# CRITICAL ASSESSMENT AND RECOMMENDATION OF REMEDIAL MEASURES ON DIMAPUR URBAN FLOOD

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# ABSTRACT

The urban flood management plan for Dimapur aims to address recurring flood events through a comprehensive approach. This abstract provides an overview of the plan, outlining its objectives, proposed measures, and expected outcomes. The plan encompasses immediate, short-term, and long-term strategies to effectively mitigate flood risks and promote sustainable development.

The introduction highlights the significance of urban flood management for Dimapur and emphasizes the need for proactive measures to protect lives, property, and the environment. The plan recognizes the importance of reducing vulnerability and ensuring the city's long-term resilience.

The proposal section focuses on key measures to manage floods in Dimapur. Immediate actions include the de-silting of drainage lines to prevent blockages and improve water flow. Short-term measures involve annual de-silting programs, removal of encroachments, slope stabilization in vulnerable areas, repair, construction, and maintenance of culverts, and the coverage of drainage lines. These measures aim to enhance drainage system efficiency, reduce vulnerability, and minimize flood risks.

For long-term flood management, the plan proposes measures such as establishing mandatory buffer zones, utilizing natural ponds and water retention areas, implementing a ban on plastic over five years, adopting phase-wise priority-based improvements in the drainage system (closed system), introducing a door-to-door waste collection system, enhancing waste processing capabilities, mandating rainwater harvesting in public buildings, and increasing permeable surfaces. These measures prioritize sustainability, environmental protection, and community engagement to build resilience against future floods.

In conclusion, the urban flood management plan for Dimapur emphasizes the importance of proactive measures, community participation, and sustainable practices in mitigating flood risks. Successful implementation of the proposed measures will enhance resilience, safeguard lives and property, and ensure sustainable development for the well-being of residents. The plan serves as a roadmap for creating a flood-resilient city, providing a safer and more prosperous future for Dimapur.

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# 1 INTRODUCTION

## 1.1 Context

Urban flood management is a critical aspect of urban planning and disaster risk reduction, aimed at mitigating the adverse impacts of floods on cities and their inhabitants. As cities like Dimapur in Nagaland continue to experience rapid urbanization and population growth, the risk of flooding becomes increasingly significant. It is essential to implement comprehensive urban flood management strategies to minimize the potential damages and ensure the safety and resilience of the city.

### 1.1.1 Importance of Urban Flood Management:

Urban flood management plays a vital role in protecting lives, property, and infrastructure in flood-prone urban areas. The following points highlight the importance of effective flood management for the city of Dimapur:

1. Risk Reduction
2. Infrastructure Resilience
3. Public Safety and
4. Economic Stability

### 1.1.2 Objectives of an Urban Flood Management Plan for Dimapur:

The following are some potential objectives that a flood management plan for Dimapur may encompass:

1. Create plans to limit the risks posed by floods in Dimapur, including locating flood-prone locations and taking action to lessen exposure to flood threats.
2. Improve the city's infrastructure by enhancing drainage systems, building flood control structures, and maintaining existing infrastructure to increase resilience to flood events.
3. Implement comprehensive waste management solutions to reduce garbage dumping in drainages and prevent blockages.
4. Establish excellent early warning systems for timely broadcast of flood alerts, and create comprehensive emergency response plans to enable rapid and coordinated action during flood disasters.
5. Encourage community engagement and understanding of flood risks, readiness, and response through educational campaigns, workshops, and public outreach programmes.
6. To reduce flood vulnerability, incorporate flood risk factors into urban planning processes such as land use zoning, construction standards, and development guidelines.
7. Adopt integrated water resource management approaches, such as efficient stormwater management, the preservation of natural drainage systems, and the promotion of green infrastructure solutions.
8. Foster collaboration among various stakeholders, including government agencies, community organizations, private sector entities, and residents, to ensure effective implementation and coordination of flood management strategies.

## 1.2 District Profile

### 1.2.1 History

The Dimapur district, which takes its name from the town of Dimapur, is significant historically since it served as the capital of the previous Dimasa Kachari dynasty. The dominant Kachari Kingdom, which belonged to the Dimasa ethnic group, established itself in Dimapur and built brick homes and temples there.

During World War II, Dimapur was significant as the Japanese started their U-Go offensive with the goal of conquering Dimapur and cutting off communication and supply routes to General Stilwell's soldiers in China. The railway and road connections became essential for supplies and reinforcements, and Dimapur played an important role as a staging area for Allied forces.

Dimapur's historical significance, megalithic remains, and association with World War II events make it a fascinating destination for history enthusiasts and tourists looking to experience the region's rich cultural legacy.


*Figure 1:Administrative Circle map of Dimapur (Source: GIS & Remote Sensing Centre, Nagaland)*

### 1.2.2 Overview

Dimapur district extends from west to east and is situated in the south-west portion of Nagaland.

This district and specially Dimapur city has a heterogeneous mix of people from across India, and one can say that it is a 'mini-India' in every sense of the word. Besides the dominant Naga tribes who comprise about 50% of the city's population, other prominent groups include Dimasas, Bengalis, Assamese, Oriyas, Nepalis, Biharis, Marwaris, Punjabis, Tamils and Keralites besides Bangladeshi immigrants. Being a fast-growing commercial hub, the last two decades have witnessed the inflow of Tibetan traders flocking into the city.

Topographically, Dimapur district can be classified into four categories:

(i) Plain areas,
(ii) Foot Hill areas,
(iii) High hill areas and
(iv) Plateau areas.

Dimapur, being a plain area, is hot and humid during the summer (reaching a maximum of 36°C, with humidity of up to 93%) while the winter months are cool and pleasant.

The average annual rainfall is 1504.7 mm.

