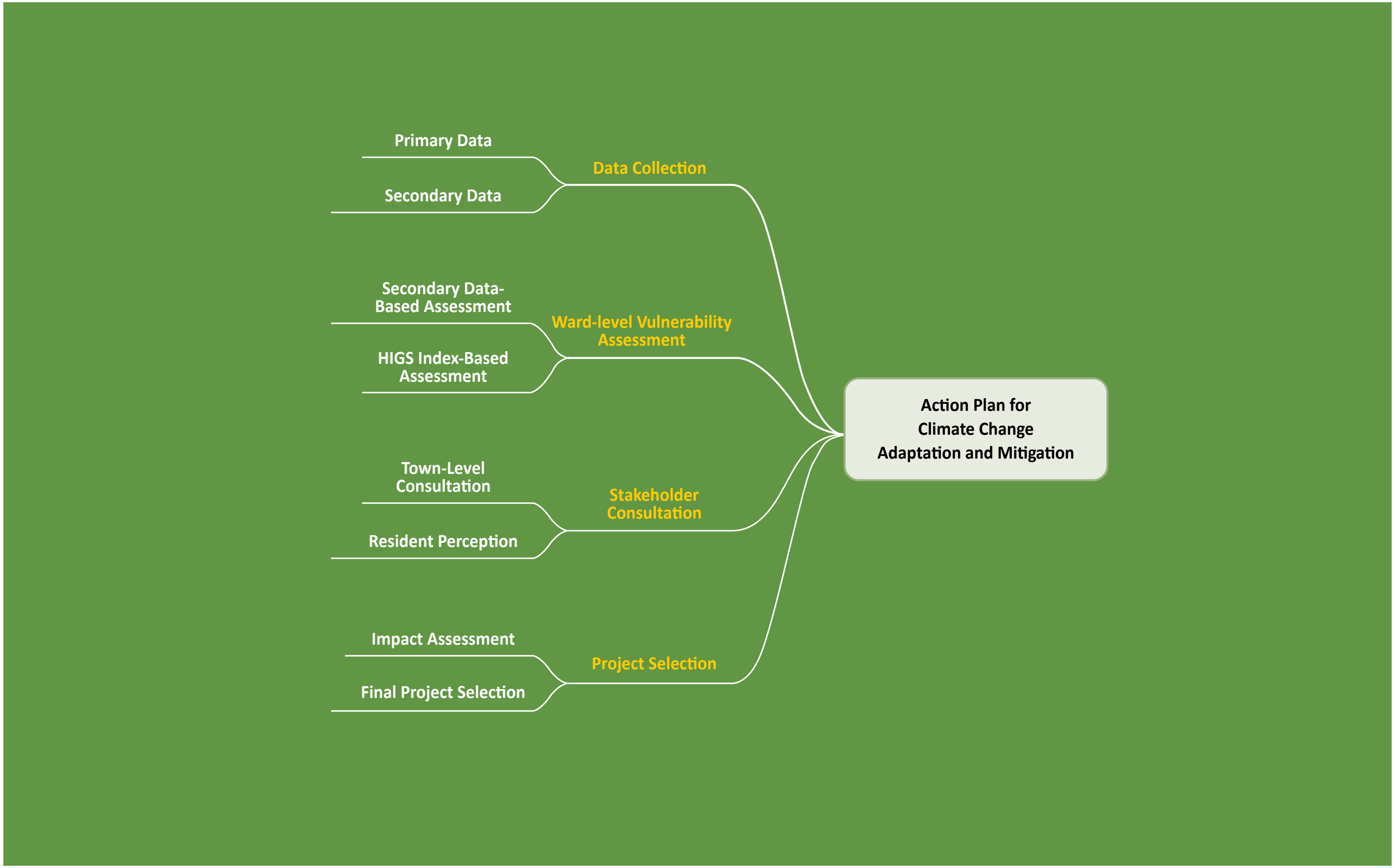


Figure 3: *Methodology of Climate Action Plan (CAP) Development*

2. PROFILE OF SAVAR MUNICIPALITY

2.1 Establishment, Area and Location

Establishment and Area: Savar Paurashava, located within Savar Upazila, was established as a "A"-category municipality on December 14, 1991, and commenced operations on March 16, 1992. It was later upgraded to an A-category municipality on 29 July 1997. The municipality covers an area of 14.08 sq. km and is divided into 9 wards, 44 mouzas, and 55 mahallas (Haq, 2020).

Location: Savar Municipality is situated within the Savar Upazila of Dhaka District in the Dhaka Division. It is about 24 kilometres northwest of Dhaka City. The municipality lies between 23.7801°N and 90.271°E.

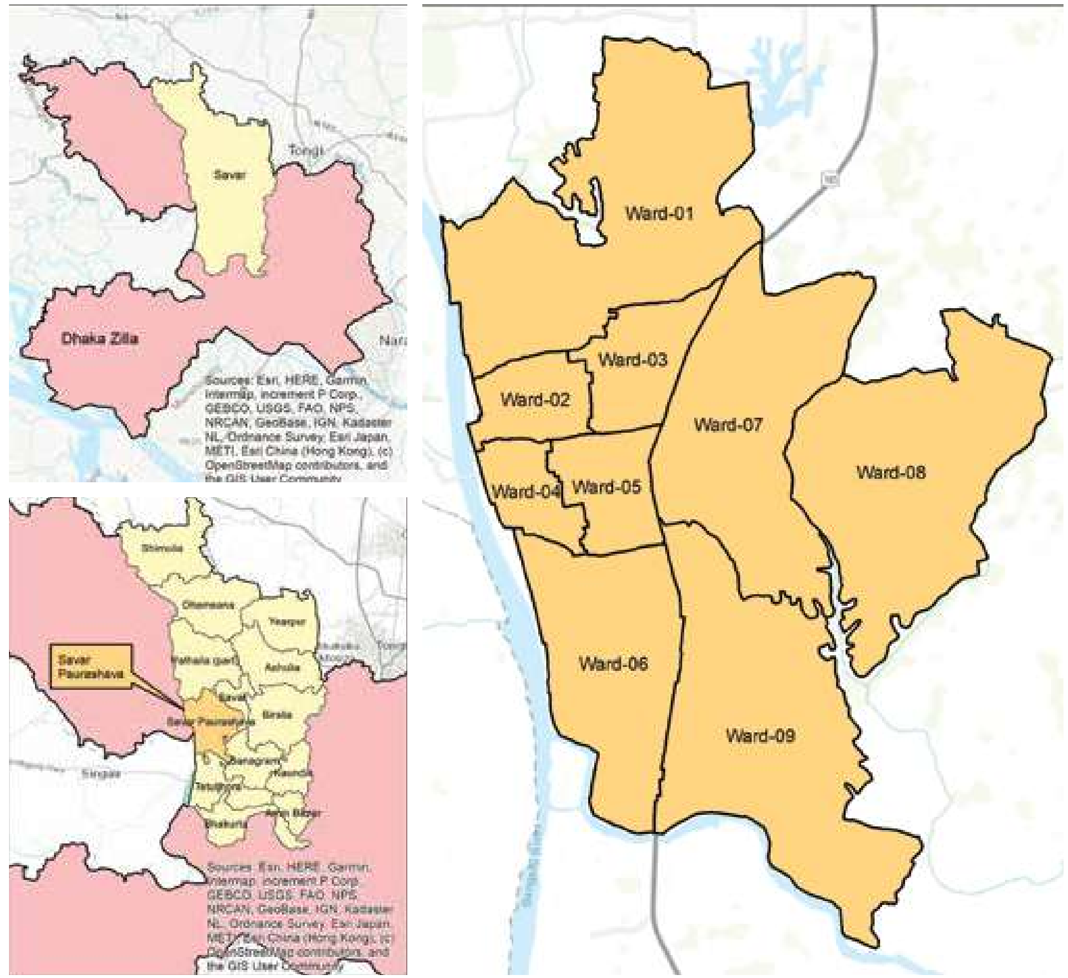
2.2 Boundary and Connectivity

Boundary:

Savar Municipality is bordered by Dhamrai Upazila to the north, Ashulia and Dhaka City to the east, Keraniganj Upazila to the southeast, and Singair Upazila (Manikganj District) to the west and south. The Bangshi River flows along the periphery, influencing land use and livelihoods. Its strategic location makes it a major urban and industrial hub within the Dhaka Metropolitan region (BBS, 2011).

Connectivity:

The Dhaka–Aricha Highway serves as the main route connecting Savar to Dhaka City and other regions, supporting industrial and commuter movement. Secondary roads and local transport such as buses, minibuses, and auto-rickshaws further enhance regional accessibility.



Map 1: *Location and Map of Savar Municipality*

2.3 Urban Development and Growth Pattern

Savar is one of the fastest-growing secondary towns near Dhaka, driven by agriculture, manufacturing (Sathe & Rahman, 2023), and major industries, including tanneries, garments, and the Export Processing Zone (EPZ). Rapid urbanization since the 1990s (Masud, 2013) has transformed it from a rural area into an industrial hub, resulting in the loss of vegetation and environmental degradation. Between 1983 and 2020, population growth and industrial expansion resulted in the large-scale conversion of agricultural land for housing, factories, and transportation infrastructure. Industrial wastewater has further contaminated the soil and damaged the ecology. Most development has occurred along the Dhaka–Aricha Highway, while the western areas near the Bangshi River remain less developed (RAJUK, 2016).

2.4 Land Use Pattern

Savar has 15 land use categories, with residential areas being the most dominant (55.28%), followed by agricultural land (11.77%) and waterbodies (8.14%) (see Map 2). When grouped into six broader categories, built-up areas cover about 73.49% of the municipality, followed by agriculture (<12%), waterbodies (<9%), vacant and open spaces (<6%), other uses (0.55%) and vegetation (0.10%) (see Figure 4) (RAJUK, 2016).

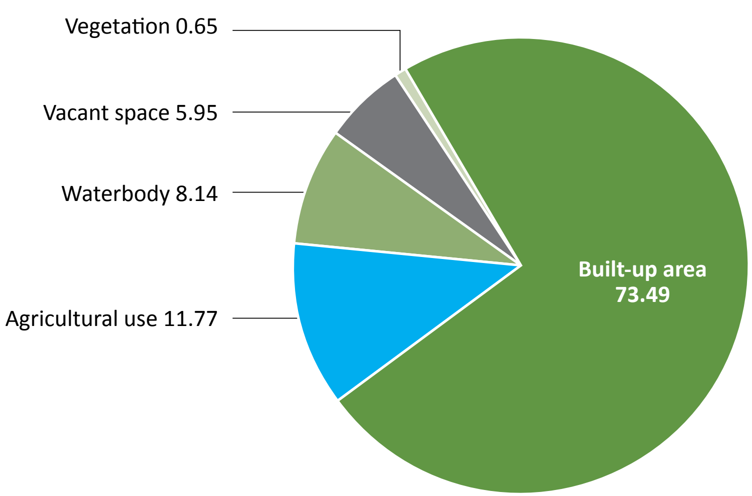


Figure 4: *Percentage of consolidated land use category*

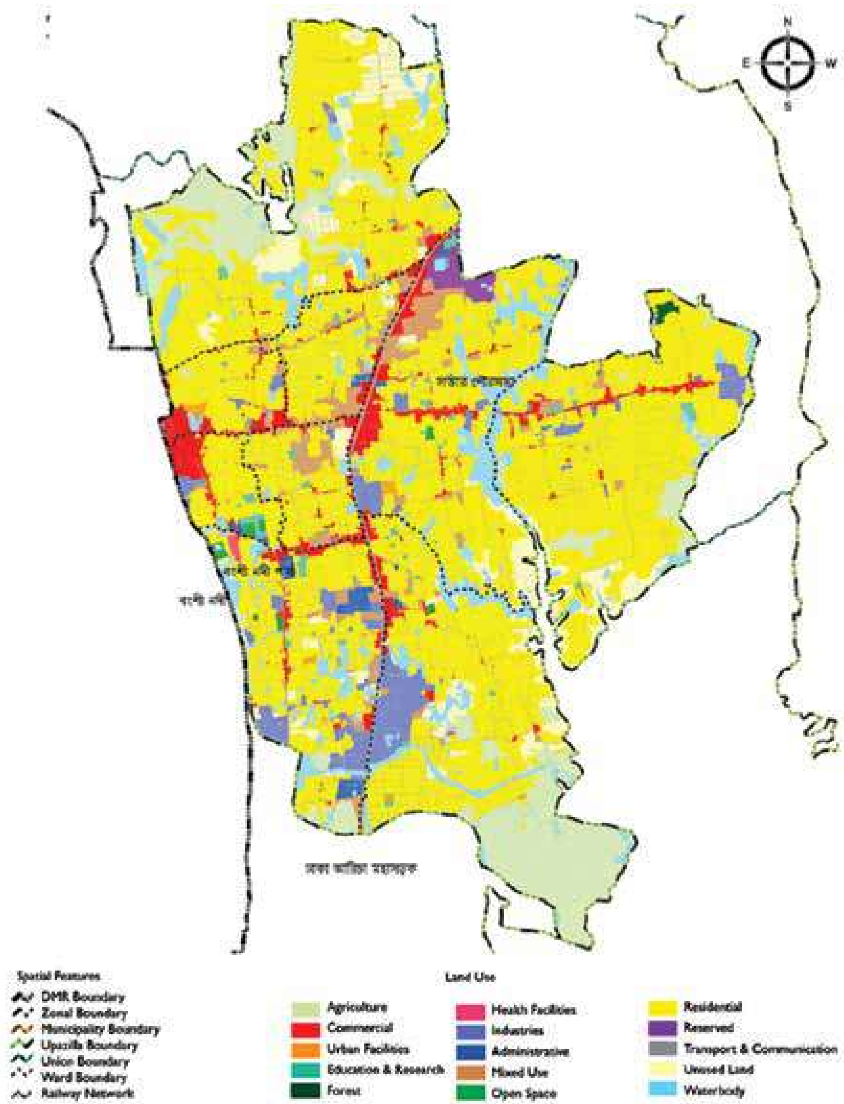
2.5 Demographic Features

According to the BBS 2022, Savar Municipality had a population of 384,093 (male: 198,719; female: 185,374) across 114,655 households in 2022 (BBS, 2022). With an annual growth rate of 2.72%, the population is projected to reach 405,247 in 2024, 488,890 in 2031, and 639,187 in 2041. Population density increased from 27,279 persons/sq. km in 2022 to 28,782 persons/sq. km in 2024, reflecting rapid urban growth. The average household size is 3.35. For ward-wise population density in 2024, refer to Map 3.

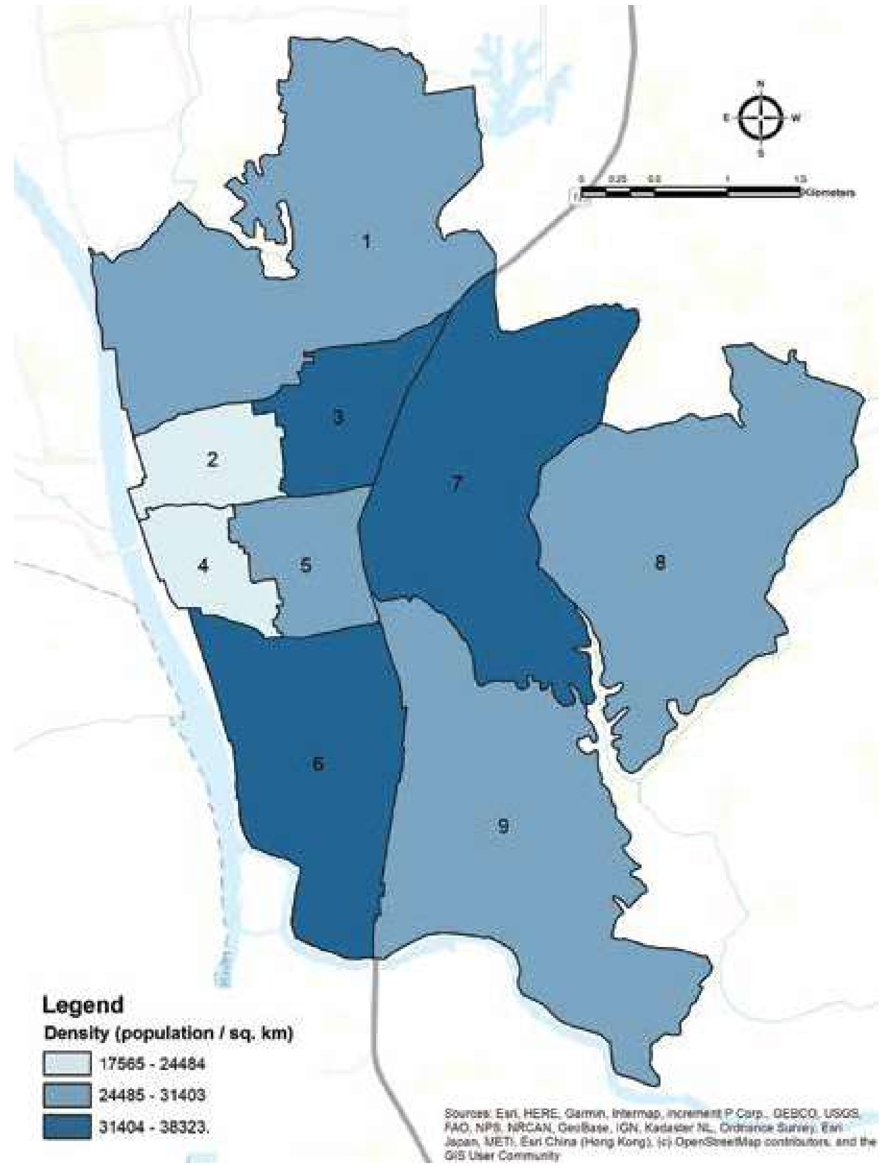
LIC Population: A total of 118,868 people (male-61,909, i.e., 52.08%, and female-56,960, i.e., 47.92%) live in 35,483 households across 1,331 LICs in 9 wards of Savar Municipality. This means one-third (29.33%) of the town's population lives in these LICs.

Educational Status: According to BBS (2022), the overall literacy rate in the municipality is 85.30% (which is higher than the national rate of 74.80%). The rate is higher in males (87.14%) than in females (83.34%). Again, 22.23% of the total population are students, and 80.61% have achieved education in different fields, of which 92.84% in general, 5.32% in religious, 1.05% in technical, and 0.79% in other fields of knowledge (BBS, 2022).

Employment Status: About half (47.14%) of the total population is employed (male-72.96% and female-27.04%), whereas 34.26% do not work, and only 0.92% of people are looking for a job/work. Besides, 17.68% of people are engaged in household work, dominated by females (98.70%). Savar's economic activities include industry and service, accounting for 51.66% and 46.79% of the total, respectively (BBS, 2022)



Map 2: *Existing land use of Savar Municipality*



Map 3: *Map showing density changes across the wards*

2.6 Local Government Bodies

Functions and Responsibilities: According to the Local Government (Paurashava) Act (2009), the Savar Municipal Government is responsible for delivering services, including maintaining the road network, managing solid waste, providing water supply, ensuring public safety, and registering various activities. DPHE provides policy and technical assistance for water supply and sanitation, and LGED provides technical support for road and drainage services. The municipality relies on its own sources or donor/NGO programs for high-level technical support for these services.

Elected Personnel, Structure and Staff: Savar Municipal Council has 13 elected members, a Mayor, 9 ward councilors, and 3 female councilors for reserved seats. The Mayor leads policy decisions, while the Chief Executive Officer (CEO) manages administration. The municipality operates with 68 regular staff members and 250 non-permanent employees across 12 sections, under three divisions, to deliver services.

Division:	(A) General Administration Division	(B) Engineering Division	(C) Health Division
Section:	1. General Section 2. Accounts Section 3. Tax Assessment Section 4. Tax Collection Section 5. License Section 6. Municipal Bazar Section 7. Education, Culture & Library Section	1. Civil Engineering Section 2. Electrical, Mechanical & WATSAN Section 3. Town Planning Section	1. Health and Family Planning Section 2. Conservancy Section

According to the organogram, Savar Municipality has a total sanctioned staff strength of 162, whereas the actual number of present staff is 68, which is 94 staff positions short of the sanctioned positions. There are 22 vacancies in the engineering division, 51 vacancies in the administration division, and 21 vacancies in the health division.

