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Research Article

Assessing Quality of Life in Slums: A Study in Municipal Areas of Purba Medinipur, West Bengal

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ABSTRACT

The proliferation of slums in urban areas poses a significant challenge for Urban Local Bodies (ULBs), with nearly one billion people worldwide residing in informal settlements marked by overcrowding, inadequate infrastructure, and poor living conditions. This study assesses the Quality of Life (QOL) of slum dwellers in the municipalities of Purba Medinipur (Haldia, Egra, Contai, Panskura, and Tamluk), West Bengal, employing both qualitative and quantitative methodologies. Primary and secondary data were collected and analyzed using statistical techniques, including composite indexing, standard deviation, component analysis, correlation matrix, and Principal Component Analysis (PCA), alongside GIS for spatial representation. Five key domains were evaluated to determine QOL: Housing Condition Index (HCI), Infrastructure and Sanitation Index (ISI), Health and Healthcare Index (HHI), Education Index (EI), and Employment and Income Index (EII). The findings reveal significant disparities in living standards across municipalities. Poor hygienic conditions and inadequate access to basic amenities contribute to unsatisfactory living standards in most slums. Notably, Panskura Municipality ranked highest in QOL, while Egra and Haldia lagged behind, particularly in housing, sanitation, and healthcare. The study underscores the urgent need for targeted policy interventions to improve living conditions in slums. These insights can inform urban planning and slum rehabilitation strategies to enhance the well-being of marginalized communities.

Keywords: Urbanisation, Slum Growth, Quality of Life, Development.

1. Introduction

Quality of life (QOL) is a multidimensional concept encompassing various facets of human experience at both individual and societal levels (Mendes, 2000; Hirschberg et al., 2001). It is influenced by a range of factors, including housing conditions, demographic characteristics, health status, asset ownership, and access to essential services (Sen, 2017). According to the World Health Organization (WHO), QOL refers to an individual's perception of their position in life within the context of their culture and value systems, and concerning their goals, expectations, standards, and concerns (WHO, 1995). As such, assessing QOL has emerged as a crucial component in healthcare and development studies, offering a holistic understanding of well-being that transcends traditional clinical or economic indicators. Determinants such as social support, economic stability, and access to healthcare services significantly affect QOL, prompting research that aims to identify and mitigate disparities across different population groups (Fayers & Machin, 2013).

The United Nations defines slums as densely populated urban areas characterized by substandard housing and severe deficiencies in basic services such as water, sanitation, durable housing, and sufficient living space (UNDP, 2013). In slum settings, QOL encompasses both the physical environment (e.g., housing quality and public utilities) and social dimensions (e.g., health, education, personal security, and economic opportunities). Over recent decades, numerous studies have attempted to evaluate QOL using macroeconomic indicators such as Gross Domestic Product (GDP) and Per Capita Income (PCI) (Stiglitz et al., 2009; Liao, 2009; Rahman et al., 2011; Rojas, 2011). However, such metrics often fail to capture the nuanced realities of disadvantaged populations.

Although urbanisation is commonly viewed as a marker of economic development, it also correlates with rising urban poverty. Slums around the world share several characteristics, including high levels of violent crime due to inadequate law enforcement, disease proliferation stemming from poor sanitation and limited healthcare access, widespread informal economic activities, political corruption, child labour, prostitution, and substance abuse. Globally, approximately one billion people reside in slums marked by overcrowding, environmental degradation, and a lack of basic services. Migration from rural areas to cities, often driven by the pursuit of better livelihoods, frequently results in settlement on vacant lands or within existing slums. This rural-to-urban migration, exacerbated by inadequate urban planning, fuels the growth of slum and squatter settlements across many cities.

Slum dwellers represent one of the most socioeconomically disadvantaged groups in urban settings. According to UN-Habitat, slums are defined by inadequate basic services, poor housing conditions (often illegal or substandard), overpopulation, unhygienic surroundings, hazardous locations, insecure tenure, and poverty-induced marginalisation. In India, the Census defines a slum as a compact area of at least 300 people or about 60–70 households, marked by poorly built, congested, and unhygienic living environments lacking essential infrastructure such as proper sanitation and access to safe drinking water (Moreno, 2003).

As of 2020, the global slum population was estimated at approximately 1.05 billion, projected to rise to 1.5 billion by 2035. The highest proportion of urban residents living in slums is found in Sub-Saharan Africa (61.7%), with Kibera in Nairobi, Kenya (UN-Habitat, 2016), being one of the largest. Southern Asia follows, where 35% of the urban population resides in slums, with notable examples in cities such as Mumbai, Delhi, Kolkata, Karachi, Manila, Jakarta, and Dhaka. Dharavi in Mumbai, the largest slum in Asia, houses around 24% of the city's population, with a density exceeding 300,000 people per square kilometre (Chatterji, 2005). In Greater Mumbai, 54.06% of the population lives in slums, constituting 41.3% of the city's urban households. Other major cities, including Delhi, Kolkata, and Chennai, report slum populations of 32.48% and 18.88%, respectively. Cities like Surat, Pune, and Ahmedabad show figures ranging between 13% and 21%, while Bangalore has one of the lowest slum populations at 10.02%, with 8.5% of urban households residing in slums (Census of India, 2011). Nearly one-sixth of India's urban population lives in slum conditions, a direct consequence of rapid urbanisation and insufficient urban infrastructure.

Conventional macroeconomic indicators like GDP and PCI are insufficient to capture the complex realities of QOL in slum settlements. A comprehensive assessment requires indicators of material well-being and socio-economic status. In this context, various indicators of objective well-being, such as housing quality, availability of amenities, access to education and healthcare, and employment status, are essential (Chen & Davey, 2009; Siddiqui, 2008; Zorondo-Rodríguez et al., 2014). While subjective well-being focuses on individuals' assessments of their life satisfaction and happiness, objective well-being is evaluated using measurable and observable indicators.