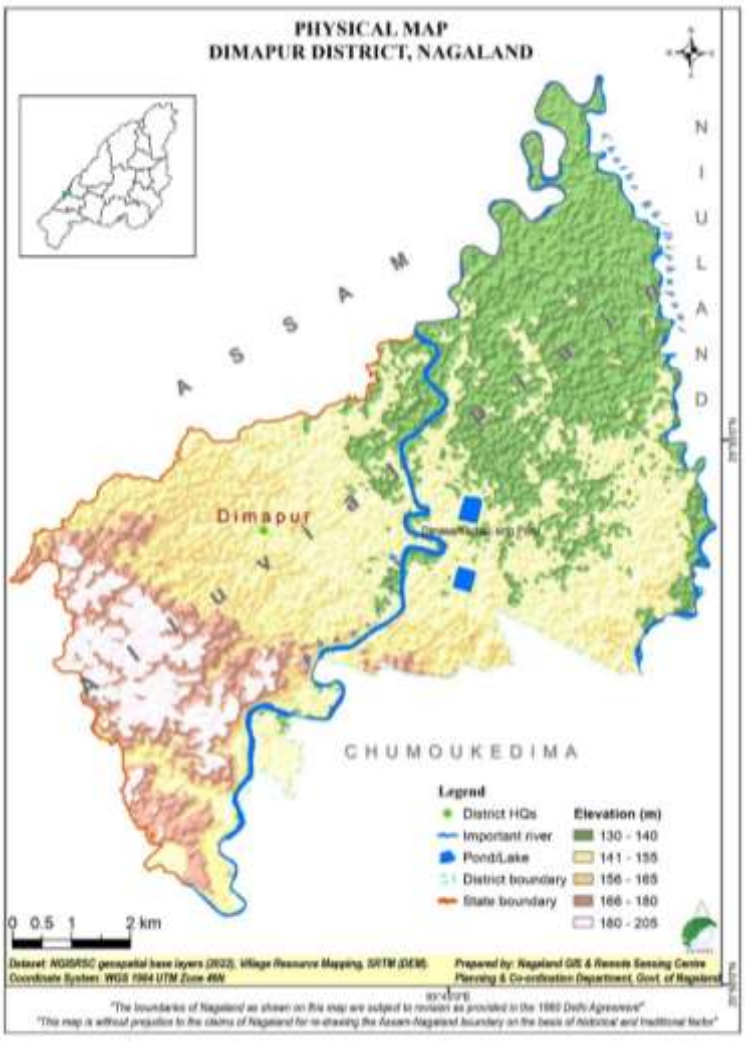


*Figure 2: Physical map of Dimapur District (Source: GIS & Remote Sensing Centre, Nagaland)*

## 1.3 Understanding Floods

### 1.3.1 Historical Perspective

India has a long history of floods, with accounts of major flood events documented in ancient texts and historical records. River valleys, such as those of the Ganges, Brahmaputra, Yamuna, and Krishna, have witnessed significant flood events throughout history.

Throughout Indian history, floods have played a role in the decline of civilizations. The Indus Valley Civilization experienced the abandonment of cities and disrupted agriculture due to changing river courses and devastating floods. During the Mughal era, major floods caused widespread destruction and economic setbacks.

In the colonial period, floods disrupted trade, agriculture, and infrastructure. Inadequate understanding of local hydrological systems led to embankment failures. These floods resulted in displacement, famines, and economic hardships. While floods were not the sole factor, they contributed to the decline of civilizations.

Ancient India showcased hydraulic engineering expertise with well-planned drainage systems and reservoirs like in Lothal. Post-independence, flood management integrated into national plans, led by the Central Water Commission. River valley projects such as Damodar Valley Corporation, Bhakra-Nangal, and Hirakud Dam regulated flows and provided flood protection. These advancements combined traditional knowledge with modern strategies for effective flood mitigation.

Over time, the approach to flood management in India has shifted from a focus on structural measures to a more holistic approach that includes non-structural measures like flood forecasting, early warning systems, community-based approaches, and integrated river basin management.

### 1.3.2 Factors Contributing to Floods

1. Monsoon Rainfall
2. River Systems
3. Cyclones
4. Topography
5. Deforestation
6. Climate change
7. Inadequate drainage system
8. Urbanization and Land Use changes

### 1.3.3 Flood Scenario in Nagaland

Nagaland's rich tribal heritage includes oral traditions and folklore that highlight the significance of floods. Indigenous communities have developed traditional water management practices, such as elevated platforms and stilted houses, to cope with floods. The government has implemented measures like embankments, drainage systems, and flood forecasting. Flood management approaches have evolved to include structural and non-structural measures, including community-based early warning systems and awareness campaigns.

# 2 FLOOD DIAGNOSTICS

## 2.1 Introduction to Urban Dimapur

Dimapur, a city located in the state of Nagaland, India, is characterized by diverse geographical features and a network of streams and drainage systems. Situated in the plains of the Brahmaputra River basin, Dimapur enjoys a relatively flat topography with gentle slopes.

The city is traversed by several streams and rivers, including the Dhansiri River. These streams, along with their tributaries, contribute to the overall drainage pattern of the city.

The drainage systems in Dimapur play a crucial role in managing rainwater runoff and preventing waterlogging during the monsoon season. Efforts have been made by the local administration to develop and maintain effective drainage infrastructure to ensure proper water flow and mitigate the risk of urban flooding.

