Smart & Sustainable Cities Should Be Slum Free-Indicator Framework for Assessment and Monitoring

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Abstract

Unrivalled urban growth is a major issue that the cities of developing nations are facing difficulty to cope with. The mushrooming of slums which perfuse the cities are the visible sign of this failure. UN-Habitat defines slum as "an area having poor structural quality of housing, overcrowding, inadequate access to safe water, inadequate access to sanitation and other infrastructures and insecure residential status". In Millennium Development Goals, for the assessment of slums, UN-Habitat defined a framework based on the above five characters. ISO 37120 also defines Shelter as one of the key indicators for Sustainable City, where major shelter indictors are focusing on the slum population of a city. For making the cities sustainable and live able, slum free city should be one of the key missions. Presence of slum has been one of the major factors affecting the live ability of any city. For a smart and sustainable city, continuous monitoring of slum is inevitable for the enhancement of living standard and making them more live able. This paper discusses about the role of Indicators be as a tools that would help in the formulation of policies which would lead the cities towards the complete slum eradication. Selection of indicators should be such that the monitoring of that particular parameter will ultimately results into the improvement of quality of life of slum dwellers and finally make the city Slum Free. This paper discusses about the definition of slum and the slum eradication policies and programs by UN-Habitat and Indian Government. Paper also focuses on the framework for slum free cities and development of indicators for continuous monitoring of the same.
Keyword- Slum Monitoring, Slum performance Indicators, Slum Free Cities, Shelter, Smart & Sustainable cities

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I. INTRODUCTION

❖ **Global situation of slums**

UN-Habitat estimates that the number of people living in slum conditions is 863 million (2013), in contrast to 760 million in 2000 and 650 million in 1990.

❖ **Indian Situation of slums**

Over 65 million (2011 census) people live in slums, up from 52 million in 2001

Fig. 1: Slum Situation

Unrivalled urban growth is a major issue that the cities of developing nations are facing difficulty to cope with. The mushrooming of slums which perfuse the cities are the visible sign of this failure. UN-Habitat publication regarding Urban Development and Management (November 2013) states that, due to the fast tempo in urbanization, the absolute slum population continuous to grow. UN-Habitat states that the more than half the world's people live in cities,54% in 2014, a proportion that is expected to increase to 66% by 2050. An additional 2.5 billion people are predicted to live in urban areas by that year[1]. This spontaneous population growth in urban areas will increase the pressure in land, which will result into a large gap between the demand and supply of the housing stock. Major population which are migrating for a better life from rural area cannot afford a house in urban area will finally

lead into the formation of the illegal squatter settlements. The acute poverty and lack of affordable housing contribute to the formation of slums. The major factors of this phenomena are Income equality. Lack of economic growth and In-Migration.

ISO 37120 also defines Shelter as one of the key indicators for Sustainable City, where major shelter indictors are focusing on the slum population of a city. For making the cities sustainable and live able, slum free city should be one of the key missions. Presence of slum has been one of the major factors affecting the live ability of any city. For a smart and sustainable city, continuous monitoring of the slum is inevitable for the enhancement of living standard and making them more livable. Local intervention strategies that build on an adequate and timely available spatial information of the slum areas is a prerequisite for any slum development program according to SulochanaShekhar[2]. Indicators are as a tool that would help in the formulation of policies which would lead the cities towards the complete slum eradication.

Selection of indicators should be such that the monitoring of that particular parameter will ultimately result in the improvement of quality of life of slum dwellers and finally make the city Slum Free consistent and also to evaluate the environmental, economic and social consequences of its implementation.
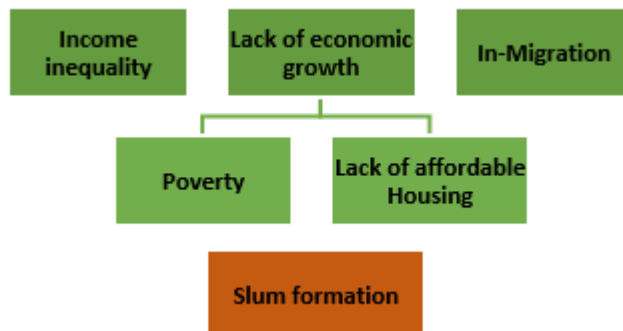

