Research Paper

EPRA International Journal of Economic and Business Review-Peer Reviewed Journal
Volume - 13, Issue - 12, December 2025 | e-ISSN: 2347 - 9671| p- ISSN: 2349 – 0187

SJIF Impact Factor (2025): 8.862 || ISI Value: 1.433 || Journal DOI URL: https://doi.org/10.36713/epra2012

PUBLIC PERCEPTIONS OF MUNICIPAL SERVICES: A STUDY OF SMART CITY, BHUBANESWAR IN ODISHA

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ABSTRACT
DOI No: 10.36713/epra25311 **Article DOI: https://doi.org/10.36713/epra25311**

The objective of the study is to analyse the perceptions of people about smart city of Bhubaneswar in Odisha. The study takes a primary study of 205 respondents from the slum areas of Bhubaneswar from the time period of October 2023 to March 2024 to examine socio-economic profiles and perception of smart city services. The sample shows the income level of individuals, which is below 30,000, as a benchmark and a non-normal income distribution. Perception results are mixed and polarized on the basis of infrastructure, water, waste, and healthcare score relatively well, while awareness, financial transparency, and grievance redressal score poorly. Regression and non-parametric tests show income, education, and job type influence satisfaction, but most models explain little variance, implying important unmeasured factors. Policy priorities emerging are improved transparency, stronger grievance mechanisms, targeted outreach, and gender-sensitive, employment-linked interventions.

KEYWORDS: ***Bhubaneswar Municipality Corporation, Development, Perception of Residents, Socio-Economic Profile, Smart City***

INTRODUCTION

Rapid urbanization and the push for technology-driven governance have made "smart city" initiatives a central pillar of contemporary urban policy in India. These initiatives promise improved service delivery, better infrastructure, and more responsive local governance, but their success ultimately depends on how residents experience and perceive those changes, particularly in vulnerable communities that often bear the brunt of urban inequities. This paper examines resident perceptions and opinions of Bhubaneswar Municipal Corporation (BMC) services using a primary survey. By focusing on low-income neighbourhoods, the study foregrounds voices that are frequently underrepresented in municipal evaluation: those for whom service reliability. transparency, grievance redressal, and livelihood impacts matter most. In this paper, the perceptions of people of Bhubaneswar about smart city is analysed.

LITERATURE REVIEW

Smart city initiatives should balance technological investments with social/civic capacities, where strategy must include people, institutional arrangements, and governance, not only sensors and platforms. Smart city is a multi-dimensional concept which covers Information and technology, governance, people/skills, economy, environment, liveability, etc. There is useful taxonomy and synthesis, which is limited in empirical testing, mainly conceptual or theoretical in nature(Sinkiene et al., 2014).Municipalities should audit their organizational capacity and community readiness before adopting participatory tech, plan for moderation, outreach, and multi-channel engagement. there is one review paper that has been made of online participatory tools(OPTs) for planning, integrating planning, organization, and information-science literature to provide criteria for tool selection. Practical, planning-oriented guidance that bridges tech and institutional realities not an empirical evaluation of tool performance(Afzalan et al., 2017). Smart-city discourse is shaped by long-term urban visions and recent knowledge economy policy. Technology push (market for solution)interacts with cities' demand for efficiency and sustainability. Historical and conceptual tracing of the smart-city idea, which identifies forces shaping the concept in terms of urban futures visions, knowledge/innovation economy, technology push, and demand pull from cities. The smart city stakeholder ecosystem is complex, and risks include drifting away from civic goals as commercial interests and fragmented agendas shape deployments. Strategic planning must retain normative urban goals in terms of equity, accessibility, and avoid treating smartness as only a technology or vendor problem. Strong conceptual framing argues convincingly for strategic planning and stakeholder alignment(Angelidou, 2017). Solid technical contribution in terms of MDTW adaptation, simulation is context specific, and practical implementation needs consideration of privacy, data governance, and driver behaviour heterogeneity. The paper proposes a practical framework to collect electric-vehicle(EV) trajectory data via edge devices, detect drivers' route preferences, and simulate pricing strategies for charging

stations. Empirical tests with the real EV trajectories for simulation experiments.(Hu et al., 2019).

