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Assessing the Disparity in Connectivity of Multiple Unit Trains in the National Capital Region

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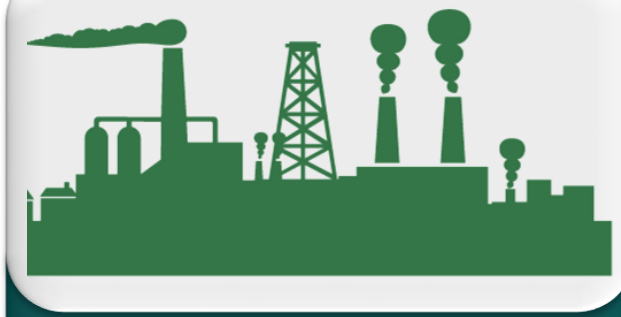
Parallel Session 3: Urban Transport Governance

05 November 2022

Kochi

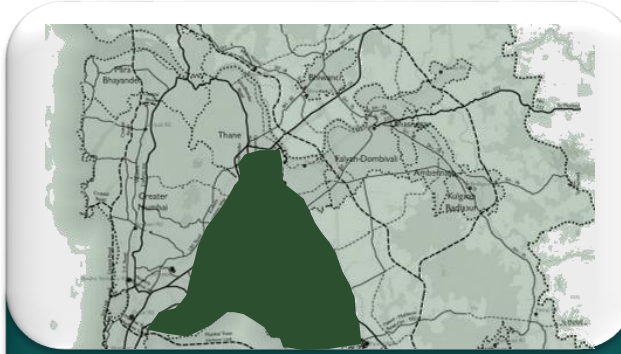
Introduction



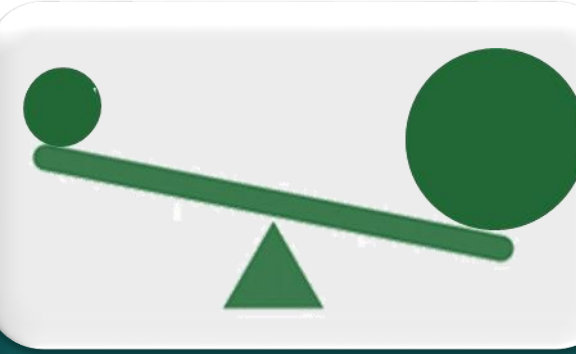
Industrialization

Employment Opportunities

Urbanization



Need to Improve Connectivity



Unbalanced Development

Sprawl of Metropolitan Cities

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Aim & Methodology

- Assessing the existing network of Multiple Units (MUs) in the National Capital Region (NCR) to identify the areas in need of better connectivity

Information Collection

- Administrative Area
- Population
- Existing MU Network

Measuring the Connectivity

- Population
- Density
- Administrative Area

Assessing the Disparity

- Gini Index

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Measures of Connectivity

$$\alpha_i = \frac{p_i}{n_i} \qquad \beta_i = \frac{a_i}{n_i} \qquad \gamma_i = \frac{\rho_i}{n_i}$$

Where, n_i = number of stations in sub-district *i*
p_i = population of sub-district *i*
a_i = administrative area of sub-district *i*
ρ_i = population density of sub-district *i*
α_i = population served per station in sub-district *i*
β_i = administrative area served per station in sub-district *i*
γ_i = population density served per station in sub-district *i*

$$G(S_1, S_2, \dots S_n) = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\left|S_i - S_j\right|}{2n \times \sum_{i=1}^{n} S_i}$$

Where, S_i = Value of the connectivity measure for sub-district *i*
n = number of sub-districts in the NCR

