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Measuring Spatial Inequality In Livability Index Using Microdata In Pakistan

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Abstract

The focus of this study is to measure livability index for detection of spatial gap in Pakistan. Livability index is a multidimensional index which covers seven major elements: housing, health, engagement, water & sanitation, energy, opportunities, and neighborhood of a livable society. All these perspectives are empirically estimated and incorporated in defining and measuring a combined livability index. Standard methodology of Principal Component Analysis (PCA) is used for estimating weighted sub-indices of livability index. The study utilizes PSLM 2014-15 which focused on almost all the dimensions of livability. The findings of the study shows a significance difference in rural-urban livability. The study concludes that location is a significant determinant of livability, especial Sindh rural and Baluchistan rural are most vulnerable in livability. Moreover, spatial inequality among regions and districts is high in Sindh followed by Baluchistan. Big cities: Lahore, Rawalpindi, Gujranwala, Karachi, Faisalabad, Quetta, Peshawar, and others have relatively better livability than small cities by population. Findings of the research are highly important for policy maker to achieve inclusive and sustainable growth by considering the empirical fact of rural urban divide and large geographic disparities at district level in Pakistan.

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Highlights

- Creating and maintaining livability can lead to sustainable development.
- Livability is multidimensional concept which can be used for cities comparison to understand policy reforms for reducing spatial inequality.
- There is large rural-urban gap in livability index in Pakistan. This gap is high in districts with lower livability score.
- Districts located in Sindh and Baluchistan are observed vulnerable in livability Index.

Introduction

Development planners and policymakers are concerned with creating, improving, or maintaining livable cities. Livability invokes as a guiding principle for the investment and decision making that shape the urban social, economic, physical, and biological environment (Pacione, 2003). The notion of a livable city in the sense of fit to live in or inhabitable requires multiple elements, such as energy, shelter, water and food, health and public safety, waste management and assimilation, social engagement, education and entertainment, creativity, economic contributions, and more. In short, livability is judged through the lens of the needs and wants of those who do or may live in society (Ruth & Franklin, 2014). Globally, Chivot (2011) elaborated the link between livability, sustainability and economic development, Al-Thani et al. (2019) explored the situation of Doha's urban livability and Froud et al. (2018) estimated the foundational livability and inequality of wealth between European cities.

Pakistan is among those developing countries in which spatial inequalities between districts and particularly, rural-urban living inequalities persist high. These inequalities are mainly caused by unplanned development strategies which are more focused to big metro cities. Moreover, cities in Pakistan are also spreading without plan and are in an urgent need to combat the sprawl if they aim to remain competitive. Some of the negative effects of the sprawl include congestion, increased transportation costs, economic inefficiency, air pollution, and no walkability. These, in turn, impact the quality of life of the inhabitants of the city. Spatial disparities also highlight housing inequality, the bottom 20%, larger in population size, occupies only 6%, whereas, the top 20% of the income class occupies 58% of the total area. The lower income strata, which make up about 40% of the households, can afford only 5% of the existing housing stock. Moreover, 20 million households belong to rural areas with compare to only 13 million in urban, regional disparities among rural and urban also remain high in multidimensional perspectives (PES, 18).

The aim of this paper is to investigate the spatial inequalities in livability among cities (districts) in Pakistan. To complete the aim of the research, the study objectives to explore and measure the role/standing of each element of livability in urban and rural living units using micro

data at district level in Pakistan. The study holds important place to inform assessments or definitions of livability and potential policies to promote it at equal importance for all the districts of Pakistan and highlighted the need for considering rural regions in development agenda. Further study is organized into four sections, overview of exiting literature is listed in section 2, material and methods are given in section 3. Results of spatial analysis are presented using maps in section 4 and conclusion is given at the end of the document.

Literature Review

There are number of studies which have captured frequently using many indices to measure wellbeing of the households. Some important names can be seen frequently in literature which combined multiple indicators into a single index. For example, Noble et al. (2006) measured multiple deprivation index by combining deprivation in income, employment, education, and housing for small area micro data in UK. Fruad at al. (2018) estimated the inequalities in livability by incorporating financial wealth, property wealth, physical wealth and private pension wealth into a single index and described the spatial inequalities in living between different regions based on said indicators. Similarly, Owens (2009) prepared a report on human settlement using the concept of livability comparison between cities and took Vancouver, Canada as case study. The study elaborated the development indicators which can best suit for explaining the livability conditions at district level analysis.