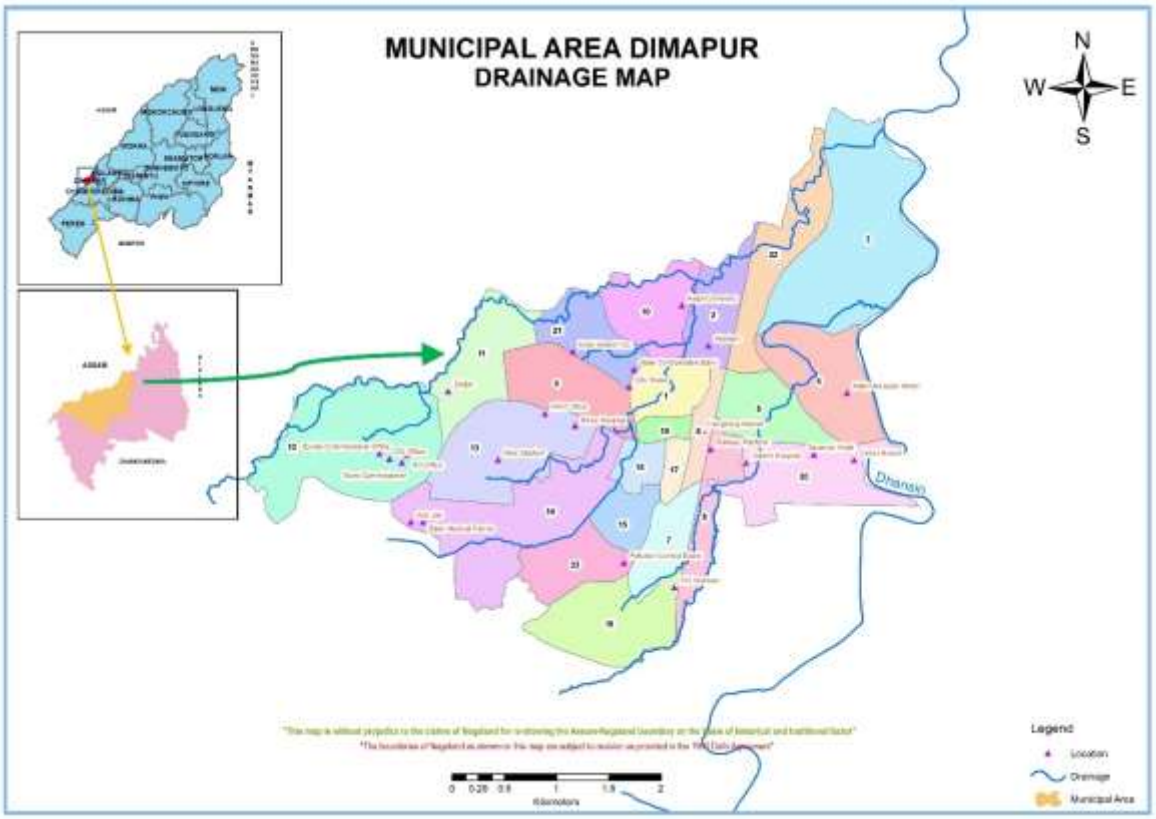


*Figure 3: Drainage Map of Dimapur (Source: Dimapur Municipal Office)*

## 2.2 Past & Recent Flood events

The following are some of the past flood incidents recorded in Dimapur:

| Year | Areas Affected | Remarks |
|---|---|---|
| 2022 | Dimapur | Flash floods and water logging |
| 2019 | Dimapur | 3 people dead & 13 areas submerged |

| | | |
|---|---|---|
| 2008 | Dobhinalla, Super Market, Nagarjan, Burma Camp, Walford, Sachu Colony, Nagagaon, Khermahal, Netaji Colony, Naharbari and Airport Area | Different colonies of Dimapur Town remained submerged during 11th - 24th September 2008 |

*Table 1: Past Flood Events*

No. of affected people due to urban floods in Dimapur (2021-22) – 1265

Dimapur continues to face significant challenges with heavy floods during the monsoon season, causing disruptions to various aspects of the city. The magnitude of these floods has been overwhelming, and despite the efforts of the government, the scale of the problem often surpasses their capacity to effectively handle and mitigate the impact.

The recurrent floods in Dimapur pose a significant threat to the normal functioning of the city, affecting infrastructure, public services, and the overall well-being of its residents.

*Figure 4: Submerged areas due to floods in Dimapur, June 12,2023 (Source: Nagaland Post)*

## 2.3 Drainage System of Dimapur

The city of Dimapur relies on three primary nullahs, namely Hospital Nullah, Dhobi Nullah, and Lengrijan Nullah, as the main drainage system. These nullahs serve the purpose of carrying wastewater from various parts of the city and channeling it to the Dhnasiri River. However, over the years, these nullahs have become vulnerable to several issues, including severe garbage dumping and excessive vegetation growth.

The open nature of these nullahs makes them particularly susceptible to the accumulation of garbage and debris, obstructing the flow of water during heavy rains. The indiscriminate dumping of waste and lack of proper waste management practices have contributed to the worsening condition of the nullahs. Additionally, uncontrolled vegetation growth along the banks of the nullahs further restricts the water flow and increases the risk of blockages.

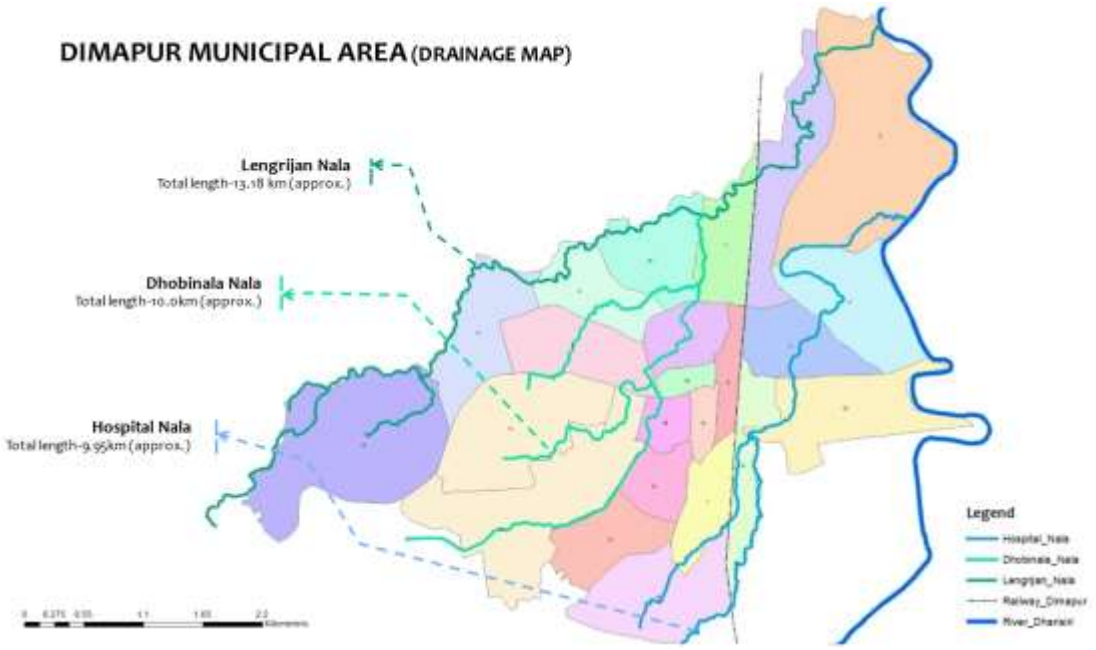


*Figure 5: Important Nullahs in Dimapur*

The Hospital Nullah, originating from the Army Supply Road and joining the Dhansiri River near the CP Office and Police Colony, plays a critical role in draining water from surrounding areas. However, blockages in this nullah have been identified as a major cause of flooding in Burma Camp, Bank Colony, and Nagarjan areas. Addressing and preventing blockages in the Hospital Nullah is essential to mitigate flooding risks in these vulnerable areas.

The Dhobi Nullah, starting from downstream areas of Sachu Colony like Signal Bosti, merges with the Lengrijan Nullah after the Holy Cross point, near NST Garage. This nullah encompasses several important connection points that traverse the heart of the city. It is crucial to address blockages along these lines to effectively control floods and ensure proper water flow within Dimapur.

The Lengrijan Nullah initiates from parts of Lower Lengrijan and converges with the Dhansiri River near the top of Burma Camp ward. Running along the border of Assam and Nagaland, this nullah passes through areas where several slums are situated. Incessant rains and blockages in this nullah often result in severe flooding, posing a significant challenge for the affected slum communities. Implementing measures to prevent blockages and improve the drainage capacity along the Lengrijan Nullah is vital to safeguard these vulnerable areas from flooding incidents.

