



Government of the people's Republic of Bangladesh  
Ministry of Housing and Public Works  
Urban Development Directorate  
82 Segunbagicha, Dhaka-1000

PREPARATION OF DEVELOPMENT PLAN FOR MEHERPUR ZILLA

## REPORT ON ASSIGNMENT-7

GIS Data Standardization with Report

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## Nearest Neighborhood Analysis

Nearest neighbor analysis is a method to assess the spatial distribution of points, like settlements or shops, by measuring the distance between each point and its nearest neighbor. It helps determine if points are clustered, uniformly spaced, or randomly distributed. The analysis calculates a nearest neighbor index ( $R_n$ ) to quantify the pattern, with values below 1 indicating clustering, 1 for random distribution, and above 2.15 for uniform distribution. Nearest Neighborhood Analysis is a statistical method used to measure the distribution of spatial features (such as points) across a given area, whether clustered, randomly distributed, or dispersed/uniformly spaced. NNA compares the average distance between each point and its nearest neighbor to what would be expected in a random distribution. Nearest Neighborhood Analysis is a spatial statistical method used to assess the distribution pattern of a set of points in space such as crime incidents, disease cases, trees, or businesses by examining the distances between each point and its nearest neighbor.

### Elaboration:

#### 1. Measuring Spatial Patterns:

Nearest neighbor analysis quantifies spatial patterns by calculating the average distance between each point and its nearest neighbor.

#### 2. Clustering, Randomness, Uniformity:

The analysis helps determine if the points are clustered together (more frequent in certain areas), randomly spaced, or uniformly spaced (evenly distributed).

#### 3. Nearest Neighbor Index ( $R_n$ ):

A key outcome of the analysis is the  $R_n$  value, which is calculated using the formula:  $R_n = 2 * \sqrt{(n/A)} * d$ , where:

$d$  = average distance between each point and its nearest neighbor.

$n$  = the number of points.

$A$  = the area under study.

#### 4. Interpreting $R_n$ Values:

$R_n < 1$ : Indicates a clustered or aggregated pattern.

$R_n = 1$ : Indicates a random distribution.

$R_n > 2.15$ : Indicates a uniform or regular pattern.

It helps determine whether a spatial pattern is:

- **Clustered** (points are closer together than expected),
- **Random** (no apparent pattern),
- **Dispersed** (points are more evenly spaced than expected).

## Key Concepts & Formula

The **Nearest Neighbor Index (NNI)** is calculated as:

The **Nearest Neighbor Index (NNI)** is calculated as:

$$NNI = \frac{\text{Observed Mean Distance}}{\text{Expected Mean Distance}}$$

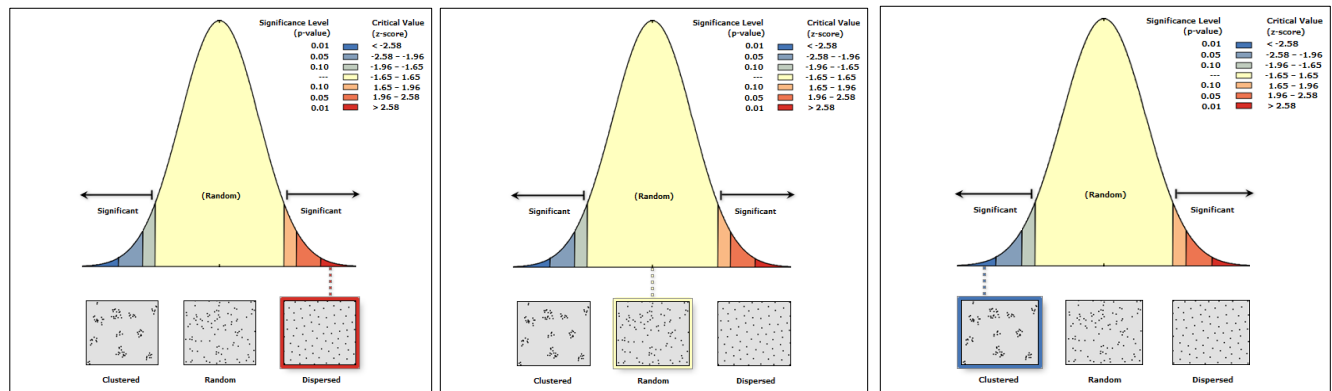
Where:

- **Observed Mean Distance** = average of all distances from each point to its nearest neighbor.
- **Expected Mean Distance** (for a random distribution) =  $\frac{1}{2\sqrt{\lambda}}$ , where  $\lambda$  is the point density (points per unit area).

$R = \text{Observed mean Distance} / \text{Expected mean distance}$

$R = 0 = \text{Random} < 1 = \text{Clustered} > 1 = \text{Dispersed}$

### Different type of NN Pattern:



Source: Prepared by Consultant, 2025

### Observed Mean Distance

The **Observed Mean Distance** is the **average distance** from each point in your dataset to its **nearest neighboring point**, which reflects the actual spatial arrangement of the points (e.g., brickfields, hospitals, crime locations). It is the first step in determining whether the points are clustered, random, or dispersed.

### Expected Mean Distance

The **Expected Mean Distance** represents the average distance one would expect between points if they were randomly distributed in a study area.

