

Use of Urbanization Index Model by using Multi - Dimensional Aspects for Assessing Urbanization Level

Mani Megh¹, Dr.M.K.Kaushik²

¹Mani Megh PG Student DAVIET Jalandhar

²Dr.M.K.Kaushik Professor DAVIET Jalandhar

Abstract

There is need to understand the revise and new role of urban planning especially in context of inclusive planning and harmonious city development programmes. The information of urbanization levels has demonstrated the significance of urbanization for poverty elimination, financial improvement, and modernization. This study tries to assess the growing Urbanization index for different study regions of Jalandhar city, Punjab from nine indicator parameters selected from wide urbanization aspects: demographic aspects, Infrastructural improvement aspects, spatial aspects and economic development aspects. The Urbanization index calculation methodology proposed in this study was used to know the degree the urban city of the studied areas and for comparison of the urbanization levels of distinctive areas which helped to identify growth of different regions and also used to measure the impact of growing urbanization levels. The highly urbanized areas identified needs immediate attention and special consideration to secure these areas from the impacts on the prevailing run-off creating forms and also to discover practical means to significantly reduce the effects on catchment boundaries and on the drain water pathways affecting the Kala Sanghian Drain.

Keywords: Urbanization, Kala Sanghian drain, Urbanization parameters, Urbanization Index, Normalized Urbanization Index.

Abbreviations: UI -Urbanization Index, NUI - Normalized Urbanization Index, UN - United Nations, US - United States, URI - Urban-rural India, PUAS - Pre-urban Agricultural System, SSI - Survey Stratification Index, GIS - Geographical Information System, USGS - United States Geological Survey, QGIS - Quantum Global, Information System, IIR - Index of Relative Rurality.

1 Introduction

Urbanization is characterized as the increment in extent of individuals living in urban regions. Urbanization is also characterized by the joined together Countries as development of individuals from provincial to urban ranges with population development break even with to urban migration. The urban agglomerations of many countries in Latin America and West Africa have more than 2,000 people. In the United States, Edge has 2,500 people. Urban agglomerations in Italy have a population of over 10,000 inhabitants (Gupta, 2013). As defined by the Indian census, an urban population needs at least 5,000 people. 75% of the male workforce works in non- agricultural enterprises. The population density should be at least 400 square kilometers.

In Punjab, a shift in Population from one area (the area dispersed across rural in which agricultural is the dominant economic activity) towards one another areas where industrial and service sector activities are dominant. The urbanized areas are usually characterized by dense urban settlement and improved physical/social infrastructural facilities. The aggregation of population from a dispersed settlement pattern to a compact one, paved away for great transformation in the society.

Literature Study

Various researchers have attempted measurement of urbanization levels in terms of urban catchments/ concentrations.

Yach et al., (1990) point to a few characteristics of urbanization, counting fast population development and concentration, and progressed get to employment, education, and modern health care. In a calculated examination, McDade and Adair, 2001 found that a high population density and the availability of infrastructure and services (telephone, mail, transportation, electricity, water and health care facilities) were all connects of urbanity. There are a few parameters that analysts by and large select to demonstrate the urbanity.

Vlahov and Galea, (2002) propose that urbanity is characterized by the changes that come almost dueto changes in population size, density, heterogeneity, and separate from other populated centers.

Montgomery et al., (2003) gives a table of components that cities changed ordinarily vary between urban and rustic situations which incorporates (but isn't restricted to) populace thickness and measure, get to instruction, the extent of products and administrations accessible, get to wellbeing administrations, and progressed get to water and electricity.

(Hugo et al., 2004), Barve et al. (2005) utilized the combination of a composite index based on ground measurement of chosen ecological indicators and GIS investigation to determine and approve risk maps in a wild life haven in southern India. The complete think about region was isolated into 30 ha lattice cells and the GIS based parameters were chosen such as separate to settlement and streets, number of towns and streets in 3 KM butter zone around each network cell, normal slant in and around each lattice cell (all exclusively normalized to 0-1) mapping of the Weighted composite danger file distinguished powerless ranges at the edge of the haven and around manors in it. The risk record was at that point utilized to characterize transects for deciding environmental markers such as tree species, lavishness or extent of cut and broken stems (due to animals or human attack) in stratifying the towns for irregular examining. These ecological indicators were highly correlated with the GIS-derived threat indices.