Chivot (2011) measured quality of livability index for major cities of the globe using the dimensions ranging from environment, infrastructure, health and safety, socio-political and socio-economic indicators. Cynthia and Guadalupe (2016) measured the impact of urban growth on inequality and segregation using the concept of urban livability. They ranked the fast-growing urban cities by measuring livability index using seven sub indicators which are in line with multidimensional inequality indicators. Measurement of multidimensional inequality is an exigent exercise as many variables contribute in it.

Many other studies are also with similar style, but with different subject. For example, Macchia and Plagnol (2018) measured that impact of confidence in government institutions including police and military on life satisfaction. For measuring life satisfaction, they asked about the living situations and what quality of life individuals are enjoying (objective and subjective wellbeing). They found positive and significant relationship between subjective and objective wellbeing and confidence with institutions. Many social researchers have investigated Multidimensional Poverty Index (MPI) for different countries like, Batana (2008) in Sub-Saharan countries, Metha and Shah (2003) in India, Alkire and Santos (2010) in America. In case of Pakistan, the literature on measuring livability index is scarce, however, many authors have conducted studies on multi-perspective inequalities, poverty, and deprivation. The bulk of literature on poverty and inequality issues can provide importance of many indicators to be studied in case of Pakistan and measuring inequality in these indicators can be the source of policy making

(Sial et al., 2015). This study is a preliminary effort to test empirically the concept of spatial inequalities in livability index with special reference to Pakistan which is important for academia and policy institutions to join hands with research for making effective policy for reducing geographic gaps in livability.

Material and Methods

Formulation of Livability index

The study has followed, Owens (2009), Chivot (2011), Ruth and Franklin (2014), Froud et al. (2018), and Al-Thani et al. (2019) to develop and measure livability index with following notation.

$$\text{Livability Index} = \left(\frac{1}{7}\right)\text{Housing}^{h} + \left(\frac{1}{7}\right)\text{Health}^{h} + \left(\frac{1}{7}\right)\text{Engagement}^{h} + \left(\frac{1}{7}\right)\text{Water \& Sanitatin}^{h} + \left(\frac{1}{7}\right)\text{Energy}^{h} + \left(\frac{1}{7}\right)\text{Opportunities}^{h}\left(\frac{1}{7}\right)\text{Neighborhood}^{h} \quad h=1, 2, \ldots\ldots. K.$$

The value of livability index ranges from 0 to 1; 0 for worst livable condition and 1 for perfect livable condition. Since, data limitation play role in selecting among the suitable indicators for each element, by following the valid exiting evidence, each weighted index is estimated by incorporating most appropriate indicators mentioned in Table 1.

Table-1: Description of the Perspectives and Dimensions

Livability Dimension	Working Definition	Indicators	PSLM Sections
Housing	Situation of assets in use	Durable assets in possession by household (e.g. car, refrigerator, room cooler and others)	Section F
Health	Child health	1: Immunization 2: Diarrhea	Section I
Clean Drinking Water and sanitation	Access to clean drinking water and Sanitation facility within dwelling unit	1: Access & usage of clean drinking water 2: Toilet & sanitation facility in use	Section G
Engagement/Education	Amount of education	1: Reading and writing ability 2: Problem solving 3: Average years of schooling	Section E
Neighborhood	Distance for access to water, store, transport,	Time distance to reach clean drinking water,	Section G

	highs school and health clinic.	Store/market, public transport, high school, and clinic/hospital.	
Energy	Cooking and lighting	1: Access and use of gas for cooking 2: Access and use of electricity for lighting	Section G
Opportunities	Participation and Satisfaction with institutions	Opportunity to use and satisfaction with Basic health unit, Police Bank, School, Post, Road, public Bus and Drinking Water.	Section J

Weighting the items—Principal Component Analysis

When constructing a composite index with a set of variables, a decision must be made about the weights to assign to each indicator. Principal Components Analysis (PCA) was recommended as a method for determining weights for components of composite asset index by Filmer and Pritchett (2000). Guidelines for the use of PCA for asset indices were published by Vyas and Kumaranayake (2006).

