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An appraisal of housing quality of living in Durgapur: A spatial approach

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Abstract

Studies on quality of life became a significant preoccupation with geographers with the emergence of welfare geography. There has however been a shift in the concept of housing quality from being determined only by Gross Domestic Product per capita during the 1950s to a multi-dimensional perspective in recent years. In this context, this paper analyses the spatial pattern of household quality of living (HQLI) in the industrial city of Durgapur utilizing ward-level data for the year 2011. Results show that HQLI deteriorates away from the city center, more towards the southern part of the city, as revealed by the regression residuals mapping. Reducing such spatial disparities and developing these underdeveloped areas is crucial to identify and mitigate intra-urban disparities in access to essential urban services and amenities.

Keywords: *Housing Quality of Living Index, regression residual mapping, ward level*

Introduction

Studies on Quality of Life (QoL) have witnessed a shift in the approaches to theorizing it. Such studies were dominated by a utilitarian approach during the 1950s, with an assumption that increased consumption inevitably resulted in higher income, leading to better levels of well-being (Samuelson, 1937). In recent years there has, however, been a shift to compute composite indices of QoL that are multidimensional, including both objective and subjective parameters (Sumner, 2006; Mu, Kang, & Zheng, 2023), the former including variables like the dwelling unit type, dwelling condition, and number of rooms and amenities (Elsinga & Hoekstra, 2005) while the latter reflecting characteristics of the user-desires, specific needs, and expectations.

QoL is an essential parameter of sustainability (Yosuff, 2020), which is contingent on parameters like housing materials (Murad and Raquib, 2007), cramped conditions of living (Satterthwaite, 2003), traumas emanating from one's housing quality (Aliu and Adebayo, 2010), lack of privacy owing to overcrowding (Zainal , Kaur, Ahmad, & Khalili, 2012), distance from the center of the city which negatively impacts housing quality in peripheral zones (Rahaman and Siddique, 2019). Space is an important parameter while determining the spatial pattern of QoL in households (Mondal, 2020).

There has been a spurious growth of urbanisation after Independence in India both in metropolitan and class I cities like

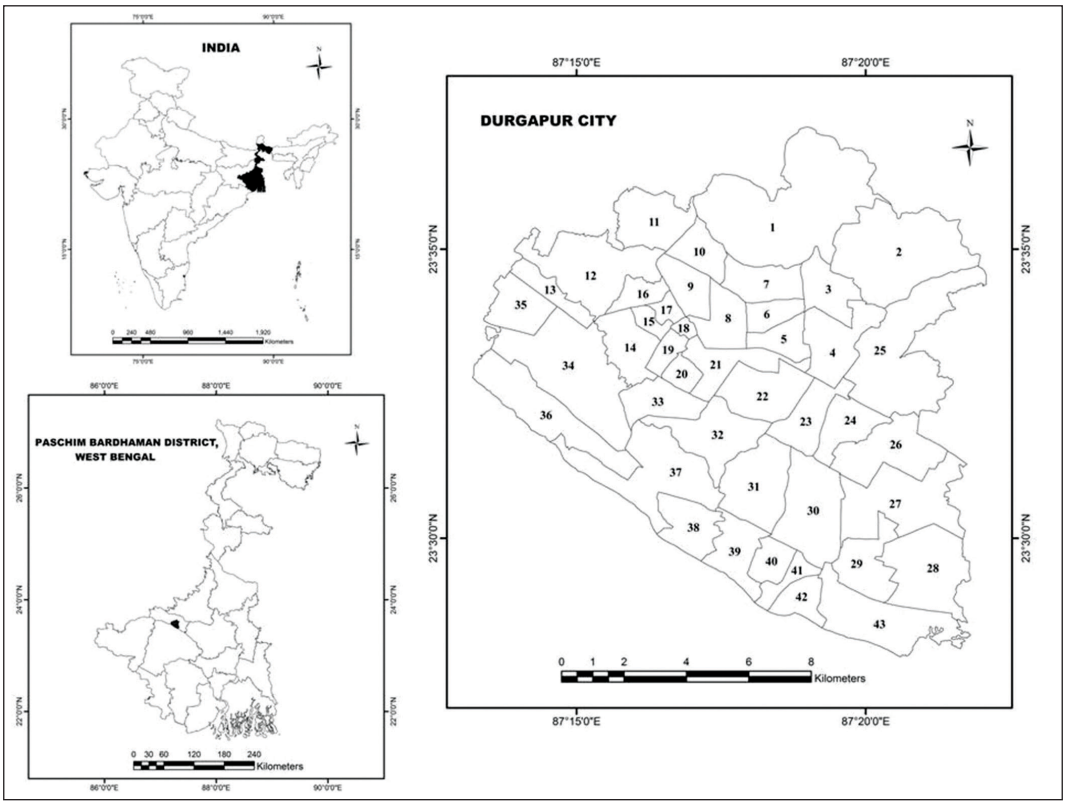

Fig. 1: Location of the study area

Durgapur, Bhilai, and Bokaro. During the Second Five Year Plan (1956-61), large-scale public investments in these areas, essentially rural in their population composition boosted economic production, transforming many such areas into urban centres. The town of Durgapur is an excellent example of such a transformation that experienced rapid population growth in the 1960s to become a major industrial centre of trade and commerce by 1981 (Jagannathan, 1987), necessitating extraordinary expansion in urban infrastructure to sustain the resident population by providing equitable access to amenities like housing. In the last two decades, the focus on housing consumption has primarily aligned with the quality of life and basic well-being (Jiboye, 2011). As housing quality is spatially heterogeneous (Haque, Rana, & Patel, 2020), the present work aims to explore the spatial variation in the level of housing quality at the ward level in Durgapur and the factors affecting it.

Study area

Durgapur, located in the Paschim Bardhaman district of West Bengal, witnessed rapid changes in the immediate post-independence period when heavy and basic industries were set up during the second five-year plan. The Durgapur Municipal Corporation comprises 43 wards, with ward no 22 (Fig. 1) being the Central Business District. As per the Census of India, 2011, Durgapur is a class I town with a population of 580,990.