Perception gaps between administrators and citizens matter politically and for legitimacy as governments must monitor public perceptions and link efficiency reforms with protecting core services. The paper compares perceptions of ordinary citizens vs municipal decision makers about service changes during cutbacks in the 1990s.there are surveys and attitudinal analysis has been made. Decision-makers were more likely than citizens to view service changes positively and to support cutbacks or shifting responsibilities away from municipalities. Citizens perceived declines in key services in terms of healthcare and childcare, and resisted further reductions. Citizens' negative perceptions of service declines are associated with resistance to further reforms, where decision makers' positive perceptions are correlated with support for continued retrenchment(Blomberg, 1999).Policy/finance reforms that rely on complex instruments need careful institutional capacity-building and critical assessment of narratives that can normalise risky practices. Sociological /process tracing analysis of how narratives shaped the expectations and adoption of financial derivatives by municipalities. There are interviews and comparisons mode has been accepted. Deep qualitative insight into expectation formation, which is useful for understanding municipal decision-making beyond pure econometrics(Fastenrath et al., 2018). Design of fiscal decentralisation and equalisation requires close calibration to local cost structures, where fiscal rules that look good at the aggregate level can mask local inequities. There is solid fiscal analysis with policy relevance, context specific to Slovenia's institutional framework. There is an analysis of Slovenia's system for financing municipalities and its compliance with decentralisation principles. There is the use of fiscal data from 2002 to 2009(Brezovnik & Oplotnik, 2012). Municipal financial problems are multi-causal; HR perceptions alone may not predict fiscal distress, which points toward the importance of institutional governance, revenue base, and broader fiscal rules. Useful local case study and institutional contextualisation; small sample and perception-based measures limit generalisability. There is a perceived HR risk that did not have a statistically significant influence on reported financial problems in the sample. The paper discusses municipal funding sources, MFMA responsibilities, and institutional requirements(Prinsloo, S; Walker, C; Botha, L; Bruwer, JP; Smit, 2016). Urban environmental monitoring needs expansion beyond priority pollutants, which as emerging contaminants, require updated monitoring strategies. There are no target approaches that reveal pollutants not covered in routine monitoring, where snow sampling provides a useful passive integrative sample for winter atmospheric deposition(Mazur et al., 2017). Local revenue mobilisation requires public education, transparency about spending, and trust building. This connects to municipal finance discussions, where revenue utilization and perceptions are discussed. There is useful empirical evidence in an African informal sector context, which is targeted at tax administration rather than general municipal service perceptions. There is low tax knowledge and a weak perceived benefit from taxes, where high non-payment rates. Perceptions of how the government spends taxes affect compliance. There is a survey of 400 small traders on tax knowledge and perceptions in Obuasi municipality. There is divergence between expert/official views and citizen perceptions on the role of narratives in shaping official choices. For Bhubaneswar, this underscores the finding that governance/transparency perceptions lag behind infrastructure satisfaction, as there is governance legitimacy is a crucial policy target(Anane & Asamoah, 2015).

MATERIALS AND METHODS

The study used a primary survey of 205 randomly selected respondents from slum areas of the Bhubaneswar Municipal Corporation (October 2023–March 2024). It examined socio-economic characteristics (income, consumption, savings, years of residence, age, gender, education) and perceptions of smart city services, including awareness, usability, infrastructure, waste management, water and electricity, safety, transparency, healthcare, job opportunities, and municipal growth. Respondents were asked about their knowledge, usage, and satisfaction with various BMC services and smart city initiatives. A domain was considered developmentally on track when at least 50% of residents expressed satisfactory responses to related questions.

RESULTS

Socio-economic profile of the residents and their perception analysis, based on data collected during the field survey.

Table 1: Test Result of Frequency & Percent of Socio-Economic Variables

Variable	Category under Variable	Frequency	Percent
Gender	Male	98	47.8
	Female	107	52.2
Education Level	Below 10th	83	40.5
	10th to 12th	38	18.5
	12th to 15th	84	41
Job Cat	Business	58	28.3
	Custodial	81	39.5
	Clerical	66	32.2
Year of Living	Below 10 yr	69	33.7
	10yr to 20yr	61	29.8
	20yr to 30yr	75	36.6
Marital Status	Married	158	77.07
	Unmarried	47	22.93
Age	20 to 30 yr	87	42.44
	30yr to 40 yr	63	30.73
	40yr to 50 yr	55	26.83

Source: Primary Data

Table- 1 shows the descriptive analysis of the demographic profile of 205 respondents, showing a slightly female-majority sample (52.2%). Education levels are bimodal, with most respondents either below 10th standard (40.5%) or in the 12th–15th range (41%). Occupationally, the sample is largely working-class, dominated by custodial (39.5%) and clerical jobs (32.2%). Residency duration is well distributed, with both long-term settlers and newer residents represented. Most participants are married (77.07%), and the age distribution is concentrated among young to middle-aged adults (20–50 years). Overall, the sample reflects a working-class, predominantly married population with diverse residency experience and a slight female majority.

Cronbach's Alpha; Reliability statistics

Table 2: Test Result of Cronbach's Alpha

Item-Total Statistics				
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Awareness of Smart City & Facilities	25.00	49.127	-.026	.746
Use of Smart City Services?	24.83	41.119	.471	.696
Rating on Financial Management	24.42	43.657	.301	.717
Safety & Security Level	24.89	44.910	.306	.715
Grievance in Municipality	24.82	43.430	.338	.712
Growth of BMC's Expenditure	24.95	42.390	.449	.700
Satisfaction Level of Roads and Infrastructure	25.11	43.871	.316	.715
Satisfaction level Water & Electricity Supply	25.28	46.770	.167	.728
Satisfaction level Waste Management (Garbage Collection, Recycling)	24.93	43.264	.416	.704
Satisfaction Level Healthcare Facilities (BMC Hospitals, Clinics)	25.13	44.507	.375	.709
Satisfaction Level Parks, Gardens, and Recreational Spaces	25.28	45.204	.358	.712
Satisfaction Level, Transparency, and Communication on Operational Work	25.19	43.505	.391	.707
Satisfaction Level Job Opportunities	25.17	45.002	.282	.718
Satisfaction level Smart City Initiative	25.10	42.000	.595	.688
New Residential and Commercial Developments	25.09	46.702	.117	.736
Effectiveness of utilisation of revenue	25.41	45.999	.365	.713

Source- Author's calculation

The above Table 2 shows the reliability analysis of the data set. This shows the internal consistency among the variables. The value of Alpha is 0.727, as it indicates that the data is acceptable and has reliability. It indicates that the set of 16 variables moderately consistently measures the same overall construct. It has been proven that the questionnaire is reasonably reliable, but a few items may be weakening internal consistency.