The present study aims to assess the QOL of slum dwellers in the municipalities of Purba Medinipur district in West Bengal, India, with a focus on material well-being. Despite the region's economic strengths in agriculture and fisheries, increasing rural-to-urban migration has led to the emergence of informal settlements in semi-urban areas. Migrants seeking better economic opportunities often settle in poorly serviced slum clusters, facing challenges related to housing, employment, healthcare, and education. However, the specific objectives of this study are to assess the quality of life (QOL) of slum dwellers in the municipalities of Purba Medinipur. To compare the QOL of slum dwellers among the municipalities of Purba Medinipur and to identify the determinant factors influencing the quality of life among slum dwellers.

2. Database and methodology

2.1 Geographical description of municipalities

Purba Medinipur is the southernmost district of the Burdwan Division in the Indian state of West Bengal. Spanning an area of 4,151.64 square kilometres, the district lies between 21°36′35″ N to 22°57′10″ N latitudes and 86°33′50″ E to 88°12′40″ E longitudes. It was officially established on January 1, 2002, following the bifurcation of the erstwhile Medinipur district into two administrative entities—Purba Medinipur and Paschim Medinipur. Geographically, Purba Medinipur is bounded by Paschim Medinipur to the north and west, the state of Odisha to the southwest, the Bay of Bengal to the south, South 24 Parganas and the Hooghly River to the east, and Howrah district to the northeast (Figure 1). The district headquarter is located in Tamluk.

Purba Medinipur is administratively organised into four subdivisions, i.e., Tamluk, Contai, Haldia, and Egra. The district comprises 25 community development blocks, 21 police stations, five municipalities, 223 gram panchayats, and 11,796 villages. The five municipalities include Tamralipta (Tamluk), Contai, Egra, Haldia, and Panskura (Figure 1). The district is well-connected to Kolkata via National Highway 6 (NH-6), which enters the district at Kolaghat and passes through Howrah. Rail connectivity is ensured by the South Eastern Railway, with entry at Kolaghat and exit at Khirai station. Purba Medinipur comprises 5.34% of the total area and accounts for 5.58% of West Bengal's population. According to the Census of India (2011), the district had a population of 5,095,875, with a population density of 1,076 persons per square kilometre. The decadal population growth rates were recorded at 13.02% (1991–2001) and 17.21% (2001–2011).

Established in 1956, Tamralipta Municipality is located at 22.22°N latitude and 88.55°E longitude. The town is situated on the right bank of the Rupnarayan River. The region features loamy, highly fertile soil and low-

lying marshy areas formed through the depositional reworking of the Hooghly and Rupnarayan river systems. The municipality covers an area of 17.86 square kilometres and, as per the 2011 Census, had a total population of 65,312, of which 29,603 were slum dwellers. Tamluk is recognised for its healthcare infrastructure, which includes a district hospital, medical college, and numerous private nursing homes, serving the broader region.
Contai Municipality was established in 1958 and is situated between 21.47°N to 22.78°N latitudes and 87.45°E to 87.75°E longitudes. It lies approximately 30 kilometres inland from the coastal town of Digha and is a significant tourist destination in Eastern India. As per the 2011 Census, Contai had a population of 92,226, reflecting a 19% increase from its 1958 population of 77,497. The town has witnessed gradual urban growth, supported by its role as a regional service and tourism hub.
Egra Municipality was constituted on 9 June 1993 and is located at 21.9°N latitude and 87.53°E longitude. Covering an area of 17.21 square kilometres, Egra had a total population of 30,148 according to the 2011 Census. The municipality contains 20 slum clusters encompassing 62 slum pockets, with a total slum area of 1.62 square kilometres and a slum population of 14,690, constituting approximately 85% of the total municipal population. Egra has shown steady growth, with its population increasing from 25,180 in 2001 to 30,148 in 2011, marking a decadal growth rate of 20%.
Established on 9 June 1997, Haldia has evolved from a small village into one of West Bengal's major industrial and port cities. Located at the confluence of the Hooghly and Haldi rivers, Haldia is approximately 125 kilometres from Kolkata. The municipality area is characterised by intensive industrial development, leading to significant land-use change, particularly the conversion of agricultural land into industrial estates. As per the 2011 Census, Haldia Municipality had a population of 200,827 across 26 municipal wards. Industrialisation has significantly influenced urban development; however, it has also contributed to environmental degradation. Alkaline, salt-affected soils are prevalent in this area, exacerbating the region's ecological stress.
Panskura Municipality is geographically positioned between 22.25°N to 22.42°N latitudes and 87.42°E to 87.70°E longitudes. It is located along National Highway 6, between Kolkata and Kharagpur. Bordered by Kolaghat block to the north and the Kasai River to the west, Panskura Municipality was established on 8 June 2002. It consists of 17 municipal wards and covers an area of 17.08 square kilometres. The urban population was recorded at 57,932 in the 2011 Census. Although the population data of 2011 indicates substantial municipal development.