Concept and definition

The definition of housing quality is space and context-specific; in formal or informal settlements, rural or urban, public or private sector housing (Sengupta, 2006). Housing quality is defined as the "grade or level of acceptability of dwelling units and their associated and immediate residential environment, including the design and functionality of housing structures, building materials used, the amount of internal and external space pertaining to the dwelling, housing utilities, and basic service provision" (Meng & Hall, 2006, p. 415). Housing quality measures are highly subjective as they are context-specific. Variables determining housing quality in developing countries rarely apply to developed countries (Ibem, 2012). For example, in the USA, housing quality is measured by conditions of interior and exterior parts of buildings, availability of heating and cooling facilities, availability of indoor plumbing, and number of persons present per room (Ferrell, Kelley, & Bertrand, 1977). In a work carried out in the states of Nigeria, variables ranging from flooring, walling, and roofing materials to type of toilet facility, sources of water and lighting, drainage, and type of housing units are important (Morenikeji, et, al., 2017). A study carried out to map the housing quality in the city of Kolkata used parameters like census houses in good condition, houses with a concrete roof, concrete/burnt brick wall, concrete floor materials, households having at least two dwelling rooms, a separate kitchen for cooking, access to essential services such as electricity, access to a treated tap, drinking water inside the premises, clean fuel, improved latrine, bathing facility within the premises and sewerage connection (Haque, Rana, & Patel, 2020). Measuring housing quality dimensions is thus heavily contingent on the context and available information. Despite varying definitions, it can be safely assumed that housing quality is affected by socioeconomic parameters, neighbourhood conditions, housing structure, adequacy of space, and family composition (Ibem, 2012). In the present study, housing quality is measured as an aggregate of twenty-two most commonly and widely used parameters of housing quality in the Indian context (Table 1).

Table 1: Components of housing quality

Housing Index	Basic amenities index	Assets & finance index
Good condition of houses	Tap water from a treated source	Banking
Concrete roof materials	Drinking water within the premises	Television
Concrete wall materials	Source of lighting - electricity	Computer/ Laptop with internet
Concrete floor materials	Households having bathroom facility	Landline and mobile phone
Dwelling rooms of 3 & above	Flush/Pour Latrine connected to Piped Sewer System	Scooter/motorcycle/moped
Owned houses	Waste water disposal connected to closed drainage	Car/Jeep/van
Permanent houses	Access to LPG/PNG	
	Electricity used for cooking	
	Kitchen facility inside the house	

Datasets and methods

The Ward map has been obtained from the Municipal Corporation and digitized in ArcMap 10.2.2. Primary census abstract and household amenities data have been collected from the Census of India, 2011. The Household Quality of Living Index (HQLI), a multidimensional concept, has been calculated by considering three parameters of housing, basic amenities, and assets and by averaging the three indexes (Fig. 2). Composite score and Standard Deviation technique put forth by Bracy in 1952 and modified by R.L. Singh and Rana P. B. Singh in 1979 have been used for determining HQLI with multiple parameters. Differential weights have been assigned to each of the variables (Table 1) with a value of one denoting the worst condition and the value increasing with relatively better conditions. The weight and proportion of parameters obtained for each of the indicators for a particular ward have been aggregated to arrive at the composite score.

Karl Pearson's correlation coefficient has been used to find out the degree of association between HQLI and selected indicators. The regression analysis has been done to find out the predicted values of the dependent variable for any given set of independent indicators, which in turn is determined by the high value of R^2.

The difference between the observed (Y) and predicted (Yc) variables has been calculated based on which residual regression mapping has been done (Table 1) to find the problem and prospect wards of Durgapur.

A positive relationship between explanatory indicators like percentage of household size with three members, rented housing, literate females, main working population and permanent houses, and housing quality, areas with positive regression residuals indicate prospect areas, while areas with negative residuals represent problem areas (Clarke, 1967). Regarding a negative relationship between housing quality and the percentage of households with five members, slum population, SC/ST, and illiterate population, areas with positive regression residuals refer to problem areas, and areas with negative residuals indicate prospect areas.

Caste hierarchies in the Indian context are crucial in influencing life activities, educational and employment opportunities, housing, and access to basic public goods and services (Haque, 2016). In this context, the proportion of the depressed caste or communities such as the Scheduled castes (SC) or the Scheduled Tribes (ST) population has been considered with regard to its effect on HQLI. Majority of the illiterate people lack skills that constrain them from accessing quality employment (Muliana & Idris, 2019). Overcrowding within the household premise is measured by a household size of five or more which are often associated with problems of several morbidities and emotional problems (Zainal, Kaur, Ahmad & Khalili, 2012). HQLI is expected to relate negatively with slums which usually lack proper building design, building materials and scarcely receive basic amenities.

The proportion of literate females in each ward of Durgapur is taken as a proxy of social development. It is assumed that households with women pursuing their studies beyond the secondary level were more likely to be better aware of their home environment quality, especially hygiene (Bilance, 1997). Households in most parts of India have witnessed a significant decline in mean household size as per the Census of India 2011 (Nayak & Behera, 2014). So, it was expected that the household

size with three members would positively relate to HQLI as the resources would be optimally distributed between the members. It is assumed that owned houses have better housing quality than rented homes as people living in owned houses tend to invest money in improving the structure and design of their dwellings (Daniere, 1994), though there are contrary examples too, as people tend to save money and choose to stay in rented homes as it is affordable for them in the short run (Kumar, 2016). Gradually they focus on investing in improving the quality of their rented apartments, which positively impacts HQLI. Main workers in the population are a significant explanatory variable as they ensure greater financial strength that can translate to better housing quality.

Analysis

Multiple regression technique has been employed to validate the presence of a significant relationship between the ten explanatory indicators and housing quality. The statistical testing of the calculated correlation coefficient value is done through the student's t-test. p values were significant as they were less than t statistics (Table 2).

In this section, we also explain the reasons for choosing certain explanatory indicators (statistically significant) to show their effect on HQLI. For all the mentioned indicators (Table 2) the p-value is less than 0.05, thereby leading to acceptance of the alternate hypothesis that there exists a significant relationship between HQLI and the selected independent indicators.

