COMPARISON OF URBAN FORM PARAMETERS OF LAHORE WITH ITS NEIGHBORING CITIES

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ABSTRACT: Urban form is the spatial imprint of urban transportation and associated land-use. It may be computed by various measures i.e. population density, employment density, Mix Density Index, Entropy Index, accessibility index, etc. No study has been conducted to explore the urban form of cities in Punjab. The objective of this studywas to compute and explain the urban form and compare its urban form variables in Lahore with neighboring Towns i.e. Ferozewala, Kasur, Pattoki, Sharaqpur and Muridkey. Lahore being the largest populated city of Punjab havinga monocentric and dense urban structure has changed during the last several years, preliminary analysis showed that Lahore has sprawl type of urban form whereas Muridkey, Kasur, Sharaqpur, Pattoki and Ferozewala have different types of urban forms varying from polycentric to monocentric. The urban form variables have the larger values for Lahore as compared to other neighboring cities. For making policy decisions related to different sectors like Transportation, Health and Education etc.it is recommended to conduct a thorough longitudinal study of urban form and to formulate the policies accordingly.

Key words: Urban form, Lahore, Population Density, Entropy Index, Mix Density Index,Accessibility Index

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INTRODUCTION

Lahore is the biggest city of the province of Punjab and stands second population wise in Pakistan (Government of Punjab, 2012). It being the provincial capital is attractive for people having more employment opportunities, having better living standards, better educational and health facilities, resulting into the shifting of people from rural areas to Lahore. People from all over the province are shifting towards Lahore, which eventually resulted in expansion of the city for the last many decades (Safdar and Kazmi, 2014). Different studies show that with the expansion of city, various problems have originated in different areas of the city including travel time loss, environmental degradation, fuel and economy lossestraffic congestion, high prices near work zones and fuel losses etc. (Kevin*et.al;* 2008; Jeffrey, 2009). Due to the increase in usage of private vehicles and low price of land, people tend to live in suburb areas instead of city center or near it all around the world. Due to this phenomena various social, economic, environmental and traffic issues are increasing day by day in different countries of the world. A dramatic change in urban form in the world occurred in 20^{th}century when automobile hit the market and heavy investments have been made on road network led accessibility to inaccessible areas (Hanna and Kanaroglou, 2007). This had a long term impact on spatial pattern of residential and employment areas as people shifted from central core areas to suburbs due to lower land cost and facilities for people to approach employment area on private vehicles. Cities underwent expansion and importance of Central Business District(CBD) area gradually decreased and urban form bridged the polycentric and dispersedsystem. Before the car traffic system, grid type pattern of roads existed, with the increase in use of automobiles, the grid system gradually was converted into curvilinear or cul de sac pattern in 1950s. This resulted in lower density of land use and private car became the most favorable mode to travel especially in North America (Jean *et. al;* 2013). Monocentric cities can be seen in European, Chinese and Japanese metropolitan areas whereas North American urban areas and Canadian cities, in contrast, are mostly decentralized and have low density neighborhoods (Jean *et. al;* 2013).

Different researches have suggested that while planning cities in such a way that promotes smart growth eventually controls all losses. No such research has been conducted in Pakistan to identify the urban form of cities. Spatial pattern of human activities in definite point at a particular time is defined as urban form (William*et. al;* 1996).

The urban form can be investigated by density, diversity and design of a particular area. Different researchers use different methods to conduct the research of the same nature. Job-Housing mix can be computed by calculating the Mix Density Index (MDI) which compares Population density and Employment density in an area (Genevieve and Small, 1993). Higher value of MDI shows high density in an area (Kevin*et. al;* 2008). Heterogeneity of an area in terms of land use can be determined by Entropy Index. It explains the diversity of land use as has been reported by (Adel*et. al;* 2011). Entropy Index (EI) ranges from 0 to 1. An even

distribution of different lands using implying value of "1" shows heterogeneity nature of an area. Contrary to this value of 0 shows the homogeneity land use (Dimitris and Kanaroglou, 2008). Moran's I coefficient can be used to determine the level of clustering. Moran's I coefficient ranges from +1 to -1. High positive value shows closely scattered high density suburb areas, value close to zero shows scattering whereas -1 shows the chess board pattern of development (Yu-Hsin, 2005). Different researches have investigated about the urban form and its relationship with different transportation variables, travel Patterns and health activities etc.

The objective of this research is:

- To compute the urban form variables for Lahore and Neighboring cities.
- To compare the urban form variables of Lahore city at the level of town and union council.
- To compare the urban form variables of neighboring cities of Lahore including Ferozewala, Kasur, Muridkey, Sharaqpur and Pattoki at Union council level.

MATERIALS AND METHODS

Data collection and Study Area: A comprehensive study wasconducted for Lahore Urban Transport Master Plan in 2012. Study area comprised of Lahore and some part of its neighboring cities. Primary data required for the investigation of urban form was collected through different surveys conducted for Lahore Urban Transport Master Plan (LUTMP), 2012. Lahore is located in the eastern side of Punjab and shares its boundary with Kasur, Ferozewala, Sharaqpur, Pattoki and Muridkey: which are also included in this study. Primary data on Town and Union council level was taken from Lahore Urban Transport Master Plan, 2012. By using the refined primary data selected urban form variables for this research were computed.

Comparison of Urban form variables: Different urban form variables were selected and computed by keeping in view the previous researches and studies. Net Population Density (P.D), Net Employment Density (E.D), Mix Density Index (M.D.I), Entropy Index (E.I), Accessibility Index to Population (A.I.P) and Accessibility Index to Employment (A.I.E) were computed for the Lahore city on Town and Union council level. Whereas for neighboring cities of Lahore, these selected urban form variables were computed and compared on Union council level.

Investigation of Urban form: Different variables were used to investigate the urban form by different researchers (Yosef, 2006;Jeffrey, 2009;Reid and Clemente,2013). In the research mentioned above, urban form variables were used to investigate the urban form of Lahore and neighboring cities. These urban form variables have already been selected by (Jeffrey, 2009) to investigate the urban form of Canadian cities.

Net Population Density: It is defined as the number of people living in unit built up area. Unit may be of Town level, Union council level or Census level. For Lahore, density was computed on Town and Union Council level whereas for neighboring cities of Lahore, it was computed on Union council level.

Net Population Density = Population/Built up Area

Unit of measurement is persons/hector.

Net Employment Density: Number of employments per unit built up areaare defined as net employment density.

Net Employment Density = Employment/Built up Area

The number of employment opportunities were not directly available in Lahore Urban Transport Master Plan, 2012 data therefore daily travel log and employed trips were counted and considered as employment. This was considered as the limitation of this research which needed to be accurately computed for future research. The unit of measurement was persons/hector.

Mix Density Index: Housing mix balance with employment in an area is known as Mix Density Index.

Mix Density Index (M.D.I) = (Net Population Density X Net Employment Density) / (Net Population Density + Net Employment Density)

Larger value of population and employment density in an area had larger M.D.I whereas lower value of each density computed the lesser M.D.I.

Entropy Index: Entropy Index of an area showed the mixing of different land uses in an area. Value closer to zero showed the homogeneity where value close to 1 showed the heterogeneity of land uses.

$$E.I = - \sum P_k.\ln(P_k)/\ln(k)$$

P_k= Proportion of Land use k

K = Number of Land uses

Accessibility Index to Population: Accessibility index explained the design perspective of urban form. It showed how easy it was for the residents of an area to approach destination area.

A.I.P = Population of area $_i$/Travel time from area i to j^2

Accessibility Index to Employment:

A.I.E = employment of area $_i$/Travel time from area i to j^2

Urban form depended upon density, diversity and design. Density aspect was covered under population and employment density, Entropy index and MDI covered diversity and design aspect was covered by A.I.P and A.I.E.

RESULTS AND DISCUSSION

Investigation of Urban form for Lahore on Town Level: Population density, Employment density, Mix

density index, Entropy Index, Accessibility Index to population and Accessibility Index to Employment were computed on Town level for Lahore city. Table-1 which showed the maximum, minimum, average and Moran's I of all urban form variables used for the investigation. A higher Population density was observed in Shalimar Town, Ravi Town, Samanabad Town and Data GanjBaksh Town which existed in the central core area of city and people tended to live near commercial hubs therefore population density was more near the city center and as we move away from the center, population density became lower. A higheremployment density was observed in towns where population density was higher. The potential reason might be that business center existed in and around these towns. High employment opportunities were found to be higher in these towns due to the existence of main business hub. The Entropy index was found to be high in Ravi Town, Samanabad Town, Shalimar Town, Data GanjBaksh Town and Gulberg Town. Each type of land use existed in these towns. Wagah Town and Nishtar Town had lower E.I value, having existence of large proportion of agriculture area.

MDI was found to be higher in Shalimar Town, Ravi Town, and Cantonment which showed higher balance of employment and population was observed to be higher in these towns. With an increase in distance from city center, MDI gradually decreased. Lower value of MDI led to longer commuting distances which was a characteristic of non-contiguous urban form (Kockelman, 1997; Donggen and Chai, 2009).

A.I.P was found to be higher in Ravi Town, Shalimar Town and Gulberg Town asthese towns had higher population and low travel time among these towns therefore was found more accessible from other towns. A.I.E was found higher in the towns where A.I.P was high due to the low travel time value. Road network density in high accessible areas wasfound greater as compared to low accessible areas.

All urban form variables had high intensity in each town which existed adjacent to each other. By investigating all urban form variables computed in this research on Town level, it was observed that Lahore is monocentric in nature. Maps of all urban form variables on Town level could be observed in Figure-1 to Figure-6.

Investigation of urban form on Town level was found to be coarser in nature which needed to be investigated on some basic level therefore the investigation of urban form was done on Union council level.

Investigation of Urban form for Lahore at Union Council Level: By moving from investigation of urban form at Town level, the same urban form variables were computed at Union Council level. Maximum, Minimum, Average and Moran's I values of all urban form variables at union council level are presented in Table-2.

The population density was found to be higher in different union councils which existed spatially scattered. Some union councils fall within city business area, some fall in Samna bad Town, some along Canal and some near and around industrial area of city. The same population density, employment density was also found higher in spatially scattered union councils and was not found in clusters. It was also noted that some union councils along canal, some in industrial area and some in business central area had high employment density. The population density and Employment density showed an increasing trend at union council level rather than core areas of the city which showed the sprawl type of urban form.

MDI showed the mix balance between employment and population of an area. The MDI was also found to be higher in central city where only one was found near the border and one at the industrial area. MDI was found to be higher in discontinuous union councils. The lower value of MDI increased with the commuting distances. E.I was found to be higher in city centers and along the canal and in cantonment. A.I.P was also found higher in union councils which existed in city center and along the canal. The potential reason might be high population and low travel time. A.I.E was also found to be higher at union councils which existed in the city center and along the canal. All urban form variables maps of Lahore on union council level can be seenin Fig - 7 to Fig - 12. After investigation of all urban form variables, urban form of Lahore was found to be Polycentric in nature and was bridging towards sprawling. Some Canadian cities had also similar type of urban forms as in Lahore which has been reported by (Jeffrey, 2009). The Urban form of Lahore was found contrary to urban form of Nagpur which fall under the category of compact urban farm(Rajashree*et. al*; 2014). Some major cities of the world also fall in sprawl type of urban form which include: Madrid, Paris, Mumbai, Shangai as has been reported by (Jean*et. al*; 2013).

Urban form variable comparison of Lahore at Town and Union Council Level: Graphs of all urban form variables (average) for Lahore at Town and Union Council level have been presented in Fig-13. It was found after the comparison that average net population and net employment density had higher values when computed on Union council level instead of Town level. In case of Mix density Index same pattern existed and the values were found to be quite higher on Union council level. The entropy Index was computed on both levels was found to be almost equal. Contrary to other urban form variables, Accessibility Indexes were lower in value when computed at Union council level. The potential reason might be the higher travel time value at this level of investigation.

Investigation of Urban form for Ferozewala on Union Council Level: Population density was found to be higher scale in central area and decreased outwards. In comparison to Lahore, population density on lower side where as the Moran's I value showed random scattering in Ferozewala. Moving towards employment density, it was found highest in Union councils which fell on western side of Town away from urban core. The potential reason might be the presence of Industries and factories which generated employment opportunities for the residents. Highest Employment density was found on Union council level in Ferozewala Town which was found to be closer to the average employment density of Union councils in Lahore. Union Councils which had more population density had lesser employment density. The population density was found to be more along the main highways and itgradually decreased while going away from the highways. MDI was found to be on higher side in union councils which existed away from urban core and it showed a high mix balance of population and employment. The higher values of MDI decreased the commuting timing as has been reported by (Kockelman, 1997and Donggen and Chai, 2009). The MDI value was found half the average value of MDI in Lahore. Entropy Index was found high in urban core and low in union councils which were away from urban area. Agricultural area showed a higher proportion in Union councils where E.I value was found to be lower. Moving towards A.I.P and A.I.E, these urban form variables were found to be higher in Union councils which existed on major highways passing through Ferozewala Town. The potential reason might be the existence of higher population and higher accessibility from other union councils. Values of all urban form variables used in this study are presented in Table-3. Whereas maps of all urban form variables are shown in Figure-14 to Figure-19.

Each urban form variable had higher value in different union councils of Ferozewala which showed polycentric type of urban form.

Investigation of Urban form for Kasur on Union Council Level: Kasur falls on the southern side of Lahore having plenty of agricultural land. Whole of the Kasur district was not included in Lahore Urban Transport Master Plan study, 2012 was considered as study.

Population density was found to be highest in this Union council where urban area decreasedon the western side of this small town. Employment density was found to be more in VillageChak 55 due to presence of factories. This union council showed more employment opportunities compared with other areas. The average Population density and employment density were found to be more than average densities in Ferozewala Town. MDI was found to be highest in Chak 55 union council due to more employment opportunities. Entropy Index was found to be more in KotRadhaKishan small town which showed the presence of more types of land use in better proportion. Other Union councils i.e. Bablana andOttar had major proportion of agricultural land use which resulted in lower entropy index. The accessibility Index of Population and Employment was found to be higher in Union councils which had more accessthrough the roads network. A.I.P and A.I.Eshowed the design aspect of Urban form as has reported by (William*et. al;* 1996).

Maximum and Minimum average and Moran's I valuesare shown in Table-4. Maps of all urban form variables were developed and are shown in Fig-20 to Fig-25. Different urban form variables had distinct distribution of low and high values. Kasur had monocentric type of urban form but inclining towards polycentric type of urban form. Due to inclusion of limited part of Kasur in this study the computed type of urban form may be different from actual one.

Investigation of Urban form for Sharaqpur on Union Council Level: Sharaqpura small town is located on Northern side of Lahore. This union council is considered as the urban zone of this town. The population density was found to be highest in Sharaqpur Union council compared with all other union councils but average population density of all other union councils was found to be lesser than Kasur, Ferozewala and Lahore. Employment density was found to be higher in Sharaqpur and Mandianwala union councildue to their commercial value.Sharaqpur and Mandiawala union councils had higher M.D.I than all other union councils which showed high mixed balance between population and employment. This type of balance showed relatively continuous type of urban form like reported by (Donggen and Chai, 2009). The M.D.I was found to be almost equal to Kasur. E.I was found to be high in Mandianwala Union council which showed more land use in this union council whereas all other union councils had homogenous type of land use. A.I.P and A.I.E values were found to be higher in Union councils which were located on main highways. Dhamkian union council had higher A.I.P whereas Mandianwala union council had higher A.I.E in Sharaqpur Town.

Maps of all urban form variables used in this research were developed and are presented in Fig-26 to Fig-31 whereas salient features of urban form variables of sharaqpur union council are presented in Table-5. By investigating Moran's I value and all urban form variables, it was concluded that Sharaqpur had monocentric type of urban form.

Investigation of Urban form for Pattoki on Union Council Level: Pattoki falls in the western part of city Lahore having more population thanSharaqpur Town. Phool Nagar union council had higher population density

than all other union councils rather than more population density than Sharaqpur Town. Other union councils had lower population densities due to presence of rural area and higher proportion of agricultural land. Employment density was also found to be higher in Phool Nagar union council due to urbanization. M.D.I was found to be higher in Phool Nagar union council which gradually decreased outwards. E.I was found to behigh in this union council which showed the presence of different land uses in this union council. Other union councils which had lower E.I had higher proportion of agricultural area. A.I.P and A.I.E were found to be higher in union councils which fall near highways due to high accessibility.

The maps of urban form variables are presented in Fig-32 to Fig-37 and salient features of urban form variables of this union council are presented in Table-6. From Moran's I value it found to belike Chess board urban form but it seems to be more inclined towards monocentric urban form on reviewing the maps.

Investigation of Urban form for Muridkey on Union Council Level: Muridkey Town exists in Northern side of city Lahore and Ferozewala and shares the boundary with Ferozewala Town and Gujranwala District. All urban form variables used in this study were found to be higher in Muridkey union council where urban area exists. All other union councils of this town had lower intensity of urban form variables. The potential reason could be the existence of large proportion of agricultural land. Population density and Employment density was found to be highest in Muridkey union council. Compact nature of urban form existed in small town. The Muridkey Town had the lowest average population density when compared to all other towns studied in this research. Due to existence of urban core in this union council, employment density was also found to be highest. MDI, which is the balance between population density and employment density, was found to be highest in Muridkey Union council amongst all union councils in Muridkey Town. Entropy Index was also found to be highest in Muridkey which showed the presence of high number of land uses in large proportion. Accessibility indexes to Population and employment were found to be high due to presence of main roads and highway passing throughMurdikey. The maps presented in Fig-38 to Fig-43 and salient features of the urban form variables of Muridkey Town are shown in Table-7. By investigating urban form variables it was concluded that Muridkey had monocentric urban form.

Urban form variables comparison of Lahore and Neighboring cities on Union Council level: Bar graphs of different urban form variables (average) used in this study were developed and are presented in Fig-44. The average value of net population density was found to be highest in Lahore city among all neighboring cities. Kasur falls at second highest whereas Muridkey had the lowest value of this urban form variable when computed for cities mentioned in this research. Moving towards net employment density, same trend existed but Ferozewala Town had the lowest value amongst all towns and cities included in this study. Mix density Index had the same trend as was found for net population density. The average value of entropy index was found to be highest for Lahore whereas Pattoki Town had the lowest value of this urban form variable. When the same comparison was made for Accessibility index of population and employment, the trend was found to be more or less same as for as other urban form variables were concerned. Sharaqpur Town had the lowest values of Accessibility Index; the potential reason might be the lower density of road network as compared to other neighboring towns.

Conclusion: Lahore havinga monocentric type of urban form when investigated on Town level but had polycentric bridging towards sprawl when investigated on Union council level. Ferozewala had polycentric type of urban form whereas Muridkey, phoolnagar, Sharakpur and Kasur had monocentric nature of urban form at Union council level. It was also concluded from this research that investigation of urban form when done at union council level showed realistic results as compared to Town level. Higher value difference was observed for most of the urban form variables when computed at two different levels of analysis ,i.e at town and Union council level. Entropy Index was the only urban form variable which had the almost same average value on both Town and Union council level for Lahore. Larger values of accessibility indexes for Lahore as compared to its neighboring cities showed the lower density of road network in neighboring cities.

It is recommended for policy makers in field of Transportation, Health, Education and Environment etc. to develop relationship between urban form and policy accordingly. Master plans and zoning of the cities may be developed by considering the urban form and their variables.

