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Development of gender sensitive vulnerability index for urban Indian slums

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By using large-scale secondary data collected from 69th round of NSSO, the present study has developed a gender sensitive vulnerability index for the population living in urban slums. A total 21 rational indicators are chosen which cover socio-economic status, demographic settlements, access to basic amenities and access to government health facilities. The study finding reveals that female- headed households have least access to basic amenities and living under extreme poverty and health sensitive settlements. The results also highlight that female-headed households are highly vulnerable in the economic backward states of Uttar Pradesh, Bihar, Assam and Madhya Pradesh. Hence, it is recommended that resources including health infrastructure, slum up-gradation should be mobilized by addressing demographical settlements of slums.

Keywords: Gender, Indicator approach, Livelihood vulnerability, Notified and non-notified slums

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The level of urbanisation has increased from 29% to 49%, while CO_2 emissions from fossil fuel consumptions increased by 500% during 1950-2005 at the Global level[1]. As urban areas are concentrated with large scale economic activities, households, industries and numerous infrastructures, therefore, these are the hotspots of energy consumption and prime sources for emission of GHGs. Urban are with 55% of total population consume 60-80% of total energy and produce almost 70% anthropogenic GHGs at the Global level. It is observed that the impact of this phenomenon is distributed differently among regions, ages, and income groups. In the urban areas, slums are placed where people live in intolerable conditions with minimum resources and have higher number of criminal activities. Open defecation, lack of basic amenities, inadequate access to water, sanitation and open sewage with hazardous long chronicle disease across all the aged households are common phenomena[2]. Poverty in slums is relatively higher compared to other parts of society with also having higher rate of social and economic discrimination rates. Slum dwellers have limited access to government health, credit and insurance and also having limited capacity to cope with financial and natural shocks. With higher unemployment rate and dependency ratio female- headed households are living bottom line of the society even in the slums.

There is disproportionate huge rural migration to urban informal sector i.e., slums. The proponents of modernization theory claim that slums are transitory phenomena. They claim that urban poverty is preferable to rural poverty as it is a revealed preference of migrants. Their per capita income is much higher than that of rural counterparts. As economic growth process trickles down in the urban areas, it gives way to formal housing, basic amenities and public utilities, and slums reach at the developed stage of the economy[3,4,5]. However, it is observed that life is very miserable in slums, less than subsistence level and is not temporary phenomena. In many developing countries including India, slums have been developed for generations and people live there with great deprivation[5].

As far as India is concerned, there has been continuous growth in slum population in urban areas the in recent decades. According to Population Census[7] total slum population was around 65 million out of 291 million urban population (nearly 22.4% of urban population) and with a decadal growth of 25% from its previous decade. Regionally, slums in urban areas are emerged due to growth in urbanization and industrialization, higher productivity in secondary and tertiary sector against primary sector, large scale migration from rural to urban areas as cities are the beacons of providing jobs. Consequently, most areas

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of cities are converting into slums characterized with shortage of proper houses, over crowdedness, unprecedented water crises, contamination of water, excessive air and noise pollution, traffic bottlenecks, problems of solid waste management, critical inadequacy in basic amenities and public utilities, with unhygienic condition[8]. It is observed that the deprivation/denial of basic services those are essential for human health in notified slums is lesser than those of the dwellers in the non-notified slums in India during 1993-2012[9].

The issue of gender inequality for women slum-dwellers cannot be ignored as the number of people migrating from rural to urban landscape in India trends upwards every year continuously, where the share of women is substantial[10]. These women are deprived of both adequate and safe basic amenities along with proper respect and dignity there are supposed to be entitled. Women slum dwellers face heavy burden of domestic work such as collection of water and woods from far away, cook and looking after their children along with working as part time elsewhere to assist their male counterparts in economic subsistence[11]. Further, they have no ownership of assets except for small dowry they brought into their marriage. They have no purchasing or decision-making power within the household other than small household purchases, which in turn impacts on their children's nutrition, survival and literacy. Gender inequality further leads to inefficient composition of labour, where positive benefits of female education and employment are not fully utilised and women's political participation are not represented. Further, women suffer at a larger extend in slums due to inadequate services and infrastructure, which enhances violence against them[12,13,14,15].

In the above, the present study aims at developing a gender sensitive vulnerability index for the population living in urban slums. With regional dimensions, study highlights the main influencing indicators that determine higher livelihood vulnerability among the female- headed households over their male counterparts.