Uchinda and Nelson A. (2010) proposed an alternative measure of urban concentration termed as "agglomeration index", based on three factors such as, population density, size of the population in a "large urban center and

travel times to the urban center. All factors used in the index were based on the conceptual framework of agglomeration economics". Researchers typically used the urban-rural division to depict urbanity. The dominance of the urban-rural division dates were for back as 1940s when UN begun detailing on world's urbanization patterns and the polarity proceeds to be the rule shape of urban categorization utilized by the UN National Population Division (as detailed by the Winner and Hugo 2004),

Satterthwaite (2010) composes that a basic classification framework embraced for the collection and dispersion of population information does not reflect the obscuring of provincial and urban regions, the differing qualities of settlements inside urban and rustic settings, the expanding file and complexity of urban frameworks, and the unused shapes of urbanization that are developing. Anthropogenic change of scenes impacts on the prevailing run-off creating forms and key how ways having a significant effect on catchment boundaries and waste pathways (Rodriguez et al., 2013).

Eshtawi et al. (2016) distinguished a 1% increment in urban zone contributing to a 41% diminishment in add up to penetration in a test catchment within the Gaza Strip zones. The presumption that impressions surfaces come about in zero invasions was illustrated to be erroneous.

Schlesinger J. (2015) created "Urban-rural File (URI) for two African cities in arranges to consider urban and peri- urban agrarian frameworks. In this way file combines a tall determination adj. Nonexistent (for creating a degree of urbanization in terms of Part density of existing buildings) and remoteness in terms of travel times of the city middle (determined from extricated road systems). The improvement of such record depends on spatial structures and requires tall determination "satellite images", progressed software programs and progressed abilities in GIS examination.

Mcgrane et al., (2016) summarized that anthropogenic change of the geography and surfaces as a result ofurbanization happens at a run of scale.

Hoffman et al. (2017) proposed a Survey-Stratification File (SSI), created to stratify towns within the Bangalore metropolitan locale of India by their degree of urbanity or

rurality in arrange to draw an agent test for the overview. It utilize freely available spatial input information such as handset or outstanding disciple pictures given by USGS and open source GIS computer program such as QGIS. The file was created essentially to “Index of relative rurality (IIR) as an unweighted normal of two normalized input factors and offers the comparative properties of the last mentioned.

Therefore, there requires a re-examine the urbanization record in its multi-dimensional concept, moving a step ahead of the statistic criteria to have a practical record. In this study the nearby cities of Kala Sanghian drain of Jalandhar, Punjab (India) is taken as a study area. There are total seven different locations which are chosen which surrounds the points marked on drain (fig 1.) i.e., S0 is near Dhogri road, S1 location is adjoining Nurpur, S2 location is near Transport Nagar, S3 location is near DAV College, S4 location is in Wariana, S5 location is front side of Ibban, S6 location is nearby Manan, S7 location is near Khanpur Dhadda have been chosen for deciding the Urbanization index along the Kala Sanghian Drain. The nine urbanization parameters has been selected i.e., Populace size, Population density, Education facilities, Health services, Industries, Electricity facilities, type of roofing material, assests and % of Built-up area to analyze in this investigation to choose the urbanization level of this load of areas which can additionally assist with recognizing the reason for dissolution of water of the drain

2 Material & Method

Study Area

In this study, an endeavor has been made to create Urbanization index model. The developed model is then applied to different nearby locations of Kala Sanghian Drain in the state of Punjab: S0 is near Dhogri road, S1 location is adjoining Nurpur, S2 location is near Transport Nagar, S3 location is near DAV College, S4 location is in Wariana, S5 location is front side of Ibban, S6 location is nearby Manan, S7 location is near Khanpur Dhadda to estimate the level of Urbanization in these regions. The model developed is then validated using the urbanization

level given by Census of India, 2011. Here fig 1 shows all the marked points on the drain and the surrounded area of these points about 4 to 5 km’s each are further investigated to calculate urbanization index.