Table 1. Salient Features of Urban form variables of Lahore on Town level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	594.15	69.73	285.85	0.28
2	Employment Density (Persons/hector)	181.02	12.91	65.97	0.24
3	Mix Density Index	128.46	11.11	52.05	0.29
4	Entropy Index	0.67	0.15	0.48	0.26
5	Accessibility Index to Population	84,886,552	6,019,015	39,245,890	0.34
6	Accessibility Index to Employment	23,904,112	1,643,318	10,808,944	0.34

Table 2. Salient Features of Urban form variables of Lahore on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	3,563.94	1.28	444.782	0.21
2	Employment Density (Persons/hector)	1,057.55	1.68	96.67	0.23
3	Mix Density Index	1,351,684.11	8.06	72,699.91	0.13
4	Entropy Index	0.9	0.01	0.5	0.21
5	Accessibility Index to Population	173,385.45	137.66	42,065	0.59
6	Accessibility Index to Employment	124,924.11	160.39	10,311	0.28

Table 3. Salient Features of Urban form variables of Ferozewala on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	491.62	50.16	169.177	-0.07
2	Employment Density (Persons/hector)	77.33	7.81	26.27	0.13
3	Mix Density Index	38,588.24	449.84	6,328.45	0.01
4	Entropy Index	0.66	0.09	0.32	0.47
5	Accessibility Index to Population	5,918.64	280.94	1,419.71	0.32
6	Accessibility Index to Employment	798.43	43.94	222.42	0.3

Table 4. Salient Features of Urban form variables of Kasur on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	572.96	143.46	351.77	-0.34
2	Employment Density (Persons/hector)	69.65	20.74	42.93	-0.37
3	Mix Density Index	40,551.88	4,570.67	17,389.83	-0.36
4	Entropy Index	0.42	0.14	0.23	-0.08
5	Accessibility Index to Population	12,252.38	598.21	5,296.77	0.02
6	Accessibility Index to Employment	1,702.44	54.38	756.18	-0.05

Table 5. Salient Features of Urban form variables of Sharaqpur on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	282	154	208.395	-0.84
2	Employment Density (Persons/hector)	36.96	21.68	29.11	-0.95
3	Mix Density Index	10,753.73	3,517.84	6,667.38	-0.89
4	Entropy Index	0.35	0.17	0.29	-0.11
5	Accessibility Index to Population	1,122.97	12.64	630.96	0.36
6	Accessibility Index to Employment	155.37	1.73	85.39	0.35

Table 6. Salient Features of Urban form variables of Pattoki on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	6,508.16	109.92	1,055.87	-0.33
2	Employment Density (Persons/hector)	974.11	11.2	159.51	-0.29
3	Mix Density Index	6,347,183.66	1,448.18	807,871.34	-0.33
4	Entropy Index	0.49	0.08	0.21	-0.38
5	Accessibility Index to Population	1,491.3	234.81	806.16	-0.08
6	Accessibility Index to Employment	257.16	21.99	133.34	-0.01

Table 7. Salient Features of Urban form variables of Muridkey on Union Council level.

Sr. No	Urban form Variable	Maximum	Minimum	Average	Moran's I Value
1	Population Density (Persons/hector)	480.14	41.12	161.69	-0.42
2	Employment Density (Persons/hector)	217.58	11.48	55.33	-0.43
3	Mix Density Index	105,170.21	990.33	19,666.66	-0.42
4	Entropy Index	0.45	0.09	0.29	0.01
5	Accessibility Index to Population	51,263.54	200.61	11,022.71	-0.34
6	Accessibility Index to Employment	22,881.31	32.94	4,198.87	-0.39

