Spatial Analysis of the Intra-urban Quality of Life: A Study in the Darjeeling Town in India

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1 Introduction

The term wellbeing is in itself a very ambiguous term and is devoid of any concrete definition, as the idea of the concept may vary from one individual to another and is very multidimensional in aspect (Fleurbaey and Blanchet 2013; Das et al. 2019). However, the concept of wellbeing in economics and development studies is usually seen from the perspective of the quality of life (QOL). Quality of life has been defined by the World Health Organisation (WHO) as "an individual's perception of his or her position in life taken in the context of culture and value systems in which he or she lives in relation to his or her goals, expectations, standards and concerns" (WHO 1999).

There has always been a general tendency among the scholars to measure and analyze the quality of life (QOL) although there is no single model or a comprehensive set of measures to do so (Stimson and Marans 2011). Yet, two main approaches, i.e., of the objective dimension and of the subjective dimension have been developed over the last few decades to define the QOL (Diener and Suh 1997). Objective wellbeing refers to the material and social circumstances which are believed to cultivate individual's or community's sense of wellbeing (SDRN 2005),

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and it is based on the analysis of secondary sources of data like the census data. On the other hand, subjective wellbeing implies individual's self assessment of their own wellbeing (SDRN 2005) and is based on primary data collected through sample surveys (Stimson and Marans 2011).

The measurement of objective QOL involves a set of social indicators pertaining to the GDP, housing conditions, education levels, income, etc. The main functions of these social indicators are to measure the state of QOL and the changes over time; to understand the major aspects and dimensions; to find out social conditions which could be judged normatively; to be embedded in a social model and to be used for public policy goals (Smith 1973). Therefore, objective measures of QOL should include those factors that can be objectified, quantified and be translated into policies. The use of different social indicators to study QOL started in USA during the 1960s with the publication of HEW indicators and HEW trends (Smith 1973; Pacione 1982; Stimson and Marans 2011). Many scholars like Bauer (1967), Gross (1966), Sheldon and Moore (1968), etc. started taking interest in this field. Parallelly, this kind of study was being undertaken across the Atlantic in UK by group of researchers like Moser (1970), Shonfield and Shaw (1972) to name among the few, but most of the published works of early 1970s were non spatial, and it was only after the entry of geographers into the field that new dimension of space was added (Pacione 1982). Perle (1970), Smith (1973), Harvey (1972) were the first geographers among the many to contribute in this field. During the last two decades, some significant studies have been conducted both by the agencies and as well as by the individuals; some international agencies like UN-HABITAT (2003) and World Bank (2003) had started focusing on the issues related to wellbeing of the urban dwellers, and scholars like Bohnke (2005), Nussbaum (2006), Haq and Zia (2012) have used objective indicators to measure QOL. In India, Parry et al. (2012), Haque (2016), Das et al. (2019), etc. have written articles related to wellbeing and quality of life.

This study measures the objective QOL in terms of material factors like housing, services and amenities of the urban households of Darjeeling town. The material dimensions of the QOL that emphasizes on individual material resources are important as they represent economic conditions of individual's material ownership which can be transformed into wealth, according to each individual's preferences and capabilities (Sen 2004; Cambir and Vasile 2015). These individual material factors that have been selected can be regarded as various component indices (indexes) by themselves and have been used to develop the composite index for measuring the QOL of the different households of Darjeeling town; the individual component indexes along with the composite index have been mapped in the town, and the areas have been identified which are lagging behind in terms of material aspects of QOL. Clusters of high QOL and low QOL have been, identified and further, those clusters can be treated as target areas, where the public policies related to the material aspects of QOL can be implemented and their progress can be monitored.

2 Dealing with One Among the Oldest Municipalities in India

The Darjeeling Municipality is one of the oldest municipal towns in India and was first constituted on July 1, 1850, with 10 wards (Dash 1947). Darjeeling was developed as a sanitarium and under the capable administration of Dr Campbell, who was appointed in 1839 as the first superintendent of the area, around 70 European houses along with the bazaar, jail and boarding house for the sick was constructed in the town (Malley 1907). He is credited for developing the hill station, for introducing tea and coffee and for encouraging immigration in the area. Darjeeling town developed as a typical hill station, where the European section was located on the higher ridge with all magnificent buildings like Gothic churches, town hall building, bungalows and hotels overlooking the market square (bazaar) and native quarters situated down below. The 1881 maps of the town, which are all depicted in Aditi Chatterji's book "Contested Landscape: The Story of Darjeeling," clearly shows that the town was divided into two sections, i.e., the White town or the European section on the upper ridges and the Native Quarters situated on the lower reaches. The European section received all the facilities, whereas the native quarters received the bare minimum.

