

Assessing Physical Development in the Local Areas of Bhopal by Evaluating Identified Physical Amenities

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Abstract: *In India, there are 8 cities which have four million plus population, out of which 37 cities with one million plus but less than four million populations and 449 cities are there with one lakh, but less than one million population as per 2011 census. The 2011 census clearly shows how important cities are in India and how fast India is developing. Indian cities that were already large at the time of independence have continued to increase in size until they have reached the stage of mega cities. The same location and economic forces that drove the original growth of cities at favorable geographical sites have continued to attract migrants in search of opportunities. The problem of inadequate physical amenities in any such growing city of developing country is inevitable. There is a need to assess existing level of physical development in local areas of any such city to find out a gap between demand and supply of physical amenities. Bhopal, the city selected to assess physical development in its local areas, is one such city with the population of more than one million, but less than four million. Also the geography, demography and economics of the city make it an ideal city for the study. The paper intends to assess level of physical development in the local areas of Bhopal, by evaluating identified physical amenities.*

Index Terms: *city, local areas, physical amenities, physical development*

I. INTRODUCTION

In developing country housing, along with physical infrastructure, social infrastructure, environmental aspects, economy and governance are the major areas to be worked upon to ensure development. The policies, programs, schemes and projects to address the problem of inadequate physical development are focused at both international and local levels. These efforts to address the problem can be applicable only when existing status of physical development is known, to find the gap between demand and supply. To know the existing status need to assess local area physical amenities was felt. The study aims to assess the physical development in local areas with identified physical amenities. The assessment of physical development in the local areas was based on the secondary data of physical amenities

available from government organisations. The secondary data available from Census 2011[5] was for 80 wards and the

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Bhopal Municipal Boundaries has 85 wards at present. Therefore secondary data of physical amenities was extracted from Smart Map Bhopal [Bhopal Smart City Development Corporation Limited] [4] for the study. This data was for all 85 wards within Bhopal Municipal Corporation Boundaries and was last updated in 2014. Ward-wise secondary data of physical amenities was not directly available, it was extracted from the latest updated Maps available with Bhopal Smart City Development Corporation Limited (Smart Map Bhopal) [Bhopal Smart City Development Corporation Limited] [4] for the study.

II. UNDERSTANDING THROUGH KEY DEFINITIONS

A. Urban or City

City is comprised of group of neighbourhoods. [Adams, Bassett and Whitten 1929] [1]

Area covered within the Municipal Boundaries is defined as city for the study.

B. Local Area

Belonging to the area where one lives is local. Neighbourhood or community is also sometimes referred as Local area.

Concept neighbourhood by Clarence Stein and Henry Wright of twentieth century is defined as; a central green space grouped around by superblock of residential units, with separate vehicular and pedestrian ways, and a road hierarchy with culs-de-sac to locally accessed roads. A self-contained neighbourhood has a cluster of superblocks. A city is a group of neighbourhoods. [Adams, Bassett and Whitten 1929] [1]

Clarence Perry- The physical arrangement of nursery school, parks, sports grounds and local shops was the idea of neighbourhood for Perry. Every neighbourhood was to be a unit of city. [PERRY, CLARENCE. 1929] [11]

The Local area is also defined as wards in the URDPFI GUIDELINES [URDPFI GUIDELINES.]. [12]

The Local area is defined as wards for the study.

C. Local Area or Area Based Development

Improvement (retrofitting), city renewal (redevelopment), city extension (green field development) and pan city concept (using modern technology solutions to the existing city infrastructure) are the components adopted for area based development; which will change the existing deteriorating areas into better planned ones and to accommodate the expanding populations in newly developed urban areas. [MOUD. 2015] [10]

The development of the Local area on the basis of locally felt needs is termed as local area development.[MOSPI. 2016.] [9]

III. IDENTIFYING INDICATORS AND SUB-INDICATORS

A. Water Facility

For the study, indicator of physical development, water facility has been confined to number of water tanks (sub-indicator) in the local areas (wards). Literature review show that tap water was accessible to 70.89% [Handbook, District Census 2011, Part XII B] [6] of the Bhopal's urban population. Out of the total Households 396,666, of which 62.24% has a treated water supply and 8.65 has untreated water supply and population dependent on hand pump is 7.4% (not an indicator for middle income group physical amenities) and on tube well/bore well is 15.36% , rest 2.35% is dependent on tank/pond/ lake for its water need. [Handbook, District Census 2011, Part XII B, Table-3] [6].The statistics show that more than 15% of the population is dependent on other sources because of the insufficient supply of water. This problem can majorly be resolved by increasing the capacity of water i.e. by increasing the number of water tanks in the local areas(wards), wherever required. Hence need to survey number of tanks was identified.