## 2.4 Identification of Flood-prone areas

| Time/Period of Occurrence | Potential Impact | Vulnerable areas |
|---|---|---|
| May to September | Damage to houses, roads, fields, vegetation and other infrastructure Loss of life, crops, community and livestock | Dhobinala, Burma camp Area, New Market Area, Bank Colony, Walford Area, Super Market Area, Nagarjan Area, Khermahal |

| | | |
|---|---|---|
| | | Area, Netaji Colony, Rail Colony, Niu Colony, Riverbelt Colony, Zeliangrong Colony, Sachu Colony, Police Colony, Holy Cross Area, Lengrijan |

*Table 2: Vulnerable Areas of Dimapur*

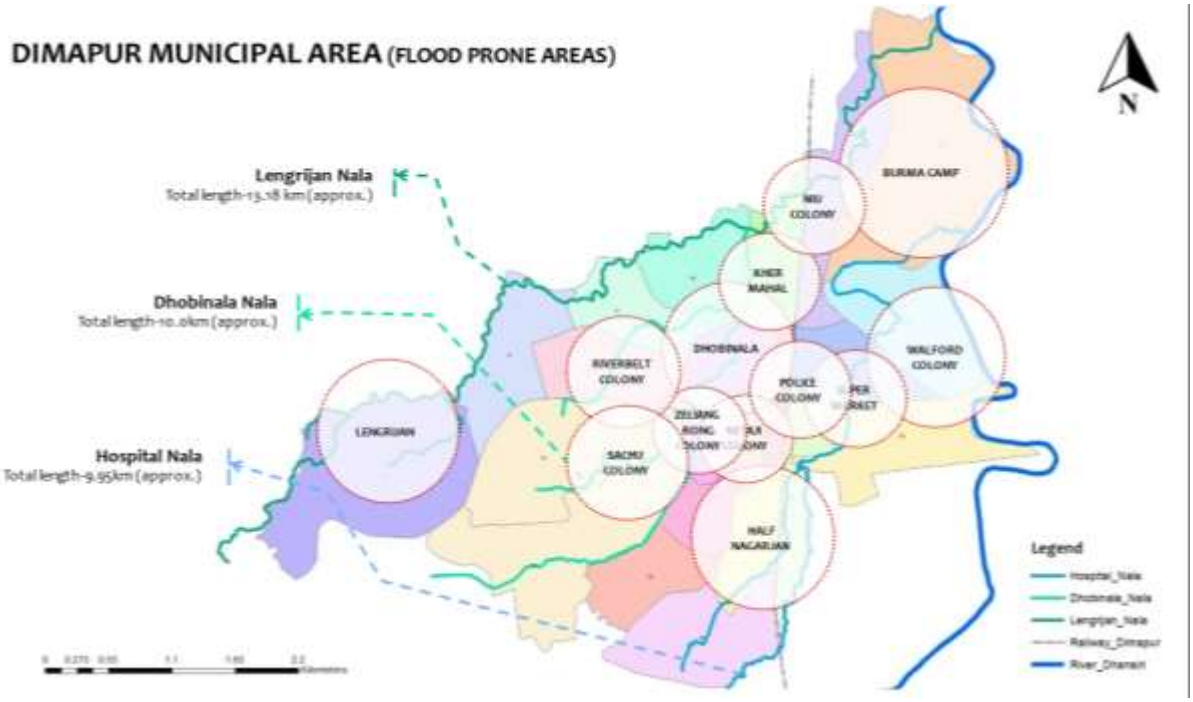


*Figure 6: Areas prone to Flood risk in Dimapur*

## 2.5 Impacts of Urban floods in Dimapur

### 1. Social Impacts:

- Disruption of normal life and social activities.
- Psychological distress and trauma among affected individuals.
- Disruption of education and healthcare services.

### 2. Economic Impacts

- Damage to businesses, commercial establishments, and infrastructure.
- Reduction in economic productivity and growth.
- Increased financial burden on individuals and the government for recovery and rehabilitation efforts.

### 3. Environmental Impacts:

- Contamination of water sources and degradation of water quality.
- Soil erosion and loss of fertile agricultural land.
- Disruption of ecological balance and biodiversity loss.

### 4. Infrastructural Impacts:

- Damage to roads, bridges, culverts, and drainage systems.
- Disruption of transportation networks and decreased accessibility.
- Flooding of residential areas, schools, hospitals, and public buildings.
- Interruption of utilities such as electricity, water supply, and communication networks.

**5. Property Loss:**

- Damage to houses, buildings, and infrastructure.
- Destruction of personal belongings, furniture, and assets.
- Decrease in property value and increased insurance claims.

**6. Health and Safety:**

- Exposure to contaminated water, debris, and hazardous materials.
- Risk of injuries, accidents, and drowning during flood events.
- Poor sanitation and hygiene conditions leading to health risks.

**7. Displacement and Livelihood Loss:**

- Forced evacuation and temporary or long-term displacement of residents.
- Loss of agricultural crops and livestock, impacting rural communities.
- Disruption of livelihoods, particularly for daily wage earners and small-scale farmers.

# 3 VULNERABILITY FACTORS

## 3.1 Physical Vulnerability

- No. of urban households in Dimapur Municipal Corporation – 42100 (**53.5%** of total district households)

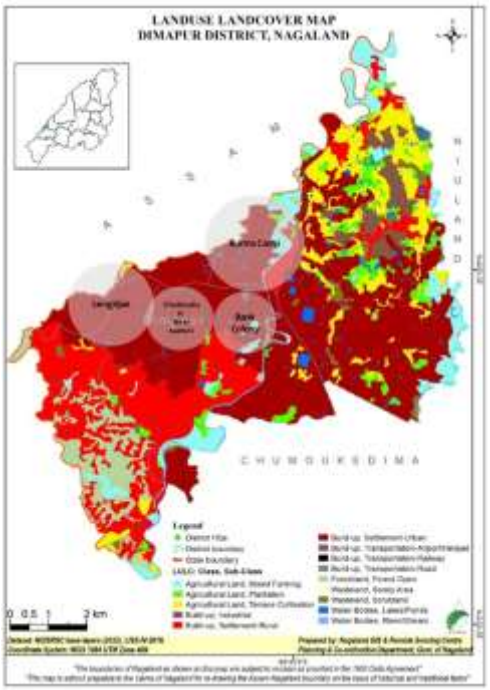


*Figure 7:LULC Map showing high concentration of urban settlement in vulnerable areas (Source: GIS & Remote Sensing Centre, Nagaland)*

More than half of the households in the district are located in the urban areas of Dimapur Municipal Corporation which makes it more vulnerable to the floods.

- Only **57%** of the structures located in Dimapur Municipal Corporation area re permanent structures, which can depict the extreme vulnerability of the buildings to floods.