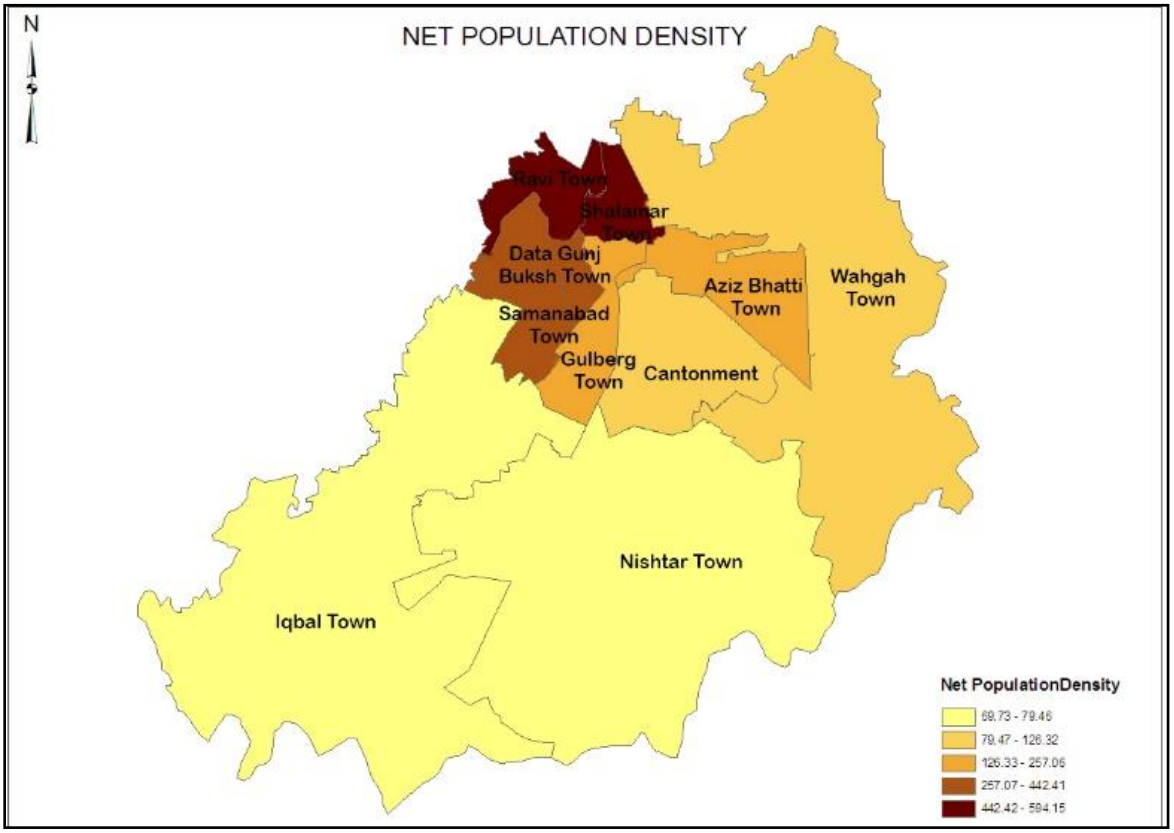


Figure 1: Map of Net Population Density of Lahore on Town level

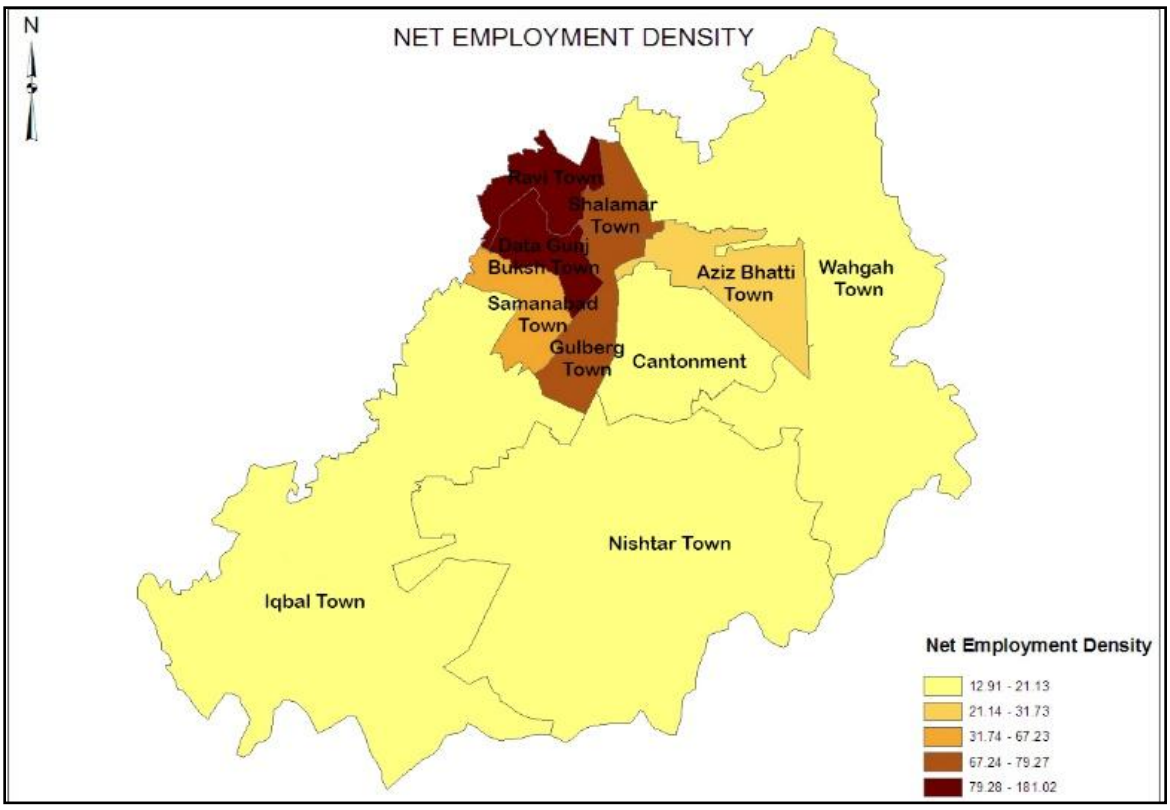


Figure 2: Map of Net Employment Density of Lahore on Town level

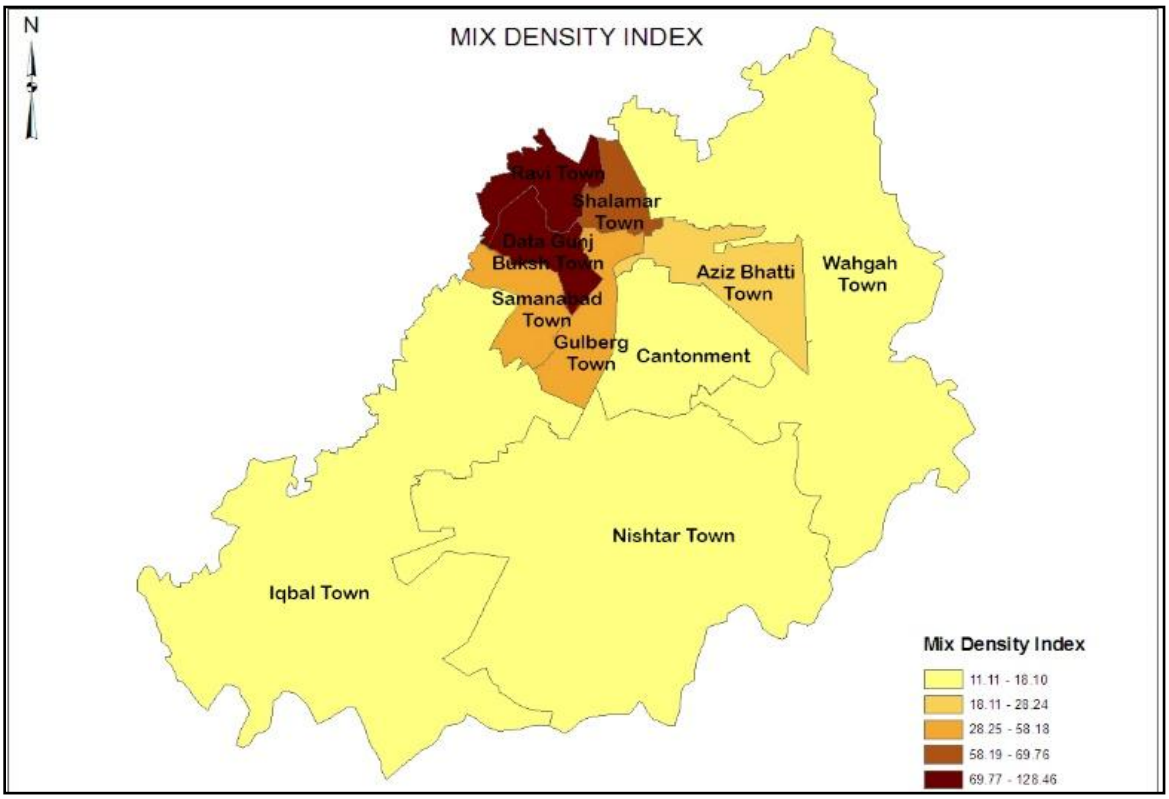


Figure 3: Map of Mix Density Index of Lahore on Town level

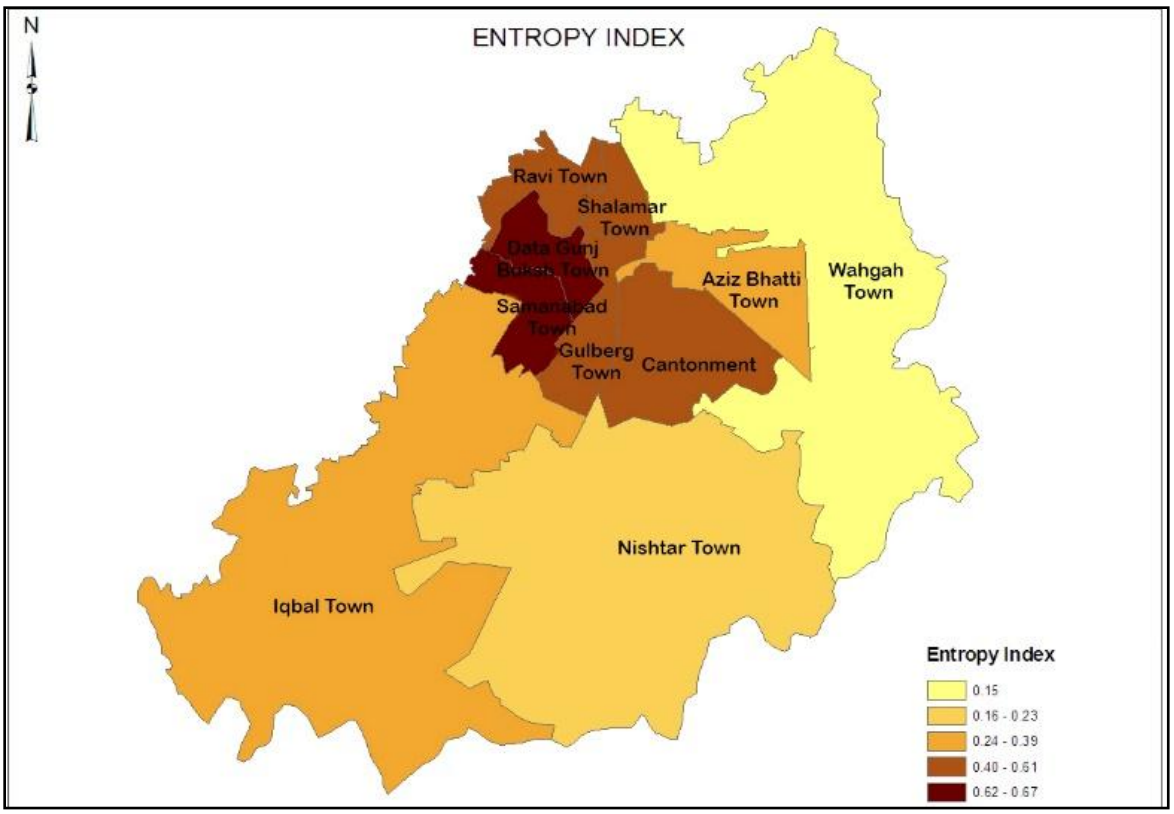


Figure 4: Map of Entropy Index of Lahore on Town level

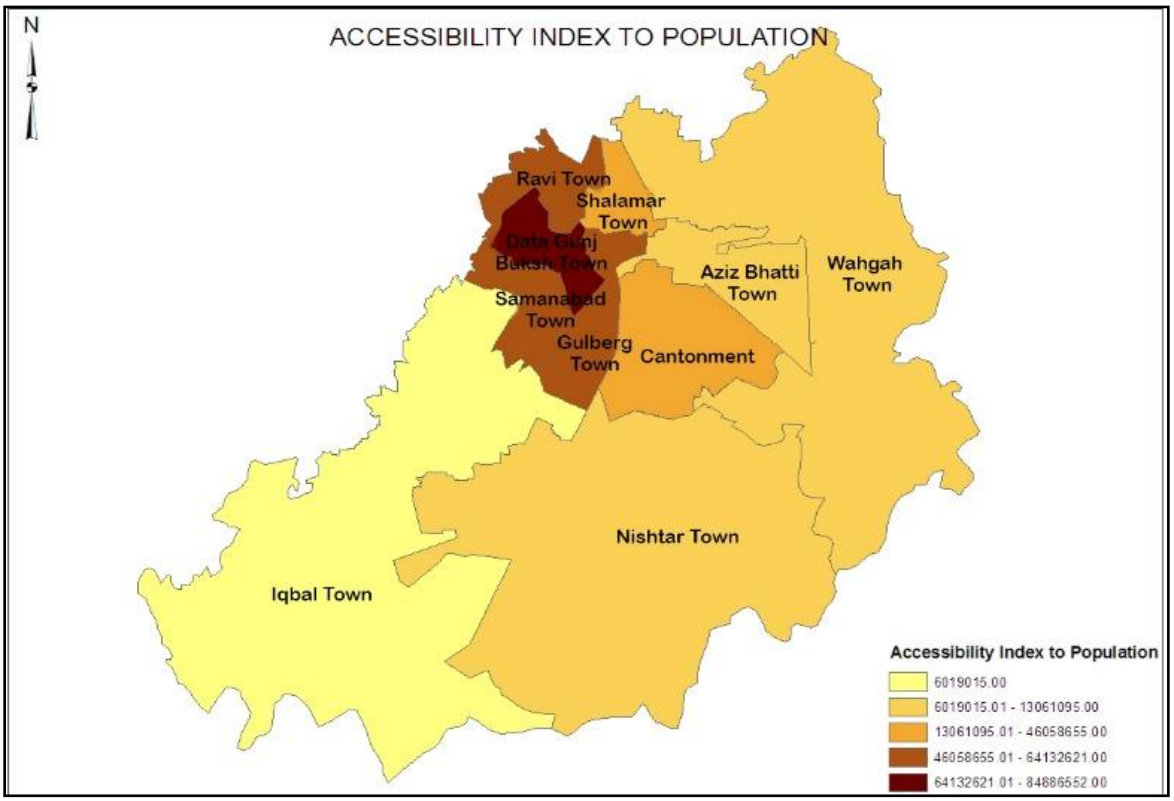


Figure 5: Map of Accessibility Index to Population of Lahore on Town level

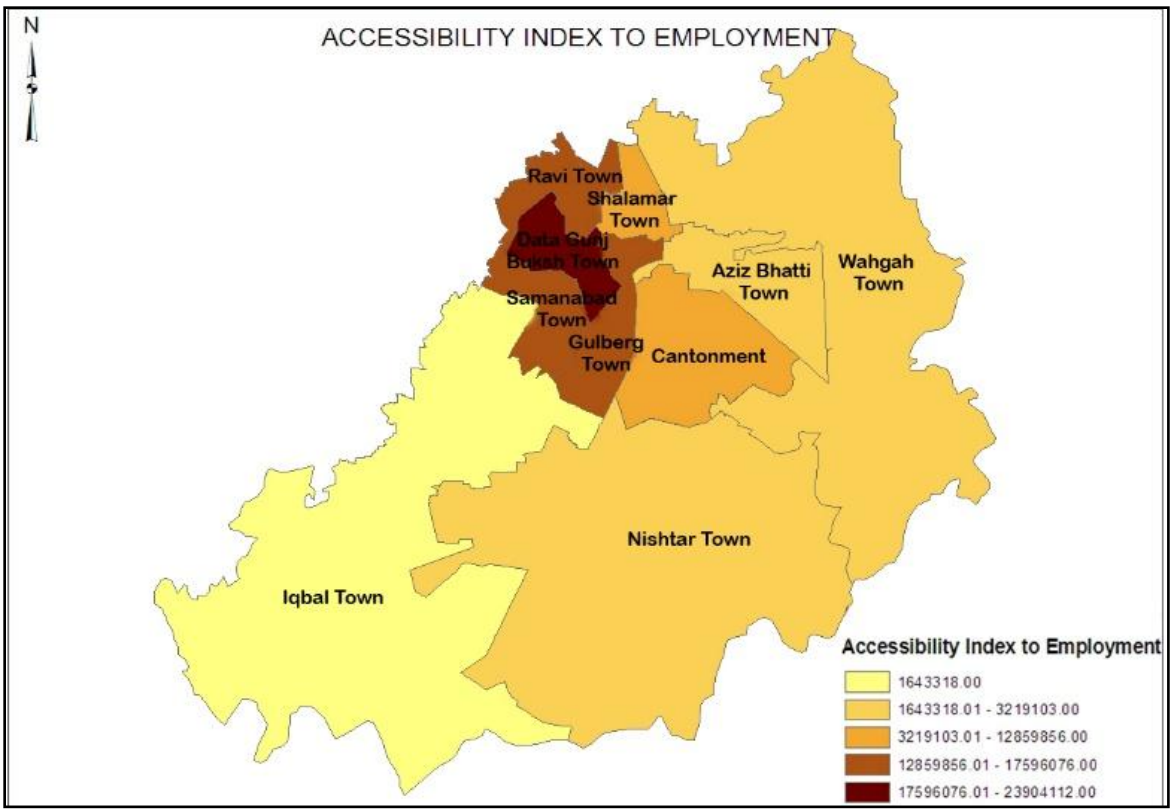


Figure 6: Map of Accessibility Index to Population of Lahore on Town level

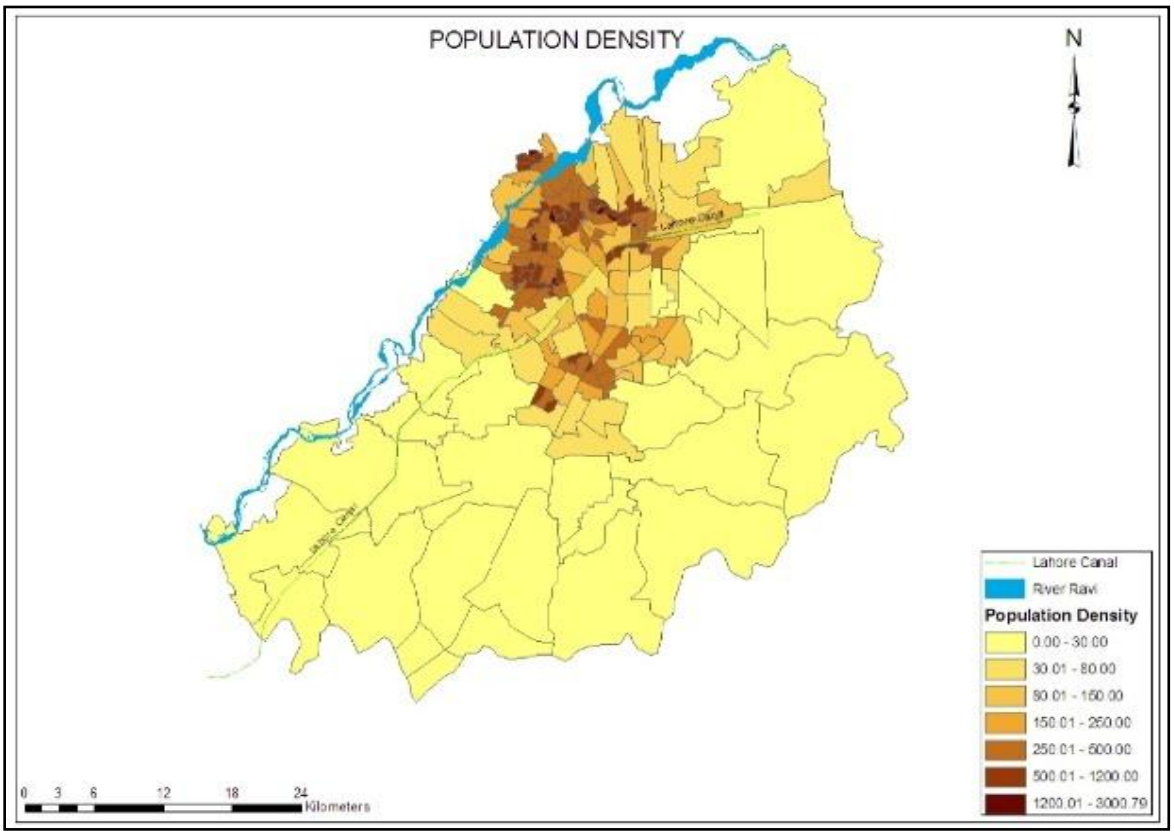


Figure 7: Map of Net Population Density of Lahore on Union Council level

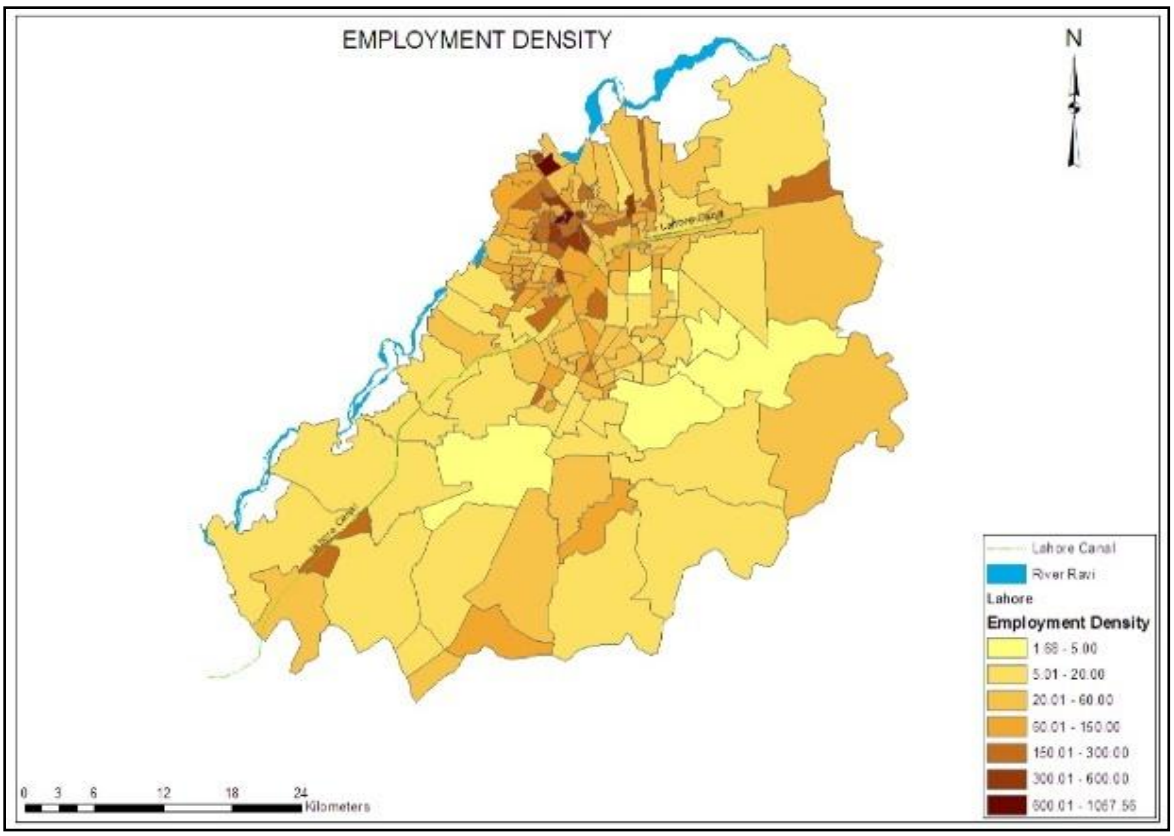


Figure 8: Map of Net Employment Density of Lahore on Union Council level.

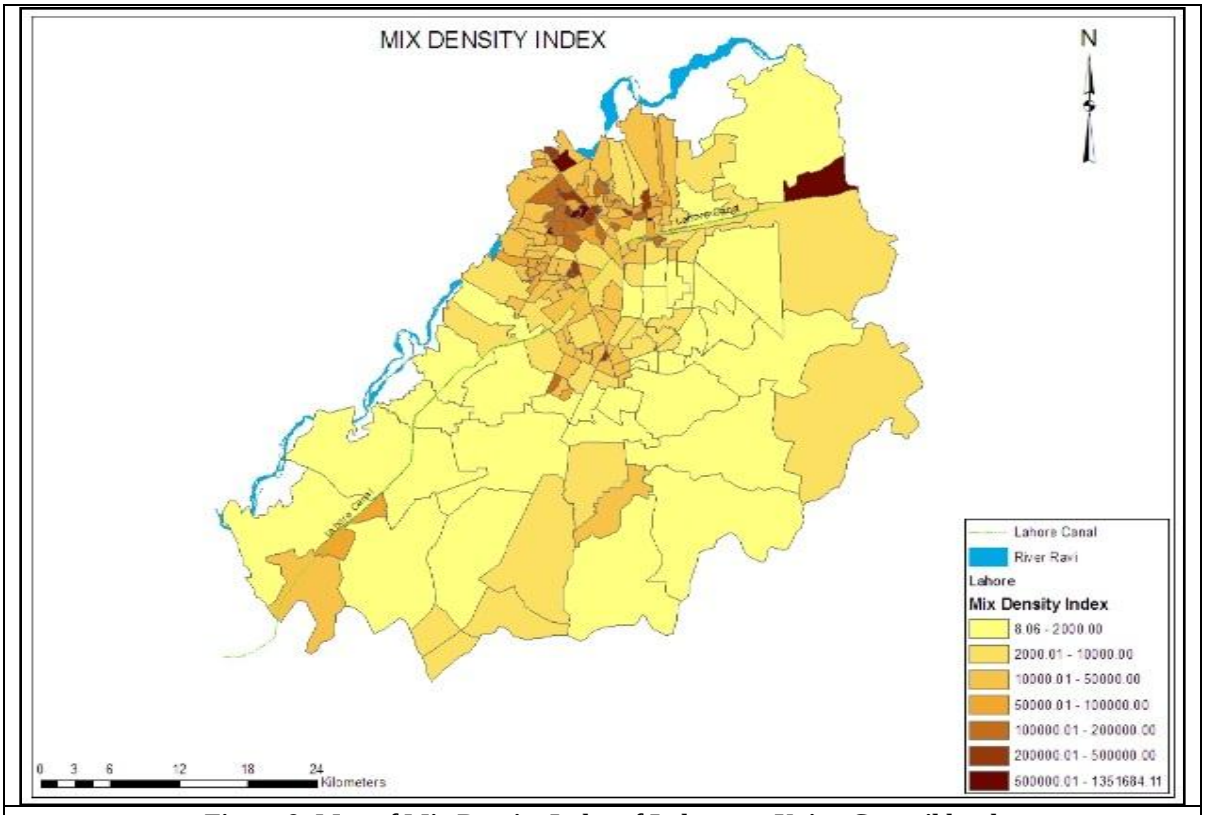


Figure 9: Map of Mix Density Index of Lahore on Union Council level

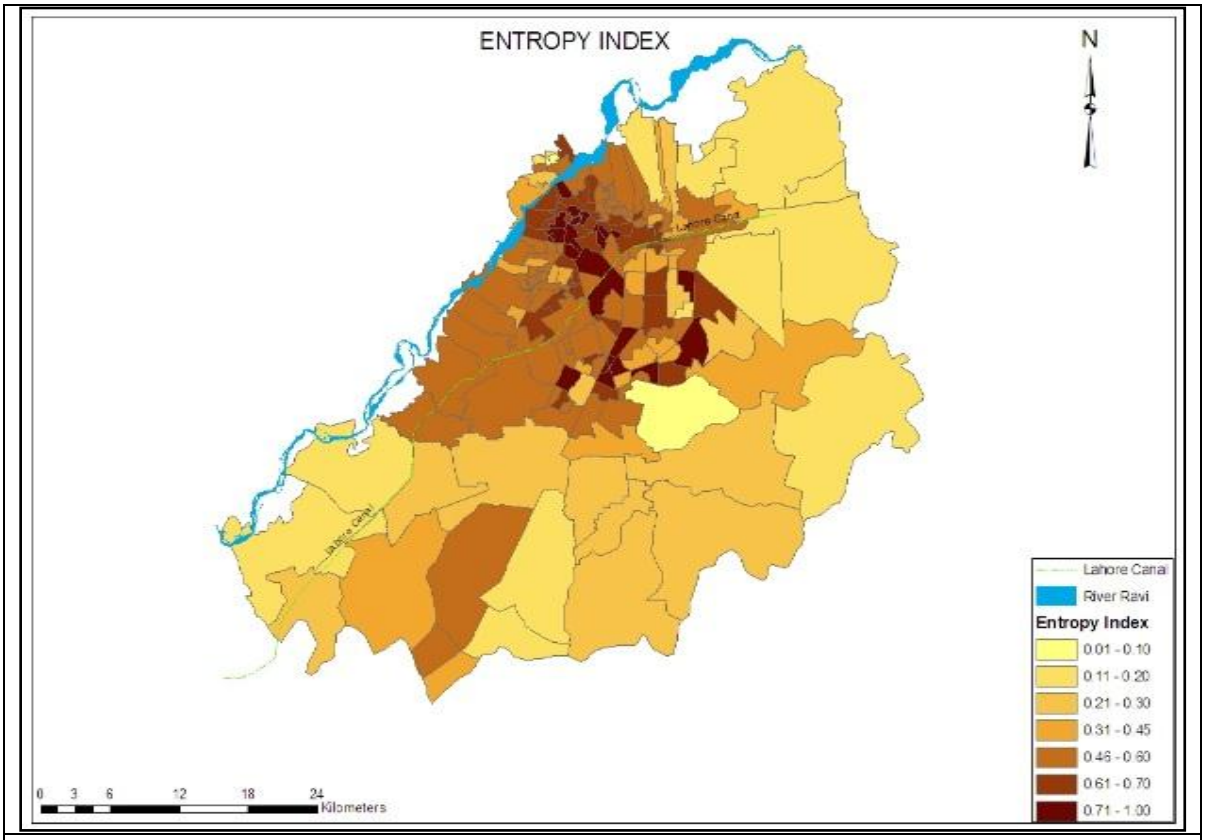


Figure 10: Map of Entropy Index of Lahore on Union Council level

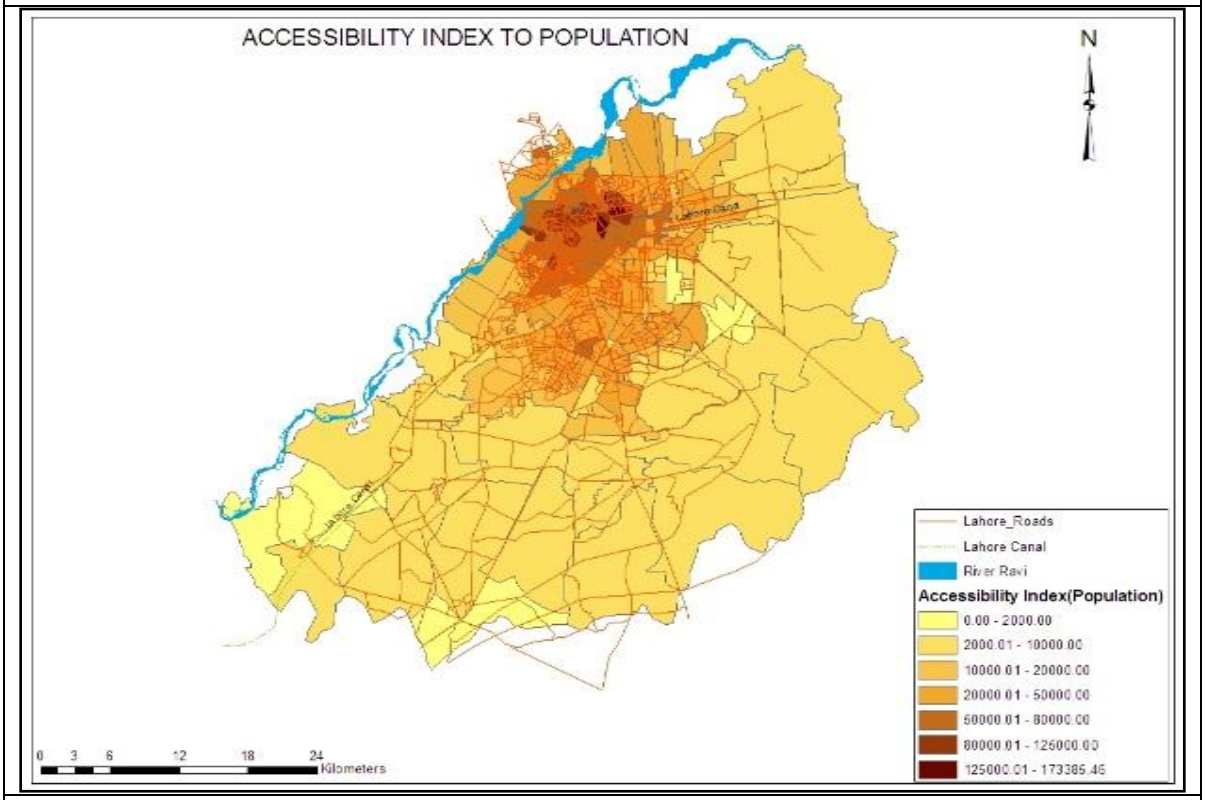


Figure 11: Map of Accessibility Index to Population of Lahore on Union Council level

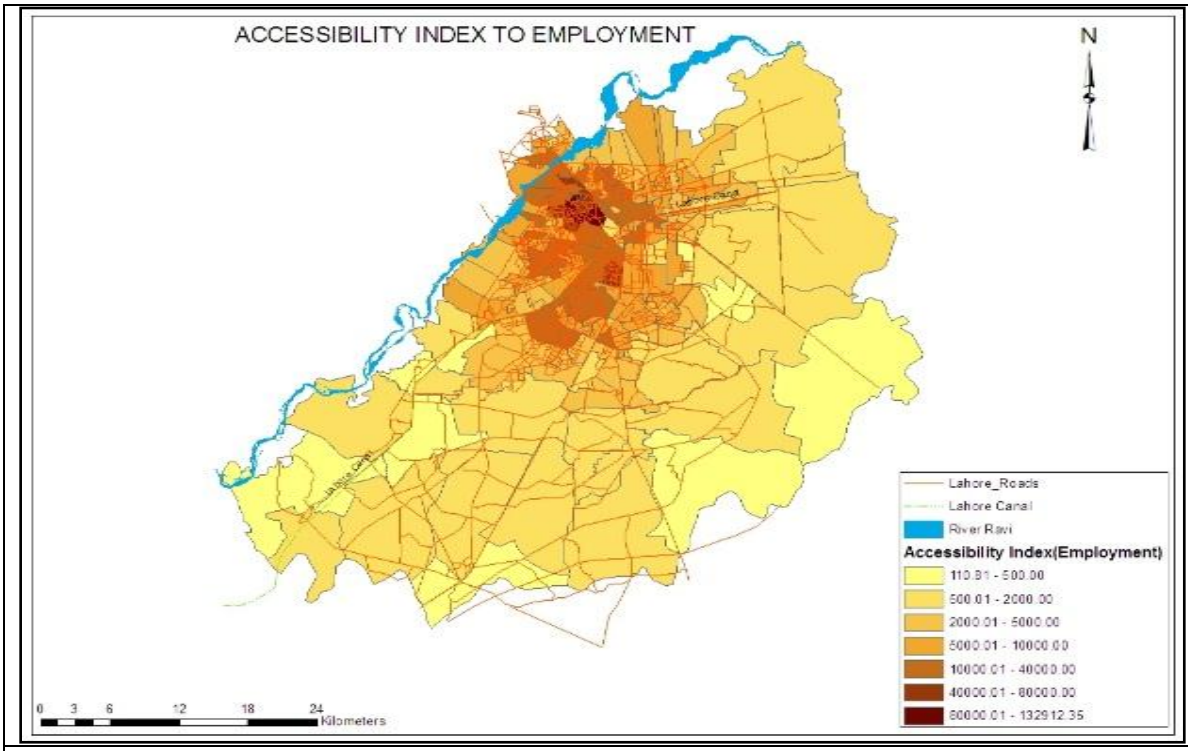
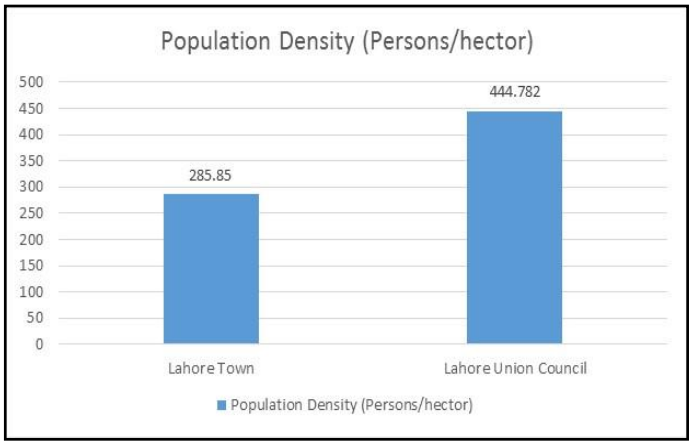
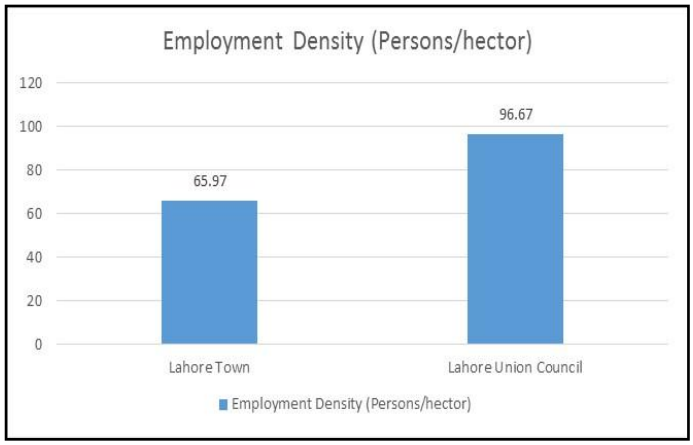