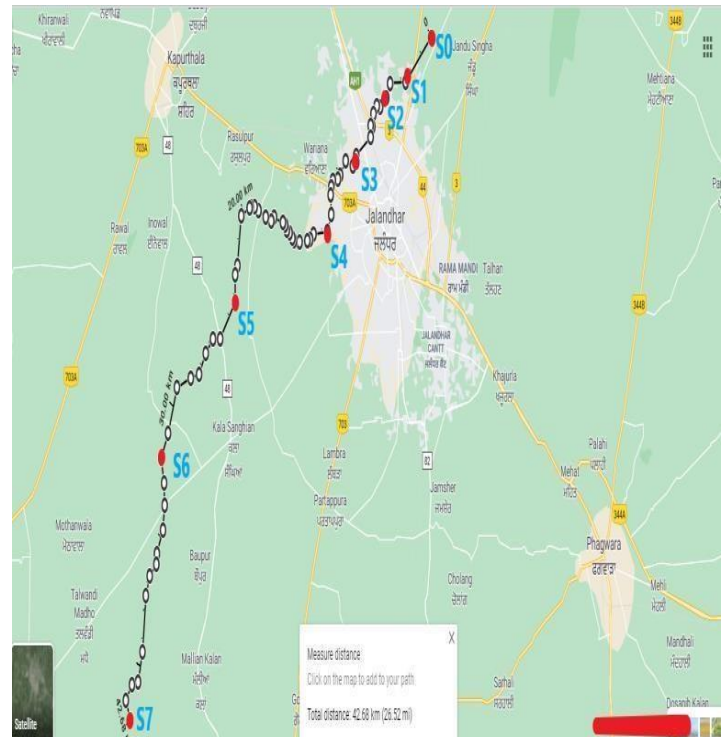


Fig 1. Points marked (S0, S1, S2, S3, S4, S5, S6, S7) on the Kala Sanghian drain on Jalandhar map

(<https://www.google.com/maps/place/Jalandhar,Punjab/@31.3223787,75.5033788,12z>)

Urbanization index

In the present study, four multi-dimensional aspects has been developed the urbanization index, considered for selecting the marker parameters for the urbanization:

1. Demographic aspect
2. Infrastructural development aspect
3. Spatial Aspect
4. Economic development aspect

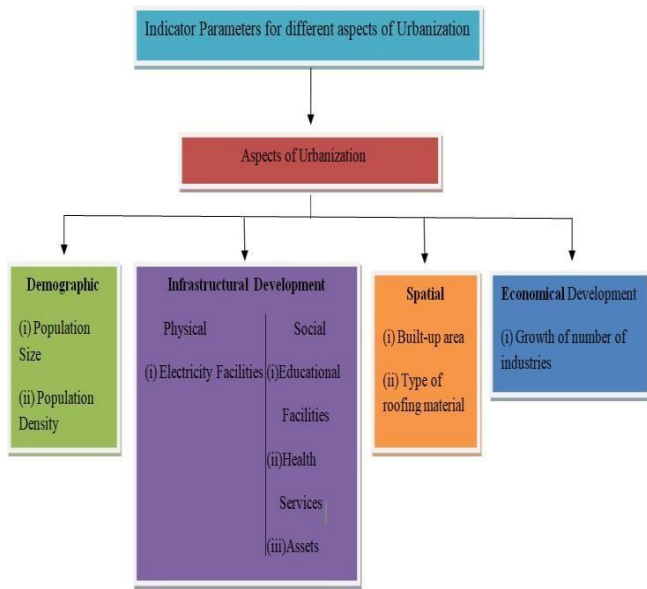


Fig. 2. Indicator Parameters for different aspects of Urbanization

The set of nine indicator parameters were recognized, and each indicator was gathered into “four aspects of urbanization as demographic, infrastructural development, spatial and economic development” labeled as UIj “Group of indicator parameters used for urbanization index calculation” (as shown in Fig.2) in the Jalandhar city regions of Punjab state. The aggregated score of points for indicator parameters was used to calculate urbanization index values for each location. In addition to “statistical data’ a geographical based approach based on “remote sensing data (Google Earth)” was also used. In the present study, an endeavor has been made to create the Urbanization index model using the nine indicator parameters under the four above-mentioned aspects of Urbanization. Table 1 shows the indicator parameters selected for different aspects of Urbanization.