Mapping deprivation

The housing deprivation rate reflects housing deficiencies in a particular area. It also gives an idea about the quality of the accommodation and acts as a proxy measure of decent housing (Streimikiene, 2015). Household amenities data were used to map deprivation. Housing deprivation is measured from the composite score (Table 3), devised to understand the HQLI using the composite score and standard deviation technique. The lower the value, the greater the degree of deprivation. In this case, the greater the distance from the city center (Fig. 4), the likelihood of deprivation is more for all the parameters and the aggregate as well. The

Table 2: Indicators affecting HQLI

Independent variables (%)	Coefficients	Standard Error	t Stat	P-value
Household size 5	-0.01362	0.38512	0.97199	0.03538
Slum	-0.01609	0.02380	-0.67632	0.04036
Illiteracy	-0.15731	0.39690	0.69447	0.03636
SC/ST population	-0.07931	0.05525	-0.16086	0.04354
Permanent Housing	0.14402	0.04068	0.04095	0.00125
Rented House	0.00875	0.03540	0.80617	0.04740
Literate Females	0.02683	0.34507	0.93850	0.04775
Main workers	0.16698	0.1511	1.10485	0.04746
Household size 3	0.40324	0.18032	2.23624	0.03243
3 Dwelling Rooms	0.21628	0.06694	3.23085	0.00285

Source: Based on authors' calculation

Table 3: Composite score values of HQLI

Statistical Values	Composite Score	Wards	HH Quality of Living
Mean+ 2 σ to Mean + 3 σ	23.78 - 29.16	9, 22, 27	very high
Mean+ 1 σ to Mean+ 2 σ	18.4 - 23.78	5, 6, 7, 10	high
Mean to Mean+ 1 σ	13.02 - 18.4	3, 4, 15, 16, 17, 19, 20, 24, 26, 29, 35, 42	medium
Mean- 1 σ to Mean	7.64 - 13.02	8, 11, 12, 13, 14, 18, 21, 23, 25, 28, 32, 36-40, 43	poor
Mean- 2 σ to Mean- 1 σ	2.26 - 7.64	1, 2, 30, 31, 33, 34, 41	very poor

Source: Computed by the authors

deprivation in peripheral areas is more with fewer household amenities compared to the central areas. HQLI is high in ward no 22, the central business district (CBD) followed by ward no 27, which is a secondary CBD having an abundance of commercial and business functions with adequate space to house educational and residential buildings (West Bengal Housing Board, 1991). The wards which are in closer proximity to wards no 22 and 27 display higher HQLI (Fig. 3).

Analysing regression residuals

Examining the spatial expression of the residuals by mapping may help to understand what additional factors influence the household QoL at the ward level. The maps so made are placed beside the regression residual map for the same parameter for a better understanding of the association between the two.

The average female literacy rate in Durgapur is 80.84 percent. The rate is more than 70 percent in the wards nearer the CBD and around ward number 27 (Fig. 4). This pattern confirms the concentric zone model of Burgess (1925) that the centre of the city has a concentration of educational, employment, and health facilities, which contributes to a higher literacy, better jobs, and accessibility to healthcare facilities (Rahaman & Siddique, 2019). As one moves away from ward no 22 or ward no 27, the rate declines to 50-60 percent in wards 1, 33, and 36 and to less than 50 percent in wards 2 and 34. As far as the map of the regression residuals of housing quality on female literacy is concerned (Fig. 5), wards 9,10, 22, 27, 34, and 36 recorded considerably better housing quality which can be attributed to the presence of educational institutions and awareness among the people to educate their girl child. In other words, households with women who have pursued their studies beyond the secondary level are more likely to be better aware of their home environment quality (Bilance, 1997) unlike dwellings where female literacy is lower. On the contrary housing quality was found to be inferior in ward numbers 30, 31, 38, 39, 41, 42, and 43 largely on account of the presence of negative factors like poor economic conditions or lack of adequate educational facilities impacting HQLI. These wards are designated as problem regions.

With an average of 22.87 percent illiterate in Durgapur, Illiteracy is the highest in ward number 34, with a rate as high as 45.84 percent (Fig. 6). The proportion of illiterates tends to increase away from the city centre (Fig. 6), pattern reflected in HQLI as well (Fig. 7) indicating the poor economic condition of the people associated with lack of adequate educational facilities in these wards. As socio-economically disadvantaged, primarily

