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Assessment of Urban Development from Urban Quality of life score for Indian Cities

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Abstract

Urban development should not be presented only in term of economic progress but also in terms of access to basic amenities, infrastructure, transportation, opportunities, environmental condition and gender equality for each and every segment of the society. In today's world, transportation plays an important role to access all the opportunities for an individual. However, in previous literature, development of different indices lack in taking the accountability of transportation and gender equality as an important attribute in development of such indices. This paper examines provision of various urban amenities in Indian cities andanalyses gap in the provision of urban development. In this study, the authors developed an urban Quality of Life (QoL) score to quantity the urban development and livability for Indian cities. Based on the urban QoL score this paper put forward the direction of development for different cities based on the different aspect of development. Principal component analysis (PCA) was used to develop a composite score to quantify the urban QoL. This study helps us in understanding the importance of transportation and gender equality attribute for urban development. This study recommends the incorporation of transportation parameter of an urban agglomeration to analyses the well-being and QoL of an urban area. This paper concludes by addressing that the urban QoL mainly revolve around the accessibility of transportation network from transportation prospective.

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1. Introduction

Scientists and policy makers are increasingly concerned about quantifying the overall development of an urban area. For developing countries, not only infrastructure development but other well-being development also plays an important role for achieving livable environment. While previously traditional economic indicators serves many useful purposes, they have several limitations. For example, increase in GDP of the nation will definitely enhance the economic condition of the nation but this may lead to the exploitation of natural resources increase in pollution etc. However, there are serval limitations to define well-being indices solely on economic parameter and public's capability to obtain goods and services in a city. This may further lead to income inequality in the urban area. The data set used in this study shows a high positive correlation of 0.73 between the GDP per capita of Indian cities with the slum population per unit area in Indian cities. In some cases, economic development may be inversely correlated with certain aspects of quality of life (QoL) such as leisure time or a healthy environment (Diener & Suh, 1997). Development in all sectors are needed for the sustenance and growth of urban societies.Diener & Suh, 1997 argued that subjective well-being measures and social indicators are essential to evaluate a society, and add significantly to the traditional economic indicators that are favoured by most of the policy makers. With the rapid urbanization trends in India, there is a need to evaluate the urban development based on the concept of social, economic and environmental aspect. Everyone wants a city that have good economic activity so that the opportunities for an individual increases as well as a better liveability. As reported in past literature QoL is define based on two factor 1) Subjective well-being and 2) Objective well-being (Das, 2008; Diener & Suh, 1997; Land, 2000). Thus, researchers have increasingly turned to additional approaches to defining and measuring the QoL. Globally concept of QoL has been studied by many authors but a standard and globally accepted definition has not been concluded yet. The QoL concept for urban areas for developing economy can mainly revolve around parameter such as basic amenities, economic development, infrastructure development, transportation access parameters, environment parameters, safety and security, gender equality etc.There is a need for appropriate urban planning, policies, and balanced development in the cities and towns.Thus this study aims to evaluate urban QoL of developing economy based not only on the advance parameters of development but also on the basic need parameter which are essential for sustainable growth of the society. This study makes a comparative analysis of Urban QoL for Indian cities. The paper is mainly divided into 3 sections. The first part consist of literature review, conceptual framework development and the data collection procedure. The second part of the study deals with, selection of variable and the measurement of indicators based on the selected variables. The third part of the study consist of the analysis and modelling which in turn represents the results and the conclusion of the study.

2. Literature Review

Concept of QoL has started gaining popularity and has been given importance by many researcher around the world but standard globally acceptable definition has not been derived. Many scholars suggest that the idea ofQoL is too broad to define.It can be suggested that QoL depends on both objective factors i.e.external urban environment factors and subjective factor which are related to perception of theindividual (Vittersø& Nilsen, 2002). Initial efforts by social scholar's reveals that evaluation ofQoL at a public level focussedon complete social parameters such as family income, divorce rate or crime rate etc.(Felce&Perry, 1995).World Health Organization (WHO) defines the multi perspective nature of QoL: "WHO describes Quality of life as individual's perception of their position in lifein the framework of culture and value system in which they live and in relation to their objectives, expectations, standards and concerns. This definition identifies six extents of QoL:physical well-being, psychosomatic well-being, freedom, social relationships, individual'sbeliefs and environment (WHO, 1997).As suggested by some researchers, there are three key philosophical methods to determining quality of life (Brock, 1993). The first based on religion, philosophy idea; the second is based on the satisfaction of preferences and the third is based on perspective of individuals (Diener& Suh, 1997).