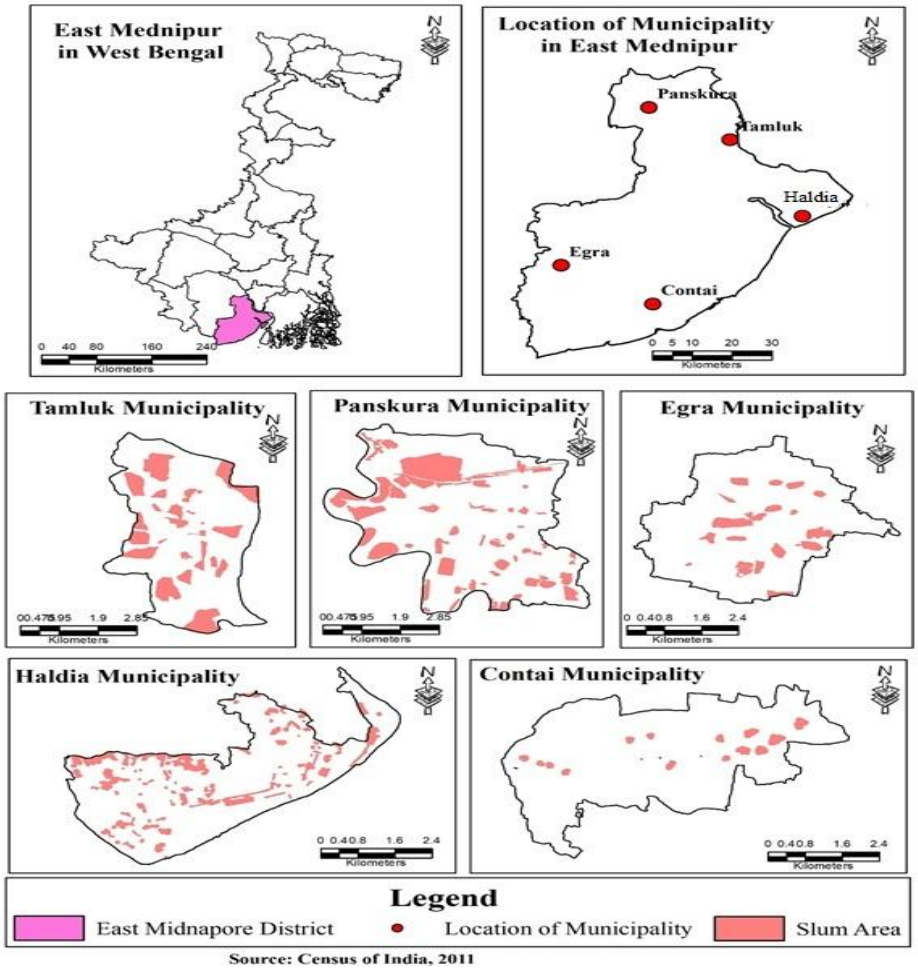

Figure 1: Location of the study area

Rapid urbanization and infrastructural development are evident across the municipalities of Purba

Medinipur. Egra Municipality demonstrated a moderate yet steady expansion with a 20% population growth between 2001 and 2011. Contai experienced a similar trend with a 19% increase over the same period. Tamralipta emerged as the fastest-growing municipality, reflecting significant urban transformation supported by healthcare, transport, and administrative infrastructure. Despite the absence of 2001 population data for Panskura, census evidence suggests substantial urban development by 2011. Haldia, owing to its industrial base and port facilities, remains the most populous and economically significant urban centre in the district. These municipalities collectively reflect sustained urban expansion driven by economic activity, rural-to-urban migration, and infrastructural investments (Census of India, 2011) (Figure 1).

2.2 Data collection method

This study utilised both primary and secondary data sources to comprehensively assess the quality of life (QOL) among slum dwellers in the municipalities of Purba Medinipur district. Primary data were collected through a structured household survey administered within notified slum areas across all five municipalities. A random sampling method was employed to ensure the unbiased selection of respondents. From each selected municipal ward, slum households were surveyed using randomised procedures. The selection of slum pockets within each ward was guided by population concentration, ensuring representation from both high-density and low-density slum areas. A total of 351 households were surveyed across fifteen slum clusters located in the municipalities of Tamralipta, Contai, Haldia, Egra, and Panskura. The structured questionnaire was designed to capture data across multiple dimensions of QOL, specifically focusing on five key domains: Housing conditions, Infrastructure and sanitation, Health and healthcare access, Education and employment and Household income.

Secondary data were obtained from various official sources, including the District Statistical Handbook, Census of India (2011), municipality office records, and relevant government and public reports. All spatial analyses and visual representations were conducted within a Geographic Information System (GIS) framework. This facilitated spatial correlation and mapping of household-level data across the municipalities, providing a visual dimension to the patterns of urban deprivation and quality of life.

Table 1: Selected sample size of the municipalities of Purba Medinipur

Name of the municipality	Ward no.	Name of the slum	Household	Sampled household
Haldia	13	Rashpukur Jhupri	420	77
	3	Bhagyabantapur Paschim Muslim Pally	221	40
	19	Bhawanipur Culvert Colony	10	10
Tamralipta	9	Balbal Para	210	38
	10	Rail Colony Para	157	29
	16	Sweeper Colony Bastee	47	10
Contai	3	Mansatala Para (Paschim)	67	12
	8	Barik Para	43	11
	4	Nakku Para	19	10
Egra	6	Giripara Adibasi Colony	110	20
	13	Sitala Mandir Para	169	31
	7	Majhi Para	17	10
Panskura	2	Kanakpur Modhya bandh	117	21
	9	Muslim para	81	15
	17	Tilandapur Harijan Mali & Madhyapara	92	17
Total			**1780**	**351**

Source: Census of India, 2011

2.3 Selection of slum areas in municipalities

The selection of slum areas in the municipalities of Purba Medinipur was based on two primary criteria. Firstly, within each of the five municipalities—Tamralipta (Tamluk), Contai, Egra, Haldia, and Panskura—three municipal wards were selected to ensure a representative distribution of slum populations. These wards were chosen based on relative concentrations of slum population: one ward with a high concentration, one with a medium concentration, and one with a low concentration of slum dwellers. Each selected ward encompassed the entire population of that administrative unit, ensuring comprehensive demographic coverage. Secondly, the spatial distribution of slums within each municipality was considered to capture locational variation. Accordingly, three slum-related wards were selected based on their distance from the municipal core: One slum was chosen from the central urban core, representing the densest and oldest settlement. A second slum was selected from a peri-urban area, which exhibits a medium degree of urban development and transition. The third slum was drawn from a ward situated at the periphery of the municipality, representing the area with the greatest spatial distance from the urban centre. In total, fifteen wards were selected across the five

municipalities for detailed study (Table 1). These fifteen wards comprised 1,780 households, which were surveyed for this research. Among them, Rashpukur Jhupri (Slum Cluster - 125), located in Ward No. 11 of Haldia Municipality, was identified as having the highest number of both slum dwellers and slum households.