Table 1 Indicator parameters selected for different aspects of Urbanization

S.No.	Aspects	Description	Considered in this study (Yes/No)
1.	Demographic	Population size Population density Mortality Sex Ratio Geographical Area Migration Area under agriculture Poverty	Yes Yes No No No No No No
2.	Spatial	Built-up area Type of roofing materials Nearest railway station road distance Nearest city with population of 1lakh & more distance	Yes Yes No No
3.	Infrastructural development	Electricity Facilities Availability of health services Number of vehicles Water supply and sewerage Roads and expressways	Yes Yes No No No
4.	Economic development	Growth of number of industries Physical capital or infrastructure Natural resources	Yes No No

Urbanization Index Model

The Urbanization index model is created within present study consists of 5 steps:

1. The determination of parameters for the estimation of the urbanization level.
2. Advancement of the urbanization scale for each of the urbanization parameter.
3. Getting the focuses for each of the urbanization parameter utilizing the urbanization scale.
4. Getting the Urbanization index by accumulating the points have gotten for each urbanization parameter.
5. Obtaining the Normalized Urbanization Index.

Selection of Parameters for Measurement of Urbanization

In a view of the literature reviewed, the following parameters have been considered for the measurement of urbanization, in this study:

- a) Population size and Population density
- b) Educational facilities and Availability of health services
- c) Growth of number of Industries.
- d) Electricity facilities
- e) Roofing types
- f) Assets (i.e, TV, computer/ laptop, telephone/mobile phone and scooter/car).
- g) Percentage of Built- up area

Advancement of Urbanization Scale for each of the Urbanization Parameter

For each of the over urbanization parameters the scale is formed to assign the points from 1 to 10 by considering the extensively of the information and the neighborhood and encompassing improvement in this

study area. The justification of selecting each of the urbanization parameters is discussed below:

Population Size and Population Density the primary aspect of defining urbanicity is a demographic aspect. The Census criteria of different countries have considered the demographics to delimit the urban areas.

Table 2 Points for Population Size

Population Size	Points
<300000	1
>300000-500000	2
>500000-1500000	3
>1500000-2000000	4
>2000000-2500000	5
>2500000-4000000	6
>4000000-5000000	7
>5000000-6000000	8
>6000000-7000000	9
>7000000-8000000	10

Table 3 Points for Population Density

Population density (persons per sq.km)	Points
<200	1
>200-400	2
>400-600	3
>600-800	4
>800-900	5
>900-1000	6
>1000-1300	7
>1300-1400	8
>1400-1500	9
>1500	10

Educational Facilities and Availability of Health Services

The parameters such as Educational facilities and Availability of health services are considered because it correlates the urbanicity by number of researchers. (Yach et al., 1990; McDade and Adair, 2001).

Table 4 Points for Available Educational Facilities

Education Facilities	Points
Primary School	1
Secondary School	1
Senior Secondary School	1
Vocational training facility	1
Colleges (if >40) (otherwise 0 points)	6

Table 5 Points for Available Health Services

Health Services	Points
Hospitals (if >15)	4
Health Centre	2
Dispensary	1
Family welfare Centre	1
Nursing home	1
Primary health subCentre	1

Growth of Number of Industries Growth of number of Industries directly influences the economic growth. The economic growth of an area is closely related with urbanization.

Table 6 Points for Growth of Number of Industries

Number of industries	Points
<100	1
>100-500	2
>500-3000	3
>3000-6000	4
>6000-9000	5
>9000-11000	6
>11000-12000	7
>12000-13000	8
>13000-14000	9
>14000	10

Electricity Facilities Facility of electricity connection is an indication of urbanization because electric transmission development starts from urbanized area and progresses towards rural area.