Source: Li et al., 2018

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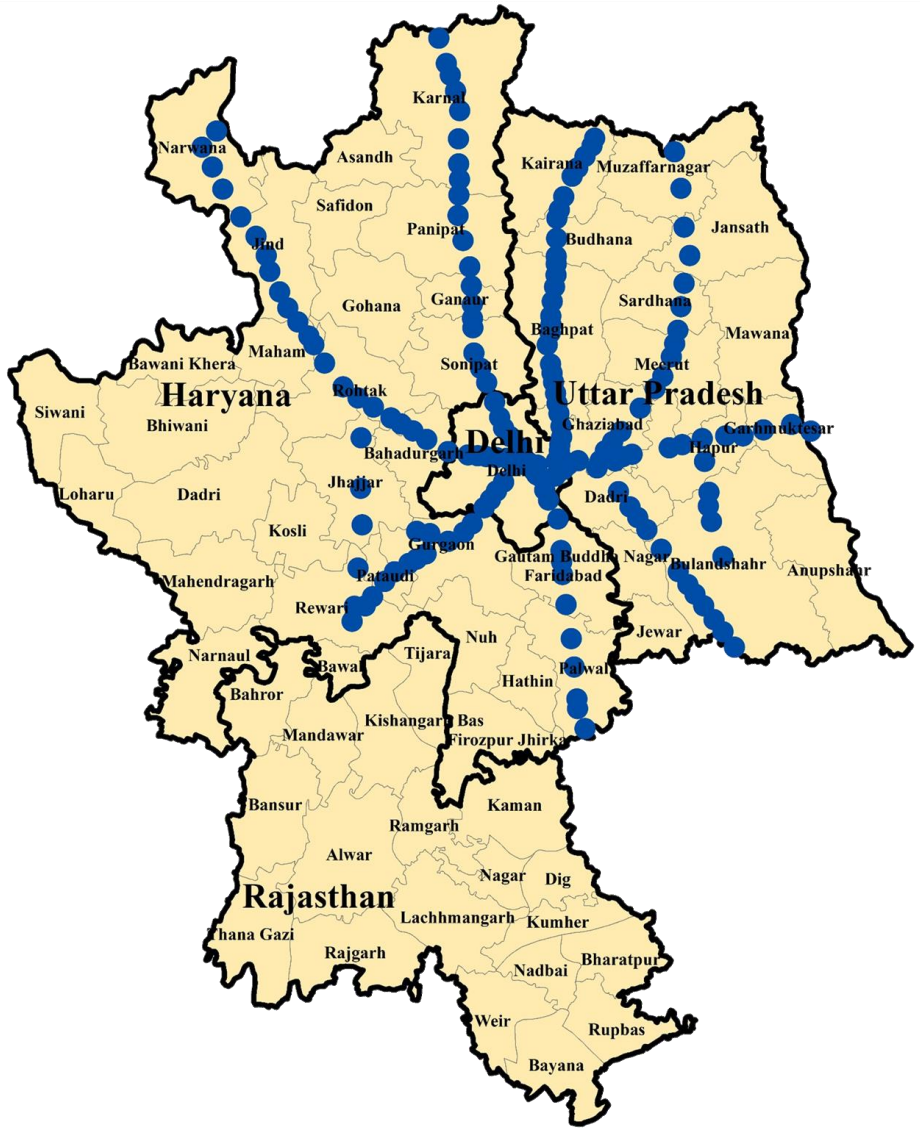
Study Area Description

- Unique metropolitan region having **inter-state regional planning** along with the national capital Delhi in its core
- Total area covered by this region is about **55,083 sq. kms.**
- MU railway network acts as a suburban rail **service for intercity travel** within the NCR



Source: National Capital Region Planning Board, 2017 & 2021

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Distribution of Stations

No. of stations in sub-district (a)	No. of sub-districts (b)	Total no. of stations (c=a*b)	Cumulative no. of stations ($d_n = \sum_{i=1}^{n} c_i$)	Cumulative no. of sub-districts ($e_n = \sum_{i=1}^{n} b_i$)
0	38	0	0	38
2	3	6	6	41
3	7	21	27	48
4	6	24	51	54
5	1	5	56	55
6	3	18	74	58
7	2	14	88	60
8	2	16	104	62
12	2	24	128	64
14	1	14	142	65
33	1	33	175	66