Sl.	Name of Division	Number of Sections	Staff Required as per Organogram	Present Staff	Vacant Positions
1	General Administration Division	7	75	24	51
2	Engineering Division	3	54	32	22
3	Health Division	2	33	12	21
	Total	**12**	**162**	**68**	**94**

Source: Savar Municipality, October 2024.

The positions of Mayor and councilors are currently vacant due to the political situation, and the municipality is run by an administrator appointed by the Interim Government. There is no dedicated slum development section; the task is managed by a Social Development Officer and two Community Mobilizers under the Engineering section, mainly through donor- and NGO-supported programs.

Committees: Savar Municipality has established several coordination committees to align development activities and prevent overlaps. In line with the Local Government (Paurashava) Act 2009, it has formed one Town Level Coordination Committee (TLCC) and 9 Ward Committees (WCs), along with a Disaster Management Committee (DMC) and 15 Standing Committees (SCs), including one on disaster management. However, these committees remain largely non-functional due to limited awareness of roles, lack of political will, and inadequate financial resources (UNDP, 2022).

Town Level Coordination Committee (TLCC): The Town Level Coordination Committee (TLCC) is chaired by the Mayor, with the Paura Nirbahi Officer (PNO) serving as Member Secretary. It consists 50 members, including representatives from government offices, NGOs, civil society, and academia. Among them, 40% are women and 10% are low-income representation. The committee meets quarterly (UNDP, 2022).

Ward Committees (WCs): There are 9 Ward Committees, each chaired by the Ward Councilor and vice-chaired by the Female Ward Councilor. Each committee has 10 members, with 40% women and 10% from LICs. The committee meets quarterly to identify and prioritize local issues for the Municipal Council, though its overall performance remains weak.

Municipal Disaster Management Committee (MDMC): As per the Standing Order on Disaster (2019), Savar Municipality established a Municipal Disaster Management Committee (MDMC) on December 8, 2022, comprising 40 members, led by the Mayor, with the Panel Mayor and CEO serving as Vice-Chair and Member Secretary, respectively. The committee includes councilors, officials, and representatives from government, NGOs, and the community, responsible for coordinating activities before, during, and after disasters. However, no ward-level DMCs have been formed yet.

Standing Committees (SCs): The municipality has 15 Standing Committees, each covering a specific subject, with 6 members, except for the one on Information & Culture, which has 5 members. These committees review project proposals and provide recommendations to the council.

Training for Staff: Municipal staff have participated in several government- and donor-funded training sessions; however, no training needs assessment has been conducted. Most training opportunities remain issue-based and limited in scope.

2.7 Ecological Resources

Savar Municipality is partly located in a low-lying area and partly in the vast alluvial plain formed under the influence of the Dhaleshwari and Bangshi Rivers, which is rich in terms of its variety of flora and fauna. Some of these species grow naturally, while others have been introduced. The faunal diversity in the area comprises typical amphibians, birds, reptiles, fish, and mammals found throughout the country. However, no protected area or reserve forest/biodiversity conservation areas exist in and around the town (BMDF, 2018).

2.8 Baseline Condition

2.8.1 Poverty Scenario

The Poor Settlements and Vacant Land Mapping (2011) identified 1,331 LICs across all 9 wards of Savar Municipality (see Map 4). These settlements house 118,868 people (male 61,909; female 56,960) in 35,483 households, representing about 29.33% of the town's total population. LICs are scattered throughout the municipality, with a higher concentration in the central areas (refer to figure 5). Most are small and newly established, while the larger ones are in worse condition. Land tenure and housing quality are poor, and access to basic services and economic opportunities is limited, though some infrastructure and social conditions have shown improvement.

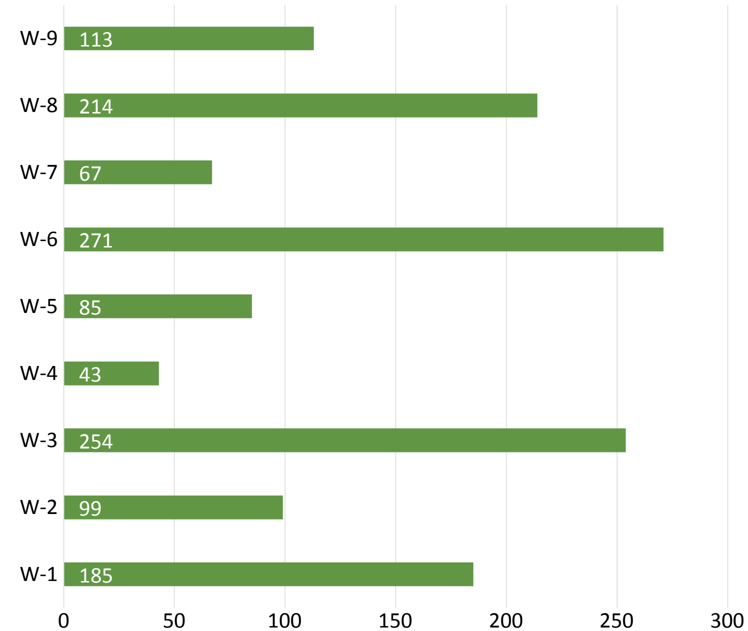
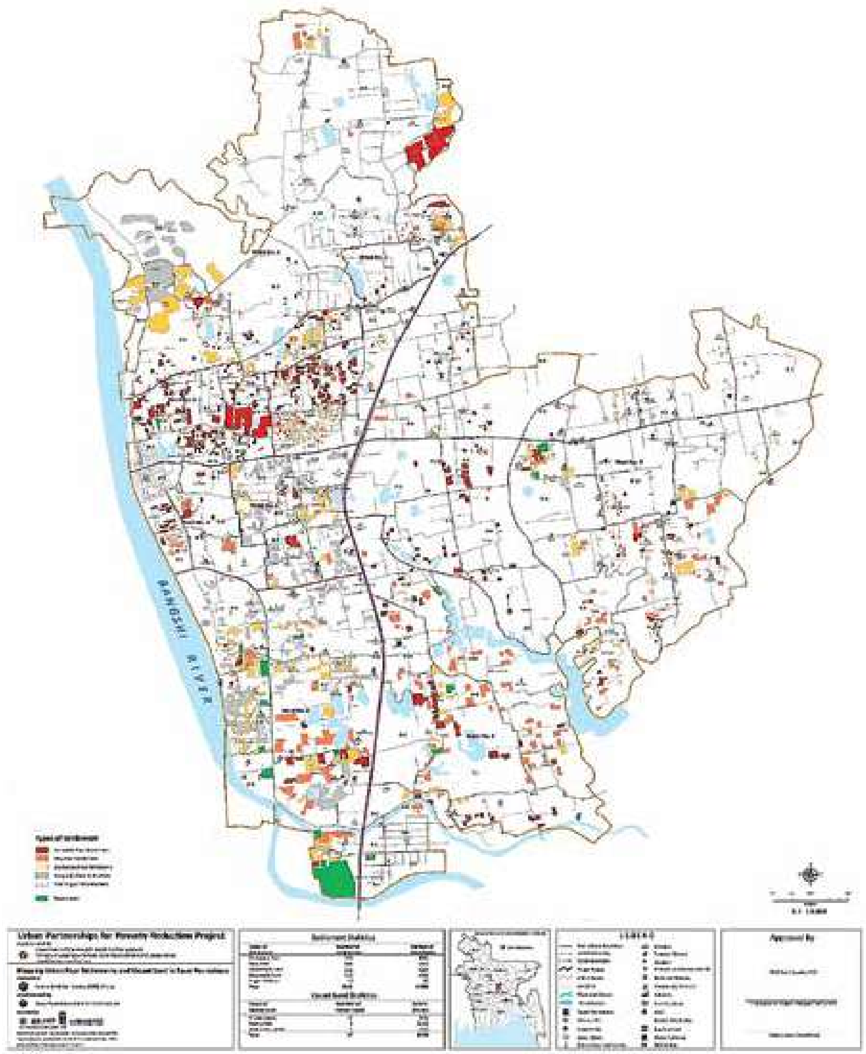


Figure 5: *Number of LICs by ward*



__Map 4:__ LICs of Savar Municipality

2.8.2 Water Supply

Savar's main surface water sources are the Dhaleswari, Buriganga, and Bangshi rivers, along with several canals (Karnapara Khal, Oicha Nuabda Khal, Arapara Khal), ponds, and small depressions. The groundwater table is shallow, with the main aquifer located below 50m (BMDF, 2018), and no arsenic contamination has been reported. The municipality has no piped water supply, and almost all households (99.96%) rely on deep or shallow tube wells for their drinking water, while only 0.04% use bottled, well, or surface sources (Figure 6) (BBS, 2022).

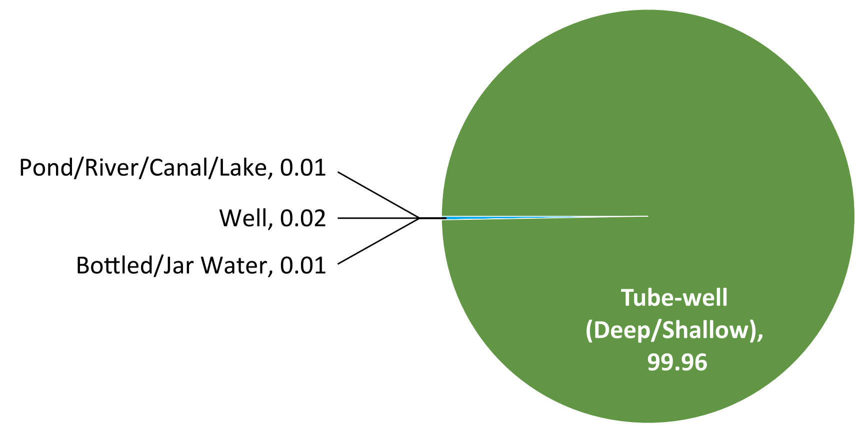


***Figure 6:** HHs by main source of drinking water*

2.8.3 Solid Waste Management

Primary collection and transportation: The municipality generates around 185 tons of waste daily. About 45% of waste is collected through door-to-door services, with the municipality collecting roughly 67 tons per day. However, LICs remain unserved, and residents often dump waste in vacant spaces, open drains, or canals near the slums. All 9 wards are under municipal collection coverage (Waste Concern, 2021).

Secondary Collection and Transportation: The municipality has no fixed transfer stations, and manual waste sorting remains inefficient. A mobile secondary transfer station operates effectively in densely populated market areas.

Waste Processing and Disposal: An unofficial landfill is located at Komlapur, Birulia Union, where approximately 67 tons of waste were previously disposed of daily, although no disposal is currently taking place (Waste Concern, 2021).

Street Sweeping and Drain Cleaning: The municipal conservancy section hires street sweepers for street sweeping and drain cleaning. Drain cleaning involves removing dirt from drains and allowing the excavated materials to dry on the roadside before collecting them for disposal.

2.8.4 Sanitation and Wastewater

Sanitation: Most households (99.44%) have access to toilet facilities, whereas only 0.01% use raw/open/hanging latrines and 0.01% have no access to latrines. No sewerage system exists in the town. Again, 53.38% of the households use separate toilets, and 46.62% use shared toilets; refer to **Figure 7**. Additionally, 98.32% of households have handwashing facilities, while only 1.68% lack both soap and water facilities in their toilets.

Wastewater: The municipality has about 45% septic tanks and 54% pit latrines as sanitation containment coverage. Again, 20% of the toilets have soak wells. Containment units are not designed in accordance with the building code; 26% of units have no outlet or overflow, and 46% of units require desludging. There is an on-site sanitation system with a Vacutag service for sludge collection and transportation; however, the municipality is unable to operate it due to a lack of trained personnel. There is no FSTP in the municipality. Savar Municipality has no wastewater/greywater management system. All the grey water is discharged into the open grounds, waterbodies, drains and low-lying areas.

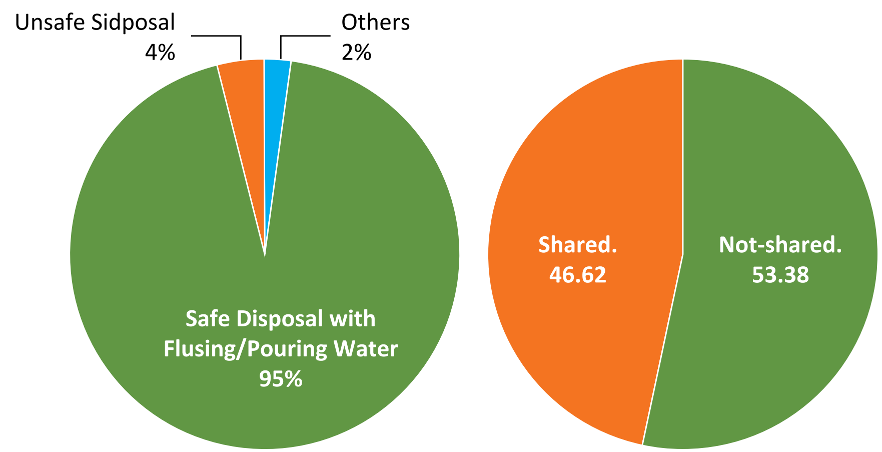


Figure 7: *Percentage of general households by toilet facility and Percent of general households by type of toilet use*

Source: BBS District Report for Dhaka, 2022

2.8.5 Drainage

Savar Municipality has limited drainage coverage, and most drains are open and poorly maintained, resulting in solid waste blockages and frequent waterlogging during heavy rainfall. The total drainage network spans approximately 183 km,

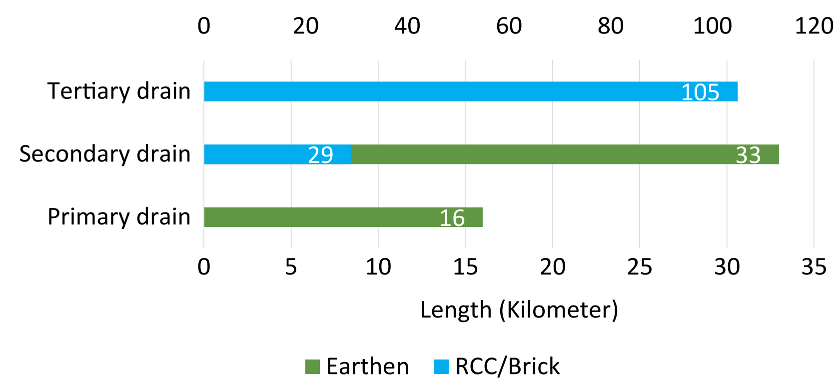


Figure 8: *Drainage system classification of Savar municipality*

comprising 16 km of primary, 62 km of secondary, and 105 km of tertiary drains (see Figure 8). A vast municipal area follows natural gravity flow, discharging into nearby rivers and canals such as the Bangshi, Dhaleshwari, and Turag Rivers, along with Kornapara Khal, Oicha Nuabda Khal, Arapara Khal, ponds, and low-lying areas that act as the main outfalls.

2.8.6 Housing Condition

The housing condition of the Savar municipality represents three types of information: (a) land used for residential purposes, (b) ownership status of the houses, and (c) structure of the main dwelling houses.

(A) **Land used for residential purposes:** The residential and homestead land use category occupies 55.28% of the municipality's total land, the town's highest single land use category (RAJUK, 2017).

(B) **Ownership status of the houses:** One-fifth (20.43%) of the households live in their own dwelling units, whereas the remaining 79.57% live in rented dwelling units; refer to **Figure 9**.

(C) **Structure of the dwelling houses:** About half (48.80%) of the dwelling houses in the town are pucca, followed by 36.76% semi-pucca houses, 14.14% Kancha houses, and 0.30% jhupri houses; refer to **Figure 10**. structure type, floor materials, wall materials, and roof materials, respectively.

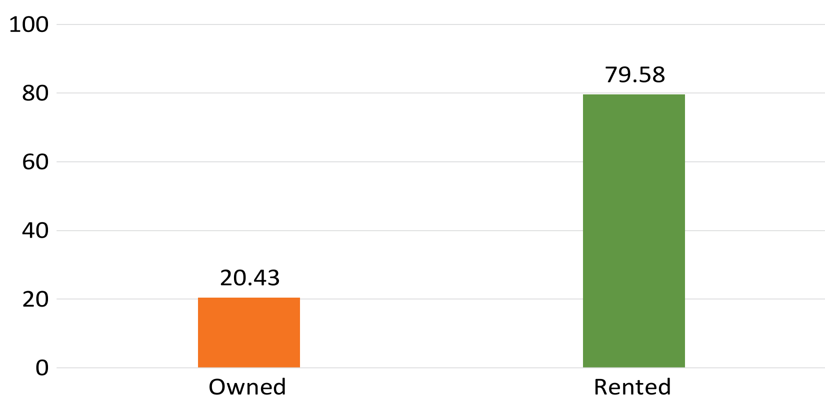


Figure 9: *Percentage distribution of HHs by ownership of dwelling units*

Source: BBS District Report for Dhaka, 2022

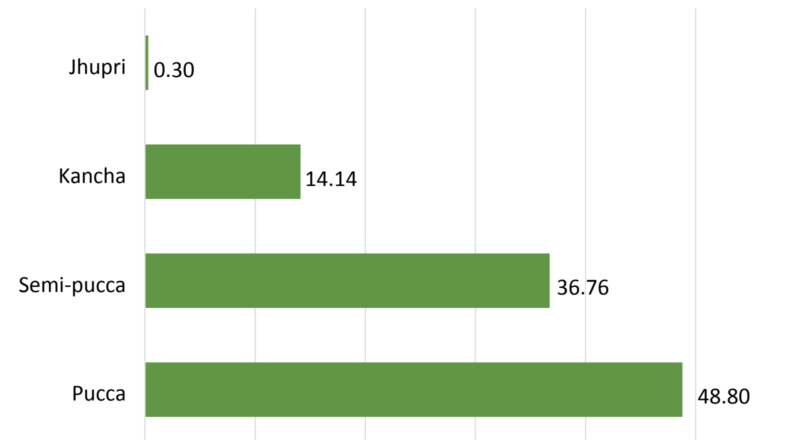


Figure 10: *Percentage distribution of dwelling units by structure type*

Source: BBS District Report for Dhaka, 2022

2.8.7 Transportation System

Savar Town is connected to the country's other regions through communication networks, including highways and waterways.

Roadway: Savar Municipality has a 267 km road network, comprising 74.91% pucca roads, 14.98% semi-pucca roads, and 10.11% earthen roads. Most pucca roads are in good condition, except in Ward 3, while the earthen roads are generally in poor condition throughout. Heavy vehicle movement threatens road durability, and the municipality lacks sufficient funds for regular maintenance. Traffic congestion occurs in all wards, especially in areas such as Nayabari, Nama Bazar, Amtala Mor, Registry Office, Bank Colony, Katlapur Bazar, Bazar Bus Stand, Rajashon Road, and Genda Bus Stand, mainly due to the presence of battery-operated rickshaws between 7:30 a.m. and 1:30 p.m. Improved traffic management and regulation of battery rickshaws are needed to ease congestion.

Waterway: Three rivers, namely the Turag River in the south-east, the Dhaleswari River in the south, and the Bangsi River in the west, surround the municipality area (Sharif & Esa, 2014). There are a boat ghat in ward no. 1, a boat ghat in ward no. 2, and two boat ghats in ward no. 6 (Waste Concern, 2021).

2.8.8 Electricity

Electricity: Savar Municipality enjoys excellent electricity coverage. In the town, 99.98% of households have access to electricity, whereas only 0.02% have no electricity connection. Of the total households, 99.92% get electricity from the national grid, 0.04% from solar power, and 0.01% from other sources; refer to **Table 2**.