Till 1916, the Municipality was governed by nominated commissioners under the Bengal Municipal Act (Act III of 1884) and the Special Act (Act I of 1900). After 1916, the commissioners were elected, and again in 1932, the Bengal Municipal Act (XV of 1932) was introduced which continued till the time of independence (Dash 1947). After independence, the first election on the basis of universal adult suffrage was held in the year 1964, but the newly elected board could not take charge due to an injunction; fresh elections were held in 1966 but were soon superseded by the state government, this frequent interference by the state government in the functioning of the Darjeeling Municipality became a recurring affair thereafter. On October 12, 1988, the West Bengal Government upgraded the Darjeeling Municipality from category "D" to category "A" and the number of wards was increased from 26 to 32 (Khawas 2003). The Bengal Municipal Act of 1993 introduced the Chairman in Council system of governance, whereby the Municipality is run by the Chairman along with the Vice-Chairman and a Board of Councilors (Department of Urban Development and Municipal Affairs 2020). In year 2001, the area of Darjeeling Municipality was 10.75 km^2 but after the reorganization and bifurcation of wards in 2011, the town now covers an area of 7.43 km^2 (Darjeeling Municipality 2011) only; the town has around 22,000 households, 116 "samaj" (traditional community based organization), over 350 hotels and restaurants, 25 vegetable markets, 10 fish and meat markets and 89 institutional holdings (Chhetri and Lepcha 2012). The density of population in Darjeeling town is 15,990 persons per sq.km as per 2011 census report. The high density of population within the town exerts immense pressure on the existing infrastructure which was actually designed for 1000 persons only (Chhetri and Tamang 2013) (Fig. 1).
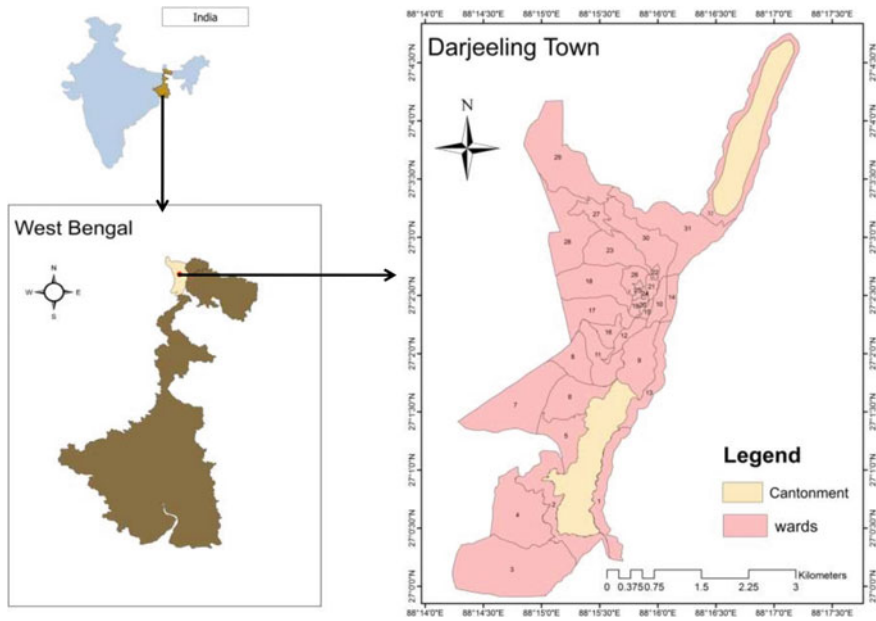
Fig. 1 Location map of Darjeeling town

3 On Calculating the QOL

Secondary data from the Municipality records and Census of India Reports have been used to identify intra-urban variations of the QOL of the households. The data have been analyzed by SPSS 17 software, and ArcGIS 10.2.1 has been employed to prepare maps and also for the spatial autocorrelation statistics. All the base maps which have been used to prepare the different figures in the study have been obtained from the Municipality of Darjeeling as hardcopies, these were subsequently digitised in ArcGIS software for further analysis. The details regarding the materials and methods section have been explained in the following paragraphs.

3.1 Acquiring and Managing the Datasets

The study has been conducted on the basis of secondary data collected from Primary Census Abstract (PCA 2011), House Level Primary Census Abstract (HLPCA 2011) and Darjeeling Municipality Records (2011). The information related to socio-economic data like Female working Population and Literates was derived from PCA and Municipality Records, whereas the data regarding housing conditions, basic services and amenities were derived from HLPCA (Table 1).

Table 1 Important indicators and their sources

Notation	Indicator	Source
X_1	% of households having TV	House Level Primary Census Abstract (HLPCA 2011)
X_2	% of households having phone (landline and mobile)	Do
X_3	% of households having LPG connection	Do
X_4	% of households having good housing condition	Do
X_5	% of households having water (within the compound)	Do
X_6	% of households accessing banking service	Do
X_7	% of households having motorcycle	Do
X_8	% of households having computer with Internet	Do
X_9	% of households having computer	Do
X_{10}	% of households having motorcar	Do
X_{11}	% of households having permanent shelter	Do
X_{12}	% of households having cement roof	Do
X_{13}	% of households having toilet present	Do
X_{14}	% of households having electricity	Do
X_{15}	% of female literates	Darjeeling Municipality Records (2011)
X_{16}	% of female workers	Primary Census Abstract (PCA 2011)
X_{17}	% of households having kitchen	House Level Primary Census Abstract (HLPCA 2011)
X_{18}	% of households having own house	Do

Thus, all the three secondary data sources were referred for analyzing the material QOL of the urban dwellers of Darjeeling Town for developing the Composite Index map and the hotspot map (Fig. 2).

Firstly, the data was normalized within the range of 0–1 with the help of Min-Max normalizer. The most desired value achieved after the normalization process is 1 and the least being 0. Data normalization technique helps to compact the data of different sizes into a common scale so that the larger values may not influence the results; this is most helpful in those situations where the data present are in different magnitudes or in different units. The following formula was used for the normalization process.