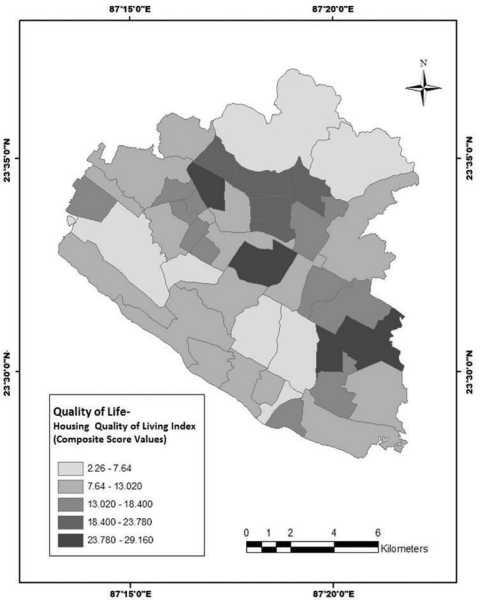

Fig. 2: QoL by composite score values

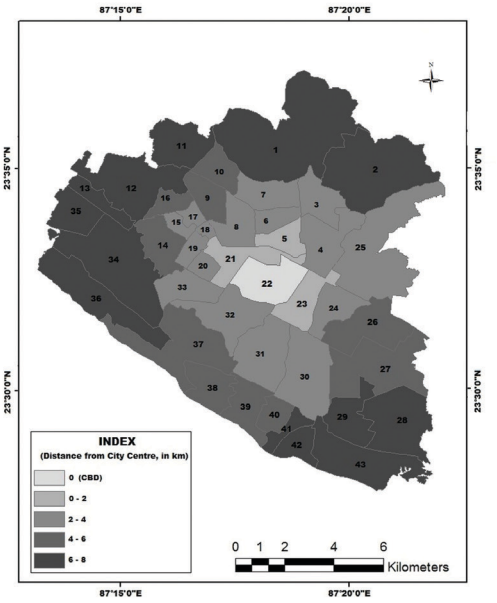

Fig. 3: Distance of ward centres from the CBD

the SC and ST people settle in the periphery of the city, their dwellings tend to be of lower quality. Owing to a lack of resources, they are unable to afford education, and limited skill acquirement hinders their employment opportunities, thereby forcing them to live in dwellings of poor quality (Ibara & Ikiemi, 2021). This is true of Durgapur as well. On the other hand, the secondary CBD (ward number 27) displays low illiteracy levels and greater values of high quality of living index, which is in sharp contrast to the wards surrounding it. In the case of regression residuals of HQLI on illiteracy rate (Fig. 7), the problem regions comprise ward numbers 21, 29, 30, 31, 32, 38, 39, 40, 41, 42, and 43 where the illiteracy rate has negatively impacted the housing quality. The illiteracy rate brings down the HQLI, as observed in the strong negative relationship between these two variables.

The proportion of three member households is the highest in ward no 39, located in the southern periphery of the city (Fig. 8). This is true of the central and eastern portions of the city where the primary CBD (Ward number 22) and secondary CBD (Ward number 27) are located and in the wards surrounding it. In urban areas, the nuclear family has emerged as the dominant form of a residential unit which has accelerated with the pace of urbanisation and industrialisation in India (Singh, 2003). Residents in central part of the city have better access to education, experience, and awareness of the benefits of smaller family sizes. As regards the relationship with HQLI, the percentage of households with 3 to 5 members has been used assuming that resources are optimally distributed in households of smaller size. Households with three members show better housing quality in ward numbers 13, 22, and 27. The rest of the cityscape displays a moderate situation, whereas the problem regions are confined to ward numbers 30, 38, 39, 40, and 41 in the southern part apart from ward numbers 1 and 2 in the north (Fig. 9).

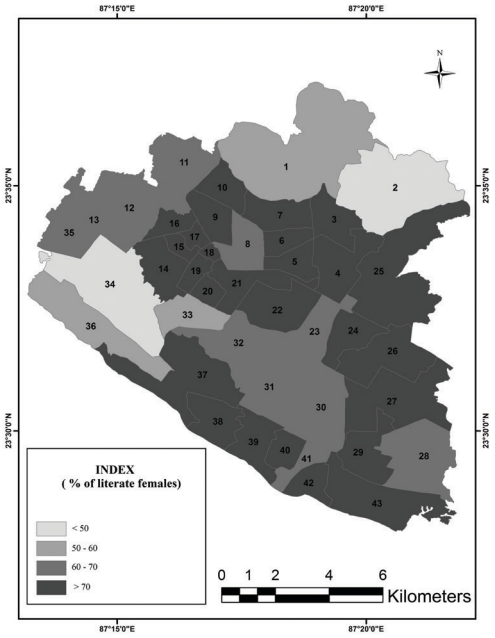

Fig. 4: Proportion of literate females

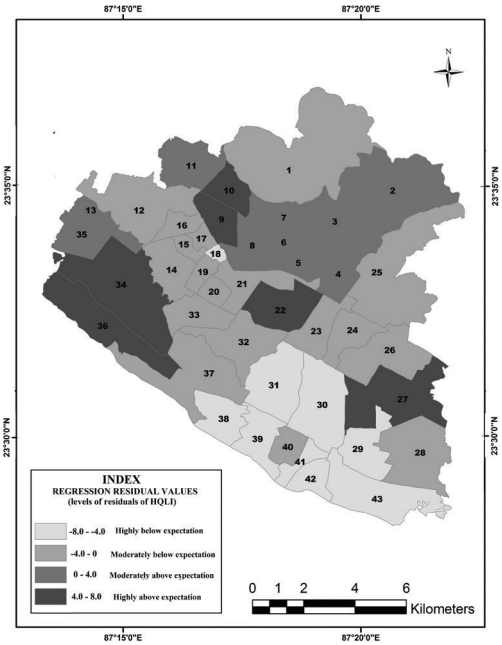

Fig. 5: Regression residuals of HQLI on female literacy rate

Table 4: Degree and direction of the relationship between HQLI & selected factors

Explanatory Variables	Correlation of Coefficient
3 Dwelling Rooms	0.792**
HH size 3	0.734**
HH size 5	-0.712**
Permanent Housing	0.842**
Rented	0.543**
Slum Housing	-0.650**
SC+ST Population	-0.612**
Literate Females	0.862**
Illiterate Population	-0.849**
Main workers	0.594**

***Statistically significant at 0.05 significance level*

The highest proportion of large-sized households with five members is found mainly in the outskirts, primarily in ward no 33 (Fig. 10). Such households that reflect conditions of overcrowding display a strong negative relationship with HQLI (Table 4). People living in overcrowded conditions are more likely to have several health issues, poorer educational attainment, and emotional problems (Zainal, Kaur, Ahmad & Khalili, 2012) which can negatively impact HQLI. Wards, primarily located in the southern