Table 2: Percentage of households by main source of electricity

Percentage of Households by Main Source of Electricity			
National	**Solar**	**Others**	**No electricity**
99.92	0.04	0.01	0.02

Source: BBS District Report for Savar, 2022

3. CLIMATE RISK AT NATIONAL AND REGIONAL LEVELS

This chapter is based on the "Climate Risk Country Profile: Bangladesh" published by the World Bank in 2024. The report outlines the current and projected scenarios of the adverse impacts of climate change on Bangladesh and the Dhaka Division, including Savar.

1. **Climate Type:** Bangladesh has a moist, humid, tropical monsoon climate (average mean temperature of 25.71°C) with one rainy and dry season (2,174.10 mm annually), influenced interannually by the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD).

2. **Temperature:**

	National Level		Khulna	
	Max	Min	Max	Min
Warmest	32.01^{0}C	25.49^{0}C	31.88°C	26.18°C
Coolest	25.26^{0}C	12.31^{0}C	25.58°C	12.26°C

Between 1991 and 2020, Bangladesh recorded a mean annual temperature of 25.71°C, with an increase of 0.16°C per decade from 1971 to 2020. The warmest months occur between May and August during the monsoon season, while January remains the coolest month of the year.

Projected Temperature:

- **2020-2039:** Will increase by 0.41°C (−0.19°C, 0.76°C) from the historical reference period to 26.03°C period to 26.59°C (25.78°C, 27.56°C).

Extreme Heat Risk:

By midcentury, Bangladesh is expected to face higher day and night temperatures, along with more intense heat due to greater moisture in the air.

2020–2039: The number of very hot days (Heat Index above 35°C) will rise to about 100 days per year (range: 56–129).

2040–2059: The number is expected to further increase to approximately 133 days per year (range: 86–172 days).

Southern coastal areas are expected to experience the largest increase in hot days, particularly during the pre-monsoon (spring) season.

Northern and eastern floodplains are expected to experience the largest increase in hot days during the summer months.

3. **Precipitation:**

   (A) National Level (1971–2020):

   - **Mean annual precipitation:** 2,174.10 mm.
   - **Regional trends:**
     - **Eastern divisions:** Drier annually, especially during spring pre-monsoon months.
     - **Western divisions:** Wetter annually, particularly in post-monsoon fall months.

Projections (SSP3-7.0):

- Overall **annual precipitation expected to increase by midcentury**, with regional and seasonal variability.
- **Southern divisions:** Decrease in 2020–2039, mainly in **pre-monsoon** months.
- **Northern divisions:** Highest increase by 2040–2059, during **monsoon** months.

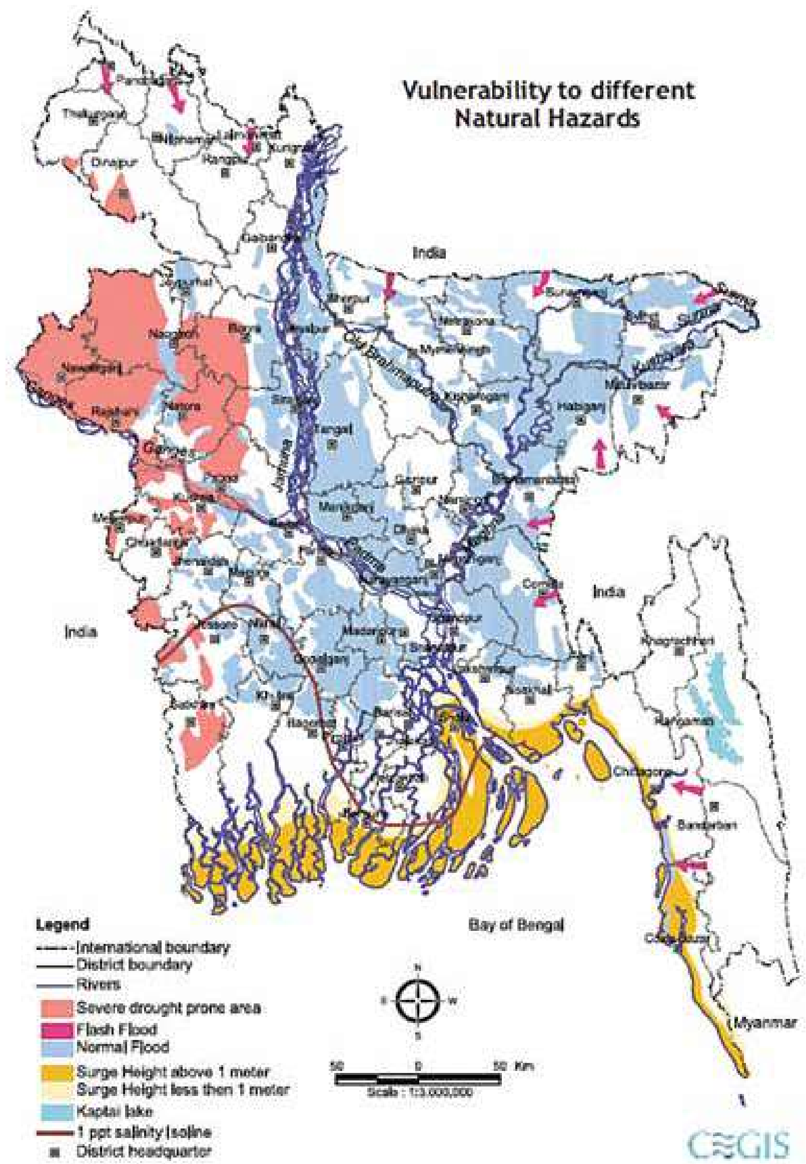
(B) Dhaka Region (1971–2020): The region recorded the largest annual rainfall increase, rising by +13.3 mm per decade.

Projected annual rainfall:

- **2020-2039:** 2053.69 mm (1684.22 mm, 2466.07 mm)
- **2040-2059:** 2058.90 mm (1677.97 mm, 2591.62 mm)

Precipitation Intensity & Risk (2040–2059):

- The average highest 5-day rainfall is expected to increase by about 25 mm (range: −97 to 143 mm).
- This will lead to a higher risk of flooding due to more intense rain events.
- The northern regions are likely to see the biggest increase in extreme rainfall, with heavy rain events that once happened every 100 years possibly occurring every 58 years, increasing the risk of flooding and damage to infrastructure.



__Map 5:__ Bangladesh's Climate-Related Hazards

4. **Climate-Related Hazards:**

- Sea level rise and inundation will increasingly threaten Bangladesh's deltaic coastal zones, causing a significant retreat of the coastline by the end of the century without mitigation measures.
- The frequency and intensity of flooding along major river systems and droughts in the northwest divisions have increased and will likely continue to persist.
- Climate variability can exacerbate Bangladesh's moderately high seismic risk conditions. Earthquake and landslide hazards pose the greatest risk along the northern and eastern borderlands.

4. GREENHOUSE GAS (GHG) EMISSION INVENTORY

To assess the greenhouse gas emissions from the municipal services provided by the Savar Municipality, the following activities have been identified:

i) Street lighting;

ii) Electricity consumption by public buildings owned by the municipality;

iii) Fuel consumption by municipal vehicles;

iv) Fuel consumption by waste management vehicles;

v) Solid waste generated within the municipal boundary;

Data for the 2020-21, 2021-22, 2022-23, and 2023-24 financial years, regarding electricity consumption, fuel consumption, and solid waste generation, have been collected and analyzed. The greenhouse gas emissions from the activities mentioned above have been calculated using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Guidelines 2019 Refinement. Collected data from the municipality is shown in Table 3:

Based on the data mentioned above, the GHG emissions of the Savar Municipality are shown in Table 4.

Table 3: Fuel Consumption, Electricity Consumption, and Solid Waste Generation Data

Sl No	Source	2021	2022	2023	2024
1	Fuel Consumption for Vehicle (Excluding Waste Management) (Liters/year)	27,255	29,325	23,000	29,053
2	Fuel consumption for Vehicle (Waste Management) (Liters/year)	91,245	98,175	77,000	97,263
3	Electricity Bill (General Head) (kWh/year)	125,637	149,753	161,025	144,579
4	Electricity Bill (Water Head) (kWh/year)	74,493	88,792	95,475	85,724
5	Solid Waste Generation (tons/year)	69,844	71,499	77,219	83,397

Source: Savar Municipality, 2024

Table 4: CO_2 Emissions from Different Sources in Savar Municipality

CO2 Emission		2020-2021		2021-2022		2022-2023		2023-2024	
		Tons/Year	% of total emission	Tons/Year	% of total emission	Tons/Year	% of total emission	Tons/Year	% of total emission
Fuel used by vehicle	Excluding Waste Management	73	0.5%	79	0.3%	62	0.2%	78	0.2%
	Waste Management	245	1.7%	264	1.1%	207	0.7%	262	0.7%
Electricity	General Head (Tons/Year)	84	0.6%	134	0.6%	108	0.3%	97	0.3%
	Water Head (Tons/Year)	50	0.4%	60	0.3%	64	0.2%	57	0.2%
CO2 Emission from SWM		13739	96.8%	23275	97.7%	30792	98.6%	37046	98.7%
Total CO_2 Emission		14191		23812		31233		37540	

Table 4 shows that the solid waste sector is the largest contributor to greenhouse gas emissions in the municipal services provided by the Savar municipality. Figure 11 shows the CO_2 emission trend in Savar Municipality (Tons/Year). To reduce emissions from the solid waste sector, the following interventions, as shown in Figure 12, may be considered.

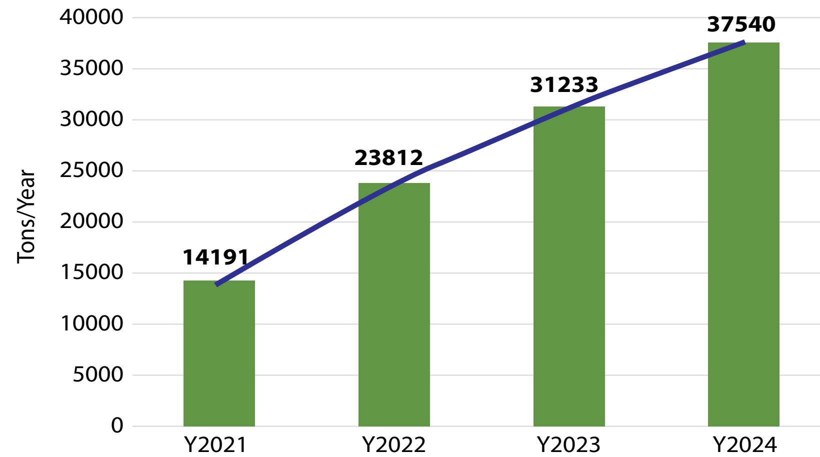


Figure 11: *CO_2 Emission Trend in Savar Municipality (Tons/Year)*

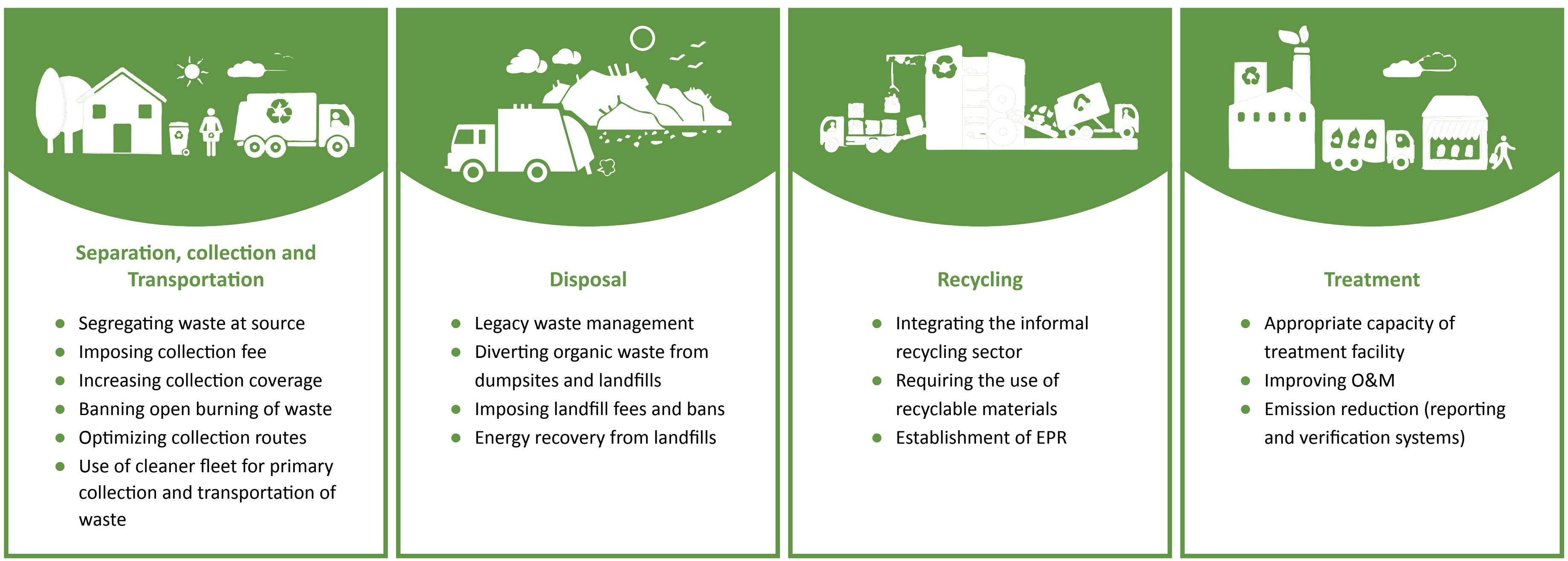


Figure 12: *Probable Interventions to Reduce GHG Emission*

5. METHODOLOGY OF CLIMATE VULNERABILITY ASSESSMENT OF SAVAR MUNICIPALITY

The methodology for assessing municipal vulnerability under this Climate Action Plan follows two primary approaches. One approach focuses on adapting to the hazard, and the other focuses on mitigation.

5.1 Vulnerability Assessment Using Secondary Sources:

A comprehensive vulnerability assessment of Savar Municipality was conducted using satellite imagery to analyze key climatic parameters, such as rainfall and temperature, identifying wards most exposed to extreme weather events. For this assessment, satellite images have been collected from reliable sources, including the USGS (United States Geological Survey), CRU (Climatic Research Unit), and the Center for Hydrometeorology and Remote Sensing (CHRS). Satellite observations overcome gaps in station-based weather data, providing insights into local variations and supporting detailed comparisons at the ward level.

5.1.1 Development of Overlay Analysis of Vulnerability Assessment

A comprehensive climate action plan requires a detailed analysis of land use, temperature fluctuations, rainfall patterns, and flood vulnerability to pinpoint urban areas most susceptible to climate extremes. These four factors provide a holistic view of a region's exposure to climate-related risks.

5.1.1.1 Land Cover Classification and Land Use Change

Land use and land cover (LULC) classification is crucial for assessing climate vulnerability in urban areas, as it reveals how natural and human-modified landscapes evolve over time. The conversion of green spaces to built-up areas intensifies waterlogging and exacerbates the urban heat island effect. Using GIS-based satellite imagery analysis, we prepared LULC maps for Savar Municipality, identifying wards affected by deforestation, urban expansion, or other land cover changes, and highlighting areas most vulnerable to climate hazards.

5.1.1.2 Land Surface Temperature Map:

Rising temperatures are a direct impact of climate change, causing frequent heatwaves that threaten public health, strain energy systems, and exacerbate environmental degradation. Using satellite-derived data, Land Surface Temperature (LST) maps for Savar Municipality have been prepared to assess spatio-temporal temperature dynamics and identify wards most exposed to extreme heat. This Ward-wise LST mapping guides municipal climate planning by identifying priority areas and supporting targeted heat mitigation strategies.

5.1.1.3 Rainfall Map

Climate change is altering rainfall patterns, leading to more frequent and intense rainfall events that occur over shorter periods. Such heavy rains increasingly overwhelm drainage, causing frequent flash floods and waterlogging that threaten urban infrastructure and public health. Hence, local rainfall data is essential for identifying vulnerable areas. Using satellite imagery, a rainfall map was created to capture spatial variations in rainfall intensity across wards, informing climate adaptation strategies to better manage the impacts of rapid-onset rainfall events.

5.1.1.4 Flood Risk Map

Floods are becoming more frequent and severe, driven by climate change. Sudden upstream rainfall often triggers rapid overflow of rivers and canals, causing damage not only to infrastructure but also to human lives, livestock. A flood risk map was developed using GIS-based analysis of topography, land elevation, rainfall intensity, and proximity to water bodies. This assessment highlights spatial variations in flood vulnerability, identifies high-risk areas, and supports targeted interventions and effective flood protection measures to minimize damage from flood events.

5.1.1.5 Overlaying Secondary Data

To identify areas most affected by extreme climate events in Savar Municipality, an overlay analysis was conducted by superimposing land surface temperature (LST), rainfall, and flood risk information. This assessment identified “hotspot” wards with consistently high temperatures, frequent heavy rainfall, and elevated flood risk, highlighting areas of compounded vulnerability. This method also uncovers spatial patterns that might not be apparent when examining each hazard individually. The findings provide crucial guidance for prioritizing adaptation and mitigation, ensuring targeted interventions in areas that are vulnerable. This approach strengthens climate resilience by addressing local needs and reducing exposure to multiple hazards.

5.2 Vulnerability Assessment Using Primary Sources (HIGS)

5.2.1 Development of HIGS Framework for Climate Vulnerability Assessment at Ward Level

The HIGS framework supports climate-resilient city planning by identifying where and how cities are most vulnerable. However, urban services and infrastructure are neither uniformly distributed nor equally impacted across the city, so some wards require specific attention. For example, certain areas may have housing predominantly consisting of Kancha and semi-pucca structures, while other wards

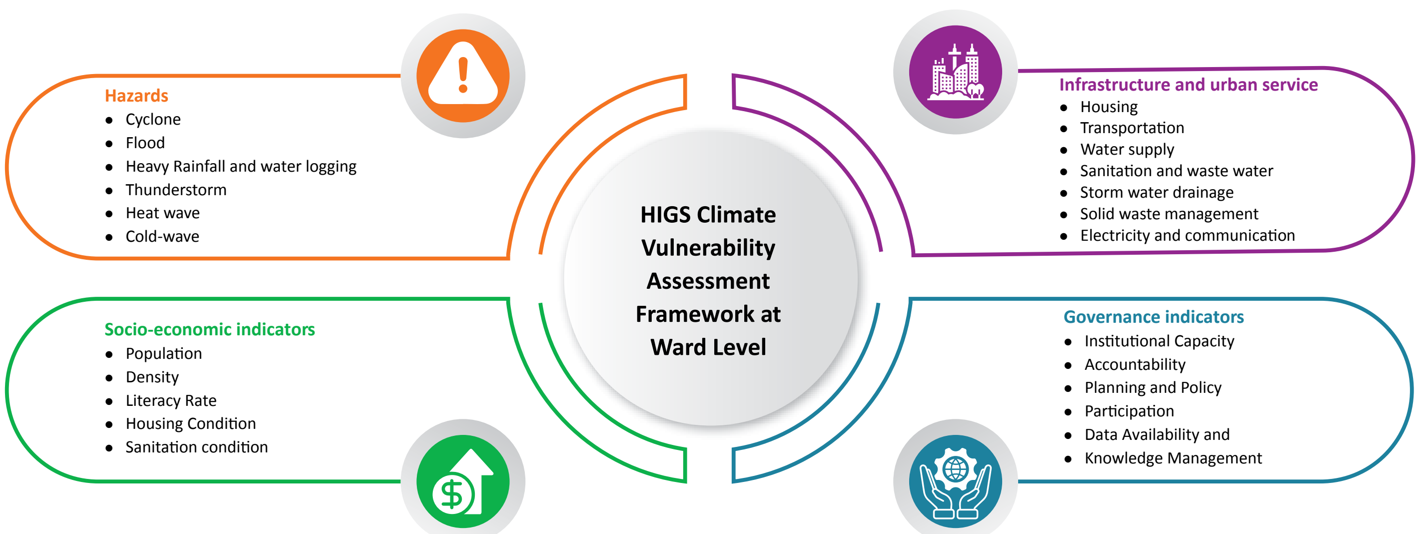


Figure 13: *Components of HIGS Framework*

may need strengthened transportation infrastructure. Similarly, the coverage and quality of critical services such as water supply, sanitation, and solid waste management vary across wards, highlighting the need for ward-specific strategies in the municipal climate action plan.