B. Education Facility

For the study, indicator of physical development, education facility has been confined to number of schools, colleges and other training institutes (sub-indicators) in the local areas (wards).Literature review of Statement-V, District Census Handbook 2011, show the complete dependency of Kolar (M) on Bhopal (M. Corp.) for its educational facility, whether for schools, colleges or other training institutes. [Madhya Pradesh, District Census Handbook 2011, Part A, Statement-V] [8]. Kolar which was 3rd town as per census 2011, but now it comes under Bhopal Municipal Corporation and it is now required to address this issue on priority.

C. Lighting Facility

For the study, indicator of physical development, lighting facility has been confined to number of smart poles (sub-indicator) in the local areas (wards). Literature review show that out of 396,666 households, in urban areas of Bhopal, 97.03% i.e. 384,871 households has electricity supply.[Handbook, District Census 2011, Part XII B, Table-3][6].Therefore availability of streetlights etc. is not an issue (though their workability and maintenance can be an issue). Preference is given to shift to more smart solutions in the future, so smart poles were considered for the study.

D. Health facility

For the study, indicator of physical development, health facility has been confined to number of hospitals, blood bank and other (dispensaries/clinics) (sub-indicators) in the local areas (wards).Literature review of Statement-IV, District Census Handbook 2011, show the complete dependency of Kolar (M) on Bhopal (M. Corp.) for its health facility, whether for hospitals, blood bank, dispensaries or clinics. [Madhya Pradesh, District Census Handbook 2011, Part A, Statement-IV] [8]. Kolar which was 3rd town as per census

2011, but now it comes under Bhopal Municipal Corporation and it is now required to address this issue on priority.

E. Public facilities

For the study, indicator of physical development, public facilities has been confined to number of community centres, public libraries/reading rooms, crematoriums, work-shed for artisans , bus-stops, cultural activity centres, public parks other public works (fire-station) and other (cinema halls) (sub-indicators) in the local areas (wards). Literature review of Statement-V, District Census Handbook 2011, show the complete dependency of Kolar (M) on Bhopal (M. Corp.) for its health facility, whether for public libraries/ reading rooms or community centres, etc. [Madhya Pradesh, District Census Handbook 2011, Part A, Statement-IV] [8]. Kolar which was 3rd town as per census 2011, but now it comes under Bhopal Municipal Corporation and it is now required to address this issue on priority.

F. Sanitation and Public Health

For the study, indicator of physical development, sanitation and health facilities has been confined to number of public toilets and number of garbage bins (sub-indicators) in the local areas (wards). Literature review of Table 5 [Handbook, District Census 2011, Part XII B] [6] show that population dependent on public toilets is 2.99% i.e. 11,855 households in urban areas of Bhopal. About 13.12% i.e.52,043 households do not have access to toilets at all and others using open pit ,open drain , night soil (serviced by humans and animals)toilets sum up to 1.62 %. Table-5 [Handbook, District Census 2011, Part XII B] [6]. This statistics demand to address this problem on priority and provide public toilets, as a first hand solution and then providing individual toilets in premises in future. Bhopal municipal corporation within its boundaries have provided with drainage connectivity to almost 91.52% of households i.e 366,1833 out of 396,666 households (57.96 % closed and 33.26 % open drainage system)which covers major urban areas and hence can be removed from the list of priority for the research study[Handbook, District Census 2011, Part XII B ,Table 6] [6]. The study and Swacch Bharat Abhiyan brings number of garbage bins in the priority list and hence is considered for the study.

