Chapter 42
Assessing the Impact of COVID-19 on Urban Socio-economic Vulnerability and Wellbeing for Integrated Planning: A Quantitative Enquiry in the Katwa Municipality, West Bengal

Tanmoy Basu, Biraj Kanti Mondal, and Rima Das

Abstract The present study focuses on the quantitative investigation of economic vulnerability and assesses the perception survey carried out among 75 residents of Katwa Municipality, an up-growing urban area in Purba Barddhaman District, West Bengal. To estimate the socio-economic vulnerability during the lockdown, standardised factor scores have been calculated in the analysis of principal components and GIS-based mapping has been employed also. Among the total working population of the surveyed household, about 20% have changed their occupation, wages have been reduced by 35 and 35% have lost their occupation during the lockdown period. The highly socio-economic vulnerability has been observed in the wards where households and population are also high. The regression coefficient shows that the increasing trend of marginal other workers has the significantly ($p < 0.1$) highest marginal effect on the socio-economic vulnerability. The Likert scale measuring perception indicated that the majority of the respondents agreed with their socio-economic vulnerabilities caused by lockdown during the pandemic situation. The significant outcome of the study indicates the initiation of diversified income generation opportunities and deliberates its contribution to the formation of location-specific planning for the socio-economic development and integrative management of the study area.

Keywords Vulnerability · Perception · COVID-19 · Lockdown · Quantitative · GIS

T. Basu
Department of Geography, Katwa College, Purba Barddhaman, West Bengal 713130, India

B. K. Mondal (✉)
Department of Geography, Netaji Subhas Open University, Kolkata 700064, India
e-mail: birajmondal.kolkata@gmail.com

R. Das
Department of Geography, Bhangar Mahavidyalaya, South 24 Parganas, West Bengal 743502, India

U. Chatterjee et al. (eds.), *Urban Commons, Future Smart Cities and Sustainability*,
Springer Geography, https://doi.org/10.1007/978-3-031-24767-5_42

Introduction

COVID-19 (novel coronavirus disease) is one of the severe pandemics of the present century. It started to spread globally as acute respiratory syndrome from January to March 2020. The lockdown period had been started in March 2020 in several countries of the world after the declaration of the World Health Organisation about COVID-19 as the first pandemic globally spread in the twenty-first century (Onyeaka et al. 2021). India faced an extensive lockdown situation during the outbreak of COVID 19 which tremendously impact the national–regional economy of this developing country. According to The Lancet (2020), 18,985 active COVID cases and 603 death reports had been declared in the 31 states and union territories on 30 January 2020. The first lockdown period was extended up to April 2020 with restrictions on public activities within the territory and transportation to and from other countries. The common people of Indian rural and urban areas are affected by the restrictions of lockdown in their social and economic activities. The urban residents and migratory labours engaged in specialising economic activities faced a problematic situation with deducing from their occupation during the entire lockdown period (Jesline et al. 2021; Allain-Dupré et al. 2020). The impact of lockdown on the urban common people is here exemplified in global, national and regional-level scenarios. There were opposite scenarios among the people engaged in businesses and services about their worry about the uncertainty of their occupation in Khulna City Corporation of Bangladesh (Haque et al. 2020). COVID-19 lockdown devastatingly impacted the global urban economy as the misappropriation of women in the informal sectors globally and in the 'hardest hit sectors' like the tourism industry, hospitality management and other services (United Nations 2020). In South Asian countries including India, the pandemic situation of COVID-19 and associated lockdown devastated many migrant workers who had been migrating within the territory of a country (Rasul et al. 2021). They have mainly belonged to informal sectors of the economy that had lost their occupation and were hindered by the restrictions of transport and public movement during lockdown to return to their home (Rasul et al. 2021). Gupta et al. (2021) observed that about 65% of the sample household consisting one migrant person who was engaged in agriculture or non-agricultural labour in an Indian urban area. Gupta et al. (2021) also postulated that the average weekly income of the local household of Indian Sundarbans was not so much originated from local sources. Khan et al. (2022) noted that near about 68.3% of the households were vulnerable to their economic conditions in absence of a steady and secure income from their occupation in Bangladesh. Moreover, about 59.9% of a household consisting of single-income-generation persons were also vulnerable to economic conditions as their average monthly income was reduced during COVID-19 (Khan et al. 2022). Nicola et al. (2020) found that the COVID-19 pandemic has impacted the global communication systems, business and organisational activities which have affected unwittingly on the financial markets and economic conditions worldwide. The lockdown situation also deranged the commodity and service 'supply chains' by creating the incoordination of governmental responses and activities (Nicola et al. 2020).

Martin et al. (2020) opined that the lowest income population was mostly affected by the COVID-19 crisis in the San Francisco Bay Area. The mean recovery period for the affected persons is double (14.3 months) for the lowest income quintile in comparison to the highest income quintile whose mean recovery period is 7.2 months (Martin et al. 2020). Gururaja and Ranjitha (2022) postulated that the impact of COVID-19 and its associated lockdown on employment is in the lower-income countries of the world like India. During COVID-19, 62% of informal employment was inadequately impacted in the world. The significant factors which predicted the risks of COVID 19 in the States and Union Territories of India were ageing, interstate migration, international migration, literate, casual labour in non-agriculture. Moreover, joint or extended family, drinking water outside premises, population density and proportion of the urban population also significantly determined the risks of COVID 19 (Pathak et al. 2020). The non-significant factors were the Scheduled Caste or the Scheduled Tribe population, the Muslim population, casual labour in agriculture, poverty, the proportion of the slum population, and health expenditure (Pathak et al. 2020). Tamrakar et al. (2021) resulted out that the percent of the 15–59 aged population, percent of marginal workers and population density were significantly associated with the infection rate of COVID-19 in India. Socio-economic variables, such as the literate population, ST population, urban population and the average person sleeping in a room significantly, predicted the infection rate of COVID-19 (Tamrakar et al. 2021). According to the analysis by Tamrakar et al. (2021), the Indian districts which have a good infrastructure at the household level have higher feasibility of the rate of infection of COVID-19. Aneja and Ahuja (2021) mentioned in their study that a significant number of 'fiscal' and monetary policies had been measured by the respective authority to combat the impact of lockdown during COVID-19. Aneja and Ahuja (2021) also suggested measuring special attention to the vulnerable sections of India. Attention is needed on the poverty-driven people, small- and medium-scale industries and the non-indispensable commodities sector which has the worst thrash in the demand contraction during the COVID-19 pandemic situation (Aneja and Ahuja 2021). Lahiri and Sinha (2021) studied that household-level individuals have been negatively affected by the lockdown situation regarding loss of their job, deduction of wages or salaries and other related problems around the world including in India. The spread of COVID-19 in India among the proportions of overcrowding households was significantly higher in the rural areas (51%) among the poverty-stricken, socio-economically improvised and depreciated communities. Chaudhary et al. (2020) postulated that COVID-19 had impacted the fiscal and monetary policy of India. The authors opined that the COVID-19 pandemic originated a lesson to the Indian planners and policymakers for dispensing a great impulsion to the sectors in an extensive way (Chaudhary et al. 2020). The sectors could make a superior allocation of resources and diminish the inequality and disparity situations of income generation in India (Chaudhary et al. 2020).

In West Bengal, the 1st case of COVID-19 was observed on 17 March 2020 (Konar et al. 2020). Mondal et al. (2021) identified seven districts consisting of a large number of urban populations included in the high affectivity zone of COVID-19 in West Bengal, those were Howrah, Kolkata, and northern Jalpaiguri. Nadia,

Hooghly, Purba Bardhaman and Paschim Bardhaman districts were belonging to low or moderate affectivity zone (Mondal et al. 2021). The rest of the districts of West Bengal were included in the safe zone (Mondal et al. 2021). Choudhury et al. (2022) proved in their study that there was no significant difference in the household income, expenditure and savings of the studied groups in the pre-COVID situation in Hooghly district of West Bengal. Besides, there was no significant difference in household expenditure also during the COVID situation Choudhury et al. (2022). Choudhury et al. (2022) also identified that there was a significant difference in household income and savings during the COVID situation in Hooghly district of West Bengal. Nath et al. (2021) mentioned the situation of COVID cases based on Government records that Kolkata is one of the vulnerable cities in India where the total COVID-19 infection cases were more than 37,000 and the total numbers of deaths were 1200. In Kolkata city, the urban sprawling and congested areas were mostly affected by COVID 19 and about 30% of the slum population to the total population who are deprived and driven by poverty were mostly affected (Ghosh 2013). In this context, the present study attempts to identify the socio-economic vulnerability of COVID-19 in the selected urban unit area and assess the perception of the residents about their wellbeing situation during COVID-19 in 2020–2021.

Objectives

The objectives of the present study are

1. To identify the socio-economic situation of the residents of Katwa Municipality during COVID-19 lockdown period (2020–2021).
2. To formulate the socio-economic vulnerability index in the study area during the lockdown.
3. To analyse the relationship among the socio-economic indicators and the marginal effect of the indicators on the vulnerability index.
4. To access the perception of the respondents on the lockdown situation and suggest major policy measures to sustain the development of the urban dwellers in Katwa Municipality.

Materials and Methods

Study Area

Katwa Municipality is selected as the study area of the present study. It is situated between 23° 37 min north to 23° 39 min north latitude and 88° 6 min east to 88° 8 min east longitude in Purba Bardhaman district of the state of West Bengal, India. It is situated at the confluence of Ajay and Bhagirathi rivers in Gangetic West Bengal

where the climate is tropical monsoon. The city is a statutory town of Purba Bardhaman district (former Barddhaman district) with geographical and historical value consisting of a total of 81,615 population and 19,382 households in 2011 (Census of India 2011). The decadal growth rate of population and households are 12.28% and 21.26% from 2001 to 2011, respectively, in Katwa Municipality (Census of India 2001, 2011). The male and female literacy rates are 90.25 and 83.94% in 2011 (Census of India 2011). The municipality area consists of 19 wards (Census of India 2011), and presently, ward number-12 is divided into two wards, those are ward number-12 and ward number-20. The facilities of the residents of this municipality area are well connected with Burdwan city, the district capital by bus and train, and with Kolkata, the state capital by train route. The surrounding areas of Katwa Municipality of Katwa Subdivision of Purba Bardhaman district are mainly rural. Agriculture is the primary economic activity alongside the bank of river Bhagirathi, whereas the municipal area has functioned as multiple economic activities. There was 0.98% of cultivators and 1.94% of agricultural labourers and 5.25% of household industry workers and 91.79% other workers in the total workers, respectively, in Katwa municipality (Census of India 2011). During COVID-19, the Katwa Subdivisional Hospital was a significant and primal health-facilitate centre of the municipality and surrounding areas (Fig. 42.1).

Katwa municipality is selected as the study area of the present study as one case of death occurred due to comorbidity in the primer phase of COVID-19 in the surrounding areas of Katwa. The present study focuses on the socio-economic conditions at the household level and socio-economic vulnerability in the wards of Katwa Municipality during the lockdown in 2020–2021. As the town is one of the significant urban growth centres of Purba Bardhaman district of West Bengal as well as subdivisional, the urban socio-economic situation could be correlated with the working profile, COVID vulnerability and residential perception of their wellbeing. Besides, some migratory labours of West Bengal were returned to their native Katwa and surroundings during the lockdown. Regarding this, socio-economic conditions and vulnerabilities with perceptual wellbeing are under consideration as the objective of the present study conducted in Katwa Municipality.