This makes the conceptual framework difficult for urban QoL for Indian condition. The definition of urban QoL for Indian cities will revolve not only around the economic progress but also around the distribution of basic amenities in urban area etc. Where past studies conducted in western countries tries to capture all the aspect of development, lack in taking the accountability of some of the important parameter such as basic amenities, gender equality and transportation access parameter in development of QoL indicators for urban areas. This may be because

of the facts that they have overcome the issues related to clean water supply, drainage system, toilets within the premises etc. which are the basic amenities in an urban area. But when we focus on urban QoL for developing countries there is a need to address such basic parameter as well from the QoL perspective. Similarly due to heavy population load in urban area of developing countries, as a researcher we cannot directly conclude the transportation access parameter based on travel time saving and mobility but initially accountability need to be given to the spread of transportation network, accessibility etc.

McMahon 2002, developed QoL indicators for Bristol, UK. In this study the levels of QoL indicator were define starting from European level common indicators to the community level indicators, but these indicators lack in taking theaccountability ofinfrastructure development and the gender equality component. This study concluded that this indicators which are related to their QoL has led to political, community or individual action for change.Hajduova et al., (2014) developed 3 clusters to classify 10 European Union countries. This study deals with the relation between quality of life and environmental quality in 10 selected countries.The International Living Magazine every year evaluates and ranks countries from all around the world based on the level of quality of life. In theevaluation process they take into account9different categories-1) cost of living,2) economy, 3) culture, 4) environment, 5) freedom, 6) health, 7) infrastructure, 8) safety and 9) climate. There are other very famous surveys and indices which attempts to evaluate the QoL aspect but lack in taking some of the important parameter, from developing economy point of view. Where for Indian cities these evaluation parameter remains the same, the actually issue of QoL is not address in such indices. Cities in developing economy witness a huge diversity not only in terms of culture but also in terms of their socio economic background. This makes it of importance that the urban QoL concept should not only revolve around important economic and social parameters but also on the basic amenities, opportunities etc.

3. Conceptual framework

Urbanization trends in India has witness a steep increase and faster than expected trend according to the 2011 Census (Bhagat, 2011). According to the 2011 Census, a growth rate of 2.76% per annum was observed of urban population during 2001-2011. The urban population grown to 377 million in urban area in India. This can be justified
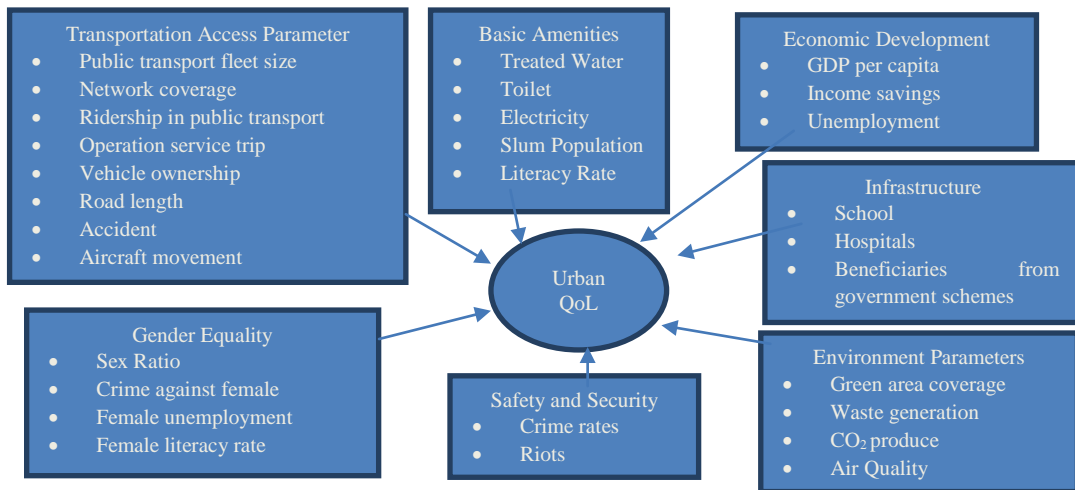