G. Recreational Facilities

For the study, indicator of physical development, recreational facilities has been confined to number of playgrounds(stadiums), multipurpose halls (also open air theatres), gardens (also marriage gardens are counted as open areas and activity centers)/vyayamshalas/gyms and others (swimming pools) (sub-indicators) in the local areas (wards). Literature review of Table V [Madhya Pradesh, District Census Handbook 2011, Part A] [8] show the complete dependency of Kolar (M) on Bhopal (M.Corp.) for its stadium and other recreational facility. Kolar which was 3rd town as per census 2011[5], but now it comes under Bhopal Municipal Corporation and it is now required to address this issue on priority.

H. Urban Development

For the study, indicator of physical development, urban development facilities has been confined to pedestrian

ways and cycle tracks (sub-indicators) in the local areas (wards). These two sub-indicators are the need of future and are in the priority list. Cycle track was initiated by Bhopal Municipal Corporation and is in its list too, but have been developed in very few wards. Concept of pedestrian roads or pathways is the need of time, where we cannot increase the size of roads due to existing developments and at the same time cannot stop the increase in the number of vehicles. Pedestrian ways are the need of future and hence in the priority list for the study.

The aim of this study is to assess physical development in the local areas of Bhopal by evaluating the identified indicators and sub-indicators (physical amenities).

IV. JUSTIFICATION FOR SELECTING BHOPAL AS A CASE:

Bhopal being the State Capital is growing relatively at a rapid pace and is likely to promote increasing urbanization in and around it. The regional and sub-regional infrastructure will have to be strengthened to support increased urban productivity in manufacturing and supporting services. Bhopal which is growing at a rapid pace due to increasing migration not only from within the State but also from neighboring seven states, calls for more pragmatic policies to take flow of the population in a balanced way. In the large context and longer perspective, development policies will have to consider the role of secondary cities and sub-cities described above to support the economic growth-taking place in the State Capital Region. It may be necessary to channelize the growth into other neighboring cities and sub-cities to maintain the quality of life in the mother city, as well as in the region, as a long-term measure.

A. Parameters considered for selection of city-

Following parameter were responsible for making decision for Bhopal as a case city

1. Population Growth Trends
2. Urbanization & Migration
3. Potential for Exceptional Growth
4. City Representing Middle Income Group of Indian Society

Over the last decade, in urban India the income of an average household has increased by about a third between 1993 and 2010 as a result of rapid economic growth. In this period, economic growth not only lifted millions of households out of poverty, but also gave rise to an emerging middle class, which is growing at a fast pace [Meyer & Birdsall 2012][7]. Various studies have projected that in the next decade middle class would be the dominant section of the Indian population. The scope of this is limited to explore the physical amenities provided to the middle-income group (MIG) for its living. The city development plan of Bhopal prepared in 2005 state that as per official definition by the government of India for income groups, the city of Bhopal is predominantly inhabited by MIG and LIG households. Bhopal has nearly 26.7% households belonging to MIG and 34.7% belonging to LIG, aggregating targeted households for the study to 61.4% in the

local areas (wards) of Bhopal.[Bhopal Municipal Corporation 2006] [3]

B. A City at Glance

Table-1 is gives a brief description of the city of Bhopal

S.NO	FEATURES	
1	Gross Area of the city	285.00 Sq Km
2	Net Area of the city	2772 Sq Km
3	Lake area	38 sq.km
4	Population	17,98,218
5	Population Density	50 pph
6	% of the State	2.57% Population
7	Sex Ratio	890
8	% of Slum	31.0 % Population
9	No of Wards	85
10	No of Zones	19
11	Average Rainfall	1200mm
12	Water Supply	234.3 MLD
13	Solid Waste	550 T per day generated
14	Height above MSL	Height varying from 460 to 625 MSL.
15	Wind Direction	Westerly and south -westerly.
16	Drainage pattern	: The natural drainage is provided by the three major valleys.
17	Physical features	Slope of the hills majorly towards north and southeast.
18	Mineral Resources	There are no known, minerals
19	Soil Profile	Rocky hard red soils and black cotton soil ranged' to 10' deep.
20	Air connectivity	To Mumbai and Delhi regularly.