Expected mean distance =

$1/2(\sqrt{n/A})$  Here,  $n$  = The total

number of points  $A$  = Area

$n/A$  = points density

## P value

The p-value tells the probability that your observed spatial pattern (e.g., clustering or dispersion) could have occurred by chance, assuming a random distribution of points. The p-value measures how likely it is to get a z-score as extreme as the one you observed if the null hypothesis (random distribution) is true.

P-value	Meaning	Interpretation
< 0.01	Less than 1% chance pattern is random	<b>Highly significant (strong evidence of clustering or dispersion)</b>
< 0.05	Less than 5% chance pattern is random	<b>Significant</b>
> 0.05	More than a 5% chance pattern is random	<b>Not significant (pattern could be random)</b>
< 0.10	Weak evidence, borderline significance	<b>Sometimes considered</b>
> 0.10	<b>Likely due to chance</b>	<b>Not significant</b>

## Z Value

The Z-value (or Z-score) tells how far the observed pattern is from the expected (random) pattern, measured in standard deviations.

Z-value	Pattern	Significance (p-value)
<b><math>Z &lt; -2.58</math></b>	Strong clustering	<b><math>p &lt; 0.01</math> (very significant)</b>
<b><math>Z &lt; -1.96</math></b>	Clustered	<b><math>p &lt; 0.05</math> (significant)</b>
<b><math>-1.96 &lt; Z &lt; 1.96</math></b>	Random	<b><math>p &gt; 0.05</math> (not significant)</b>
<b><math>Z &gt; +1.96</math></b>	Dispersed	<b><math>p &lt; 0.05</math> (significant)</b>
<b><math>Z &gt; +2.58</math></b>	<b>Strong dispersion</b>	<b><math>p &lt; 0.01</math> (very significant)</b>

## Key Point:

- A high negative Z = Clustered
- A high positive Z = Dispersed
- A Z close to 0 = Random

## **The Bell Curve (Normal Distribution)**

- The center (yellow area) represents the null hypothesis
- The point pattern is random
- This region is where the z-score falls between -1.65 and +1.65 (or for stricter tests, between -1.96 and +1.96).
- High p-values (e.g.,  $> 0.10$  or  $> 0.05$ ) — not enough evidence to reject the null.

## **Left Tail (Blue Area)**

- Represents significantly clustered patterns.
- Z-scores are less than -1.65 (more negative).
- Corresponds to low p-values (e.g.,  $\leq 0.05$  or  $0.01$ ).
- This means: points are closer together than expected under randomness — you reject the null hypothesis.

## **Right Tail (Red Area):**

- Represents significantly dispersed (regular) patterns.
- Z-scores are greater than +1.65 (more positive).

- Also corresponds to low p-values.
- This means: points are farther apart than expected under randomness — again, reject the null.

### Nearest Neighborhood Analysis of Meherpur Paurashava:

A Nearest Neighbor Analysis (NNA) was conducted to examine the spatial distribution of urban features within Meherpur Paurashava. This method measures how point features (such as tube wells, schools, or health facilities) are arranged across the area—whether clustered, randomly distributed, or uniformly dispersed. The analysis was based on spatial data projected using the UTM Zone 45N coordinate system and covered the full administrative boundary of Meherpur Paurashava. This suggests that the observed pattern is not due to random chance but rather influenced by underlying spatial or socio-economic factors, such as population density or land use planning. The findings highlight the need for more equitable spatial planning, particularly in under-served areas that may lack access to essential services or infrastructure.

The Nearest Neighbor Analysis (NNA) conducted at the ward and locality levels within Meherpur Paurashava reveals a varied spatial distribution of urban features across different areas. A significant number of localities—particularly in agricultural zones and peripheral neighborhoods—exhibit **dispersed patterns**, indicating features are spread out more uniformly in space. Notably, **Ward Nos. 05, 06, 07, and 09** display several **clustered localities**, including Dighir Para, Kashob Para, and Shishu Para, suggesting concentrated development or population density in those areas. In contrast, mixed results were found in **Ward Nos. 01, 03, and 08**, where both clustered and dispersed patterns co-exist alongside localities with **random distributions**, such as Stadium Para and Hotel Bazaar. These variations reflect underlying socio-economic, infrastructural, and land use differences across the Paurashava. The identification of clustered and dispersed zones is essential for equitable urban planning and can help in prioritizing areas for infrastructure expansion, service delivery, and future development.

Ward_No	Name	Locality	Result
07	Ward No. 07	Agricultural Area	Dispersed
09	Ward No. 09	Stadium Para	Random
08	Ward No. 08	Agricultural Area	Dispersed
06	Ward No. 06	Foujdary Para	Clustered
03	Ward No. 03	Fulbagan Para (North)	Dispersed
04	Ward No. 04	Agricultural Area	Dispersed
02	Ward No. 02	Haldar Para	Clustered
01	Ward No. 01	Court Para	Random
01	Ward No. 01	Bospara (South)	Random
01	Ward No. 01	Kasari Para	Clustered
01	Ward No. 01	Pyada Para	Clustered
01	Ward No. 01	Shaheed Ghafoor Road	Dispersed
01	Ward No. 01	Hotel bazaar	Random
01	Ward No. 01	Ghat Para	Clustered
01	Ward No. 01	Ponder Ghat	Dispersed
01	Ward No. 01	Ghosh Para	Clustered
01	Ward No. 01	Mission Para	Dispersed