Data Sources

The present study has been conducted using both secondary data and a primary field survey. Relevant secondary data have been collected from Census of India (2011). A primary field survey has been done in December 2021 by selecting 75 households using simple and purposive random sampling techniques. The households are characteristically consisting of varied socio-economic and infrastructural conditions.

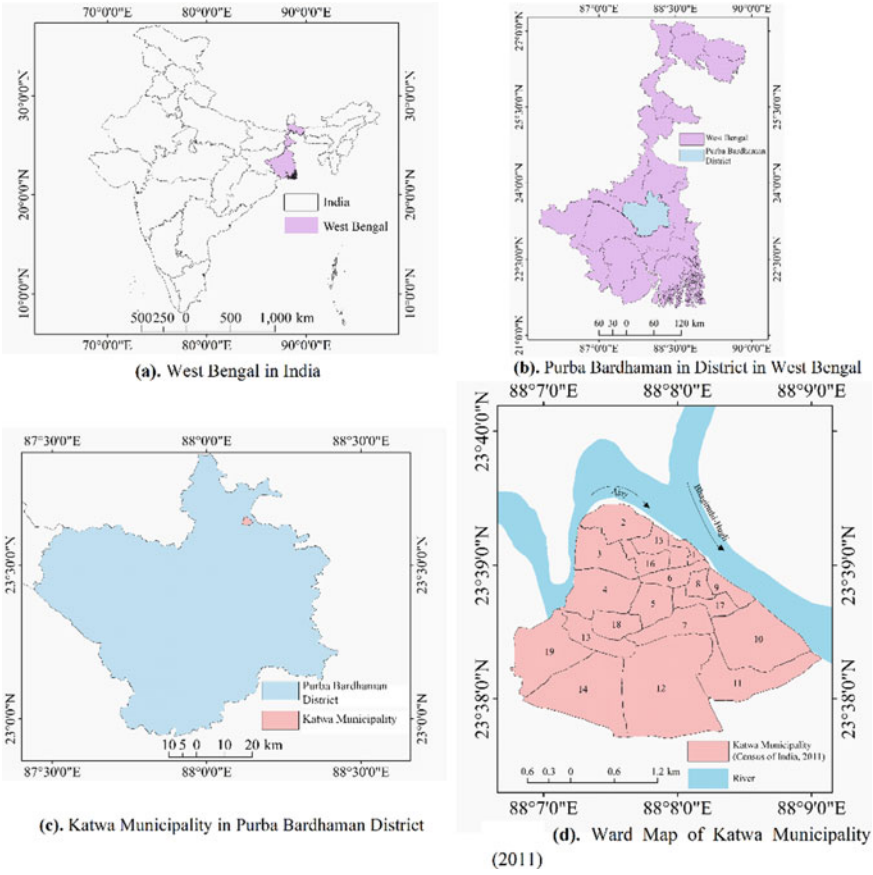


Fig. 42.1 **a–d** Location map of the study area

Methods and Techniques

Socio-economic Vulnerability Analysis

In the COVID-19 context of India, vulnerability has been measured in different ways. Bhattacharya and Banerjee (2021) measured the Health Vulnerability Index (HVI) and Economic Vulnerability Index (EVI) of COVID-19 in the major twenty-two states of India. Health vulnerability and economic vulnerability have been measured by ranking the states based on health-related and economic indicators (Bhattacharya and Banerjee 2021). Mishra et al. (2020) measured the urban COVID Vulnerability Index using the social distancing, lockdown and direct health variable-related indicators in India. Mishra et al. (2020) constructed a pairwise comparison matrix to measure the vulnerability index in the Analytical Hierarchy Process. Sahu and Mishra (2021) applied the statistical methods of max–min normalisation and multiple indicators

combination to construct the COVID-19 Vulnerability Index (VI) in Indian states and UTs. Sahu and Mishra (2021) formulated an equation of Vulnerability Index that Vulnerability Index is the difference between Exposure and Adaptive Capacity multiplied by Sensitivity. Based on the selected indicators of exposure, adaptive capacity and sensitivity, the vulnerability index ranges from −1 to +1 (Sahu and Mishra 2021). Sarkar and Chouhan (2021) used the statistical methods of Z-score data normalisation, principal component analysis (PCA) and aggregating indicators to build up the Socio-Economic Vulnerability Index (SoEVI) of COVID 19 in Indian districts. The construction of the index is based on the selected socio-economic indicators, and it ranges from 1 to 100 (after normalisation of the index). Here, a higher index value represents greater vulnerability (Sarkar and Chouhan 2021). Zhang et al. (2014) postulated that regional environmental vulnerability assessment is based on the information entropy, the extension of the evaluation index number field in normalisation. The method has been modified for the assessment of the proposed regional eco-environmental vulnerability with an improved entropy weight model (Zhang et al. 2014). Li et al. (2022) also used the entropy weight method with positive index calculation and negative index calculation formula to measure the economic system vulnerability.

In the present study, vulnerability assessment is based on the extracted factor scores of principal component analysis (PCA). Primarily data standardisation has been made to avoid internal inconsistency. The composite indices method has been implemented through Factor analysis of PCA on each of the pre-defined criteria to bring out the significant factors of socio-economic conditions and vulnerability of the respondents. For the composite factor analysis, the following formula (PCA, Pearson 1901) has been used:

$$P_1 = \Sigma a_{j1} X Z_j \text{ or } P_1 = a_{11}.Z_1 + a_{21}.Z_2 a_{11}. + \ldots + a_{n1}.Z_n \quad \text{(i)}$$

where P_1 denotes the composite index of development of a unit study as the first factor denotes the factor loading of the 'j'th variable and 1 indicates the factor number that is the first factor-vector of factor loadings.

While the Z_j denotes the standardised value of the 'j'th variable, which is expressed as

$$Z_j = \frac{X_j - X_m}{\delta_j} \quad \text{(ii)}$$

where X_j denotes the original value of 'j'th variable, X_m denotes the mean (simple arithmetic mean) of 'j'th variable, and δ_j denotes the standard deviation of 'j'th variable.

In this aspect, the mean and standard deviation are calculated by using the following formula:

$$\text{Mean} = \frac{\Sigma x}{n} \quad \text{(iii)}$$

$$\text{Standard Deviation (SD, } \sigma) = \sqrt{\left(\frac{x - \overline{x}}{n}\right)} \tag{iv}$$

where $\overline{x}$ is the arithmetic mean; x is the individual value of items; n is the number of terms in the distribution.

Standard error mean has been estimated following the formula of Carlin and Doyle (2000). According to Carlin and Doyle (2000), the SEM must itself be estimated by using the sample SD (s) in place of the unknown σ, the formula is

$$\text{SEM} = \frac{s}{\sqrt{n}}$$

Finally, mean composite factor scores have been calculated using the standardised factor scores extracted from PCA.

$$\text{Mean Composite Factor Scores} = \frac{\text{Factor}_1 + \text{Factor}_2 + \text{Factor}_3 + \ldots + \text{Factor}_n}{\text{Total number of extracted factors}} \tag{v}$$

where, n is the factor.

Correlation and Regression Analysis

To find out the correlations, the following Pearson's formula of r (Pearson 1896) has been used:

$$r = \frac{n\Sigma xy - \Sigma x.\Sigma y}{\sqrt{n\Sigma x^2 - (\Sigma x)^2}\sqrt{n\Sigma y^2 - (\Sigma y)^2}} \tag{vi}$$

where r = Correlation coefficient; x = Independent variable; y = Dependent variable and n = No. of observations.

The multiple linear regression model has been used to identify the relationship between mean composite factor scores and their determinants. The formula of the multivariate regression model (Uyanık and Güler 2013) is

$$Y = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n + e_t \tag{vii}$$

where

Y is the dependent variable (here, mean composite factor scores)
X_1 is the independent variable
β_1 is parameter
e_t is error.

The standardised predicted values and standardised residuals are derived from the analysis of the multiple linear regression model.

In the post-estimation analysis of the regression model, the marginal effect of the population mean has been estimated using the following formula adopted by Leeper (2017),

$$\text{Marginal effect concerning } X_1 = \frac{\mathrm{d}Y}{\mathrm{d}X_1} = \beta_1 + \beta_3 X_2 \tag{viii}$$

where

d is the change
Y is the dependent variable
X is the independent variable
β_1 is parameter.

In this study, the coefficient value indicates the marginal effects of the statistical population mean of the determinants on the dependent variable. The linear regression model has been performed with a degree of freedom of $n - 1$ (Rawlings et al. 1998) and a confidence coefficient of 0.95 and 0.99.

The test of significance (Fisher 1925 following Student 1908) analysis has been adopted using the following formula,

$$t = r\sqrt{\frac{n-2}{1-r^2}} \tag{ix}$$

where t = Value of significance; r = Correlation coefficient; r^2 = Coefficient of determinants and n = No. of observation. In the study, the degree of freedom is (n − 1) and confidence intervals are 95 and 99%.

Perception Analysis

To assess the perceptual wellbeing of the respondents during the COVID-19 lockdown in 2020–2021, the rating scale based on a five-point Likert scale (Likert 1932) has been formulated. Based on their perception of agreement, the rating scale has been structured as Table 42.1.

The perceptual responses have been categorised based on the rating scale, and the percentage of the respondents of each response has been calculated using the following formula,

$$\text{Percentage of respondents of individual responses in each category of respondents} = \frac{\text{Number of respondents of an individual responses in each category}}{\text{Total respondents in each category}} \times 100 \tag{x}$$

Table 42.1 Perception analysis (Likert scale)

Scale point	Description
1	Strongly disagree
2	Disagree
3	Neutral/undecided
4	Agree
5	Strongly agree

Source Likert (1932)

Results

Socio-economic Situations of the Respondents During the Lockdown

The participants' observation and municipal database show that COVID cases were less than 10% in Katwa and its surroundings compared to the other areas. The phases of lockdown from 2020 and 2021 hindered the socio-economic upliftment of the municipality from diverse perspectives. The primary field survey reports that 53% of the male and 47% female population were more or less affected by the barrier situation of COVID-19 lockdown. The affected population is mostly Hindu and Muslim in Katwa Municipality and surrounding areas. Out of the total surveyed population, 59% were belonging to the general caste, 16% were Scheduled Castes (SCs) and 25% were Other Backward Classes (OBCs). During COVID 19 the literacy education system collapsed and become online-depended. But most of the poverty-driven students were deprived by this system of the lack of e-resources and proper access to electronic gadgets and the internet. During COVID 19, 0.5% of the total surveyed population were illiterate. The percentage of the working population was 42% engaged in various economic activities. But, unfortunately, the percentage of the non-working population is high (85%) who lost their job due to lockdown situations mainly in informal sectors. The various working population categories were 6% of labour, 11% self-employed, 6% of household industry workers (and shopkeepers or marketers); 2% were engaged in the transport sector, 41% were servicemen, and 23% were businessmen; only 2% workers were engaged in agriculture and allied activities, rest of the working population were engaged in other activities in this municipality area. Most of the residents have an income ranging from rupees 10,000 to 50,000 (60%). 26.67% had their income below rupees 10,000 and 13.33% above rupees 50,000. The overall expenditure and health expenditure were changed during the COVID-19 lockdown. The highest percentage of respondents' households were belonging to the lowest total health expenditure (< rupees 20,000 for 80%, and < rupees 5000 for 73.33%, respectively). The income, expenditure, savings and credit profile have been represented in Figs. 42.22, 42.23, 42.24, 42.25 and 42.26. Most of the working population (60%) were aged between 25 and 50 years including COVID warriors in Katwa. The health conditions of the COVID victims deteriorated during

the 2nd and 3rd phases of COVID-19. Health expenditure was below rupees 5000 for 73.33% of respondents' households; rupees 5000–10,000 for 20%, and above rupees 10,000 for 6.67% of respondents' households. Out of the total affected population by the lockdown situation, 32% were belonging to below the poverty level (BPL). There was 25% of the respondents who are above 50 years most vulnerable to health issues during the pandemic. Out of the total affected population by the lockdown situation, 32% were belonging to below the poverty level (BPL). Household conditions of the respondents were kuccha in the case of 5%, pucca (87%) and mixed (8%). The lockdown phases also vulnerably affected the lives and livelihoods of the city-dwellers. Twenty percent of the total respondents changed their occupation during and after lockdown. Twenty-one percent had lost their jobs during the lockdown. Twenty percent of the respondents were engaged in a new job or occupation after lockdown. Salary or wages were reduced, and income had been changed in the case of 35% and 30%, respectively, of the respondents. Health expenditure increased in the case of 85% of the total respondents. There were 10% of migratory labours who lost their job and returned to their native areas in Katwa and surroundings from the other states of India and were quarantined. After initiatives of mass vaccination by the respective governmental authority, cent percent of the total respondents were vaccinated from 2021 to 2022. To sustain their economy, 61% had to get financial or non-financial assistance from others, and 39% of the total respondents helped others during the socio-economic and health-related vulnerable situations during COVID-19 lockdown (Figs. 42.2, 42.3, 42.4, 42.5, 42.6, 42.7, 42.8, 42.9, 42.10 and 42.11).