Table 1 – Bhopal at glance

Source: Baseline Survey of Bhopal [2]

V. DATA OF IDENTIFIED INDICATORS AND SUB-INDICATORS

A comprehensive list of identified indicators and sub-indicators of physical development finalized from literature review was prepared. It list had 8 indicators and its 25 sub- indicators of physical development. These identified indicators were undertaken for quantitative analysis. Data was of identified indicators and sub-indicators (physical amenities) were extracted from the Bhopal Smart City Development Corporation Limited (Smart Map Bhopal) [Bhopal Smart City Development Corporation Limited] [4] for all 85 wards or local areas of the Bhopal city for the study. Figures 1-20 show the data on Smart Map Bhopal of identified sub-indicators of indicators. And few numbers were given directly by the urban planners at the Bhopal Smart City Development Corporation Limited.

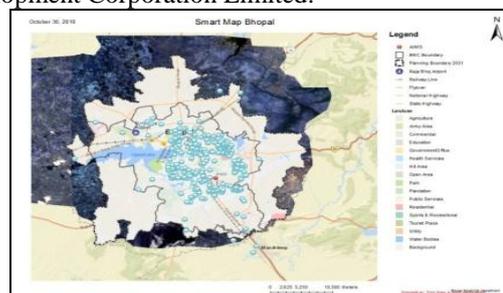


Figure-1 Water Tanks in Bhopal



Assessing Physical Development in the Local Areas of Bhopal by Evaluating Identified Physical Amenities

Source: Bhopal Smart City Development Corporation Limited [4]

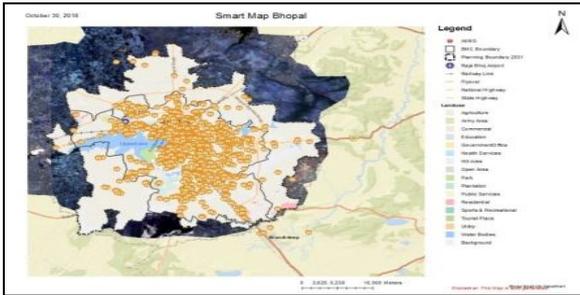


Figure-2 Schools in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

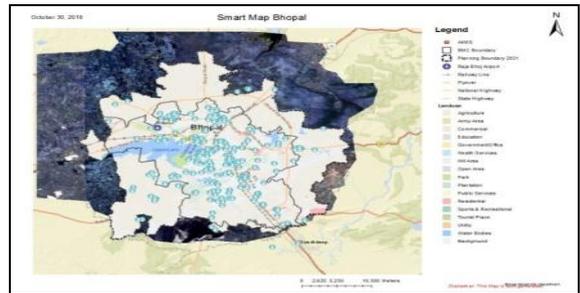


Figure-3 Colleges in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

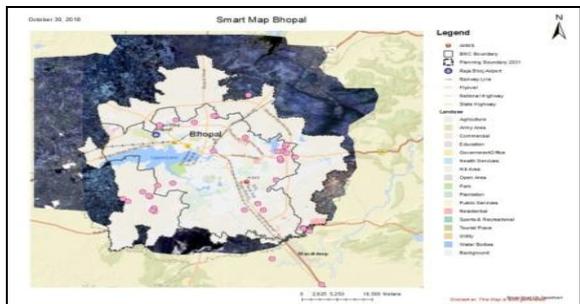


Figure-4 Engineering Colleges in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

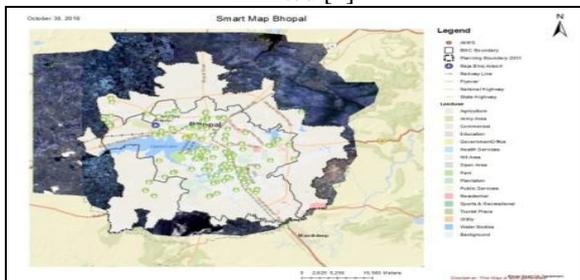


Figure-5 Other Learning Institutes in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