Figure 1Conceptual Framework of Urban QoL

from the fact that the absolute increase in the urban population was higher than that in the rural population since 1950. This makes it of high importance to understand the concept of QoL of urban areas of India. The high growth rate of urbanization with limited infrastructure facilities constrains, degrade the QoL of the urban area. This gave rise to negative environment impact, causes shortage of safe water, and accelerated emergence of slums followed by

poor sanitation, health facilities and educational infrastructure. Similarly, this increased the pressure on transportation facilities, which resulted in issues concerning transport congestion. Thus the evaluation of urban QoL need a serious in-depth investigation in context of basic amenities, economic development, infrastructure development, transportation access parameters, environment parameters, safety and security, gender equality for urban areas in India. Figure 1 shows the conceptual framework for this research to quantify urban QoL.

4. Study area and data collection

The study aims to explore with the quantification of overall development and the growth of some of the important sectors, which are directly related to the QoL measure of the urban agglomeration. To evaluate the sustainable growth of the urban agglomeration this study takes into account 14 cities of India. Table 1 present the different study areas and basic census data of 2011 of these cities. Preliminarily data shows that nearly 8 percent of the nation population resides in these cities, which contribute to only 0.19 percent of the total area of India. Traditional Census of India has provided a rich source of data for the several parameter of urban agglomeration. Crime, economic, infrastructure, and environment related data have been extracted from the Open Government Data Platform (A Digital India Initiative) website provided by Government of India ("Open Government Data (OGD) Platform India,"). The transportation related data was extracted from different comprehensive mobility studies conducted in different cities. The selection of the cities for the analysis was purely based on the availability of the data and to make sure that cities are not taken from specific part of India.

Table 1 Basic 2011 Census Data of 14 Cities in India

Sr. No	City	Population in 2011	Area (km^2)
1	Ahmedabad	5577940	468.92
2	Bengaluru	8499399	709
3	Bhopal	1883381	285
4	Chandigarh	1025682	114
5	Chennai	8696010	426
6	Delhi	16314838	1113.65
7	Hyderabad	7749334	650
8	Indore	1964086	172.39
9	Jaipur	3046163	484.64
10	Kolkata	14112536	205
11	Lucknow	2901474	600
12	Mumbai	18414288	603.4
13	Patna	2046652	234.7
14	Pune city	3124458	276.4

Source- ("City Census 2011,")

5. Selection of variable for Urban QoL

It can be said that the level of parameters of various aspects like economical aspect, infrastructure aspect, transportation aspects etc. differ among the cities. However, a city having better transportation facilities may not have a less crime rate or crime against female or adequate educational institutions. So a proper measure is needed to derivebased on suitable indicators which can best reflects the level of livability and QoL of the city. Hence, a composite score has been computed by considering the most depictive and best possible indicators, which can serve the above objective. Here the authors have taken into account 34 different indicators from all the possible aspect of better QoL measure. Table 2represents the details of variables and their definitions applied.

Table 2 Different aspects and Variable under them to define Urban QoL

Aspects	Variable
Basic Amenities	% of Household (HH) with treated tap water
	% of HH with toilet within premise
	% HH with electricity as main source
	% of population in slum
	Persons literacy %
	Spread of slum (Total population in slum per unit city area)
Economic factors	GDP per capita (1000INR)
	Average Savings (Average Income of household –Average Expenditure of household)
	Unemployment rate 2011
Safety and Security	Crime rate 2011
	Riots rate 2011
Transportation Access Parameter	No. of public bus fleet (National Transport Development Policy Committee, 2013)
	No. of public buses per km of network length
	Total public transit network coverage length per unit area (Bus + BRTS + Rail + Metro +Tram)
	Total public transit daily ridership/population
	Daily service trip of Metro+ Suburban Train
	Number of Aircraft movement
	Vehicle per capita in 2011
	Vehicle ownership/road length in 2011
	Road length in km.
	total no. of person killed per km. of road 2011
Environment factor	% of forest area in city
	Municipal Solid Waste Per Capita Waste Generation (kg/day)
	Generated waste/area of landfill used for waste dumping
	CO_2 kg/capita/year
	PM10 concentration
	PM2.5 concentration
Infrastructure parameter	No. of school per unit area
	No. of bed per capita in research and medical centres
	Beneficiaries Availing Government health Scheme Facilities per capita
Gender equality parameter	Sex ratio in 2011
	Crime rate against women in 2011
	Unemployment rate in 2011 for females
	Difference in literacy rate between male and female