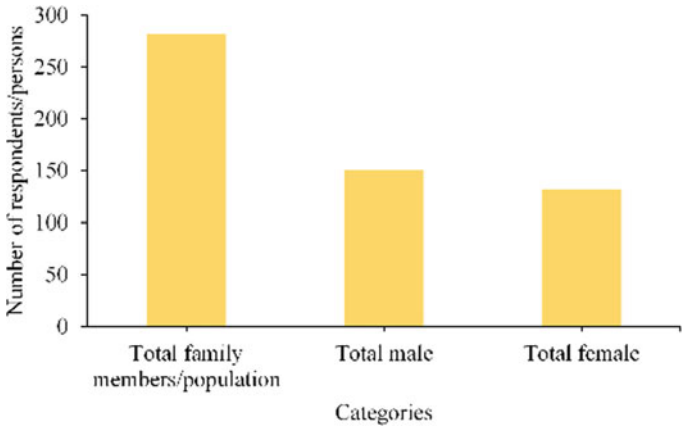


Fig. 42.2 Socio-economic profile-I of the respondents: total surveyed family members, male and female population

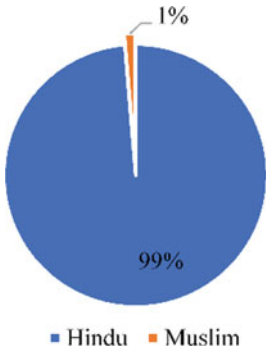


Fig. 42.3 Socio-economic profile-I of the respondents: religious categories of the respondents

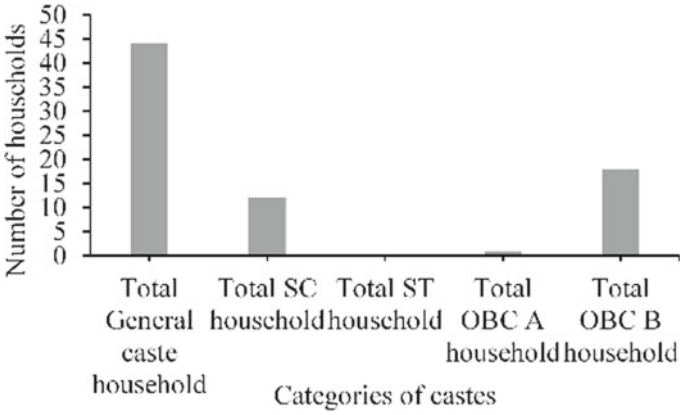


Fig. 42.4 Socio-economic profile-I of the respondents: caste-wise categories of the respondents

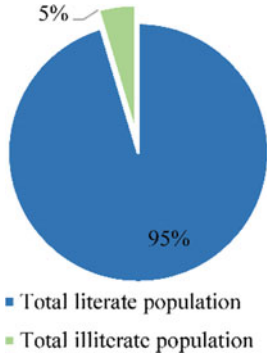


Fig. 42.5 Socio-economic profile-I of the respondents: literacy profile of the respondents

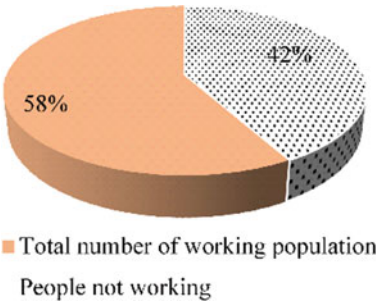


Fig. 42.6 Socio-economic profile-I of the respondents: total workers and non-workers

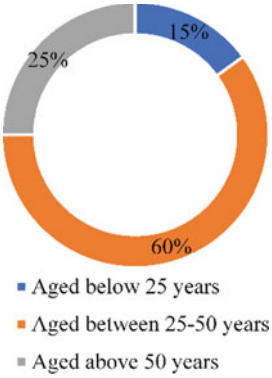


Fig. 42.7 Socio-economic profile-I of the respondents: age profile of the respondents

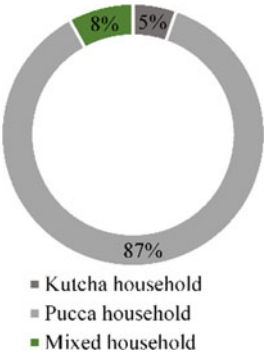


Fig. 42.8 Socio-economic profile-II of the respondents: household conditions of the respondents

Assessment of the Socio-economic Indicators

Various indicators have been selected to access the socio-economic vulnerability of the COVID-19 lockdown situation in Katwa Municipality. Regarding this, a total of 15 indicators based on ward-wise socio-economic indicators have been chosen (S1). S2 shows the descriptive statistics (mean, standard deviation and standard error of

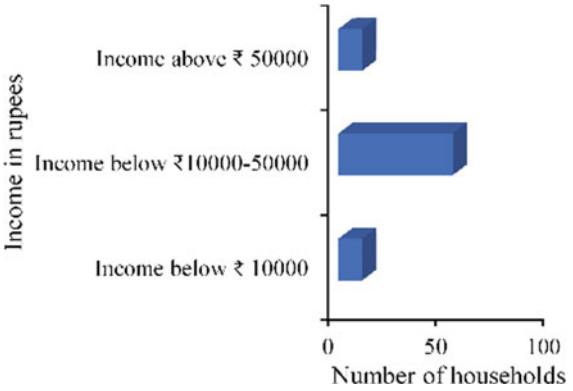


Fig. 42.9 Socio-economic profile-II of the respondents: income situations of the respondents

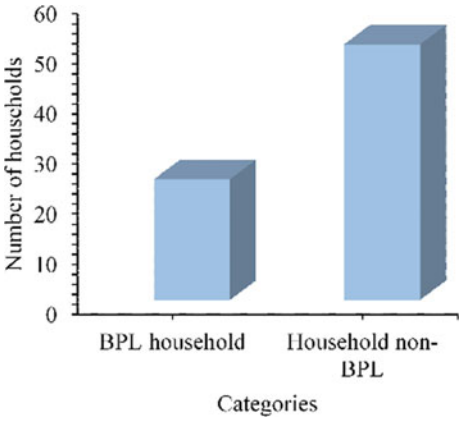


Fig. 42.10 Socio-economic profile-II of the respondents: total BPL and non-BPL households

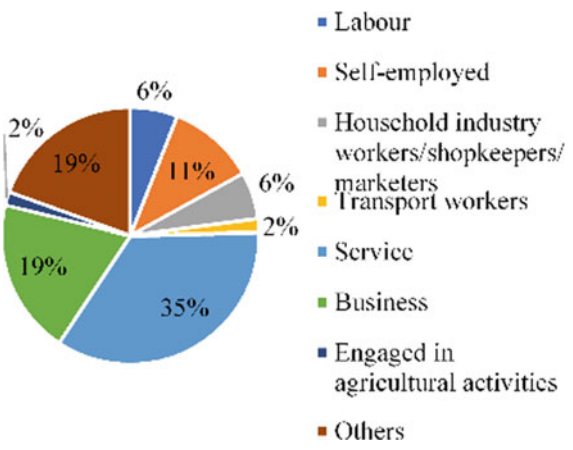


Fig. 42.11 Socio-economic profile-II of the respondents: occupational structure of the respondents

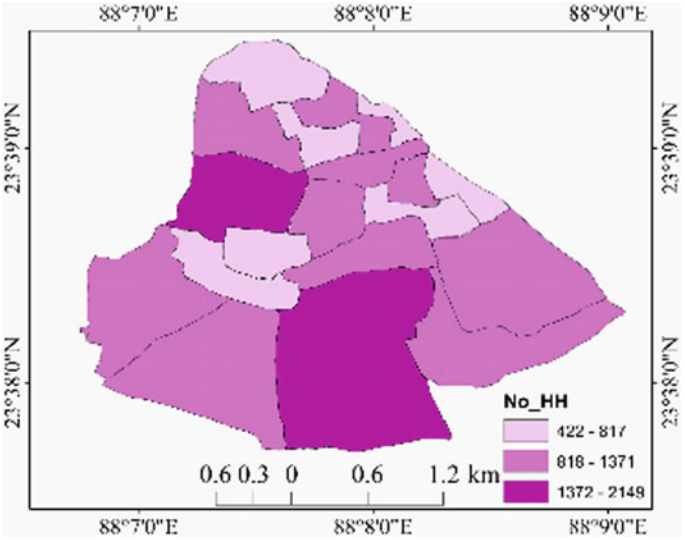


Fig. 42.12 Ward-wise distribution of selected socio-economic status of the respondents: distribution of total numbers of households

mean or SEM) of the selected indicators—a total number of households, male population, female population, population below 0–6 years, SC population, ST population, total literacy rate, the total number of main cultivators, agricultural labourers, household industry workers and other workers and marginal cultivators, agricultural labourers, household industry workers and other workers. The indicator, marginal household industry workers have the lowest difference of standard deviation value from the mean (SEM = 8.07), and the total literacy rate has the highest difference of standard deviation from the mean (SEM = 304.62). The household distribution is high in wards 4 and 12, and the population is also high in those wards including ward number 19. SC and ST populations are also congested in ward number 19. The distribution of households is low in ward numbers 1, 2, 9, 13, 16, 17 and 18. The total population is low in wards 1, 2, 5, 6, 8, 9, 13, 16, 17 and 18. The total literacy rate and total working population are low also in the wards numbers 1, 2, 13, 16 and 18. Figures 42.12, 42.13, 42.14, 42.15, 42.16, 42.17 and 42.18 show the ward-wise distribution of various socio-economic indicators of Katwa Municipality.