PCA is a "data reduction" procedure. It involves replacing a set of correlated variables with a set of uncorrelated "principal components" which represent unobserved characteristics of the population. The principal components are linear combinations of the original variables; the weights are derived from the correlation matrix of the data or the covariance matrix if the data have been standardized prior to PCA. The first principal component explains the largest proportion of the total variance. If the first few principal components explain a substantial proportion of the total variance, they can be used to represent the original items, thus reducing the number of variables required in models (Bartholomew et al., 2002)

For constructing each index, the first principal component is taken to represent the household's status (Howe et al., 2008). The weights for each indicator from this first principal component are used to generate a household score. The weights are normalized to get indices scores range from 0-1 for better understanding (Bhan and Jana, 2015).

Measuring spatial inequality—Group Gini coefficient

The Gini coefficient is the most widely used measure of inequality. Based on the Lorenz curve, it measures the extent to which the distribution of a given variable deviates from the uniform distribution (a perfectly equal distribution). Works of Stewart (2008), Stewart et al. (2010) and others on horizontal inequality (between groups) offers arguably the most extensive consideration

of Gini coefficient along with coefficient of variation and Theil index as good measures to capture group dimensions in inequality. Since, we are interested in estimating spatial inequality at region level, so, we estimated group Gini as follows:

$$\text{Group GINI} = \frac{1}{2\underline{y}} \sum_{r}^{R} \sum_{s}^{S} P_r P_s |y_r - y_s|$$

Where, $\underline{y}$ is the mean of distribution, y_i is the region i and n is the number of regions. Where, y_r the share of households with livability index of r group and P_r is the share of population in r group among R groups. Possible values range between 0 and 1, with 0 mean a perfectly equal distribution and 1 a perfectly unequal.

The Data:

The study used micro data set of Pakistan Social and Living Standards Measurement Survey (PSLMS) 2014-15. It aims rapid assessment of program initiatives for poverty reduction with context to MDGs and helpful for SDG indicator monitoring. This micro data is collected by Pakistan Bureau of Statistical, Government of Pakistan. The data set covers 78,635 households (13965 urban & 64670 rural) covering 1210 urban and 4116 rural primary units from 114 districts. It covers multiple socio-economic indicators: household characteristics, education, health, institutional satisfaction, social satisfaction, and many others.

Results and Discussion:

Empirical findings of the study are explained in two steps. In the first step, decompositions of livability index is described by elaborating seven indices (values range from 0 to 1) of all the perspectives. Using the indicators mentioned in Table 1, exploratory PCA was applied and weighted indices are calculated. In the second step, accumulative index is estimated for rural and urban areas with equal weights. The spatial presentation of each dimension index values is described in Table 2 using at districts level data.

Table-2: Division Wise Descriptive Analysis of Each Dimension of Livability Index in Rural-Urban Region in Pakistan.

	Engagement (education index)		Housing (assets index)		Health index		Opportunities index		Energy index		Water & sanitation index		Neighborhood index	
District	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Abbottabad	0.46	0.52	0.48	0.67	0.80	0.79	0.53	0.67	0.62	0.99	0.81	0.94	0.81	0.98

Mardan	0.41	0.45	0.50	0.64	0.77	0.80	0.67	0.70	0.58	0.88	0.87	0.88	0.94	0.98
Peshawar	0.41	0.47	0.55	0.74	0.72	0.78	0.61	0.62	0.72	0.98	0.78	0.86	0.96	0.99
Rawalpindi	0.52	0.53	0.59	0.74	0.88	0.88	0.65	0.56	0.67	0.99	0.75	0.89	0.93	0.99
Faisalabad	0.45	0.51	0.46	0.63	0.73	0.75	0.65	0.60	0.63	0.93	0.88	0.75	0.97	0.99
Gujranwala	0.45	0.51	0.51	0.66	0.81	0.84	0.47	0.56	0.73	0.97	0.95	0.97	0.98	0.99
Lahore	0.47	0.52	0.54	0.68	0.89	0.92	0.55	0.56	0.78	0.97	0.92	0.99	0.98	0.99
Multan	0.41	0.50	0.34	0.62	0.71	0.78	0.57	0.59	0.59	0.96	0.66	0.89	0.92	0.98
Rajanpur	0.18	0.39	0.20	0.48	0.93	0.95	0.66	0.63	0.35	0.56	0.61	0.91	0.83	0.95
Rahim Yar Khan	0.38	0.46	0.29	0.53	0.61	0.66	0.59	0.60	0.47	0.83	0.78	0.86	0.87	0.96
Ghotki	0.37	0.44	0.25	0.44	0.51	0.55	0.55	0.60	0.52	0.84	0.59	0.54	0.86	0.96
Hyderabad	0.37	0.47	0.27	0.55	0.59	0.73	0.28	0.42	0.58	0.93	0.58	0.59	0.91	0.99
Thatta	0.31	0.47	0.12	0.46	0.67	0.93	0.29	0.53	0.28	0.99	0.31	0.75	0.88	0.93
Tharparkar	0.33	0.46	0.08	0.34	0.61	0.79	0.17	0.61	0.18	0.52	0.09	0.46	0.79	0.99
Karachi	0.44	0.51	0.44	0.60	0.84	0.90	0.39	0.45	0.89	0.99	0.68	0.94	0.94	0.98
Quetta	0.39	0.39	0.56	0.56	0.58	0.73	0.62	0.52	0.76	0.94	0.46	0.52	0.88	0.92
Sibbi	0.24	0.42	0.24	0.57	0.54	0.73	0.30	0.55	0.32	0.95	0.36	0.74	0.60	0.91
Dera Bugti	0.32	0.39	0.20	0.50	0.47	0.50	0.50	0.67	0.44	0.89	0.18	0.54	0.70	0.99
Lasbela	0.24	0.43	0.12	0.41	0.54	0.74	0.13	0.34	0.28	0.75	0.16	0.70	0.78	0.94
Islamabad	0.52	0.54	0.66	0.74	0.88	0.92	0.63	0.56	0.80	0.95	0.89	0.93	0.98	0.98