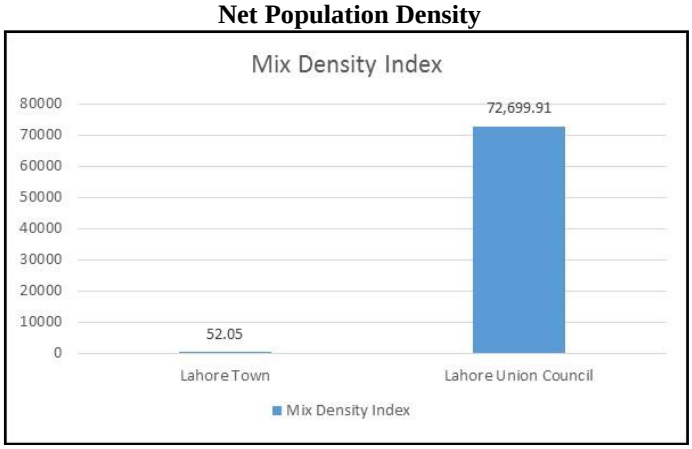
Figure 12: Map of Accessibility Index to Population of Lahore on Union Council level



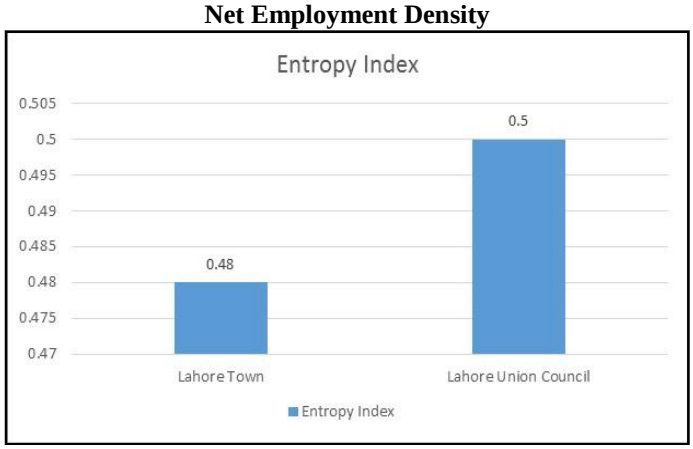
Net Population Density



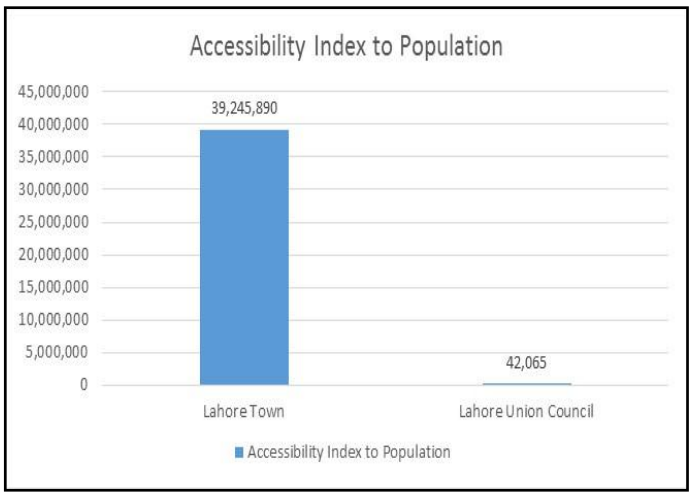
Net Employment Density

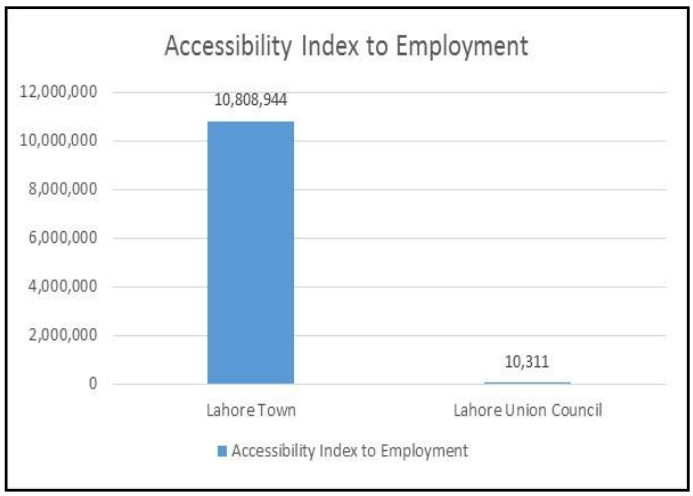


Mix Density Index



Entropy Index





Accessibility Index to Population **Accessibility Index to Employment**

Figure 13: Comparison of Urban form variables (average) of Lahore on Town and Union Council Level

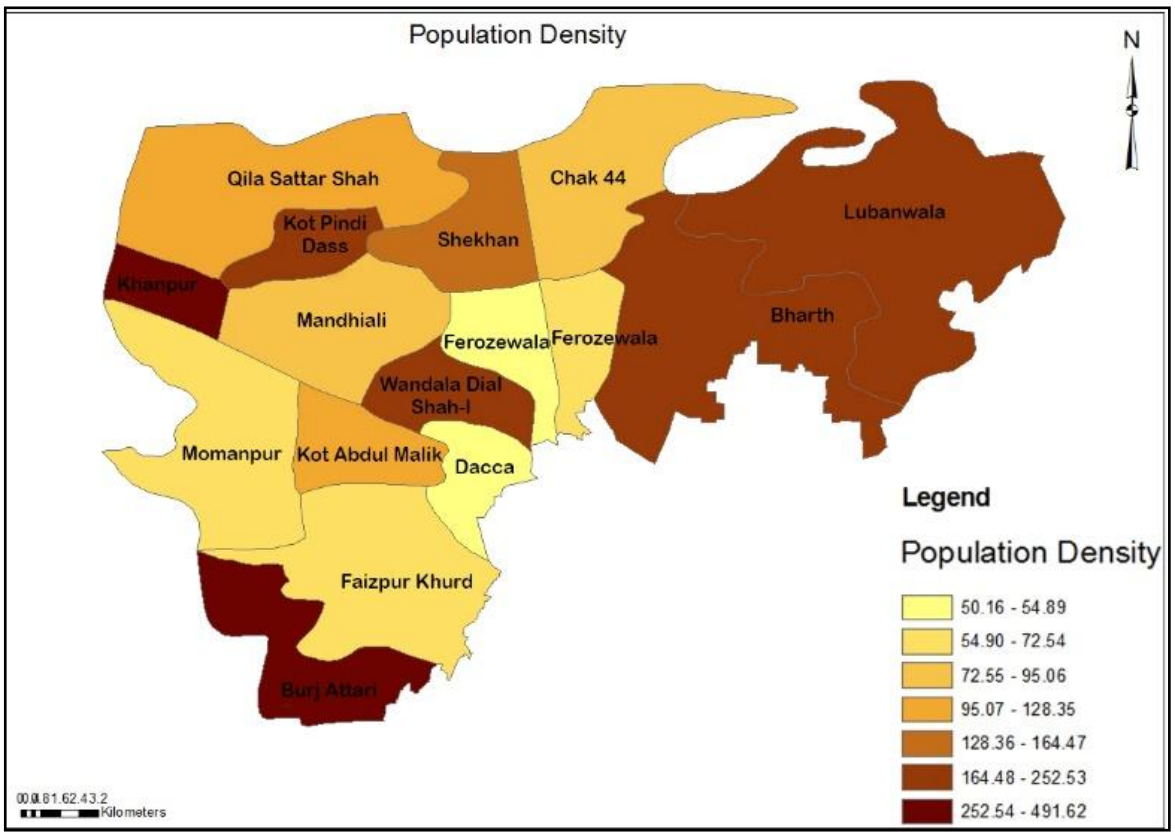


Figure 14: Map of Net Population Density of Ferozewala on Union Council level

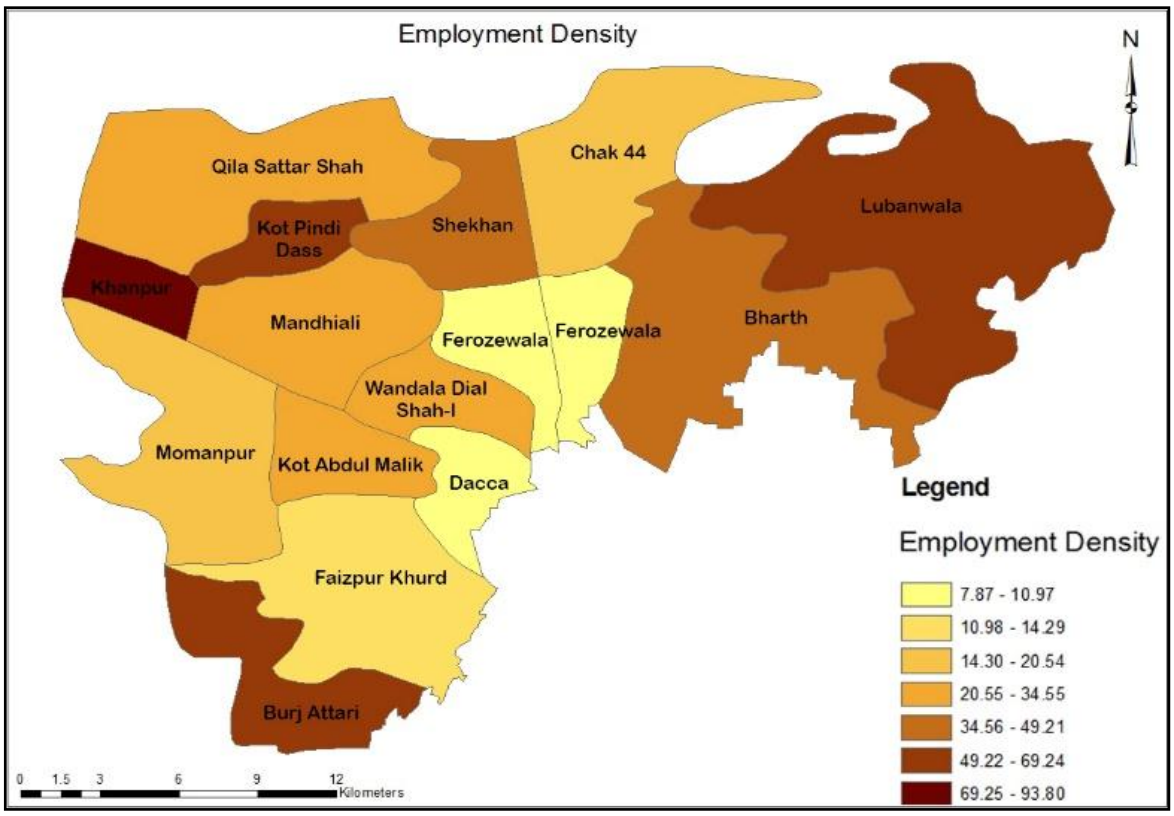


Figure 15: Map of Net Employment Density of Ferozewala on Union Council level

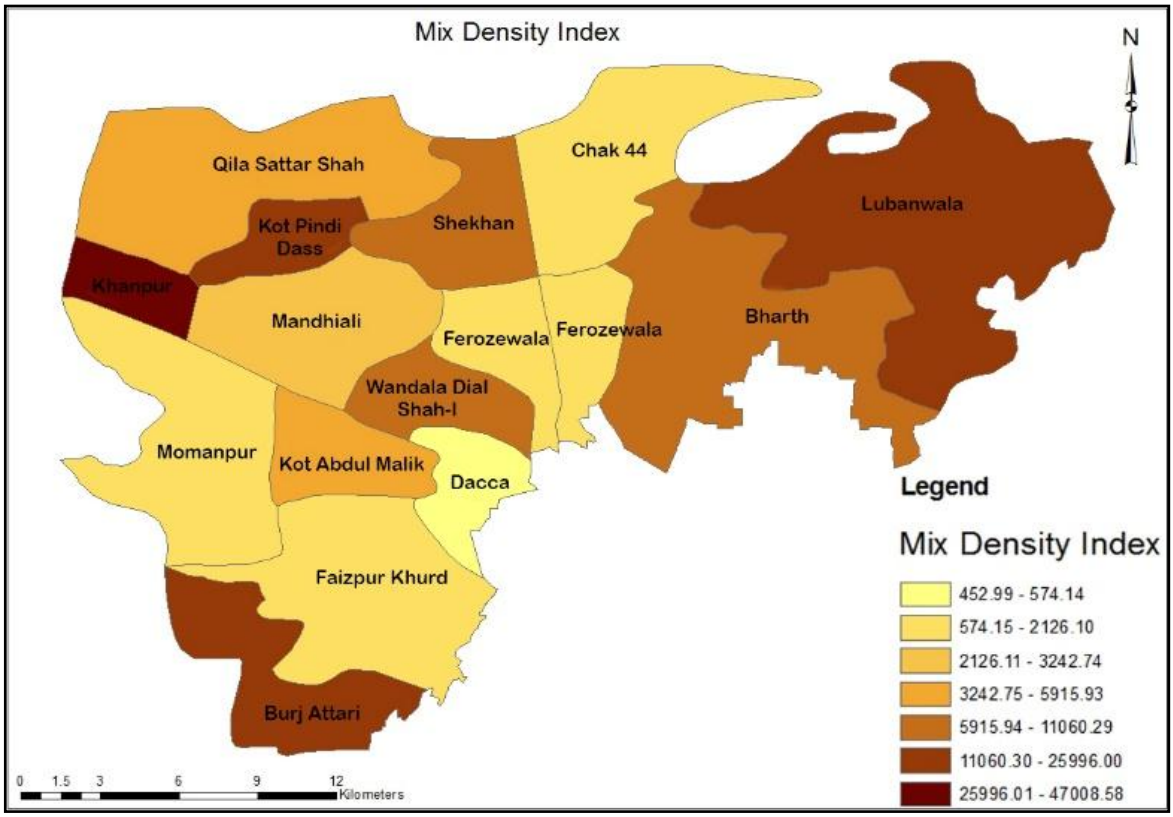


Figure 16: Map of Mix Density Index of Ferozewala on Union Council level

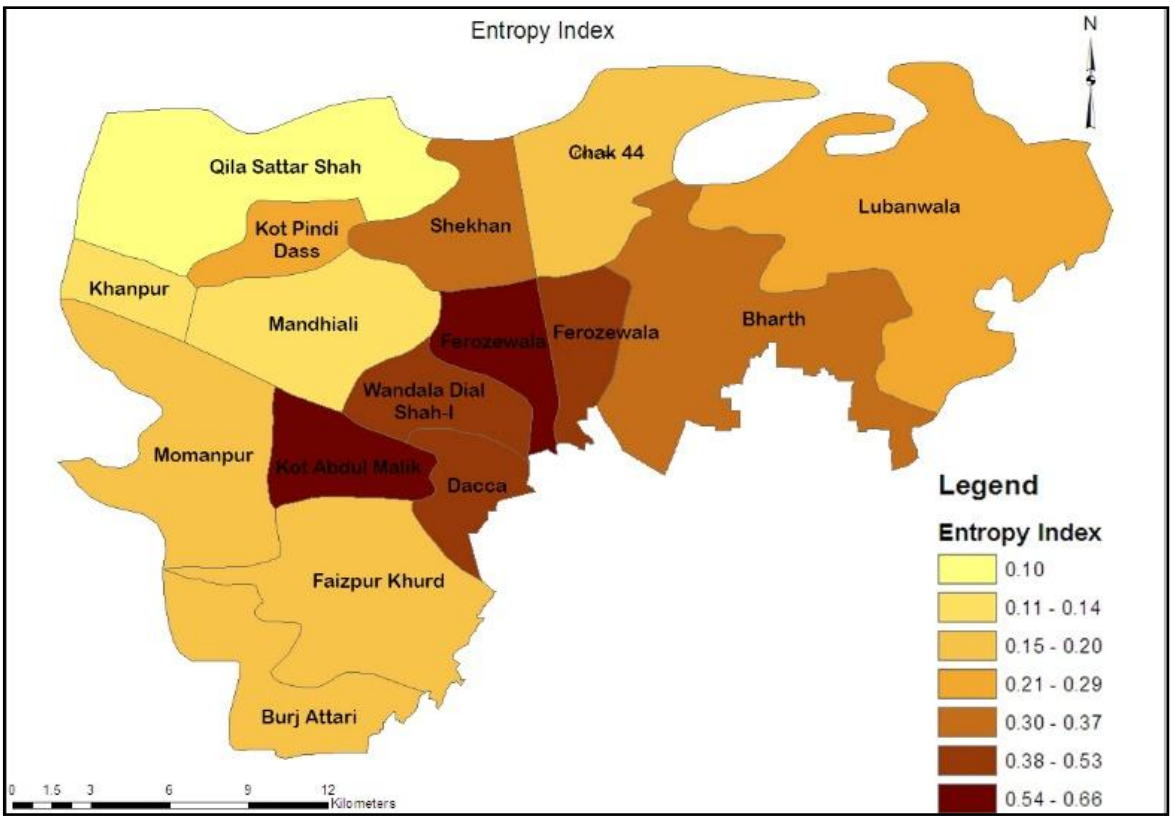


Figure 17: Map of Entropy Index of Ferozewala on Union Council level

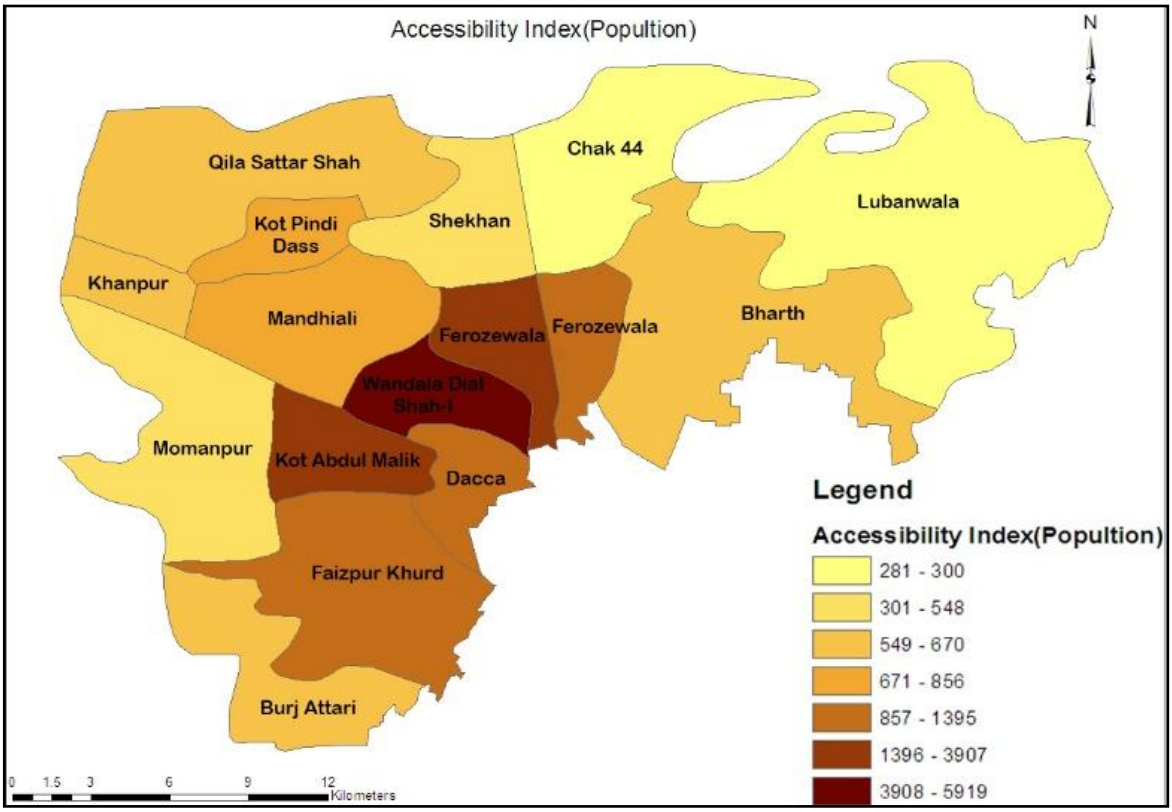


Figure 18: Map of Accessibility Index to Population of Ferozewala on Union Council level