Fig. 2: Formation of slums

II. DEFINITIONS OF SLUM

UN-Habitat definition of Slum widely using for defining slum all over the world. UN-Habitat defines a slum as an area that has one or more of the following five characteristics which are poor structural quality of housing, overcrowding, inadequate access to safe water, inadequate access to sanitation and other infrastructure and insecure residential status. A global definition may fail to account all the local problems in a slum, sometimes according to the purpose slums are defined by the respective government.

ISO 37120 Definition of slum defines A slum household shall refer to a group of individuals living under the same roof in an urban area who lack one or more of the following five conditions:

A. Durable Housing
A house is considered "durable" if it is built on a non-hazardous location and has a structure permanent and adequate enough to protect its inhabitants from the extremes of climatic conditions, such as rain, heat, cold and humidity.

B. Sufficient Living Area
A house is considered to provide a sufficient living area for the household members if not more than three people share the same room.

C. Access to Improved Water
A household is considered to have access to improved water supply if it has a sufficient amount of water for family use, at an affordable price, available to household members without being subject to extreme effort, especially on the part of women and children.

D. Access to Sanitation
A household is considered to have adequate access to sanitation if an excreta disposal system, either in the form of a private toilet or a public toilet shared with a reasonable number of people, is available to household members.

E. Secure Tenure
Secure tenure is the right of all individuals and groups to effective protection against forced evictions. People have secure tenure when there is evidence of documentation that can be used as proof of secure tenure status or when there is either de facto or perceived protection against forced evictions.

Fig. 3: ISO 37120 slum definition

Indian Census 2011 classifies slum as
Notified, Recognized and Identified.

F. Notified
All notified areas in a town or city notified as 'Slum' by State, Union territories Administration or Local Government under any Act including a 'Slum Act' may be considered as Notified slums

G. Recognized
All areas recognized as 'Slum' by State, Union territories Administration or Local Government, Housing and Slum Boards, which may have not been formally notified as slum under any act may be considered as Recognized slums

H. Identified
A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities.

III. PERFORMANCE MEASUREMENT OF SLUM

For a developing a sustainable city, one of the major method which we need to adopt is "Monitor, assess and improve". For the improvement of any system a proper assessment should be there. For example, any doctor prescribe a medicine to a patient only after thorough assessment and if the doctor has been monitoring a person in advance it is very easy to prescribe a medicine for him. There were lot of urban planners who considered city as a human body. Slum which considered as cancer of a city in urban planning perspective also a major part of the cities which we need to monitor and assess regularly.

Performance Indicators for slum are useful tools for decision makers, managers and technicians dealing with complex situations where they need to plan a suitable policies effectively for the uplift of these urban poor. The major advantages of a slum performance index listed as below;
−   They place performance at the center of the policy arena.
−   They can offer a rounded assessment of performance.
−   They enable judgments to be made on system efficiency.
−   They facilitate communication with the public and promote accountability.
−   They indicate which organizations represent beacons of best performance.
−   They indicate priority organizations for improvement efforts.
−   They may stimulate the search for better analytical methods and better quality data.
−   They present the 'big picture' and can be easier to interpret than trying to find a trend in many separate indicators.