Source: Total Train Info, 2022

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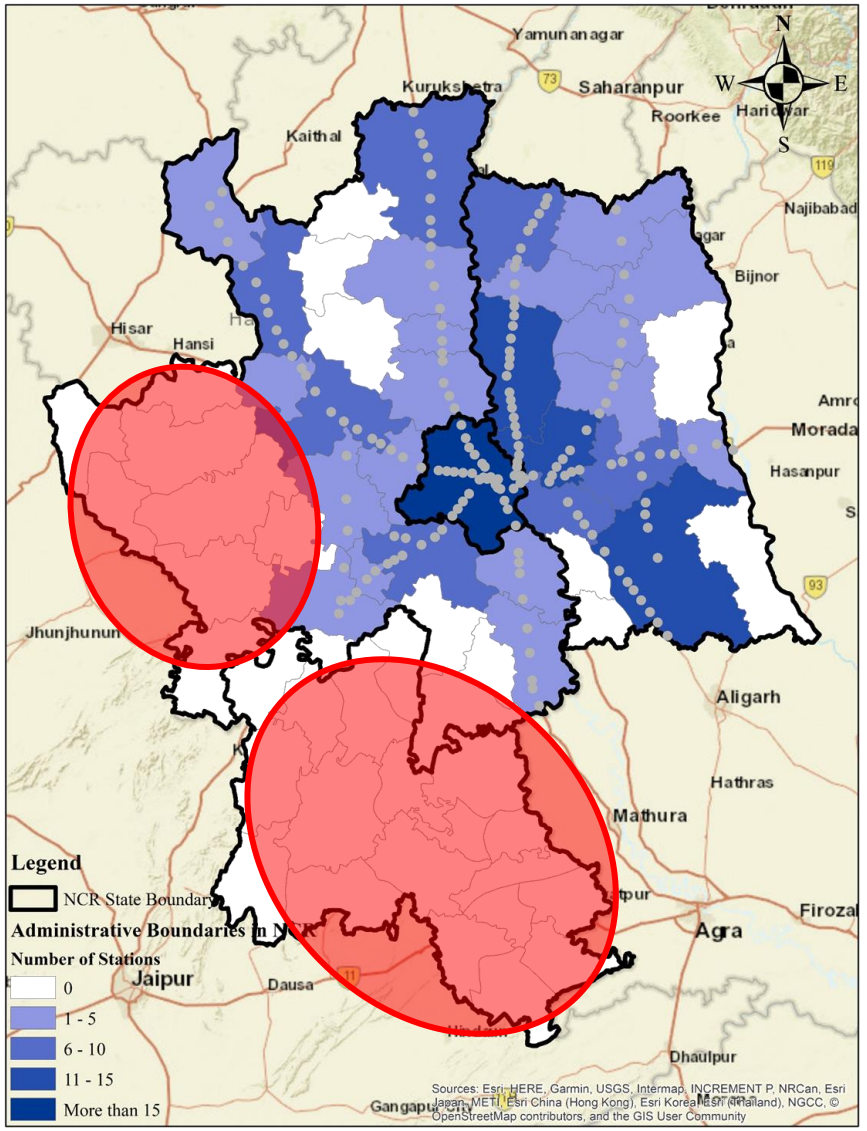
Distribution of Stations

- Most sub-districts without any MU stations are in **southern and western part of NCR**
- **Connectivity** of these sub-districts **with Delhi and other parts of NCR** is affected
- Sub-districts in **eastern and northern part** of NCR have comparatively **better connectivity**



