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# Comparative Analysis between Eastern & Western Urban India under Smart City Mission: An Insight to Inequalities, Challenges & Policy Implications

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***Abstract*— On 25th June, 2015 our honourable Prime Minister Shri Narendra Modi instigated Smart City Mission. Under this mission, 100 smart cities were selected across all the states & union territories on grounds of equality & indiscrimination. This mission serves as one of the Sustainable Development Goals (SDGs) in attaining India's sustainability according to UN Agenda by 2030. This paper examines whether all the urban cities under this programme makes equitable growth& development in all parameters taken under it. this paper put emphasis on intra- regional inequalities & disparities. In our analysis , for simplicity, we have selected only the eastern& western zone of India. In each zone, we have unbiasedly taken 17 smart cities. With inter-regional analysis ,this paper also emphasises on intra- regional inequalities & disparities which has happened to be under this mission. Smart Cities Mission includes parameters like smart energy management , solid waste management, community halls, open spaces, water conservation, communication networks, smart transportation, electricity, street lights, roads, ITC neighbourhood, health, etc. In our study we have chosen 7 parameters such as health, electricity , open spaces, community halls, solid waste management, street poles, roads constructed . Here we have done our research with the help of " R Software". While collecting data on different cities, it has been found that values of some parameters has been missing . In addition to that , the findings of our analysis interprets that government policy fails to provide effective & equitable growth in all parameters as well as cites considered under Smart Cities Mission.**

***Index Terms*— Smart City Mission, equality, indiscrimination, UN Agenda, Solid Waste Management, ITC Neighbourhood, open spaces, community halls.**

## I. INTRODUCTION

On 25th June 2015, the Smart Cities Mission was introduced by the Union Ministry of Housing and Urban Affairs. The main objective of this programme was to improve the standard of living in selected 100 Indian urban cities by promoting these cities which ensures financial assistance, sustainable environment& usages of smart solutions . Through this mission , our Union Government seeks to promote equality , economic growth & development, inclusivity and with it thus attains its sustainable development goals in terms of health, education, zero hunger, no poverty, gender equality , industry & innovations etc.

This mission is based on the ideology of neoliberal urbanism , cooperative & competitive federalism & policy mobilization. This scheme is fully sponsored by our Union Government thus providing a financial assistance of Rs 48,000 crs . Along with this, there has been equal contribution of resources from all the States ( and Union Territories) as well as from private sector through Public Private Partnerships (PPP).

There are 2 different components of Smart City Mission : Area- based Development and Pan-City Solutions . The first component includes restoration of the existing urban cities by providing improved infrastructural facilities. Development of solely new urban areas with provisions of smart & efficient technologies falls under this components . Projects like New Town Kolkata, Bhendi – Bazar (Mumbai), GIFT city , Naya Raipur. etc. Pan- City Projects are basically based on smart technologies. Under these projects , various sectors are technology driven like waste management, energy management, water management, e-governance etc. Besides these, other components of this mission includes Special Purpose Vehicle (SPV) which acts as a representation of both government officials as well as for multinational companies & thus serving the purpose of programme implementation.

The Smart Cities Mission includes infrastructural facilities like adequate & timely water supply , electricity supply, digitalisation, IT Connectivity, education, heath, roads, waste management, open spaces, community halls, transportation, e-governance and. affordable housing. In this paper, for simplicity purpose, we have taken only 7 parameters mainly heath, roads, electricity, street lights, open spaces, community halls & solid waste management. Not only that out of 100 smart Indian cities , we have done our research only on eastern & western urban cities. From each zone we have unbiasedly selected 17 cities for our analysis to examine whether Smart City Mission is successful in achieving equitable & long – term growth in all the concerned parameters taken under its consideration.

## II. OBJECTIVES OF OUR STUDY

1 ) To analyze whether the selected urban cities under this mission have attained equal growth in all parameters taken into considerations.

2)To examine the cost & expenditures incurred by our Union Government on different projects under Smart City Mission .