2.4 Sampling and sample size

In the Purba Medinipur Municipality, there are a total of 1780 households in fifteen slums (Census of India, 2011). Slum households were selected using the following equation (Yamane, 1973);

$$n = N1 + (Ne2) \quad (1)$$

Where N is the household size (HH=1780), and e is the level of precision (here ± 5 per cent precision level), assuming a 95 per cent confidence level at p = 0.05. After obtaining a sample size of 351 using the above equation (Eq. 1), then applied Yamane's formula for sample size calculation.

Selection as the number of HHs in the slums of municipalities of Purba Medinipur is known and not infinite. The slum wise sample size was determined using a proportionate allocation approach using equation 2;

$$n1 = n \times (N1/N) \quad (2)$$

Where $n1$ = sample size to be selected, n = total sample size, $N1$ = selected slum households and N = Total households of the selected slums. For example, in the case of Rashpukur Jhupri (Slum Cluster - 125), ward no 11 of Haldia municipality slum, the sample size has been found, = [326*(420/1780)] = 76.92 = 77 (Table 1). A minimum of ten household surveys should be conducted in each small slum area or ward, resulting in a total sample of 351 households. A detailed list of surveyed households from each selected slum has been given in Table 1.

Table 2: Selected variables for assessing the quality of life in the municipalities of Purba Medinipur

Components	Variables	Direction	Source
Housing Conditions	Permanent dwelling	+	Majale (2008), Mitlin and Satterthwaite (2002), Alder (1995), Tanni et al. (2014), S Mondal (2020)
	Tenure status (Own)	+	
	Access to electricity	+	
	Sanitation facilities	+	
	More than 2 rooms	+	
	Permanent roof	+	
Infrastructure and Sanitation	Access to clean drinking water	+	Jha & Tripathi (2014), Haq et al. (2009).
	Distance to water source <500 m.	+	
	Sewage facility	+	
	Pucca road	+	
	Waste dumping	+	
	Solid waste management	+	
Health and Healthcare	Access to healthcare	+	Alder (1995), Haq et al. (2009), Jha & Tripathi (2014)
	Frequency of illness (Child)	-	
	Delivery rate in govt. hospital	+	
	Having a health care scheme (Swastha Sathi)	+	
Education	Literacy rate	+	Martinez et al. (2008), Moser (1998), Mondal et al. (2021), Haq et al. (2009)
	Educational attainment (Secondary)	+	
	Access to educational facilities	+	
Employment and Income	Daily wage earner	-	Ehrenpreis (2006), McClelland et al. (1998), Mondal et al. (2021), Jha & Tripathi (2014)
	Income levels (>10,000/Month)	+	
	Poverty rate (AYY)	+	
	Savings (Yes)	-	

Source: Prepared by Authors

2.5 Selection of variables

In assessing the quality of life (QOL) within municipal areas, five core dimensions are commonly regarded as fundamental: material well-being, health, education and literacy, engagement in the productive sphere, and participation in the social sphere (Stewart, 2002). The construction of a composite QOL index requires a systematic approach beginning with the selection of relevant variables grounded in a sound theoretical framework. This process is often referred to as the "top-down" approach, wherein variables are pre-determined based on existing theoretical and empirical literature. Alternatively, the "bottom-up" approach is frequently adopted in the context of composite QOL measurement, particularly in community-level or grassroots studies. This method involves deriving dimensions directly from respondents through surveys, allowing individuals to identify which aspects of life are most relevant to their perceived well-being (McGranahan et al., 1972; Sirgy, 2011).

This study adopts a primarily objective framework for evaluating the QOL of slum dwellers across selected municipalities in Purba Medinipur district, West Bengal. The choice of variables is informed by their relevance, measurability, and availability at the household level. Objective indicators are prioritized for their capacity to provide quantifiable and comparable data across different locations. The key indicator domains

used in this study include: Housing Conditions, Infrastructure and Sanitation, Economic Indicators, Health-related Indicators, and Education-related Factors. These indicators were selected based on field surveys and responses collected from sample households across fifteen slum wards within five municipalities of the district. Each of the indicators is further subdivided into several specific variables that allow for a disaggregated analysis of the factors influencing QOL (Table 2).

2.6 Standardization of variables

In quantitative analysis, particularly when dealing with multiple variables across different units or scales, standardization is essential to ensure comparability and to avoid distortion in analytical outcomes. When prior information about the variability of an outcome variable is unavailable, standardized effect sizes offer a unit-free metric, which is especially useful for determining the required sample size and comparing the relative magnitude of different variables (Ketchen & Shook, 1996).

In this study, a total of twenty-three variables were selected under five major dimensions of quality of life. Given the diverse nature and measurement scales of these variables, all data were subjected to a standardization procedure to bring values into a common scale, constrained within the interval 0 and 1. This ensures that each variable contributes equally to the composite index, regardless of its original unit or range. To achieve this, a linear transformation equation was applied. The data variables are standardized using the general standardization equation.

$$X_{id} = \frac{OB_{val} - MIN_{val}}{MAX_{val} - MIN_{val}} \qquad (3)$$

Where X_{id} denotes the Range Equalization Method, OB_{val} stands for the actual value of the i^{th} district, MIN_{val} represents the minimum value of the i^{th} district, and MAX_{val} denotes the maximum value of the i^{th} district.