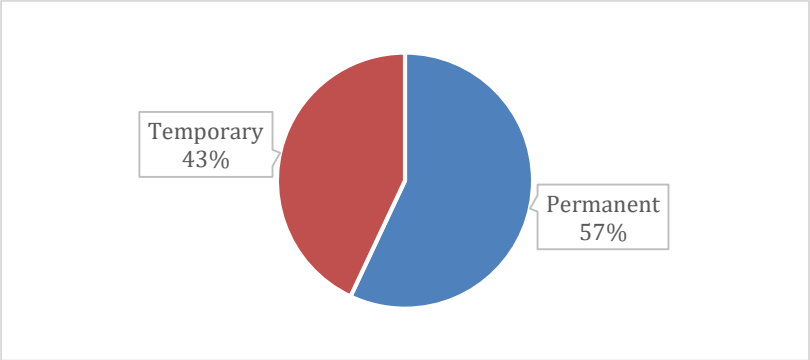


*Figure 8: % of permanent structures in Dimapur MC (Source: Census 2011)*

- SEWERAGE SYSTEM

| TYPE | % OF HOUSEHOLDS |
|---|---|
| Piped Sewerage System | 10.4% |
| Septic tanks | **74.2%** |

*Table 3:Statistics of Sewerage system in Dimapur MC (Source: Census 2011)*

Around 75% of sewerage goes into septic tanks, which are prone to overflow during obstructions and may exacerbate flood severity.

- WASTE WATER MANAGEMENT SYSTEM

| OUTLET TYPE | % OF HOUSEHOLDS |
|---|---|
| Closed Drainage | 16.9% |
| Open Drainage | **65.4%** |
| No Drainage | **17.7%** |

*Table 4: Waste water Outlet types in Dimapur MC (Source: Census 2011)*

Almost 80% of the waste water drainage system is either open drainage or has no drainage. This emphasises the critical necessity to upgrade the city's drainage infrastructure to a closed system.

## 3.2 Social Vulnerability

- Percentage of population in Dimapur MC – 1,22,834 (**32.5%** of total district population)

The significant proportion of the district population residing in the municipal area of Dimapur, accounting for almost 35%, indicates that a majority of the population lives in flood-prone urban areas. This concentration of residents in flood-prone zones poses significant challenges and highlights the vulnerability of the population to flood events.

- Percentage of working population in Dimapur MC – 43,734 (only **35.5%**)

The high dependency ratio in the municipal area of Dimapur, where only 35% of the population is engaged in formal employment, leaves a significant portion of the population socially and economically vulnerable, particularly in the face of floods. This situation indicates that a large number of individuals rely on the working population for their livelihoods and basic needs.

- The percentage of owned houses in Dimapur MC is only **26.6%**

The low rate of homeownership in Dimapur, where only 26% of houses are owned, highlights the economic vulnerability of the population, particularly in the event of floods. During flood events, rented or informal housing may lack the necessary structural resilience and protective measures to withstand the destructive forces of water. As a result, the occupants of these houses face a higher risk of property damage and displacement.

- Density of population living in urban Dimapur

The contrast of the two photos below, the first from 2018 and the latter from 2023, demonstrates the city's rapid urbanisation.

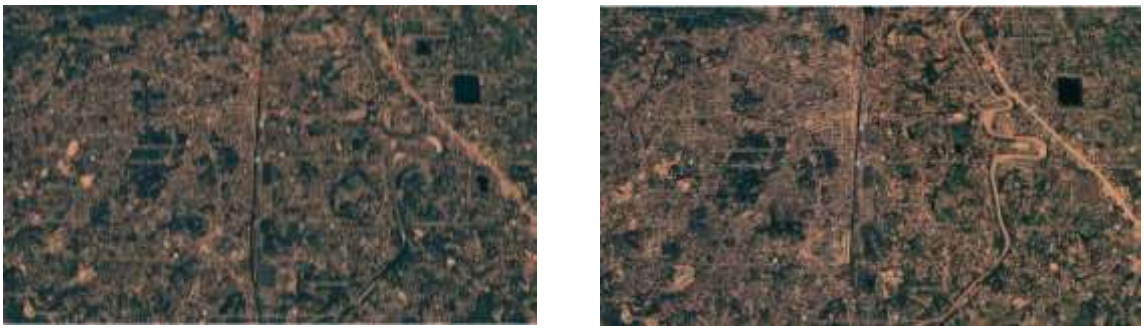

*Figure 9:Image showing the growth in urban density around the vulnerable areas (2018 & 2023)*

## 3.3 Environmental Vulnerability

Dimapur faces environmental vulnerabilities to urban floods due to its topography, deforestation, encroachment of water bodies, inadequate drainage infrastructure, climate change impacts, and ecological degradation. These factors contribute to the city's susceptibility to flooding, leading to social, economic, and infrastructural impacts. Addressing these vulnerabilities requires sustainable land use, reforestation, improved drainage systems, and climate change adaptation.

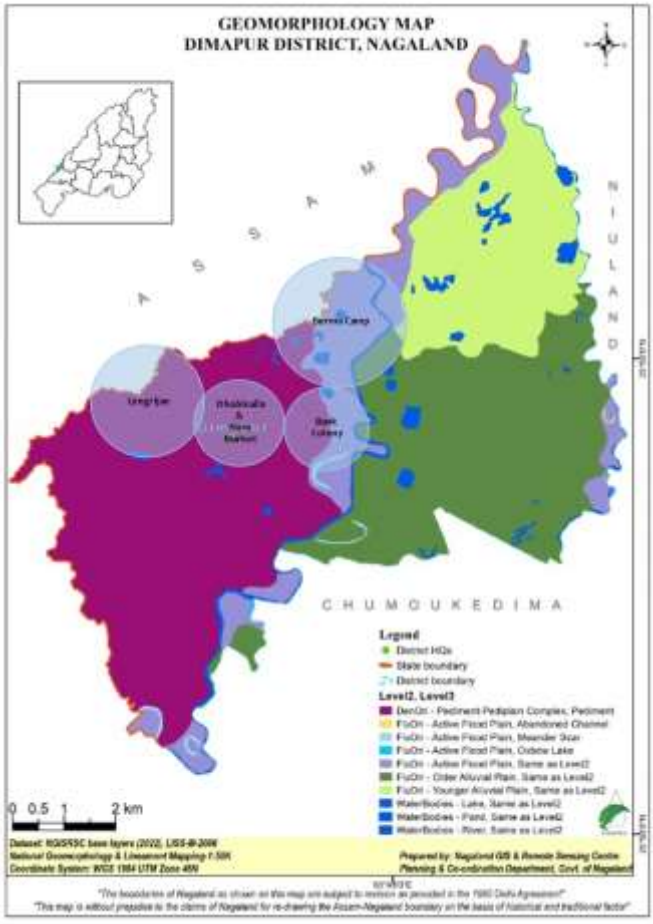


*Figure 10:Geomorphology map of Dimapur District (Source: GIS & Remote Sensing Centre, Nagaland)*

The accompanying map demonstrates that, while two of the locations, Burma Camp and Bank Colony, are regularly flooded due to their location in the Dhansiri River flood plain, the rest areas are flooded due to urbanisation and climate change consequences.