6. Methods of indicators measurement

Indicators are being measured for seven different aspect to give a comprehensive picture about the QoL in Indian urban area: 1) Basic amenities, 2) Economic Parameter, 3) Infrastructure Parameters, 4) Transportation access

parameters, 5) Environment factors, 6) Safety and security, and 7) Gender equality parameters. This parameter are further sub divided into 34 indicators (Table 2). The choice of such indicators for QoL for Indian cities are based on following criteria:

- The indicator should be easy in its quantification and in its definition to help simplify complex information
- The indicators should reflect sustainable growth
- The indicators should be able to represent the trends over time to monitor the direction of QoL and sustainability
- The indicators should be flexible enough to acknowledge the change in society
- They should be independent of scale because these indicators should work on the principal dimensional homogeneity, i.e. measured in the same units. As the data sets used in this study have different ranges and dimension, but various data transformations can be deployed to address this problem. For example, "standardization" (or "scaling") within variables will express each observation relative to its position in the distribution for that variable.

6.1. Basic amenities

Past literature has insight that the world has shifted to a different phase of development definition where development is no more defined just on the income growth of the economy, but reasonably on the significant reduction in portion of population disadvantaged with 'basic human needs'(Mishra & Shukla, 2015). This approach to development, highlights on providing access to basic amenities needs to people at household level(Goldstein, 1985; Hicks & Streeten, 1979; Zienkowski, 1971). Therefore, there is a need to assess the individual dimension of scarcity to quantify the overall development and QoL in an urban area of India. This study makes an attempt to analyseQoL of Indian urban area in term of 'basic human needs' important for a human life: access to toilet facility, safe drinking water, electricity, literacy and population in slum. The indicators analysed in this aspect were 1) % of Household with treated tap water 2) % of Household with toilet within premise 3) % of Household with electricity as main source energy in house 4) % of population in slum of the city, 5) Average person literacy rate in % and 6) Spread of slum in an urban area.

6.2. Economic development

Cities are key locations for development and economic growth of the nation. As suggested byAlibegović et al., (2006), cities in the world nearly generate more than half of nation's economic activities. Urban development also dependents and can be measured through the city GDP and unemployment. They are important indicators in providing a strong measure of the investment level which indicates the economic growth, opportunities and better QoL for an individual in an urban area. Economic indicators used in this analysis are 1) Per capita Gross domestic product of city 2) Average savings in household (Average Income of household –Average Expenditure of household) and 3) Unemployment rate in a city (no. of persons/ person-days in unemployment per 1000 persons/ person-days in the labor force)

6.3. Safety and security aspects

While cities generate economic activity, the security challenges they face expand and intensify as their populations rise.Man-made risks are also growing. As the opportunities in the cities increases, it becomes a point of attraction for all the people from different communities especially in India, where cities are having a high diversity in term of religion and believes. The aspect of QoL should take into account the sense of safety and security not only in term of crime rate but also in terms of community harmony, which has been taken care by very few studies. To indicate an individual's religious safety measure, number of riots in 2011 has been taken as an indicator for urban QoL and for the sense of safety of the society as a whole crime rate in 2011 has been taken as an indicator in this aspect of QoL.

6.4. Transportation access parameter

The concept of QoL, which revolves around well-being and happiness, is highly affected by urban policies (Frey &Stutzer, 2002). As suggested by Nakamura, et al., (2017) transport studies have developed the integrated QoL index for the policy evaluation. First, the QoL evaluation for land-use transport systems pays more attention to easy access from residential locations to various opportunities of activities (Lotfi&Koohsari, 2009). Gu F, et al., (2016) tries to model QoL of an urban area from transportation prospective with access as central focus of the study. This literature can help in developing indicators of QoL from transportation point of view. In this study following indicators were develop to quantify QoL of the urban area for Indian cities- 1) Number of Public bus fleet size in the city 2) Number of buses available per km of network length (represents reliability of public transport) 3) Total network coverage of public transportation per unit area of city (Bus+ BRTS+ Rail+ Metro+ Tram) 4) Total public transit daily ridership divided by population of city (represent public transportation efficiency) 5) Daily service trip of Mass rapid transit system (Rail and Metro) 6) Aircraft movement from the airport of the city 7) Per capita vehicle ownership 8)Vehicle ownership per unit road length of the city (represent the level of traffic congestion) 9) Road Length (represent transportation infrastructure) and 10) Total number of person killed in road accident per km of road length of the city (represent the traffic safety situation of the city).