Materials and methods

Data Source

The study has used large-scale data collected from 69th round of NSSO. Data set comprises of rich information on socioeconomic status, access to drinking, sanitation and other facilities of population living in urban slums. Awareness of seasonal diseases, their copping behaviour and living conditions during flooding are assessed by developing gender-sensitive vulnerability index.

Estimation Method

Rational indicators are chosen keeping in the view of their relevance of the study area and availability of the data. Since indicators are measured in different units, these, are subjected to normalisation in different units. Further, all are kept within the comparable range between zero (0) and one (1)[16,17].

Normalisation is done based on the functional relationship of among indicators with targeted index-livelihood vulnerability. If there is a positive relationship exist (increase in the target index with an increase in the value of the indicator) between indicators, then they are normalised by using the equation (1).

$$Y_{ij} = \frac{K_{ij} - Min(X_{ij})}{Max(X_{ij}) - Min(X_{ij})} \quad \ldots (1)$$

Where, Y_{ij} is the index for the i[th] indicator related with j[th] district, K_{ij} is the actual/observed value of i[th] indicator for the j[th] district, $Max\ (X_{ij})$ and $Min\ (X_{ij})$ is the maximum and minimum value of i[th] indicator among all the L (I=1…43) districts, respectively. If variables have negative functional relationship, then equation (2) isused

$$Y_{ij} = \frac{Max(X_{ij}) - K_{ij}}{Max(X_{ij}) - Min(X_{ijk})} \quad \ldots (2)$$

Weight

The assignment of appropriate weight for different components is an important issue in the construction of an index. Therefore weight is calculated using Iyenger and Sudharshan[18] methodology (eq. 3 & 4).

$$[\mathrm{W_i} = \frac{\mathrm{K}}{\sqrt{\mathrm{Var(Cid)}}}] \quad \ldots (3)$$

$$Where, [K = \frac{1}{\left\{\frac{1}{\sum_{i=1}^{n}\sqrt{Var(Cid)}}\right\}}] \quad \ldots (4)$$

Where, '$\mathrm{W_i}$' denotes the weight, $\mathrm{Var\ (Cid)}$ is variance of Y_{ij}. Weight is multiply in the index value calculated in equation 1 or 2 as follows.

$$Z_j = \frac{\sum_i^k Y_{ij} * W_i}{\sum_i^k W_i} \quad \ldots (5)$$

Z_j is the index score for the j[th] district; W_i is the weight corresponding to i[th] indicator; k is the total number of indicators; and $\sum_i^k W_i$ is the summation of weights. Finally, district level livelihood vulnerability indices for male and female- headed households were calculated. The quintile estimation also was used for quantification of livelihood vulnerability. Therefore, districts were divided into three categories, viz., 0 to 33[rd] percentile (low), values above 66[th] percentile were classified as High and the remaining districts were classified as medium.

Livelihood vulnerability index is constructed using socio-economic characteristics of the slum households, viz., (i) ownership of slum, (ii) surrounding area of slum, (iii) location of slum, (iv) physical location of slum, (v) water-logging areas in slums, (vi) water-logged approach road, (vii) access of electricity, (viii) structure of houses, (ix) nature of road in the slum premises, (x) nature of approach road in the slum premises, (xi) distance from the motorable road, (xii) source of drinking water, (xiii) latrine facility, (xiv) sewerage system, (xv) drainage system, (xvi) garbage collection, (xvii) frequency of garbage collection, (xviii) distance from nearest government primary school, (xix) distance from nearest government hospital, (xx) slum households having membership of association, and (xxi) households benefitted from JNNURM. Moreover, STATA statistical software version 13 and QGIS version 3.6.2 are used to analyse the data.

Results and discussion

Descriptive Statistics

Descriptive statistics of slum dwellers reveal that male-headed households are relatively living in better conditions than that of their female headed counterparts. About 30.75% of male-headed households are living in all seasonal houses, while only 16.43% of female-headed households are living in all seasonal houses. Differential statistics are also reported in the access of safe drinking water latrine and bathroom. About 42.24% of male-headed households having access to safe drinking water, while only 38.24% of female-headed households having access to safe drinking water. In the urban slums, access to latrine has major social implications for female-headed households. Table 1 shows that only 22.25% of female-headed households having access to latrine within premises. Micro environment such as assess of sewage, drainage and garbage systems have not only provide health security but also reduce the health expenditure. Results reveal that slum households are living in the deteriorating conditions with minimum health security. More than half of the female-headed households don't have access to all seasonal roads, while nearly 75% of population belonging to backward social groups do not have same facility. Difference in the income also has been reported between male and female- headed households, i.e., 9826.75 & 8454.82.