Table 3: Components and variables through PCA

Variables	Component			
	1	2	3	4
Access to educational facilities	0.961			
Pucca road	0.955			
Solid waste management	0.947			
Waste dumping	0.943			
Having a health care scheme (Swastha Sathi)	0.903			
Access to healthcare	0.877			
Access to clean drinking water	0.772	-0.538		
Educational attainment (Secondary)	-0.763			
Sewage facility	0.748		0.527	
Literacy rate		0.976		
Poverty rate (AYY)		-0.955		
Daily wage earner		0.937		
Sanitation facilities	0.622	-0.757		
Income levels (>10,000/month)		0.754	0.62	
Tenure status (Own)		0.609	0.519	-0.534
Delivery rate in govt. hospital			-0.977	
Frequency of illness(Child)			0.914	
Savings (Yes)			0.874	
More than 2 rooms			0.756	0.584
Permanent roof	0.542		0.651	
Distance to water source <500 m.				0.953
Access to electricity				0.922
Permanent dwelling			0.574	0.74

Source: Authors' calculation based on the primary survey

2.7 Principal component analysis (PCA)

Principal Component Analysis (PCA) is a widely used multivariate statistical technique for summarizing complex datasets and enhancing computational efficiency (Krishnakumar & Nagar, 2008). In previous studies, researchers have employed PCA to construct composite indices that measure human well-being and quality of life (Biswas & Caliendo, 2002; Lai, 2003; McGillivray, 2005; Wong, 2012; Haq & Zia, 2013; Ferrara & Nistico, 2014). This research also adopts PCA to reduce dimensionality and develop a composite index for evaluating the quality of life in slum settlements.

PCA effectively identifies the most significant variables by explaining the variance among a large set of intercorrelated indicators and transforming them into a smaller number of uncorrelated (independent) components. As noted by Singh et al. (2004), it is a powerful tool for pattern recognition and variable reduction in complex data structures. Moreover, PCA is computationally efficient and addresses several limitations

associated with traditional composite index construction methods, such as issues related to aggregation, standardization, and non-linear relationships.
In this study, PCA was used to determine the weights of the variables included in the composite index. Specifically, the score coefficient of the first principal component (PC1), which accounts for the highest proportion of variance among the variables, was employed as the weighting criterion (Table 3).

2.8 Development of composite index

A composite indicator was used to identify districts in the study that were backwards. Composite indices are particularly useful for their comprehensiveness, multidimensionality, and indicator reduction (Vyas & Kumaranayake, 2006). The Composite Development Indicator (CDI) is a multidimensional measure of development used in this study, comprising five key domains: the Housing Condition Index (HCI), Infrastructure and Sanitation Index (ISI), Health and Healthcare Index (HHI), Education Index (EI), and Employment and Income Index (EII).

$$HCI = \frac{(SCc1 \times SDv1) + (SCc2 \times SDv2) \ldots SCnx \times SDnx}{N} \quad (4)$$

$$ISI = \frac{(SCc1 \times SDv1) + (SCc2 \times SDv2) \ldots SCnx \times SDnx}{N} \quad (5)$$

$$HHI = \frac{(SCc1 \times SDv1) + (SCc2 \times SDv2) \ldots SCnx \times SDnx}{N} \quad (6)$$

$$EI = \frac{(SCc1 \times SDv1) + (SCc2 \times SDv2) \ldots SCnx \times SDnx}{N} \quad (7)$$

$$EII = \frac{(SCc1 \times SDv1) + (SCc2 \times SDv2) \ldots SCnx \times SDnx}{N} \quad (8)$$

Where HCI, ISI, HHI, EI and EHI are the individual indices; SC_{c1} is the component score coefficient; SD_{v1} is the Standardized value of the indicator, and N is the number of indicators considered for computation of each index, respectively. The Composite Index was computed with the help of the following equation:

$$C1x = \frac{HCI + ISI + HHI + EI + EHI}{Nind} \quad (9)$$

It can affect socioeconomic inequalities (Saisana & Tarantola, 2002). The quality of life in a slum is essentially the average of individual indices. And N_{ind} is the number of indices. Average HCI, ISI, HHI, EI and EHI values are shown in the Composite Index. After that, the weightage values of all individual indicators were summed up to form a value for the particular parameter. Individual parameter scores have been analysed comparatively in municipality wise rankings to analyse the present quality of life.

3. Results and discussion

3.1 Description of socio-economic indicators

The descriptive statistics (Table 4) provide a comprehensive overview of various socio-economic indicators related to the living conditions of slum dwellers in the municipalities of Purba Medinipur. Each variable offers valuable insights into the residents' quality of life, reflecting both the day-to-day challenges they face and the performance of municipal services.
The mean score for Permanent Residences is 60.9, with a standard deviation of 8.6. This suggests that while a majority of dwellings exhibit relative structural stability, there remains significant variability among households. The range spans from a minimum of 51.8 to a maximum of 73.3, indicating marked disparities in housing conditions, encompassing both secure and precarious living situations. A positive skewness of 0.717 suggests that although permanent structures dominate, a notable segment of the population resides in less stable housing. The Tenure Status (Own) has a mean of 42.8 and a high standard deviation of 25.4, indicating irregular patterns of homeownership. The minimum score of 13.4 reflects a vulnerable group likely living in rented or informal arrangements, while the maximum value of 65.4 indicates that some households have achieved ownership. The negative skewness of -0.472 reveals that homeownership is not widespread, reflecting housing insecurity for many slum residents.
In terms of access to electricity, the mean score stands at 88.2 with a standard deviation of 13.6. However, the high average indicates that most households have access, and the minimum score of 4.0 highlights the existence of extreme deprivation in certain areas. The strong negative skewness of -2.180 implies that while access is widespread, a few households face severe energy poverty, accentuating existing inequalities. The Sanitation

Services indicator yields a mean of 85.8 and a standard deviation of 7.53. The range from 78.2 to 98.1 demonstrates relatively high levels of access, though not universal. The positive skewness of 1.300 suggests that a significant portion of the population benefits from improved sanitation, reflecting the effectiveness of some local interventions. Access to clean water shows a mean score of 63.0 and a standard deviation of 12.7. While many households have access, the minimum value of 47.0 indicates that some continue to face challenges in securing reliable and safe water sources. A maximum score of 96.0 points is considered a high service level for others. The skewness of 0.106 suggests a relatively symmetrical distribution, although underlying disparities persist.