# 4 CONCERNING FACTORS

## 4.1 Impact of Climate Change

The impact of climate change on urban floods in Dimapur is a growing concern. Here are some key impacts of climate change on urban floods:

1. Increased Intensity and Frequency of Rainfall
2. Altered Rainfall Patterns and Seasonality
3. Increased Urban Heat Island Effect

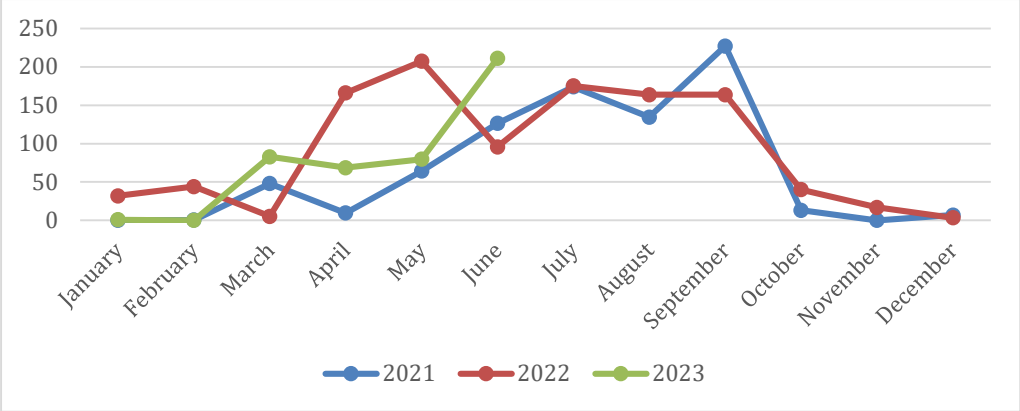


*Figure 11: Cumulative Rainfall Data of Dimapur (2021-2023)*

The above image depicts the increased rainfall in the months of May to September in the years 2021-23.

## 4.2 Impact of Urbanization & Land Use changes

Urbanization and land use changes have significant impacts on floods. Here are some key effects:

1. Increased Surface Runoff
2. Loss of Natural Water Storage
3. Encroachment
4. Urban Drainage System Capacity
5. Inappropriate waste management system

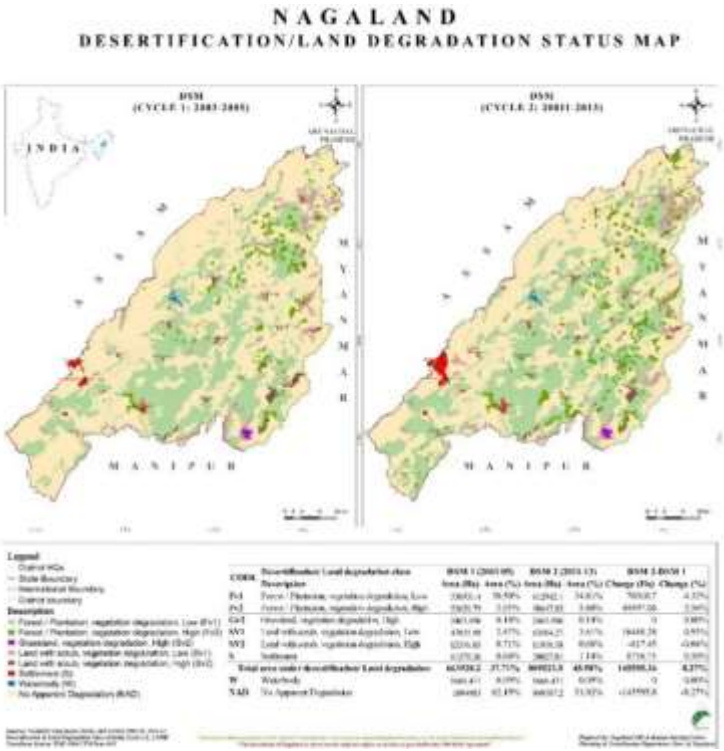


*Figure 12: State Desertification/Land Degradation status map of Dimapur (Source: GIS & Remote Sensing Centre, Nagaland)*

The above map depicts the extent of urbanization in Dimapur and therefore highlighting all the above discussed impacts on urban floods.

## 4.3 Poor Sewerage & Waste Management

Improper disposal of solid waste, such as plastics, paper, and other debris, can lead to the blockage of drains, culverts, and stormwater channels. When drains are clogged with waste, rainwater cannot flow freely, resulting in water accumulation and increased flood risk during heavy rainfall events.

Inadequate waste management can result in sewage backups and overflow, especially during heavy rains. When sewage systems are overwhelmed, wastewater can backflow into streets, homes, and other urban areas, causing not only health hazards but also exacerbating flood risk.

*Figure 13: Pictures showing heavy garbage dumping in the drainages of Dimapur*

*Figure 14: Images showing the growth of vegetation in the drainages of Dimapur*

*Figure 15: Images showing encroachment on the drainages of Dimapur*

As a result, some of the major issues causing the floods are:

1. Garbage disposal through drains
2. Development of vegetation
3. Encroachment
4. A lack of maintenance
5. Non-existent infrastructure

# 5. FLOOD MANAGEMENT STRATEGIES

This chapter provides a comprehensive framework for effective flood management, combining both structural and non-structural approaches. It aims to minimize the occurrence of floods, enhance preparedness and response capabilities, and promote sustainable urban development in flood-prone areas.

## 5.1 Immediate Measures

- **Proposal 1: De-silting of drainage lines on priority basis**
  - Implementation Plan:

STEP-1 (Assessment)

- Identify the completely blocked sections of the drainage lines

STEP-2 (Resource Allocation)

- Allocate the necessary resources such as manpower, equipment, and cleaning materials for the task.
- Determine the budget and secure necessary funding for the cleaning operation.

STEP-3 (Prioritization)

- Prioritize the blocked sections based on the severity of the blockage and the potential impact on the surrounding areas.
- Give higher priority to areas prone to flooding or areas that pose risks to public health and safety.

STEP-4 (Clearing Operation)

- Remove garbage, debris, and vegetation obstructing the drainage lines manually or using mechanized equipment like excavators or jetting machines.
- Ensure proper disposal of the cleared waste in designated locations.