There is a low corrected item as total correlation is less than 0.3, which means that the item does not align well with the rest of the scale. In awareness about the smart city case, the value is -0.026, which signifies the negative correlation. In the water & Electricity Satisfaction level, it has 0.167, and in the New Residential development level, it is 0.117; these items are not contributing much to overall reliability. The two rates are not aligned at all in their scoring, so this could be due to different rating criteria. Reliability of the Alpha value is ok overall, but can be improved by removing or revising a few low-performing items.

Perception Analysis of Sample Residents of BMC

Table 3: Frequency & Percentage of Perception Analysis of Sample Residents of BMC

Variable	Rank	Frequency	Percentage
Use of Smart City Services	Agree	60	29.27
	Strongly Agree	10	4.88
	Neutral	20	9.76
	Disagree	50	24.39
	Strongly Disagree	65	31.71
Rating on Financial Management	Agree	45	21.95
	Strongly Agree	35	17.07
	Neutral	32	15.61
	Disagree	52	25.37
	Strongly Disagree	41	20.00
Safety & Security of Smart City	Agree	45	21.95
	Strongly Agree	45	21.95
	Neutral	32	15.61
	Disagree	42	20.49
	Strongly Disagree	41	20.00
Grievance in Municipality	Agree	62	30.24
	Strongly Agree	31	15.12
	Neutral	30	14.63
	Disagree	26	12.68
	Strongly Disagree	56	27.32
Growth of BMC	Agree	37	18.05
	Strongly Agree	45	21.95
	Neutral	21	10.24
	Disagree	52	25.37
	Strongly Disagree	50	24.39
Satisfaction Level in Road & Infrastructure	Agree	47	22.93
	Strongly Agree	40	19.51
	Neutral	21	10.24
	Disagree	45	21.95
	Strongly Disagree	52	25.37
Satisfaction Level in Water & Electricity Supply	Agree	52	25.37
	Strongly Agree	38	18.54
	Neutral	30	14.63
	Disagree	49	23.90
	Strongly Disagree	36	17.56
Waste Management	Agree	45	21.95
	Strongly Agree	43	20.98
	Neutral	33	16.10
	Disagree	50	24.39
	Strongly Disagree	34	16.59
Healthcare Facilities	Agree	44	21.46
	Strongly Agree	51	24.88
	Neutral	23	11.22
	Disagree	46	22.44
	Strongly Disagree	41	20.00
Parks, Gardens, and Recreational Spaces	Agree	46	22.44
	Strongly Agree	52	25.37
	Neutral	12	5.85
	Disagree	52	25.37
	Strongly Disagree	45	21.95
Transparency and Communication on Operational Work	Agree	37	18.05
	Strongly Agree	43	20.98
	Neutral	10	4.88
	Disagree	57	27.80
	Strongly Disagree	58	28.29
Job Opportunities	Agree	48	23.41
	Strongly Agree	43	20.98

	Neutral	11	5.37
	Disagree	50	24.39
	Strongly Disagree	53	25.85
Effectiveness of the Utilization of Revenue	Agree	37	18.05
	Strongly Agree	53	25.85
	Neutral	22	10.73
	Disagree	45	21.95
	Strongly Disagree	49	23.90

Source- Primary data and Author's Calculation

The perception analysis table-3 shows mixed but largely negative views on several smart city services. Most respondents are dissatisfied with the use of smart city services (56.1% negative) and express low adoption. Financial management perceptions also lean negatively, with limited confidence in BMC's fiscal practices. Safety and security receive balanced responses with a slight positive tilt, while grievance redressal remains highly polarized. Perceptions of BMC's growth and road infrastructure are mostly negative, indicating dissatisfaction with development and service efficiency. Water and electricity supply receive moderately positive responses, and waste management is viewed as average, with nearly equal satisfaction and dissatisfaction. Healthcare facilities are among the better-rated services, though opinions remain divided. Parks and recreational spaces show strong polarization. The weakest area is transparency and communication, where over half of the respondents report dissatisfaction. Job opportunities and revenue utilisation also attract substantial negative feedback. Overall, while basic services like healthcare and utilities fare comparatively better, residents show significant concerns regarding governance, transparency, infrastructure quality, and employment-related outcomes.