01	Ward No. 01	Notun Para	Random
02	Ward No. 02	Fulbagan Para (South)	Dispersed
02	Ward No. 02	Mukharji Para (South)	Dispersed
02	Ward No. 02	Thana Para (South)	Dispersed
02	Ward No. 02	Boro Bazaar Para (West)	Dispersed
02	Ward No. 02	Nilmoni Hall Para	Dispersed
02	Ward No. 02	Bospara (North)	Clustered
03	Ward No. 03	Mukharji Para (North)	Dispersed
03	Ward No. 03	Tati Para	Clustered
03	Ward No. 03	Bel Para (South)	Dispersed
03	Ward No. 03	Khan Para (South)	Dispersed
03	Ward No. 03	Sheikh Para (South)	Dispersed
03	Ward No. 03	Thana Para (North)	Dispersed
04	Ward No. 04	Sheikh Para (North)	Clustered
04	Ward No. 04	Hotath Para	Clustered
04	Ward No. 04	Mathpara	Clustered
04	Ward No. 04	Khan Para (North)	Dispersed
04	Ward No. 04	Notun Para	Random
04	Ward No. 04	Kalachadpur	Clustered
04	Ward No. 04	Bel Para (North)	Dispersed
06	Ward No. 06	Kashob Para	Clustered
06	Ward No. 06	Boro Bazaar Para (East)	Random
06	Ward No. 06	Mondol Para	Dispersed
06	Ward No. 06	Poura Eidgah Para	Clustered
06	Ward No. 06	Townhall Para	Dispersed
06	Ward No. 06	Gor Para	Clustered
09	Ward No. 09	Ponder Ghat	Dispersed
09	Ward No. 09	Baman Para	Clustered
09	Ward No. 09	Raypur	Dispersed
09	Ward No. 09	Khandokar Para	Clustered
09	Ward No. 09	Agricultural Area	Dispersed
08	Ward No. 08	Stadium Para	Random
08	Ward No. 08	Hotel Bazaar	Random
08	Ward No. 08	Bus Stand Para	Random
08	Ward No. 08	College Para	Clustered
08	Ward No. 08	Marcus Para	Random
08	Ward No. 08	Mallik Para	Clustered
08	Ward No. 08	New Bus Terminal	Dispersed
08	Ward No. 08	Sheikh Para	Random
07	Ward No. 07	Hotel Bazaar	Random
07	Ward No. 07	Kasari Para	Clustered
07	Ward No. 07	Sheikh Para	Random
07	Ward No. 07	Mallik Para	Clustered
07	Ward No. 07	Dighir Para	Clustered
05	Ward No. 05	Agricultural Area	Dispersed
05	Ward No. 05	Dighir Para	Clustered
05	Ward No. 05	T N T Para	Dispersed



07	Ward No. 07	Foujdary Para	Clustered
07	Ward No. 07	Mia Para	Random
09	Ward No. 09	Poshur Har Para	Clustered
09	Ward No. 09	Gorosthan Para	Clustered
09	Ward No. 09	Agricultural Area	Dispersed
09	Ward No. 09	Shishu Para	Clustered
09	Ward No. 09	Court Para	Random
09	Ward No. 09	Circuit House Para	Clustered
09	Ward No. 09	Shishu Para	Clustered
09	Ward No. 09	Poshur Hat Para	Clustered
09	Ward No. 09	Ponder Hat	Dispersed
09	Ward No. 09	Post Office Para	Dispersed
05	Ward No. 05	Kashob Para	Clustered
05	Ward No. 05	Chokro Para	Clustered
05	Ward No. 05	Hotat Para	Clustered
05	Ward No. 05	Police Line	Clustered
07	Ward No. 07	Police Line	Clustered
07	Ward No. 07	Soshanghat	Clustered
09	Ward No. 09	New Bus Terminal	Dispersed
07	Ward No. 07	Agricultural Area	Dispersed
Source: Prepared by Consultant,2025			