STEP-5 (Regular Maintenance)

- Implement a regular maintenance schedule to prevent future blockages.
- Educate the public about the importance of proper waste disposal to prevent blockages.

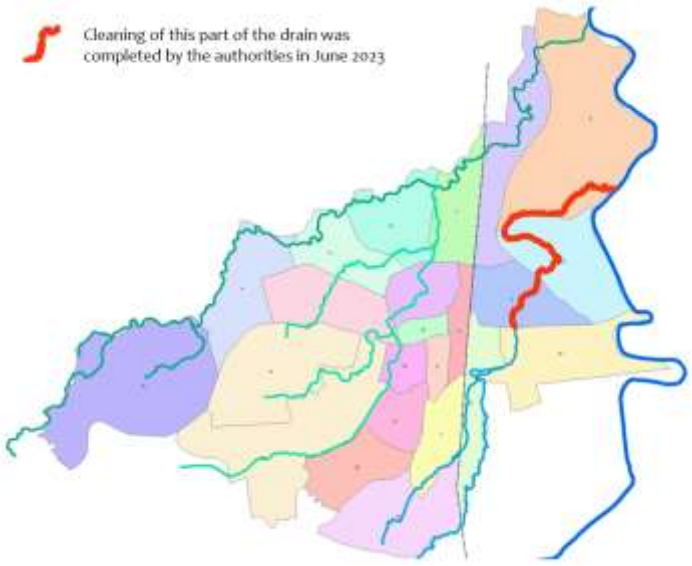


*Figure 16: Figure showing the already cleaned part of Nullah by the DMC in June 2023*

## 5.2 Short-term Measures

- **Proposal 2: Annual Pre-Monsoon De-Silting Program**

Implementing annual de-silting of drains before May 31st brings several benefits to Dimapur:

- Prevent flooding: De-silting the drains annually helps to remove accumulated sediment, debris, and obstructions. This ensures that the drainage system has sufficient capacity to handle excess water during the monsoon season, reducing the risk of flooding in low-lying areas and flood-prone zones.
- Protect infrastructure: Regular de-silting prevents blockages in the drainage network, safeguarding critical infrastructure such as roads, bridges, and buildings from water damage. By maintaining clear drains, the structural integrity of infrastructure assets is preserved, reducing maintenance costs and ensuring their longevity.
- Efficient water flow: De-silting the drains facilitates efficient water flow, enabling the proper discharge of rainwater into natural waterways or retention ponds. This helps to maintain the overall functionality of Dimapur's drainage systems, preventing the accumulation of stagnant water and minimizing the adverse impacts of prolonged flooding.

*Figure 17: Pictures of the recent De-silting Program taken up by DMC, June 2023 (Source: Dimapur Municipal Corporation)*

- **Proposal 3: Encroachment Removal and Restoration Initiative**
  - Implementation Plan

STEP-1 (Survey & Identification)

- Conduct a survey of the drainage lines to identify encroachments. This can involve visual inspections, mapping, and documentation of encroachments along the drainage network.

STEP-2 (Legal & Regulatory Assessment)

- Review local laws, regulations, and building codes related to encroachments on drainage lines.
- Determine the legal authority responsible for addressing encroachments and the processes involved in their removal.

STEP-3 (Notification)

- Notify the owners or occupants of the encroaching structures or properties about the violation and the need for removal.

STEP-4 (Alternative Solutions)

- Explore alternative solutions, such as providing incentives for voluntary removal or relocation of encroachments.

STEP-5 (Enforcement & Removal)

- Coordinate with relevant authorities, such as local government bodies, law enforcement agencies, and the municipal corporation, to enforce the removal of encroachments.
- Employ appropriate methods for removing encroachments, which may include demolition, dismantling, or relocation of structures.

- **Proposal 4: Slope Stabilization in vulnerable areas**

Implement measures to stabilize embankments along rivers and streams in Dimapur through dredging, slope stabilization, and erosion control.

This proposal aims to reduce flood risk, protect infrastructure, and preserve the environment. It involves identifying vulnerable areas, designing engineering solutions, engaging the community, forming partnerships, and establishing maintenance and monitoring protocols. By implementing these measures, Dimapur can safeguard against erosion, minimize flooding, and promote long-term cost savings while preserving the ecological balance of its waterways.

Common stabilization measures include:

- Slope vegetation: Establish vegetation cover to enhance slope stability by improving soil cohesion and reducing water runoff.
- Retaining walls and geosynthetics: Install retaining walls or use geosynthetic materials like geotextiles, geogrids, or geomats to reinforce the slope and provide stability.
- Grading and terracing: Modify the slope geometry through grading and terracing to reduce the slope angle and enhance stability.

*Figure 18: One good example of where slope stabilization can be done*

- **Proposal 5: Culvert Restoration and Construction Program: Enhancing Drainage Infrastructure for Dimapur's Flood Resilience**

  - REVITALIZING EXISTING CULVERTS FOR EFFICIENT WATER FLOW

- Clear debris and vegetation from the culvert and its surrounding area.
- Repair or replace damaged culvert components, such as corroded pipes, deteriorated concrete, or faulty joints.
- Reinforce weak or unstable sections using suitable materials, techniques, and structural supports.
- Ensure proper alignment and connectivity of the culvert to the drainage system.

  - EXPANDING DRAINAGE INFRASTRUCTURE THROUGH NEW CULVERT CONSTRUCTION

Identify the culverts that cannot be repaired or the sites where new culverts may be required, and begin the building and maintenance process.

*Figure 19; Existing culvert in the Walford area that has to be improved because it is extremely close to the road surface*

- **Proposal 6: Drainage lines covering initiative**

The proposed initiative to cover drainage lines in Dimapur is crucial to prevent garbage dumping and enhance flood resilience. Uncovered drainage lines are vulnerable to misuse, leading to blockages and increased flood risks. By covering the lines, we create a barrier that restricts unauthorized access and prevents garbage accumulation. This proactive measure ensures smooth water flow, reducing flood hazards and promoting a cleaner environment for the well-being of residents.

  - Implementation Plan

STEP-1

- Identify areas prone to garbage dumping or litter accumulation, such as marketplaces, commercial zones, or crowded public spaces.

STEP-2

- Select suitable materials for the slabs and lids, considering factors like durability, load-bearing capacity, resistance to weathering, and ease of maintenance.

STEP-3

- Launch public awareness campaigns to educate residents, businesses, and visitors about the importance of not dumping garbage into the drainage lines.