IV. EXISTING SLUM PERFORMANCE INDICATORS

For the assessment of Millennium development goals for slum development, UN developed a set of slum indicators though which we can measure the performance of a slum. ISO 37120 also takes shelter as a parameter for a sustainable city. The Indicators which proposed under shelter are showing the performance of the city in terms of slum population. Rajiv awas yojna also proposed a framework for the assessment of slum with slum free city action plan for each city. But these frame works not considering the all aspects of quality of life. The slum schemes and policies and schemes which implemented without proper monitoring and assessment miserably failed thorough out the nation. So for we need a composite performance index which indicate the performance of a slum in all means. Some slum Indicator frameworks are:
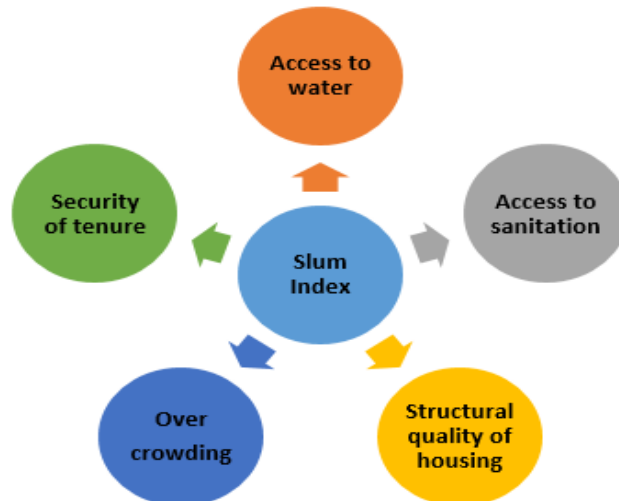
A.   UN-Habitat Indictors of Slum

Fig. 4: UN Slum Indicators

1)   Access to Water
1)   Indicator: Inadequate drinking water supply

A settlement has an inadequate drinking water supply if less than 50% of households have an improved water supply:
−   Household connection
−   Access to public stand pipe
−   Rainwater collection
With at least 20 litres/person/day available within an acceptable collection distance.

2)   Access to Sanitation
1)   Indicator: Inadequate sanitation

A settlement has inadequate sanitation if less than 50% of households have improved sanitation:
−   Public sewer;
−   Septic tank;
−   Pour-flush latrine;
−   Ventilated improved pit latrine.
The excreta disposal system is considered adequate if it is private or shared by a maximum of two households.

3)   Structural Quality of Housing
1)   Indicator: a. Location
−   Proportion of households residing on or near a hazardous site. The following locations should be considered:
−   Housing in geologically hazardous zones (landslide/earthquake and flood areas);
−   Housing on or under Garbage Mountains;
−   Housing around high-industrial pollution areas;
−   Housing around other unprotected high-risk zones (eg railroads, airports, energy transmission lines).
2)   Indicator: b. Permanency of structure

Proportion of households living in temporary and/or dilapidated structures. The following factors should be considered when placing a housing unit in these categories:
−   Quality of construction (eg materials used for wall, floor and roof);
−   Compliance with local building codes, standards and bylaws.

4)   Overcrowding
1)   Indicator: Overcrowding

Proportion of households with more than two persons per room. The alternative is to set a minimum standard for floor area per person (eg 5 square metres).

5)   Security of Tenure
1)   Indicator: Security of tenure
−   Proportion of households with formal title deeds to both land and residence.
−   Proportion of households with formal title deeds to either one of land or residence.

– Proportion of households with enforceable agreements or any document as a proof of a tenure arrangement.

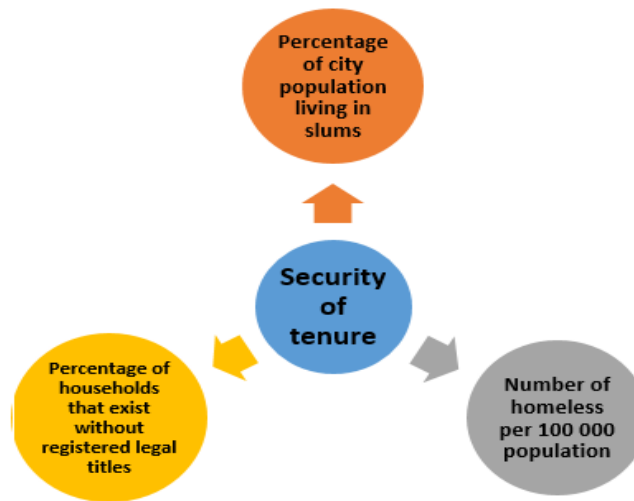B. *ISO 33720 Indictors for Shelter*

Fig. 5: ISO 37120 Indicators for shelter

1)   Percentage of City Population Living In Slums (Core Indicator)

The percentage of the population living in slums is an indicator of the number of city residents living in substandard or insecure housing. Evidence shows that slums are growing and becoming permanent features of urban landscapes. One out of every three city dwellers lives in a slum today. Since slums host significantly large proportions of the urban population it is important to measure them.