6.5. Environment Aspects

Evaluation of urban QoL need to take into account good environmental indicators, which not only describe the current impact but also the future environmental condition. As environmental condition has a high interaction with all the aspects of activity in an urban area, which makes it highly important aspects as far as the sustainability is concern. For example, excessive activity in urban area tend to increase the traffic results in excessive urban pollution. The important environmental parameter for an urban area mainly revolve around the green area coverage, waste generation and management, water quality and air quality. In this study to capture the complete environmental factors for urban QoL the following indicators are analyzed –1) % of land covered with forest 2) Per capita Municipal solid waste Kg/day(represent the waste generation and awareness about the environment) 3) Total waste generated per unit area of landfill available in the city (represent the waste management service of the city) 4) Per capita CO_2 in kg per year 5) Concentration of PM10 in the city and 6) Concentration of PM2.5 in the city.

6.6. Infrastructure development

Infrastructure development plays an important role for sustainable and equitable economic growth (Haque, 2016). Infrastructure development is a basic requirement for enhancing the living standards of the citizens. With the increase in the urban sprawl whether this infrastructure development in Indian cities has to cope with this sprawl. If the urbanization trends growth is more as compared to infrastructure development, this may cause anunstable and huge gap between supply and demand of infrastructure and urban civic facilities.Thus, urban QoL is highly dependent on the spread and access of these infrastructure facilities. In this study to understand the impact of infrastructure development the following indicators are analyzed – 1) Number of school per unit area of the city (represent the spread and access of facilities) 2) Number of beds in medical research institute per capita and 3) Beneficiaries Availing Government health Scheme Facilities per capita (represent the subsidies services).

6.7. Gender equality aspects

Gender equality is not just a social concern for the world; it is a human right, a concern for all of us, because economic, social and political development cannot be achieved when half of the nation's population is sidelined (Robinson et al., 2015). The World Bank suggests some significant areas for decreasing this gender inequality. Reduction in human capital of gender gaps, specifically education. Enhancing female access to education and economic opportunities. Motivating and encouraging women participation as representatives of communities and political systems (The World Bank, 2012). As suggested by World Bank nearly $160.2 trillion of loss in human capital wealth due to gender inequality if they assume that women would earn as much as men (Wodon&Briere,

2018). This makes gender equality in India very important, where 17% of the women population resides. In India, the perception about urban safety is mostly; govern by the women safety, so for better urban QoL gender equality is of high important. Very few studies globally has address the QoL measure with gender equality. This study tries to analysis the following indicators as an important aspect of urban QoL from gender equality prospective - 1) Sex ratio of cities in 2011 (represent the acceptance of women in society because in many cases abortion is the exercise of terminating a pregnancy based upon the expected sex of the infant) 2) Crime rate against women 2011 3) Unemployment rate 2011 for females (represent access for economic opportunities for female) and 4) Difference in literacy rate between male and female (represent access for basic educational opportunities for female).

7. Modelling framework

The quantification of UrbanQoL for this study was accomplish by developing a composite score. The following assumption were followed to develop this score a) The variables were made independent of scale b) Estimation of coefficient or weights for each variable. The scaling method was different for different variables and was termed as indicator of variable *i* based on Equation 1.

$$Indicator(X)_i = \frac{\left| Maximum\ or\ Minimum\ value_i - Actual\ value\ (x_i) \right|}{Maximum\ value\ (max_i) - Minimum\ value(min_i)} \quad (1)$$

Where, max_i = maximum value from variable *i*, min_i = minimum value from variable *i*, and x_i = actual value of variable *i*

The maximum and minimum value changes as per the index for example, the formula used for % of HH with treated tap water was $\left| min - x \right| / (max-min)$ in which 100 was assumed to be the maximum value and minimum value was estimated from the variable itself. This makes the % of HH with treated tap water indicator for a city as 1 when 100% of the household of that city are getting treated water and 0 for the city corresponding to the minimum % of HH with treated tap water. For % of population in slum index formula used was as (max-x)/ (max-min) in which minimum value was assumed to be 0 (represents no one living in slum) and maximum value was estimated from the variable itself. Therefore, value of this indicator will be 0 in case of the city whose maximum population resides in slum and will be 1 if no one resides in slum. In this way, all the indicators will range from 0 to 1 which makes them scale independent, where 1 represent best scenario for the indicator from sustainable point of view and 0 as the worst scenario for that indicator.