## Nearest Neighborhood Analysis of Meherpur Paurashava

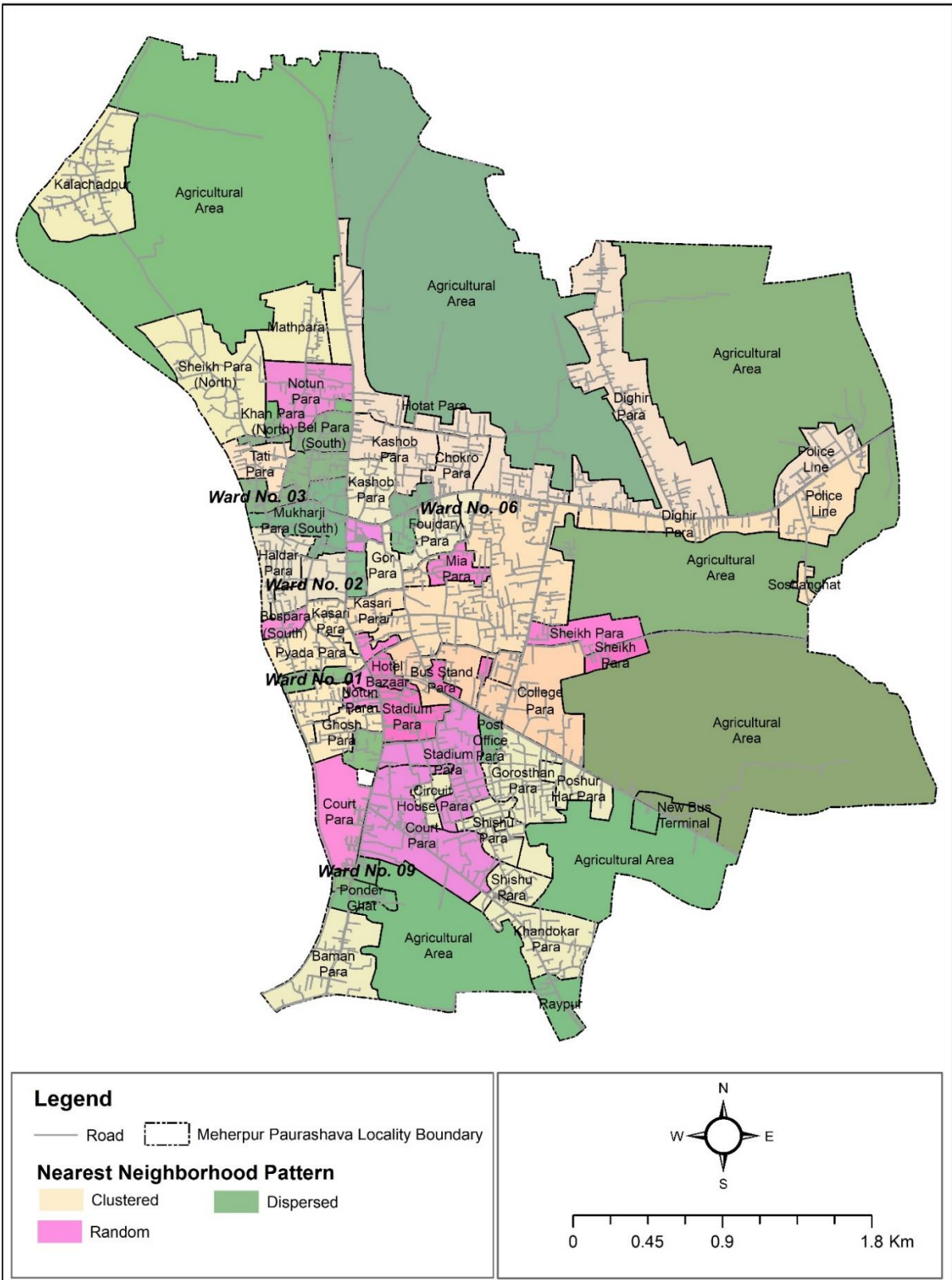


Figure 01: Nearest Neighborhood Analysis of Meherpur Paurashava

Source: Prepared by Consultant, 2025

### Ward-wise Nearest Neighborhood Analysis of Meherpur Paurashava:

The ward-level Nearest Neighbor Analysis (NNA) of Meherpur Paurashava demonstrates a predominantly **clustered spatial pattern** across the municipality. Out of the nine wards, **seven wards (01, 04, 05, 06, 07, 08, and 09)** exhibit **clustered distributions**, indicating a tendency for urban features or settlements to be spatially concentrated. This suggests that development or population density is more centralized in these areas, possibly due to economic activities, infrastructure, or historical growth patterns. **Ward No. 03** displays a **dispersed pattern**, which may point to more rural or low-density development, while **Ward No. 02** shows a **random distribution**, indicating no clear spatial tendency. These findings are crucial for urban planners and policymakers, as they highlight areas where resources are densely focused versus areas that may require more balanced development to ensure equitable service access across the Paurashava.

Ward_No	RESULT
01	Clustered
02	Random
03	Dispersed
04	Clustered
05	Clustered
06	Clustered
07	Clustered
08	Clustered
09	Clustered