Extent of Livelihood Vulnerability

Large-scale inter districts variations is identified in terms of livelihood vulnerability of households living in urban India (Table 2). Based on the district

Table 1 — Socioeconomic statistics of male and female-headed households

Characteristics	Male-headed households	Female-headed households
Access to All seasonal house (%)	30.75	16.43
Households having access to Safe drinking water (%)	42.54	38.24
Households having latrine facility (%)	29.24	22.25
Underground sewage system (%)	8.24	4.25
Households having drainage system (%)	7.54	5.23
Households having water logging problems during rainy season (%)	83.24	90.65
Households having garbage disposal system (%)	9.25	7.58
Access to all season road (%)	45.65	34.25
Literacy rate (%)	59.24	45.24
Backward (SC/ST) population (%)	65.42	75.25
Age of household	39.54	35.24
Mean household Income (INR)	9826.75	8454.82
Households size	5.2	4.5

Source: Authors estimation, 2020

Table 2 — District wise extent of livelihood vulnerability in India

Ranges	Male-HHs Vulnerability	Female-HHs Vulnerability	Total (Male+ Female)
Low	164 (34.02)	90 (18.67)	169 (35.06)
Medium	158 (32.78)	112 (23.24)	156 (32.37)
High	160 (33.20)	280 (58.09)	157 (32.57)
Total	482 (100.00)	482 (100.00)	482 (100.00)

Source: Authors estimation, 2020. Note: 0 to 33rd percentile is Low), 34th to 66th percentile is classified as Medium, whereas values above 66th percentile were classified as High.

level estimation, low level of livelihood vulnerability is percolated to the extreme position in 164 districts in many states, viz., Andaman and Nicobar, Meghalaya, Mizoram, Orissa, Punjab, Sikkim, Tripura & Pondicherry (2 districts), Andhra Pradesh & Arunachal Pradesh (5 districts), Assam & Maharashtra (7 districts), Bihar (16 districts), Goa(1 district), Gujarat (7 districts), Haryana, Uttaranchal & Himachal Pradesh (4 districts), Jammu & Kashmir (9 districts), Karnataka & Rajasthan (8 districts), Kerala (6 districts), Madhya Pradesh (18 districts), Manipur (8 districts), Nagaland (3 districts), Tamil Nadu (10 districts), Uttar Pradesh (16 districts) and West Bengal (6 districts). It is further reflected that nearly 12% of slum households do not have any kind of residential proof at all India level, which is highest in Assam (37.7%) followed by Mizoram (32%), Maharashtra and Andhra Pradesh (35%).

Further, number of districts with medium ranges of livelihood vulnerability is reported in 158 districts across all states, viz., Andhra Pradesh (7 districts), Arunachal Pradesh, Karnataka & West Bengal (3 districts), Assam (14 districts), Bihar (16 districts), Gujarat, Jammu & Kashmir, Nagaland (4 districts), Haryana (8 districts), Himachal Pradesh, Punjab (6 districts), Madhya Pradesh (13 districts), Maharashtra (9 districts), Meghalaya, Uttaranchal (2 districts), Orissa, Tamil Nadu (5 districts), Rajasthan (11 districts) and Uttar Pradesh (24 districts).

Furthermore, number of districts with high ranges of livelihood vulnerability reported in 160 (34%) districts across all states, viz., Andhra Pradesh (11 districts), Arunachal Pradesh, Assam & Uttaranchal (3 districts), Bihar, Karnataka, Rajasthan (10 districts), Chandigarh, Dadar and Nagar Haveli, Daman, Delhi, Manipur, Meghalaya, Mizoram, Pondicherry & Goa (1 district), Gujarat (9 districts), Haryana, Jammu & Kashmir (4 districts), Himachal Pradesh, Sikkim (2 districts), Kerala (7 districts), Madhya Pradesh (15 districts), Maharashtra, Uttar Pradesh (14 districts), Orissa, Tamil Nadu (6 districts), Punjab (5 districts) and West Bengal (8 districts).

The district level data on livelihood vulnerability clearly reflects that there is proliferation of vulnerability at district level vis-a-vis country level. Further, the extent of vulnerability varies across slums with the district or with a particular city. For instance, 76% of male dwellers living in notified slums have better accommodation facility, whereas the corresponding figure is only 58% for female dweller of non-notified slums at all India level.