Table 4: Descriptive Statistics of Perception Analysis of Sample Residents of BMC

	Awareness	Usability of Smart City Services	Rating on Financial Management	Safety & Security Level	Grievance in Municipality	Growth of BMC's Expenditure	Roads and Infrastructure Work	Water & Electricity Supply	Waste Management	Healthcare Facilities	Parks, Gardens, and Recreational Spaces	Transparency and Communication on Operational Work	Job Opportunities	Smart City Initiative	New Residential and Commercial Developments	Effectiveness of utilisation of revenue
Mean	7.50	7.92	7.36	8.00	7.97	7.87	8.31	8.26	8.50	8.90	8.62	8.46	9.25	9.23	9.66	9.91
Standard Error	0.31	0.33	0.33	0.32	0.32	0.32	0.29	0.32	0.30	0.32	0.32	0.30	0.32	0.33	0.31	0.33
Median	7.00	7.50	7.00	7.00	7.50	8.00	8.00	8.00	9.00	9.00	9.00	8.00	10.00	9.50	10.00	10.00
Mode	1.00	6.00	1.00	2.00	4.00	6.00	8.00	1.00	9.00	7.00	7.00	3.00	14.00	5.00	15.00	15.00
Standard Deviation	4.48	4.77	4.74	4.57	4.63	4.59	4.24	4.58	4.28	4.61	4.66	4.38	4.59	4.69	4.53	4.71
Kurtosis	-1.07	-1.27	-1.25	-1.15	-1.21	-1.11	-0.95	-1.14	-1.01	-1.19	-1.22	-1.13	-1.09	-1.30	-1.22	-1.08
Skewness	0.25	0.18	0.25	0.19	0.22	0.15	0.02	0.00	0.00	-0.10	-0.09	0.08	-0.32	-0.14	-0.27	-0.39
Range	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Minimum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Sum	1559.00	1648.00	1530.00	1664.00	1657.00	1636.00	1729.00	1718.00	1769.00	1851.00	1792.00	1760.00	1924.00	1919.00	2010.00	2062.00

The descriptive statistics, table-4, show that perceptions are highest for revenue utilisation, new residential development, job opportunities, and overall smart city initiatives, all with mean scores above 9, indicating strong approval of urban development efforts. Lower-rated areas include financial management, awareness, and grievance handling, reflecting weaker satisfaction with governance and citizen support systems. High standard deviations and a full 1–16 rating range indicate wide variability and polarized opinions. Skewness values near zero and negative kurtosis suggest broadly spread, nearly symmetrical responses. Mode values reveal strong contrasts: some variables with high averages still show many very low ratings (e.g., awareness, financial management), while development-related variables show clusters of very high ratings.

Infrastructure, utilities, waste management, and healthcare receive generally positive evaluations, whereas grievance redressal, financial management, and transparency record lower trust levels. Overall, public perception is most favourable toward physical development and revenue utilisation but remains divided on governance quality, communication, and administrative efficiency.

Correlation Matrix on Perception of the Residents:

Table 5: Correlation Matrix of Socio-Economic Profile of Sample Residents of BMC

Variable	Age	Gender	Education Level	Job Cat	Year of Living	Income (Per Month)	Expenditure on Education	Expenditure on Food	Expenditure on House Maintenance	Saving
Age	1									
Gender	-0	1								
Education Level	-0.1	-0.03	1							
Job Cat	0.1	-0.03	0.15	1						
Year of Living	0.05	-0.61	0.02	0.04	1					
Income (Per Month)	-0	-0.08	0.09	0.02	0.05	1				
Expenditure on Education	-0	0.08	0.01	-0.06	-0.12	0.28	1			
Expenditure on Food	-0.1	0.09	0.09	0.02	-0.05	0.21	0.26	1		
Expenditure on House Maintenance	-0.1	-0.17	0.14	0.02	0.12	0.07	-0.06	0.03	1	
Saving	0.02	-0.09	0.04	0.03	0.08	0.85	-0.15	-0.11	-0.16	1

Source- Author's Calculation

The correlation analysis table 5 shows a very strong positive relationship between income and savings (0.85), indicating that higher-income households save more. Income also has a moderate positive link with education expenditure (0.28), and education and food expenditure are weakly correlated (0.26). A strong negative correlation between gender and years of living (-0.61) suggests gender-based settlement patterns over time. Savings show small negative associations with house maintenance and education spending. Most other correlations are near zero, indicating minimal linear relationships among age, job category, education level, and expenditure patterns. Overall, savings are largely income-driven, while other spending relationships are weak and reflect only minor trade-offs.

Table 5: Normality Test of Income of the Respondent

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Income of the Respondent	.172	205	.000	.924	205	.000
a. Lilliefors Significance Correction						

Extreme Values				
			Case Number	Value
Income of the Respondent	Highest	1	13	24000.00
		2	83	24000.00
		3	85	24000.00
		4	89	24000.00
		5	92	24000.00[a]
	Lowest	1	32	12000.00
		2	19	15000.00
		3	10	15000.00
		4	205	16000.00
		5	204	16000.00[b]
a. Only a partial list of cases with the value 24000.00 is shown in the table of upper extremes.				
b. Only a partial list of cases with the value 16000.00 is shown in the table of lower extremes.				

The Above table-5 shows the normality test of Income based on the Kolmogorov-Smirnov and Shapiro-Wilk tests. Both tests show P-values of 0.000(Less than 0.05), meaning the income of the respondent is not normally distributed. This implies we may go for the non-parametric statistical methods for the analysis involving the variable.

Multiple respondents have an income of 24,000, and some respondents have a low income as low as 12,000,15,000, or 16,000. These extremes are not necessarily "Outliers" in a statistical sense, but they mark the range limits. The repeated extreme values suggest the data might be clustered at certain

fixed salary points, not spread smoothly like a normal curve. The presence of multiple maximum values(24,000) may indicate a ceiling effect, as some respondents might be at the top of a fixed pay range.