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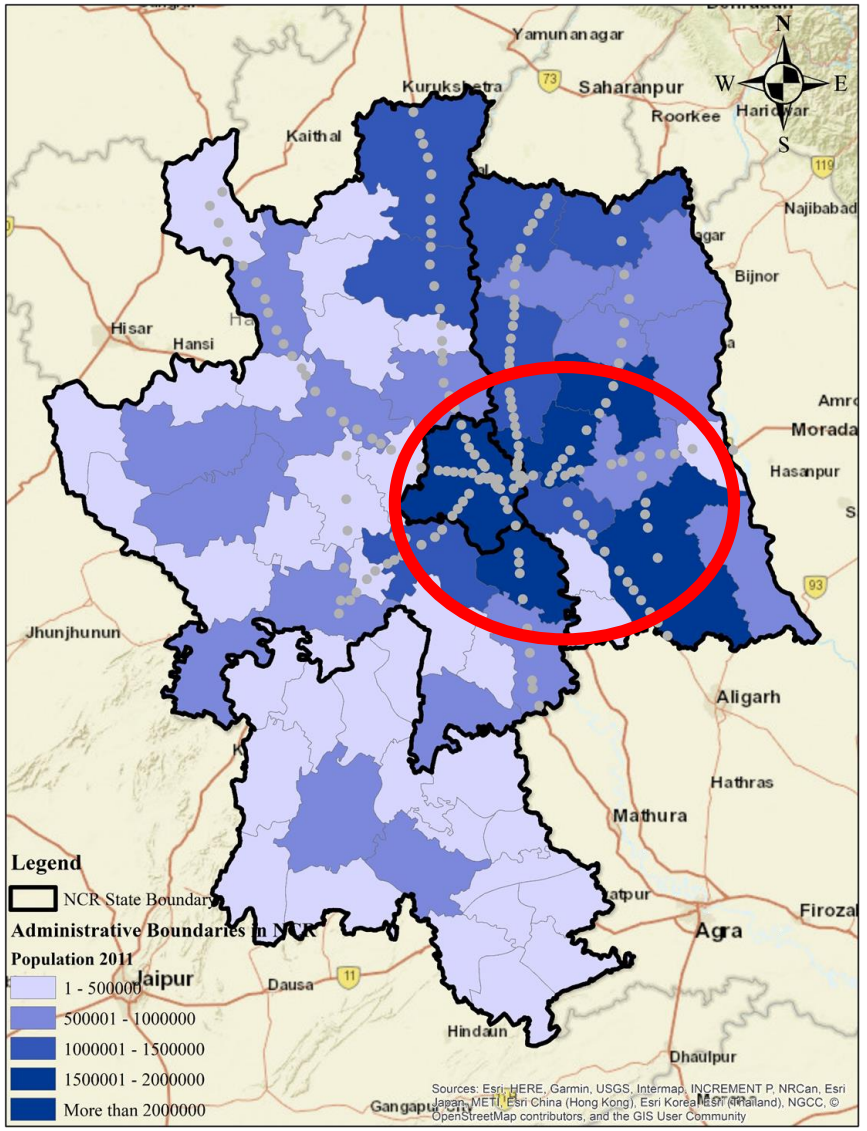
Population Distribution

- Population of NCR **concentrated** in the sub-districts present **in the core**
- **Higher population** observed in sub-districts of **Ghaziabad, Bulandshahr and Meerut**
- Sub-districts with **lower population in western part of NCR** portray disparity in the metropolitan region