The estimation of coefficient for each indicators was based on the Principal component analysis(PCA). The coefficient derived from first principal component (PC) of PCA were used as weights for each indicator respectively. As it explains the maximum amount of variance. PCA is an unsupervised data-mining tool. The aim of unsupervised approaches are to reduce dimensionality and scoring all observation based on the composite index. PCA take into account the variation in a correlated multi-attribute to a set of uncorrelated components. The analysed uncorrelated components are called as PC which are a particular linear combination of the original variables and are estimated based on the eigenvectors of the correlation or covariance matrix of the variables. The first principal component may be a better approximation than equally weighted or simple averages of the variables as it accounts for the variations shared by all variables. Thus, PCA can be useful when there is a high degree of correlation among the variables.

The urban QoL therefore consists of seven different indices: 1) Basic amenities index (BAI), 2) Economic development index (EDI), 3) Infrastructure development index (IDI), 4) Transportation access index (TAI), 5) Environment impact index (EII), 6) Safety and security index (SSI), and 7) Gender equality index (GEI) refer Equation 2. The selected 34 indicators are under these seven index (Table 2). The overall composite score of Urban QoL can be formulated as the sum of the entire indices (Equation 3). The complete procedure of development of composite score of urban QoL is presented in Figure 2.

$$Index^k = \sum_i \alpha_i^k X_i^k \quad (2)$$

$$Urban\ QoL\ score = BAI + EDI + IDI + TAI + EII + SSI + GEI \quad (3)$$

Where X^k_i = indicator of variable *i* representing k^{th} aspect of development and α^k_i = estimated coefficient using PCA for indicator *i* for k^{th} aspect of development.
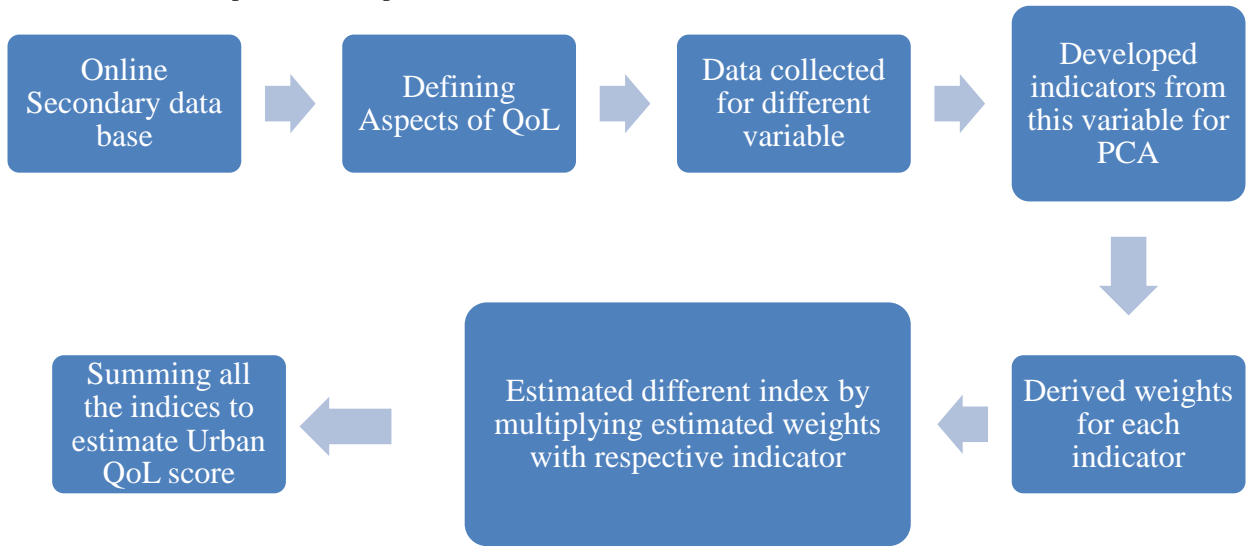