3)To examine the effectiveness of government policies and its implementations regarding different aspects under

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this Mission.

4)To critically examine both inter- regional as well as intra -regional inequalities & disparities.

5)To study whether our country would be capable of achieving its sustainability within 2030 by its Smart Cities Mission programme .

## III. RESEARCH GAP

This paper focuses mainly on the inter-regional as well as intra-regional gaps & disparities of urban India. For analytical simplicity we have divided the study into two regions: Eastern region(including North-eastern cities) and Western region. Each region comprises 17 cities, selected in an unbiased manner. The analysis is based on seven key parameters under Smart Cities Mission. It includes :

- Health ("Number.of hospital beds" is taken in our study)
- Electricity Consumption
- Roads
- Street Lights
- Open Spaces
- Households & Firms Door to Door Collection( Solid Waste Management)
- Community Facilities

During the study, two major challenges were encountered.

- Several cities showed missing values across different parameters.
- The dataset was available only up to 2021–2022, as no updated data has been published by the Ministry of Housing and Urban Affairs since then.

These limitations represent the primary research constraints and gaps in our analysis.

## IV. RESEARCH METHODOLOGY

In this paper, our primary objective is to study the regional-disparities in respect of the parameters under Smart City Mission .The analysis of the disparities has been done by two approaches : Inter-Regional Disparities & Intra-Regional Disparities. The main aim of our study is to analyse whether Smart City Mission is able to benefit the urban cities equally in all sectors. The analysis of the data obtained will be done in " R programming" . The steps below describes the entire methodology:

### A. Data Collection

The data consist of updated yearly dataset of 2021- 2022 for various parameters under this mission. From analytical simplicity , we are considering only eastern region(including North-eastern cities) and Western region of India. In each region , we have arbitrarily chosen 17 cities & 7 parameters. The 7 parameters are :

- Health ("no.of hospital beds" is taken in our study)
- Electricity Consumption
- Roads
- Street Lights
- Open Spaces
- Households & Firms Door to Door Collection( Solid Waste Management)
- Community Facilities

The source is assumed to be a structured CSV file or Excel spreadsheet with the first column as **Cities** and subsequent columns representing the **Parameters** considered in our study .

### B . Statistical Analysis

**(i)Inter-Regional Analysis :**Here we will perform two types of test

**(1)Shapiro-Wilk Test (Normality Test)**

- **Objective**: Check whether the data for each parameters follows normal distribution.
- **Test used**: shapiro.test() in R.
- **Null hypothesis ($H_0$)**: The data is normally distributed.
- **Interpretation**: If p-value < 0.10, reject $H_0$ ⇒ data is **not** normally distributed.

**(2)Mann Whitney U Test (Non-Parametric Test)**

In this case 2 types of test will be performed:

**( a) Mann Whitney U Test (Two-sided) :**

- **Null Hypothesis ($H_0$):**No significant mean growth difference between thetwo regional cities.
- **Alternative Hypothesis ($H_1$)**: Mean Growth in Eastern Cities ≠Mean Growth in Western Cities
- **Interpretation** : A **p-value < 0.1** suggests *significant differences in the mean growth between two regional cities.*

**( b) Mann Whitney U Test (One-sided) :**

- **Null Hypothesis ($H_0$):**Mean Growth in Eastern Cities = Mean Growth in Western Cities.
- **Alternative Hypothesis ($H_1$)**: Mean Growth in Eastern Cities < Mean Growth in Western Cities.
- **Interpretation** : A **p-value < 0.1** suggests *significant growth in western cities as compared to eastern cities.*

From the dataset it has been seen that the mean of Eastern cities is less than that of western cities , so while taking the Alternative Hypothesis we shall consider only " Mean Growth in Eastern Cities <Mean Growth in Western Cities.