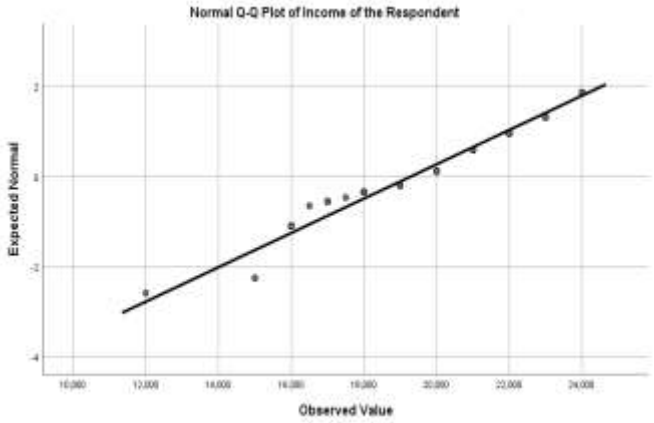


Fig.1: Normal Distribution of Income through Q-Q Plot

The above figure no.1 shows the Normal Q-Q plot for the Income of the Respondents. This Q-Q plot compares the distribution of the data to a perfectly normal distribution. If the Data were normal, all points would closely follow the diagonal reference line. But the Points at the lower income end(around 12,000-15,000) are below the line, indicating a negative skew in that tail, more low-income values than expected in a normal distribution. Data points in the mid-income range(16,000-20,000) align fairly well with the line, suggesting moderate fit in the center of the Distribution. At the Higher end(22,000-24,000), points are above the line, showing a positive skew pattern, as more high-income cases are at the extreme than a normal curve would predict. The pattern curves slightly away from the line at both ends, meaning the distribution is not perfectly normal as likely due to clustering at fixed salary points and the ceiling effect seen in our descriptive statistics.

The above diagram and the test result show that the income variable is not normally distributed.

T Test

For the analysis of T T-test, here the Research Hypothesis has been set with a test value.

Research Hypothesis: The income of the people has increased by ₹30,000 as a result of the benefits provided by the Smart City initiative.

Statistical Hypothesis

Null: There is no significant difference in the income & the Smart City initiative.

Alt: There is a significant difference in the income & the Smart City initiative.

Table 6.T Test of the Variable Income as a test value of 30,000

One-Sample T Test						
	Test Value = 30000					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Income of the Respondent	-58.335	204	0.000	-10707.3	-11069.2	-10345.4

The above table-6 shows the one-sample t-test of the Continuous Variable, i.e, Income, with a test value of Income, i.e,30,000. The result shows that the sample mean of income is significantly lower than 30,000. The t-statistic of -58.33 indicates a very large difference, and the p-value(0.000) shows this is highly statistically significant. The 95% confidence interval does not contain 0, reinforcing that the true mean income is very likely below 30,000. The average income shortfall is about 10,707. If 30,000 is considered a target income (e.g, Living Wage, Minimum Standard, Policy Benchmark), then the population is facing substantial income insufficiency.

Independent Sample T test

For the Analysis of the Independent Sample t-test, there is a comparison has been made between the categorical value & the Continuous Variable.

Research Hypothesis: Male Employees are paid more in salary in comparison to female Employees.

Statistical Hypothesis:

Null: There is no significant difference in the salaries of male and female employees.

Alt: There is a significant difference in the salaries of male and Female Employees

Table 7:Independent Sample T Test of the Income between Male & Female

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Income of the Respondent	Equal variances assumed	0.11	0.74	1.16	203	0.25	426.52	367.14	-297.37	1150.42
	Equal variances not assumed.			1.16	200.7	0.25	426.52	367.43	-297.99	1151.03

Source- Author's Calculation

The above table- 7 shows the T Test of the Sample of Categorical Value, i.e, Male & Female, with the continuous Variable Income of them. The result signifies the P-value, which shows that there is a statistically insignificant result in nature, as the value is 0.25. The mean income difference of 426.52 between the two groups is not statistically meaningful. The confidence interval includes 0, indicating that he true mean difference could be positive, negative, or zero. So there is no significant difference in the income between the two groups, which is compared above. This suggests that the income is not significantly affected by the grouping variable, like(Gender, Region, etc.).

Mann-Whitney Test

Table 8. Mann-Whitney Test between Income and the Categorical Variables

	Dependent Variable: Income					
Variable	Group 0	Group 1	Rank Sum	Adjusted Variance	z	p value
Satisfaction with Road & Infrastructure	108	97	21115	174604.26	1.7	0.089
Health Care Facilities	96	109	21115	174404.25	-1.604	0.108
Parks, Gardens & Recreational Activities	107	98	21115	174770.93	3.506	0.000
Job Opportunities	103	102	21115	175104.27	0.528	0.597
Job Category	103	102	21115	175104.27	-2.27	0.002
Usability of Smart City Services	115	90	21115	172504.21	0.975	0.3295
Education	96	109	21115	174404.25	1.044	0.296
Gender	101	104	21115	175070.94	-0.768	0.442
Year of Living	106	99	21115	174904.27	0.909	0.363
Growth of BMC	100	105	21115	175004.27	-0.253	0.8
Effective Utilisation of Revenue	97	108	21115	174604.26	-1.137	0.255

The above table 8 shows that only two variables show a statistically significant difference in income. In the recreational Activities like Parks, Gardens, and other recreational things of the Local Government has a significant impact on the income of the Residents of the Smart city. People who differ in satisfaction with recreational infrastructure have significantly different income levels. Higher satisfaction might be associated with Higher income and vice versa.