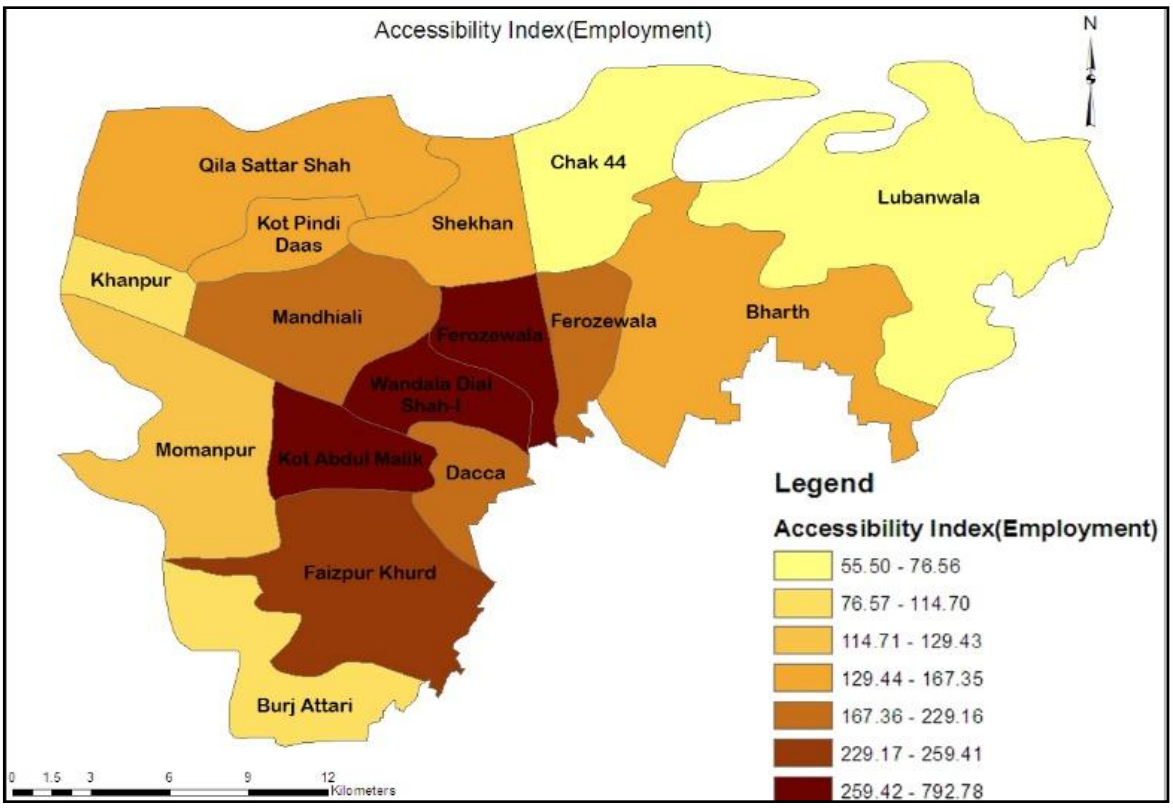


Figure 19: Map of Accessibility Index to Population of Ferozewala on Union Council level

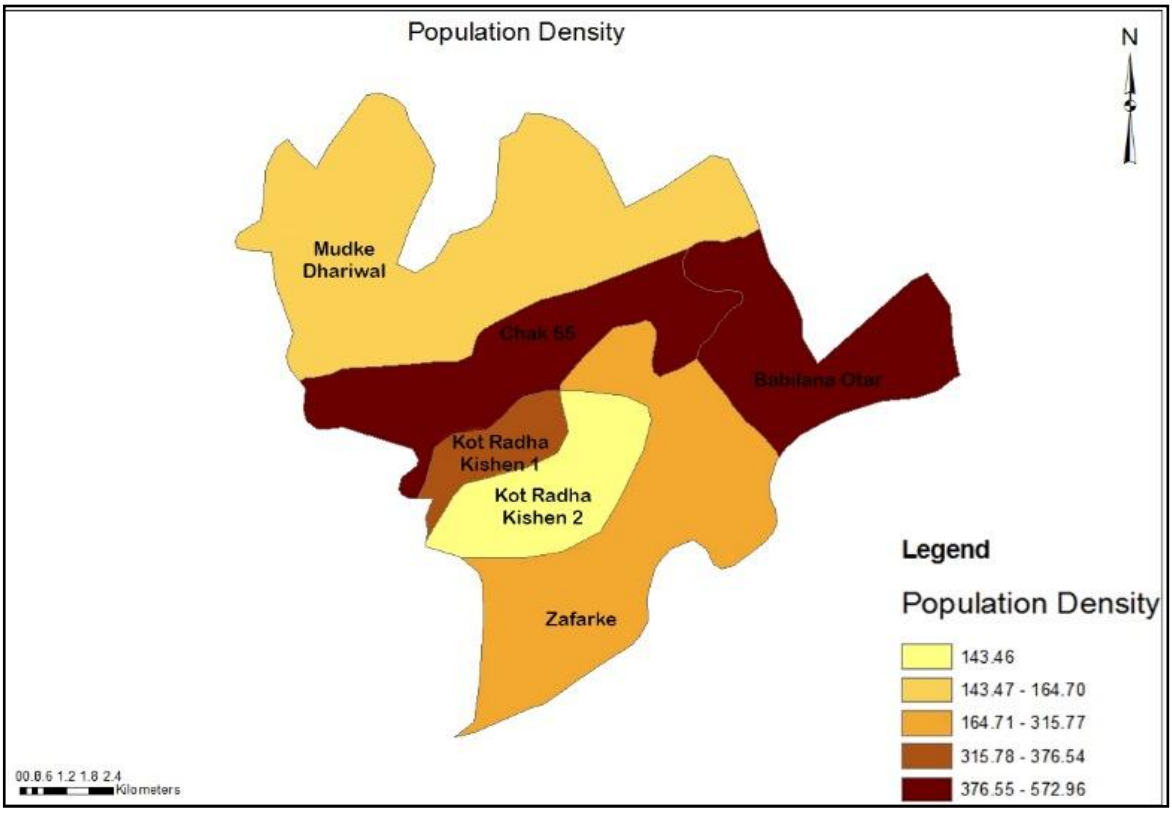


Figure 20: Map of Net Population Density of Kasur on Union Council level

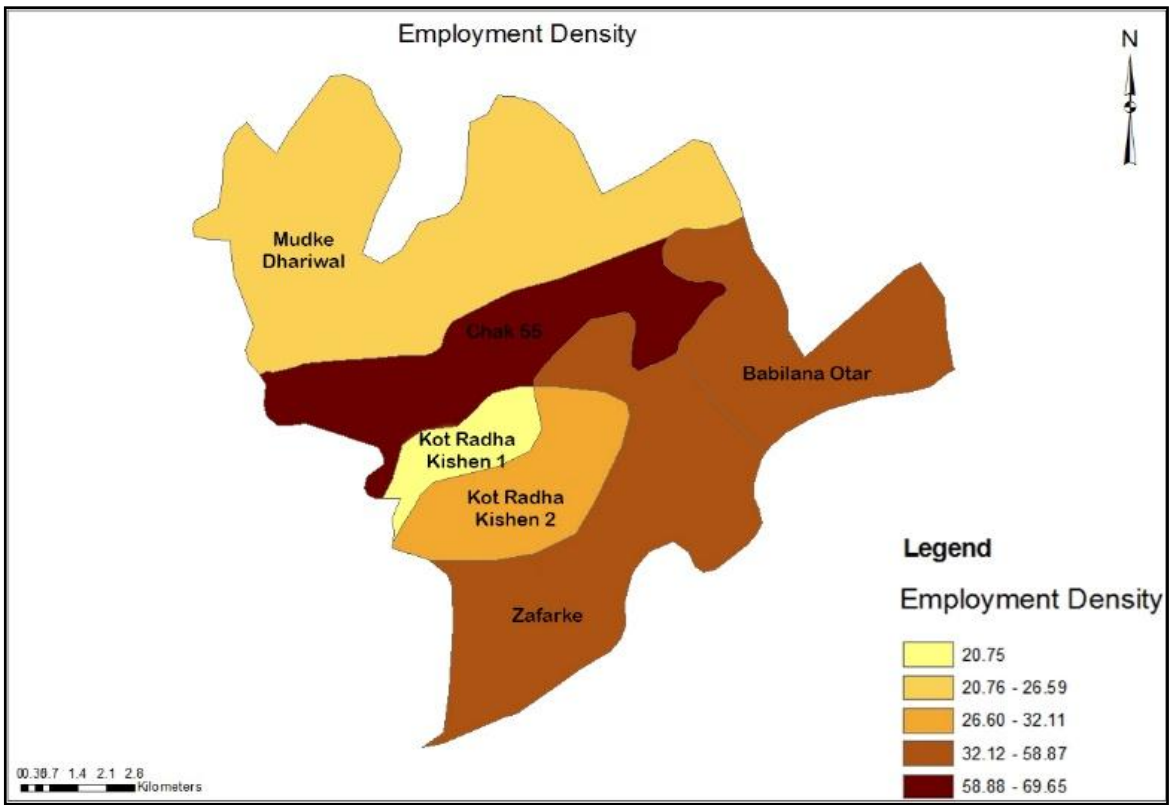


Figure 21: Map of Net Employment Density of Kasur on Union Council level

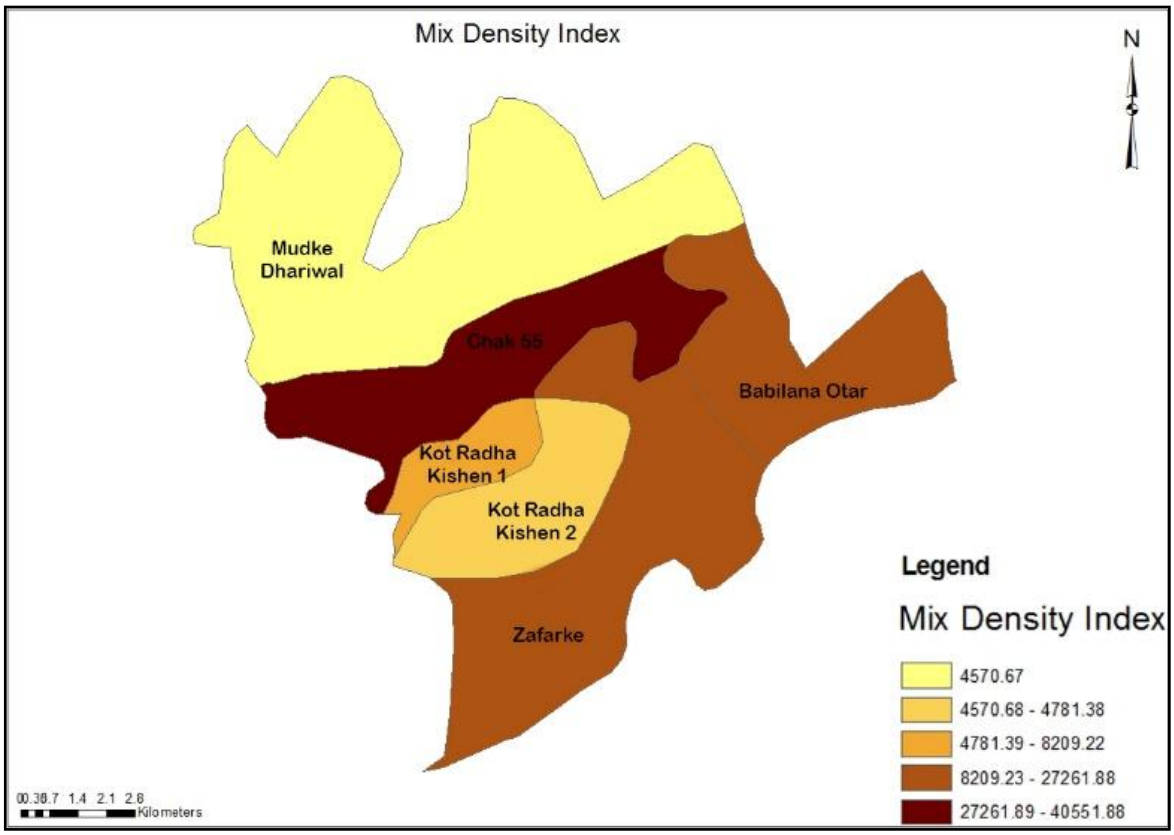


Figure 22: Map of Mix Density Index of Kasur on Union Council level

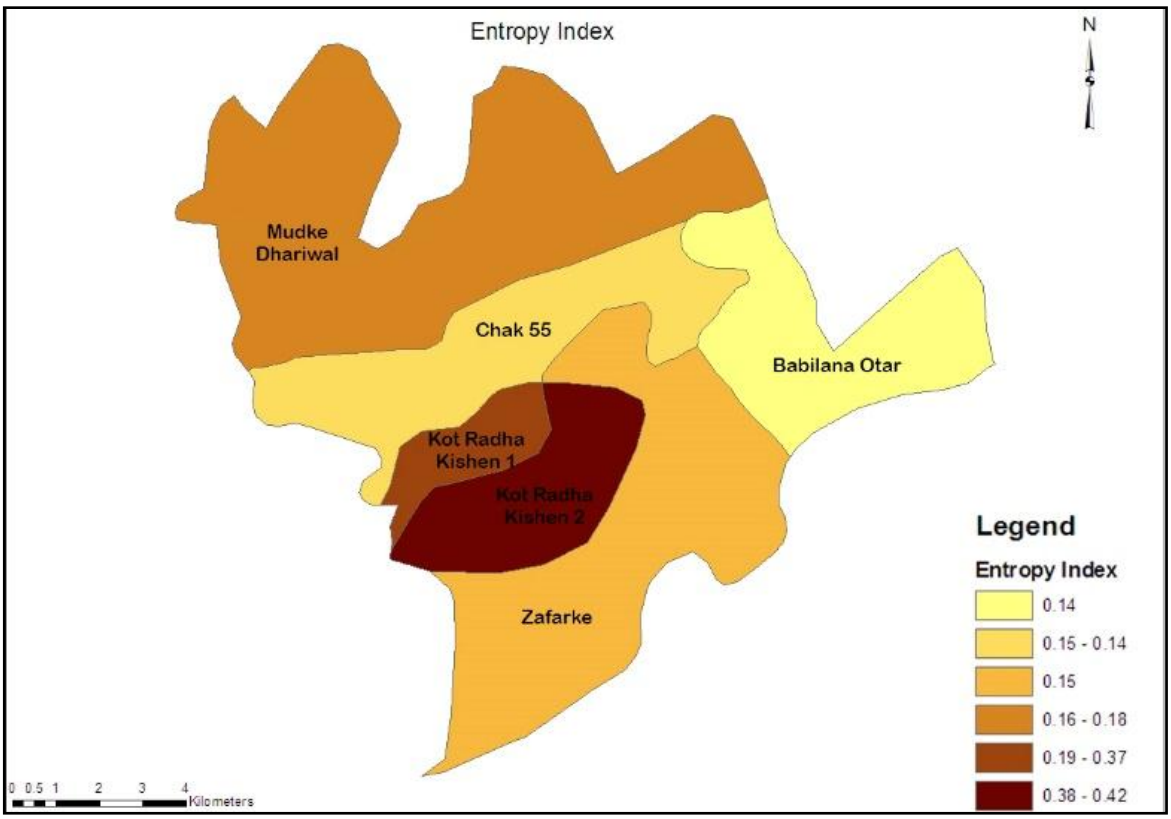


Figure 23: Map of Entropy Index of Kasur on Union Council level

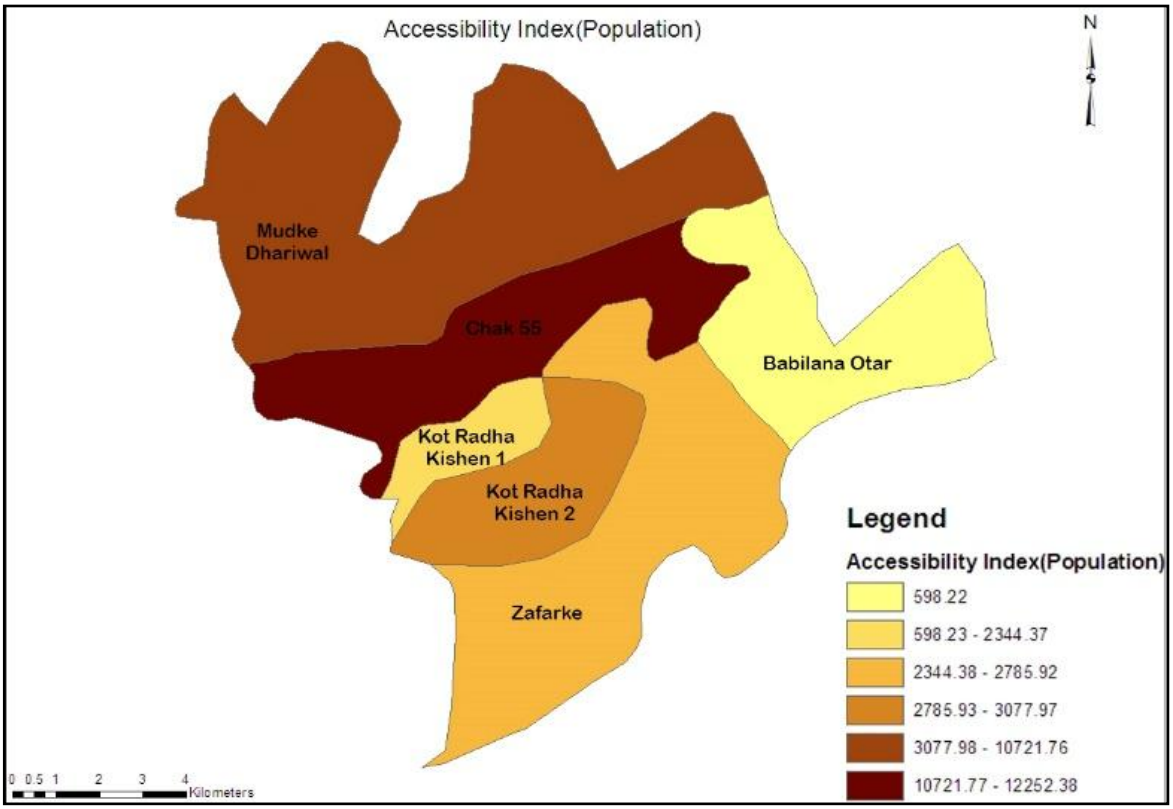


Figure 24: Map of Accessibility Index to Population of Kasur on Union Council level

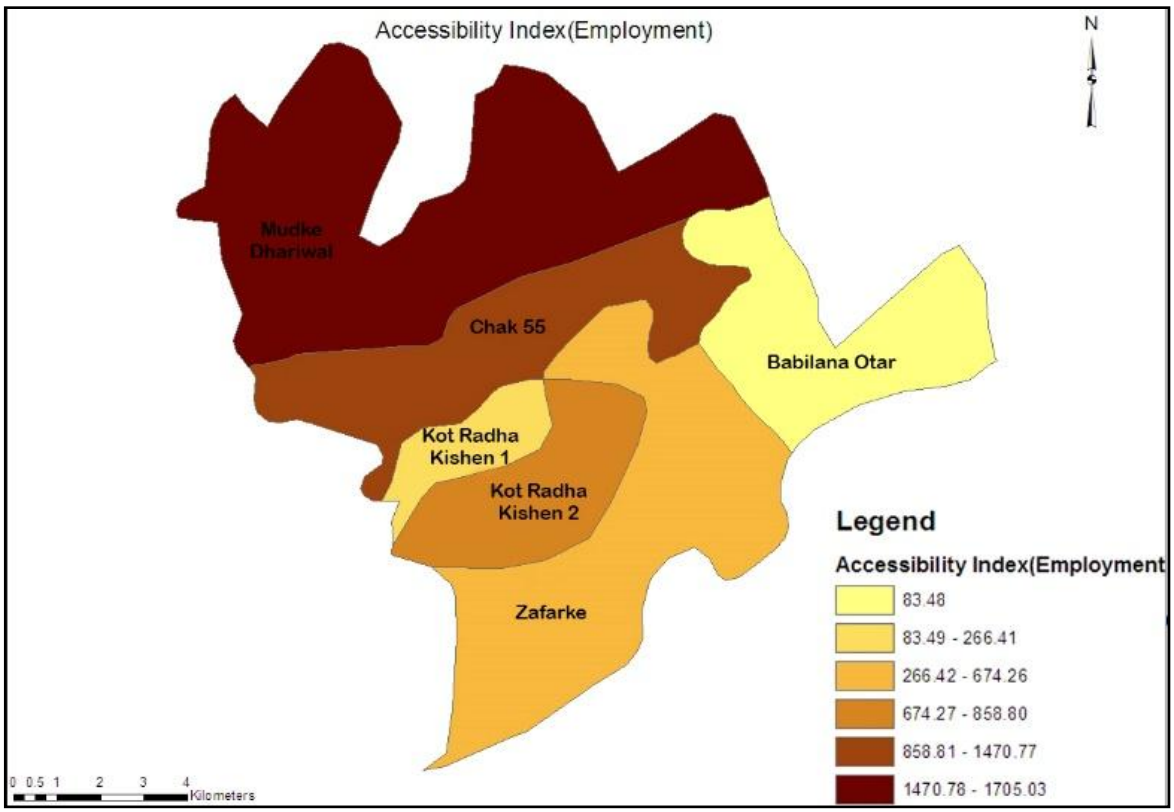


Figure 25: Map of Accessibility Index to Employment of Kasur on Union Council level