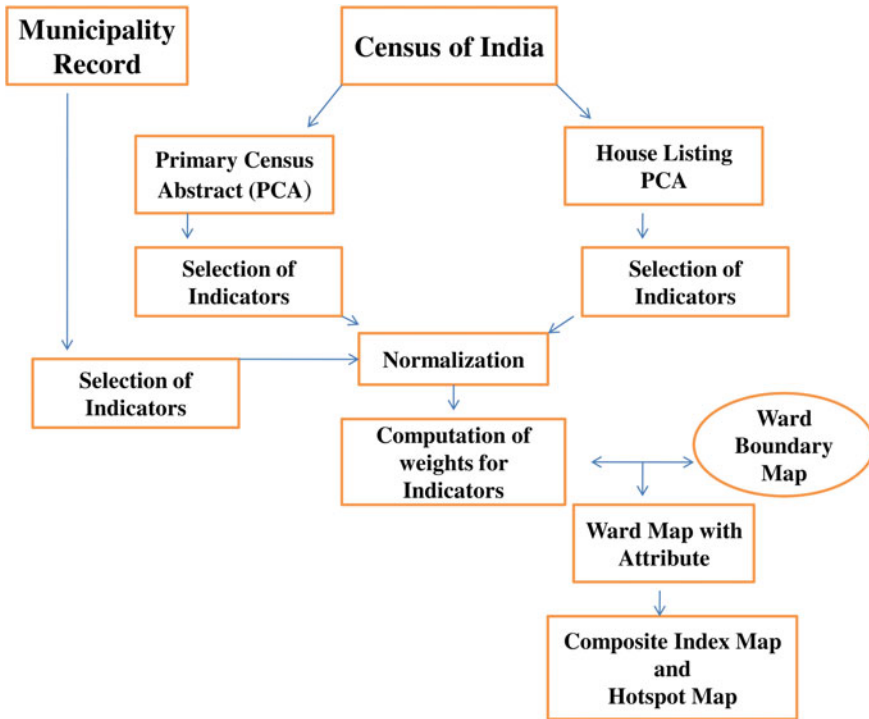$$X_n = \frac{X_0 - X_{\min}}{X_{\max} - X_{\min}} \tag{15.1}$$

Fig. 2 Flowchart of the mapping methodology

where

X_n	new value for variable X,
X_0	actual value of variable X,
X_{min}	minimum value in the data set,
X_{max}	maximum value in the data set.

3.2 Fetching the Principal Components

Principal component analysis (PCA) is the method of data reduction; it is the mathematical process that uses orthogonal transformation to convert a set of observations of correlated variables into a set of values of linearly uncorrelated variables called components (Haq and Zia 2013). The numbers of principal components are less or equal to the number of the original variables. All the principal components having eigenvalue of 1 and more are selected, and the first principal component has the largest possible variance, the second greatest variance by the

second principal component and so on. These principal components have been used as component indexes and later been used to construct the Composite Score Index for measuring the QOL. The PCA has been calculated with the help of following formula (After Haq and Zia 2013).

$$X_i = \lambda_{i1}F_1 + \lambda_{i2}F_2 \ldots + \lambda_{ij}F_j \tag{15.2}$$

where

X_i ith indicator,

λ_{ij} Factor loading which represents the proportion of the variation in X_i which is accounted for by the jth factor.

$\sum \lambda_{ij}$ is called the communality, and it is equivalent to the multiple regression coefficients in regression analysis.

F_j symbolizes jth factor or component.

3.3 Construction of a Composite Score Index

In order to analyze the intra-urban variations in QOL, Composite Score Index has been constructed and mapped. Composite Score Index is very comprehensive and multidimensional in nature and can represent multiple indicators by one aggregate value (Kararach et al. 2017). In this method, the ward-wise component scores were extracted by using varimax rotation. Thereafter, all the five component scores were added to get the total component score, and this total component score, was further divided by the number of components to construct the composite index.

$$CS_{index} = \frac{TCS}{N} \tag{15.3}$$

where

CS_{index} Composite Score Index,

TCS   Total component score,

N Number of components.

3.4 Spatial Autocorrelation Analysis

This study uses Global Moran's I as a first measure of spatial autocorrelation. Moran's I ranges from -1 to 1, where the value of 1 means perfect positive spatial autocorrelation, the value of -1 indicates perfect negative spatial autocorrelation and the value of 0 signifies perfect spatial randomness (Tu and Xia 2008; Fu et al. 2014). It also calculates Z-scores, the high Z-score indicates occurrence of spatial

clustering of the phenomenon, and on the other hand, low Z-score indicates dispersion.

Calculations for Moran's I are based on a weighted matrix, with units i and j. Similarities between units are calculated as the product of the differences between Y_i and Y_j with the overall mean.

$$I = \frac{N}{W} + \frac{\sum i \sum j (Yi - \overline{Y})(Yj - \overline{Y})}{\sum i \sum j W_{i,j}} \tag{15.4}$$

where

N is the number of spatial units indexed by I and j,
Y_i is the variable, $\overline{Y}$ is the mean of Y,
$W_{i,j}$ is the matrix of spatial weights with zeros on the diagonal and W is the sum of all W_{ij}

Spatial autocorrelation statistics like Moran's I are global in nature as they estimate the overall degree of spatial autocorrelation for the given dataset. Sometimes the estimated degree of autocorrelation may vary significantly across geographic space. Local spatial autocorrelation statistics are used in this conjunction to provide estimates disaggregated to the level of the spatial analysis across space. Getis-OrdGi* statistics has been used as the second measure of spatial autocorrelation. The Getis-OrdGi* functions as the local spatial autocorrelation statistics and uses hotspot analysis to seek out clusters. The hotspot analysis with the help of Z-scores and P-values identifies areas where the features with high or low values cluster spatially. A feature with a high value may not be a statistically significant hotspot, to be a statistically significant hotspot; the feature with high value should be surrounded by other features with that have high values as well (Essri 2020). Composite scores have been analyzed by Global Moran's I statistics to ascertain whether the spatial autocorrelation of the dataset has occurred or not, and then Getis-OrdGi* statistics is used as the local spatial autocorrelation statistics to identify the clusters of high material QOL and the clusters of low material QOL.