Another variable is Job Category with the Income level, where the P Value is 0.002 and the Z value is -2.270. Respondents grouped under different job categories have significantly different income levels, and job category is a direct cause of the income, and it has been considered a direct determinant, so the result is logical.

Despite this, all the variables have P values>0.05, suggesting no statistically significant difference in income across the groups.

Krushal Wallis H Test Result

Table 9. Kruskal-Wallis Test with the Dependent Variable Income and Other Categorical Variables

Dependent Variable: Income

Variable	Chi-sq (with ties)	df	p-value	Significance
Growth of BMC	15.513	3	0.001	Significant
Satisfaction with Roads & Infrastructure	16.186	3	0.001	Significant
Health Care Facilities	13.786	3	0.003	Significant
Effectiveness of Revenue Utilisation	17.180	3	0.000	Significant
Year of Living	9.074	2	0.028	Significant
Satisfaction with Parks, Gardens & Recreation	9.067	3	0.044	Significant
Job Opportunities	12.655	3	0.005	Significant
Waste Management	17.898	3	0.000	Significant
Education Level	3.893	3	0.273	Not Significant

The table-9 results show that income varies significantly across several perception-based categories, including satisfaction with BMC's growth, roads and infrastructure, healthcare, revenue utilisation, job opportunities, parks and recreation, and years of living. Higher satisfaction in these areas generally aligns with higher income levels. Only education level shows no significant relationship with income, suggesting that income differences are not driven by educational attainment. Overall, multiple service-related perceptions are linked to income variation, whereas education has no meaningful impact.

Ordinary Logistic Regression

Table 10.Ordinal Logistic Regression of Smart City Services with other variables

LRchi2(4)	**8.65**
Prob>chi2	**0.07**
Log likelihood	**-276.11**
Pseudo R2	**0.02**

Use of Smart City Services	Coefficient	Std. err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
Year of Living	13625.00	141967.00	0.96	0.34	141999.00	4145.00
Log of Income	2.32	0.94	2.48	0.01	0.49	4.16
Education Level	0.05	0.15	0.36	0.72	-0.25	0.36
Gender	-0.48	0.36	-1.31	0.19	-1.19	0.24

The Above table- 10 shows that the Likelihood Ratio test checks whether at least one predictor has a non-zero coefficient. The P-value is 0.007, which means the model is not statistically significant at the 5% level. The log likelihood is -276.11, used for comparing nested models, and the Pseudo R2 is 0.02 tends to only 2% of the variation is explained by the predictors, which is weak in explanatory power. It means many other factors influence smart city services. Only Income has a statistically significant and positive effect on the smart services usage, and other variables do not show a significant effect in this model.

Table 10.1.Ordinal Logistic Regression of Financial Management with other variables

LRchi2(4)	**11.59**
Prob>chi2	**0.01**
Log likelihood	**-272.06**
Pseudo R2	**0.02**

Rating on Financial Management	Coefficient	Std. err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
Education Level	0.52	0.16	3.28	0.00	0.21	0.83
YearofLiving	-0.01	0.01	-0.41	0.69	-0.04	0.02
Gender	-0.12	0.33	-0.36	0.72	-0.77	0.53

The above table 10.1 shows that the chi-square value is 11.59 and the p-value is 0.01, which is statistically significant at the 5% level. This means at least one of the predictors is significantly associated with the dependent variable. Pseudo R2 is 0.02 tends to explain only 2% of the variation is explained by the predictors which is weak in explanatory power.

Education level is the only statistically significant predictor. Each one-unit increase in education level increases the odds of giving a higher financial management score by 0.52. Year of living and Gender show no meaningful effect in the analysis.

The model is statistically significant overall, but practical predictive power is weak as the low Pseudo R2.

Table 10.2.Ordinal Logistic Regression of Roads & Infrastructure with other variables

LRchi2(4)	**12.72**
Prob>chi2	**0.01**
Log likelihood	**-276.26**
Pseudo R2	**0.02**

Satisfaction level on Roads and Infrastructure	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	0.03	0.02	1.88	0.06	0.00	0.06
LogofIncome	2.06	0.93	2.21	0.03	0.23	3.88
Age	-0.03	0.02	-1.89	0.06	-0.07	0.00

The above table 10.2 shows that the chi-square value is 12.72 and the P value is 0.01 signifies that the model is statistically significant overall at the 5% level, which means at least one predictor has a significant association with satisfaction levels.Pseudo R2 is 0.02 tends to explain only 2% of the variation is explained by the predictors which is weak in explanatory power. Income is the only clearly significant predictor(p=0.03), with a strong positive effect. Year of living and Age are borderline significant values (P=0.06). The direction of effect is that longer residence is slightly higher satisfaction, and older age leads to slightly lower satisfaction. A unit increase in income increases the higher satisfaction by 2.06, which is substantial in magnitude.