Source: Prepared by Consultant,2025

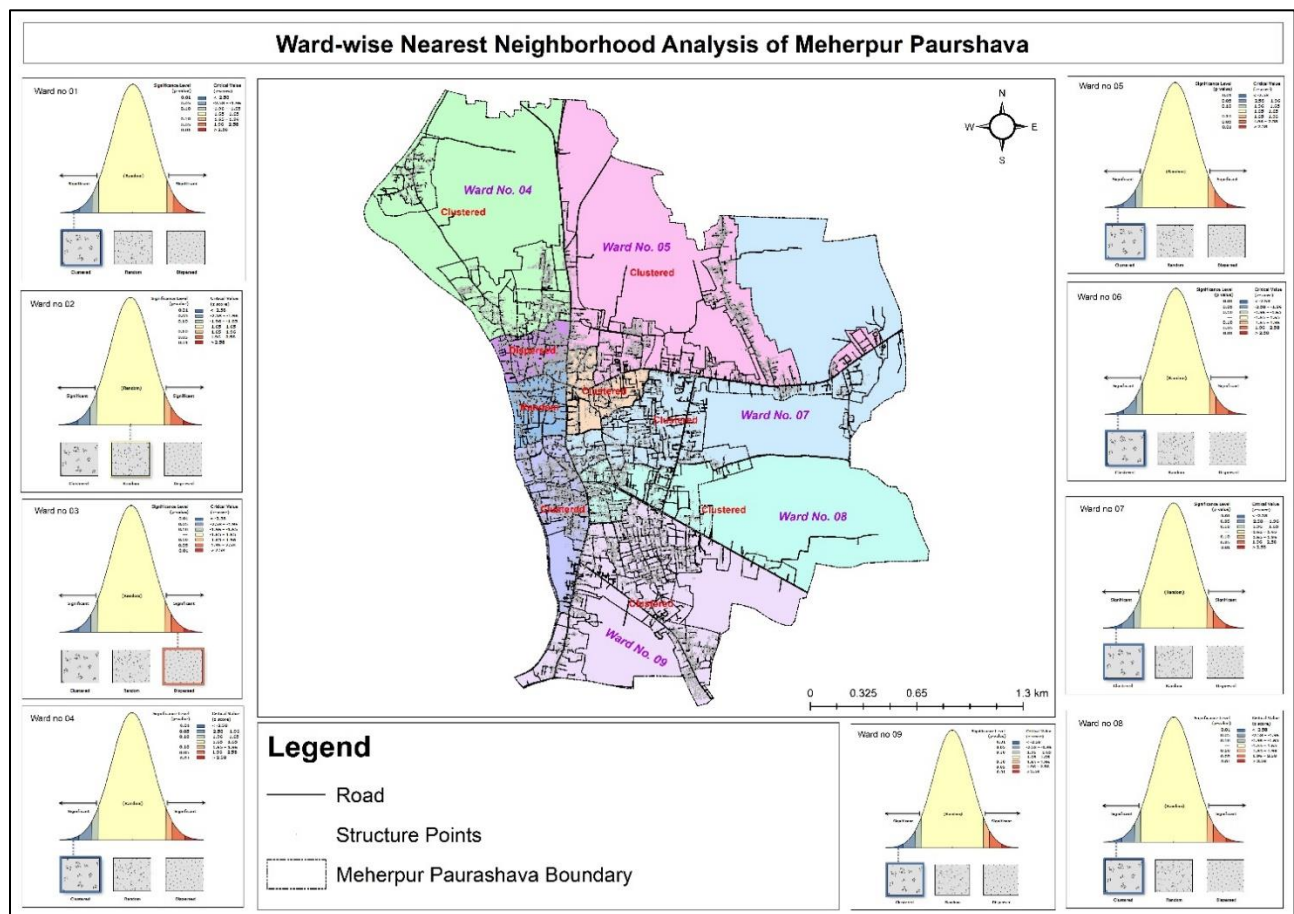


Figure 02:Ward wise NN analysis of Meherpur Paurashava

Source: Prepared by Consultant,2025

## Ward-wise Nearest Neighborhood Analysis of Gangni Paurashava:

The Nearest Neighbor Analysis (NNA) conducted for all nine wards of Gangni Paurashava reveals a consistently **clustered spatial distribution** across the entire municipality. Each ward—from Ward No. 01 through Ward No. 09—demonstrates a pattern where urban features or residential units are concentrated in close proximity to one another, rather than being randomly distributed or dispersed. This strong tendency toward clustering indicates centralized development, possibly influenced by factors such as accessibility, socio-economic activity, and the spatial planning framework of the Paurashava. Such clustering can enhance the efficiency of service delivery and infrastructure use but may also signal areas of over-concentration that could benefit from future spatial rebalancing. These insights are essential for guiding sustainable urban development, infrastructure planning, and equitable distribution of public resources.

Ward Name	Nearest Neighborhood
Ward No. 01	Clustered
Ward No. 02	Clustered
Ward No. 03	Clustered
Ward No. 04	Clustered

Ward Name	Nearest Neighborhood
Ward No. 05	Clustered
Ward No. 06	Clustered
Ward No. 07	Clustered
Ward No. 08	Clustered
Ward No. 09	Clustered