The Getis-OrdGi* local statistics is expressed as;

$$Gi^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \overline{X} \sum_{j=1}^{n} w_{i,j}}{S \sqrt{\frac{\left[\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}} \tag{15.5}$$

where

x_j is the attribute value for feature j,
$w_{i,j}$ is the spatial weight between the feature I and j,
n is the total number of features; and

$$\overline{X} = \frac{\sum_{j=1}^{n} x_j}{n} \tag{15.6}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \left(\overline{X}\right)^2} \tag{15.7}$$

4 An Excerpt of the Empirical Findings

The findings are based on the results obtained from PCA. The main objective for conducting the PCA is to reduce the original number of explanatory variables to a smaller number of independent factors; these independent factors can explain the whole set of variables. This study tries to find out the spatial variations in the QOL of the urban dwellers of Darjeeling town with the help of 18 objective indicators (Table 1). These 18 indicators have been classified into five components by PCA, and the variables within the component are strongly correlated with each other but not with the variables of the other components. The five principal components explain 73% of the total variance (Table 3).

4.1 KMO and Barlett's Test of Sphericity

KMO and Barlett's test of sphericity is a measure of sampling adequacy that is recommended to check the case to variable ratio for the analysis being conducted. The result of KMO is 0.616 which implies that the factor analysis can be performed for the dataset, and Barlett's test of sphericity is less than 0.05, which means that the result is significant indicating that some correlation exists among the variables (Table 2).

Table 2 Statistic of Kaiser–Meyer–Olkin measure of sampling (KMO) and the results of Bartlett's test. *Source* Computed by the authors

Adequacy value of sampling Kaiser–Meyer–Olkin (KMO)	0.616	
Barlett's test of sphericity	Chi-square	323.655
	Degree of freedom	153
	Significance level	0.000

4.2 Explaining the Principal Components

The first principal component has the eigenvalue of 3.996 and explains 22% of the variance (Table 3). The first principal component includes six indicators of QOL out of the total 18. The indicators included in the first principal component are presence of TV, presence of phone (landline and mobile), LPG connection, good housing condition, presence of water within the compound and access to the banking service. This component tends to have most of the indicators related to the amenities along with the housing condition (Table 4). The positive signs of the PC1 indicate higher QOL on the basis of the above-mentioned indicators, and the negative sign signifies lower QOL. The highest component score can be seen in ward no 9 and the lowest in ward no 4 (Table 5), which means that the % of amenities with good housing condition is highest in ward no 9 and lowest in ward no 4. When the PC1 is spatially mapped, then it can be noticed that those wards like 1, 9, 10, 21, 24 and 26 which were historically part of the white town during the British Period have higher QOL and the outskirts like ward no 32, 29, 28, 27, 23, 18, 17 and 4 which were later extensions or part of the native town have lower QOL and are lagging behind in terms of amenities and good housing condition. The posh areas of the bygone era exhibit higher values (Fig. 3a).

The second principal component has an eigenvalue of 15.721 and explains 15% of the variance (Table 3). The second principal component includes presence of motorcycles, presence of computers with Internet services, presence of computers and presence of motorcars (Table 4). The second component has the indicators related to transport along with computers and Internet connections. Ward no 30 has the highest score in terms of PC2 and ward no 3 the lowest (Table 5). When spatial distribution of PC3 is examined, then it is found that ward no 30 and its peripheral wards with exceptions of ward no 5 and ward no 32 show higher levels of QOL (Fig. 3b).

The third principal component has an eigenvalue of 15.600 and explains 14.445 of the variance (Table 3). It includes indicators related to housing infrastructures like permanent shelter, cement roof, presence of latrines and presence of electricity (Table 4). The housing infrastructure of ward number 16 is the highest and that of the ward no 3 is the lowest (Table 5). The business and tourist districts located in ward numbers 9, 10, 11, 12, 15, 16, 19, 25 which are the parts of Jalapahar ridge, Toongsong area, the areas surrounding the Mall, Judge Bazaar area and Ghoom area (ward no 4) have better housing infrastructure as compared to those areas located at the outskirts of the town (Fig. 3c).

The fourth principal component explains 12.277% of the variance and has an eigenvalue of 15.210 (Table 3). Indicators related to gender like female literates and female main workers along with housing-related indicator like presence of kitchen falls under this component (Table 4). Ward number 27 has the highest score in terms of % of female literates and female working population (Main worker category), whereas ward no 5 has a very poor score (Table 5). A group of adjacent

Table 3 Total variance explained. *Source* Computed by the authors

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	5.778	32.101	32.101	5.778	32.101	32.101	3.996	22.200	22.200
2	2.381	13.228	45.329	2.381	13.228	45.329	2.721	15.116	37.316
3	1.953	10.851	56.180	1.953	10.851	56.180	2.600	14.445	51.761
4	1.702	9.457	65.637	1.702	9.457	65.637	2.210	12.277	64.038
5	1.329	7.385	73.022	1.329	7.385	73.022	1.617	8.984	73.022
6	0.980	5.442	78.464						
7	0.846	4.698	83.162						
8	0.726	4.034	87.196						
9	0.509	2.829	90.026						
10	0.388	2.154	92.180						
11	0.350	1.947	94.126						
12	0.310	1.722	95.848						
13	0.211	1.173	97.022						
14	0.181	1.008	98.029						
15	0.119	0.659	98.689						
16	0.109	0.604	99.293						
17	0.074	0.413	99.706						
18	0.053	0.294	100.000						