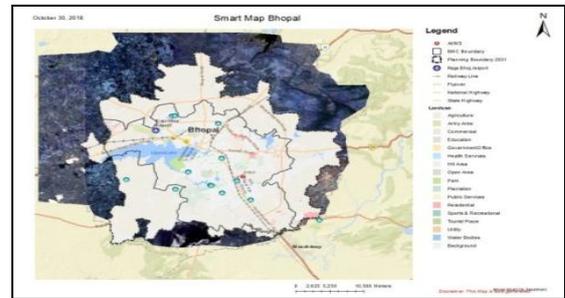


Figure-6 Universities in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

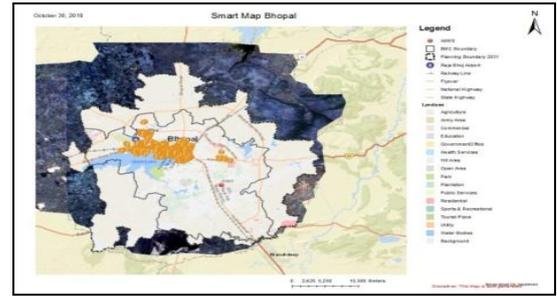


Figure-7 Smart Poles in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

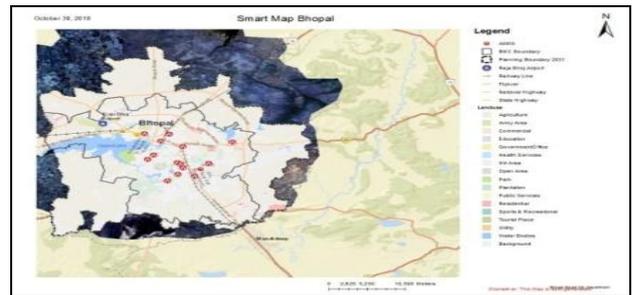


Figure-8 Community Halls in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

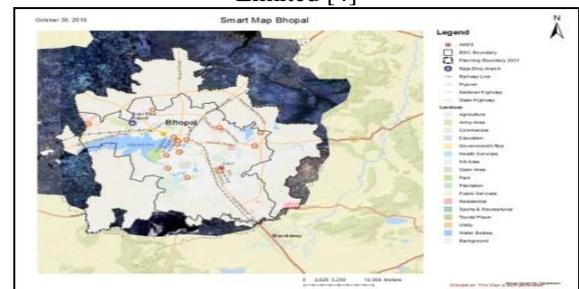


Figure-9 Public Libraries in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