Table 7 Points for Electricity Facilities

Households* (%)	Points
<5	1
>5-10	2
>10-15	3
>15-20	4
>20-25	5
>25-30	6
>30-35	7
>35-40	8
>40-45	9
>45	10

*Households having main source of lighting as electricity (% of total population)

Roofing Types In this study, roofing type has been selected to measure urbanization. In India, the households having concrete as predominant roof material are generally found in urban areas whereas the households having grass/thatch/bamboo/wood/mud/plastic/polythene / handmade tiles/ slate / stone are pinpointing of lower economic status and are generally observed in rural areas.

Table 8 Points for Roofing Types

Households** (%)	Points
<4	1
>4-8	2
>8-10	3
>10-12	4
>12-14	5
>14-16	6
>16-18	7
>18-20	8
>20-22	9
>22	10

**Households having concrete as predominant roof material (% of total population)

Assets(i.e,TV,computer/laptop, telephone/mobile phone and scooter/car) The standard of living is higher in urban areas compared to moderately urban or rural areas. Hence the possibility

of owning the assets like TV, computer/ laptop, telephone/mobile phone and scooter/car increases as one move from rural to urban areas.

Table 9 Points for Assets

Households*** (%)	Points
<0.2	1
>0.2-0.4	2
>0.4-0.6	3
>0.6-0.8	4
>0.8-1.0	5
>1.0-1.2	6
>1.2-1.4	7
>1.4-1.6	8
>1.6-1.8	9
>1.8	10

***Households with TV, Computer / Laptop, Telephone / Mobile phone, Scooter / Car (% of total population)

Percentage of Built-up Area As the economic activities of an area increases, the agricultural area decreases and solid and permanent dwellings increase.

Table 10 Points for % of Built-up area

% of Built-up area to total area	Points
<0.3	1
>0.3-0.6	2
>0.6-0.9	3
>0.9-1.2	4
>1.2-1.5	5
>1.5-1.8	6
>1.8-2.1	7
>2.1-2.4	8
>2.4-2.7	9
>2.7	10

Urbanization Scale and the Urbanization index (by aggregating the points) for Urbanization Parameters

As per the data for various parameters at the locations under this study, each of the urbanization parameter utilizing the urbanization scale. Urbanization index (UI) of the station is calculated as per equation 1.

$$UI_j = \sum_{i=1}^n P_{i,j} \dots(1)$$

Where, n= number of Urbanization parameters, j= station under study

Urbanization index for each of areas have been gotten by accumulating the points gotten as over for each urbanization parameters. As there are nine urbanization parameters considered in this study. The urbanization index for each area which we have selected changes from 0 to 90 i.e., minimum to maximum. Thus, the urbanization list gotten for each locale area ranges from 0 (no urbanicity) to 90 (high urbanicity) points.

Table 11 Level of Urbanization for Urbanization scale of Census of India, 2011

Urbanization scale(% of urban population to the total population)	Level of urbanization
<12.50	Highly rural
12.51-27.51	Moderately rural
27.51-42.51	Moderately urban
42.51-57.51	Highly urban
>57.51 -90	Very highly urban

Obtaining the Normalized Urbanization Index

Normalized Urbanization index is formed by normalizing the urbanization index of the area over the greatest value of the urbanization index (based on urbanization parameters) for this study.

Urbanization Index (NUIj) = (UIj/Max. score i.e, 90)*100.

The Census of India, 2011 has developed the Urbanization scale based on the % of urban population to total population. As per the census criteria, the urbanization scale is divided into five classes as shown in Table 11. In the present study, for the validation of the urbanization scale model, the Urbanization Scale given by Census of India, 2011 is further categorized into 5 levels, i.e. highly rural, moderately rural, moderately urban and highly urban and very highly

urban (Table 11). In the present study, the Normalized urbanization index is also divided into similar 5 levels (Table 12).

Table 12 Level of Urbanization for Normalized UI ranges

Normalized UI	Level of urbanization
0-20	Highly rural
>20-40	Moderately rural
>40-60	Moderately urban
>60-80	Highly urban
>80	Very highly urban

3. Data Collection

For the Urbanization index and the Normalized Urbanization Index scores

The urbanization parameters scores were collected for seven locations along the Kala Sanghian drain, Punjab i.e,

S0 is near Dhogri road,

S1 location is adjoining Nurpur,

S2 location is near Transport

Nagar,

S3 location is near DAV College,

S4 location is in Wariana,

S5 location is front side of

Ibban,

S6 location is nearby Manan,

S7 location is near Khanpur Dhadda

The data for the parameters vise, Population size, Population density, Electricity facilities, roofing types and assets are collected from census of India of year 2011 for the decade 2001 to 2010. The data for the parameters vise, Educational facilities, Health services and Industries are collected from manual survey and also with help of Google map which are shown in Fig 3.