Table 10.3.Ordinal Logistic Regression of Roads & Infrastructure with other variables

LRchi2(4)	**21.53**
Prob>chi2	**0.00**
Log likelihood	**-269.84**
Pseudo R2	**0.04**

Satisfaction level with healthcare facilities	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	-0.06	0.02	-3.48	0.00	-0.09	-0.02
Age	0.04	0.02	2.32	0.02	0.01	0.07

The above table 10.3 shows that the value of chi-square is 21.53 and the p-value is 0.001, as it indicates that the model is highly significant overall, meaning the predictors jointly explain variation in satisfaction. Pseudo R-squared is 0.04, as about 4% of the variation in satisfaction is explained, and still a small effect size, but better than the earlier road & Infrastructure model. In the case of the Year of Living variable, for each additional year in the city, the log of income has a higher satisfaction drop of 0.06. This could suggest that long-term residents have seen a decline in health care quality or have higher expectations. In the Age variable, each additional year of age increases there is increment of satisfaction level by 0.04, possibly because older people use healthcare services more and perceive them more positively.

Table 10.4.Ordinal Logistic Regression of Smart City Initiative with other variables

LRchi2(4)	**100.60**
Prob>chi2	**0.00**
Log likelihood	**-220.03**
Pseudo R2	**0.19**

Satisfaction with Smart City Initiative	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	-0.07	0.02	-4.52	0.00	-0.10	-0.04
Gender	-0.72	0.37	-1.96	0.05	-1.45	0.00
Age	0.16	0.02	7.66	0.00	0.12	0.20
Education Level	0.10	0.16	0.63	0.53	-0.22	0.42

The above table 10.4 shows the significant value as the chi-square value is 100.60, and the P value is 0.001. Pseudo R-squared value is 0.19, which indicates that about 19% of the variation in satisfaction is explained, which is relatively strong for social perception data compared to a previous study.

The longer someone has lived in the city, the less satisfied they are with the smart city initiative, possibly due to higher expectations or awareness of shortcomings over time. If the Negative coefficient corresponds to females, women might be slightly less satisfied, but he effect is small and only just significant. Age has the strongest effect as it shows older residents have a significantly positive approach to the smart city initiative.

Table 10.5.Ordinal Logistic Regression of Utilisation of Revenue with other variables

LRchi2(4)	**9.39**
Prob>chi2	**0.05**
Log likelihood	**-275.97**
Pseudo R2	**0.02**

Effectiveness of the Utilisation of Revenue	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
YearofLiving	0.00	0.01	0.25	0.80	-0.02	0.03
Education Level	0.19	0.15	1.22	0.22	-0.11	0.49
Gender	-0.73	0.36	-2.03	0.04	-1.44	-0.02
Age	0.03	0.02	1.66	0.10	0.00	0.06

The above table 10.5 shows the statistically significant value between the variables, but overall, the effect size is small due to the Pseudo R-squared, which is 0.02, as only 2% of the variation in perceptions is explained, indicating very low explanatory power compared to the smart city initiative model. The p-value is 0.05, and the chi-square value is 9.39.

Gender is the only statistically significant factor, but other variables have no significant value. The Model explains very little of the variation in satisfaction, suggesting perceptions of revenue utilisation might be influenced by other factors.

Table 10.6.Ordinal Logistic Regression of Waste Management with other variables

LRchi2(4)	**16.14**
Prob>chi2	**0.003**
Log likelihood	-230.02
Pseudo R2	**0.03**

Satisfaction level on Waste Management	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
Year of Living	0.04	0.01	-2.89	0.004	-0.08	0.01
Education Level	0.49	0.17	2.89	0.004	0.15	0.82

The above tables 10.6 show the statistically significant value overall, meaning the predictors jointly explain differences in satisfaction levels. The p-value is 0.003, and the chi-square value is 16.14. The model explains around 3% of the variance in satisfaction, which is small but meaningful. The Pseudo value is 0.03.Log likelihood is 0230.02, which is used for the model comparison and indicates a better fit. Both Predictors are statistically significant at the 1% level. If the year of living coefficient is negative, then the longer-term residents are more critical of waste management, possibly because they have seen little improvement over time or compare current services unfavourably to past expectations. Education shows a positive association, as more educated respondents may better understand or appreciate the waste management system of the smart city. Even though the model explains only 3% of the variance, the effects of education and residency duration are both clear and significant. Communication and service improvements may need to be targeted more towards long-term residents, who may be harder to please.

Table 10.7.Ordinal Logistic Regression of Water & Electric Supply with other variables

LRchi2(4)	**9.69**
Prob>chi2	**0.001**
Log likelihood	**-149.72**
Pseudo R2	**0.031**

Satisfaction level on Water & Electric Supply	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
YearofLiving	0.03	0.02	2.25	0.02	0.00	0.06

The above table 10.7 shows that the chi-square value is 9.69 and the p-value is 0.001, which indicates that the model is statistically significant overall as the predictors explain variation in satisfaction levels better than a null model. The R-squared value is 0.031, which indicates that the model explains about 3.1% of the variance, which is small but non-trivial for

social perception data. The value of log likelihood is -149.72, as lower than the null model, indicating improvement in fit. There is a positive association between years of living and the satisfaction level of water & Electric supply. Long-term residents tend to receive services positively as they have faced hardships earlier.