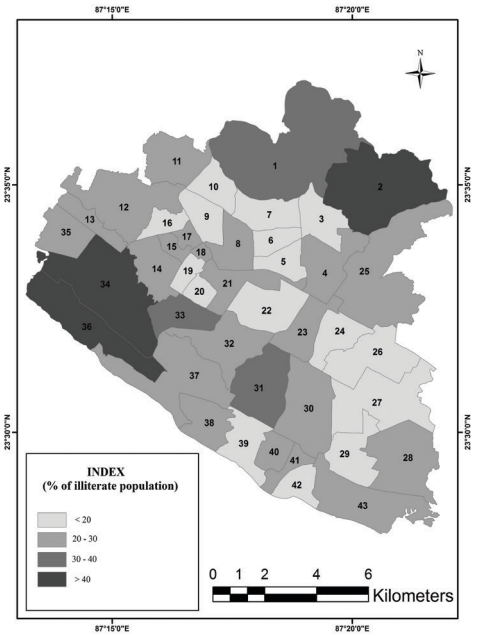

Fig. 6: Illiteracy rate

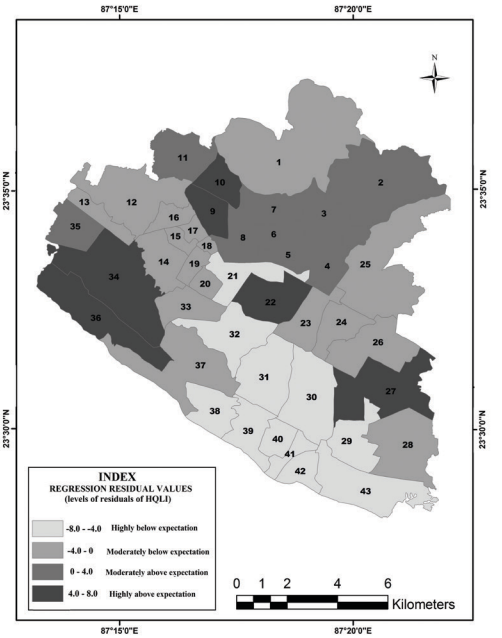

Fig. 7: Regression residual of HQLI on illiteracy rate

portion have a relatively higher proportion of household size with five members (Fig. 10) and low HQLI (Fig. 11).

Renting a house is guided by several reasons, from the decision to migrate to flexibility in managing household finances. Rented dwellings usually come up when people need more time to make long-term financial commitments (Kumar, 2016). It is observed in Durgapur that people residing in rented houses (Fig. 12) in the central part of the city have better housing quality (Fig. 13). Ward number 22 (CBD) followed by 27, 10, and 3 comprise prospect regions where the housing quality governed by rental housing is much above expectation. It becomes deplorable as one moves southward.

Scheduled castes (SC) and Scheduled tribes (ST), representing the depressed classes of the population have been combined because the ST population in Durgapur is negligible (2.16%). It is observed that there is a strong negative relationship between the presence of the SC/ST population and HQLI (Table 4). The SC/ST population has been at the lower end in all indicators of living conditions and household assets. Due to a lack of access to clean fuel like LPG/PNG, these people are forced to depend on wood, cow dung, and crop residue for cooking fuels, which automatically lowers the HQLI (Bhagat, 2013). As more SC/ST people reside in the city's outskirts (Fig. 14), the HQLI is below the expectation level in these areas (Fig. 15).

Urban slums are located primarily in areas deficient in basic means of living along with constant struggles with their occupancy over land (Khan, *et al.* 2015). As slums usually lack proper building design and quality building materials and scarcely receive basic amenities and services, the HQLI is