Source: Author's Calculation using PSLM 2014-15

Overall, Lahore and Islamabad were recoded better than other cities in all the livability perspectives, Tharparker, Lasbela, Thatta and Sibbi were found lower in livability index next as part of rural Sindh. Inequality between urban areas observed lower than inequality between rural and urban. If we disaggregate the analysis on provincial basis, Punjab is reasonable for living, KPK is on second, Sindh and Baluchistan are on third and fourth. Some of the districts from Sindh are worst for being livable. The findings of the study are in line with exiting evidence for other countries (Chivot, 2011; Ruth and Franklin, 2014 and Froud et al., 2018), although there is very limited literature that exists on empirical measurement of livability using micro data. Many have estimated livability of the cities using macro level indicators and found that there is severe inequality which exits between districts with persistent rural-urban gap.

In case of both, education index and health index, districts located in Punjab are relatively better accompanied with KPK. Particularly, Lahore, Gujranwala, Jehlam, Rawalpinidi and Faisalabad regions recorded higher education index. However; within Punjab, south location is slightly poorer in education as well as in health, particularly, Bahawalpur, Rajan Pur and others have lower values of both indices. Sindh and Balochistan are facing large vulnerability in education and health particularly in some districts, such as Tharparker, Kharan, Lasbela and Chagai.

Correlation among all the indices can be seen high in Figure 1. Three ways for inference can be seen in correlation plot: right area presents correlation values with their significance, left area describes the scatter plots of correlation with smooth fitted lines and diagonal graphs showing distribution of the indicators. Findings demonstrates that there is positive and significant correlation among all indicators, asset index and neighborhood have high correlation with other variables. Spatial location with one better indicator can have impact on other indicators too. The trend of livability is spread simultaneous in all the livability indicators. The results revealed that those areas that have higher education, health and income are also enjoying higher livability in neighborhood, opportunities, energy, and water.