Table 4 Rotated component loadings matrix with communalities. *Source* Computed by the authors

Notation	Components					Communalities
	1	2	3	4	5	
X_1	0.875					0.840
X_2	0.783					0.780
X_3	0.770					0.813
X_4	0.686					0.588
X_5	0.658					0.687
X_6	0.652					0.787
X_7		0.840				0.777
X_8		0.790				0.740
X_9		0.783				0.784
X_{10}		0.630				0.713
X_{11}			0.892			0.867
X_{12}			0.781			0.756
X_{13}			0.631			0.723
X_{14}			0.600			0.634
X_{15}				0.795		0.681
X_{16}				0.753		0.581
X_{17}				0.538		0.556
X_{18}					0.799	0.834

wards of 10, 23, 26, 27, 30 and two outlying wards of 1 and 13 have higher scores of in terms of PC4 (Fig. 3d).

The fifth principal component with an eigenvalue of 1.617 explains 8.984% of the variance (Table 3). This component is correlated with ownership of the house (Table 4). The spatial distribution of PC5 reveals a very surprising picture, except ward no 10 all the other wards that are located within the town have low house ownership scores and those areas which are located at the outskirts have higher ownership scores (Fig. 3e). This might be due to tourism boom and migration from the surrounding tea gardens and rural areas during the late 1980s to early 1990s; in the early 90s, many residential properties were converted to commercial ones. This increased population pressure led to the buildings being converted into hotels and rental properties to house the migrants and tourists alike (Chhetri and Tamang 2013). Ward no 32 that includes Lebong and Ging area which are situated on the outskirts of the town and has not experienced development of hotels and other tourism-related structures has the highest housing ownership score, while ward no 18 covering Pragati gram, Shiva Gram, Fulbari area which are very close to the CBD and have many low-income rent houses scores the lowest in terms of ownership (Table 5).

Table 5 Factor scores with ranking of the wards on the basis of Composite Score Index. *Source* Computed by the authors

Wards	PC1	PC2	PC3	PC4	PC5	Composite Score Index	Ranks
1	0.81	−0.10	−0.35	−0.93	1.26	−0.32	19
2	−0.59	−0.04	0.55	−0.58	0.30	−0.59	22
3	0.69	−1.27	−2.05	0.51	1.80	−1.75	27
4	−3.56	−0.53	1.55	0.46	1.13	−1.85	28
5	0.72	1.30	-0.50	−2.72	1.56	−0.89	24
6	0.16	0.31	−0.26	0.53	−0.46	0.64	10
7	0.14	−0.26	0.29	1.14	0.40	1.40	7
8	−0.36	−0.06	0.09	0.81	0.03	0.49	12
9	1.06	−0.98	0.79	0.63	0.18	1.54	5
10	1.04	0.71	0.89	1.57	1.05	4.42	1
11	−0.01	−0.15	0.98	−0.22	−0.04	0.60	11
12	0.77	−0.99	1.12	0.55	−0.16	1.42	6
13	0.70	−0.80	0.15	0.92	0.23	1.01	9
14	0.43	−0.77	−0.94	0.45	−0.72	−0.97	25
15	0.68	1.37	1.43	0.15	0.60	3.74	2
16	−0.32	−0.68	1.86	−0.99	−0.56	−0.24	18
17	−0.97	−0.67	−0.67	−0.64	−1.06	−3.17	30
18	−1.08	−0.63	−1.25	−1.08	−2.77	−4.59	32
19	0.12	1.06	1.14	0.09	−0.46	2.31	4
20	0.37	0.74	−0.13	−0.54	−1.91	0.07	15
21	0.86	0.15	0.11	−1.02	−0.20	0.06	16
22	0.71	0.14	0.50	−0.91	−0.60	0.32	14
23	−1.14	0.49	0.16	1.01	−0.30	0.47	13
24	0.85	−0.06	−0.33	−0.87	−1.04	−0.61	23
25	0.75	−0.40	1.23	−0.30	0.05	1.28	8
26	0.82	−1.08	−0.64	1.03	−0.42	0.06	17
27	−1.24	0.63	−1.57	1.85	−0.09	−0.36	21
28	−0.79	−0.72	0.06	−0.40	−0.63	−1.94	29
29	−1.05	0.98	−0.218	−0.20	0.79	−0.32	20
30	0.12	3.71	−1.21	0.96	−0.52	3.47	3
31	0.61	−1.19	−1.51	0.46	0.53	−1.52	26
32	0.81	−0.28	−1.29	−1.74	1.96	−4.18	31