Therefore, the HIGS framework has been adopted and contextualized to assess climate vulnerability at the ward level rather than the broader city level to achieve a more precise, localized understanding of climate risks within the city. Climate vulnerabilities vary significantly from one ward to another due to differences in factors such as land use, socio-economic conditions, and infrastructure quality. While a city-wide approach provides a broad overview, it can obscure critical variations at the neighborhood level, where climate impacts may be far more severe or specific. We can identify precise vulnerabilities and tailor interventions by focusing on the ward level. For instance, some wards may require enhanced flood protection infrastructure, while others may benefit from expanded green spaces to mitigate urban heat. This ward-level assessment enables targeted interventions tailored to each ward's specific challenges, enhancing the effectiveness of adaptation efforts.

Using the HIGS framework at the ward level also ensures optimized resource allocation and promotes social equity in climate adaptation efforts. By pinpointing the wards most at risk, municipalities can prioritize investments and interventions where they will have the greatest impact, ensuring that funds are used with maximum efficiency and efficacy. Additionally, this localized approach fosters equity by addressing the unique needs of vulnerable communities that are disproportionately affected by climate risks, such as low-income populations or areas with aging, fragile infrastructure. By adapting the HIGS framework to this level of detail, we create a model for climate resilience planning that is more effective and inclusive, leading to a more resilient and equitable urban landscape.

5.2.1.1 Hazards

The "*Hazards*" dimension reveals the diverse risks associated with climate change, including cyclones, floods, extreme temperatures, and other climate-induced events. By assessing these hazards at the ward level, we can identify areas that are particularly vulnerable to specific climate threats. As previously mentioned, some wards may be more prone to flooding and waterlogging due to their proximity to rivers or low-lying topography, while others may experience more intense heat waves due to increased built-up areas or a lack of green spaces. Understanding these spatial patterns of hazard exposure is essential for designing targeted adaptation strategies and prioritizing resources in the municipal climate action plan.

The hazards selected for the HIGS framework are cyclones, floods, heavy rainfall and waterlogging, thunderstorms, heatwaves, and coldwaves, which represent the most significant climate-related threats Bangladesh is experiencing nowadays. These hazards are selected following an in-depth review of extreme climatic events over the past 50 years in Bangladesh, focusing on those events that have shown a notable increase in frequency, intensity, or impact due to changing climate patterns. The hazards included were chosen for their prominence in the broader national context and their particular relevance to Savar. Data sources, including the Bangladesh Environment Statistics 2020, Bangladesh Disaster-related Statistics 2021, and Weather Atlas, guided the selection process. These sources provide reliable data on historical and current climate trends, offering a basis for identifying which climatic events are most pressing for Savar Municipality.

Cyclones

Cyclones are powerful tropical storms that bring destructive winds, heavy rain, and storm surges, often causing severe damage along Bangladesh's coastal and inland regions. While Savar is further inland, cyclones can still impact the area by triggering intense rainfall, power disruptions, and structural damage as they move across the country. The growing frequency and intensity of cyclones in recent decades highlight the importance of preparedness for such events.

Floods

Floods are a recurrent hazard in Bangladesh, especially during the monsoon season when rivers overflow and low-lying areas become inundated. Savar Municipality, situated near major river systems, is vulnerable to flooding, which can disrupt transportation, damage housing, and affect livelihoods. Increasing rainfall variability and changing river dynamics due to climate change are heightening the flood risks.

Heavy rainfall and waterlogging

Heavy rainfall and waterlogging are common challenges in urban areas, where drainage infrastructure is often inadequate to manage intense rain. In Savar Municipality, intense rainfall frequently exceeds the capacity of drainage systems, resulting in prolonged waterlogging that hampers daily activities. With climate change intensifying rainfall events, these disruptions are becoming more frequent, highlighting the need for effective and resilient drainage solutions.

Thunderstorms

Thunderstorms bring sudden bursts of rainfall, lightning, and strong winds, which can cause infrastructural damage and service disruptions. In recent times, thunderstorms have become more frequent and intense, occurring not only during the monsoon season but also in the post-monsoon period, disrupting electricity supply, threatening outdoor activities, and, in some cases, causing casualties. Due to their unpredictable nature, thunderstorms pose a constant threat, particularly in densely populated or inadequately sheltered areas.

Heatwaves

Heatwaves have become more severe and frequent across Bangladesh as global temperatures rise, impacting both urban and rural communities. Savar Municipality experiences intense heatwaves that disrupt daily life, increase energy demand, and threaten public health, particularly affecting vulnerable populations and those without access to cooling. As urban areas expand, the urban heat island effect intensifies these heatwaves, underscoring the need for effective cooling infrastructure and green spaces.

Coldwave

Coldwaves Although less frequent, coldwaves can have severe impacts, particularly during winter and in recent decades when temperatures drop unexpectedly. In Savar, cold waves pose health risks to low-income residents and those without adequate shelter, affecting both daily life and economic productivity. With climate shifts, coldwave patterns are becoming less predictable, creating additional challenges for local preparedness.

5.2.1.2 Infrastructure and Urban Services

This dimension focuses on key urban systems that are essential for residents' quality of life and resilience, such as housing, transportation, and water supply. By examining these infrastructures at the ward level, specific vulnerabilities can be identified in each ward's infrastructure. For instance, a ward with inadequate drainage may be more susceptible to waterlogging and flooding during heavy rains, while one with limited water supply services may struggle with drought periods. This analysis enables urban planners to prioritize infrastructure upgrades in the most vulnerable wards, ensuring that investments are directed toward areas with the greatest need.

The Infrastructure and Urban Service component of the HIGS framework encompasses critical urban systems, including housing, transportation, water supply, sanitation and wastewater, stormwater drainage, solid waste management, electricity, and communication. These urban systems were selected for their integral role in maintaining urban resilience and are prioritized in climate action planning to address each ward's unique vulnerabilities and service needs. Together, they provide a comprehensive foundation for ward-level resilience, focusing on targeted infrastructure improvements, emergency response capacity, and continuity of services under changing climate conditions.

Housing

Housing provides shelter and stability, forming the core of urban living spaces where people reside and seek safety. Natural hazards have a profound impact on housing, affecting not only the physical structure but also the broader homestead and its associated functions. Damage to homes incurs substantial rebuilding costs and often leads to increased utility expenses, such as reliance on backup power sources or alternative lighting like candles. Beyond the residence itself, residents may suffer loss of property and livestock, furthering their economic burden, while interruptions to utilities disrupt daily life. Hazard-induced displacement, whether temporary or permanent, adds to the risks, with specific safety concerns, including the potential rise in gender-based violence.

Transportation:

Urban transportation is a crucial component of a city. The impact of hazards on the transportation system extends beyond just vehicle movement, affecting various critical aspects. Infrastructure damage often leads to high rebuilding costs and operational challenges, disrupting regular maintenance and placing additional strain on transportation networks. Hazards also increase health risks, including physical injuries and mental stress for individuals using or relying on the transportation system.

Water supply

Water supply vulnerability in Savar Municipality extends beyond merely ensuring water reaches residents, encompassing several critical impacts due to natural hazards. Disruptions to maintenance and operational routines can lead to significant service interruptions, particularly when supply routes are impacted. Infrastructure damage from hazards like floods leads to increased repair costs and ongoing challenges for maintaining supply.

Sanitation and Wastewater

The urban sanitation system reveals several common vulnerabilities that become prominent during hazards. These include damage to sanitation and wastewater infrastructure, often resulting in high repair costs and operational disruptions. Flooding of facilities can lead to environmental contamination, exposing communities to untreated sewage and waste, and significantly increasing health risks.

Stormwater Drainage

Stormwater Drainage is key to preventing water accumulation and minimizing flood risks in urban areas. Proper drainage management helps protect infrastructure, reduce waterlogging, and maintain safety and accessibility. Climate-resilient drainage planning aims to enhance drainage capacity, manage rainfall patterns, and avoid disruptions.

Solid Waste Management (SWM)

Solid waste management (SWM) is a critical component of the urban system and is severely affected during hazards, leading to issues such as the discontinuation of waste collection, waste pile-ups, and increased environmental pollution. In this context, the SWM sector faces several challenges, including blockages and overflows at waste disposal sites. Additionally, the increased decomposition of waste, coupled with damage to waste management infrastructure, leads to higher repair costs. Disruptions in waste collection and transportation further complicate the situation.

Electricity and Communication

Electricity and Communication systems support daily operations, enable emergency response, and keep residents connected. Reliable energy and communication are critical in emergencies, as they support evacuation, information sharing, and recovery. Climate resilience in this sector includes strengthening power grids and ensuring uninterrupted communication channels during extreme events.

5.2.1.3 Governance

Governance plays a central role in building resilience, as effective policies, planning, and community engagement are necessary to mitigate climate change-related risks. This dimension includes indicators such as institutional capacity, accountability, planning and policy, participation, and data availability and knowledge management. This local-level governance assessment helps identify gaps in the planning and implementation of interventions, including delays in resource allocation and shortcomings in disaster preparedness. These gaps often result in inefficient responses during climate events, leaving vulnerable communities without adequate support or resources. Additionally, the absence of a clear institutional framework and responsibility at the ward level may hinder the implementation of proactive climate adaptation measures. Strengthening governance at the ward level ensures that climate adaptation efforts are not only well-planned but also effectively implemented, ensuring the effectiveness and sustainability of resilience-building initiatives.

5.2.1.4 Socio-economic characteristics

The socio-economic dimension of climate vulnerability assessment focuses on how social and economic factors influence a community's ability to anticipate, respond to, and recover from climate impacts. The socio-economic indicators selected for the HIGS framework include population size, population density, housing conditions, education level, and sanitation conditions, all of which shape a community's resilience. These factors determine the degree of exposure to climate risks and influence the capacity to implement adaptive strategies and access recovery support. For example, infrastructure and services may be overstretched in densely populated areas, reducing the capacity to manage disaster risks effectively.

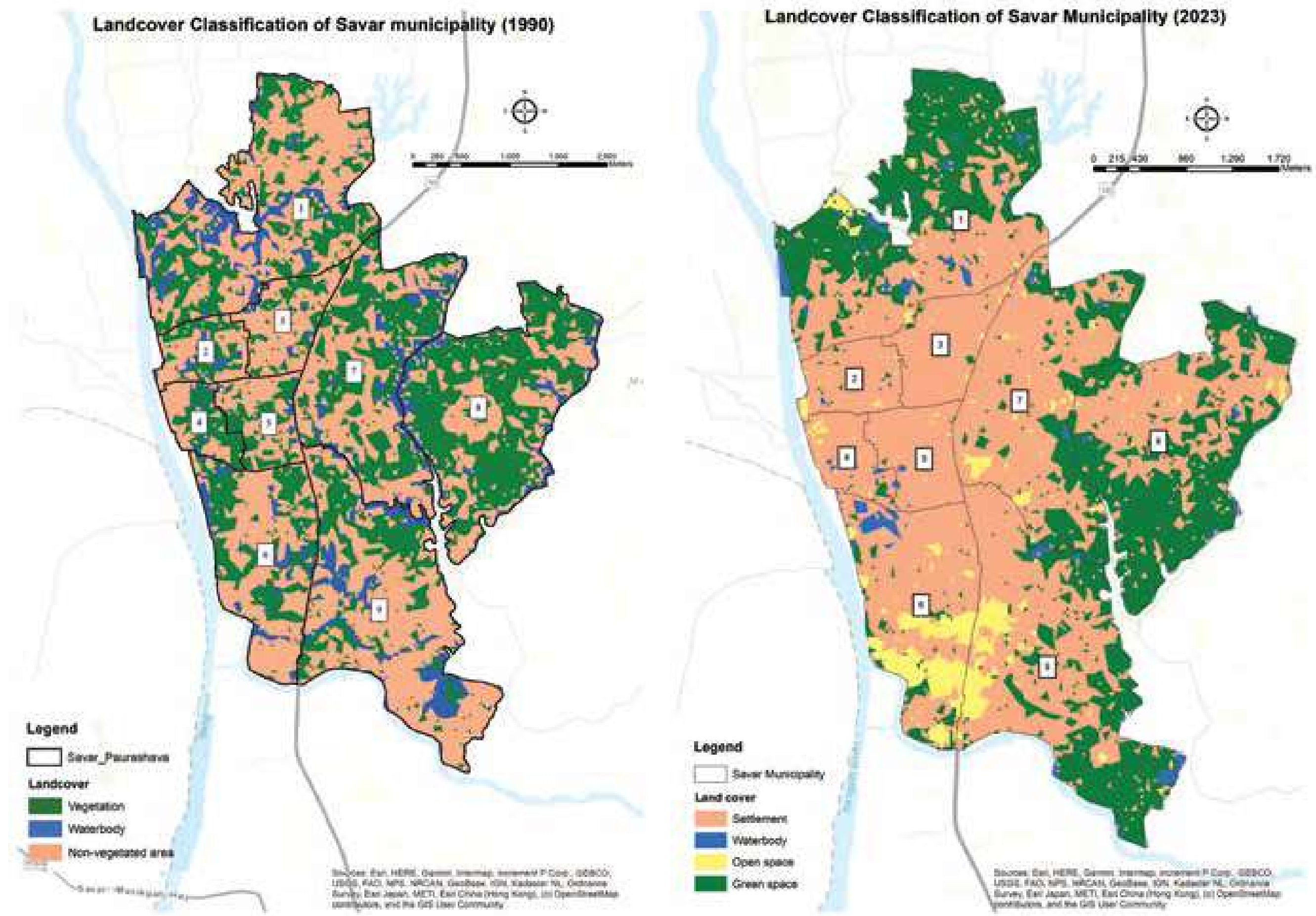
6. VULNERABILITY PROFILE ANALYSIS

This chapter presents the vulnerability profile of Savar Municipality, integrating findings from both secondary and primary data sources.

6.1 Ward Climate Vulnerability Profile of Savar Municipality Using Secondary Sources

6.1.1 Land Cover Classification and Land Use Change

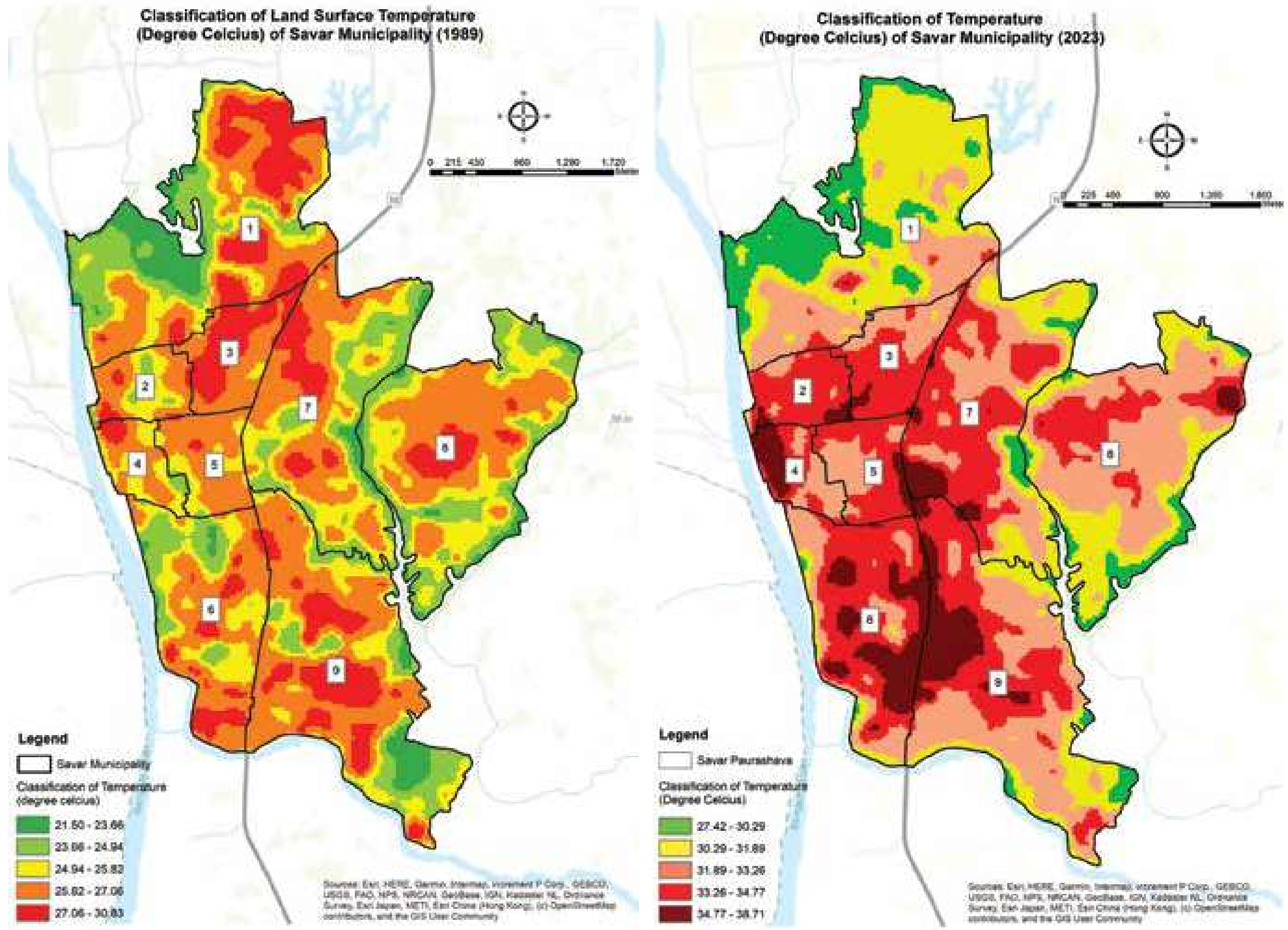
Map 6 illustrates the significant changes in land cover in Savar Municipality between 1990 and 2023, characterized by a decline in green spaces and water bodies, as well as rapid urban expansion, primarily in Wards 3, 4, 5, and 6. These land use changes have reduced Savar's natural resilience, exacerbating the urban heat island effect and disrupting the environmental balance. The loss of green and blue spaces limits the ability to regulate heat and runoff, while rapid urban growth increases flood risk, energy demand, and emissions, stressing the need for climate-responsive planning.



Map 6: *Land Cover Classification and Land Use Change from 1990 to 2023*

6.1.2 Land Surface Temperature (LST)

Map 7 shows the change in land surface temperature (LST) across Savar Municipality between 1989 and 2023, highlighting a significant rise in temperature over time. High-temperature zones that ranged between 27.06°C and 30.83°C in 1989 now exceed 38°C in 2023, primarily due to urban expansion and the loss of green and water spaces**.** The central and southern wards (4, 6, 7, and 9) show the most warming, while Ward 1 remains relatively cooler due to higher vegetation cover. These patterns indicate the emergence of urban heat island zones, increased energy demand, health risks, and reduced urban livability. Incorporating these findings into a climate action plan will support targeted strategies, such as enhancing green cover, improving urban planning, and building heat-resilient infrastructure to mitigate future risks.