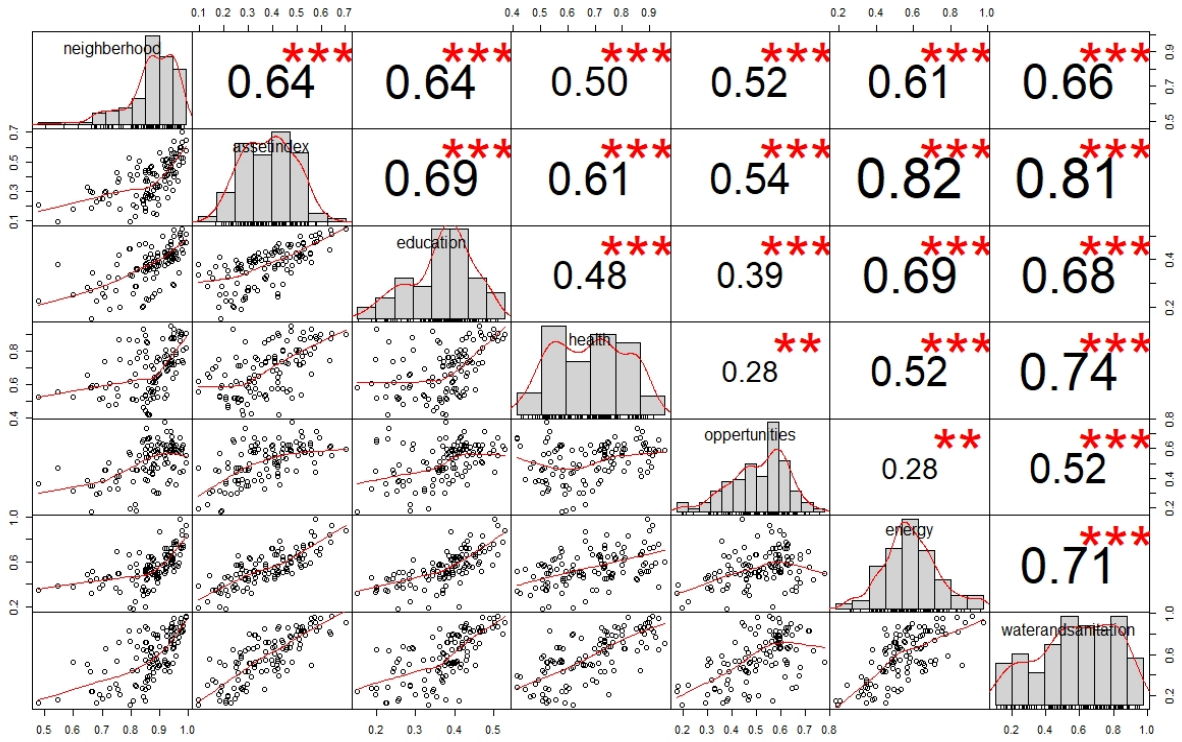

Figure 1: Correlation among indices of livability index in Pakistan, 2015. There is positive and significant correlation exist among all perspectives of livability index.
The distribution of each variable is shown on the diagonal.
On the bottom of the diagonal: the bivariate scatter plots with a fitted line are displayed.
On the top of the diagonal: the value of the correlation plus the significance level as stars.
Each significance level, p-values (0, 0.001, 0.01, 0.05, 0.1, 1) <=> symbols (“***”, “**”, “*”, “.”, " “)
Data source: PSLM 2015

While, discussing the spatial inequalities among cities of Pakistan, including urban and rural population, it is also important to check the within-rural and within-urban spatial gap. Figure 2 provides maps of within-group inequality for separate analysis of rural-rural urban sample. These results are important to target the specific rural and specific urban areas for improving livability. The results of estimated livability index (range from 0 to 1) indicate very interesting findings. Overall livable situations are better in urban then rural areas. District wise results provides more detailed view for comparing livability between districts and there can be seen large disparities among districts standing in both rural and urban livability index. Within-group inequality in rural areas seemed high than the within-urban inequality. Particularly, rural Sindh and rural Balochistan are highly deprived in livability conditions in comparison to Punjab and KPK. For measuring group inequality between rural-urban, the study estimated Group GINI of

livability index for each district. Large number of studies has estimated the horizontal inequalities among rural-urban gap by using the standard group GINI measure standardized by the work of Frances Stewart (2008). Figure 3 presents the results of spatial inequalities of livability index.