Livelihood Vulnerability in Slum Households: A Gender Perspective

The constructed livelihood vulnerability index reveals that the districts pertaining in low and medium latitudes are highly vulnerable. On the other hand, districts pertaining in high latitude are least vulnerable. Gender based analysis provides the extent of vulnerability in the male and female-headed households. Majority of the female-headed households are placed in moderately to highly vulnerable group, which is much higher compare to the male-headed households. It is observed that out of 21 indicators, 7 indicators are most influencing factors for higher livelihood vulnerability, viz., slum located in fringe area, unserviceable *katcha* house, *katcha* roads in the slum premises, *katcha* approach road, untreated water for drinking, no facility of garbage collection, and distance of more than 5 km to the government hospital. Further, female-headed households livelihood status revealed that sanitation, drinking water facility, garbage collection, drainage, sewerage system, location of slums and structure of house were main influencing indicators for persistence of higher level livelihood vulnerability. Therefore, extent of livelihood vulnerability among the male and female headed households reveals that female-headed households are highly vulnerable and have least livelihood security at district level as well as country level (Fig. 1).

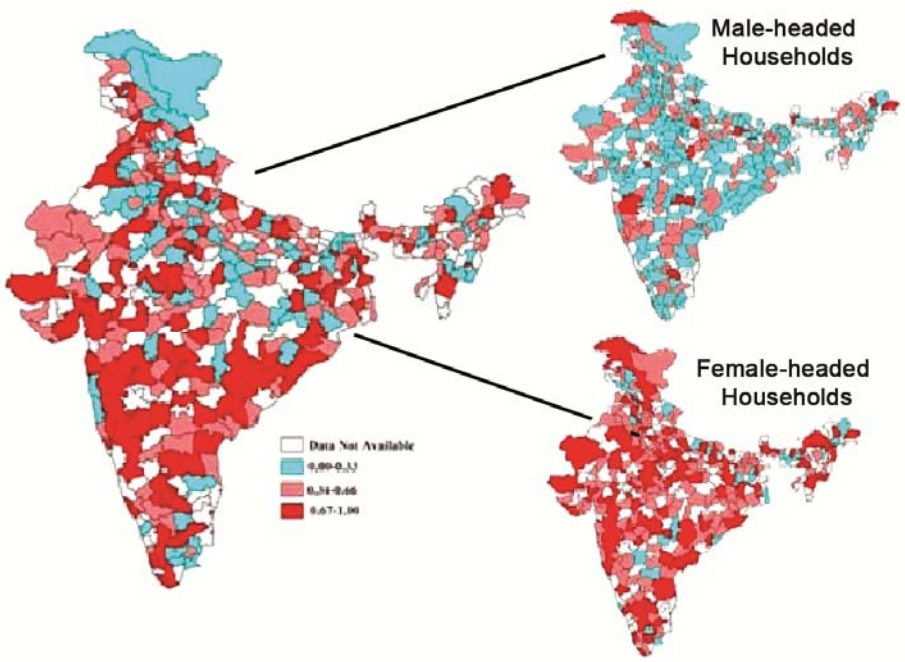

Fig. 1 — Gender wise Livelihood Vulnerablity Status

Conclusion and Policy Recommendations

Though, India's planning process has made concerted efforts in addressing various social and economic issues, yet regional disparity continue to persist as a barrier in the sustainable development path. The study results highlight the vulnerability of female-headed households in terms of access to basic amenities and micro environment. Under sanitation facility, majority of the slum dwellers do not have bathroom facility due to lack of proper house and subsequently water supply and electricity connection, especially the conditions of dwellers in non-notified slums is much heartbroken. Further, taking bath on payment basis regularly becomes economically non-viable by all members of a slum household. So far as latrine facilities is concerned, nearly half of the female-headed slums dwellers do defecate openly primarily due to two reasons. First, most of the dwellers do not have latrine facility at their houses, and second, the reasons for not using the existing latrines by the slum dwellers predominantly due to latrines are improperly connected or not connected with the sewer lines. Though few public latrines are available nearby the slum areas, however the accessibility to these public latrines is also quite expensive and also people need to stand on the row for long period. Therefore, open defecation is a serious problem in the slums especially in non-notified areas as it multiply to spread various diseases.

Under micro environmental facilities, the availability underground sewage system for male slums dwellers is wider compared to that of their counterparts in the slum regions. Further, it is observed that most of slum female-headed households are not connected with drainage system and those households have the system to release the waste water, it is nothing but the open drainage, which is much vulnerable to people. Further, the corresponding situation for female-headed households is much susceptible. Furthermore, among connected drainage system, open pucca system is wide spread, whereas covered pucca and underground system is abysmally few. The results provide useful guidelines for identifying region-specific vulnerable hotspots that need policy intervention in strengthening and securing livelihoods of slum dwellers.

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