Source: Prepared by Consultant,2025

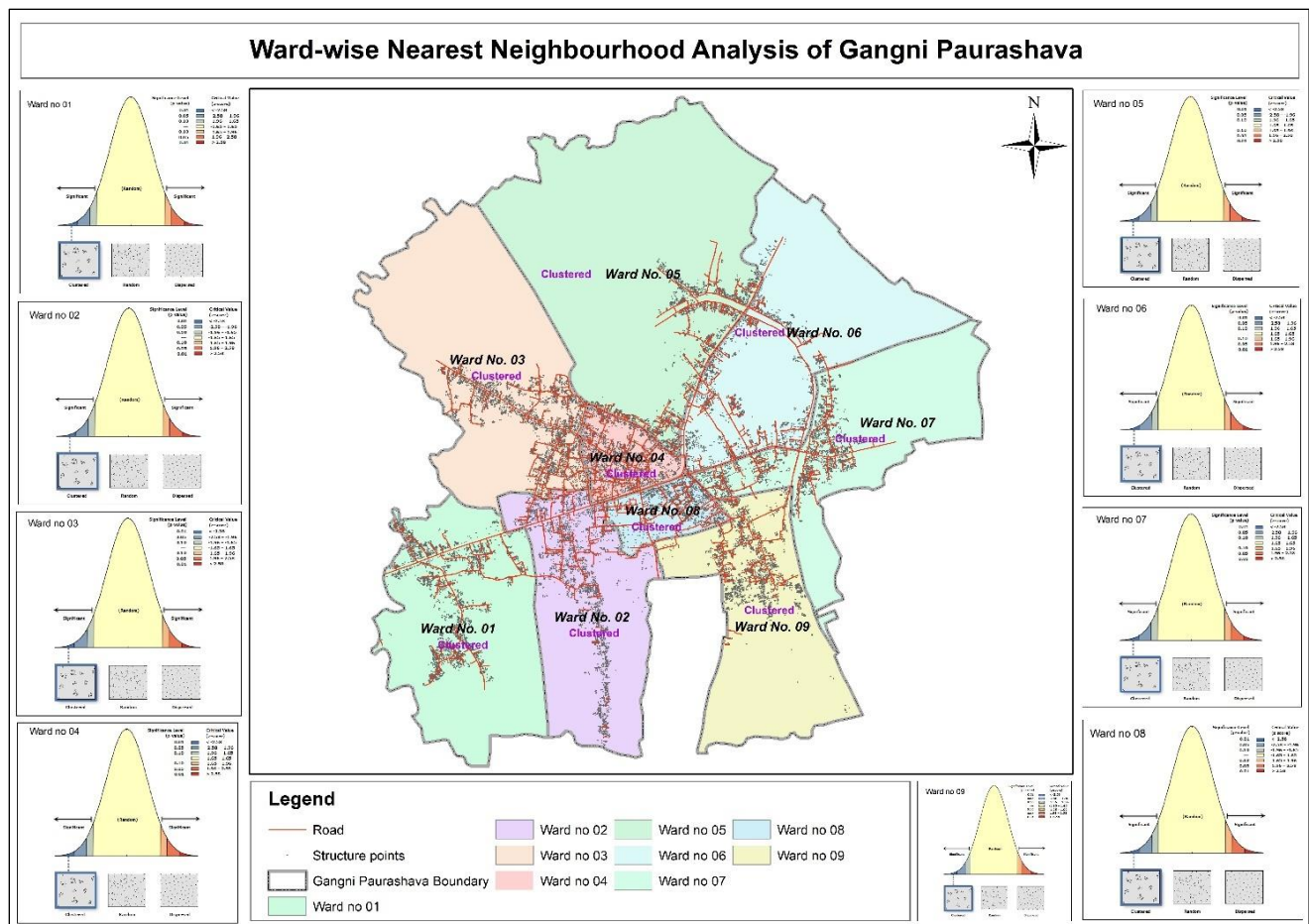


Figure 03:Ward wise NN analysis of Gangni Paurashava

Source: Prepared by Consultant,2025

## Future Settlement plan for Paurashava Area:

**Dispersed pattern:** To design a settlement pattern in a vacant area of Gangni Paurashava (Ward No. 06) focusing on a **dispersed neighborhood pattern**, here's a concept can follow, with a **plot-wise plan** where each plot is **20m x 30m**, and each plot accommodates **one settlement unit**.

### Objective:

Create a low-density, dispersed settlement layout with individual plots that ensure privacy, access to open space, and adaptability to local needs, while maintaining infrastructural efficiency.

### Key Features of the Dispersed Pattern Plan:

#### 1. Plot Dimensions & Layout

Each plot size: 20m (width) x 30m (depth)

Built-up area: Max 40–50% (approx. 240–300 sqm), rest for gardens, setbacks, and future extensions

One housing unit per plot

Orientation: Houses oriented along prevailing wind direction and sun path for natural ventilation and lighting

#### 2. Street & Access Network

Internal roads: 6–9 meters wide

Grid or semi-grid pattern for efficient access while maintaining dispersed character

Footpath/bike lanes optional on wider streets

Cul-de-sacs or loop roads to reduce through traffic and promote neighborhood identity

#### 3. Open & Green Spaces

Intermittent green buffers between clusters of 6–10 plots

Community open spaces every 150–200m radius

Maintain minimum 30–40% total site area as open space to retain the dispersed quality

#### 4. Infrastructure Planning

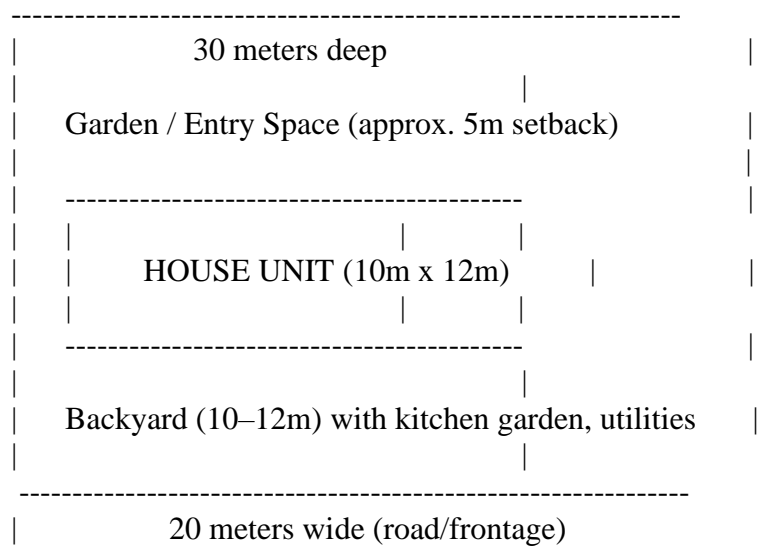
Water and sanitation: Septic tank system initially; allow provision for future centralized connection