5 Assessing Quality of Life

Composite Score Index (simple average) has been used to determine the overall QOL (material). On the basis of this index, the different wards of the town have been ranked, and it can be seen that the highest level of material QOL is present
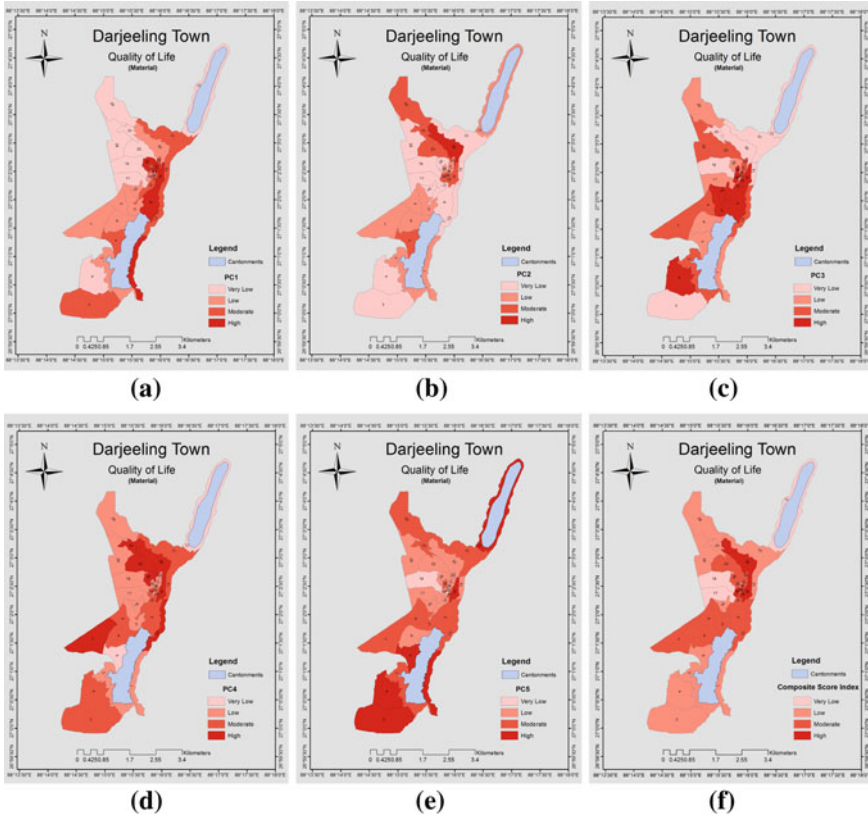
Fig. 3 **a** PC1 (amenities and good housing); **b** PC2 (transport); **c** PC3 (housing condition); **d** PC4 (gender); **e** PC5 (house ownership) and **f** quality of life in Darjeeling town

among the residents of ward no 10 followed by ward no 15 and 30. The lowest level of QOL can be observed among the households of ward no 18 (Table 5). The households of ward no 10 relatively have higher scores across all the principal components. Ward no 15 has moderate scores in most of the principal components except principal component 3 (PC3), where it got high score, whereas ward no 30 has got very mixed performance. It has performed well in principal components 2 (PC2) and 4 (PC4) while performing poorly in principal component 3 (PC3). The high QOL among the households in ward no 10 which is very close to the main promenade of the town, i.e., the mall is evident because it is the posh area of town; it is a high-class residential area where high-end hotels, restaurants and shops are located. Ward no 15 is an upper middle-class neighborhood, this area also has the presence of mid range hotels, shopping complex, restaurants, buildings and apartments; therefore, it has performed well in terms of housing infrastructure component (PC3) and has high QOL. The other ward having high QOL is ward no 30, it is a mixed neighborhood, where the houses of the upper middle class, lower

middle class and the lower class are present and this area is recently undergoing transformations in terms of its functions due to the construction of hotels especially near the mall road area. The Composite Score Index of ward no 18 is the lowest which indicates a very low QOL. It has performed very poorly because it is situated on the steep slopes of the lower reaches of the town just below the botanical garden and is a low-class residential area where the housing infrastructure (PC3), basic amenities and good housing conditions (PC1), transport (PC2) and ownership (PC5) scores are very dismal. It being a poor neighborhood has performed moderately well in gender-related component (PC4) as more womenfolk are engaged in work to supplement the income of the households.

The different wards of the Darjeeling town have been categorized to spatially analyze the intra-urban variations of material QOL of the households. These wards have been classified into four categories of QOL according to their Composite Score Index. Ward numbers 10, 15, 19 and 30 are those wards which have been classified in the category which has high level of QOL and ward numbers 17, 18 and 32 are in the very low category of QOL (Table 6). When examined spatially, the areas having high QOL are those areas which are situated on the upper ridges of the town and were once a part of the white European section of the pre-colonial times; these areas had efficient municipal services since the early times and as of today mostly perform tourism-related services. There are numerous hotels and restaurants along with high-class and upper middle-class residential buildings in these areas. The areas which have very low levels of QOL are those areas which are either situated on steep slopes on the lower reaches of the town like ward no 17 and 18 or are situated far away from the main C.B.D. like ward no 32, and these areas are not properly served by the municipality in terms of various services like water supply and has the concentration of low class residential areas, whereas rest of the areas have either moderate or low QOL (Fig. 3f) and if the average and the median composite score of QOL (Table 7) for all the households of Darjeeling town is examined, then the material QOL of the majority of the households falls under the moderate category (i.e., mean value and median value falling between −0.139 and 1.54).

Table 6 Categorization of municipal wards on the basis of Composite Score Index. *Source* Computed by the authors

Composite Score Index (QOL)	Ward numbers
High (>1.54)	10, 15, 19 and 30
Moderate (−0.239 to 1.54)	6, 7, 8, 9, 11, 12, 13, 20, 21, 22, 23, 25 and 26
Low (−3.169 to −0.239)	1, 2, 3, 4, 5, 14,16, 24, 27, 28, 29 and 31
Very low (<−3.169)	17, 18 and 32

Table 7 Descriptive statistics of Composite Score Index for Darjeeling town. *Source* Computed by the authors

N	Min	Max	Mean	Median	S.D	Variance	Kurtosis
32	−4.59	4.42	−0.14	0.06	2.00	4.04	0.67

6 Identification of Clusters

To find out the spatial variation of the material QOL in Darjeeling town, Global Moran's *I* autocorrelation test was conducted. After the spatial autocorrelation test, the calculated value of Global Moran's Index was 0.182 (Table 8), which is positive, above 0 and closer to 1, indicating clustering. Further, the Z-score of 15.04 and the *P*-value of 0.04 which is located at the orange zone confirms the presence of clusters on the basis of QOL (Fig. 4a).