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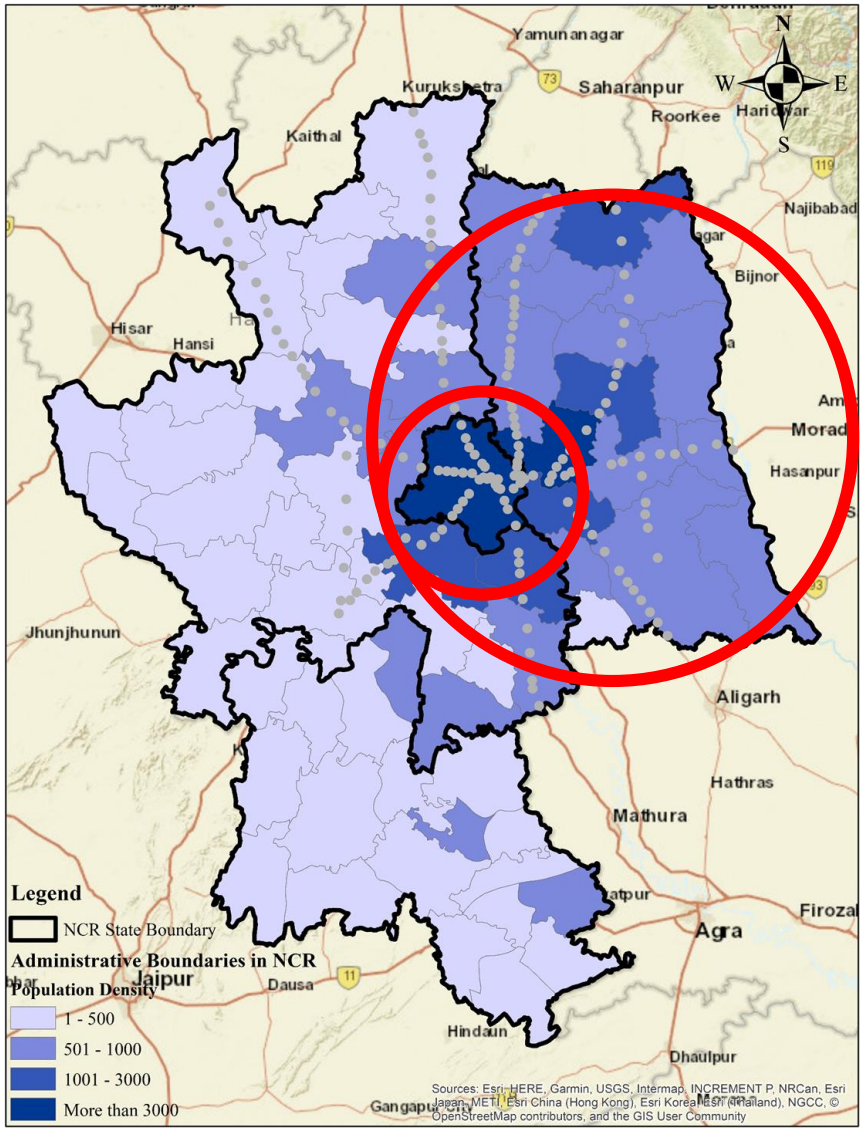
Density across Region

- Spatial distribution of population density observed concentration on **eastern and north-eastern NCR**
- **Highly dense** sub-districts located in the **central NCR**
- **Least population density** in sub-districts of **western part of NCR**



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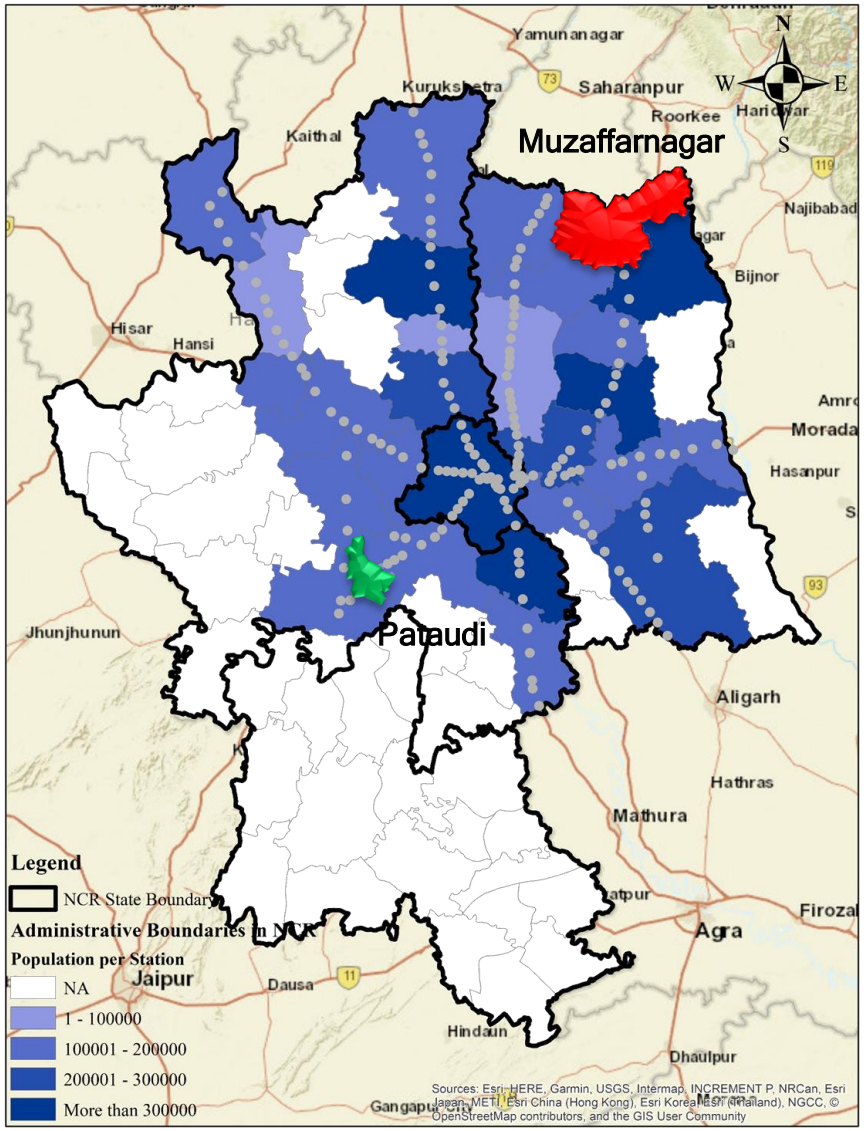
Population per Station