Figure 2 Procedure for the development of Urban QoL score

8. Results and discussion

Applying the modelling framework as describe above following weights were estimated and presented in Table 3. The expected sign of all the indicator should be positive as the development of the indicator was performed in such a manure that "1" represent best performance of the index and "0" as the worst performance. Out of 34, 27 indicators return the estimated weights as per the expected sign whereas 7 indicator sign were not logical. The correlation results shows that SSI has the highest linear correlation coefficient of 0.88 with Urban QoL score. TAI, EDI and GEI indices showed a strong linear correlation with Urban QoL score of greater than 0.75 Pearson's linear correlation coefficient. The Urban QoL score and indices were calculated using the coefficient estimated using PCA. The analysis revealed that Mumbai has the best Urban QoL score whereas Patna has the lowest Urban QoL score among 14 cities of India. The Urban QoL score and other indices were segmented into 4 different category based on their mean and standard deviation as presented Table 4. Delhi, Kolkata and Mumbai were among the cities corresponding to good Urban QoL score development. Results in Table 4 reveals, which city need to work in which direction so that the QoL of the city can be enhanced. For example megacity like Delhi need to work majorly on environmental impact parameter for sustainable and better development while Mumbai need to work in the direction of infrastructure development for the better development. Cities like Indore, Patna, Jaipur and Bhopal need to work on most of the aspects of development, which they lack for better development. As far as TAI and IDI is concern most of the city has lower index than mean which need further attention on these indices. These two aspects are basically govern by policy maker and the planner. So we will mainly discuss about how the transportation related parameter can be further enhance for different cities so that the overall QoL of the cities in India can be improved. Using Pearson's correlation coefficient it was found out that 4 parameter of TAI have strong correlation with Urban QoL score (>0.7), which are as follow- 1) Total public transit network coverage length per unit area 2) Total public transit daily ridership/population 3) Daily service trip of MRTS and 4) Number of Aircraft movement. It is quite evident that most of these transportation parameters are highly related to the access of public transportation facilities, which presents that as far as transportation derived QoL for urban area is concern it mainly revolve around the accessibility of public transportation especially for developing economy like India. Using this parameters suggestion will be made for transit network coverage, which will directly influence daily services and ridership for Ahmedabad, Bhopal, Chandigarh, Hyderabad, Indore, Jaipur, Lucknow, Patna and Pune, which in return enhance the accessibility of public transportation.

Table 3 Estimated weights for different indicators using PCA

Index	Indicator	Estimated weights
BAI	% of Household (HH) with treated tap water	0.141
	% of HH with toilet within premise	*
	% HH with electricity as main source	0.158
	% of population in slum	*
	Persons literacy %	0.176
	Spread of slum	*
EDI	GDP per capita	0.246
	Average HH Savings	0.202
	Unemployment rate	0.132
SSI	Crime rate	0.240
	Riots rate	0.208
TAI	No. of public bus fleet	0.209
	No. of buses per km of network length	*
	Total public transit network coverage length per unit area	0.206
	Total public transit daily ridership/population	0.263
	Daily service trip of MRTS	0.279
	Number of Aircraft movement	0.272
	Vehicle per capita	0.133
	vehicle ownership/road length	0.042
	Road length	0.115
	Total no. of person killed per km of road	0.028
EII	% of forest area	0.108
	MSW Per Capita Waste Generation (kg/day)	*
	Generated waste/area of landfill	*
	CO_2 kg/capita/year	0.142
	PM10 concentration	0.078
	PM2.5 concentration	0.168
IDI	No. of school per unit area	0.136
	No. of bed per capita in research and medical centres	*
	Beneficiaries Availing Government health Scheme Facilities per capita	0.106
GEI	Sex ratio	0.023
	Crime rate against women	0.188
	Unemployment rate for females	0.192
	Difference in literacy rate between male and female	0.150

Estimated weights not having logical sign

Table 4 Segmentation of cities in different classes for different aspects of development