Urban Socio-economic Vulnerability Analysis During COVID 19 Lockdown

During COVID 19, urban vulnerability has increased in health and socio-economic conditions of the urban residents. To analyse the urban socio-economic vulnerability, 15 indicators have been composited with extracting the three factors (or components, Table 42.2). The 1st component, the 2nd component and the 3rd component explain

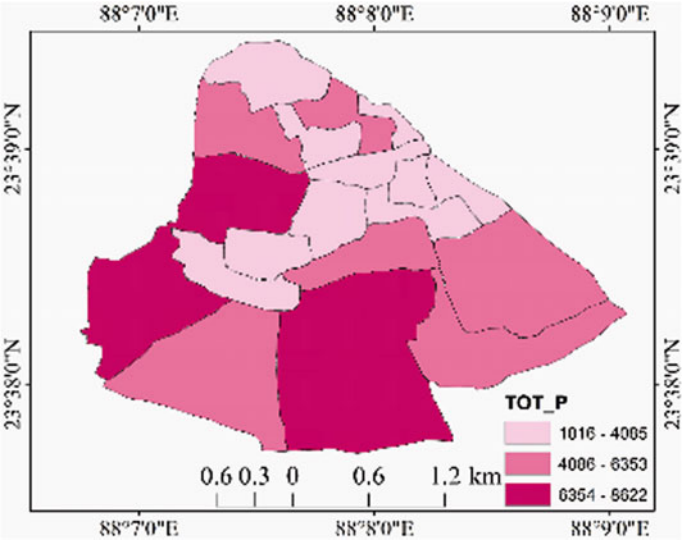


Fig. 42.13 Ward-wise distribution of selected socio-economic status of the respondents: distribution of total population

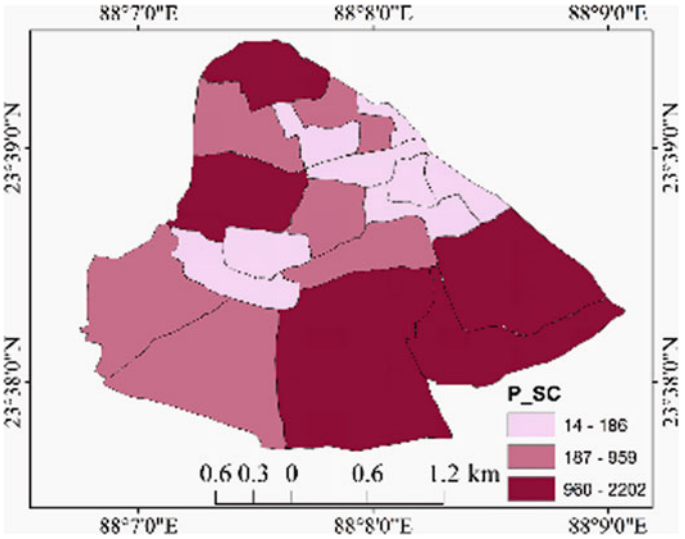


Fig. 42.14 Ward-wise distribution of selected socio-economic status of the respondents: distribution of SC population

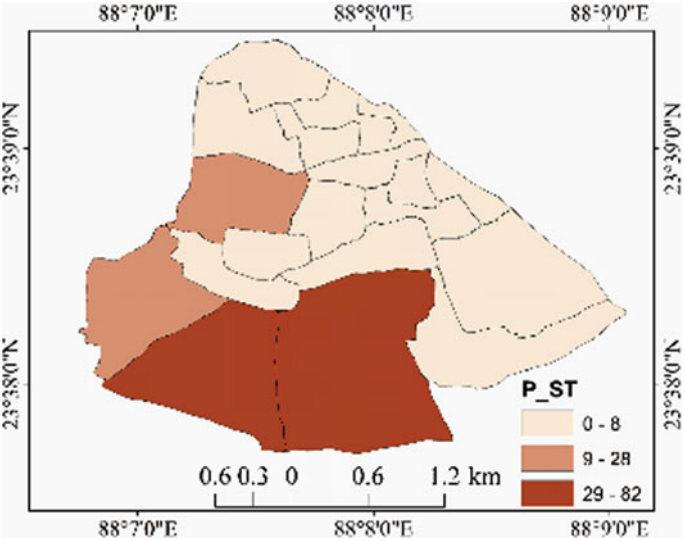


Fig. 42.15 Ward-wise distribution of selected socio-economic status of the respondents: distribution of ST population

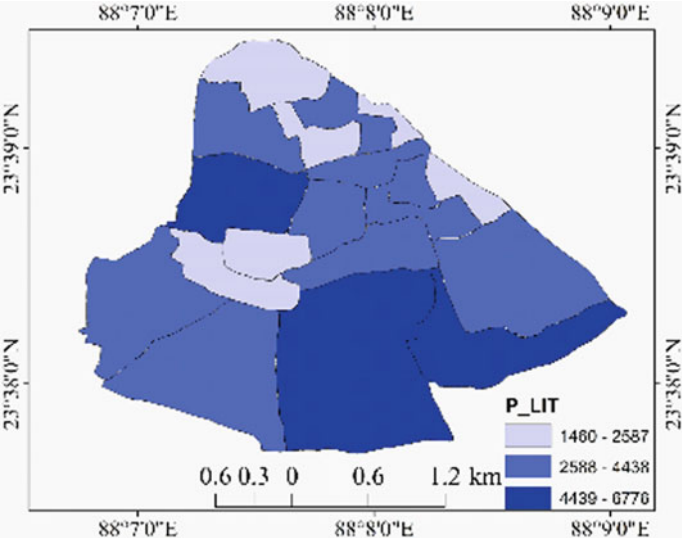


Fig. 42.16 Ward-wise distribution of selected socio-economic status of the respondents: distribution of total literacy rate

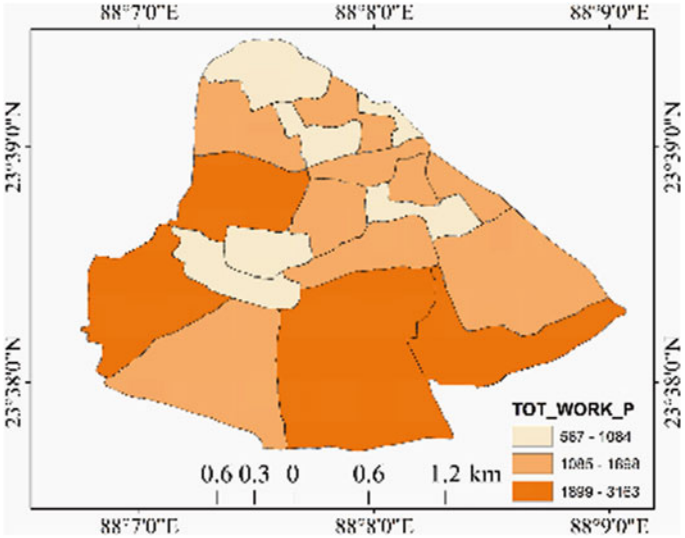


Fig. 42.17 Ward-wise distribution of selected socio-economic status of the respondents: distribution of total workers

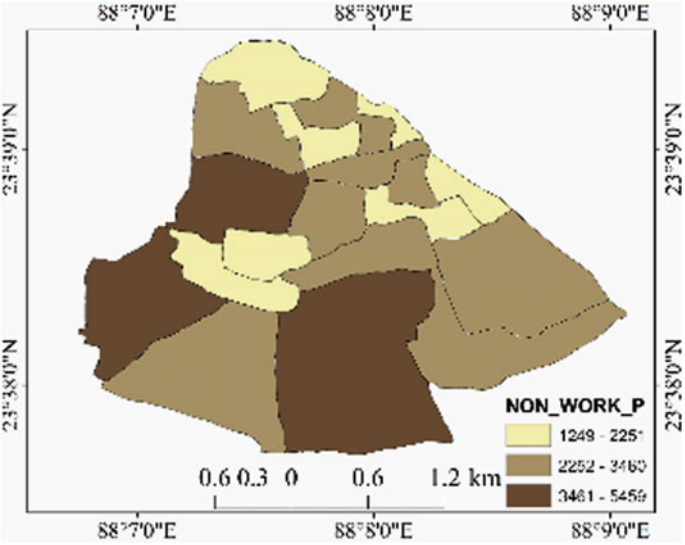


Fig. 42.18 Ward-wise distribution of selected socio-economic status of the respondents: distribution of non-workers

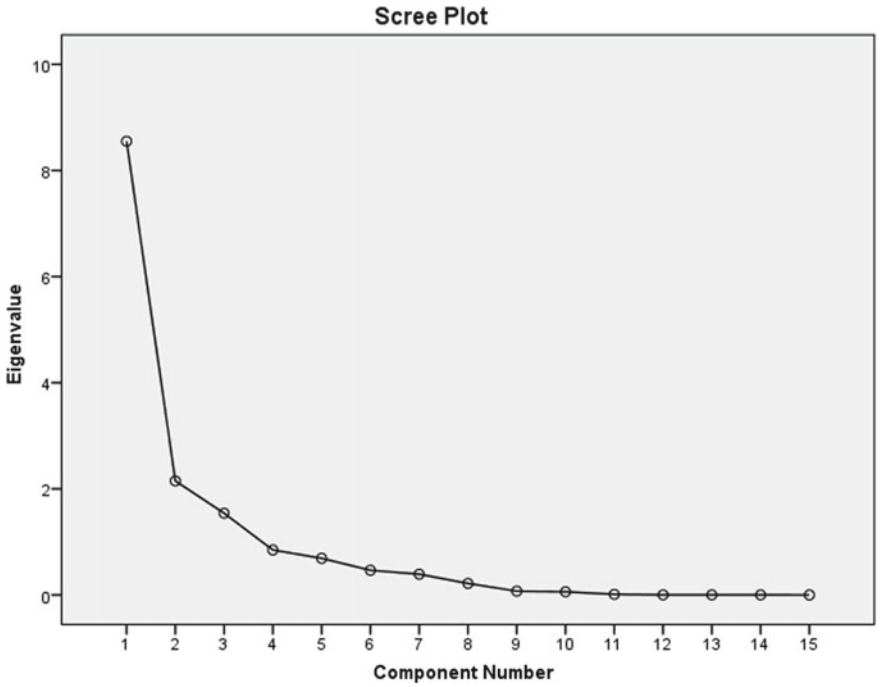


Fig. 42.19 Scree plot of factor analysis

all the indicators 48.172%, 69.288% and 81.597% cumulatively. Based on the mean composite indicators, the socio-economic vulnerability index zones have been represented in Fig. 42.21. A very low vulnerability index (−0.69 to −0.58) has been found in wards 6, 8 and 17; a low vulnerability index (−0.57 to −0.39) has been found in the wards 1, 13, 16 and 18; moderate vulnerability index (−0.38 to −0.0047) has been found in the wards 5, 7, 9, 14 and 15; high vulnerability index (−0.006 to 0.41) has been found in the wards 3, 4 and 10, and very high vulnerability index (0.42–1.0) has been found in the wards 2, 11, 12 and 19. The wards 4, 12 and 19 consist a large population, and wards 4 and 12 consist a large number of households that had a very high socio-economic vulnerability during the lockdown period. Besides, the wards 6 and 18 consist a low population and a low to a moderate number of households that had very low vulnerability during the lockdown period.