As already stated in the preceding paragraphs, the Global Moran's I gives only an estimate of the overall degree of spatial autocorrelation. In order to examine the local nature of the spatial distribution of the QOL of the households, Getis-Ord GI* was employed. The Getis-Ord GI* uses hotspots and coldspots to identify clustering of high values and low values. For all statistically significant positive and negative Z-scores, the larger Z-scores will give more intense clustering of high values (hotspots) and smaller Z-scores will result in more intense clustering of low values (coldspots) respectively.

The hotspots and coldspots can be used to spatially locate areas having high and low material QOL on the map, the areas having high QOL will be represented by hotspots and those areas where the QOL is low will be represented by coldspots. It can be observed that ward no 10 and ward no 21 are the areas which have exceptionally high levels of QOL with 99% confidence level (Fig. 4b) and are surrounded by those wards like 12, 15, 9, 14 and 20 which also have higher QOL values; this indicates that the hotspots that have been identified by the Getis-Ord GI* are significant as it is surrounded by other areas exhibiting higher values. The spatial distribution of the QOL of the households as per the Getis-Ord GI* statistics shows that the Posh tourist areas of the ward numbers 10 and 21 with their high end hotels, restaurants and high-class and upper middle-class residential areas have emerged as a cluster where the material QOL of the residents is exceptionally high, while ward no 32 which is on the northern outskirts of the town has emerged as a cluster where the QOL is very low (Fig. 4b). This highlights the point that there is a wide spatial variation of QOL among the households of Darjeeling town.

Table 8 Global Moran's Index. *Source* Computed by the authors

Moran's index	0.181872
Expected index	−0.032258
Variance	0.010989
z-score	2.042688
P-value	0.041083

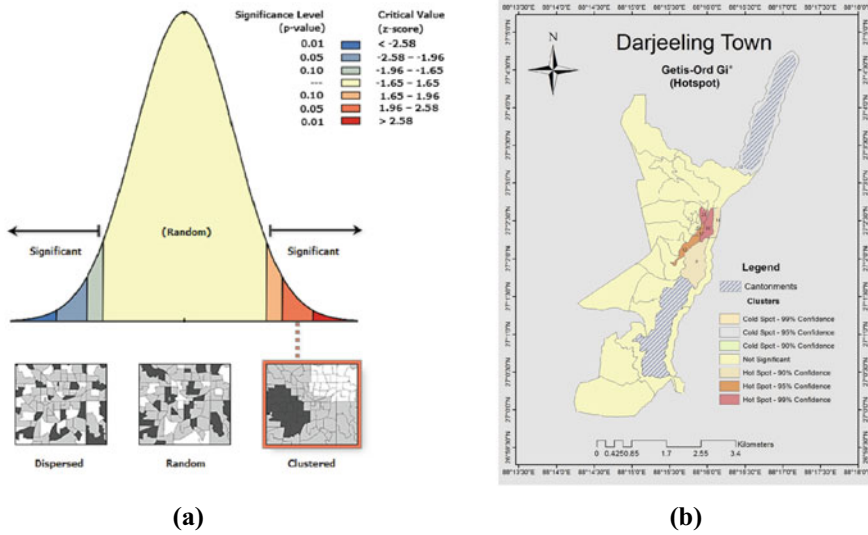(a)   (b)

Fig. 4 a Z-Score for Global Moran's *I* and b hotspots for QOL (Getis-OrdGi*)

7 Conclusions

The main objective of this study was to spatially analyze the intra-urban variations in the QOL of the different households in Darjeeling town through the principal component analyses and Getis-Ord GI* statistics. Darjeeling town since the time it was conceived and developed by the Britishers was developed as an urban space where high levels of disparity, in terms of access to urban services and housing conditions between the colonizers and the colonized would exist. The town was a divided space, with the present day wards of 10, 11, 9, 12, 14, 21 and 24 were part of the White Town while, the rest of the wards were either part of erstwhile Native Town or were later extensions. It was a space, where the Europeans would host dramas, parties, balls, picnics and would spend time with mirth and laughter (Chatterji 2007) and the life of the natives would drag on with misery, labor and sweat (Pradhan 1982). Unfortunately, the levels of disparity in terms of QOL which existed in the town during the colonial period are still present up to this day as it is evident from this study. Decolonization of the urban space has to assume paramount importance as the identified hotspots shows that high QOL is restricted only to few households of the above mentioned wards while the majority of the urban dwellers seem to be devoid of it. Therefore, a more concerted and collective effort is needed from the Urban Local Body (ULB), the Gorkhaland Territorial Administration (GTA) and the State Government to remedy such disparities which exist even after 73 years of independence. The macro-level plans developed by the Central Government have to be implemented at the micro-level by the ULB and GTA, and the two bodies need to frame target oriented local-level plans and policies

which can be evaluated by the monitoring cells. The Twelfth Five Year Plan (2012–2017) had highlighted the fact that the ULBs were not getting enough funds from the State Governments due to the absence of robust legal and intuitional frameworks as the States were not following the 74th Constitutional Amendment Act of 1992, which through Article 243W of the 12th Schedule grants constitutional status to the municipalities of India. The penetration of e-governance in the ULBs was found to be weak and very sporadic as there was lack of public participation in urban governance (GOI, 12th FYP 2012). Therefore, the Municipality of Darjeeling and the GTA should play a proactive role by maintaining very cordial relations with the State Government for the release of adequate funds for the proper implementation of major projects and programs to enhance the QOL of the households, they need to efficiently communicate with the Central Government in regard to various national level polices available for the urban development and have to setup policy mechanisms that ensures public participation and transparency for the academic and other scrutiny.