- **Muzaffarnagar** has to serve highest population behind every available station (~7,00,000/station)
- Least population per station was observed for the **sub-district of Pataudi** (~40,000/station)
- **Huge variation** in the **population served per station** in different sub-districts of NCR



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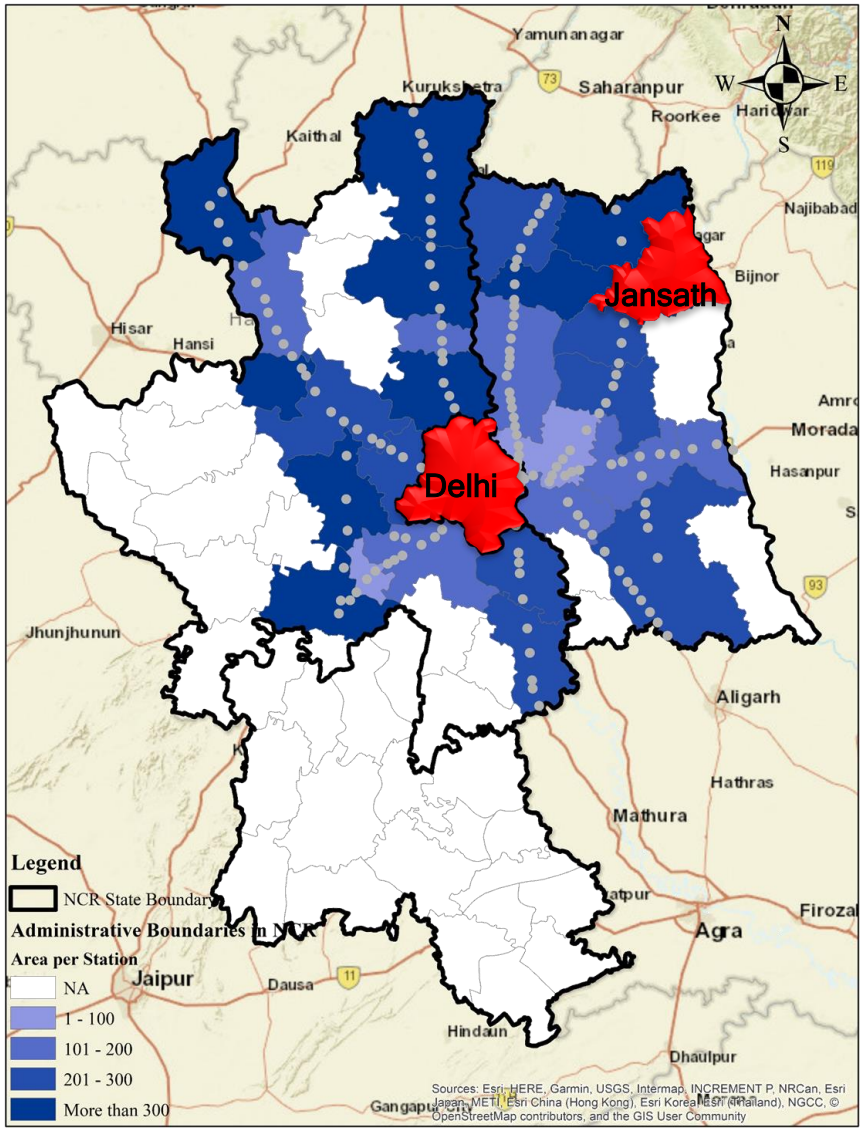
Area Served per Station