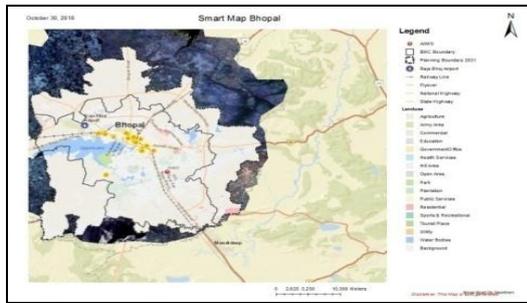


Figure-10 Crematoriums in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

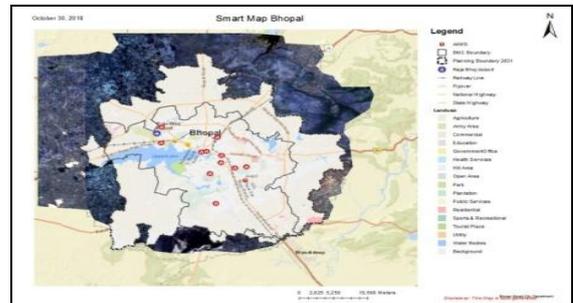


Figure-14 Fire- Stations in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

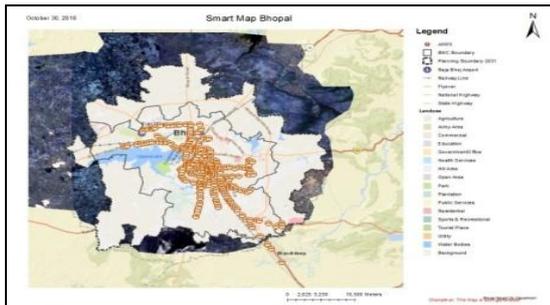


Figure-11 Bus-Stops Down in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

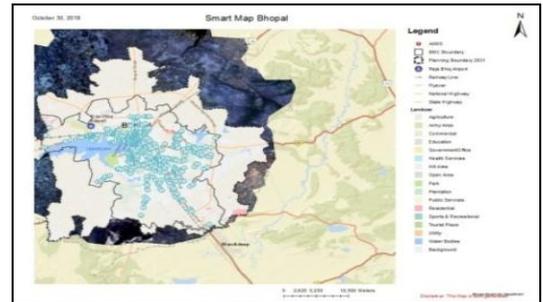


Figure-15 Public Toilets in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

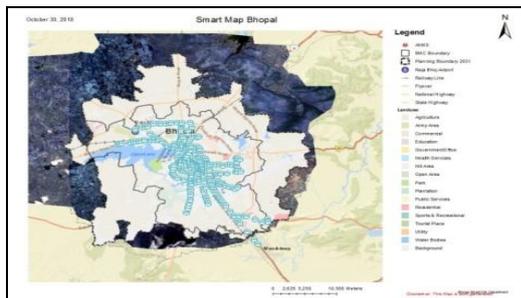


Figure-12 Bus-Stops Up in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

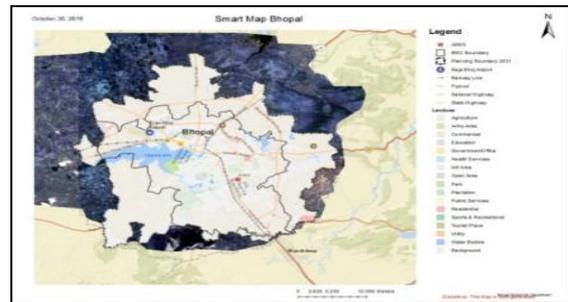


Figure-16 Solid-Waste-Dump Yard in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

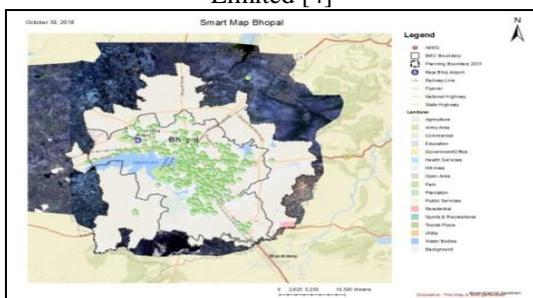


Figure-13 Parks in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

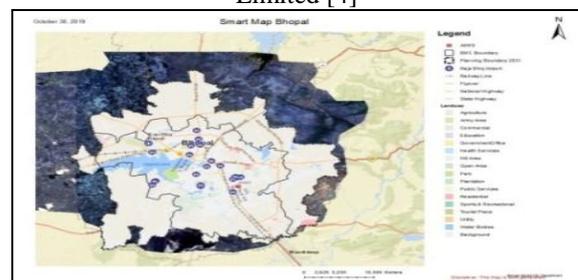


Figure-17 Sports Stadium / Play Grounds in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

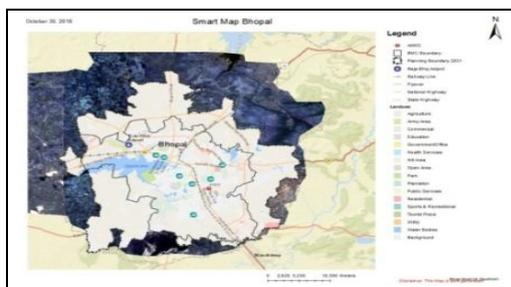


Figure-18 Swimming Pools in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

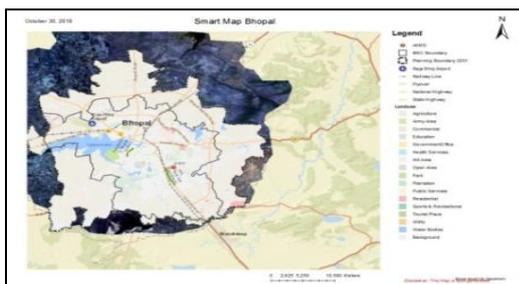


Figure-19 Cycle Tracks in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

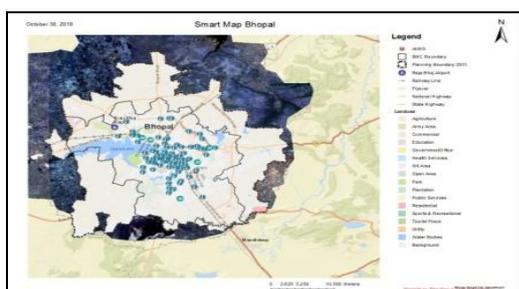


Figure-20 Smart Cycle Stands in Bhopal

Source: Bhopal Smart City Development Corporation Limited [4]