At the macro-level, the Central Government has formed the National Institution for Transforming India (Niti Aayog) on January 1, 2015. The Prime Minister's Office had asked the Niti Aayog to prepare Fifteen Year Vision, Seven Year Strategy and Three Year Action Agenda documents in 2016 (Niti Aayog 2017). Niti Aayog has recommended some policy changes and programs for the action years 2017–18 and 2019–20 under the Three Year Action Agenda. Chapter 7 of the Agenda, deals with issues related to improving urban quality of life through creation of adequate living and office space, holding down air pollution, municipal solid and creation of swamps; provision of greenery and common spaces for outdoor activity; provision of electricity, water and sewage; and provision of a vibrant transportation system that links suburbs to the center of the city and has a dense within city transport network (Niti Aayog 2017). The Aayog has reviewed some existing urban development programs like Pradhan Mantri Awas Yojana—housing for All, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart City Mission, Swachh Bharat Mission (Urban), Public Transports, Deen Dayal Antodaya Yojana—National Urban Livelihood Mission (DAY—NULM) and National Heritage City Development and Augmentation Yojana (HRIDAY) and has suggested additional measures in its Three Year Action Agenda. Of the above-mentioned programs, Pradhan Mantri Awas Yojana—housing for All, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), and Deen Dayal Antodaya Yojana—National Urban Livelihood Mission (DAY—NULM) can be of great significance in improving the QOL of the urban dwellers in Darjeeling.

Pradhan Mantri Awas Yojana—housing for All (Urban Mission) was launched in June 2015 to provide housing to all in urban areas by 2022. Under this mission, it has planned to build two crore houses for urban poor including economically weaker sections (EWS) and low-income groups (LIGs). This scheme can play an important role in improving the QOL of the households in the town, as most of the wards except wards no 10, 3, 4, 5 and 32 under Darjeeling Municipality have very low-to-moderate house ownership score (Fig. 3e). These are the wards where people suffer from extreme house ownership shortages. Other then food and

clothing, shelter is the third most important component which forms the basic requirement for honorable living. Therefore, this scheme along with the State Government's Housing Schemes for Lower-Income Group and Middle-Income Group should be implemented by giving more priority to those wards where the Housing Ownership Score (Fig. 3e) is low. The main hurdle in this regard is land ownership issue as most of the residents in the town do not have land ownership rights, The Municipality along with GTA should appeal to the State Government to grant landownership to the residents of Darjeeling Hill area in general and urban dwellers in particular.

Atal Mission for Rejuvenation and Urban Transformation (AMRUT) was launched with an objective to provide infrastructure for universal coverage of piped drinking water, sewage, green spaces and parks. The Municipality of Darjeeling has already started relaying the entire water distribution pipelines and construction of water tanks in all the 32 wards. The project will be implemented in three phases and will incur an expenditure of 15.05 billion rupees. In addition to this, development of Park along Nehru Road and Mall Road has been undertaken which is at its First Phase (State Mission Directorate-AMRUT 2018). If the Municipality would consider the ward numbers of 4, 17, 18, 23, 27, 28 and 32 as target areas (Fig. 3a) and increase the number of water connections and pipelines in those areas, then it would help in rectification of lopsided QOL in terms of access to basic services.

Deen Dayal Antodaya Yojana—National Urban Livelihood Mission (DAY—NULM) aims to create opportunities for skill developments for market-based employments and setting up of self employment ventures. Through these schemes, training and micro-credits could be provided to the households and more emphasis could be given to the involvement of the women by the municipality. Ward no 5 and ward no 32 (Fig. 3d) should be targeted in this regard and Self Help Groups and Female Co-operatives should be formed, Community-Based Organizations like samajs and Development Boards along with NGOs should be actively involved. Capacity building exercises of the poorer households and women should be frequently conducted for their gainful employment. Low-cost housing through this scheme should be constructed for the poor. Ward numbers 3, 14, 18, 27, 30, 31 and 32 (Fig. 3c) should be given special priority in this context.

Other than these schemes, Jan Dhan Yojana and Prime Minister Ujjwala Plan should be adopted as a measure for socio-economic welfare program. Its implementation along with the above-mentioned schemes should be evaluated and monitored in the three wards of 17, 18 and 32 where the overall all index of QOL is very low (Fig. 3f). The Municipality as per the 12th Five Year Plan recommendations should setup citizen's charters comprising of the local public, municipal authorities, planners and researchers in these three wards, it should involve different stakeholders in the identifications process of the key concerns and problems faced by the residents and for monitoring the developmental activities undertaken for that purpose. Ward no 32 should be considered as a special area as it has emerged as a coldspot where the QOL is very low (Fig. 4b). Special local-level policies and plans for the socio-economic wellbeing should be framed by the Municipality and the GTA, citizen's charter and monitoring cell should be tasked for evaluating the

performance of such programs. Though few programs like Swarna Jayanti Shahari Rozgar Yojana (SJSRY) and Integrated Housing and Slum Development Program (IHSDP) were under taken by the Municipality in the past, it seems these are inadequate and have not produced the desired results (Darjeeling Municipality Records 2016). Out of numerous schemes present at the macro-level which are framed by both the Central and State Governments for poverty alleviation and infrastructure improvement, the Municipality of Darjeeling has failed to seek assistance or grants nor has been able to produce any concrete action plan on its own. Therefore, the Municipal authorities along with GTA should seek assistance from the Central as well as the State Governments; they should invite planners and experts to make roadmaps for improving the wellbeing of the households of Darjeeling town.

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