Electricity and solar-ready connections

Stormwater drainage: natural swales or shallow ditches between plot groups

Road-side trees and green verges

### Typical Plot Development Plan (20m x 30m)





# Proposed Settlement pattern for Gangni Paurashava (Ward 06)

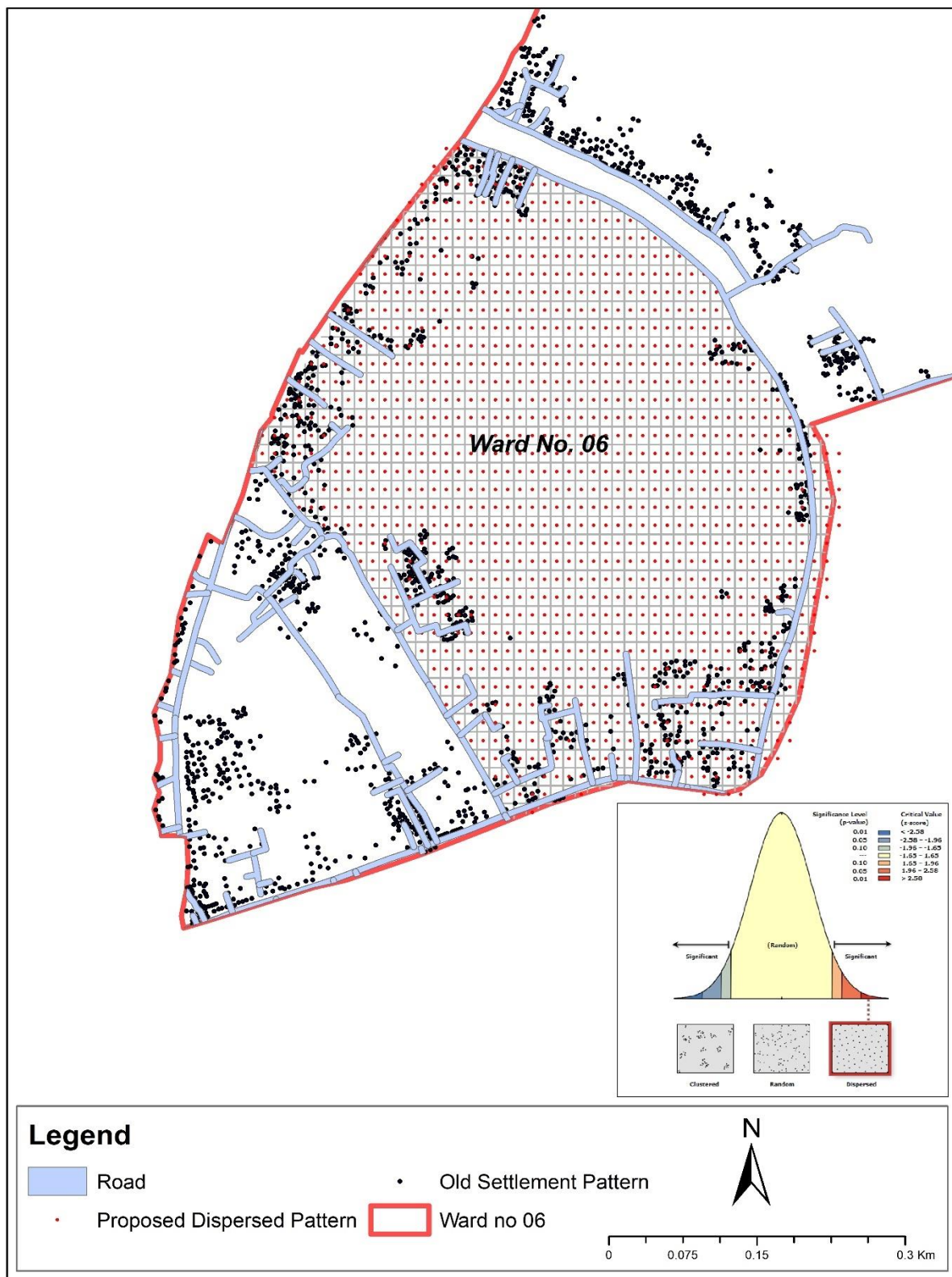


Figure 04:Proposed settlement pattern of Gangni paurashava, Ward 06

Source: Prepared by Consultant,2025

**Cluster Pattern:** The proposed compact settlement pattern within the Paurashava area emphasizes a cluster-style layout, utilizing varied plot sizes of 2 katha (10m x 13m), 3 katha (14m x 14m), and 5 katha (18m x 18m). This approach is designed to promote higher density development while maintaining functional and livable neighborhood units through the strategic grouping of plots.

**Objective:**

Design a **compact cluster settlement** with mixed plot sizes:

- **2 Katha (10m x 13m)**
- **3 Katha (14m x 14m)**
- **5 Katha (18m x 18m)**

**Key Features of the Cluster Pattern Plan:**

**1. Plot Sizes & Use**

Plot Type	Size (m)	Area (sqm)	Use
<b>2 Katha</b>	10x13	130 m <sup>2</sup>	Low-income housing / starter homes
<b>3 Katha</b>	14x14	196 m <sup>2</sup>	Mid-income homes / small duplex
<b>5 Katha</b>	18x18	324 m <sup>2</sup>	Larger family homes / home business

- **Built-up area:** 60–70%
- **Front & side setbacks:** Minimal, to retain density

**2. Cluster Layout Concept**

- **6–10 plots per cluster block**, arranged around:
  - A **shared courtyard**
  - A **narrow pedestrian street (4–5m)**
  - **One main access road** (6–9m wide) per group of clusters
- Shared **semi-private green/play area** in each cluster
- **Minimize boundary walls** to encourage interaction

**3. Road & Access Hierarchy**

- **Primary access road:** 9m wide (two-way traffic)
- **Secondary roads:** 6m wide (connect clusters)
- **Tertiary footpaths:** 4–5m inside clusters for walking/cycling