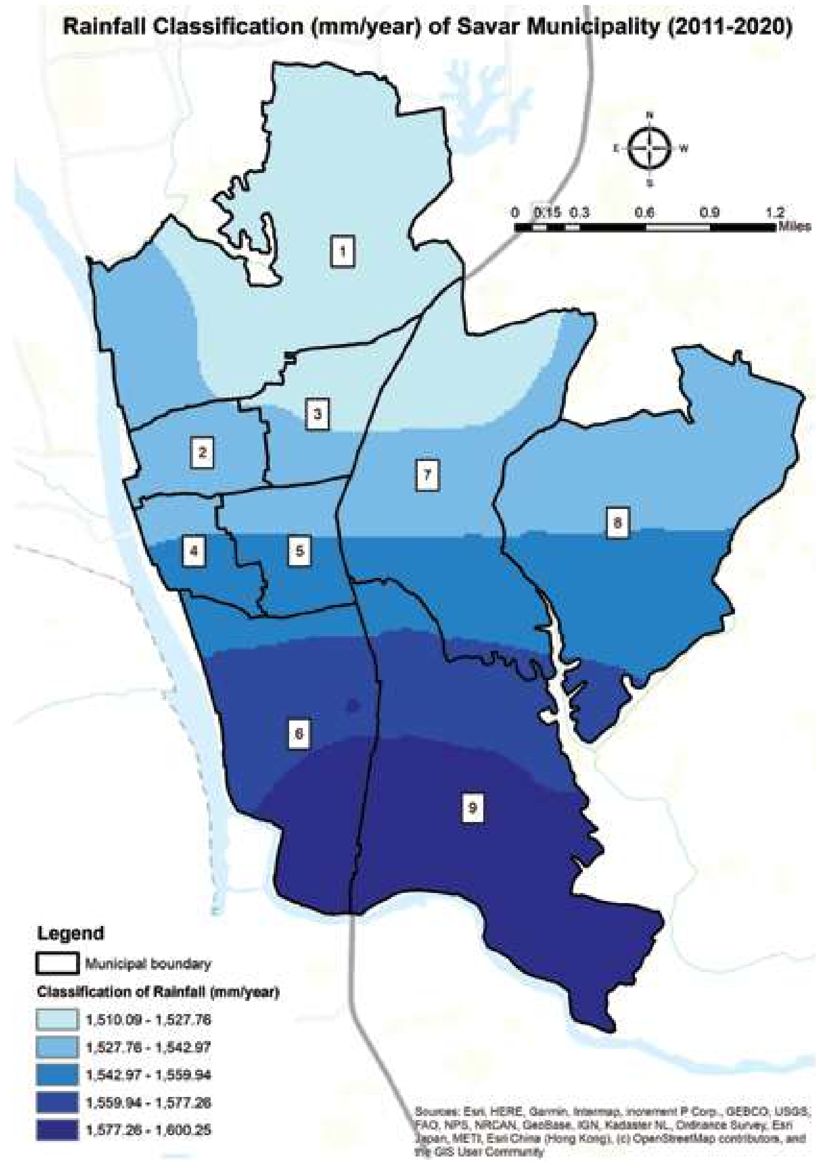
Map 7: *Land Surface Temperature (LST) Comparison between 1989 and 2023*

6.1.3 Rainfall

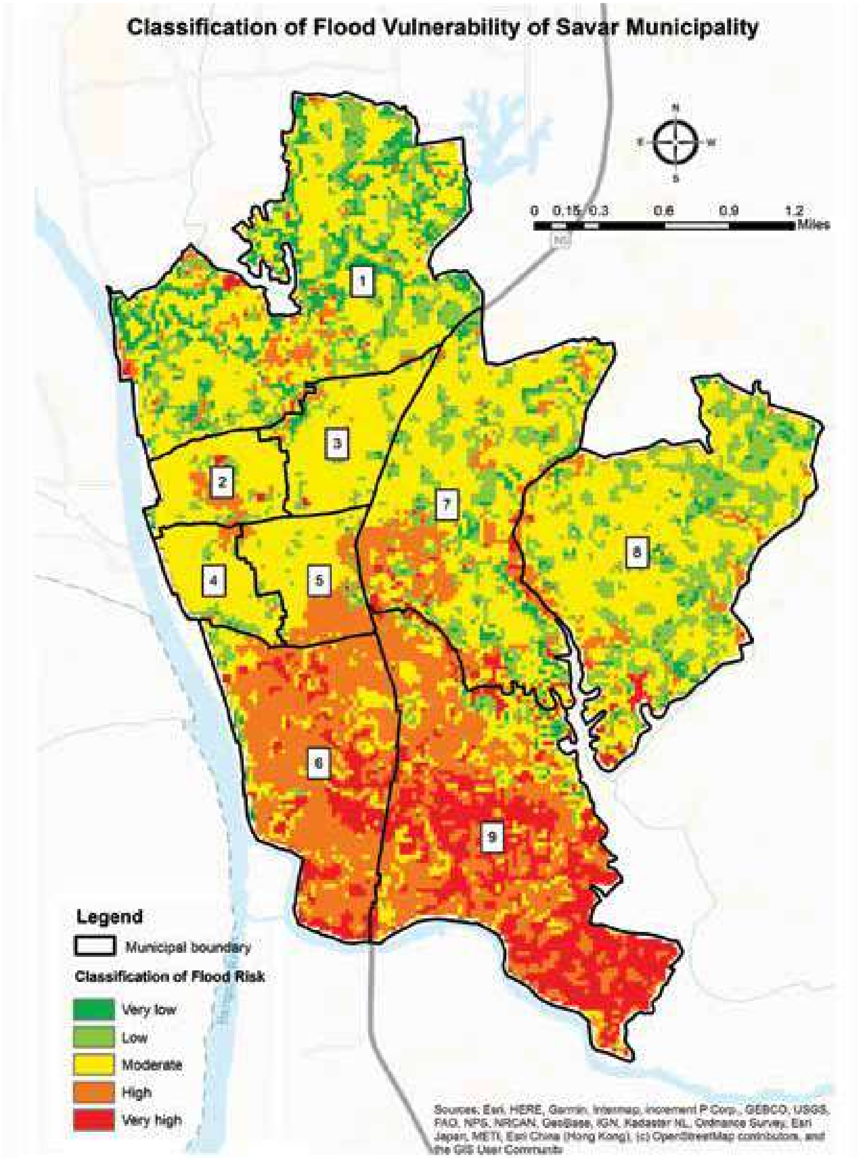
Map 8 illustrates the spatial distribution of annual rainfall across Savar Municipality from 2011 to 2020, revealing a distinct north–south variation. The southern wards, especially Wards 6 and 9, receive the highest rainfall, ranging from 1,577 to 1,600 mm/year, while the northern areas, including Wards 1, 2, and parts of 3 and 4, record the lowest rainfall, between 1,510 and 1,527 mm/year. This rainfall gradient indicates uneven water availability and differing hydrological conditions across the municipality. The southern region's higher rainfall is influenced by its proximity to river systems, which affect local weather patterns and contribute to waterlogging and flash flooding, particularly in urbanized zones with limited drainage and impervious surfaces. Conversely, the northern region's lower rainfall may lead to reduced groundwater recharge and periodic water scarcity, which in turn impacts the local water supply and agricultural productivity.

These spatial disparities call for ward-level water management strategies tailored to each area's specific challenges. In high-rainfall zones, priority should be given to improving drainage infrastructure, strengthening flood control measures, and maintaining natural retention areas. In areas with low rainfall, measures such as rainwater harvesting, groundwater recharge systems, and efficient water use practices are crucial for enhancing water security.

Additionally, integrating green infrastructure—including permeable pavements, retention ponds, and vegetated buffers—can help reduce runoff, increase infiltration, and improve resilience to uneven rainfall. Therefore, developing ward-level Climate Action Plans is essential to implement targeted interventions such as improved drainage systems, rainwater harvesting, and localized flood mitigation measures to strengthen resilience against uneven rainfall events across the municipality.



Map 8: *Rainfall Volume Change from 2011-2020*



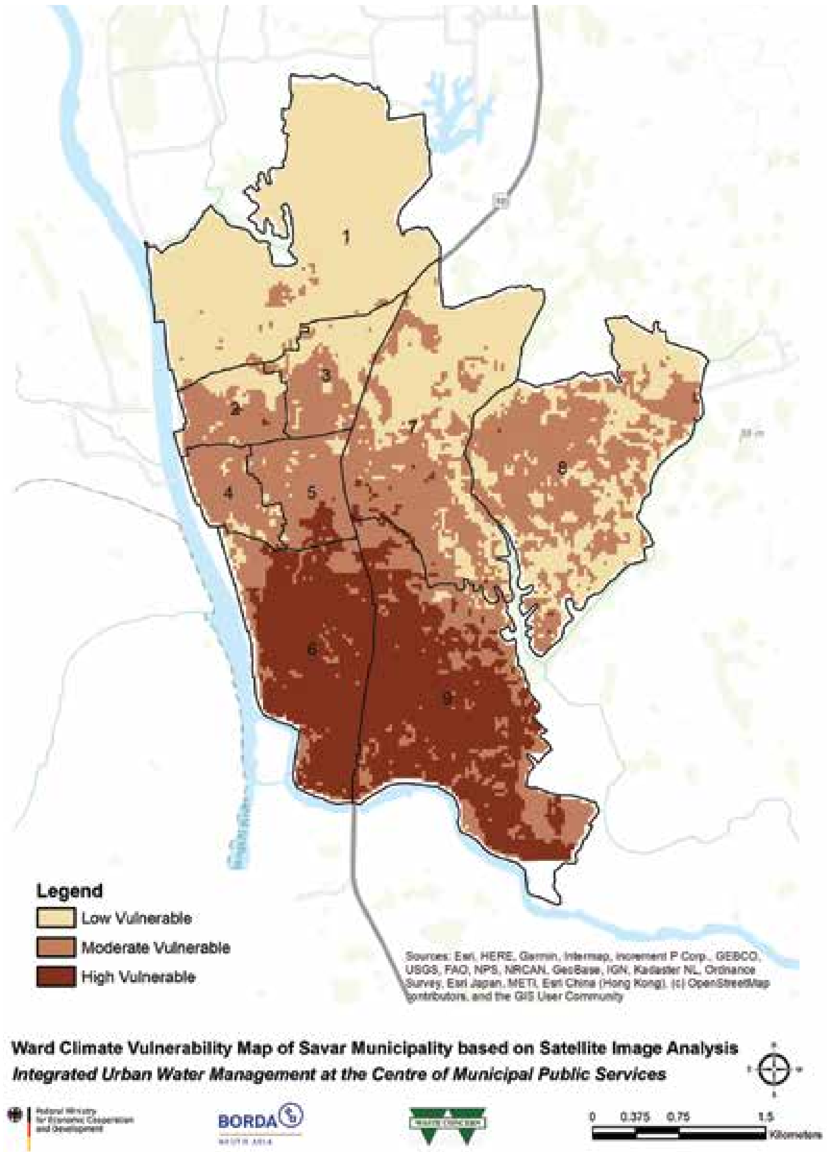
Map 9: *Flood Vulnerability Assessment*

6.1.4 Flood Risk

Map 9 illustrates the flood vulnerability classification of Savar Municipality, highlighting varying levels of flood risk across the area. The southern and central regions, including wards 5, 6, and 9, are most vulnerable to flooding, classified as "high" and "very high" flood risk zones. These areas are more prone to flooding due to their low elevation and dense urban development. Similarly, Ward 7, being farther from the river, also faces a lower flood risk, as the distance reduces the likelihood of river overflow.

proximity to water bodies**.** Additionally, the flood risk in southern areas is exacerbated by higher rainfall levels, as illustrated in Map 9, which intensifies flooding and drainage problems in these regions. Besides, some parts of wards 1 and 2, located near the river, making them susceptible to flooding from river overflow and waterlogging. Ward 3, situated in the central area of the municipality, experiences lower flood vulnerability primarily because it is farther from the adjacent river. This distance reduces the risk of river overflow, which is a significant cause of flooding in the nearby regions.

These spatial differences underscore the need for targeted flood management strategies, such as enhancing drainage networks, strengthening riverbank protection, and promoting climate-resilient urban planning, to mitigate future flood impacts and enhance the resilience of vulnerable communities against uneven rainfall events across the municipality.



Map 10: *Ward Vulnerability Map Based on Secondary*

6.1.5 Overlay

Map 10 presents the Ward Climate Vulnerability Map of Savar Municipality, developed through an overlay analysis of satellite-derived data on temperature, rainfall, and flood risk. The analysis reveals distinct spatial variations in climate vulnerability across the municipality, categorizing wards into low, moderate, and high vulnerability zones, with darker shades indicating higher risk levels.

The southern and central wards, particularly Wards 5, 6, and 9, emerge as highly vulnerable, reflecting their significant exposure to extreme heat, heavy rainfall, and flood hazards. In contrast, wards with lighter shades, such as Ward 1, show lower vulnerability, likely due to their higher elevation, better drainage, and greater vegetation coverage. The remaining wards fall within the moderate vulnerability category, indicating exposure to multiple but less severe climate stressors.

This spatial distribution reveals uneven exposure to climate-induced hazards, underscoring the need for targeted climate adaptation measures in high-risk areas. The map serves as an essential tool for climate action planning and disaster risk reduction, helping the municipality prioritize resources and interventions to strengthen overall urban resilience and sustainability.

6.2 Ward Climate Vulnerability Profile of Savar Municipality Using Primary Sources

A Climate Vulnerability Index for each ward of Savar Municipality was developed by integrating hazards, infrastructure, governance, and socio-economic indicators. This index considers both the intensity and frequency of hazards, with higher values indicating greater vulnerability. A weighting system was applied to quantify the impact intensity and frequency of hazards for the index calculation. Impact intensity and frequency responses were assigned numerical values, as presented in the following table. This approach allows the Climate Vulnerability Index to capture both the severity and likelihood of hazards, ensuring that more frequent and severe hazards contribute proportionally more to the overall vulnerability score.

Table 5: Weightage Information for Intensity and Frequency of Hazard

Dimension	Category	Description	Weight
Frequency	< 3 times/year	Low frequency	0.25
	3–5 times/year	Low to moderate frequency	0.50
	5–7 times/year	Moderate to high frequency	0.75
	> 7 times/year	High frequency	1.00
Intensity	Low impact	Minor service disruption	0.33
	Medium impact	Moderate service disruption	0.66
	High impact	Severe service disruption	1.00

Hazard Vulnerability

The Hazard Vulnerability Index (H) quantifies the extent to which a ward is vulnerable to a specific hazard, considering both its frequency of occurrence and the cumulative intensity of its impact on all infrastructure and urban systems. While satellite imagery analysis revealed only spatial variation in hazards, this quantitative assessment establishes a robust basis for comparing hazard vulnerability across wards. A higher value indicates that the ward experiences frequent hazard events with widespread and severe impacts on multiple infrastructure and urban systems.

Infrastructure Vulnerability

Similarly, the vulnerability of a specific infrastructure type within a ward is determined by the Infrastructure Vulnerability Index (I), which aggregates the effects of all hazards based on their frequency and intensity of impact on that infrastructure. The resulting infrastructure vulnerability index provides a combined score for each infrastructure type, reflecting the cumulative influence of multiple hazards on its overall risk level within the ward.

Governance Vulnerability

In the absence of quantifiable, ward-level governance indicators for climate adaptation, a uniform governance score was assigned to all wards. The governance index (G) was set at 1, reflecting the lack of measurable adaptation actions at the ward level and representing consistently high governance-related vulnerability across the municipality.

Socio-economic Vulnerability

The indicators selected for the socio-economic vulnerability assessment have different units and ranges. Therefore, min–max normalization was applied to convert them into a unitless scale from 0 to 1, allowing direct comparison across wards. After normalization, the resulting socio-economic vulnerability index (S) values range from 0 (least socio-economically vulnerable) to 1 (most socio-economically vulnerable).

HIGS Climate Vulnerability Index

The final HIGS Climate Vulnerability Index integrates four dimensions of vulnerability: Hazards (H), Infrastructure (I), Governance (G) and Socio-economic (S). The hazard vulnerability index and the infrastructure vulnerability index were subsequently rescaled to a common range [0, 1] using Min–Max normalization. The final HIGS Climate Vulnerability Index for the ward was calculated as the summation of the four dimension scores.

$$\mathbf{HIGS_w = H_w + I_w + G_w + S_w}$$

Since each dimension is normalized to the range [0, 1], the composite HIGS index ranges from 0 (the lowest possible vulnerability) to 4 (the highest possible vulnerability). The higher the HIGS index, the greater the ward's overall vulnerability to climate change.

6.2.1 Hazard Vulnerability Profile of Savar Municipality

Based on the vulnerability index calculation, the hazard vulnerability index at the ward level is presented in Table 7, using a color-gradient system where "Red" indicates the highest vulnerability levels and "Green" represents the lowest. The gradient visually highlights varying levels of susceptibility across wards. The total exposure values in the last column reflect the cumulative hazard impact for each ward, showing Heavy Rainfall and Waterlogging (26.88) is the most predominant hazard, followed closely by heatwave (24.00). The last row represents the cumulative index values, with Ward 6 showing the highest vulnerability (13.15) and Ward 7 the lowest (8.61). The variation in the index across the wards within the municipality signifies the importance of this study. Policymakers must understand that some wards require special attention. The specific areas where such interventions can be made are discussed later.

Table 6: Hazard Vulnerability Index

Hazards	Ward Hazard Vulnerability Index of Savar Municipality								
	1	2	3	4	5	6	7	8	9
Cyclone	1.73	1.73	1.54	1.13	1.03	1.41	1.21	1.99	1.08
Floods	1.00	0.91	0.69	0.91	0.57	1.71	0.58	0.49	1.90
Heavy Rainfall and WL	3.28	2.92	1.61	3.23	3.93	3.62	2.04	2.50	3.74
Thunder-storm	1.23	1.87	2.53	1.27	1.30	1.50	1.39	2.86	1.30
Heatwave	1.46	1.79	2.78	2.96	2.55	3.80	2.52	2.23	3.90
Coldwave	0.91	1.68	0.96	1.10	1.05	1.11	0.87	1.03	1.11

The *"Ward Exposure to Hazards"* chart in Figure 14, based on the vulnerability index table 7, highlights variations in hazard exposure across Savar Municipality's wards. Each bar's height represents cumulative exposure, with taller bars indicating higher overall vulnerability. The color segments within the bars represent the impact levels of specific hazards, with WVI scores ranging from 8.61 to 13.15. Heavy rainfall and heatwaves are the primary contributors to vulnerability, while floods and cyclones have minimal impact across the municipality, except in wards 6 and 9. Thunderstorms show noticeable fluctuation across the wards, with the highest impact in wards 3 and 8.

The index values of wards 6 (13.15) and 9 (13.04) are relatively high, significantly exceeding the mean by more than one standard deviation, indicating heightened vulnerability. Conversely, Ward 7 (8.61) exhibits remarkably low vulnerability levels, with a WVI score significantly below the mean by more than one standard deviation.

The majority of the wards, such as ward 2 (10.89), ward 3 (10.12), ward 4 (10.60), ward 5 (10.44), and ward 8 (11.10), have index values close to the average, indicating a moderate level of vulnerability that could be exacerbated during extreme events.

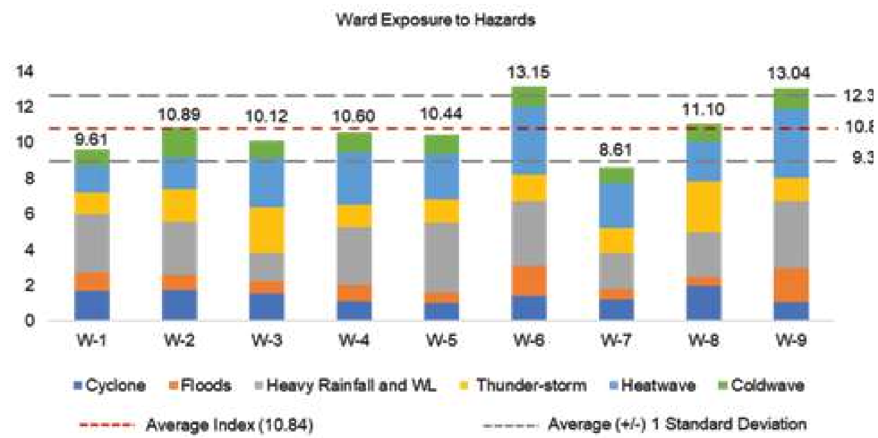


Figure 14: *Wards' Exposure to Hazards on Selected Infrastructures and Urban Systems*

6.2.1.a Cyclone

- Cyclones have a limited impact on Savar Municipality due to its inland location, away from the coastal areas where cyclones typically make landfall.
- However, Savar experiences strong winds and heavy rainfall from cyclonic systems, which can cause localized flooding, damage to infrastructure, and disruptions to daily life.
- Significant disruptions occurred in electricity and communication networks, especially in Wards 6 and 9 (Annexure 1 Figure 2).