The mean Distance to Water, as shown in Table 6, is 91.0, indicating the average distance residents' travel to obtain water. A standard deviation of 21.5 shows wide variation in accessibility. While the minimum distance of 6.0 reflects proximity for some, the maximum of 96.0 reveals that others endure significant hardship, especially affecting women and children who often bear the burden of water collection. Regarding trash management, the mean score is 80.7, with a standard deviation of 11.7. This indicates that although many households have access to waste disposal services, gaps remain. The minimum score of 30.0 reveals severe deficiencies in some areas, whereas a maximum of 100.0 suggests that some communities benefit from fully functional systems. The access to healthcare score has a mean of 46.1 and a high standard deviation of 25.7, indicating unequal access across the population. A skewness of 0.379 denotes a slight positive skew, suggesting that many respondents report limited or restricted access to healthcare services—an issue that could significantly affect community health and wellbeing (Table 4).

The literacy rate among slum residents averages 83.9, with a low standard deviation of 3.36, implying a generally high literacy level. However, a positive skewness of 0.414 suggests that a segment of the population still lacks basic literacy, which could impede their ability to engage in social and economic activities (Table 4).

The income level presents a mean of 58.1 and a standard deviation of 12.8, indicating considerable economic variability. The minimum score of 2.8 and maximum of 82.6 reflect stark income disparities, with a segment living in poverty while others maintain moderate income levels. Lastly, the savings indicator reveals a mean of 70.9 with a standard deviation of 10.9. While this suggests that many residents can save part of their income, the minimum score of 27.3 highlights that certain individuals are financially constrained, likely due to the burden of meeting daily necessities (Table 4).

The descriptive analysis highlights significant disparities in housing, service access, education, healthcare, and economic well-being among slum residents across the municipalities. These findings point to the urgent need for targeted interventions to improve infrastructure, ensure equitable access to essential services, and promote socio-economic inclusion. Addressing these challenges through coordinated policy action and community-based initiatives is vital to enhancing the overall quality of life in these vulnerable urban areas.

Table 4: Descriptive statistics of the variables

Variables	Mean	Standard deviation	Maximum	Minimum	Skewness
Permanent dwelling	60.9	8.6	73.3	51.8	0.717
Tenure status (Own)	42.8	25.4	65.4	13.4	-0.472
Access to electricity	88.2	13.6	96	64	-2.18
Sanitation facilities	85.8	7.53	98.1	78.2	1.3
More than 2 room	25.8	16.3	50	9.37	0.796
Permanent roof	55.1	14.2	73.3	36.5	-0.102
Access to clean drinking water	63	12.7	80	47	0.106
Distance to water source <500 mts.	91	11.1	98	72	-1.8
Sewage facility	32.7	16.2	53.3	15.6	0.199
Pucca road	69	19.9	93.8	46.8	0.348
Waste dumping	80.7	11.6	92.6	68.2	-0.439
Solid waste management	81.3	12.1	93.5	68.2	-0.424
Access to healthcare	46.1	25.7	75	19	0.379
Frequency of illness (Child)	27.3	12	45.5	13.5	0.768
Delivery rate in govt. hospital	82.3	17.4	96.8	52.6	-1.74
Having a health care scheme (Swastha Sathi)	92.8	7.29	98.5	81.8	-1.08
Literacy rate	83.9	5.39	89	75.4	-1.11
Educational attainment (Secondary)	37	3.36	41.9	32.8	0.414
Access to educational facilities	75.5	16.4	93	50	-1.02
Daily wage earner	47.9	14.1	57.9	23.7	-1.8
Income levels (>10,000/month)	58.1	10.9	73.9	43.2	0.184
Poverty rate (AYY)	7.74	11	27.3	1.28	2.14
Savings (Yes)	70.9	6.91	82.6	65	1.68

Source: Primary survey

3.2 Quality of life of slum dwellers in different municipalities

The Quality of Life (QOL) assessment of slum residents across five municipalities—Haldia, Contai, Egra, Tamluk, and Panskura—reveals a complex landscape shaped by socio-economic disparities and infrastructural imbalances. These variations in QOL reflect differing levels of municipal service provision, economic resilience, and access to fundamental resources.

Panskura registers the highest QOL index score of 0.64, demonstrating relatively strong performance across several key dimensions. Notably, it achieves optimal scores in permanent housing (1.00) and tenure security (1.00), along with substantial access to sanitation services (0.97) (Table 4). These indicators highlight Panskura's effective infrastructure and housing policies that contribute to enhanced living conditions. Additionally, moderate levels of access to clean water (0.67) and solid waste management (0.76) suggest capable municipal governance in essential service delivery. However, substantial deficits are observed in education (0.12) and income levels (0.30), indicating that economic and educational opportunities remain limited. These imbalances may hinder long-term socio-economic mobility despite otherwise favourable living conditions.

In contrast, Haldia presents a more uneven QOL profile with a lower composite score of 0.35. While the municipality performs moderately well in permanent housing (0.65) and sanitation access (0.91) (Table 4), it faces critical challenges in access to clean water (0.00) and suboptimal conditions in overall housing infrastructure (0.58). High levels of poverty (0.85) and low daily wage scores (0.31) further illustrate the economic vulnerability of residents. Additionally, poor outcomes in education (0.33) suggest that a lack of educational attainment may be reinforcing cycles of deprivation. These indicators collectively underscore the need for comprehensive interventions focusing on essential service provision and livelihood generation.