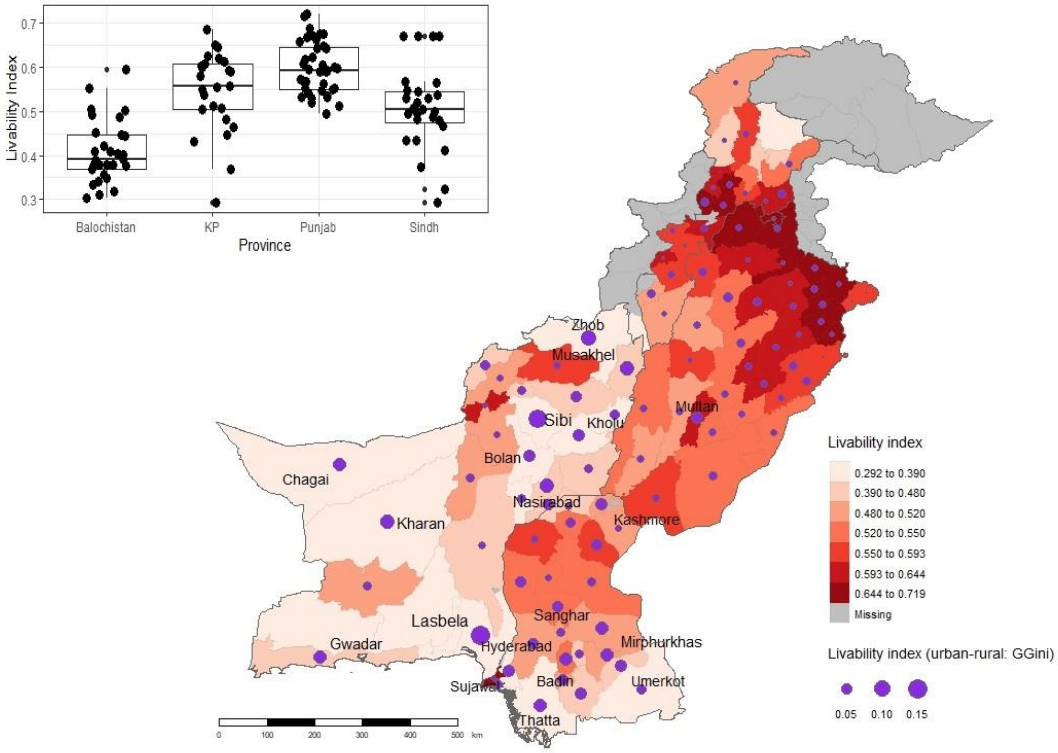

Figure-2: Spatial Inequality (Province, district wise urban-rural) in Livability Index in Pakistan, 2015.

It presents horizontal inequality[1] among rural urban regions in each district. The results indicate that those districts which have lower level of livability index are more unequal in rural-urban. Horizontal inequality in livability index in north Punjab is lower, however, it is high in Sindh and Baluchistan. There is inverse relationship between inequality and livability index. More developed regions also have lower rural urban divide and more underdeveloped regions have higher rural urban divide. Data Source: PSLM 2014-15

Discussion

The study provides six main insights. First, Pakistan is facing high spatial inequality in livability index among regions, provinces, and districts. Second, urban-rural inequality is high in districts that have lower livability index. Third, there is positive and significant correlation among sub-perspectives of livability, especially, durable housing assets and neighborhood has strong

[1] Horizontal Inequality is measured using Group GINI coefficient by following Stewart (2008).

relationship with all other perspectives. Fourth, Punjab, among other provinces, has high livability followed by Khaybar Pakhtunkhwa (KP), Sindh and Baluchistan respectively. Fifth, spatial inequality among regions and among districts is high in Sindh followed by Baluchistan. Sixth, big cities; Lahore, Rawalpindi, Gujranwala, Karachi, Faisalabad, Quetta, Peshawar, and others have relatively better livability than small cities by population.

Development economics researchers have major interest in measuring socio-economic wellbeing and its potential equality for across, ethnicity, class, gender, religion, and location. There are many studies who focused on multidimensional perspectives of wellbeing, but there is ample space for new researchers to explore in depth. There is scarce literature available on measuring livability at spatial locations and by their potential characteristics. This study aimed to fill the space and provide base for future researchers to provide inference on livability parameters to evaluate spatial disparities. The study is in line with sustainable development goal 10 for reducing inequalities and goal 11 for making sustainable cities. Since, this study is initial attempt to measure livability index using survey data, it is likely to have many lags and issues, which can be further investigated n social science researches to add improvements and strengthen the livability concept.

Conclusion

Developing sustainable cities is importance in development strategies. Sustainable Development Goals (SDGs) are focused to reducing poverty and inequality from most vulnerable segments by creating livable environment. Measuring livability at district level may take important place for policy authorities for viewing the situation of worst regions in livability and budget allocation may be followed by findings to enhance livability of vulnerable areas.

By utilizing micro data of Pakistan Social and living Standards Measurement Survey (PSLMS) 2014-15, the study estimated multi indicator livability index at district levels. The study concludes that there is large rural-urban gap in livability index and disparities exist in livable conditions among different regions of the Pakistan. Lahore, Islamabad, Gujrat, Peshawar, Karachi and Gujranwala are better districts to live in and districts of South Punjab and mostly from Sindh are among worst in livability index.

With rapid urbanization, the policy authorities focus mostly to urban areas and to some specific big cities. However; the study findings conclude that small districts located far from provincial capital are highly vulnerable and need to be pondered over for city development authorities to practice some major reforms. Urban-rural gap is alarming in districts with lower livability, which need special perusal for people who are facing worse livable conditions.

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