Table 10.8.Ordinal Logistic Regression of Recreational Activities with Other Variables

LRchi2(4)	**50.09**
Prob>chi2	**0.00**
Log likelihood	**-257.41**
Pseudo R2	**0.09**

Satisfaction level on Parks, Gardens, etc.	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
Age	0.08	0.02	4.45	0.00	0.04	0.11
YearofLiving	-0.06	0.02	-4.07	0.00	-0.09	-0.03
Gender	-1.06	0.36	-2.92	0.00	-1.76	-0.35

The above table 10.8 shows that the variable is highly statistically significant. The chi-square value is 50.09, and the p-value is 0.001, which shows that the predictors together explain a meaningful portion of the variation in satisfaction. The Pseudo R-squared value is 0.09, as it explains that about 9% of the variance is quite decent for perception-based data, and the log likelihood value is -257.41, indicating improvement in fit over the null model.

Older respondents have a positive effect on the parks, gardens, and other recreational initiatives of the smart city, possibly due to greater use for leisure, walking, or socialising with others. Longer term, Residents tend to be less satisfied, and this could point to service delineation, unfulfilled promises, or higher expectations. In the Gender Effect, women report significantly lower satisfaction could relate to safety concerns, maintenance issues, or accessibility in these public spaces.

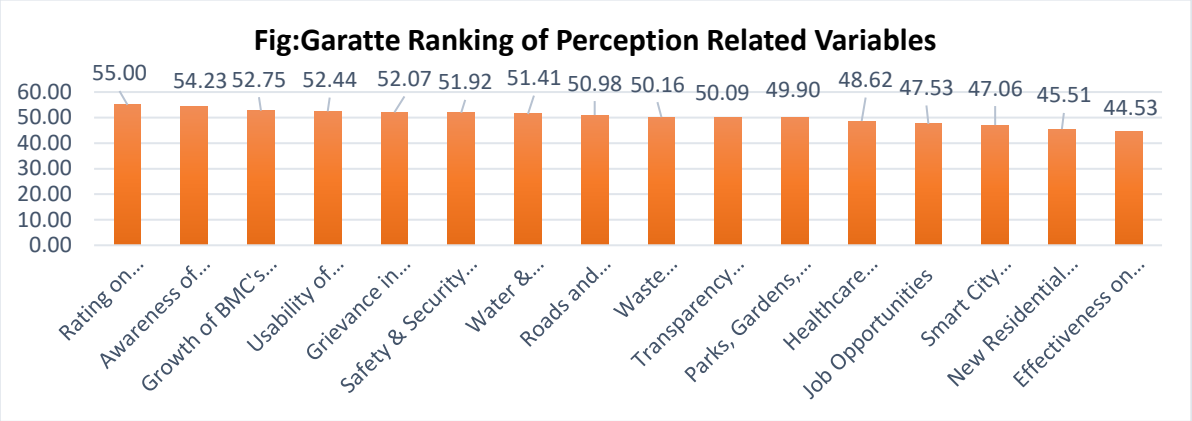
Garatte Ranking Technique

Table 11.Garatte Ranking Technique Between the Variables

Ranking on Slum Data		
Variable	**Average**	**Garatte Rank**
Rating on Financial Management	55.00	1
Awareness of Smart City & Facilities	54.23	2
Growth of BMC's Expenditure	52.75	3
Usability of Smart City Services	52.44	4
Grievance in Municipality	52.07	5
Safety & Security Level	51.92	6
Water & Electricity Supply	51.41	7
Roads and Infrastructure Work	50.98	8
Waste Management	50.16	9
Transparency and Communication on Operational Work	50.09	10
Parks, Gardens, and Recreational Spaces	49.90	11
Healthcare Facilities	48.62	12
Job Opportunities	47.53	13
Smart City Initiative	47.06	14
New Residential and Commercial Developments	45.51	15
Effectiveness of utilisation of revenue	44.53	16

The Garatte ranking shows that residents place the highest priority on governance-related aspects such as financial transparency, awareness, and grievance redressal. Core urban services like water, roads, and safety rank in the middle, indicating moderate satisfaction but room for improvement. Development-oriented factors—jobs, new projects, parks, and healthcare—rank lower, suggesting these are seen as less urgent compared to governance and service delivery issues. Overall, the results highlight the need for stronger transparency, better communication, and improved citizen outreach as key municipal priorities.

Fig.5: Garatte Ranking of Perception Related Variables



The fig.2 consists of ranking results showing that governance-related variables—financial management, smart city awareness, BMC's growth, service usability, and grievance redressal—are top priorities for residents. Mid-ranked factors include safety, water and electricity supply, and road infrastructure, indicating they are important but secondary to governance concerns. Lower-ranked items such as parks, healthcare, job opportunities, new developments, and revenue utilisation suggest these are seen as less urgent. Overall, residents prioritise transparent governance, effective communication, and accessible services over infrastructural or recreational enhancements, highlighting a gap in public understanding of revenue utilisation.

CONCLUSION

The perception of individuals is polarized, which is visible in infrastructure gains coexisting with widespread dissatisfaction with governance, transparency, and awareness. Socio-economic factors like income, education, and job category affect service uptake and satisfaction, but explain only a small share of perceptual differences. Long-term residents and women express distinct concerns with lower satisfaction in several domains, signalling the need for differentiated approaches. immediate municipal priorities which increase fiscal transparency, improve grievance redressal and communication, expand targeted outreach in slum communities, and link smart-city projects to local employment.

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