Impact of the Indicators on Socio-economic Vulnerability

The selected indicators have marginal effects on the constructed socio-economic vulnerability of the COVID 19 lockdown in Katwa Municipality. S3 represents the correlation among the selected indicators. A very high and significant correlation

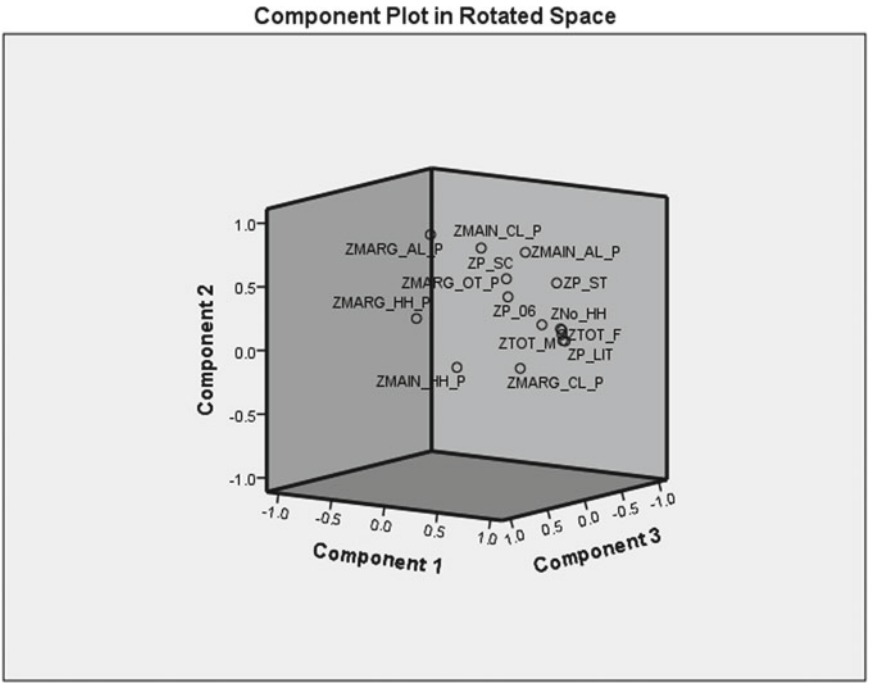


Fig. 42.20 Component plot of factor analysis

($r < 0.90$, $p < 0.01$, $p < 0.005$) value has been found in the case of the indicators-total household and total male, total female population, total literacy, main other workers; total male population, total household, total child population (0–6 years), total literate population; total female population and total household, total male population, total literate population; total child population and total male population; total literate persons and total household, total male population, total female population, main other workers; main other workers and the total number of household, total male population, total female population, total literate population. Unstandardised coefficient values have been extracted in the marginal effect analysis (dy/dx) of the multiple linear regression model (S4). A total of 14 indicators have predicted the mean composite socio-economic vulnerability index (mean composite factor score). In this analysis, the correlation coefficient value is 0.999 (significant at 0.0001 significant level). The Durbin–Watson statistic shows that there is no collinearity among the 14 predictors (DW statistic = 2.013). The variable total child population (0–6 years) has been excluded in the partial correlation method because collinearity exists with this variable. The partial correlation value is −1.00 ($p < 0.0001$). S4 shows that the significant predictors are total literacy rate, main agricultural labourers, marginal cultivators, marginal agricultural labourers and marginal other workers. The highest marginal effect has been identified in the case of marginal other workers as 1 unit increase of marginal other workers increase 1412.40 unit of the dependent variable

Table 42.2 Extracted factor scores of PCA and mean composite scores of vulnerability index

Wards	Factor-1 (FAC1)	Factor-2 (FAC2)	Factor-3 (FAC3)	Composite factor scores	Mean composite factor scores
1	−0.96	−0.52	−0.28	−1.76	−0.59
2	−1.69	2.59	1.28	2.19	0.73
3	−0.62	1.46	−0.33	0.52	0.17
4	1.43	−0.54	0.24	1.12	0.37
5	0.14	−0.99	0.05	−0.79	−0.26
6	−0.27	−0.69	−0.45	−1.42	−0.47
7	0.63	−0.29	−0.35	−0.01	0.00
8	−0.06	−0.72	−0.39	−1.17	−0.39
9	−0.37	−0.61	0.41	−0.57	−0.19
10	0.41	−0.27	1.10	1.24	0.41
11	0.52	−0.34	2.84	3.02	1.01
12	2.27	1.72	−0.95	3.04	1.01
13	−1.47	0.19	−0.48	−1.76	−0.59
14	0.47	0.82	−1.93	−0.64	−0.21
15	0.27	−0.76	0.15	−0.34	−0.11
16	−0.79	−0.44	−0.51	−1.75	−0.58
17	−0.21	−0.85	−0.43	−1.49	−0.50
18	−0.95	−0.49	−0.65	−2.08	−0.69
19	1.25	0.73	0.68	2.66	0.89

Source Authors' Calculation

(significant, $p < 0.1$). Besides, the lowest marginal impact has been identified in the case of the indicator total Scheduled Tribe population. 1 unit increase of ST population increases 7% of the predicted variable (not significant, $p > 0.1$). Figures 42.27, 42.28, 42.29 and 42.30 represent the relationship between the dependent variables and regression standardised predicted values, spatial variation of the regression standardised predicted values, the relationship between the dependent variables and regression standardised residuals and spatial variation of the regression standardised residuals regarding the analysis in the study area. The prediction is that the highly vulnerable areas of Katwa Municipality are more or less the same as the zonation of the socio-economic vulnerability index of COVID-19 lockdown.

Respondents' Perception of the Impact of Lockdown

The respondents responded with their perception of the impact of the lockdown in Katwa Municipality and its surroundings. Based on the 5-point ratings of the Likert scale in the structured questionnaire, their responses on the degree of agreement

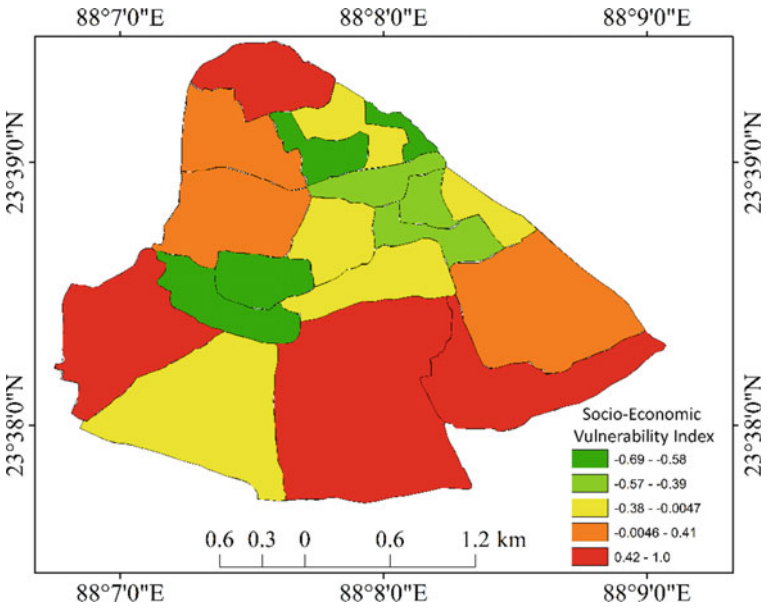


Fig. 42.21 Socio-economic vulnerability index in Katwa Municipality

Fig. 42.22 Respondents' categorisation based on economic conditions during lockdown: percentage of respondents according to income ranges

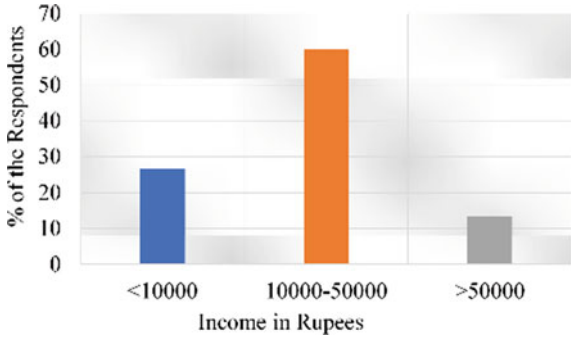
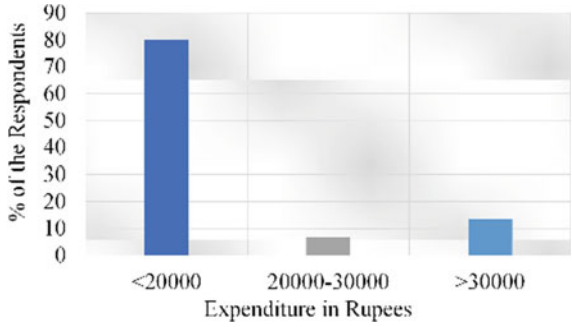


Fig. 42.23 Respondents' categorisation based on economic conditions during lockdown: percentage of respondents according to expenditure ranges



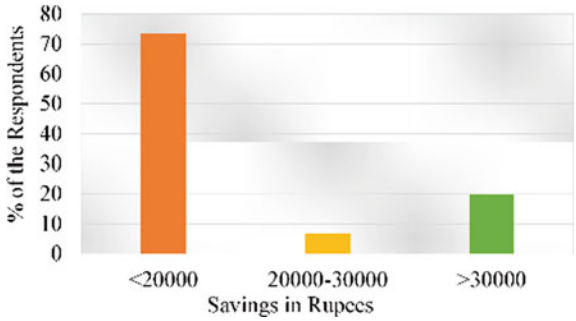


Fig. 42.24 Respondents' categorisation based on economic conditions during lockdown: percentage of respondents according to savings ranges

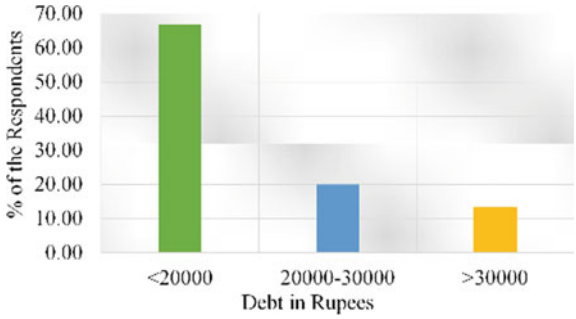


Fig. 42.25 Respondents' categorisation based on economic conditions during lockdown: percentage of respondents according to debt ranges

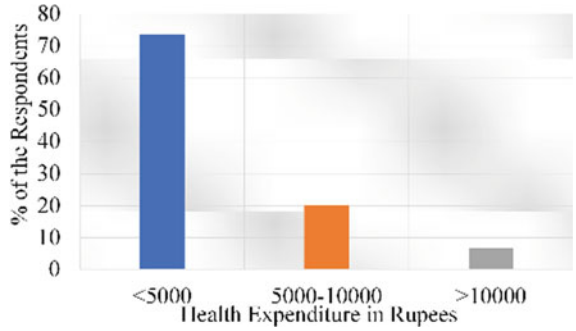


Fig. 42.26 Respondents' categorisation based on economic conditions during lockdown: percentage of respondents according to health expenditure ranges

have been recorded. Table 42.3 shows the respondents' perceptions of COVID-19 lockdown situations. In this analysis, 53.33% of respondents strongly agree with the statement that lockdown had the worst impact on families' economy. About 53.33% of the respondents strongly agree with the statement that they were conscious of the impact of lockdown on families' economy. Forty percent of the respondents agree with the statement that household expenditure was reduced during the lockdown. 33.33% of the respondents strongly disagree with the statement that they had wanted to engage in a new occupation after lockdown. About 33.33% of the respondents strongly disagree with the statement that they want to return to the previous