6.2.1.b. Floods

- Savar is less vulnerable to river flooding due to its elevated position, reducing the risk of seasonal flood inundation common in lower-lying areas of Bangladesh.

- Still, flooding remains a risk due to its proximity to the Gorai River, causing threats to infrastructure damage, water and sanitation service interruptions, etc.
- Particularly in wards 6 and 9, which are most exposed to seasonal floods due to their proximity to the river (Annexure 1 Figure 3).

6.2.1.c. Heavy Rainfall and Waterlogging

- Savar is highly vulnerable to heavy rainfall and waterlogging due to its localized topographic variation, inadequate drainage system, and high urban density.
- Wards in low-lying areas, as well as with insufficient drainage, are prone to prolonged waterlogging after heavy rainfall, such as wards 5, 6, and 9 (Annexure 1 Figure 4).
- This phenomenon causes damage to infrastructure, including eroded roads and submerged buildings, disrupts transportation, contaminates water supplies, increases public health risks through waterborne diseases, and leads to economic losses.
- The severity of these impacts fluctuates across wards, influenced by factors such as local topography, infrastructure quality, and drainage capacity.

6.2.1.d. Thunder Storms and Lightning

- Savar is moderately vulnerable to thunderstorms and lightning due to its geographical location in Bangladesh, which experiences frequent monsoon-related storms and intense weather systems.
- The impact of thunderstorms varies across the municipality, with some wards experiencing more severe damage due to factors like urban density, high-rise buildings, infrastructure quality, and tree cover. Also, areas with less developed infrastructure or more open spaces may face greater risks, particularly from fallen trees and power outages.
- Thunderstorms are a common cause for the disruption of electricity supply, affecting daily activities and services.
- Ward 8 is greatly exposed to thunderstorms due to having high-rise trees and open spaces (Annexure 1 Figure 5).

6.2.1.e. Heatwaves

- Savar Municipality is increasingly vulnerable to heatwaves, with several prolonged and extreme heat events being recorded in recent years.
- Urbanization in Savar has led to more concrete surfaces and buildings, which absorb and retain heat, creating a stronger urban heat island effect. This effect is intensified by the limited availability of vegetation and green spaces.
- Almost all the wards in Savar are experiencing prolonged heat spells, with the impact being particularly severe in the core urban areas. Vulnerability varies across Savar, with densely populated wards experiencing higher temperatures due to factors such as impervious surfaces, limited airflow, and a lack of vegetation (Annexure 1, Figure 6).

6.2.1.f. Coldwaves

- Savar municipality has experienced a few notable cold wave events in recent years, with the increase in the frequency and unpredictability of extreme weather events, potentially heightening Savar’s vulnerability to cold spells in the future

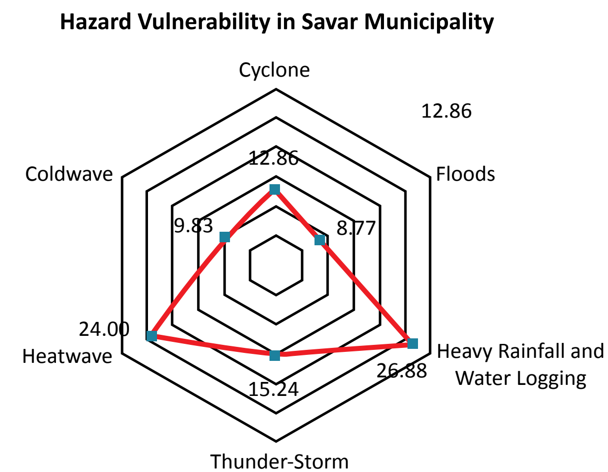


Figure 15: *Hazard Vulnerability in Savar Municipality*

- The cold wave has been particularly challenging for the residents, especially vulnerable populations, such as the elderly, young children, and low-income groups living in Kancha or semi pucca structures (Annexure 1 Figure 7).

The radar chart in Figure 15 illustrates the hazard vulnerability of Savar Municipality across six types of natural hazards. Among these, the municipality demonstrates the highest vulnerability to heavy rainfall and waterlogging, with a score of 26.88, followed by vulnerability to heatwaves at 24.00. Thunderstorms pose a moderate vulnerability level at 15.24, while cyclones and cold waves show relatively lower vulnerability scores of 12.86 and 9.83, respectively. The municipality is least vulnerable to floods, scoring only 8.77. The high vulnerability to heavy rainfall and heatwaves can be attributed to rapid urbanization, poor drainage infrastructure, and increasing impervious surfaces, which exacerbate waterlogging and intensify urban heat island effects. Recent climate extremes, such as record-breaking rainfall events and prolonged heatwaves in Bangladesh, underscore the severity of these hazards for Savar, resulting in health risks, economic disruptions, and damage to infrastructure.

This analysis informs climate action planning by identifying the need for targeted measures, such as improved drainage, green infrastructure, and heat-resilient design. Prioritizing these actions will strengthen the municipality's resilience and support sustainable urban development

6.2.2 Infrastructure and Urban Systems Vulnerability Profile of Savar Municipality

The urban system components are categorized into two parts: Non-WASH Urban Systems and WASH Systems. Non-WASH Urban Systems include critical sectors such as housing, transportation, and electricity & communication, which form the backbone of urban infrastructure and daily life. WASH Systems, on the other hand, encompass water supply, sanitation & wastewater, stormwater drainage, and solid waste management, focusing on essential services that ensure public health and environmental sustainability. Each ward's index in Savar Municipality was measured based on hazard intensity and frequency, with data collected from residents' perceptions. These hazard indexes for Infrastructure and Urban Systems are represented in the table below (Table 8).

Table 7: Infrastructure and Urban System Vulnerability Index

Infrastructure	Ward of Savar Municipality								
	1	2	3	4	5	6	7	8	9
Housing	1.47	1.61	1.61	1.93	1.88	2.04	1.34	1.66	2.06
Transportation	1.41	1.60	1.39	1.85	1.65	2.04	1.22	1.56	2.04
Electricity and Comm	1.41	1.88	1.61	1.58	1.78	2.26	1.64	1.90	2.21
Water supply	1.29	1.30	1.41	1.17	1.09	1.64	1.03	1.34	1.70
Sanitation and WW	1.31	1.30	1.31	1.20	1.19	1.55	1.09	1.29	1.45
Storm Water Drainage	1.35	1.53	1.24	1.60	1.46	1.83	1.16	1.32	1.77
SWM	1.38	1.67	1.55	1.26	1.40	1.80	1.14	1.46	1.80

6.2.2.1 Infrastructure and Urban Systems Vulnerability of Non-WASH Urban Systems

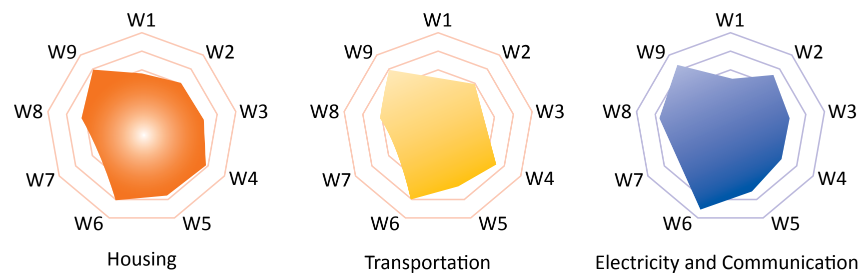


Figure 16: *Non-WASH Urban Systems Vulnerability of Wards*

The vulnerability of non-WASH infrastructure and urban systems has been assessed, identifying the most vulnerable wards for each system and also which wards have comparatively better urban systems. These findings are visually represented in the figures above. It is worth noting that wards 6 and 9 are vulnerable to all three systems.

6.2.2.2 Infrastructure and Urban Systems Vulnerability of WASH Urban Systems

The vulnerability of WASH infrastructure and urban systems has also been assessed, identifying the most vulnerable wards for each system and also which wards have comparatively better urban systems. These findings are visually represented in the figures below. It is worth noting that wards 6 and 9 are vulnerable to all three systems. The same wards were found to be more vulnerable compared to the other wards with respect to non-wash urban systems.

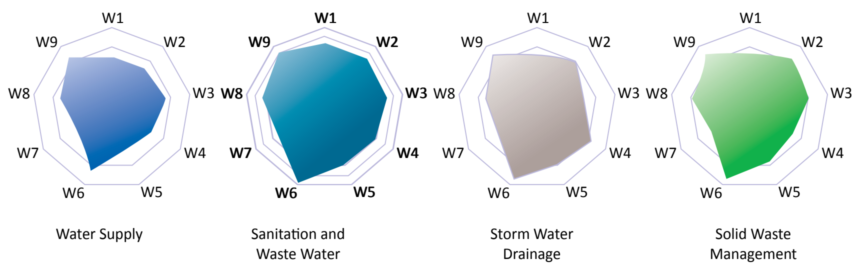


***Figure 17:** WASH Urban Systems Vulnerability of Wards*

Figure 18 provides an overview of the infrastructure and urban system vulnerabilities in Savar Municipality. The index evaluation reveals that all seven systems have comparable vulnerability scores, indicating that each system faces similar risks from hazards.

Electricity and communication are the most vulnerable, with a score of 16.3, followed by housing at 15.6 and transportation at 14.8. The high vulnerability of the electricity and communication infrastructure reflects the municipality's struggle with reliable power and communication, which can severely impact daily life, emergency responses, and economic activities. Housing and transportation issues underscore the challenges of urban expansion and inadequate planning, leading to increased vulnerability to climate hazards such as flooding and heatwaves.

Among WASH systems, SWM shows the highest vulnerability at 13.5, followed by stormwater drainage at 13.3, water supply at 12.0, and sanitation and wastewater management at 11.7. These scores reflect significant challenges in maintaining efficient waste disposal, managing drainage systems to prevent waterlogging, ensuring reliable access to clean water, and effectively handling wastewater. These issues are especially critical in the face of climate change, which can increase the frequency and intensity of heavy rainfall, putting pressure on drainage systems and raising the risk of water contamination.

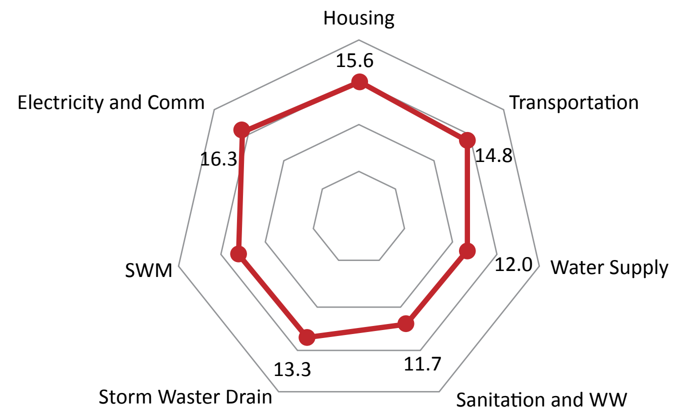


***Figure 18:** Infrastructure Vulnerability in Savar Municipality*

6.2.2.3. Ward-Wise WASH System Assessment

Analyzing the WASH systems in Savar Municipality at the ward level has yielded two key outcomes. First, it identifies the most vulnerable WASH system in each ward based on the hazard index. Second, it highlights which wards require immediate intervention to effectively reduce vulnerability.

Table 8: WASH Vulnerability Index

Ward	W1	W2	W3	W4	W5	W6	W7	W8	W9
Water supply	1.29	1.30	1.41	1.17	1.09	1.64	1.03	1.34	1.70
Sanitation and WW	1.31	1.30	1.31	1.20	1.19	1.55	1.09	1.29	1.45
Storm Water Drainage	1.35	1.53	1.24	1.60	1.46	1.83	1.16	1.32	1.77
SWM	1.38	1.67	1.55	1.26	1.40	1.80	1.14	1.46	1.80

Table 9 presents the ward-wise vulnerability of WASH systems. Red indicates the most vulnerable WASH sector for a specific ward (e.g., the SWM system is the most vulnerable in Wards 1, 2, and 3 Assessing the overall index for WASH systems reveals the most vulnerable wards in Savar Municipality, identifying those that require immediate intervention in the WASH sector. As shown in Figure 19, Ward 6 has the highest index value, closely followed by Ward 9, indicating the greatest vulnerability. This conclusion was also drawn earlier when WASH and Non-WASH systems were analysed. Ward 7 holds a relatively better position compared to the other wards from the perspective of local residents. Prioritizing improvements in stormwater drainage and solid waste management is crucial for enhancing resilience against climate-related impacts, such as heavy rainfall and flooding.

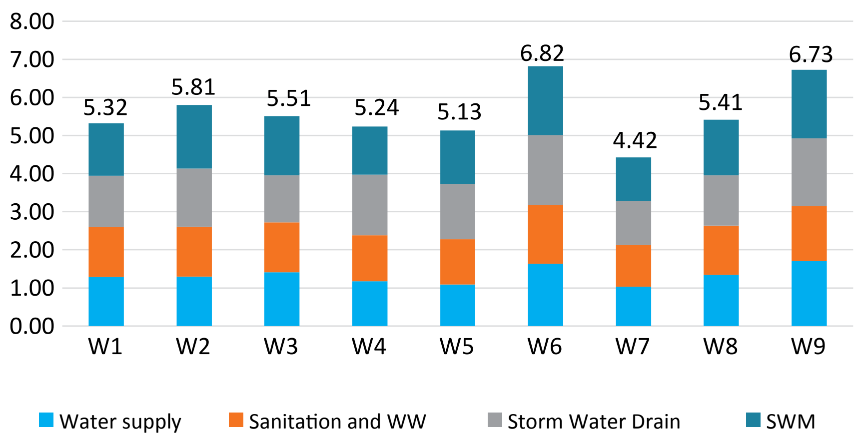


Figure 19: *Highest Vulnerable Wards in terms of WASH*

6.2.2.4 Impacts on the Infrastructure and Urban Systems during Hazards

The questionnaire survey captured the various impacts on each infrastructure and urban system that residents experienced during hazards. The magnitude of these impacts was measured based on their intensity and frequency. This analysis was essential for determining the priority needs assessments for the Savar Municipality.

For example, a key priority for intervention in the SWM sector of Savar Municipality is ensuring uninterrupted waste collection during hazards, as *"disruption of waste collection and transportation"* is the most significant challenge faced by residents. In the Non-WASH sector, particularly Electricity and Communication, the primary concern is *"disruption of internet services and communication networks due to power outages."*

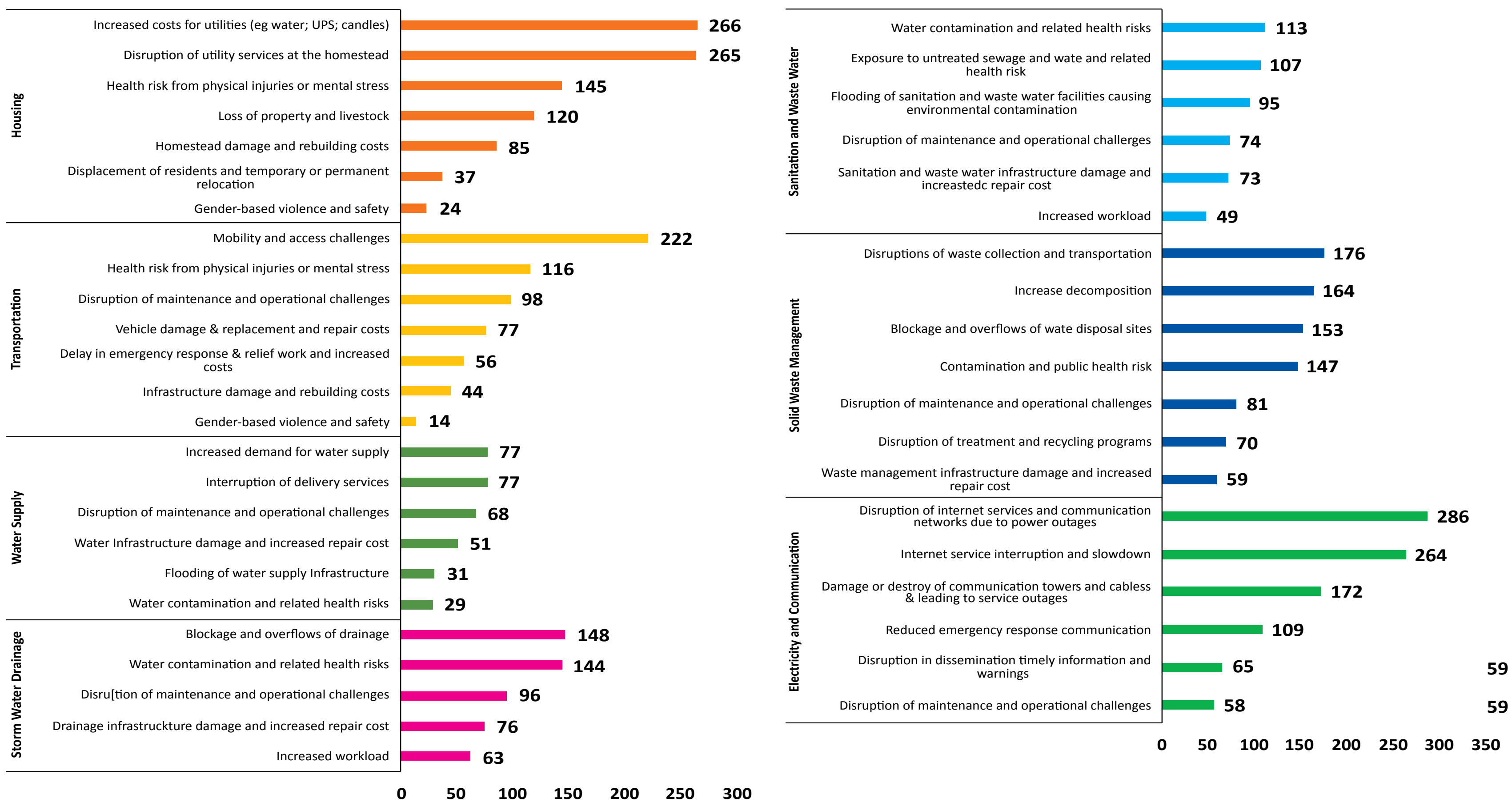


Figure 20: *Impacts Magnitude of Infrastructure and Urban Systems*

6.2.3 Governance Vulnerability Profile of Savar Municipality

The table below summarizes the key governance vulnerabilities of Savar Municipality. As previously mentioned, since there are no ward-level activities for climate action, the available qualitative information could not be quantified or scored for comparative analysis. Hence, the table provides an overall summary for the municipality as a whole. These findings highlight critical areas that require attention to enhance effective climate action planning.

Institutional Capacity	No dedicated framework for climate action or disaster preparedness at the ward level.
	Lack of trained personnel and specialized units for climate resilience activities.
	No mechanism to support awareness-raising initiatives and capacity-building efforts for climate change adaptation.
Accountability	No ward-level disaster management committees.
	No clear responsibility for implementing ward-level climate resilience measures.
	Weak enforcement of development regulations is causing unplanned growth.
Planning and Policy	No dedicated climate action plan for Savar.
	Climate adaptation considerations remain overlooked in municipal master plans and local budgetary frameworks.
Participation	Limited stakeholder involvement in climate resilience planning.
	Low public awareness of climate risks and adaptation measures.
	Lack of formal structures for community participation in climate resilience planning.
Data and Knowledge Management	Lack of ward-level climate data and associated risk or exposure information.
	No data-sharing platforms for disseminating climate data and vulnerability assessments to stakeholders, including the public, local authorities, and the private sector.

6.2.4 Socio-economic Vulnerability Profile of Savar Municipality

Table 2 illustrates the socio-economic vulnerability profile of Savar Municipality. Given the variation in measurement units across the selected indicators, all variables were normalized to a common scale between 0 to 1. A color gradient system was then applied to aid interpretation, where red denotes the highest level of vulnerability and green represents the lowest, as shown in Annexure 1.