**(ii)Intra-Regional Analysis:** In this section , we shall examine which parameter exhibits equitable growth throughout the eastern region as well as in western region , taken separately. For this purpose, we will be using Coefficient of Variation (CV)

***Coefficient of Variation = ( Standard Deviation / Mean)***

- The higher values of C.V indicates greater the relative variability.
- The lower values of C.V indicates lower the relative variability.

### C . INTERPRETATION OF THE RESULT

Based on:

- **Shapiro-Wilk Test →** Check if normality assumptions are met.
- **Mann-Whitney U- test (Non- Parametric Test)→**

**Inter-Regional Analysis**

- **Mann Whitney U Test (Two-sided) :**Check if there is any significant differences in growth between two regional cities
- **Mann Whitney U Test (Two-sided) :**Check if the growth in eastern cities is lower as compared to that of western cities.

- **Coefficient of Variation**→Check each region-wise which parameters shows higher & lower relative variability.

## V. DATA REPRESENTATION

**EASTERN CITIES**

| CITIES | Health(no .of hospital beds) | Roads(in km) | Electricity consumption (in lakhs) | Open Spaces( in sq.km) | Street Lights | Households& Firms Door to Door Collection(Solid wastes collection) | Community Facilities |
|---|---|---|---|---|---|---|---|
| NEW TOWN KOLKATA | 1491 | 183.2 | 272.25 | 3.9408 | 5508 | 35291 | 14 |
| MUZAFFARPUR | 328 | 550.36 | 106.88 | 0.032 | 19000 | 53310 | 3 |
| BHAGALPUR | NA | NA | NA | NA | NA | 274371 | NA |
| PATNA | NA | NA | 13000 | NA | 123872 | 272480 | 31 |
| RANCHI | 329 | NA | NA | NA | 52585 | 152891 | 110 |
| BIHAR SHARIFF | NA | NA | 250 | NA | 8205 | NA | NA |
| ROURKELA | 1617 | NA | 265 | NA | NA | 82131 | 1 |
| PORT BLAIR | NA | 63.285 | 11351544 | 1.289 | 14163 | 46456 | 17 |
| ITANAGAR | NA | NA | NA | NA | 3755 | 57764 | NA |
| GUWAHATI | NA | NA | NA | 0.1149 | 9652 | 245938 | 18 |
| IMPHAL | NA | NA | NA | NA | NA | 57764 | 27 |
| SHILLONG | 2348 | 220.37 | 3318.5 | 33.198 | 3282 | 36000 | 27 |
| KOHIMA | 4 | 75.39 | NA | 0.035 | 800 | 22312 | 3 |
| AIZAWAL | 358 | 343.3 | 681 | 0.1325 | 7858 | 67594 | 56 |
| NAMCHI | 130 | 41.41 | | 0.022 | 3806 | 2733 | 4 |
| PASIGHAT | NA | NA | NA | 9792291 | NA | 1455 | 9 |
| AGARTALA | 2184 | 163.01 | 295.6 | NA | 3096 | 22000 | 18 |