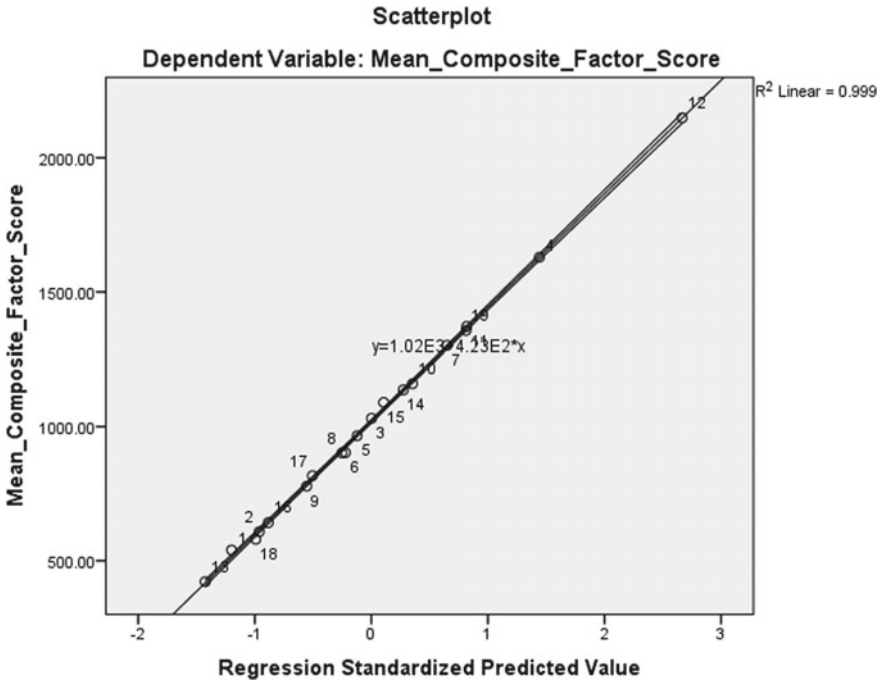


Fig. 42.27 Relationship between the dependent variable and ZPR

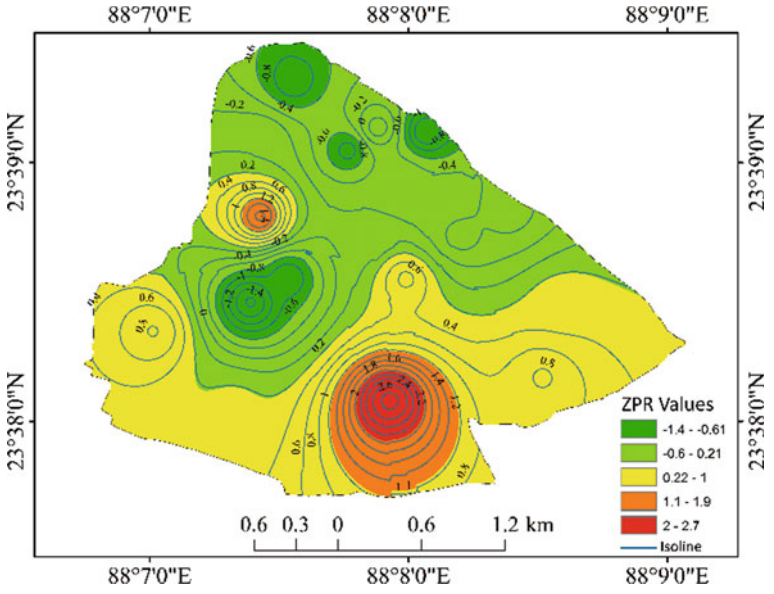


Fig. 42.28 Distribution of regression standardised predicted values

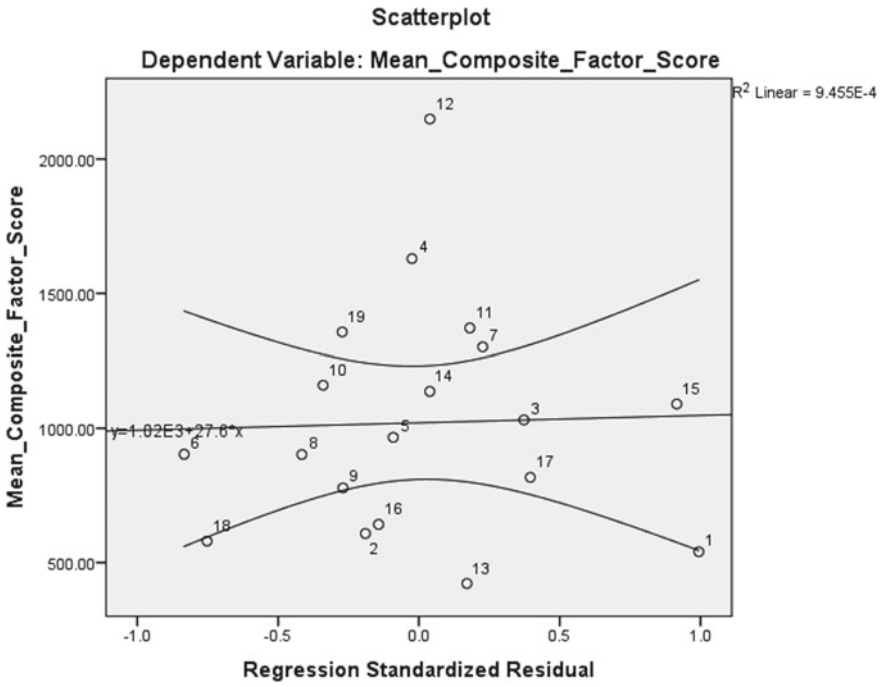


Fig. 42.29 Relationship between the dependent variable and ZRE

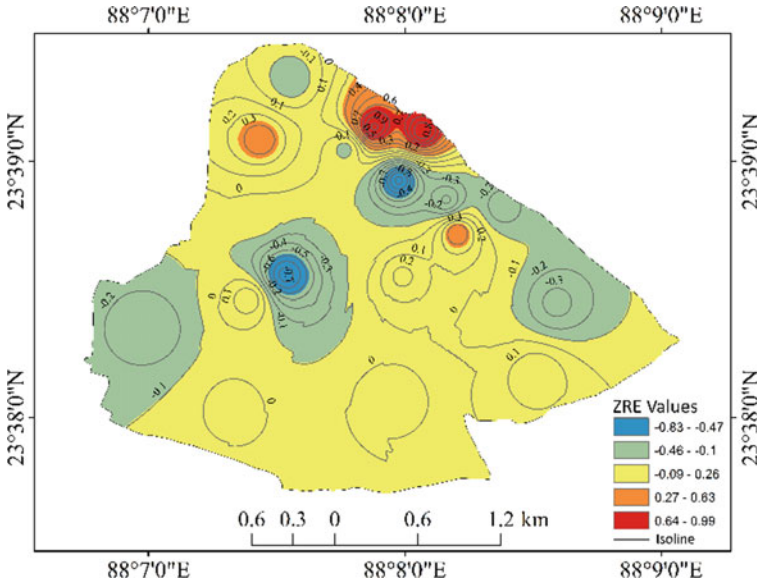


Fig. 42.30 Distribution of regression standardised residuals

occupation that they had lost. About 53.33% of the respondents strongly agree with the statement that lockdown had the worst impact on education. About 60% of the respondents strongly agree with the statement that lockdown had the worst impact on health.

Discussion and Policy Suggestions

Based on the analysis of data and respondents' perceptions, it is identified that the severity of COVID-19 and the influence of lockdown depended on the socio-economic conditions of the residents of Katwa Municipality area. A large number of residents were engaged in activities other than agriculture. They were engaged with either household industry sectors or the transport sector. Moreover, the residents were engaged with services and businesses. A mentionable number of residents are daily wage labour in Katwa Municipality. During the COVID-19 lockdown in 2020–2021, the migratory labours returned to Katwa, their hometown from the other states of India. They had either lost their jobs or their salary or wages had been reduced. A significant number of respondents among the total surveyed population disclosed that they don't want to return to their previous job. For the respondents who were still employed their income had been reduced during the lockdown. They also respond that they want to stay within the active job or occupation by reducing their expenditure on household consumption, repairing or leisure. During COVID-19, no significant amount of income had been increased for the labour class residents of Katwa Municipality. Persons engaged with services still could sustain their economic conditions, but the profits in business and agricultural activities were significantly reduced during the lockdown in 2020–2021. To sustain the economic conditions of their household debts or credits had been taken by the respondents with income below rupees 10,000. As the health expenditure increased, the total household expenditure also increased which created a disbalance of the income, expenditure, savings and debt pattern of the respondents in Katwa. The ward-wise scenarios of socio-economic vulnerability show that highly populated and settlement congested areas are more vulnerable than the others and vice versa. In this case, population increases due to returning of migratory labours, and the preliminary unconsciousness of common people in the market areas extensively influenced the socio-economic and health vulnerability of COVID-19 and associated lockdown. The wards of the municipal area were socio-economically vulnerable with varying degrees from very high to high, moderate and low to very low. The wards adjoined with the surrounding areas were more vulnerable than the wards situated in the central portion of this municipality. Besides, some of the wards with high SC and ST populations were more vulnerable. The respondents, socio-economically deprived and driven by poverty were more vulnerable than the others. There was no deviation of the total main cultivators, low deviation of main agricultural labourers and main household industry workers, and high deviation in the case of main other workers in this Municipality. In the case of the marginal workforce population, all four categories have low deviations. The main workers who had

Table 42.3 Respondents' perceptions of COVID 19 lockdown situations

Perception	No. of respondents	Percentage value
1. Lockdown had the worst impact on families' economies		
Strongly agree	40	53.33
Agree	15	20.00
Neutral/undecided	10	13.33
Disagree	10	13.33
Strongly disagree	0	0.00
2. Conscious about the impact of lockdown on families' economy		
Strongly agree	40	53.33
Agree	30	40.00
Neutral/undecided	0	0.00
Disagree	5	6.67
Strongly disagree	0	0.00
3. Household expenditure was reduced		
Strongly agree	0	0.00
Agree	30	40.00
Neutral/undecided	20	26.67
Disagree	15	20.00
Strongly disagree	10	13.33
4. Want to engage in a new occupation		
Strongly agree	15	20.00
Agree	0	0.00
Neutral/undecided	15	20.00
Disagree	20	26.67
Strongly disagree	25	33.33
5. Want to return to the previous occupation		
Strongly agree	5	6.67
Agree	15	20.00
Neutral/undecided	10	13.33
Disagree	20	26.67
Strongly disagree	25	33.33
6. Lockdown had the worst impact on education?		
Strongly agree	40	53.33
Agree	30	40.00
Neutral/undecided	0	0.00
Disagree	0	0.00
Strongly disagree	5	6.67

(continued)

Table 42.3 (continued)

Perception	No. of respondents	Percentage value
7. Lockdown had the worst impact on health		
Strongly agree	45	60.00
Agree	10	13.33
Neutral/undecided	0	0.00
Disagree	20	26.67
Strongly disagree	0	0.00

Source Authors' Calculation based on primary field survey, 2021

lost their occupation have highly deviated in number. The high and significant value of correlation between the mean composite factor scores of the socio-economic vulnerability index and its predictors shows that socio-economic conditions were strongly dependent on the vulnerability during the lockdown. The increase in the number of marginal other workers highly influenced the increase of vulnerability because of the addition of more people in socio-economic activities. The respondents of Katwa Municipality highly agreed that lockdown had the worst impact on the economy, education and health of the members of their family or household. They were also conscious of that and wanted to reduce household expenditure to sustain their financial conditions. To eradicate the socio-economic vulnerability, the study suggests some measures with personal experience and participants' observation during 2020–2021, such as,

1. Eradication of poverty with the generation of occupational facilities and scope of diversification of occupation of the marginalised people in Katwa Municipality.
2. Continuation of the previously commenced National Urban Health Mission and Universalised COVID vaccination scheme (at present booster dose).
3. Ward-wise distribution of population to decrease the risk and vulnerability of congestion of households as like the ward number 12 has been divided into two separate wards—ward number 12 and 20.
4. The education system needs to be started in a blended mode with proper access to all students and teachers with restrictions and maintenance of COVID protocols.
5. Socio-economic public activities in the city are also being started with prolonged COVID guidelines.
6. Public consciousness and active assistance with COVID warriors need to be preferred with helping underprivileged people by public and private initiatives in Katwa Municipality.