The results show that wards 1, 6, 7 and 9 exhibit relatively high vulnerability across multiple indicators. High-population wards such as 6 and 7 may face increased socio-economic vulnerability due to the greater demand for sufficient infrastructure and services to meet residents' needs. Savar Municipality has a high population density, particularly in Wards 3, 6, and 7, where the concentration of residents is notably higher (Figure 8 of Annexure 1). These densely populated areas face higher exposure to climate hazards and greater strain on resources during such events.

As illustrated in Figure 9 of Annexures 1, poor housing conditions, characterized by a high prevalence of Kancha/jhupri structures, are concentrated in Wards 1 and 5. Areas with such housing types are highly vulnerable to severe damage during extreme weather events. Low literacy rates are particularly notable in Wards 1 and 2, as indicated in Table 2 of Annexure 2. Limited literacy can significantly hinder the effective communication and use of climate-related information, as communities may struggle to understand and respond to guidance during extreme events. Sanitation vulnerability is also pronounced in Wards 1 and 9, where high rates of open defecation increase public health risks, especially during floods and periods of heavy rainfall. In contrast, Wards 2, 3 and 4 generally exhibit low vulnerability across most socio-economic indicators, with better housing conditions, higher literacy levels, and improved access to sanitation facilities.

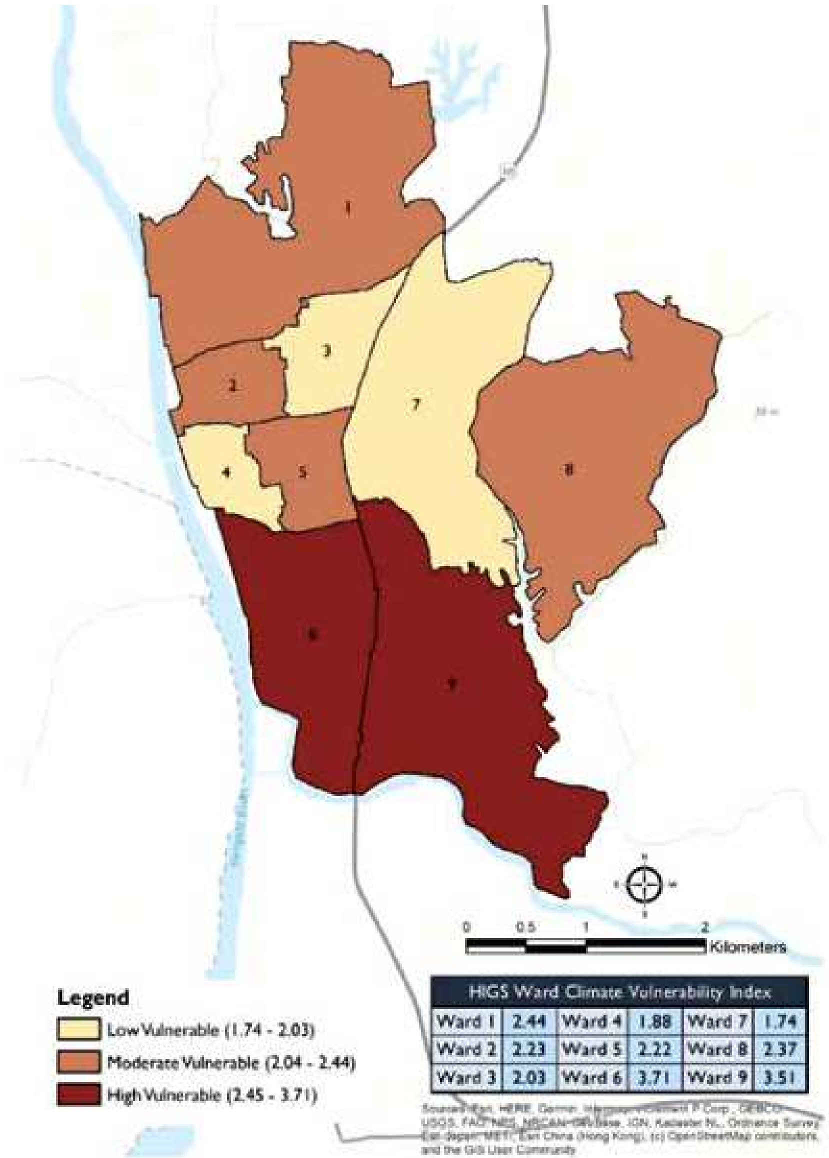
These findings underscore the importance of integrating socio-economic vulnerability into the Climate Action Plan, with targeted interventions in high-risk wards to strengthen community resilience and reduce exposure to climate-related hazards.

6.2.5 HIGS Climate Vulnerability INDEX

The Ward Climate Vulnerability Index, displayed in the table at the bottom of Map 11, presents the varying degrees of vulnerability across wards in Savar Municipality. The vulnerability index integrates the four dimensions of the HIGS framework: Hazards, Infrastructure, Governance, and Socio-economic indicators. Each dimension is normalized to a range of 0 to 1, resulting in a composite HIGS index ranging from 0 (lowest vulnerability) to 4 (highest vulnerability), providing a comprehensive understanding of ward-level vulnerability. These scores are crucial for the climate action planning process, as they identify the wards most at risk and highlight areas requiring targeted interventions. Higher index values indicate greater vulnerability, reflecting intensified climate hazards, limited infrastructure resilience, or significant socio-economic challenges.

The index further categorizes wards into three vulnerability levels: Low, Moderate, and High. Wards with the highest vulnerability scores, such as wards 6 and 9 (shaded in dark brown), are exposed to significant climate risks and require immediate attention. In contrast, wards 3, 4, and 7 (shaded in lighter tones) exhibit low vulnerability, while the remaining wards fall under moderate vulnerability. This classification indicates that most of the Savar Municipality lies within moderate to high vulnerability zones.

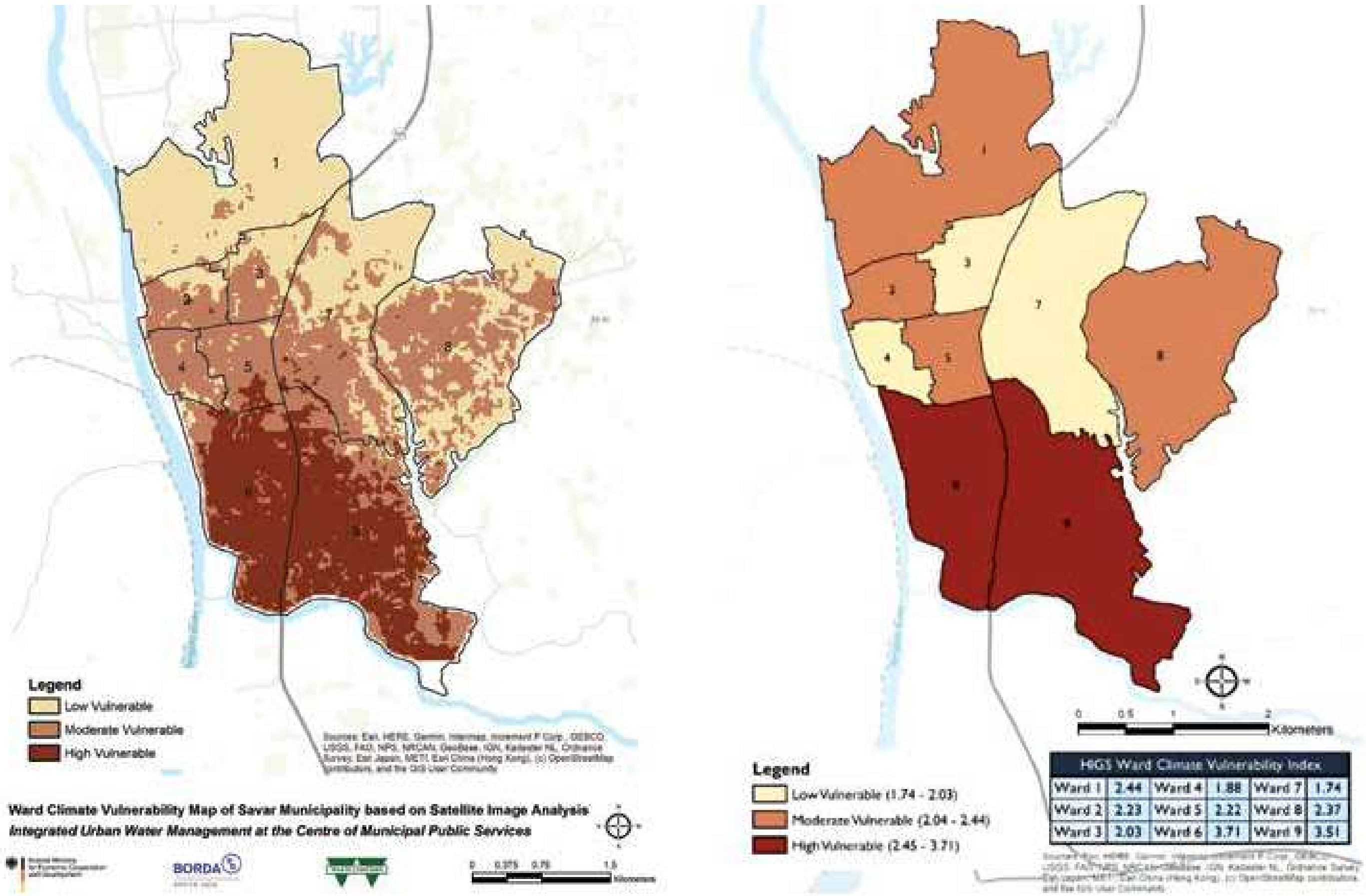
By identifying high-risk areas, the Ward Climate Vulnerability Index provides a data-driven basis for prioritizing interventions in the Climate Action Plan. Aligning resources and strategies with these vulnerability hotspots ensures that adaptation measures are both equitable and effective. Ultimately, this approach fosters long-term urban resilience and sustainability, enabling Savar Municipality to better prepare for and respond to the impacts of climate change.



Map 11: *Climate Vulnerability Map Based on HIGS Framework*

6.2.6 Correlation findings between the Satellite Vulnerability Map and the HIGS Vulnerability Map

The climate vulnerability assessment for Savar Municipality combined satellite-based analysis of secondary data with a community perception survey based on the HIGS framework to present localized spatial variation of hazards across the municipality, capturing how different socio-economic groups perceive the impact of extreme events on urban infrastructure and services. Both approaches demonstrated strong alignment, consistently highlighting highly vulnerable wards such as 10 and 16, thereby enhancing the credibility and reliability of the findings for climate action planning. Overall, this assessment provides a robust foundation for identifying vulnerable areas, prioritizing targeted interventions, and guiding evidence-based, climate-resilient urban development (Map 12).



Map 12: *Ward Climate Vulnerability Map of Savar Municipality using Primary and Secondary Data*

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7. WAY FORWARD AND RECOMMENDATION

To address urban system vulnerabilities to hazards, the residents of Savar Municipality have shared valuable suggestions. In most cases, the opinions align across different wards, reflecting similar demands and responses based on shared experiences and challenges. This section outlines the overall priority intervention, short-term and medium-term interventions identified by the residents, which, if addressed, could significantly reduce the vulnerability of municipal infrastructure to various hazards. In line with the project objectives, short-term interventions will focus on addressing vulnerabilities in the WASH systems, while medium-term measures will be implemented to address non-WASH needs. These priorities underscore the need for improved planning, enhanced maintenance, and targeted investments tailored to address specific vulnerabilities in both non-WASH and WASH urban systems. Ensuring community engagement in implementing these measures will also foster resilience and better preparedness

7.1 Way Forward and Intervention for WASH Urban Systems (Short Term)

7.1.1 Water Supply System

- Ensuring access to a piped water supply for all residents, especially LICs, with safe drinking water available during hazard events is a top priority.
- Establishing safe drinking water stations throughout the municipality to help mitigate the impacts of heatwaves on residents.
- Controlling the depletion of groundwater resources through interventions such as rainwater harvesting and restoring wetlands is crucial.
- Building or retrofitting water supply pipe systems and pumping stations using water-resistant materials will ensure resilience against floods.
- Focusing on digging more canals, liberating canals from encroachment, and stopping the filling up of ponds, canals, and rivers and increasing the navigability of rivers.

Figure 21: *Suggested Way Forward for Water Supply*

7.1.2 Sanitation and Wastewater System

- Supporting LIC residents with financial contributions and assistance to build hygienic toilet systems is essential to improve sanitation conditions.
- Preventing the overflow of septic tanks and wastewater-carrying drainage systems during hazards is a critical priority.
- Increasing the depth and width of all drains over the municipality so that it can carry more wastewater water increasing the sanitation system.
- Educating the public on proper sanitation practices during and after hazards, including safe waste disposal and water contamination prevention, is vital for community health.
- Setting up a high-capacity Faecal Sludge Treatment Plant (FSTP) and ensuring proper channels for transporting faecal sludge to the facility.

Figure 22: *Suggested Way Forwards for Sanitation and Wastewater*

7.1.3 Storm Water Drainage System

- Increasing the number of street drains with proper channeling systems to effectively prevent flooding during heavy rainfall.
- Expanding the number of retention ponds/ basins to handle intense rainfall and minimize urban flooding risks.

Figure 23: *Suggested Way Forwards for Stormwater Drainage*

- Dredging waterbodies around the municipality increases the depth and capacity of waterways, allowing faster runoff during heavy rainfall, reducing the risk of urban flooding.

7.1.4 Solid Waste Management System

- Establishing suitable waste disposal points across the Savar Municipality to address the lack of proper dumping locations faced by many residents.
- Increasing the capacity and initiatives of authorities to improve waste collection efficiency, including adding manpower, waste collection vehicles, and training programs, ensuring continuity even during hazards.
- Enforce a strict penalty system across the municipality for illegal waste dumping, with regular patrols by authorities to monitor compliance and ensure effective implementation.

Figure 24: *Suggested Way Forward for SWM*

- Conducting awareness programs for residents on waste segregation, particularly for organic, inorganic, and hazardous waste.

7.2 Way Forward and Intervention for Non-WASH Urban Systems (Medium Term)

7.2.1 Housing System

- Improving housing conditions, especially in LIC areas where Kacha Jhupri structures are prevalent.
- Providing government support to construct houses on elevated land.
- Providing government support in the transition of vulnerable housing to pucca structures along with planned urbanization for better resilience.
- Ensuring utility services are maintained at affordable costs during hazardous events.

- Establishing multiple hazard shelters in suitable locations beforehand to ensure safety.

Figure 25: *Suggested Way Forward for Housing*

7.2.2 Transportation System

- Fixing the deteriorated access roads in Savar Municipality, especially those impacted during hazards, is the residents' most prominent demand, as these roads hamper relief measures.
- Developing roads at higher elevations with modern features such as medians and proper drainage systems is suggested to enhance resilience.
- Improving road accessibility by installing energy-efficient streetlights is another key priority of the residents.
- Rebuilding access roads that are damaged during hazards should be prioritized by the government to ensure quick recovery and accessibility.

Figure 26: *Suggested Way Forwards for Transportation*

7.2.3 Electricity and Communication System

- Ensuring an uninterrupted electricity supply throughout Savar Municipality is a primary demand of the residents, not only during hazards but also before and after hazard events.
- Establishing necessary infrastructure through government intervention is required to guarantee a consistent electricity supply.
- Placing power distribution infrastructure at elevated locations is crucial to prevent risks to human life, particularly during hazards like thunderstorms and lightning.
- Enhancing the weather forecasting system and establishing an efficient emergency communication network to disseminate timely alerts and updates during critical situations.
- Installing lightning resistors in suitable locations, as part of modern protective measures such as the British System, is essential for safeguarding residents from the dangers of thunderstorms and lightning.

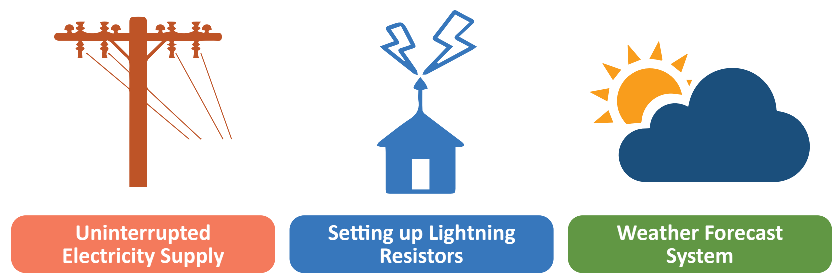

Figure 27: *Suggested Way Forwards for Electricity and Communication*

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8. CONCLUSION

The Climate Action Plan (CAP) presented in this report offers critical insights into local-level hazard vulnerabilities, highlighting the need for a shift in policy focus. While national-level hazard responses to climate change predominantly address coastal challenges such as sea level rises, storm surges, cyclones and floods, and inland challenges such as temperature increases and lack of rainfall leading to desertification, findings from this CAP reveal that urban residents in towns like Savar perceive hazards such as heatwaves, cold waves, and lightning as more threatening. One probable reason for this is that national-level hazard assessments often do not specifically consider urban areas, instead concentrating more on rural and coastal areas. These locally significant hazards often remain overlooked in broader national strategies.

This underscores the necessity for policymakers to adopt a people-centric approach that prioritizes local needs and perceptions. By identifying vulnerabilities specific to towns and integrating community-driven demands, decision-makers can develop hazard-resilient infrastructures and implement targeted interventions. The CAP serves as a crucial step toward creating adaptive, inclusive, and sustainable solutions for urban resilience, ensuring that no community's concerns are left unaddressed in the face of climate change.