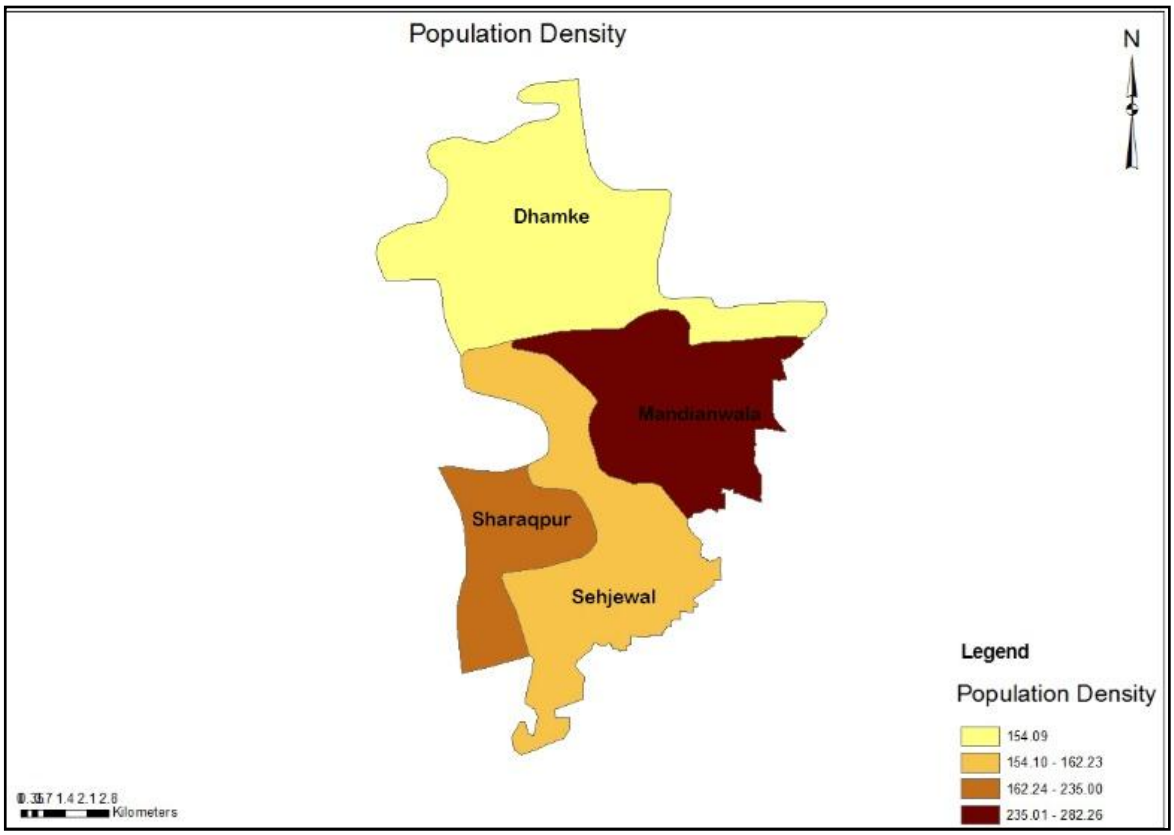


Figure 26: Map of Net Population Density of Sharaqpur on Union Council level

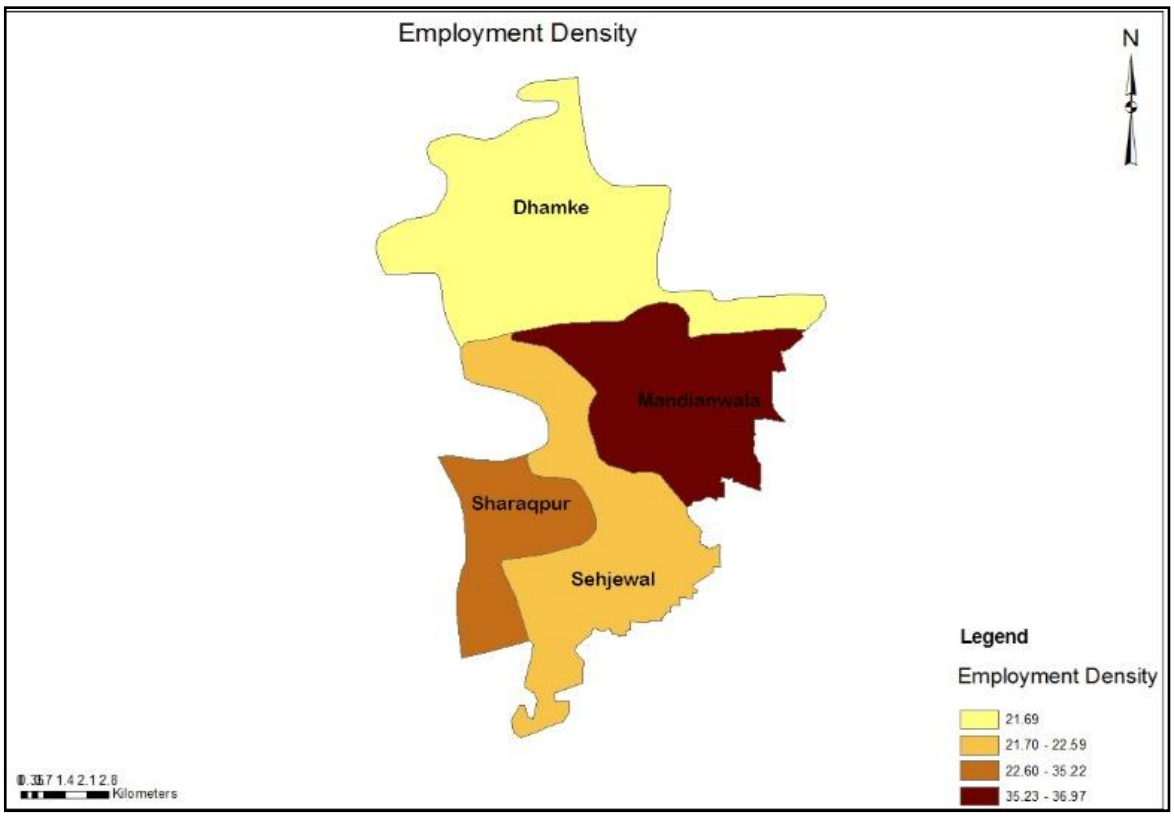


Figure 27: Map of Net Employment Density of Sharaqpur on Union Council level

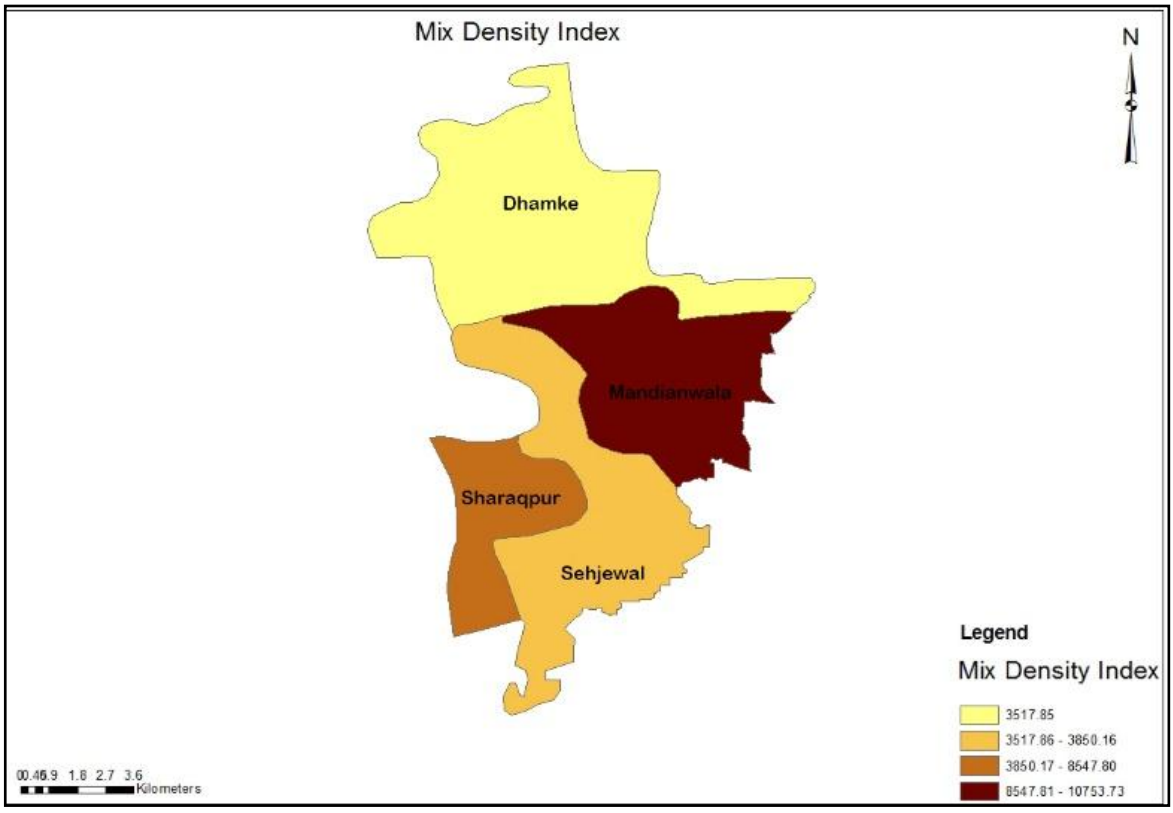


Figure 28: Map of Mix Density Index of Sharaqpur on Union Council level

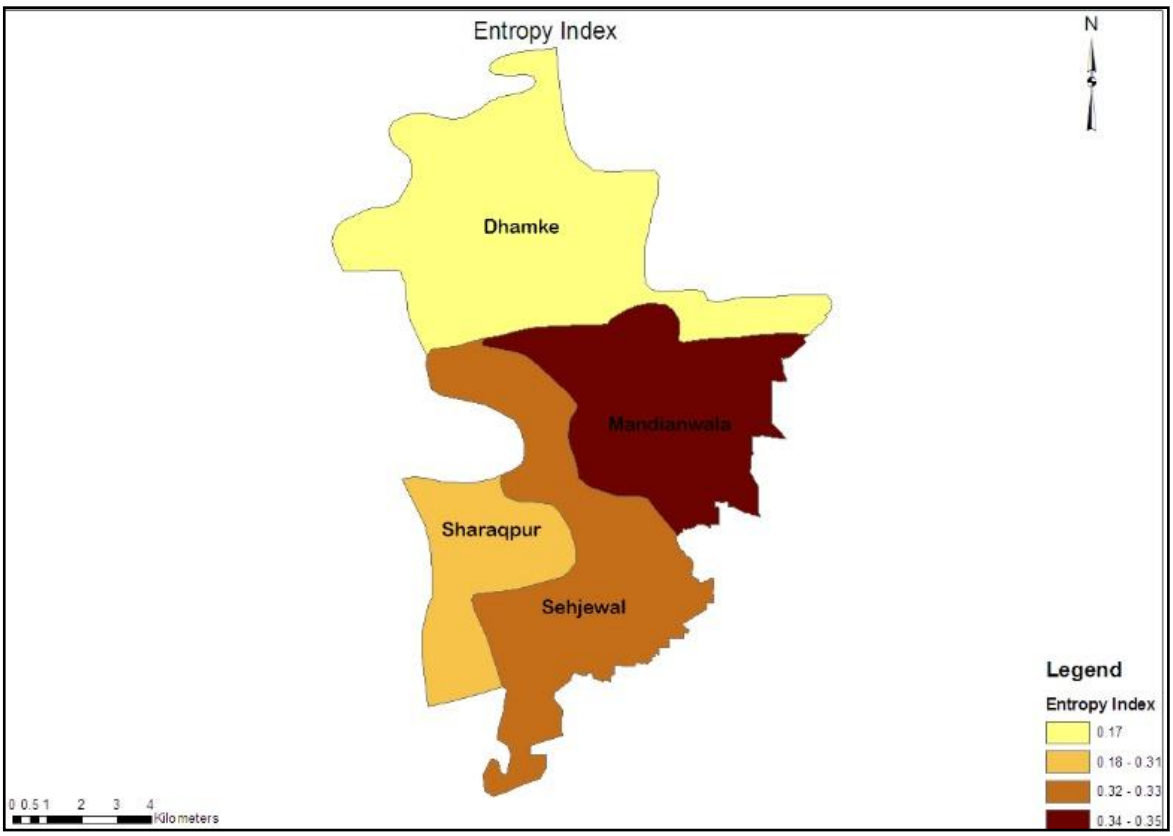


Figure 29: Map of Entropy Index of Sharaqpur on Union Council level

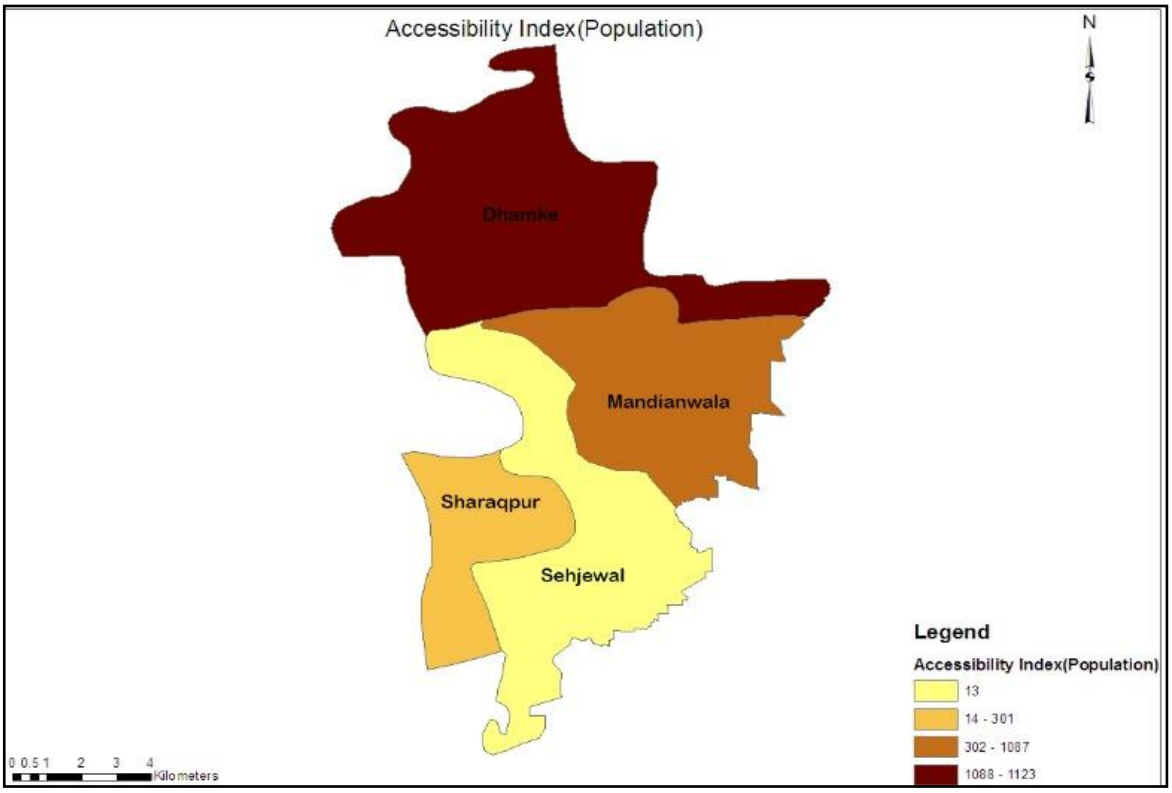


Figure 30: Map of Accessibility Index to Population of Sharaqpur on Union Council level

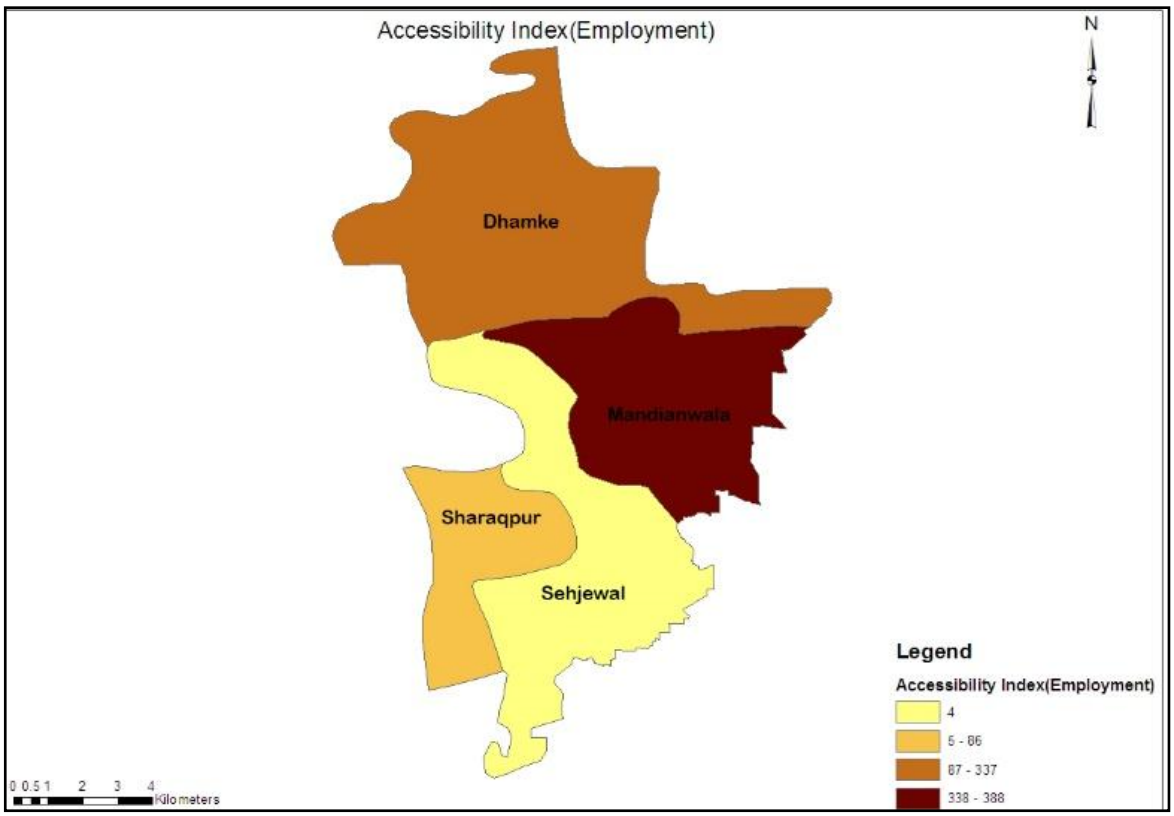


Figure 31: Map of Accessibility Index to Employment of Sharaqpur on Union Council level