2)   Number of Homeless per 100 000 Population (Supporting Indicator)

Having a home to live in can be considered a basic need. There may be several reasons for a homeless situation, such as the housing price to income ratio.

3)   Percentage of Households That Exist Without Registered Legal Titles (Supporting Indicator)
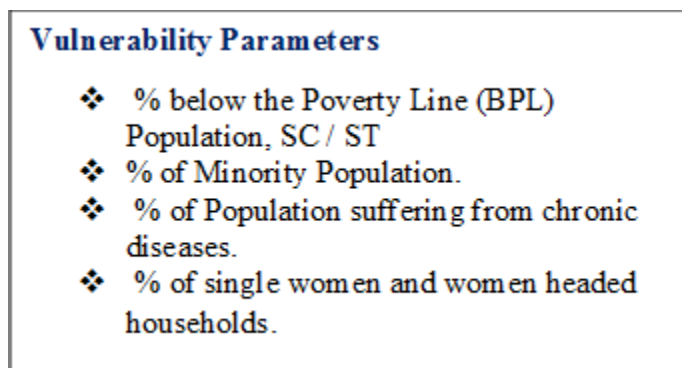
Understanding the percentage of households that exist without registered legal titles informs municipal leaders on housing security for city residents as well as housing conditions, infrastructure requirements and builds a better database for less formal parts of the city.

C. *Ray framework for Vulnerability Assessment of Slum*

In 2013 for the slum free city action plan RAY proposed a Deficiency matrix method for the assessment of individual slums in a city. Based on this Cities prepared priority list in which slum are ranked based on their deficiency matrix. For developing deficiency matrix, parameters related to Infrastructure and Vulnerability shall be collected from Socio-Economic survey details to ascertain most / least vulnerable slums and best / most deficient level of infrastructure in slums. The parameters considered under each head are listed as below:

Vulnerability Parameters

❖ % below the Poverty Line (BPL) Population, SC / ST
❖ % of Minority Population.
❖ % of Population suffering from chronic diseases.
❖ % of single women and women headed households.

All the values arrived for the parameters mentioned above shall be brought down to the scale of 1 –100. After bringing down to the scale of 1 – 100, scores shall be assigned in the range of 1-5 using one fifth of the range as benchmark. Here one fifth of the range is 20. Minimum score of 01 shall be assigned for value less than or equal to 20 and maximum score of 05 shall be assigned for value more than 80. Total score for Infrastructure and Vulnerability would be arrived at by summing up all the related individual parameters score. Then based on this slum is grouped under deficiency matrix.
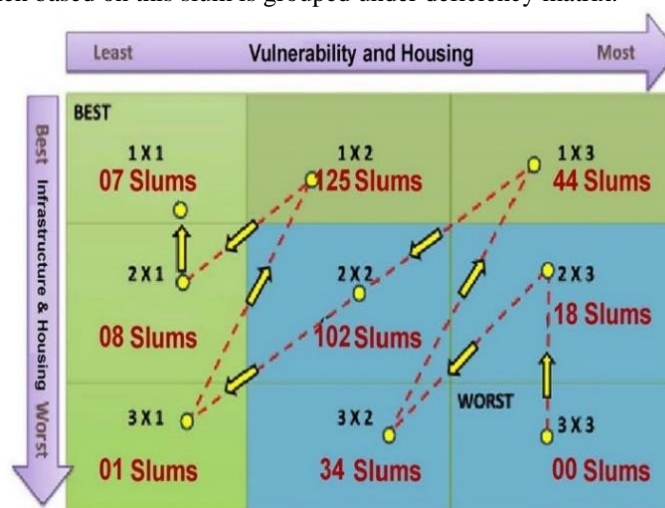