**Figure**:1 **(Source :**https://smartcities.data.gov.in)

**WESTERN CITIES**

| CITIES | Health (no.of hospital beds) | Roads(in km) | Electricity Consumption(in lakhs) | Street Lights | Open Spaces(in sq.km) | Households & Firms Door to Door Collection(Solid Wastes Collection) | Community Facilities |
|---|---|---|---|---|---|---|---|
| AURANGABAD | 60 | 1310.99 | 517.62 | 41020 | 424.88 | 362000 | 153 |
| PIMPRI CHINCHWAD | 1304 | 1208.14 | 389.59 | 73973 | 0.39 | 575289 | 36 |
| THANE | 593 | 381 | 1135.168 | 34752 | 68.55 | 495630 | 8 |
| AMRAVATI | NA | NA | 81.053 | NA | NA | NA | 3 |
| SOLAPUR | NA | NA | 2825.551 | 40000 | 73.6 | NA | 153 |
| NAGPUR | 8771 | NA | 90644.85 | 147837 | 0.3868 | NA | 59 |
| GANDHINAGAR | 1127 | NA | NA | NA | NA | 43295 | NA |
| AHMEDABAD | 4618 | 2470 | 17665.09 | NA | 2.649 | 1586080 | 65 |
| SURAT | 27287 | 3555.66 | NA | 194952 | 59.64 | 1415145 | 343 |
| KALYAN-DOMBIVALI | 260 | 422.499 | 97.35 | 27429 | 310.21 | 368202 | 13 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SILVASSA | 323 | 12 | 6402.3 | 2185 | 0.0193 | 24105 | 7 |
| DIU | NA | 27.47 | 1759320 | 1896 | NA | 5249 | 21 |
| PANAJI | NA | NA | NA | NA | NA | 14500 | NA |
| VADODARA | NA | 1475.6 | 15506.21 | 7572 | 1492770 | 614448 | 18 |
| DAHOD | 0 | 112.146 | 368.6245 | 4637 | 0.045429 | 19292 | 4 |
| PUNE | 16009 | 1398.61 | 4068.944 | 80623 | 0.9756 | 103851 | 77 |
| PANAJI | NA | NA | NA | NA | NA | 14500 | NA |

**(Source :**https://smartcities.data.gov.in)

**Figure:**2

** In our study , eastern region includes cities of eastern states as well as north – eastern states of India in order to obtain large data set thus giving better interpretations.

## VI. DATA ANALYSIS

We have divided our analysis into 2 parts

**(1)Inter-regional analysis** :-Since our area of interest is comparative analysis between eastern & western urban cities, hence we have here two sample groups . Group 1: Eastern Cities & Group 2: Western Cities. Each group contains 17 cities & 7 parameters.

In this analysis , which test can be applied in our research , depends on the data whether it is normally distributed or not. So, ***Shapiro-Wilk Test*** has been used to check the normality of the data. If the data exhibits , normal distribution , we will be using " Two- sample t-test". But if the data does not appears to be normally distributed, then we will be using Non-Parametric Test. One such Non-Parametric Test : "***Mann Whitney U Test***" is assigned here .

Theoretically , 95% confidence interval is a very good & standard one, but practically this confidence interval is not possible to achieve. One of such reason is due to our small data set. So we are slightly relaxing the condition & instead of 95% , we are using 90% confidence interval in this paper.

- *To reject the null hypothesis ($H_0$), with **90%** confidence interval we have to check whether the p-value of the test is less than **0.1** or not .*

**A. Shapiro-Wilk Test (Normality Test)**

This test checks whether the data in each sector is **normally distributed**.

- **Null Hypothesis ($H_0$):** Data is normally distributed
- **Alternative Hypothesis($H_1$):** Data is not normally distributed.
- A **p-value < 0.1** suggests **non-normality.**

## VII. DATA ANALYSIS

| Parameters | Eastern Cities (p-values) | Western Cities (p-values) | Interpretation |
|---|---|---|---|
| 1)Health | 0.0627 | 0.0004044 | Data does not appears to be normally distributed for both cities. |
| 2)Roads | 0.168 | 0.096 | For Eastern Cities data is normally significant but for western cities, it is not normally distributed.(****In our analysis, data of both the cities must be normally distributed jointly***) |
| 3)Electricity | 3.28e-07 | 7.707e-07 | Data does not appears to be normally distributed for both cities |
| 4)Street Lights | 3.306e-05 | 0.01632 | Data does not appears to be normally distributed for both cities |
| 5)Open Spaces | 3.218e-07 | 1.211e-06 | Data does not appears to be normally distributed for both cities |
| 6)Households & Firms Solid Waste Collection | 0.001178 | 0.001877 | Data does not appears to be normally distributed for both cities |
| 7)Community Facilities | 0.0007195 | 0.0005161 | Data does not appears to be normally distributed for both cities |

**Figure**:3

Thus we can say both data sets of eastern & western cities do es appears to be normally distributed. Hence we shall do the comparative analysis between eastern & western urban c ities with the help of "***Mann Whitney U Test***", which is a no n- parametric test.