Fig 3. Satellite view of different areas (a. b, c, d, e, f) chosen for our study.

(<https://www.google.co.in/maps/place/Jalandhar,+Punjab/@31.3441224,75.5257541,12.83z/data=!4m5!3m4!1s0x391a5a5747a9eb91:0xc74b34c05aa5b4b8!8m2!3d31.3260152!4d75.5761829>)

4 Result & Discussions

Urbanization Index parameters

Urbanization results primarily due to increased concentration of small scale and large scale industrial, commercial, financial and administrative setup in the cities, cultural recreational activities, technological

development particularly in the transport and communication sectors (especially around the horizons of over urbanized areas). In India, the urbanization has been taking place at an increasingly faster rate. In Jalandhar, Punjab a peculiar phenomenon is observed: industrial growth without a significant stuff of population from agricultural areas / belts to industries. The process of urbanization is seen as a demographic geo-graphical/spatial effect, infrastructural development process, socio-cultural phenomenon and economic development. For the studied areas growth of urban population was observed without a significant rise in the ratio of urban to the total population. In terms of ratio, there is not great shift from rural to urban activities. The cities of Punjab are a part of wider network and in process of new land use transformation. Visible land use transformation in the cities could be explained as an interconnected process of subaltern and exo-urbanization in nature.

Calculation for Urbanization Index parameters

As shown in the **Table 13** true representation of the Urbanization level of an area requires a holistic approach for the measurement of urbanization. For this study, the methodology was developed to evaluate urbanization index using multi-dimensional concept. The urbanization level model developed may be useful to determine the urbanization level of a district. In the present study, from Table 12 the locations S0, S1 are found to be moderately urban and S2, S3, S4 is found to be very highly urban and S6, S7, S8 are moderately rural areas. The results are compared with the urbanization levels given by Census of India, 2011. According to figure 2, for S0, S1 the level of Urbanization as a percentage of urban population to total population is 38.39% and 177.78%. From Table 11, S0.S1 falls under category –moderately urban. From figure 1, for locations S2, S3, S4, the level of Urbanization as a % of urban population to total population is 52.23%, 55.56% and 51.12 % respectively. From Table 11, S2, S3, S4 fall under category –highly urban. From figure 1, for locations S5, S6, S7 the level of Urbanization as a % of urban population to total population is 24.45%, 24.45% and 20% respectively. From Table 12 locations S5 and S6

fall under category moderately rural and S7 under highly rural. Hence for these areas the urbanization index model is validated.

Table 13 Data for Urbanization Parameters

Urban. parameters	Locations							
	S0	S1	S2	S3	S4	S5	S6	S7
Population size (Lac. Approx.)	1	2	6	4	10	0.05	0.03	0.02
Population Density (persons /sq.Km)	198	350	700	275	888	50	30	20
Education Facility	2	10	12	45	15	2	1	1
Health Services	3	8	7	19	7	1	1	1
Industry	497	2010	3035	25	5000	1	2	1
Electricity Facility(%)	32	38	42	44	38	26	27	22
Roofing (%)	17	19	19	19	20	11	12	9
Assets(%)	1.3	1.5	1.6	1.8	1.5	0.7	0.7	0.6
% of Built-up area to total area	1.9	2.0	2.2	2.6	1.9	0.7	0.8	0.5

Points for each urbanization parameter, urbanization index of each location have been shown in Table 14 and Normalized Urbanization Index has been shown for these locations in Table 15.