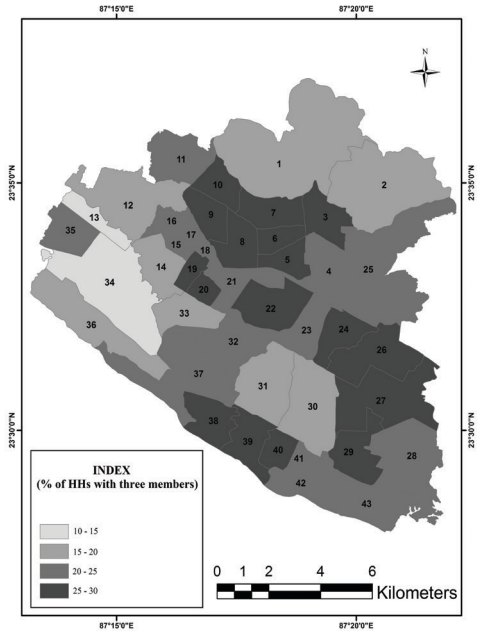

Fig. 8: Proportion of HH with 3 members

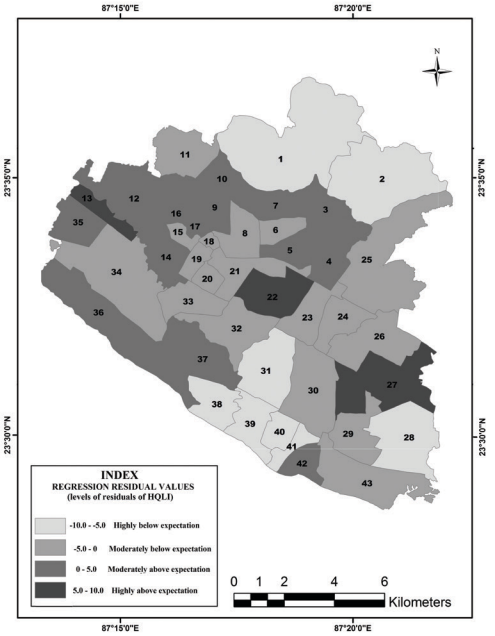

Fig. 9: Regression residuals of HQLI on HH with 3 members

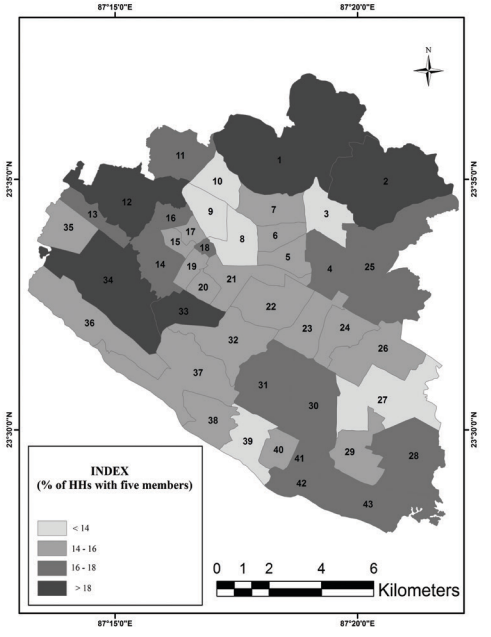

Fig. 10: Proportion of HHs with five members

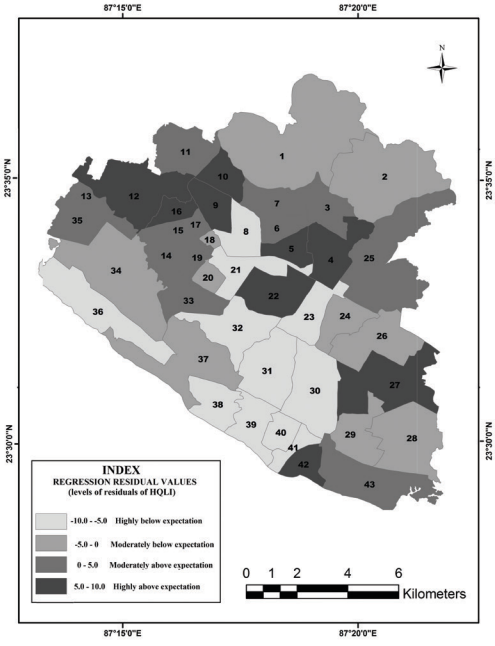

Fig. 11: Regression Residuals of HQLI on HH with 5 members

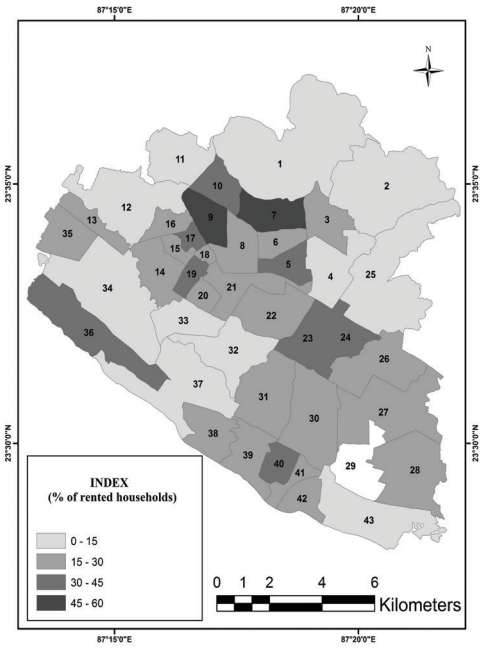

Fig. 12: Proportion of rented houses

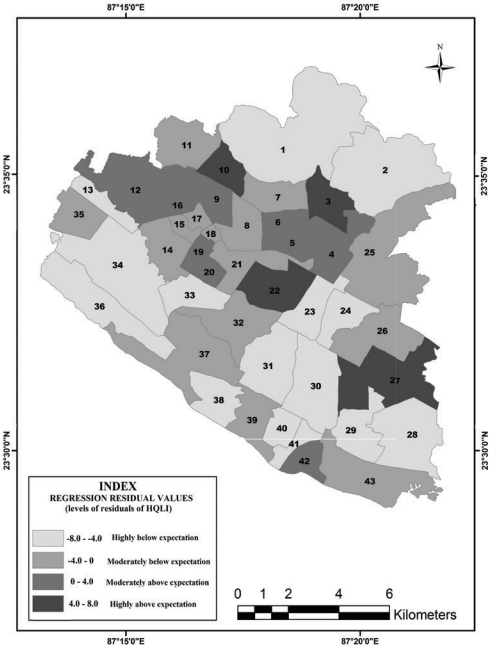

Fig. 13: Regression residuals of HQLI on rented houses

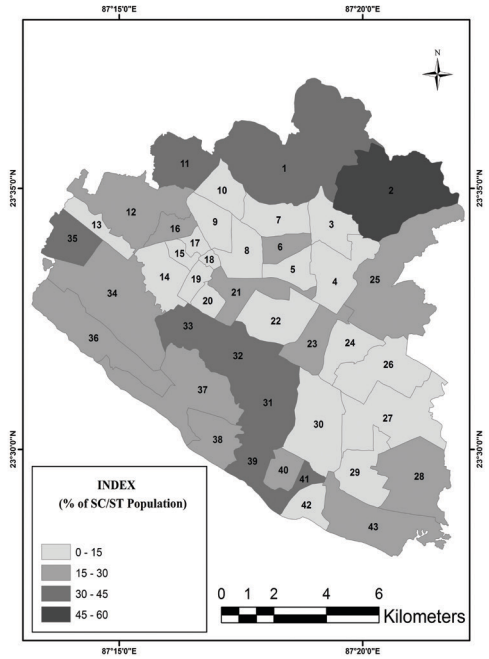

Fig. 14: Proportion of SC/ST

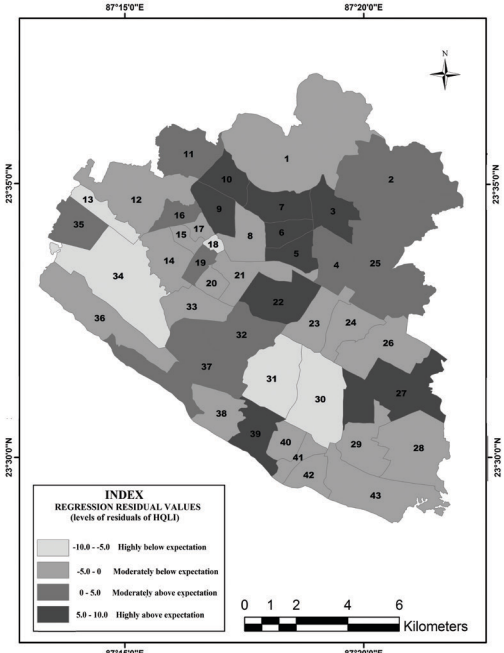

Fig. 15: Regression residuals of HQLI on SC/ST

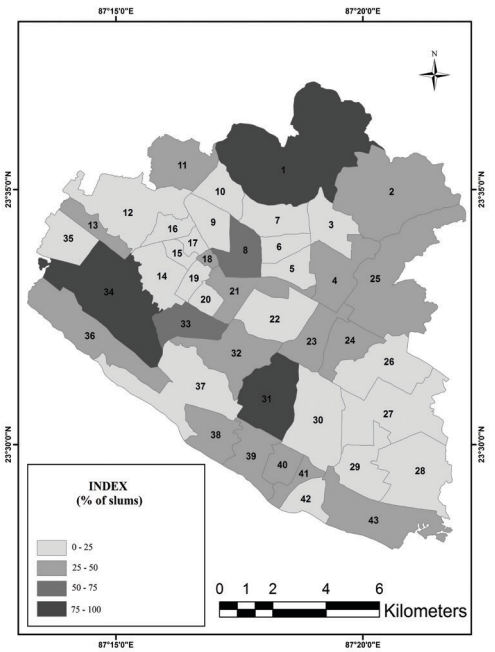

Fig. 16: Proportion of slums

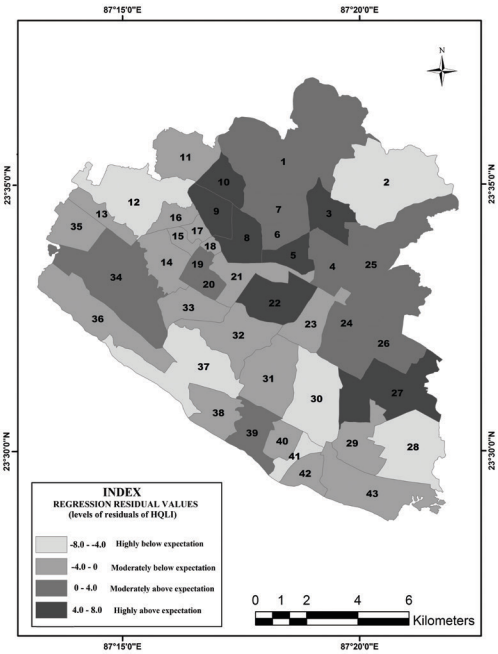

Fig. 17: Regression Residuals of HQLI on slums

negatively associated with slum housing in Durgapur. The proportion of slums, higher in the northern and southern periphery (Fig. 16), is associated with poor housing quality, often below expectations (Fig. 17).

Main workers are those who have worked for the majority of the year, unlike the marginal workers who earn more to invest in improving their living, for which there is a strong positive correlation between HQLI and the proportion of main workers. The higher percentage of main workers in the central and the northeastern portion of the city bears testimony to this relation (Fig. 18). It is also due to the influence of some positive factors like better economic conditions or availability of better employment opportunities which have formed prospect regions comprising ward numbers 3,9, 10, 22, and 27 where the HQLI is way above the expectation level, unlike the problem regions consisting of ward numbers 1, 2, 13, 15, 18 29, 30, 34, 31, 33 and 39 with less main workers (Fig. 18) which negatively impacts HQLI (Fig. 19).

Having sufficient space is essential to meet the basic need for privacy and for making home a pleasant place to stay in (Streimikiene, 2015). The largest proportion of three dwelling rooms is in ward numbers 22 (CBD) followed by 27 and 5 (Fig. 20). It has demonstrated a positive relationship with HQLI (Table 4). Based on the regressional residual mapping (Fig. 21), the problem regions are ward numbers 21, 27, 28, 30, 31 and 34. Such a cluster occupies the southeastern portion of the city and the prospect regions are ward numbers 3, 6, 9, 10, 26, and 29 located on the northern portion.

People residing in permanent houses can invest more in improving their living standard compared to residents of temporary habitations (Daniere, 2002), as evident in the case of Durgapur, where the central part of the