- Stations in **Delhi** had to serve the least area per station, indicating **significant number of stations**
- Sub-district of **Jansath** had to serve maximum administrative area per station
- **Significant stations** in administrative area of **Northern NCR** compared to other parts



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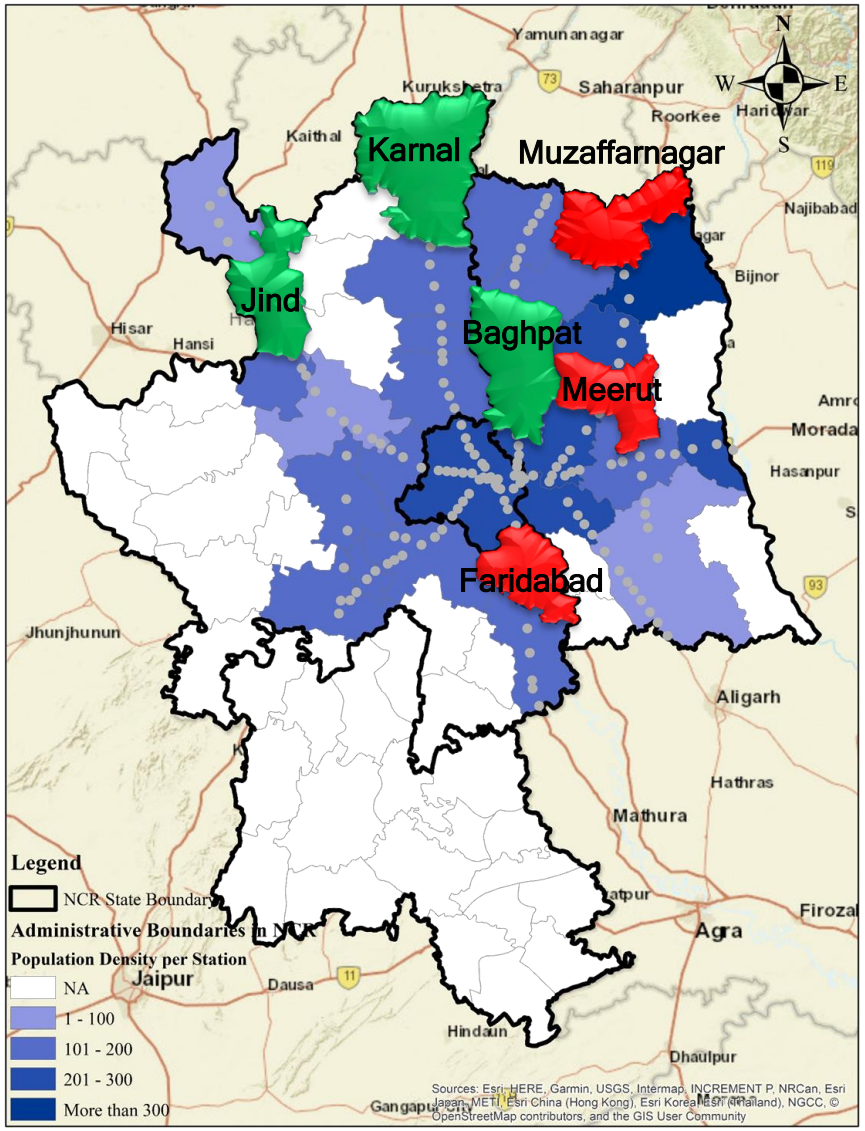
Density per Station

- Sub-districts of **Muzaffarnagar, Meerut and Faridabad** had maximum population density behind each station

- Concentration of stations per unit population density was higher in **Baghpat, Karnal and Jind**