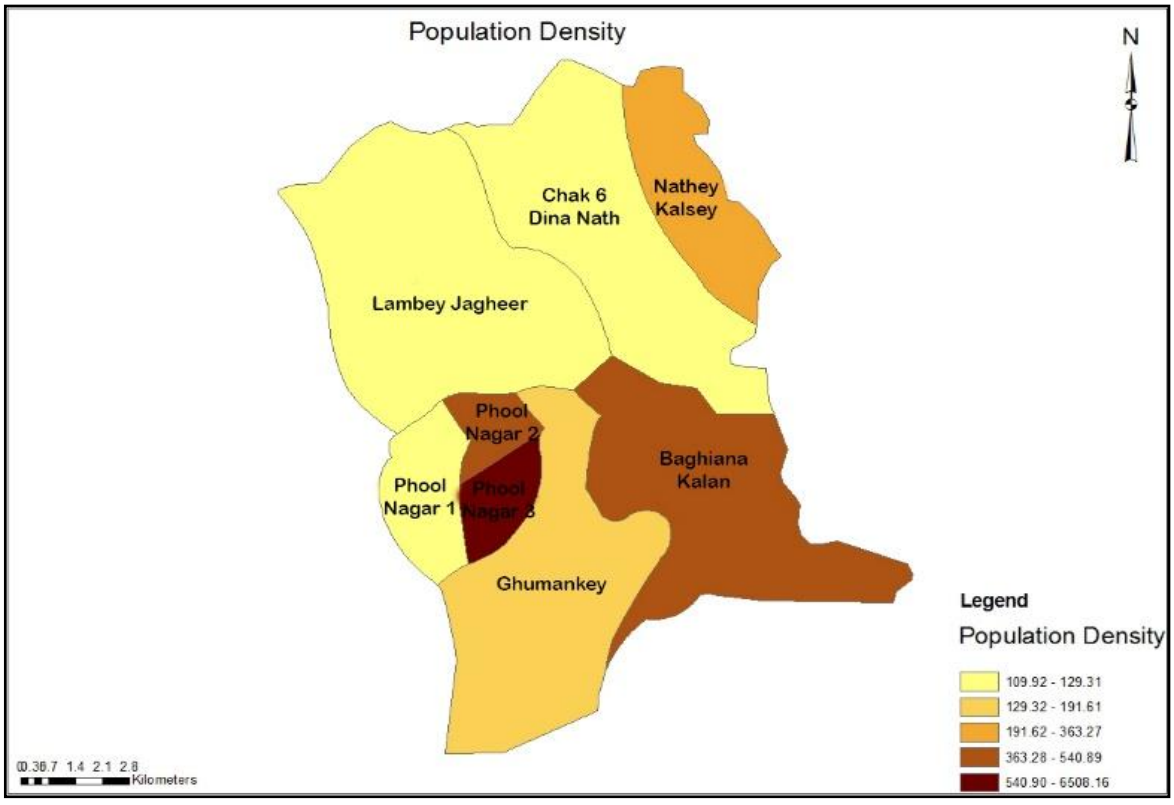


Figure 32: Map of Net Population Density of Pattoki on Union Council level

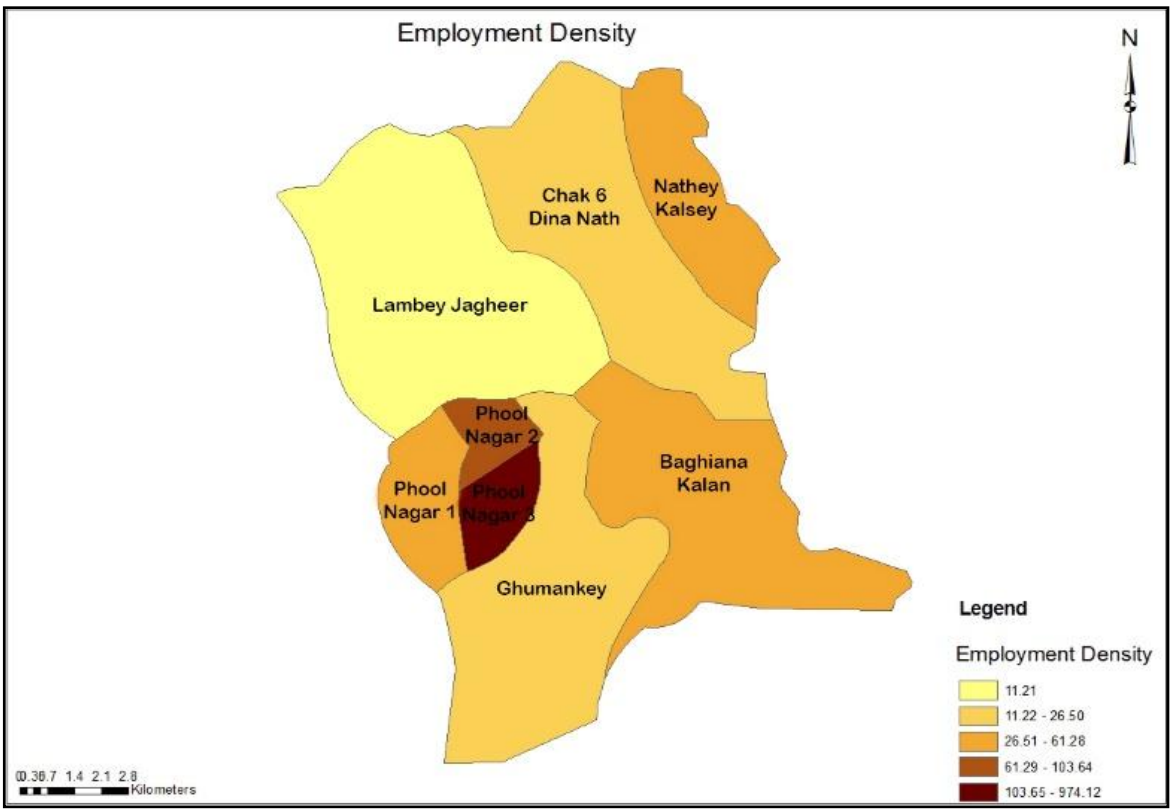


Figure 33: Map of Net Employment Density of Pattoki on Union Council level

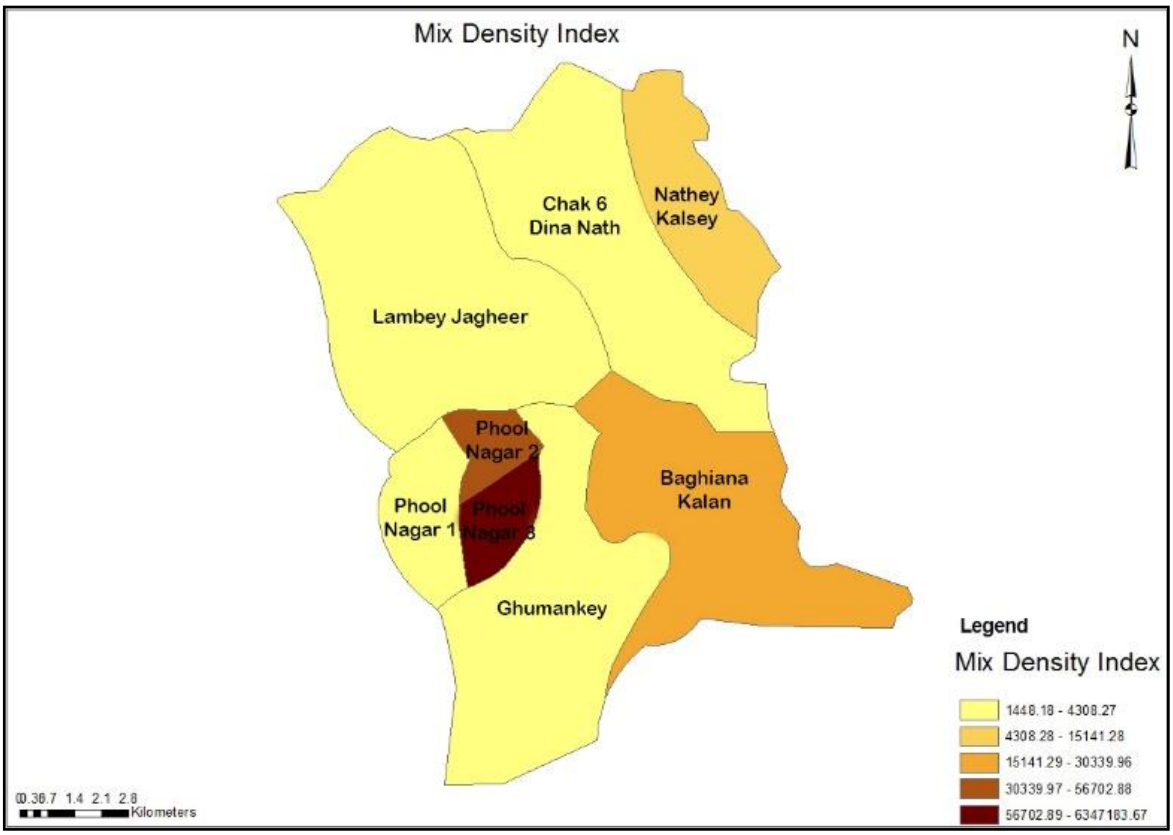


Figure 34: Map of Mix Density Index of Pattoki on Union Council level

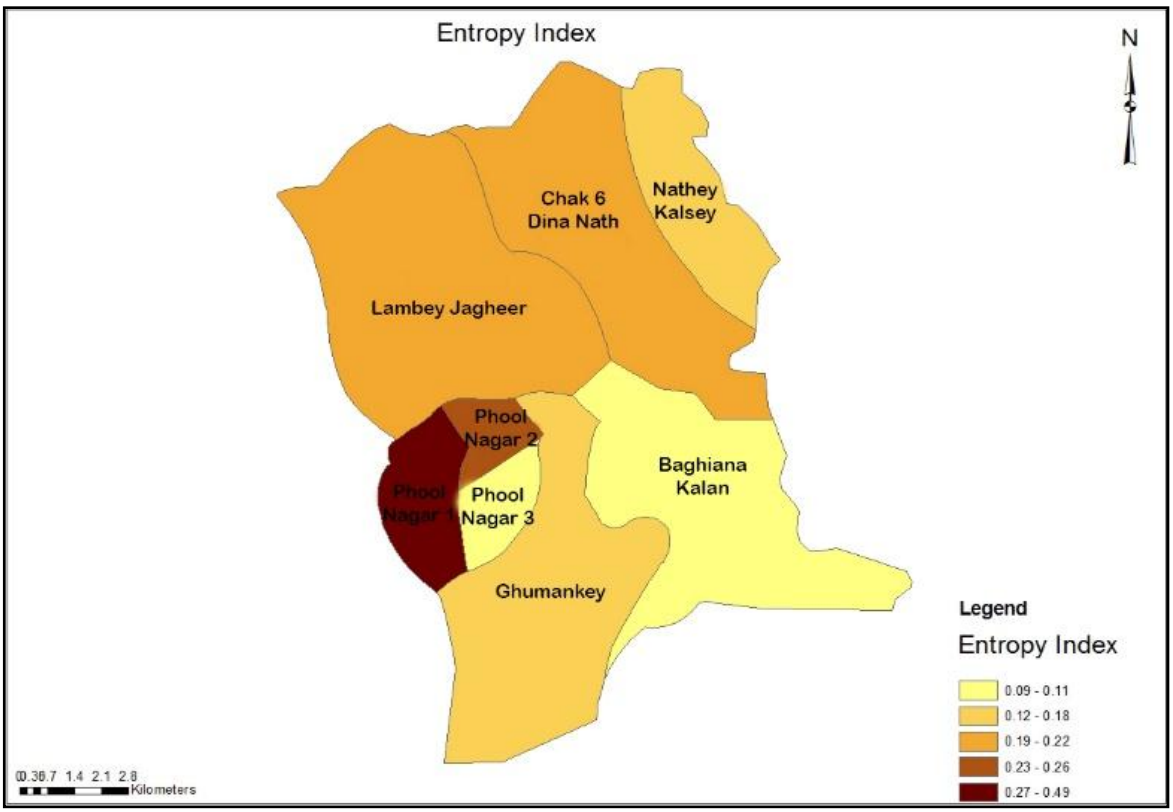


Figure 35: Map of Entropy Index of Pattoki on Union Council level

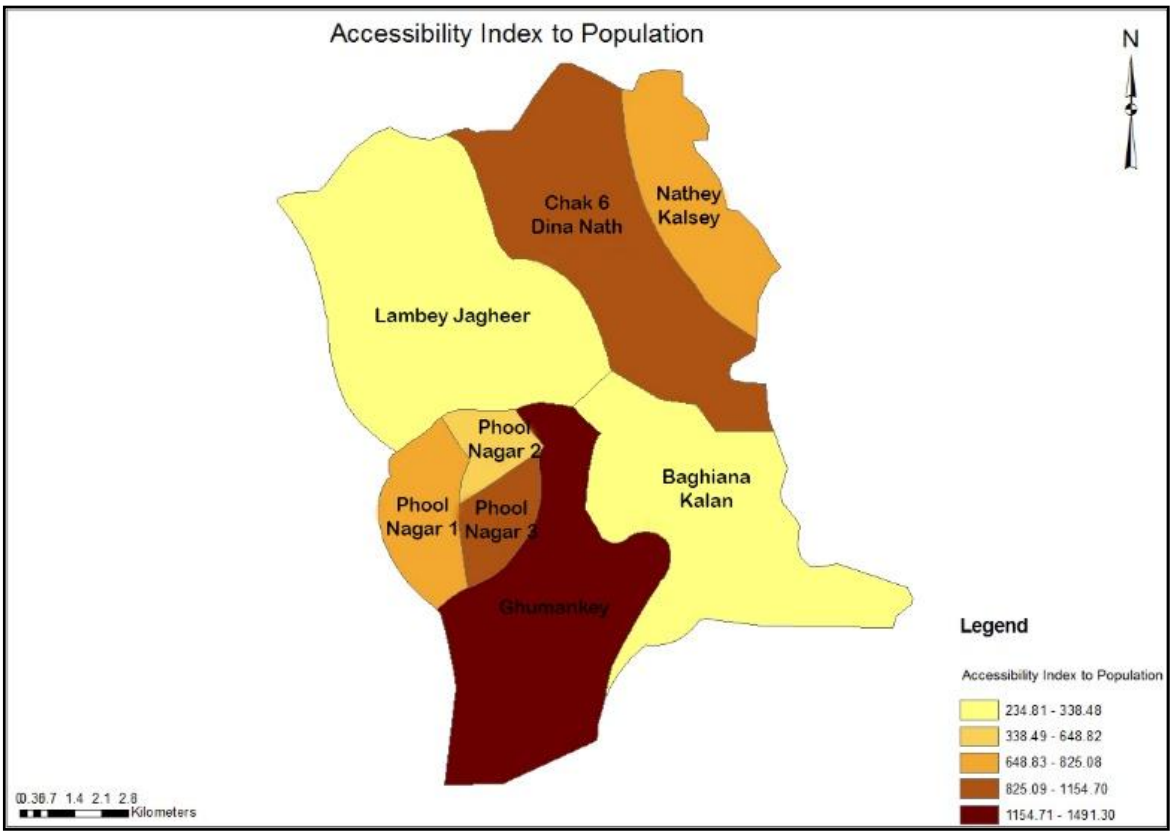


Figure 36: Map of Accessibility Index to Population of Pattoki on Union Council level

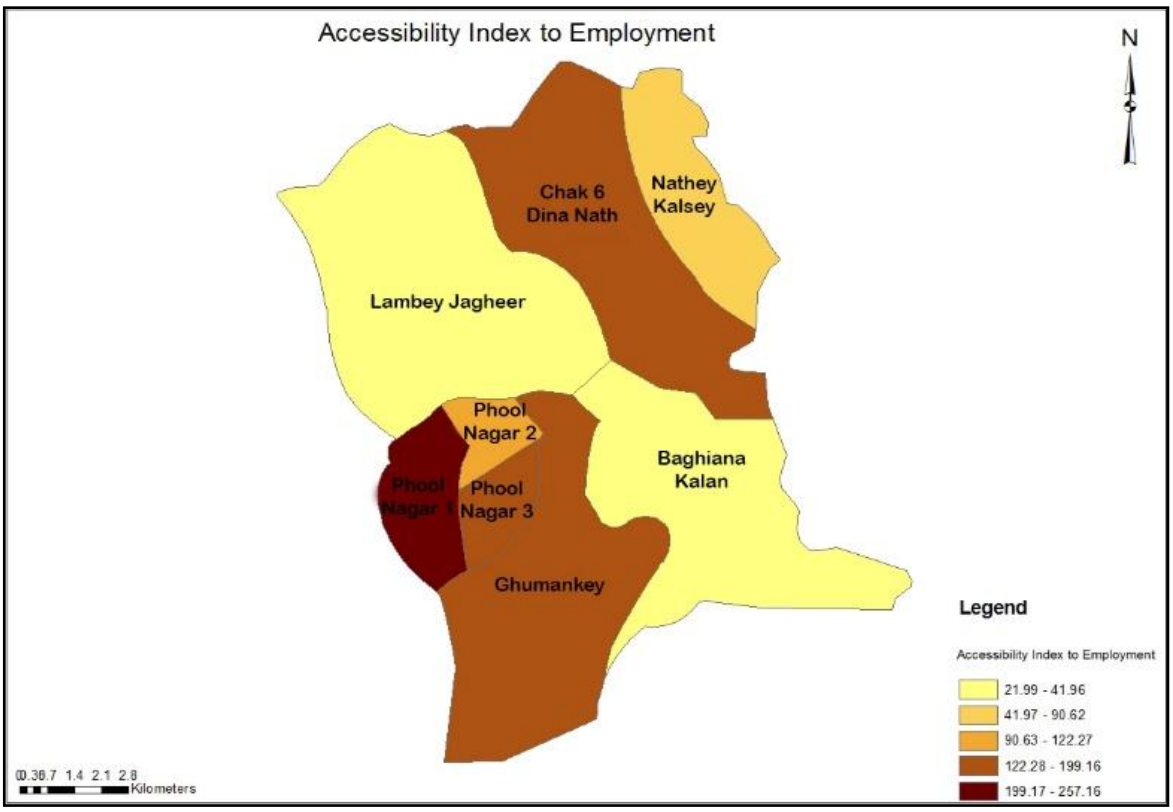


Figure 37: Map of Accessibility Index to Employment of Pattoki on Union Council level