	Mean (M)	Standard deviation (SD)	>M+SD	>M and < M+SD	>M-SD and <M	<M-SD	Highest	Lowest
Overall QoL	1.94	0.73	Delhi, Kolkata and Mumbai	Bengaluru, Chennai, Hyderabad and Pune	Ahmedabad, Bhopal, Chandigarh, Indore, Jaipur and Lucknow	Patna	Mumbai	Patna
BAI	0.23	0.09	Pune	Ahmedabad, Bengaluru, Chandigarh, Chennai,	Delhi Hyderabad, Mumbai, Kolkata,	Bhopal, Indore, Jaipur, Lucknow	Pune	Patna
EDI	0.32	0.12	Ahmedabad, Kolkata, Mumbai	Bengaluru, Chennai, Delhi, Pune	Chandigarh, Hyderabad, Indore, Jaipur, Lucknow	Bhopal, Patna	Mumbai	Patna
SSI	0.29	0.11	Kolkata, Mumbai	Ahmedabad, Bengaluru, Chennai, Delhi Hyderabad, Lucknow	Chandigarh, Pune	Bhopal, Indore, Jaipur, Patna	Kolkata	Patna
TAI	0.48	0.4	Delhi, Mumbai	Bengaluru, Chennai, Kolkata	Ahmedabad, Bhopal, Chandigarh, Hyderabad, Indore, Jaipur, Lucknow, Patna, Pune	-	Delhi	Indore
EII	0.27	0.11	Kolkata, Mumbai	Chandigarh, Chennai, Hyderabad, Indore, Pune	Ahmedabad, Bengaluru, Bhopal, Lucknow	Delhi Jaipur, Patna	Mumbai	Patna
IDI	0.08	0.05	Delhi, Kolkata	Indore, Lucknow	Ahmedabad, Bengaluru, Bhopal, Chandigarh, Chennai, Hyderabad, Jaipur, Mumbai, Patna, Pune	-	Delhi	Chennai
GEI	0.33	0.09	Chennai, Kolkata, Mumbai	Bengaluru, Delhi, Hyderabad, Lucknow, Pune	Ahmedabad, Bhopal, Chandigarh,	Indore, Jaipur, Patna	Chennai	Jaipur

As suggested by Gu et al., (2016) and Lee & Sener, (2016)QoL in urban area keeps accessibility as the central focus of QoL and transit network coverage is a performance indicator of accessibility of public transportation (Mishra et al., 2012). To estimate the future transit network coverage of cities having lower than the mean value oftotal public transit network coverage length per unit area indicator, for these cities the indicator value is equated to the mean value of indicator for all these cities i.e. 0.18. Using the formula presented in Equation 1, the variable value can be estimated as $(x – min) / (max - min)$. For this estimation the x represents the value of the variable (total public transit network coverage length per unit area), min represents the minimum value from that particular variable which is 0.32 and max represents the maximum value from that particular variable which is 14.6 from the data set of 14 cities.Table 5represent the future network coverage in total and the additional length required based on their current network coverage. The results in Table 5shows that huge transportation connectivity work needs to be given importance.For example mega city like Hyderabad need to enhance their public transit network coverage to a great extent. These results include both bus transit network and suburban rail transit network. As a small scale, solution to overcome the transit network coverage issue, it can be achieved by increasing the bus network coverage and then gradually developing infrastructure for MRTS such as metro. A policy-making suggestion is to focus metro

development in this cities and to prioritize their project to achieve uniform development from transportation access perspective among Indian cities.

Table 5 Estimation of public transit future network coverage for cities having below average "total public transit network coverage length per unit area" indicator

Cities	Future network coverage needed (km.)	Additional required (km.)
Ahmedabad	1360	568
Bhopal	826	637
Hyderabad	1885	1611
Indore	500	225
Jaipur	1405	1230
Lucknow	1740	1405
Patna	680	600
Pune	800	552

9. Conclusion

Basic amenities, Economic Parameters, Safety and Security factors, transportation factors, infrastructure parameter, Environment factors and Gender equality all contribute on a society's QoL, as well as on how specific factors influence the well-being in an urban area. Where some of the important factor such transportation access parameters and gender equality parameters are highly correlated to the QoL of urban agglomeration, which are not been given much attention by the researchers around the world in the determination of urban QoL and development. It is quite evident that QoL measurement itself is a multidimensional measurement, which should always be related to the context and reference where it has to be applied. As in developing economic the urban QoL should be define based on all the aspects starting from basic amenities, in which direction India is still working hard despite of being the world's 6th largest economy. It can be observed through this study that transportation facilities are an important attribute, which directly contributes toQoL of the urban area. It can be concluded that transportation derived QoL in urban area should primarily focus on the accessibility.For developing economics like India, it should mainly focus on the public transportation accessibility. This research gave a different development direction for different cities in which they particularly lack. This study is also important to understand the complex interaction between different aspects of development and to investigate the correlation between transportation system and the urban QoL so that the transportation planner and policy maker will be alert of how different elements of transportation systems affects various dimension of urban QoL.

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