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Annexures 1: Table and Graphs

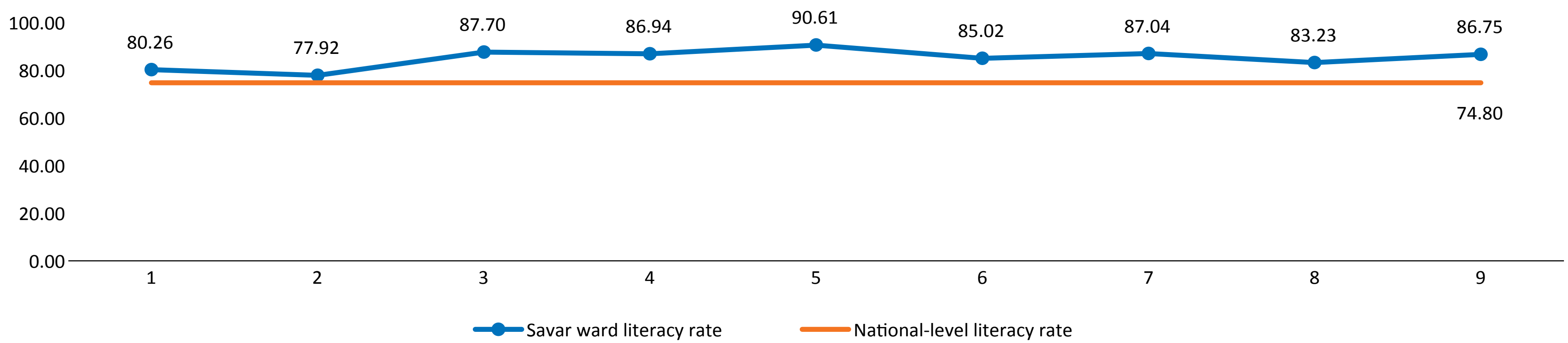

Figure 1: *Ward-wise literacy rate: National-level vs Savar Municipality*

Table 1: Drainage and waterlogging conditions by ward in Savar Municipality

Ward No.	Length of Drainage (Meter)				Outfall of the Drains	Waterlogging				
	Secondary Drain		Tertiary Drain			Locations	Duration (Hours)	When Occurs	How Occurs	Reasons
	Earthen	RCC/Brick	Earthen	RCC/Brick						
1	10	10		8	Bangsi River	Badda, vatpara, Nayabari	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
2	1	2		2	Bangsi River	Arapara to Nama Bazar	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains

Ward No.	Length of Drainage (Meter)			Outfall of the Drains	Waterlogging				
	Secondary Drain		Tertiary Drain		Locations	Duration (Hours)	When Occurs	How Occurs	Reasons
3		5	15	Bangsi River	Banpukur, Shabuj Bagh	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
4		1	5	Bangsi River	Bazar road to the registry office	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
5		1	10	Bangsi River	Bank Colony Total Area	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
6		2	10	Bangsi River & Dhaleshwari River	Razabari, katlapur	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
7	10	5	25	Turag River	Imandipur, Mazidpur, Shahibagh, Chapain road	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
8	5	2	20	Turag River	Rajashon	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains
9	7	1	10	Turag River	Anandapur, Nama Genda	1-2	During monsoon	Continuous rainfall	Irregular/no cleanup of drains, blockage created by waste disposal into man-made drains

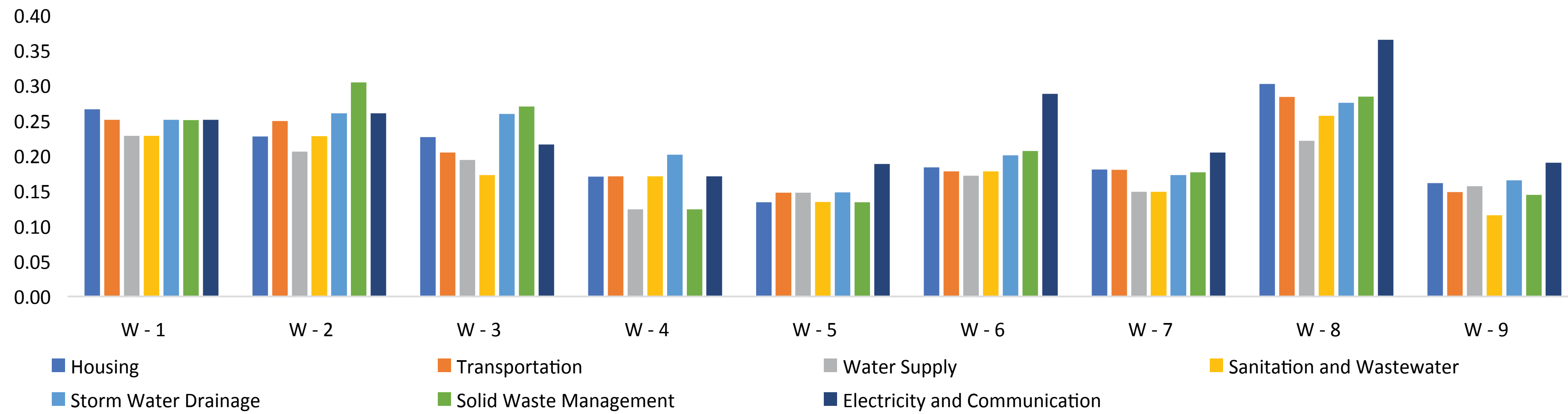

Figure 2: *Impact of Cyclone on Infrastructure and Urban Services across the Ward*

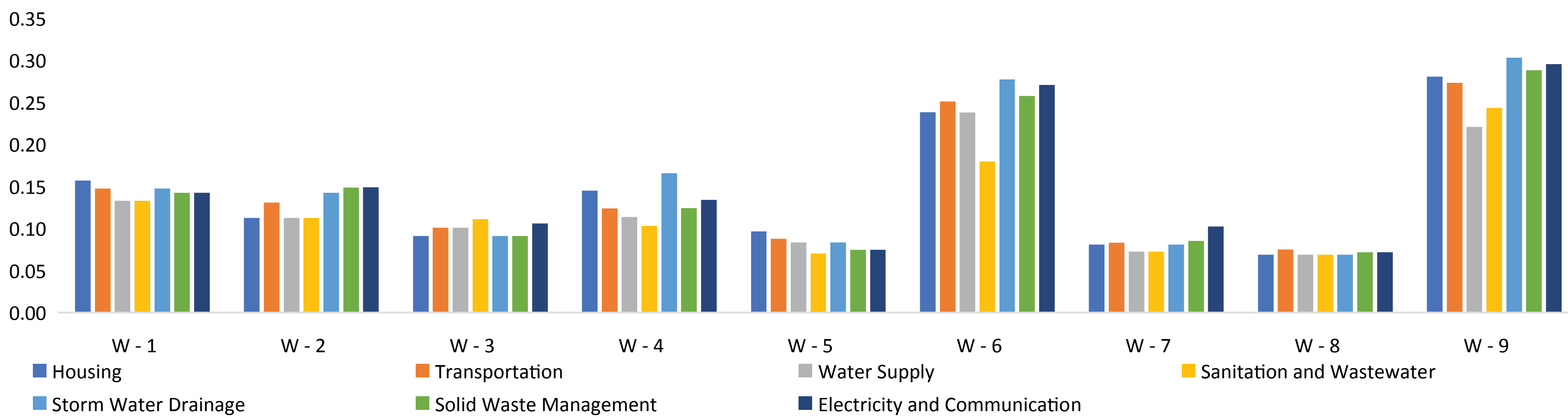

Figure 3: *Impact of Floods on Infrastructure and Urban Services across the Ward*

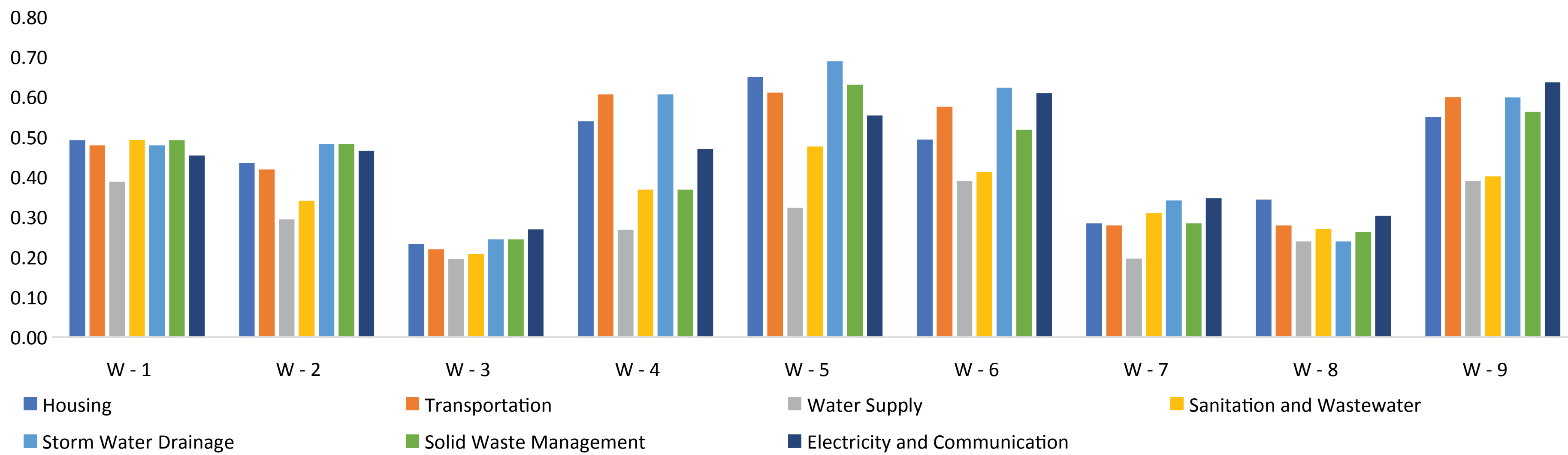

Figure 4: *Impacts of Heavy Rainfall and Water Logging on Infrastructure across the Ward*

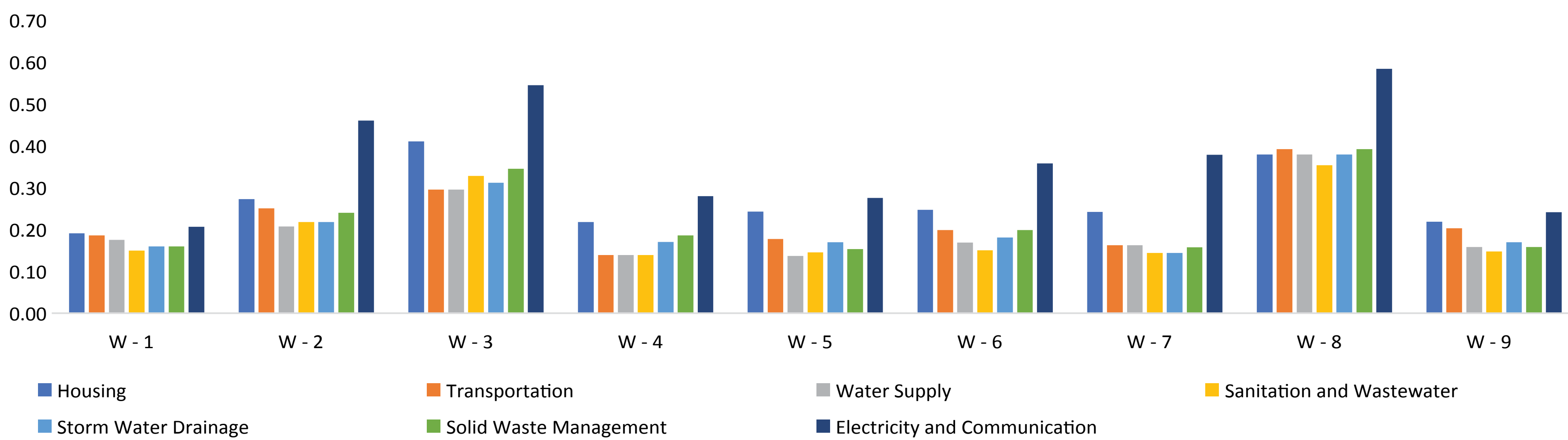

Figure 5: *Impacts of Thunderstorms on Infrastructure and Urban Services across the Ward.*

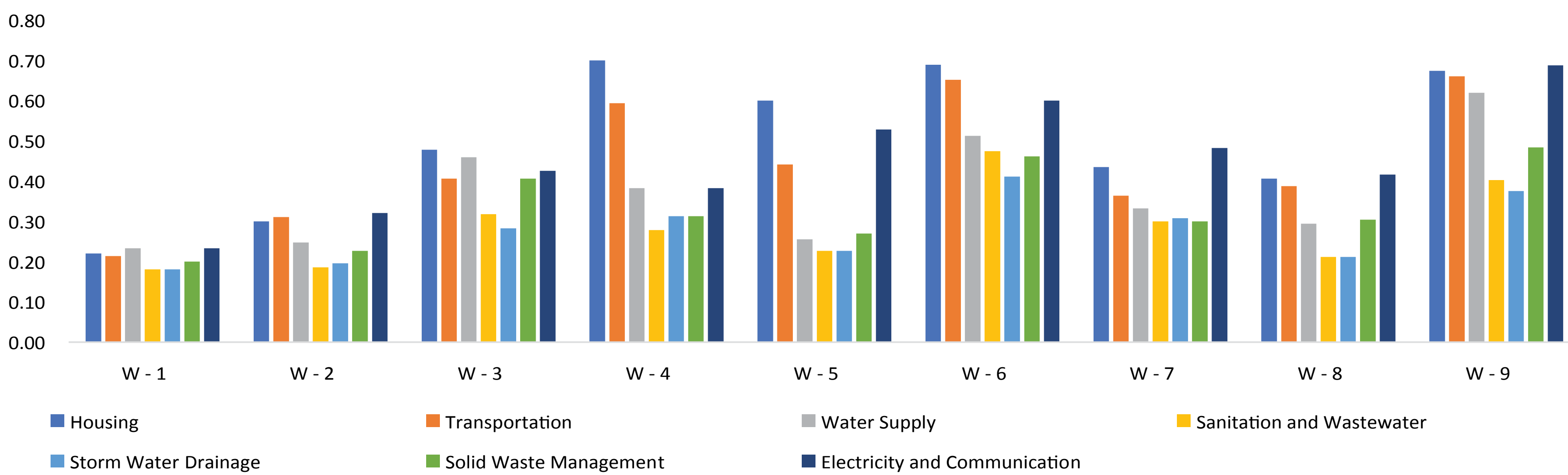

Figure 6: *Impacts of Heatwaves on Infrastructure and Urban Services across the Ward.*

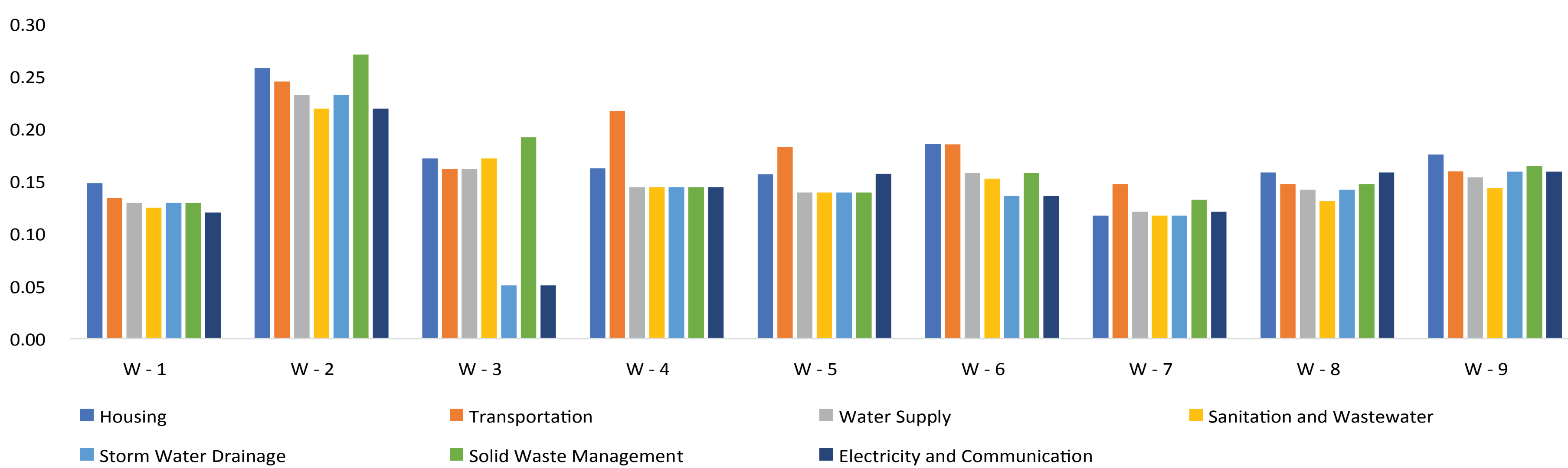

Figure 7: *Impacts of Coldwaves on Infrastructure and Urban Services across the Ward.*

Table 2: Ward Socio-economic Vulnerability Index of Savar Municipality

	Ward of Savar Municipality	1	2	3	4	5	6	7	8	9
Socio-economic Indicators	Population	0.55	0.11	0.42	0.00	0.35	1.00	0.98	0.42	0.57
	Density	0.43	0.13	0.57	0.00	0.32	1.00	0.75	0.27	0.39
	Housing Condition	1.00	0.00	0.14	0.20	0.75	0.14	0.36	0.30	0.20
	Literacy Rate	0.78	1.00	0.20	0.29	0.00	0.40	0.27	0.57	0.27
	Open Defection	1.00	0.00	0.37	0.02	0.45	0.30	0.55	0.24	0.91

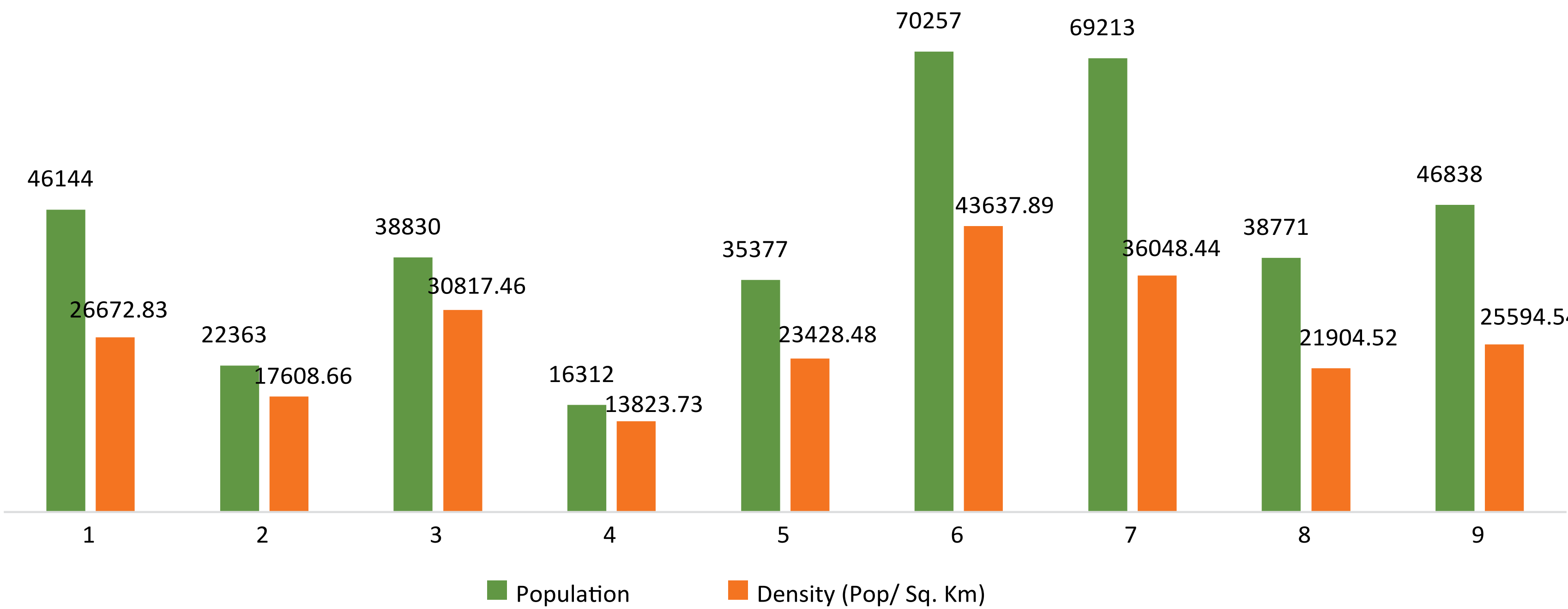

Figure 8: *Population and Density of Savar Municipality across the Ward.*

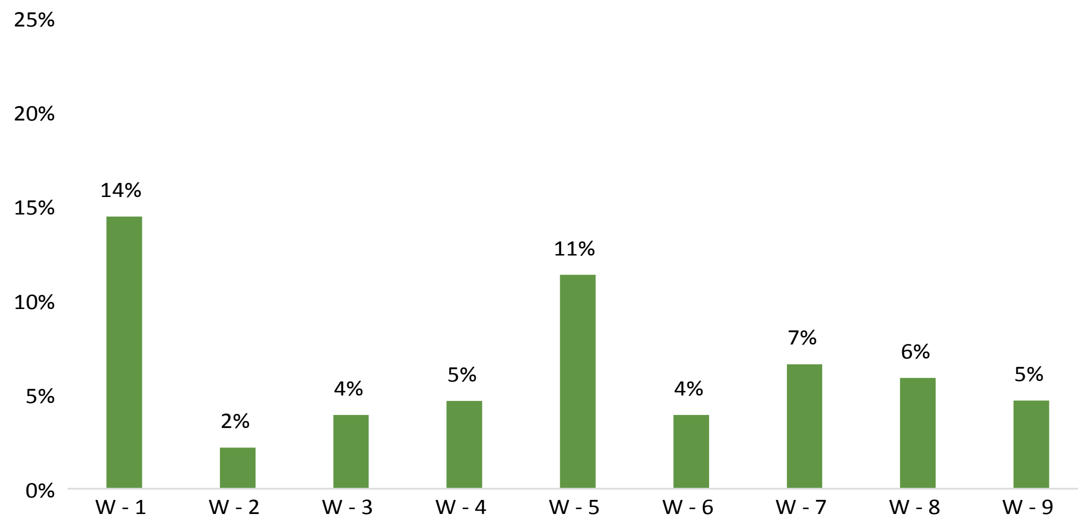

Figure 9: *Percentage of Kancha and Jhupri Structure across the Ward.*

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