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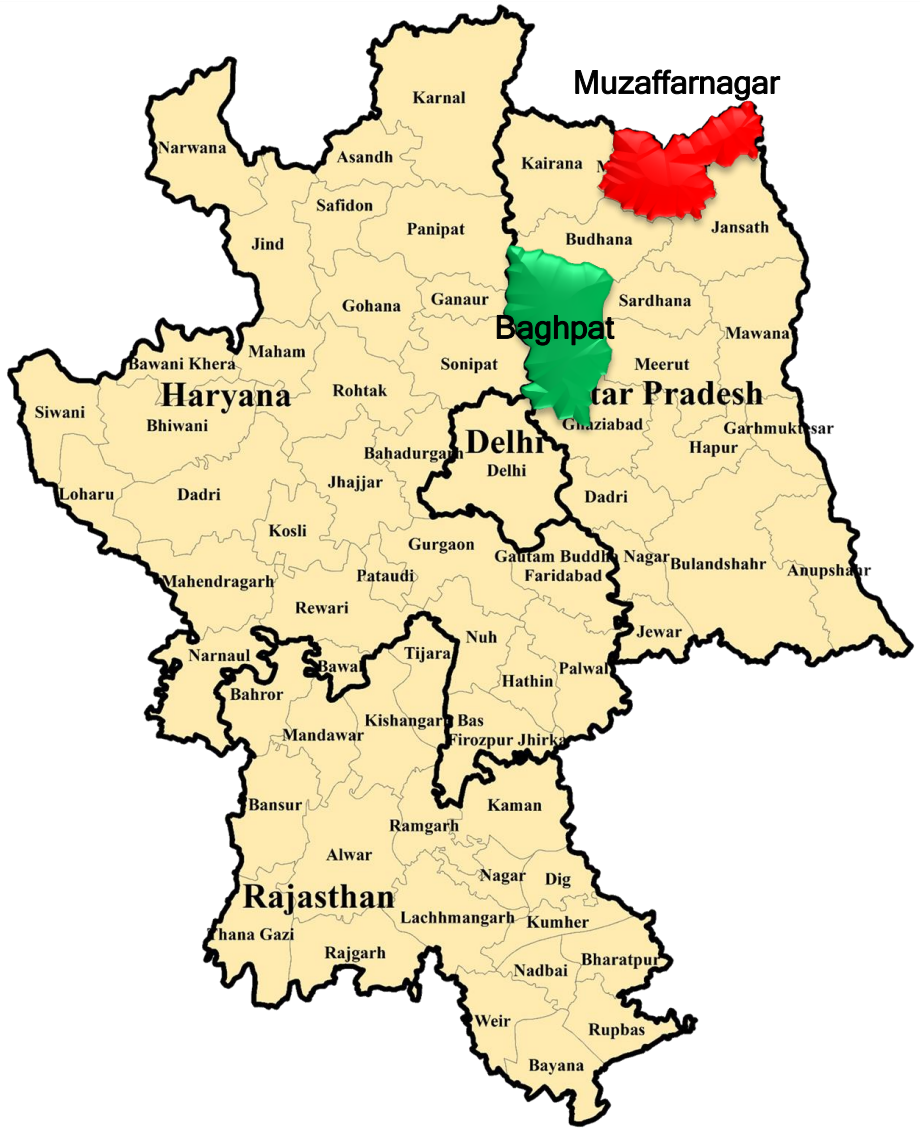
Disparity in Region

- Sub-district of **Baghpat** have relatively **better access** while **Muzaffarnagar** have **poor connectivity** to other sub-districts

- **Disparity** can be observed in the **connectivity of MUs** across the NCR

Measure of Connectivity	Gini Index
Number of Stations in Sub-district	0.75
Population Served per Station	0.73
Administrative Area Served per Station	0.70
Population Density Served per Station	0.72



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Conclusions

- A **huge disparity exists in the connectivity** of MU trains across the sub-districts of NCR which should be a concern
- Can be one of the **hurdle in development and urbanization** of sub-districts in southern and western parts of the NCR
- **Essential to connect the western and southern part** of the region to reduce disparity and improve overall connectivity
- Disparity **needs to be carefully addressed** as it plays a crucial role in economic development
- **Initiation to assess the equity** of transportation services in India and identify the areas with need of better connectivity

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Thank You

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