Contai demonstrates a comparatively favourable QOL index of 0.63, reflecting commendable achievements in tenure security (0.76) and sanitation access (0.91) (Table 6). The municipality also exhibits strength in income levels (0.97) and daily wage scores (0.52), indicating relatively sound economic conditions (Table 4). Further, high scores in housing conditions (0.71) and solid waste management (1.00) suggest effective urban service delivery. Nevertheless, challenges remain in education (0.44) and access to clean water (0.52), indicating areas where targeted policy efforts are required to sustain improvements in QOL and support long-term development.

Egra, with a QOL index of 0.32, reflects significant infrastructural and service deficiencies. The municipality reports zero access to permanent housing (0.00) and sanitation (0.00) (Table 4), suggesting critical neglect in basic service delivery. While it scores well in tenure security (0.98) and income levels (0.93), these gains are undermined by the absence of core services, thereby limiting the benefits of economic stability. Poor performance in solid waste management (0.09) and education (0.29) further amplifies the structural challenges, with likely implications for health, safety, and long-term resilience.

Tamluk records the lowest QOL index of 0.00, signifying a comprehensive lack of basic services and infrastructure. The municipality reports minimal permanent housing (0.18) and no access to education (0.00) or employment opportunities (0.00), indicating acute deprivation across essential development indicators (Table 4). While access to sanitation (1.00) and clean water (1.00) is relatively high, these services are overshadowed by the lack of adequate housing and economic infrastructure. Tamluk's conditions highlight the need for immediate and large-scale intervention across sectors to prevent further deterioration in quality of life.

Table 5: Quality of Life of slum dwellers in different municipalities

Municipality	Housing Conditions	Infrastructure and Sanitation	Health and Healthcare	Education	Employment and Income	QOL	Rank
Haldia	0.36	0.17	0.46	0.33	0.41	0.35	4th
Contai	0.50	0.83	0.92	0.44	0.46	0.63	2nd
Egra	0.30	0.09	0.50	0.29	0.41	0.32	5th
Tamluk	0.48	0.82	0.80	0.24	0.27	0.52	3rd
Panskura	0.90	0.74	0.29	0.46	0.78	0.64	1st

Source: Authors' calculation based on primary survey

Overall, Panskura leads with the highest QOL index (0.64), followed closely by Contai (0.63), primarily due to better housing, sanitation, and income-related outcomes. In contrast, Haldia (0.35) and Egra (0.32) face challenges related to inadequate infrastructure and service provision, despite some economic strengths. Tamluk (0.00) lags significantly, underscoring critical deficiencies in housing, education, and employment (Table 5).

The analysis reveals that while some municipalities demonstrate relative progress, critical disparities persist across educational access, income levels, housing quality, and basic services. Improving the quality of life for slum residents requires holistic urban planning, including targeted infrastructure investments, expanded education and healthcare services, and inclusive economic policies. Collaborative efforts involving local governments, civil society organizations, and community stakeholders are vital to fostering sustainable urban development and ensuring equitable resource distribution.

3.3 Determination of Quality of Life

The correlation matrix (Table 6) provides a comprehensive analysis of the relationships between various socio-economic characteristics and the Quality of Life (QOL) among slum dwellers in the studied municipalities. This analysis highlights several critical determinants that influence residents' well-being and the broader dynamics of urban poverty.

A prominent finding is the strong positive correlation between financial capital—particularly income levels and savings—and QOL. Households with monthly earnings exceeding ₹10,000 exhibit significantly improved living conditions, underscoring the central role of economic stability in facilitating access to essential services, security, and opportunities. This aligns with established socio-economic theories, which regard financial resources as foundational determinants of health, education, and overall life satisfaction (Table 6).

Affluent households tend to enjoy improved access to quality education, healthcare services, and housing infrastructure. As income increases, families are better positioned to invest in health and education, which in turn contribute to sustained improvements in living standards. These interlinked dynamics affirm that income is a critical driver of quality of life, reinforcing the need for policies aimed at enhancing household income and expanding economic opportunities, particularly for low-income populations.

Table 6: Dominant factors of the quality of life of slum dwellers

Variables	Quality of life (QOL)
Permanent dwelling	0.40
Tenure status (Own)	0.29
Access to electricity	0.65
Sanitation facilities	0.47
More than 2 rooms	0.23
Permanent roof	0.67
Housing Conditions	0.79
Access to clean drinking water	0.69
Distance to water source <500 m.	0.48
Sewage facility	0.97
Pucca road	0.70
Waste dumping	0.95
Solid waste management	0.94
Infrastructure and Sanitation	0.94
Access to healthcare	0.52
Frequency of illness (Child)	-0.59
Delivery rate in govt. hospital	-0.29
Having a health care scheme (Swastha Sathi)	0.87
Health and Healthcare	0.27
Literacy rate	0.34
Educational attainment (Secondary)	-0.37
Access to educational facilities	0.84
Education	0.64
Daily wage earner	0.04
Income levels (>10,000/month)	0.34
Poverty rate (AYY)	-0.01
Savings (Yes)	0.60
Employment and Income	0.49

Source: Computed by authors

Education emerges as another significant determinant of QOL. The correlation analysis confirms that higher educational attainment is positively associated with a broad range of socio-economic outcomes. Education enhances employment prospects, supports better health literacy, and fosters informed decision-making. These capabilities are crucial for navigating complex social systems and improving personal and household well-being. The strong association between education and QOL suggests that investment in education can yield long-term benefits, including enhanced health outcomes, economic stability, and life satisfaction.