## 4. Community & Infrastructure Features

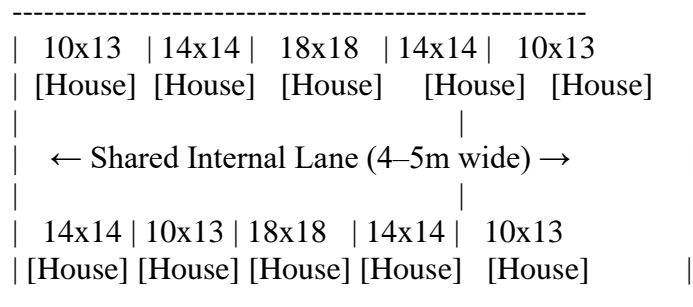
### Cluster-level facilities:

- Shared water points or supply connections
- Waste collection point
- Community gathering space (veranda/shed)

Efficient **electricity, drainage, and sanitation** lines shared within clusters

### Typical Cluster Block Layout

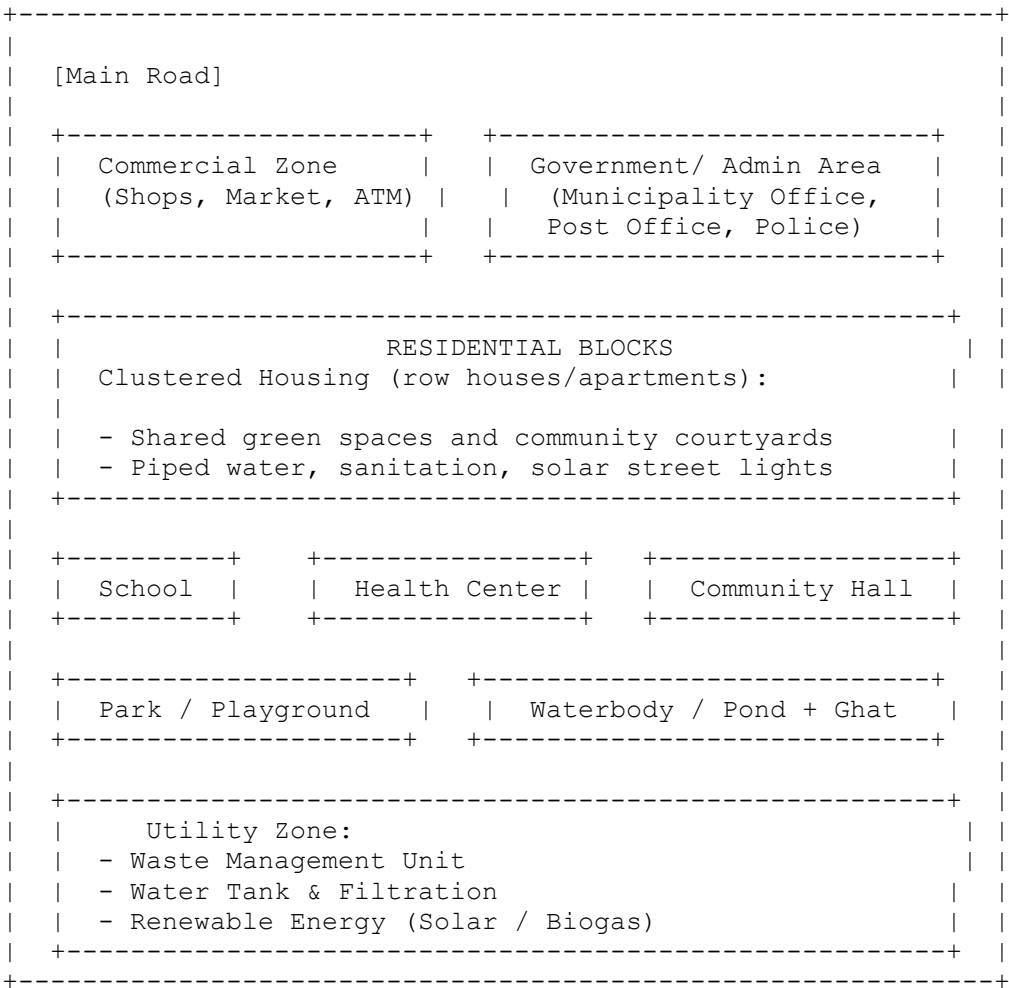
Imagine a group of 6–10 mixed plots arranged around a **central semi-public court**.



- **Mixed housing types** promote socioeconomic diversity
- Central open space can include:
  - Seating
  - Shade trees
  - Children’s play space

COMPACT URBAN SETTLEMENT PLAN FOR A MUNICIPALITY (PAURASHAVA)

Land Use Zoning Overview (Conceptual Layout)



Settlement plan for a Functional Paurashava

Zone / Function	Key Features
Residential	Clustered housing, efficient road layout, shared open spaces
Commercial	Marketplaces, shops, microbusiness hubs
Administrative	Paurashava building, ward offices, police station, fire post
Health & Education	Primary health center, clinic, school (up to secondary)
Community	Hall, library, internet kiosk, cultural center
Green/Open Spaces	Parks, playgrounds, tree-lined streets, green buffers
Utilities	Water supply, waste collection/recycling, sewage system, stormwater drains
Sustainability Zones	Rainwater harvesting, compost pits, solar lighting, biogas plant
Mobility / Roads	Grid or radial road network, pedestrian paths, cycle tracks
Emergency Services	Fire service post, ambulance bay, disaster shelter