Fig. 6: Deficiency matrix under RAY

V. COMPOSITE SLUM PERFORMANCE INDEX (CSPI)

Performance measurement is a multidimensional process. Developing Composite slum performance is a methodology for making a cities slum free. For the past years, lot of Schemes and policies were planned by the Indian government with and without the help of the United Nations for making our city slum free. As a case study, a survey has been carried out in five slums in Kochi, Kerala and we found the every slum is electrified and having closed drainage. So monitoring of electricity and drainage may not be needed in the case of Kochi. Because monitoring a parameter which performs hundred percentages need not to be assessed. The steps required for the formation of composite slum performance index is explained below:

A.   Step 1. Theoretical/Conceptual Framework
We have to make a conceptual framework which provides basis for selection of parameter which we need to monitor. For this Pilot Survey can be done through which we can make a fair understanding about the slums in a particular city .Interaction with public and stockholders can also can be done.

B.   Step 2. Data Selection
It should be based on the analytical soundness, measurability, country coverage, and relevance of the indicators to the phenomenon being measured and relationship to each other.
−   Quality assessment of the available indicators.

‒ Discuss strengths and weaknesses of each selected indicator.
‒ Summary table on data characteristics, e.g., availability (across country, time), source, type (hard, soft or input, output, process), descriptive statistics (mean, median, skewness, kurtosis, min, max, variance, histogram).

C. Step 3. Data Treatment
Consists of imputing missing data, (eventually) treating outliers and/or making scale adjustments. Confidence interval for each imputed value that allows assessing the impact of imputation on the composite indicator results.

D. Step 4. Multivariate Analysis
Should be used to study the overall structure of the dataset, assess its suitability, and guide subsequent methodological choices (e.g., weighting, aggregation).Assess the statistical and conceptual coherence in the structure of the dataset (e.g., by principal component analysis and correlation analysis).Identify peer groups of countries based on the individual indicators and other auxiliary variables (e.g., by cluster analysis).

E. Step 5. Normalization
Should be carried out to render the variables comparable. Make directional adjustment, so that higher values correspond to better performance in all indicators (or vice versa).Select a suitable normalization method (e.g., min-max, z-scores, and distance to best performer) that respects the conceptual framework and the data properties.

F. Step 6. Weighting and Aggregation
Weighting and aggregation can be done using different mathematical model (Analytical hierarchy process, Fuzzy logic, artificial neural network etc.) Expert opinion about different parameters can be incorporated with the actual data. Ranking of different parameters can and parameters can be done. Comparisons between the slum conditions of different city also can be done after using the weight obtained.