*Figure 20: Examples of drains that need covering to prevent garbage dumping*

## 5.3 Long-term Measures

- **Proposal 7: Implementing Mandatory Buffer Zones for Dimapur's Nullahs**

- Implementing a mandatory buffer zone (0.75 – 3.0 meters) along drainage lines involves defining the width of the zone and incorporating it into regulatory frameworks and policies.
- Land use plans and zoning regulations should be updated to include buffer zone requirements, restricting certain activities within the designated zone.
- Effective enforcement mechanisms are necessary to ensure compliance with buffer zone regulations, including regular inspections and appropriate penalties for violations.

- **Proposal 8: Utilizing Natural Ponds and Water Retention Areas for Rainwater Storage**

- Using natural ponds and water retention areas to store excess rainwater is an environmentally friendly approach to managing stormwater runoff.
- Proper identification and assessment of suitable areas are crucial for effective implementation.
- Regular maintenance, monitoring, and community engagement play vital roles in sustaining the functionality and ecological value of these water retention areas.


*Figure 21: Location and condition of an ancient natural pond in Dr. Haralu Colony*

The pond seen above can be cleaned of vegetation that has grown over years so that it can be utilised to store excess rain water in the area, preventing flooding.

- **Proposal 9: Plastic-Free Dimapur: Implementing an Ambitious Five-Year Plan for a Sustainable, Plastic-Free City**

  - PUBLIC AWARENESS AND EDUCATION:
    - Launch extensive public awareness campaigns to educate the population about the negative impacts of plastic and the benefits of the ban.
    - Promote alternative eco-friendly options and sustainable practices.

  - PHASE-OUT STRATEGY
    - Implement a phased approach to gradually eliminate specific categories of plastic products.
    - Prioritize single-use plastics, such as bags, straws, cutlery, and disposable packaging, as the initial targets for the ban.
    - Provide sufficient time for businesses and consumers to adapt to alternative materials and practices.

- **Proposal 10: Phased Approach for Priority-Based Improvement: Enhancing Dimapur's Drainage System through a Closed System Design**

- Phased approach: Implementing improvements in a step-by-step manner to enhance Dimapur's drainage system.
- Priority-based focus: Giving priority to areas most susceptible to flooding to address immediate drainage issues effectively.
- Transition to closed system design: Constructing closed conduits or underground pipes to minimize external factors such as garbage dumping and vegetation growth that can cause blockages.
- Efficient water conveyance: Improving water flow efficiency within the closed system design for better flood mitigation.
- Enhanced maintenance practices: Facilitating easier maintenance through regular cleaning, desilting, and inspection within the enclosed conduits to minimize the risk of blockages and ensure proper functioning.

- **Proposal 11: Door-to-Door Waste Collection System**

- Efficient waste collection: Implementing a door-to-door waste collection system to ensure efficient and regular waste collection from residential areas.
- Improved waste management: Enhancing waste management practices by promoting segregation at source and providing separate collection bins for different types of waste, such as recyclables and organic waste.
- Reduction of open dumping: Minimizing open dumping of waste by facilitating doorstep collection, thereby reducing environmental pollution and health hazards.
- Increased recycling rates: Encouraging residents to separate recyclable materials through the door-to-door collection system, leading to higher recycling rates and reduced landfill usage.
- Community engagement: Promoting community participation and awareness through education campaigns to foster a sense of responsibility and encourage active involvement in waste reduction and proper disposal practices.

- **Proposal 12: Enhanced Waste Processing Systems**

- Enhanced waste processing infrastructure: Upgrading waste processing facilities to improve their capacity, efficiency, and technology for faster and more effective waste disposal.
- Sustainable waste management: Implementing environmentally friendly waste processing methods, such as composting, anaerobic digestion, and recycling, to minimize the environmental impact of waste and promote resource recovery.
- Reduction of landfill usage: Focusing on diverting waste from landfills by maximizing waste processing capabilities. This reduces the burden on landfills and helps protect the environment from potential pollution risks.
- Integration of advanced technologies: Adopting innovative waste processing technologies, such as waste-to-energy systems, to harness the energy potential of waste and reduce reliance on fossil fuels.
- Compliance with environmental regulations: Ensuring waste processing systems adhere to strict environmental regulations and standards to safeguard the environment, minimize emissions, and protect public health.

- **Proposal 13: Mandatory Rainwater Harvesting for Public Buildings in Dimapur Municipal Corporation**

- All public buildings within the DMC shall undertake rainwater harvesting within a period of five years, by the year 2028.
- This includes government offices, educational institutions, hospitals, community centres, and other public facilities.
- The MC shall establish a monitoring mechanism to ensure compliance with the rainwater harvesting mandate.

- Regular inspections will be conducted to verify the installation and functioning of rainwater harvesting systems in public buildings.
- Non-compliance may result in penalties or sanctions.

- **Proposal 14: Increasing Permeable surfaces in the city of Dimapur**
  - CONSTRUCTION OF PERMEABLE PAVEMENTS

The objective of this part of the proposal is to increase the use of permeable pavements in Dimapur, which will enhance water drainage and reduce stormwater runoff. Permeable pavements allow rainwater to infiltrate into the ground, minimizing the strain on drainage systems and mitigating the risk of urban flooding.

*Figure 22: Example of a permeable pavement*

  - MANDATORY PERMEABLE SURFACES IN PUBLIC BUILDINGS

The objective of this part of the proposal is to make it mandatory for public buildings in Dimapur to have a certain percentage of permeable surfaces. This will further contribute to improved water drainage, groundwater recharge, and reduced stormwater runoff.

## 6. CONCLUSION

In conclusion, the flood management plan for Dimapur addresses the pressing need for proactive measures to mitigate the frequent flood events that have been plaguing the city. The plan emphasizes the importance of comprehensive strategies to tackle the identified challenges, including garbage disposal in drains, vegetation growth, encroachment, lack of maintenance, and inadequate infrastructure.

By implementing the proposed measures, such as improving waste management practices, implementing regular vegetation maintenance, enforcing land-use regulations, enhancing maintenance protocols, and investing in robust infrastructure, Dimapur can significantly reduce its vulnerability to floods. These measures will contribute to the resilience and sustainability of the city, safeguarding lives, livelihoods, and infrastructure from the devastating impacts of flood events.

Moreover, the flood management plan recognizes the need for community engagement and participation. By fostering collaboration among government agencies, community organizations, and residents, the plan encourages a collective effort towards flood preparedness, response, and recovery. Public awareness campaigns and educational initiatives will empower individuals to understand and address flood risks, ultimately creating a more informed and resilient society.

The successful implementation of the flood management plan for Dimapur will not only mitigate the immediate risks associated with floods but also pave the way for a sustainable and flood-resilient city. It is a testament to the commitment of the government, stakeholders, and the community to protect the well-being and prosperity of the city's residents for generations to come.