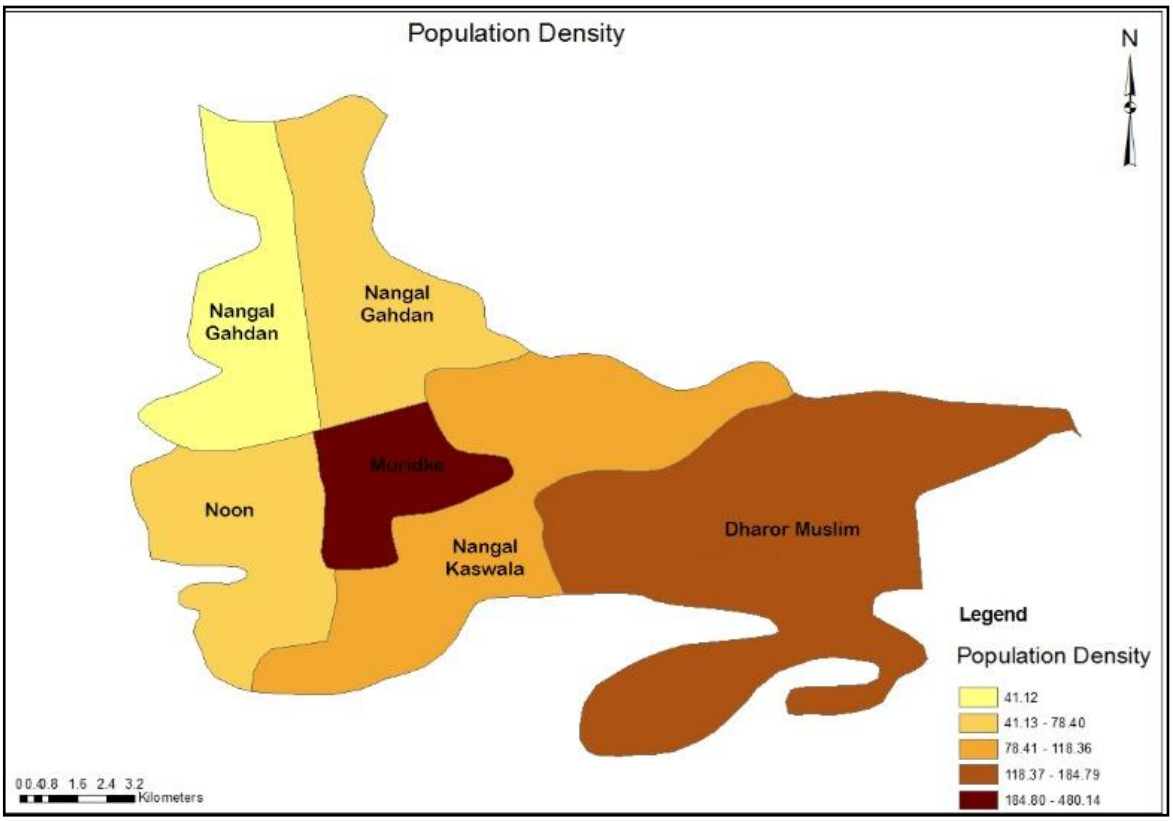


Figure 38: Map of Net Population Density of Muridkey on Union Council level

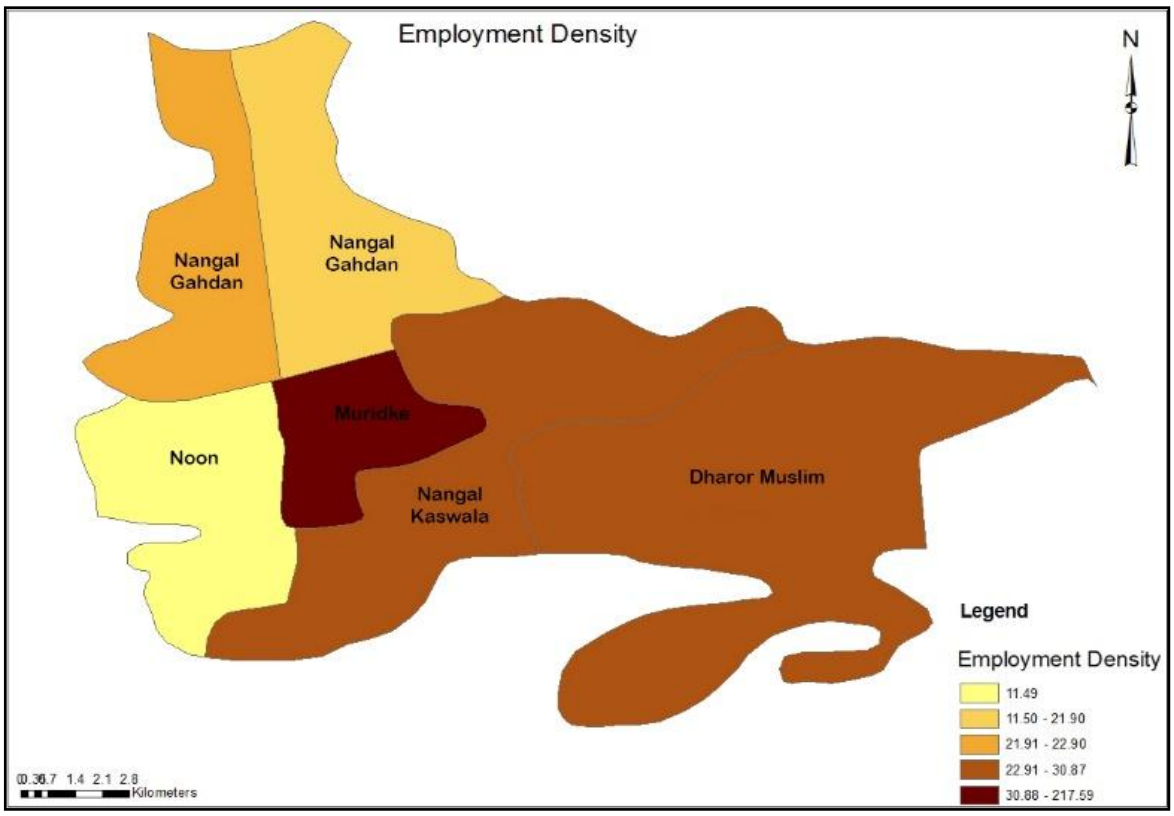


Figure 39: Map of Net Employment Density of Muridekey on Union Council level

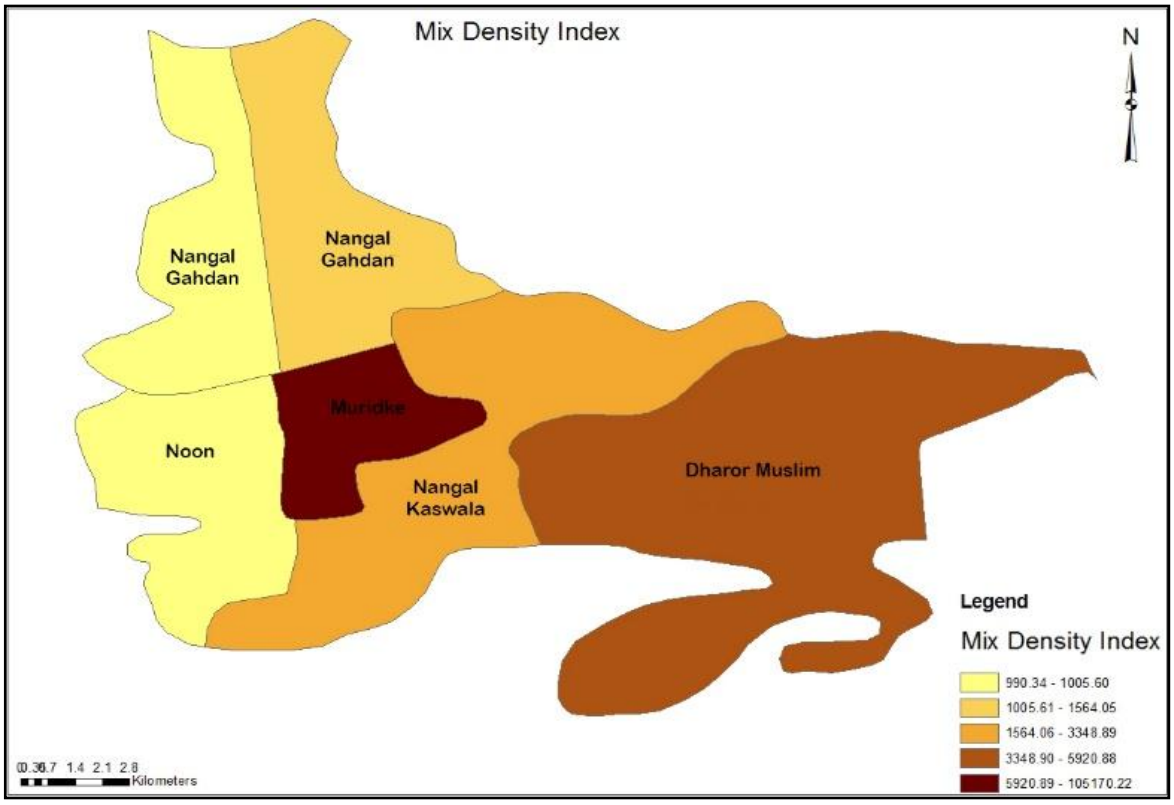


Figure 40: Map of Mix Density Index of Muridkey on Union Council level

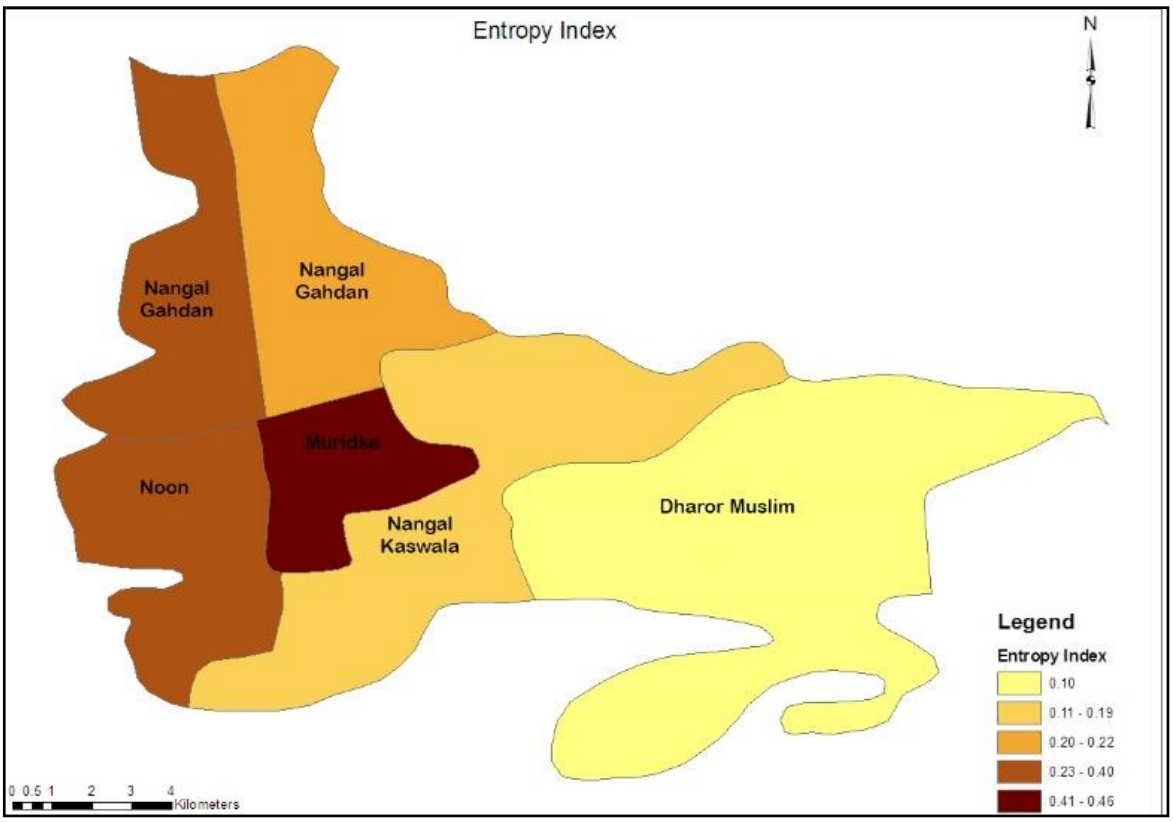


Figure 41: Map of Entropy Index of Muridkey on Union Council level

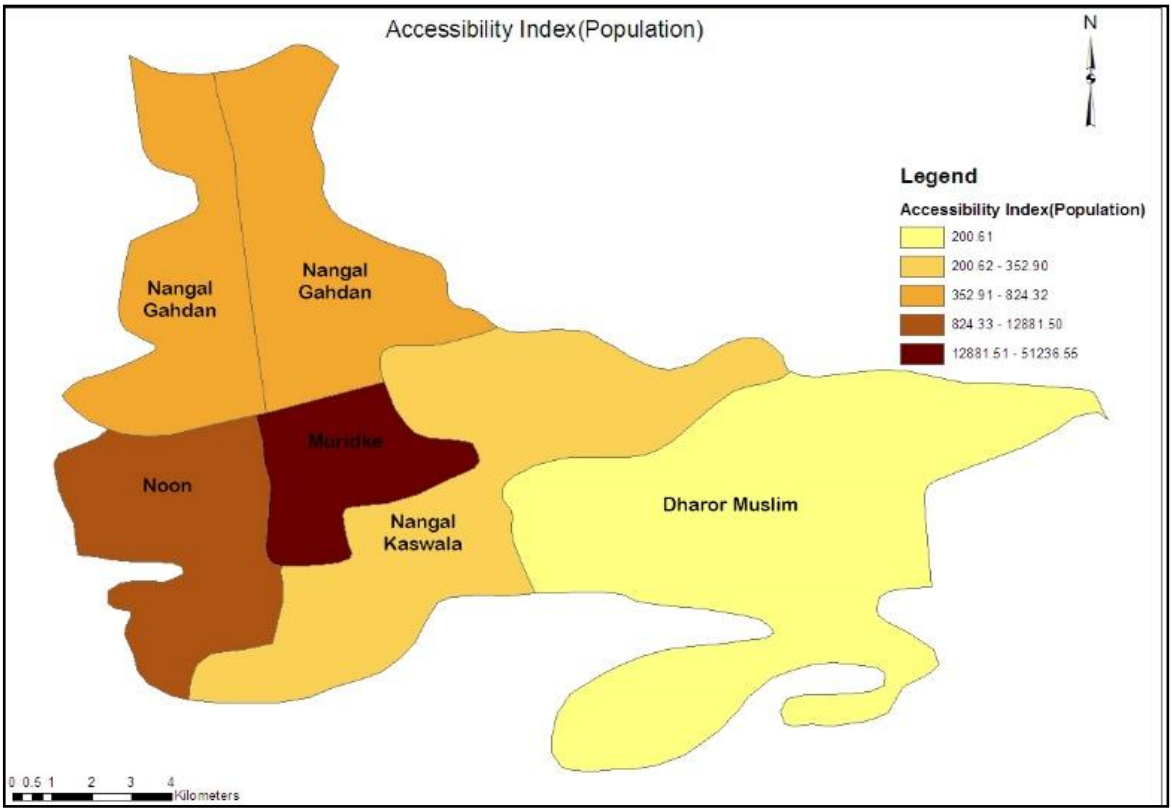


Figure 42: Map of Accessibility Index to Population of Muridkey on Union Council level

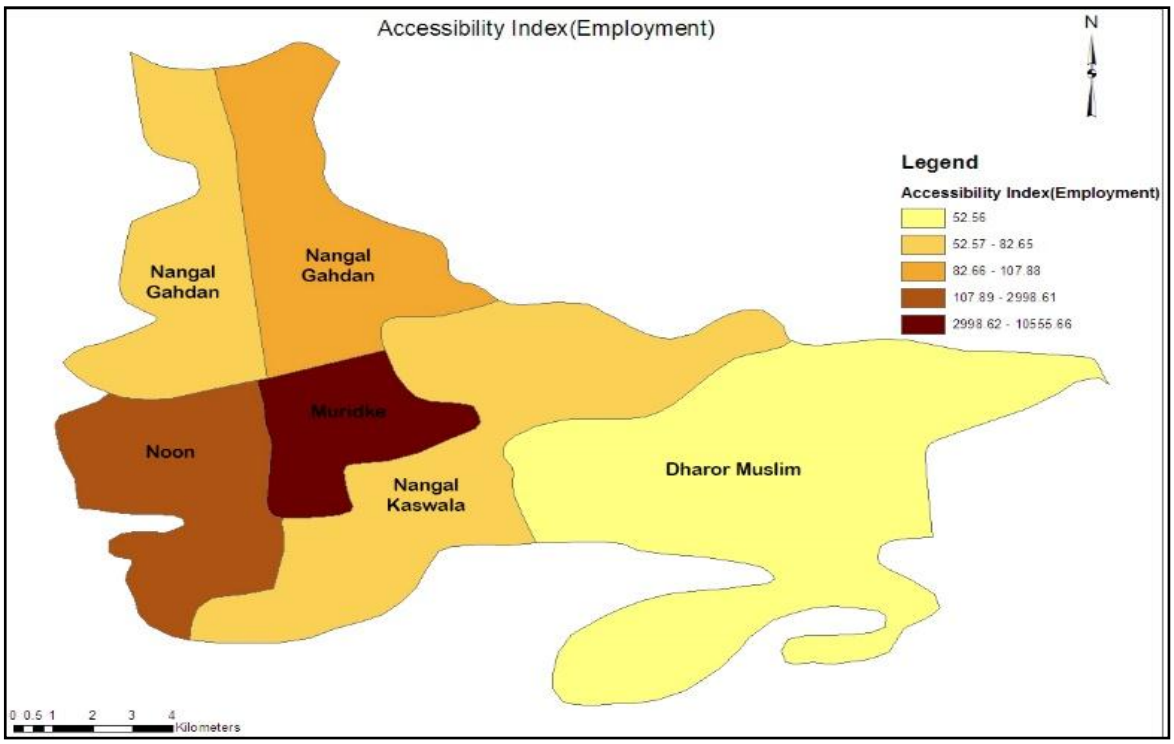
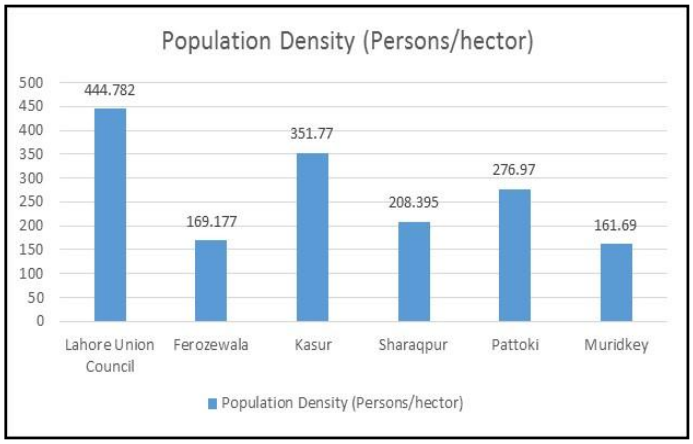
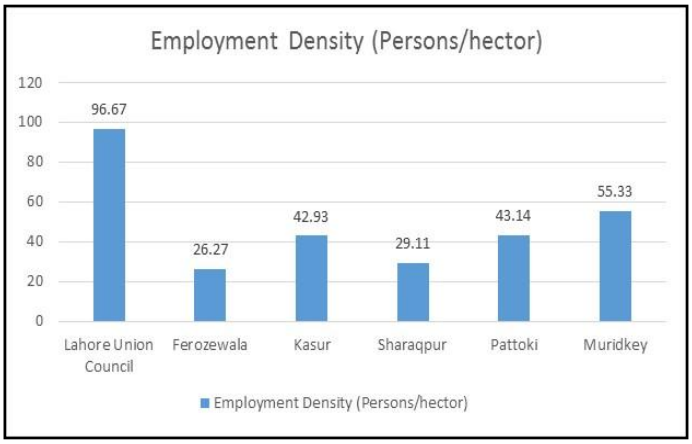


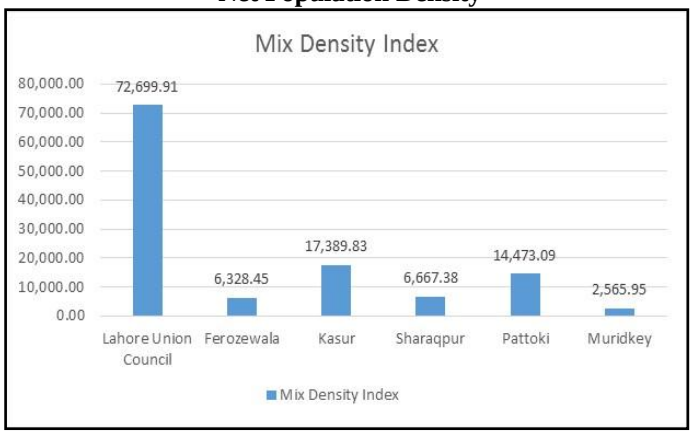
Figure 43: Map of Accessibility Index to Employment of Muridkey on Union Council level



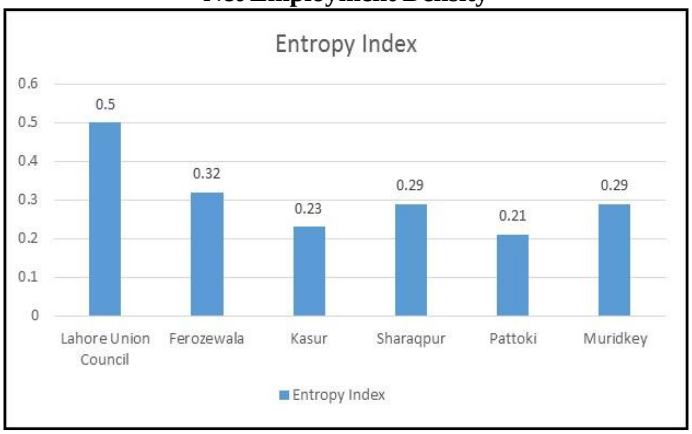
Net Population Density



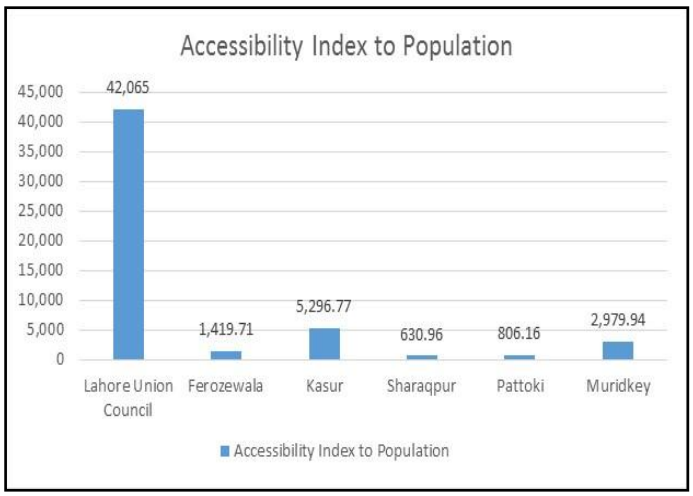
Net Employment Density

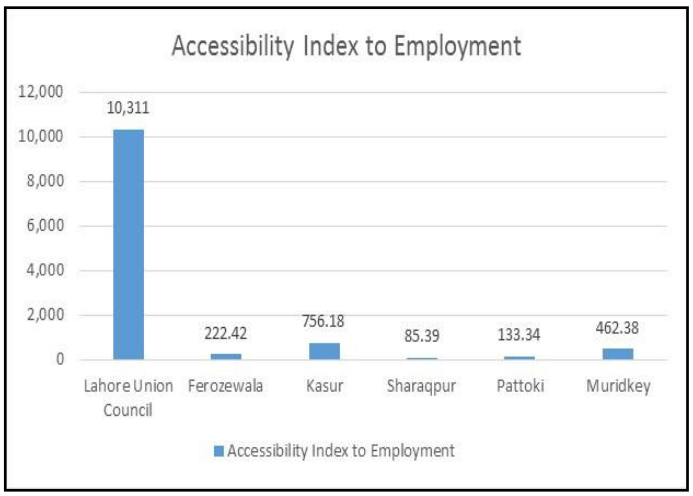


Mix Density Index



Entropy Index





Accessibility Index to Population **Accessibility Index to Employment**

Figure 44: Comparison of Urban form variables (average) of Lahore and neighboring cities on Union Council Level.

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