**B. Mann Whitney U Test (Non-Parametric Test)**
This test checks whether there is any difference in the growth of eastern & western urban Indian cities as considered in our analysis . In this case 2 types of test will be performed:

**( i) Mann Whitney U Test (Two-sided) :**

**Null Hypothesis ($H_0$):** The mean growth of Eastern cities is equal to the mean growth of Western cities.

**Alternative Hypothesis ($H_1$):** The mean growth of Eastern cities is not equal to the mean growth of Western cities.

**A p-value < 0.1 suggests** *that the difference in growth between Eastern and Western cities is* ***statistically significant*** *at the 10% level.*

| Parameters | p- values | Interpretations |
|---|---|---|
| Health | 0.120 | No significant difference in the distribution of **Health** values |
| Roads | **0.0908** | Significant difference in the distribution of **Road**values |
| Electricity | 0.357 | No significant difference in the distribution of E**lectricity consumption** values |
| Street Lights | 0.122 | No significant difference in the distribution of **Street lights** values |
| Open Spaces | 0.2188 | No significant difference in the distribution of **Open Spaces**values |
| Households & Firms Door to Door Collection | 0.22 | No significant difference in the distribution of **Households Firms Door to Door Collection**values |
| Community Facilties | 0.167 | No significant difference in the distribution of **Community Facilities** values. |

**Figure**:4

**( ii) Mann Whitney U Test (One-sided) :**

- **Null Hypothesis ($H_0$):** Growth in Eastern Cities = Growth in Western Cities.
- **Alternative Hypothesis ($H_1$)**:Growth in Eastern Cities < Growth in Western Cities.

- A **p-value < 0.1** suggests *that growth in western cities as compared to eastern cities is* ***statistically significant*** *at the 10% level.*

**Since it has been observed that the mean of Eastern cities is less than that of western cities , so while taking the Alternative Hypothesis we shall consider only "Growth in Eastern Cities < Growth in Western Cities.

| Parameters | p- values | Interpretations |
|---|---|---|
| Health | 0.327 | No significant evidence that **Health** values in eastern cities are lower than in western cities |
| Roads | **0.0468** | Significant evidence that eastern cities have lower mean **Road**values |
| Electricity | 0.289 | No significant evidence that **Electricity**values in eastern cities are lower than in western cities |
| Street Lights | **0.0488** | Significant evidence that **Street Lights**values in eastern cities are lower than in western cities |
| Open Spaces | 0.148 | No significant evidence that **Open Spaces**values in eastern cities are lower than in western cities |
| Households & Firms Door to Door Collection | **0.0147** | Significant evidence that **Households Firms Door to Door Collection**valuesin eastern cities are lower than in western cities |
| Community Facilties | 0.131 | No significant evidence that**Community Facilities**valuesin eastern cities are lower than in western cities. |

Figure:5 Summary of Significant Findings (90% Confidence)

1. ROADS:

• Both two-sided and one-sided tests show significant differences, with eastern cities having fewer roads than western cities.

2. STREET LIGHTS:

• One-sided test shows eastern cities have significantly fewer street lights than western cities.

3. HOUSE HOLD FIRMS DOOR TO DOOR WASTE COLLECTION:

• One-sided test shows eastern cities have significantly lower waste collection values than western cities.

For all other variables : Health, Electricity Consumption, Open Spaces and Community Facilities, there are no statistically significant differences between eastern and western cities at the 90% confidence level.

2)INTRA- REGIONAL ANALYSIS:- In this sub-section we shall examine which parameter exhibit equitable growth throughout the eastern region as well as in western region , taken separately. Here we shall make a comparative analysis among the different parameters of a particular region. For this we take the help of Coefficient of Variation (CV) which shows comparison of variability across the parameters , regardless of their units. It is expressed with the help of the following formula :

Coefficient of Variation = ( Standard Deviation / Mean)

- The higher values of C.V indicates greater the relative variability.
- The lower values of C.V indicates lower the relative variability.