Conclusion

The present study has highlighted the socio-economic situation of the residents of Katwa Municipality during the COVID-19 lockdown period in 2020–2021 using the datasets of secondary and primary field surveys. The urban residents are mainly

dependent on multiple economic activities varying from agriculture to service. Most of the people were engaged in other activities than cultivators, agricultural labourers and household industry workers. In this context, the lockdown situation had heterogeneously impacted the respondents of Katwa city. As the data shows that a significant number of working populations lost their job during the lockdown, about 13.33% of workers had migrated from other states to Katwa and its surroundings during the lockdown. Income had been changed also in case of a significant number of the occupants. The composition of the selected indicators shows that wards number 2, 11, 12 and 19 were very highly vulnerable in the context of the socio-economic conditions of the residents of the Katwa Municipality. Most of the wards with congested households and high population show a very high to high and moderate socio-economic vulnerability during COVID-19 lockdown. The indicators—total literacy rate, main agricultural labourers, marginal cultivators, marginal agricultural labourers and marginal other workers—significantly predicted the extracted factor scores. Marginal other workers show the highest marginal effect on the predicted variable that increase of marginal other workers including daily labour and migratory labours had increased the vulnerability in case of their deprived socio-economic conditions during the lockdown situation. To sustain the overall socio-economic development of Katwa Municipality, integrated urban-regional developmental planning needs to be implemented.

Acknowledgements We acknowledge the students of Semester-V (General) of the Department of Geography of Katwa College, Katwa, Purba Bardhaman in West Bengal to actively participate in the primary survey of the present study.

Supplementary Materials

S1. Socio-economic Indicators

Socio-economic variables	Census code
Total number of household	No_HH
Total population	TOT_P
Total male population	TOT_M
Total female population	TOT_F
Child population (0–6 years)	P_06
Male child population (0–6 Years)	M_06
Female child population (0–6 Years)	F_06
Scheduled caste population	P_SC
Scheduled tribe population	P_ST

(continued)

(continued)

Socio-economic variables	Census code
Total literacy rate	P_LIT
Male literacy rate	M_LIT
Female literacy rate	F_LIT
Total workers	TOT_WORK_P
Total male workers	TOT_WORK_M
Total female workers	TOT_WORK_F
Main workers	MAINWORK_P
Main cultivators	MAIN_CL_P
Main agricultural labourers	MAIN_AL_P
Main household industry workers	MAIN_HH_P
Main other workers	MAIN_OT_P
Marginal workers	MARGWORK_P
Marginal cultivators	MARG_CL_P
Marginal agricultural labourers	MARG_AL_P
Marginal household industry workers	MARG_HH_P
Marginal other workers	MARG_OT_P
Non-workers	NON_WORK_P
Non-workers (male)	NON_WORK_M
Non-workers (female)	NON_WORK_F

Source Census of India (2011)

S2. Descriptive Statistics of the Selected Indicators

Indicators	Mean		Std. deviation
	Statistic	Std. error	Statistic
No_HH	1020.11	97.08	423.18
TOT_P	4295.53	407.45	1776.02
TOT_M	2176.32	209.08	911.36
TOT_F	2119.21	198.71	866.14
P_06	357.84	43.78	190.81
M_06	184.16	21.96	95.72
F_06	173.68	22.05	96.12
P_SC	641.53	139.72	609.01
P_ST	11.00	4.91	21.42

(continued)

(continued)

Indicators	Mean		Std. deviation
	Statistic	Std. error	Statistic
P_LIT	3430.89	304.62	1327.82
M_LIT	1797.84	163.19	711.32
F_LIT	1633.05	142.46	620.98
TOT_WORK_P	1511.47	153.19	667.76
TOT_WORK_M	1248.74	119.85	522.43
TOT_WORK_F	262.74	36.66	159.80
MAINWORK_P	1330.68	132.26	576.52
MAIN_CL_P	9.32	2.14	9.32
MAIN_AL_P	18.89	6.45	28.11
MAIN_HH_P	55.68	11.90	51.87
MAIN_OT_P	1246.79	122.52	534.07
MARGWORK_P	180.79	30.12	131.29
MARG_CL_P	5.47	1.12	4.88
MARG_AL_P	10.47	3.38	14.72
MARG_HH_P	23.63	8.07	35.17
MARG_OT_P	141.21	22.52	98.16
NON_WORK_P	2784.05	256.85	1119.59
NON_WORK_M	927.58	91.18	397.46
NON_WORK_F	1856.47	166.83	727.20
Valid N (listwise) = 19			

Source Authors' Calculation

S3. Correlation Matrix of the Selected Indicators

Correlations									
		No_HH	TOT_M	TOT_F	P_06	P_SC	P_ST	P_LIT	MAIN_CL_P
No_HH	Pearson correlation	1	0.980**	0.982**	0.803**	0.769**	0.504*	0.985**	0.295
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.028	0.000	0.221
TOT_M	Pearson correlation	0.980**	1	0.997**	0.900**	0.739**	0.534*	0.949**	0.359
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.019	0.000	0.131
TOT_F	Pearson correlation	0.982**	0.997**	1	0.890**	0.724**	0.498*	0.953**	0.329
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.030	0.000	0.168
P_06	Pearson correlation	0.803**	0.900**	0.890**	1	0.623**	0.493*	0.723**	0.462*
	Sig. (2-tailed)	0.000	0.000	0.000		0.004	0.032	0.000	0.047
P_SC	Pearson correlation	0.769**	0.739**	0.724**	0.623**	1	0.403	0.701**	0.466*
	Sig. (2-tailed)	0.000	0.000	0.000	0.004		0.087	0.001	0.044
P_ST	Pearson correlation	0.504*	0.534*	0.498*	0.493*	0.403	1	0.485*	0.365
	Sig. (2-tailed)	0.028	0.019	0.030	0.032	0.087		0.035	0.125
P_LIT	Pearson correlation	0.985**	0.949**	0.953**	0.723**	0.701**	0.485*	1	0.203
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.001	0.035		0.404
MAIN_CL_P	Pearson correlation	0.295	0.359	0.329	0.462*	0.466*	0.365	0.203	1
	Sig. (2-tailed)	0.221	0.131	0.168	0.047	0.044	0.125	0.404	
MAIN_AL_P	Pearson correlation	0.629**	0.613**	0.589**	0.552*	0.804**	0.591**	0.548*	0.590**
	Sig. (2-tailed)	0.004	0.005	0.008	0.014	0.000	0.008	0.015	0.008
MAIN_HH_P	Pearson correlation	0.384	0.444	0.439	0.562*	0.445	-0.054	0.331	0.154
	Sig. (2-tailed)	0.105	0.057	0.060	0.012	0.056	0.825	0.166	0.529
MAIN_OT_P	Pearson correlation	0.981**	0.986**	0.991**	0.857**	0.678**	0.481*	0.964**	0.255

(continued)

(continued)

Correlations									
		No_HH	TOT_M	TOT_F	P_06	P_SC	P_ST	P_LIT	MAIN_CL_P
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.001	0.037	0.000	0.291
MARG_CL_P	Pearson correlation	0.538*	0.556*	0.581**	0.511*	0.420	0.084	0.506*	0.111
	Sig. (2-tailed)	0.018	0.013	0.009	0.025	0.074	0.733	0.027	0.650
MARG_AL_P	Pearson correlation	0.046	0.057	0.025	0.099	0.541*	0.109	-0.033	0.584**
	Sig. (2-tailed)	0.853	0.816	0.920	0.686	0.017	0.656	0.893	0.009
MARG_HH_P	Pearson correlation	0.261	0.278	0.243	0.260	0.502*	-0.067	0.256	0.240
	Sig. (2-tailed)	0.281	0.249	0.315	0.282	0.028	0.784	0.289	0.322
MARG_OT_P	Pearson correlation	0.748**	0.786**	0.773**	0.782**	0.858**	0.432	0.681**	0.422
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.064	0.001	0.072

Correlations								
		MAIN_AL_P	MAIN_HH_P	MAIN_OT_P	MARG_CL_P	MARG_AL_P	MARG_HH_P	MARG_OT_P
No_HH	Pearson correlation	0.629**	0.384	0.981**	0.538*	0.046	0.261	0.748**
	Sig. (2-tailed)	0.004	0.105	0.000	0.018	0.853	0.281	0.000
TOT_M	Pearson correlation	0.613**	0.444	0.986**	0.556*	0.057	0.278	0.786**
	Sig. (2-tailed)	0.005	0.057	0.000	0.013	0.816	0.249	0.000
TOT_F	Pearson correlation	0.589**	0.439	0.991**	0.581**	0.025	0.243	0.773**
	Sig. (2-tailed)	0.008	0.060	0.000	0.009	0.920	0.315	0.000
P_06	Pearson correlation	0.552*	0.562*	0.857**	0.511*	0.099	0.260	0.782**
	Sig. (2-tailed)	0.014	0.012	0.000	0.025	0.686	0.282	0.000
P_SC	Pearson correlation	0.804**	0.445	0.678**	0.420	0.541*	0.502*	0.858**
	Sig. (2-tailed)	0.000	0.056	0.001	0.074	0.017	0.028	0.000
P_ST	Pearson correlation	0.591**	-0.054	0.481*	0.084	0.109	-0.067	0.432
	Sig. (2-tailed)	0.008	0.825	0.037	0.733	0.656	0.784	0.064
P_LIT	Pearson correlation	0.548*	0.331	0.964**	0.506*	-0.033	0.256	0.681**
	Sig. (2-tailed)	0.015	0.166	0.000	0.027	0.893	0.289	0.001
MAIN_CL_P	Pearson correlation	0.590**	0.154	0.255	0.111	0.584**	0.240	0.422
	Sig. (2-tailed)	0.008	0.529	0.291	0.650	0.009	0.322	0.072
MAIN_AL_P	Pearson correlation	1	0.215	0.573*	0.104	0.506*	0.156	0.576**
	Sig. (2-tailed)		0.376	0.010	0.670	0.027	0.524	0.010
MAIN_HH_P	Pearson correlation	0.215	1	0.411	0.237	-0.069	0.515*	0.441
	Sig. (2-tailed)	0.376		0.081	0.329	0.780	0.024	0.059
MAIN_OT_P	Pearson correlation	0.573*	0.411	1	0.532*	-0.032	0.212	0.712**

(continued)

(continued)