Housing infrastructure also shows a substantial correlation with QOL. The presence of permanent housing and stable living conditions is positively linked to higher quality of life scores (Table 6). Adequate housing ensures physical security, reduces exposure to environmental hazards, and supports better physical and mental health. Conversely, substandard housing often correlates with increased risks of respiratory illness, communicable diseases, and stress-related disorders. Therefore, ensuring access to safe and durable housing should be a top priority for policymakers aiming to enhance urban living standards.

While essential, services such as access to potable water, solid waste management, and healthcare exhibit moderate correlations with QOL. These services are indispensable for maintaining public health and hygiene;

however, their impact on overall quality of life appears conditional on the presence of supporting socio-economic and infrastructural elements. For instance, clean water is vital for preventing waterborne diseases, and waste management ensures environmental hygiene. Yet their potential benefits may not be fully realized in the absence of public awareness, consistent supply, or user education. Therefore, these services should be integrated into a broader, multi-sectoral strategy for urban development.

Interestingly, specific infrastructure components such as sanitation facilities and sewage systems display weak or statistically insignificant correlations with QOL. This suggests that their mere presence does not guarantee improved living conditions. Their effectiveness is likely influenced by infrastructure quality, user awareness, and cultural practices related to hygiene. Consequently, efforts to improve sanitation infrastructure should be complemented by community outreach and hygiene education programs to maximize their impact.

A particularly notable and concerning observation is the inverse relationship between the delivery rate in government hospitals and QOL. This negative correlation implies potential dissatisfaction with public healthcare services, possibly due to issues such as long wait times, perceived inefficiencies, understaffing, or lack of essential supplies. Such dissatisfaction can erode public trust in government facilities and push residents toward more costly or inaccessible private alternatives. Addressing these concerns requires targeted reforms in public healthcare delivery to restore confidence and ensure equitable access to quality medical care.

In sum, the correlation matrix underscores the complex socio-economic interactions that shape quality of life in slum communities. Financial stability, education, and housing quality emerge as primary drivers of well-being. These findings call for a multi-dimensional policy framework that addresses the intertwined nature of poverty, infrastructure, and access to services. Economic development strategies must prioritize income enhancement and employment generation, particularly for the most vulnerable segments. Likewise, educational investments—especially for youth and marginalized groups—are essential for long-term socio-economic mobility.

Simultaneously, upgrading housing infrastructure is critical to ensuring safe and stable living environments. Policies must focus on affordable housing initiatives while improving the condition of existing shelters. Moreover, while access to basic services like clean water, sanitation, and healthcare is essential for public health, their effectiveness depends on integration with educational outreach and community participation to ensure proper utilization and sustainability.

Ultimately, the findings from the correlation analysis (Table 6) highlight that improving the quality of life for slum dwellers necessitates a holistic, inclusive approach. By implementing comprehensive policies encompassing economic empowerment, educational advancement, housing improvements, and enhanced public service delivery, urban planners and administrators can promote sustainable development and equitable quality of life across slum communities.

5. Conclusion

This study has examined the quality of life (QOL) of slum dwellers across five municipalities in Purba Medinipur district, West Bengal, using a combination of multivariate statistical methods and Principal Component Analysis (PCA). The analysis provides a comprehensive understanding of the disparities in living conditions, access to services, and socio-economic characteristics across these urban slums. The findings reveal that urban slums in municipalities such as Egra and Haldia exhibit significantly lower quality of life compared to others. These two municipalities recorded QOL index scores of 0.32 and 0.35, respectively, ranking fifth and fourth among the five municipalities (Table 5). Primary survey data indicate that households in these regions suffer from inadequate housing conditions, poor infrastructure, limited sanitation facilities, and insufficient healthcare services.

Conversely, the municipalities of Panskura and Contai demonstrate comparatively higher quality of life, with QOL scores of 0.64 and 0.63, ranking first and second, respectively (Table 5). These municipalities exhibit strong performance in multiple domains: Housing conditions (0.90 in Panskura, 0.50 in Contai), Infrastructure and sanitation (0.74 and 0.84), Health and healthcare access (0.80 and 0.92), Education (0.46 and 0.44), and Employment and income levels (0.78 and 0.46, respectively) (Table 4).

One of the most critical indicators of development in slum areas is the literacy rate. Literacy enhances individuals' socio-economic mobility and improves access to resources and services. As Schultz (1996) argues, literacy is the most significant form of human capital, reflecting acquired capabilities and potential for personal and societal advancement. The slum literacy rates in the municipalities—Haldia (84.20%), Tamluk (88.99%), Contai (84.13%), Egra (75.38%), and Panskura (87.97%) are all higher than the national average (74.04%) and the West Bengal state average (77.08%), as per the 2011 Census, except Egra, which falls marginally below the state average. This relatively high literacy across most slum communities is a key positive finding, distinguishing these areas from urban slums in other Indian cities. For example, studies by Gill (2007) reported that nearly 50% of the slum population in Bombay and Chandigarh was illiterate, underscoring the significance of educational achievement in Purba Medinipur.

The analysis further identifies education, monthly income, housing type, sewage facilities, and sanitation as the most influential determinants of quality of life across all municipalities. These factors form the backbone of slum residents' socio-economic status. To address the disparities, municipal authorities should prioritize

achieving universal access to metalled roads and a piped water supply, which are essential for improving hygiene, mobility, and access to services.

Overall, this study portrays a demographic characterized by moderate living conditions, a labour-driven economy, limited financial security, and notable disparities in infrastructure and amenities. Despite these challenges, the relatively high literacy rates in most slums present a critical opportunity for targeted policy interventions. Stakeholders—including government bodies, NGOs, and private sector entities—must collaborate to promote entrepreneurship, generate employment, and enhance access to services in these vulnerable areas. Strategic and inclusive planning is essential to uplift the quality of life of slum dwellers in Purba Medinipur and pave the way for sustainable urban development.

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