VI. PROPOSED METHODOLOGY

A. Block diagram

Figure-21 is a block diagram showing methodology in brief.

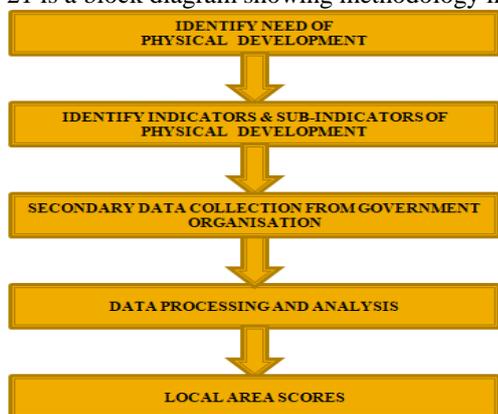


Figure-21

B. Algorithm

Assessment of physical development, by evaluating identified physical amenities, involves four steps:

1. Evaluate indicators and sub-indicators
2. Indicator Standardization
3. Tool
4. Local Area Scores.

1) Evaluate indicators and sub-indicators

Secondary data of all identified physical amenities, 8 indicators and its 25 sub-indicators, is collected from the Bhopal Smart City Development Corporation Limited [4] and is collected for each Local Area (ward) independently to know the status of physical development in it.

2) Indicator Standardization

All 8 indicators and its 25 sub-indicators of the study are measured using the same unit i.e. in numbers and if absent it is given the value 0.

All the indicators of study with high values signify availability; the standardised value of these indicators is calculated as follows:

$$\text{Standardised Value} = \frac{\text{Indicator Value} - \text{Min (Indicator Value)}}{\text{Max (Indicator Value)} - \text{Min (Indicator value)}}$$

3) Tool

In this study, Principal Component Analysis (PCA), which is a well - established statistical data reduction technique is used. It takes a large set of indicators and sub-indicators, which derives a smaller set of factors, while keeping as much variation as possible in a sample. PCA achieves dimension reduction by creating new, artificial variables called Principal components. Each principal component is a linear combination of the observed variables. Each of these new principal components after PCA is all independent of one another. It is calculated by solving an algebraic eigen value problem, finding the eigenvectors (PC's) of the covariance matrix of original data base. In doing so, PCA reveals the underlying structure of how the data is distributed. It also describes the strength of the relationships between each individual indicator and the underlying sub-indicators. For the purpose of the analysis, only sub-indicators that explained the bulk of the differences in the underlying data are used and those of least importance can be dropped off. Principal Component Analysis (PCA) is widely used because it's simple, it's fast and it works.

4) Local Area Scores

Score of each local area or ward represents the status of physical development in it. Lesser value shows lower status of physical development. Score is calculated using the secondary data giving the present status of these indicators and sub-indicators of its availability and number in the local areas (wards) of Bhopal. This data was collected from Municipal Corporation, Smart City Office, ISBT, Bhopal [4]. It was extracted from smart map data of Bhopal. Though complete data of these physical amenities in Bhopal was surveyed by the department in 2014 and mapped on smart map Bhopal site, but this data was not available ward wise. The department official helped to extract this data ward wise



from map. These ward wise amenities, indicators and sub-indicators, were then compiled in the tabular format as part of study. The data was then made unit less and then standardized value for each indicator and its sub-indicators was calculated. For standardised value the formula used was:
Standardised Value = $\frac{\text{Indicator Value} - \text{Min (Indicator Value)}}{\text{Max (Indicator Value)} - \text{Min (Indicator value)}}$

Then scores for all local areas (85-wards) of Bhopal with its existing amenities, (identified indicators and its sub-indicators) from secondary data was developed after application of Principal Component Analysis (PCA) Tool.