EASTERN CITIES

| Parameters | Coefficient of Variation(C.V) |
|---|---|
| Health | 0.95 |
| Roads | 0.83 |
| Electricity Consumption | 3 |
| Street Lights | 1.73 |
| Open Spaces | 3 |
| Households & Firms Door to Door Collection | 1.05 |
| Community Facilities | 1.19 |

Figure:6

Interpretation of the findings (Coefficient of Variation) for Eastern Cities:

1) Open spaces & Electricity Consumption have the highest C.V value (=3) thus indicating extreme relative inequalities of both the parameters among the eastern cities.

2) Roads has the lowest C.V value which implies lowest relative inequalities among all the eastern cities.

3) Parameters such as Health, Street lights, Households & firms door to door collection & Community

4) Facilities depicts moderate relative inequalities within the region.

**WESTERN CITIES**

| Parameters | Coefficient of Variation(C.V) |
|---|---|
| Health | 1.6 |
| Roads | 0.99 |
| Electricity Consumption | 3.32 |
| Street Lights | 1.12 |
| Open Spaces | 3.46 |
| Households & Firms Door to Door Collection | 1.28 |
| Community Facilities | 1.37 |

**Figure**:7

**Interpretation of the findings (Coefficient of Variation) for Western Cities:**

1)Open Spaces has the highest C.V value thus exhibiting extreme relative inequalities among the western cities.

2) Electricity Consumption , after open spaces , has a higher C.V value which indicates larger relative inequalities within the region.

3)Roads has the lowest C.V value indicating lowest relative inequalities.

4) Remaining Parameters such as Health, Street Lights, Households & Firms Door to Door Collection & Community Facilities show moderate C.V values thus depicting presence of relative inequalities within the region.

## VII. CONCLUSION

In this paper, we have examined the growth of regional inequalities between the eastern & western Indian urban cities under Smart City Mission. To obtained our desired result, we have divided our analysis into two parts: Inter – Regional Analysis and Intra- Regional Analysis. In both the approach , "R" programming has been used for deriving the desired result.

The ***Inter-Regional Analysis*** shows that *only in case of the parameters , namely Roads , Street lights & Households & Firms door to door collection;* ***the growth of eastern cities is much lower with respect to the growth of western cities.*** While in case of other remaining parameters like Health, Open Spaces, Electricity Consumption & Community Facilities; ***there is no such significant difference between the two regional urban cities , taken under consideration.***

Now let us focus on ***Intra-Regional Analysis***, where we have observed the inequality separately region -wise. The result obtained shows: ***In both Eastern cities as well as Western Cities under Smart City Mission ; Open spaces & Electricity Consumption depicts extreme variability in each respective regions, while Roads depicts lowest variability in each respective regions.***

Thus by adjoining both the analysis, we can conclude that *though eastern cities have fewer roads in respect to western cities, but its growth is nearly equitably distributed in both eastern & western urban cities under Smart City Mission of India.* Also it has been observed that western cities is slightly more ***focused , advanced & developed*** in areas of Construction of Roads, Street Lights & Solid Wastes Collection from Households & Firms , as compared to eastern cities. With this analysis, we can say that Smart City Mission does not ensure equitable growth in all areas & in all Indian urban cities. The reason for its failure lies behind the fact of too much expenditure in Indian election cycles both by Union & local governments, political unrest, unprecedented

COVID-19(which has pushed back our economy), projects delay , inefficient way of handling investment etc.

## VIII. FUTURE PROSPECTS

1) Active & Joint Participation of Public and Private sector is required for efficient & economical way of handling investment.
2) The projects under this mission must encourage active participation of the citizens through democratic policies.
3) More emphasis on climate resilience, green building & sustainability

Effective implementation of Pan -City Initiatives like smart waste management, smart water management, broad network coverage for all the people across the cities, Integrated Control & Command Centres (ICCC) like traffic & emergency responses.

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