G. Step 7. Visualization of the Results
Should receive proper attention given that it can influence (or help to enhance) interpretability. Policy maker who is a non-technical person cannot understand the meaning of composite index, so we need to represent the result such a way that it can be interpreted by a non-technical person also. Geographical Information system can be also used for the visualization of the result.
For our slum performance index parameters which can monitor can be;
1) Basic Infrastructure
2) Quality of housing
3) Social Characteristics
4) Economical Characteristics
5) Connectivity
6) Access to services
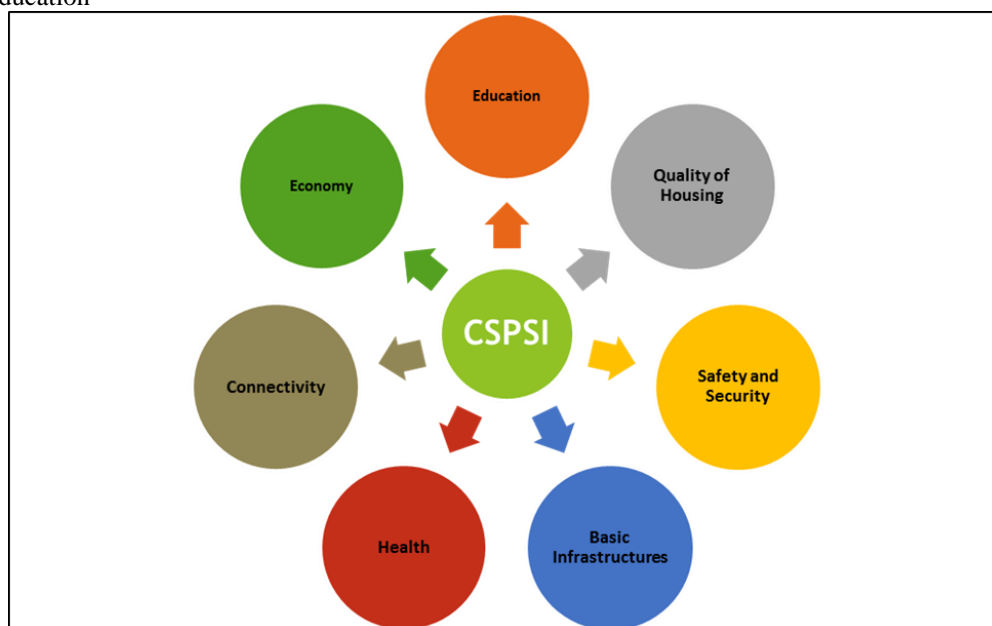7) Safety and security
8) Health and education

Fig. 7: Parameters for CSPI

H. Different Indicator Considered Under Each Parameters

Sl.No	Parameter		Indicator
1	Basic Infrastructures(B)	Access to water(B1)	– Percentage of Households not having own piped water supply – Source of drinking water – Existence of Rain water harvesting system
		Access to Sanitation(B2)	– Percentage of households not having toilet with septic tank and flush – Percentage of households not having toilet own bathroom – Number of Public toilets
		Access to solid waste management(B3)	– Percentage of households not having Door to Door Collection – Number of collection/dumping points in the slum.
		Access to drainage(B4)	– Percentage of area covered with drain – Status of drain(open/closed)
2.	Economy(E)	Income-Expenditure(E1)	– Average Income – Average savings
		Occupation(E2)	– Percentage households having permanent occupation
		Job dependency(E3)	– Ratio of Number of working persons to number of non-working persons
		Distance to working place(E4)	– Average distance to working place
		Banking Services(E5)	– Percentage of families not having bank account
3.	Housing(H)	Structural quality	– Percentage of Kutcha houses
		Congestion in house	– Ratio of Number of room to number of family members – Ratio Total area of a house to number of persons
		Formal title for house	– Percentage of houses not having formal title for land and house
4.	Health and Education(HE)	Access to hospital facilities	– Average distance to access medical facilities
		Access to education facilities	– Average distance to access education facilities – Percentage of households having at least higher secondary education
5.	Connectivity	Condition of access to slum	– Condition of main access to slum – Average width of internal roads
		Vehicle population	– Percentage of households not having vehicle
		Access to public transportation	– Number of bus stops in 500m

VI. CONCLUSIONS

Slum performance indicators and indices would be one of the crucial factors which Indian Cities need to focus upon provided they are designed in a manner which is aligned to the Vision of the City as a slum free focusing on enhance quality of life of urban poor. The following are suggested and proposed so far as composite slum performance index is concerned.

1) Set the goals, audience and principles of an index to lay the foundation for slum free city.
2) Slum Indicators should represent the best in data quality. Understanding the underlying structure of the data guides adjustments made to the index and produces more appropriate conclusions.
3) While weighing of parameters is concerned it is suggested that more scientific methods using Data Envelop Analysis, AHP, and Multiple Criteria Decision Making (fuzzy logic) may be adopted.
4) For Indian Cities effort should be made create such slum performance frameworks which helps the authorities in taking judicious decisions which promotes slum free cities.

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