5) Flow Chart

Figure-21 is a Flow Chart showing methodology in detail.

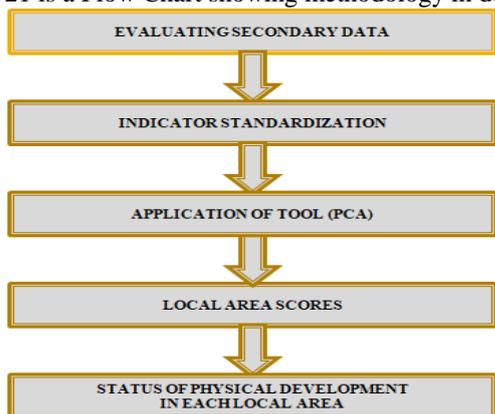


Figure-22

VII. RESULT

Result of the study was named as Existing Amenity-PCA-Scores. Result gives the status of physical development in local areas (wards) of Bhopal. Table - 2 Summarizes the results and is named as Existing Amenity-PCA- Scores for all wards (1-85)

Existing Amenity-PCA- Scores									
1	1.600954	18	0.760196	35	0.653224	52	2.551499	69	0.818225
2	0.585454	19	0.755013	36	0.717959	53	2.227362	70	0.754502
3	1.043713	20	0.659741	37	1.045862	54	2.154893	71	0.393459
4	0.237106	21	0.573288	38	0.431363	55	0.961927	72	0.502933
5	1.29228	22	0.459978	39	0.474838	56	0.801535	73	0.099021
6	1.809182	23	0.31747	40	0.136494	57	2.294537	74	1.076248
7	1.484745	24	2.624702	41	0.183874	58	1.331797	75	0.694768
8	2.750457	25	1.640061	42	0.686604	59	0.717224	76	0.786653
9	1.494799	26	1.893281	43	2.403096	60	1.332954	77	0.542323
10	10.40748	27	0.825891	44	0.394702	61	1.165805	78	0.43063
11	0.252793	28	0.605564	45	3.797021	62	1.352209	79	0.646125
12	0.740729	29	1.863834	46	1.569365	63	1.24671	80	0.883654
13	0.964096	30	0.938233	47	0.329502	64	1.581666	81	0.985169
14	0.22125	31	1.634288	48	0.882169	65	1.464184	82	1.442523
15	0.37178	32	2.586547	49	0.984256	66	1.260005	83	0.820835
16	0.855127	33	1.178511	50	0.313318	67	1.074932	84	0.684156
17	0.950614	34	1.951357	51	1.043839	68	1.244632	85	1.232994

Table - 2 Existing Amenity-PCA- Scores

VIII. ANALYSIS

Analysis of the resultant scores gave the status of physical development in each local area (ward) with identified physical amenities (indicators and sub-indicators). Lesser the score lower the status of physical development in the local area (ward). Lower scores indicate the need of physical development on priority. The average score when taken as the bench mark value enables to identify the local areas below it and these areas requires physical development on priority.

Figure- 21 reflects the status of physical development in each local area (ward) of Bhopal with identified physical amenities. The bench mark value is represented by red line.

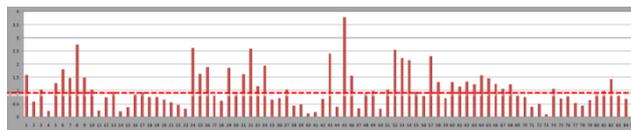


Figure-23

IX. CONCLUSION

The results of the study enabled to assess the status of physical development in local areas (wards) of Bhopal. Lesser score reflects lower physical development in the local area (ward) and higher score reflects better status of physical amenities in those local areas (wards) as compared to others. The study results are completely based on the data available of the identified indicators and its sub-indicators from the secondary source. This study lacks people’s perception, for these identified indicators and its sub-indicators in reality, for its availability and maintenance. The study needs to incorporate people’s perception in future before finding local area scores. The priorities of people should also be taken into consideration for assessing the local area needs and fulfilling them. The physical development can be best achieved by public participation, as it is for them and hence their satisfaction and involvement would enhance the overall scenario.

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