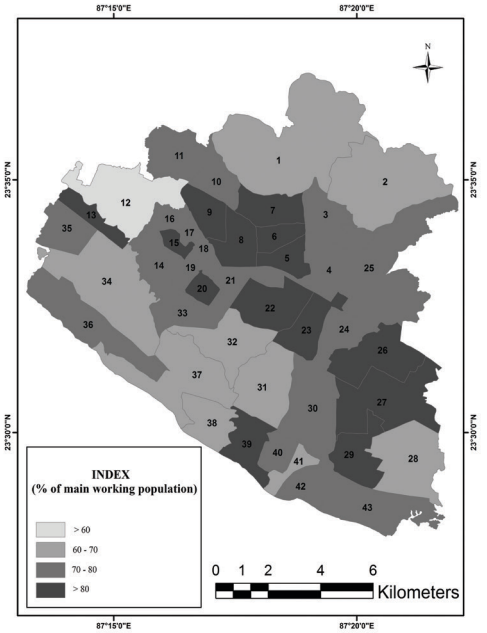

Fig. 18: Proportion of main workers

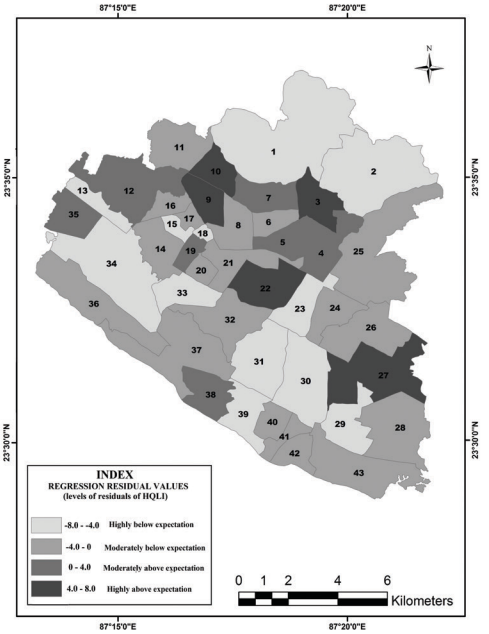

Fig. 19: Regression Residuals of HQLI on main workers

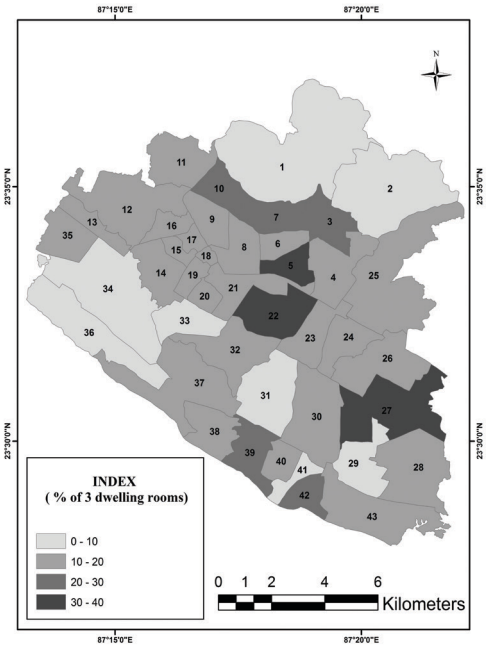

Fig. 20: Proportion of three dwelling rooms

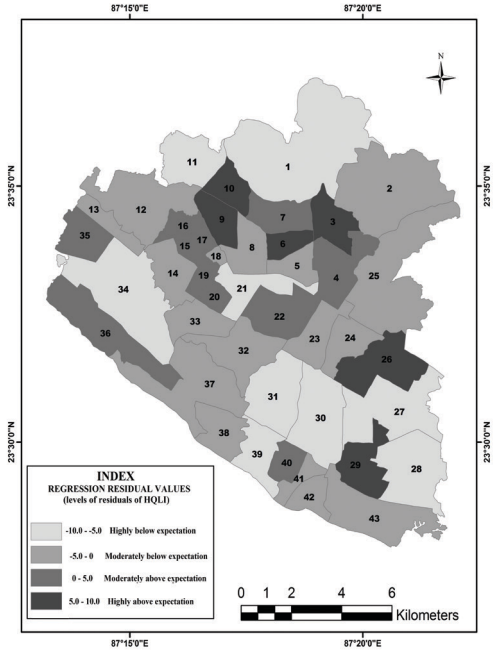

Fig. 21: Regression Residuals of HQLI on three dwelling rooms

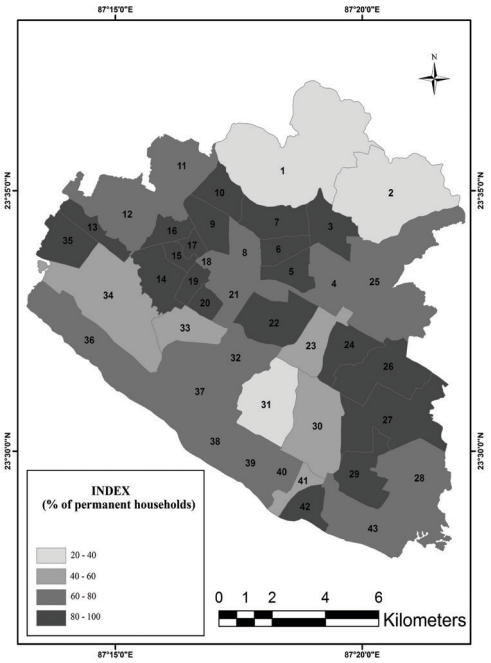

Fig. 22: Proportion of permanent houses

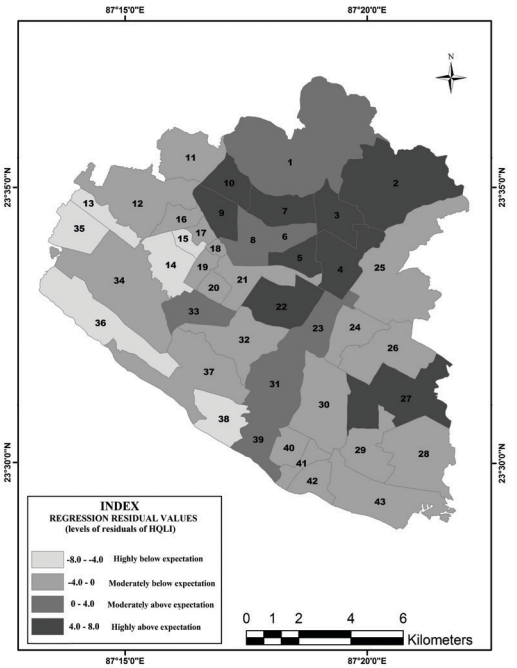

Fig. 23: Regression Residuals of HQLI on permanent houses

Table 5: Problem and prospect regions of Durgapur based on HQLI

Explanatory Variables	Prospect Regions (Ward No)	Problem Regions (Ward No)
Household size 3	22, 27, 13	28, 31, 38, 39, 40, 41
Household size 5	4, 5, 9, 10, 12, 16, 22, 27, 42	8, 21, 23, 30, 31, 32, 38, 39, 40, 41
Permanent Housing	2, 3, 4, 5, 6, 7, 9, 10, 22, 27	13, 14, 38
Rented Houses	3, 10, 22, 27	12, 13, 23, 24, 28, 29, 30, 31, 36, 38, 40, 41
Slums	3, 5, 8, 9, 10, 22, 27	2, 12, 28, 30, 37, 41
SC/ST	3, 5, 6, 7, 9, 10, 22, 27, 39	13, 34, 31, 30
Literate Females	9, 10, 22, 27, 34, 36	29, 30, 31, 38, 39, 41, 42, 43
Illiteracy	9, 10, 22, 27, 34, 36	21, 29, 30, 31, 32, 38, 39, 40, 41, 42, 43
Main Workers	3, 9, 10, 22, 27	1, 2, 13, 23, 29, 30, 31, 33, 34, 39
Three dwelling rooms	3, 6, 9, 10, 26,29	21, 27, 28, 30, 31, 34, 39

Source: Computed by the authors

city extending up to north depicts a cluster of prospect regions where the permanent housing is more conspicuous. The proportion of permanent houses decreases (Fig. 22) along with housing quality towards the south (Fig. 23).

The residuals computed have been associated with a spatial unit, primarily at the ward level, and upon adding geographic features to the regression model, the problem and prospect regions have been delineated (Table 5).

Conclusion

This study highlights the existence of significant intra-city variation in HQLI within Durgapur. The quality of housing distribution in the city is characterised by a stark spatial inequality across the city. HQLI becomes deplorable away from the city centre, particularly in the southern part of the city as evident from residual regression mapping. Wards with a greater concentration of SC/ST population display low HQLI, necessitating the provision of target-based housing to ensure balance in the quality of the residences. No significant difference in HQLI is found between rented housing and owned houses though the former has a stronger positive association. The proportion of literate females has a positive association while lower literacy level is negatively associated with HQLI. The results of the study are limited to one city only, hence cannot be generalized. Dependence on secondary data too limits its applicability. The primary survey is expected to bring out a nuanced understanding of the qualitative aspect. However, the current study not only allows comparison across wards by capturing intra-city variation and this micro study brings out the local needs for better city planning in the future.

Competing interest

The authors declare that they have no conflict of interest.

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