Table 14 Urbanization Index for Locations i.e., S0, S1, S2, S3, S4, S5, S6, S7

Sr. No.	Parameters	S0	S1	S2	S3	S4	S5	S6	S7
1.	Population Size	1	1	3	2	3	1	1	1
2.	Population Density	1	2	4	2	5	1	1	1
3.	Industries	2	3	4	1	4	1	1	1
4.	Roofing Type	7	8	8	8	8	4	4	3
5.	Electricity Facilities	7	8	9	9	8	6	6	5
6.	Medical Facilities	2	2	2	2	2	1	1	1
7.	Education Facilities	1	1	1	1	1	1	1	1
8.	Assets	7	8	8	8	8	4	4	3
9.	% of Built-up area	7	7	8	8	7	3	3	2
	Urbanization Index	35	40	47	50	46	22	22	18

Table 15 Normalized Urbanization Index of all the sampling locations.

Sampling Location	Normalized Urbanization Index
S0	38.89
S1	177.78
S2	52.23
S3	55.56
S4	51.12
S5	24.45
S6	24.45
S7	20

This study reveals that percentage of urban population to total population is 52.23%, 55.56% and 51.12 % respectively in the studies areas locations S2, S3, S4 which fall under the category of highly urban areas of the city around Kala Sanghian Drain in the state of Punjab on the basis of urbanization indicator chosen as demographic, infrastructural development, spatial and economic development. These highly urbanized areas needs immediate attention and special consideration to secure from the impacts on the prevailing run-off creating forms and also to discover practical means to

Significantly reduce the effects on catchment boundaries and drain water pathways.

Interpretation and Validation

For the affirmation of results gotten through urbanization index, the affectability test was too performed. The affectability test for urbanization was based on weight choice criteria. In this respect a “questionnaire” was created on the premise of existing population density, infrastructural development, spatial and economic development parameters of the examined locale and was disseminated to 20 city specialists (people groups from organization, natural, law, economy, mechanical improvement, arrangement and social improvement fields). A number of studies have been carried out with a differing extend of work in several parts of the world that refers on one way or other urbanization/ urban development and its related wonder. Reddy and Balachandra (2013, 2012) conducted study on two mega cities of India: Banglore and Mumbai and compared the observed values with Singapore, Shanghai and London.

5. Conclusions

1. An urbanization index (UI) model values express the level of urbanization in studied areas. Thus index is a summarized view of different prospective of urbanization.
2. This study reveals that percentage of urban population to total population is 52.23%, 55.56% and 51.12 % respectively in the studies areas locations S2, S3, S4 which fall under the category of highly urban areas of the city around Kala Sanghian Drain in the state of Punjab on the basis of urbanization indicator chosen as demographic, infrastructural development, spatial and economic development. These highly urbanized areas needs immediate attention and special consideration to secure from the impacts on the prevailing run-off creating forms and also to discover practical means to significantly

reduce the effects on catchment boundaries and drain water pathways.

3. Our cities are expanding beyond municipal boundaries rapidly. The share of population in urban areas its growth and distribution in urban settlements has been considered as primary factors of urbanization. Increase in percentage built up area and types of roofing materials used along with infrastructural development in the area were also considered as primary factors of urbanization. The investments in the industries (especially number of large scale industries), and its effect/ share of makers were also considered.
4. The UI includes indirect reference of many indicators also such as basic services, housing conditions, increase in no. of counting of vehicles, provision of educational and health service facilities, increase number of assets has also been considered as an indicator of urbanization.
5. This study is useful for the planners and policy makers for the future urban planning of the state of Punjab to overcome the issues of haphazard urban development unmatched with industrial areas establishment and development.

The merit of the simplified index lies within the quickness of giving results, which seem connected in different intrigue contexts. This study emphasizes on maintaining balance of regional development for higher and sustainable economic growth not only in Punjab but also in India as well.

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Affiliations



Miss Mani Megh completed his bachelor's degree in civil engineering from D.A.V.I.E.T Jalandhar affiliated to Punjab Technical University. She is currently pursuing m.tech Degree from D.A.V.I.E.T Jalandhar.



Dr. M K Kaushik Assistant professor having 13.2 Years of experience in teaching and currently working as a assistant professor D.A.V.I.E.T Jalandhar. His Research/Interest Area are Waste Water Treatment Technologies, Waste Management, Pollution Monitoring, Geo Environmental Engineering.