Correlations								
		MAIN_AL_P	MAIN_HH_P	MAIN_OT_P	MARG_CL_P	MARG_AL_P	MARG_HH_P	MARG_OT_P
	Sig. (2-tailed)	0.010	0.081		0.019	0.897	0.383	0.001
MARG_CL_P	Pearson correlation	0.104	0.237	0.532*	1	-0.006	0.011	0.523*
	Sig. (2-tailed)	0.670	0.329	0.019		0.979	0.964	0.022
MARG_AL_P	Pearson correlation	0.506*	-0.069	-0.032	-0.006	1	0.412	0.453
	Sig. (2-tailed)	0.027	0.780	0.897	0.979		0.080	0.052
MARG_HH_P	Pearson correlation	0.156	0.515*	0.212	0.011	0.412	1	0.563*
	Sig. (2-tailed)	0.524	0.024	0.383	0.964	0.080		0.012
MARG_OT_P	Pearson correlation	0.576**	0.441	0.712**	0.523*	0.453	0.563*	1
	Sig. (2-tailed)	0.010	0.059	0.001	0.022	0.052	0.012	

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)
Source Authors' Calculation

S4. Regression Coefficients

Coefficients[a]							
Model		Unstandardised coefficients		*t*	Sig.	95.0% confidence interval for B	
		B	Std. error			Lower bound	Upper bound
1	(Constant)	1456.57	602.45	2.42	0.07	−216.10	3129.25
	No_HH	−0.09	0.36	−0.25	0.81	−1.08	0.90
	TOT_M	0.12	0.24	0.52	0.63	−0.54	0.79
	TOT_F	−0.28	0.58	−0.48	0.66	−1.89	1.34
	P_SC	2.83	1.64	1.73	0.16	−1.71	7.37
	P_ST	0.07	0.10	0.70	0.52	−0.21	0.35
	P_LIT	−8.06	3.67	−2.19	0.09*	−18.25	2.14
	MAIN_CL_P	−2.89	1.82	−1.59	0.19	−7.93	2.16
	MAIN_AL_P	−3.52	1.54	−2.28	0.09*	−7.80	0.77
	MAIN_HH_P	0.16	0.24	0.67	0.54	−0.51	0.84
	MAIN_OT_P	−6.93	3.44	−2.02	0.11	−16.48	2.62
	MARG_CL_P	−11.72	4.65	−2.52	0.07*	−24.62	1.19
	MARG_AL_P	−5.95	2.41	−2.47	0.07*	−12.63	0.73
	MARG_HH_P	−1.79	0.93	−1.92	0.13	−4.36	0.79
	MARG_OT_P	1412.40	582.76	2.42	0.07*	−205.60	3030.40

[a]Dependent variable: Mean_Composite_Factor_Score
R square: 0.999
$F > 0.0001$
Durbin–Watson Statistic: 2.013
*$P < 0.1$

Excluded variables[a]								
Model		Beta In	*t*	Sig.	Partial correlation	Collinearity statistics		
						Tolerance	VIF	Minimum tolerance
1	P_06	−3.703[b]	−3099.913	0.000	−1.000	6.896E−5	14,500.416	2.270E−6

[a]Dependent variable: Mean_Composite_Factor_Score
[b]Predictors in the model: (Constant), MARG_OT_P, P_SC, MAIN_OT_P, MARG_CL_P, P_LIT, MAIN_CL_P, MAIN_AL_P, TOT_F, P_ST, MARG_AL_P, MARG_HH_P, MAIN_HH_P, TOT_M, No_HH
Source Authors' Calculation

References

Allain-Dupré D, Chatry I, Michalun V, Moisio A (2020) The territorial impact of COVID-19: managing the crisis across levels of government. In: OECD Policy Responses to Coronavirus (COVID-19), vol 10, pp 1–94. 1620846020-909698535

Aneja R, Ahuja V (2021) An assessment of socioeconomic impact of COVID-19 pandemic in India. J Public Aff 21(2):1–7. https://doi.org/10.1002/pa.2266

Bhattacharya M, Banerjee P (2021) COVID-19: indices of economic and health vulnerability for the Indian states. Soc Sci Humanities Open 4(1):1–6. https://doi.org/10.1016/j.ssaho.2021.100157

Carlin JB, Doyle LW (2000) 3: basic concepts of statistical reasoning: standard errors and confidence intervals. J Paediatr Child Health 36(5):502–505. https://doi.org/10.1046/j.1440-1754.2000.00588.x

Census of India (2001) District Census Handbook Barddhaman, Village and Town Wise Primary Census Abstract (PCA). Directorate of Census Operations, West Bengal, Series-20, Part-A and B

Census of India (2011) District Census Handbook Barddhaman, Village and Town Wise Primary Census Abstract (PCA). Directorate of Census Operations, West Bengal, Series-20, Part XII-B, 1-464

Chaudhary M, Sodani PR, Das S (2020) Effect of COVID-19 on economy in India: some reflections for policy and programme. J Health Manag 22(2):169–180. https://doi.org/10.1177/0972063420935541

Choudhury T, Souman Samanta PKP, Maiti A (2022) Impact of COVID-19 pandemic on households in West Bengal: a study in Hooghly District. Sch J Arts Humanit Soc Sci 1:24–31. https://doi.org/10.36347/sjahss.2022.v10i01.004

Fisher RA (1925) Theory of statistical estimation. Proc Camb Philos Soc 22(5):700–725. https://doi.org/10.1017/S0305004100009580

Ghosh S (2013) Regional disparities of slums, 2013—an overview with special emphasis to Kolkata. Int J Humanit Soc Sci Invention 2(3):48–54

Gupta A, Zhu H, Doan MK, Michuda A, Majumder B (2021) Economic impacts of the COVID-19 lockdown in a remittance-dependent region. Am J Agr Econ 103(2):466–485. https://doi.org/10.1111/ajae.12178

Gururaja BL, Ranjitha N (2022) Socio-economic impact of COVID-19 on the informal sector in India. Contemp Soc Sci 17(2):173–190. https://doi.org/10.1080/21582041.2021.1975809

Haque MN, Ansar SB, Biswas G, Islam MR, Al Mamun A (2020) The impact of COVID-19 on socio economic condition of city people: lessons from the selected KCC area. J Eng Sci 11(2):117–126. https://doi.org/10.3329/jes.v11i2.50903

Jesline J, Romate J, Rajkumar E, George AJ (2021) The plight of migrants during COVID-19 and the impact of circular migration in India: a systematic review. Humanit Soc Sci Commun 8(1):1–12. https://doi.org/10.1057/s41599-021-00915-6

Khan M, Kabir KH, Hasan K, Sultana R, Hoque F, Imran SA, Karmokar S (2022) Households' socioeconomic vulnerability assessment due to COVID-19 outbreak: a web-based survey in Bangladesh. Electron J Gener Med 19(3):1–12. https://doi.org/10.29333/ejgm/11797

Konar A, Banerjee T, Roy A (2020) Detailed study of Covid-19 outbreak in India and West Bengal. Int J Multidisc 05(05):39–49. https://doi.org/10.31305/rrijm.2020.v05.i05.010

Lahiri S, Sinha M (2021) A study of the socio-economic implications of the COVID-19 pandemic. Australas Acc Bus Financ J 15(1):51–69. https://doi.org/10.14453/aabfj.v15i1.5

Lancet (2020) India under COVID-19 lockdown. Lancet (London, England) 395(10233):1315. https://doi.org/10.1016/S0140-6736(20)30938-7

Leeper TJ (2017) Interpreting regression results using average marginal effects with R's margins. In: The comprehensive R archive network. Reference Manual, pp 1–31. Retrieved from https://cloud.r-project.org/web/packages/margins/vignettes/TechnicalDetails.pdf

Li Z, Wu J, Cui X, Mi Z, Peng L (2022) Assessment and influencing factors analysis of economic system vulnerability of the Belt and Road Initiative countries. Plos One 17(1):1–17. https://doi.org/10.1371/journal.pone.0262611

Likert R (1932) A technique for the measurement of attitudes. Arch Psychol

Martin A, Markhvida M, Hallegatte S, Walsh B (2020) Socio-economic impacts of COVID-19 on household consumption and poverty. Econ Disasters Clim Change 4(3):453–479. https://doi.org/10.1007/s41885-020-00070-3

Mishra SV, Gayen A, Haque SM (2020) COVID-19 and urban vulnerability in India. Habitat Int 103:1–11. https://doi.org/10.1016/j.habitatint.2020.102230

Mondal BK, Sahoo S, Paria P, Chakraborty S, Alamri AM (2021) Multi-sectoral impact assessment during the 1st wave of COVID-19 pandemic in West Bengal (India) for sustainable planning and management. Arab J Geosci 14(23):1–26. https://doi.org/10.1007/s12517-021-08836-z

Nath B, Majumder S, Sen J, Rahman MM (2021) Risk analysis of COVID-19 infections in Kolkata Metropolitan city: a GIS-based study and policy implications. GeoHealth 5(4):1–17. https://doi.org/10.1029/2020GH000368

Nicola M, Alsafi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C et al (2020) The socio-economic implications of the coronavirus pandemic (COVID-19): a review. Int J Surg 78:185–193. https://doi.org/10.1016/j.ijsu.2020.04.018

Onyeaka H, Anumudu CK, Al-Sharify ZT, Egele-Godswill E, Mbaegbu P (2021) COVID-19 pandemic: a review of the global lockdown and its far-reaching effects. Sci Prog 104(2):1–18. https://doi.org/10.1177/00368504211019854

Pathak PK, Singh Y, Mahapatro SR, Tripathi N, Jee J (2020) Assessing socioeconomic vulnerabilities related to COVID-19 risk in India: a state-level analysis. Disaster Med Public Health Preparedness 1–14. https://doi.org/10.1017/dmp.2020.348

Pearson K (1896) Mathematical contributions to the theory of evolution. III. Regression, heredity and panmixia. Philos Trans R Soc Lond 187:253–318. https://doi.org/10.1098/rsta.1896.0007

Pearson K (1901) On lines and planes of closest fit to system of points in space. Phil Mag 6(2):559–572. https://doi.org/10.1080/14786440109462720

Rasul G, Nepal AK, Hussain A, Maharjan A, Joshi S, Lama A et al (2021) Socio-economic implications of COVID-19 pandemic in South Asia: emerging risks and growing challenges. Frontiers Sociol 6:1–14. https://doi.org/10.3389/fsoc.2021.629693

Rawlings JO, Pantula SG, Dickey DA (eds) (1998) Applied regression analysis. Springer texts in statistics, p 25. https://doi.org/10.1007/b98890

Sahu N, Mishra MM (2021) Assessing the vulnerability index of COVID-19 pandemic in India. Geogr Environ Sustain 14(4):131–139. https://doi.org/10.24057/2071-9388-2021-059

Sarkar A, Chouhan P (2021) COVID-19: district level vulnerability assessment in India. Clin Epidemiol Global Health 9:204–215. https://doi.org/10.1016/j.cegh.2020.08.017

Singh SK, Aditi, Mondal S (2020) Socio-economic vulnerabilities to COVID-19 in India: swimming against the tide. Glob J Med Res 20(4):6–16

Student (1908) The probable error of a mean. Biometrika 6(1):1–25. https://doi.org/10.2307/2331554

Tamrakar V, Srivastava A, Saikia N, Parmar MC, Shukla SK, Shabnam S et al (2021) District level correlates of COVID-19 pandemic in India during March–October 2020. PloS One 16(9):1–17. https://doi.org/10.1371/journal.pone.0257533

United Nations (2020) COVID-19 in an urban world. United Nations, New York, NY, USA, pp 1–30

Uyanık GK, Güler N (2013) A study on multiple linear regression analysis. Procedia-Soc Behav Sci 106:234–240. https://doi.org/10.1016/j.sbspro.2013.12.027

Zhang X, Wang C, Li E, Xu C (2014) Assessment model of eco-environmental vulnerability based on improved entropy weight method. Sci World J 797814:1–7. https://doi.org/10.1155/2014/797814