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A quantitative analysis of spatial organization of the urban centers in Kashmir Valley: A geographic information systems-based study using primacy index, rank-size rule, and nearest neighbor index

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ABSTRACT

Kashmir Valley located in the heart of huge mountain ranges has experienced urbanization over time and space and is presently home to 46 urban centers located in different parts of the region. The present study aims at analyzing the spatial distribution pattern and spacing of the towns using geographic information system and the rarely used quantitative technique of near neighbor analysis. Kashmir Valley is characterized by the strong urban primacy of Srinagar city which is 8 times larger than the population of Anantnag town, 16 times larger than the population of Baramulla, and 17 times larger than the population of Sopore town. The application of rank-size rule reveals that the relationship among the urban centers in Kashmir Valley is not in conformity with it. The study reveals that the urban settlements in Kashmir Valley are randomly distributed and do not exhibit any specific distribution pattern. The range of spacing varies from 33 km to 3 km. The average distance of spacing between the settlements is 9 km, while the hypothetical mean nearest neighbor distance is 18 km. The inferences of the analysis could be used as inputs for the spatial planning process and balanced urban development.

KEY WORDS: Geographic information system, Kashmir Valley, near neighbor analysis, primacy index, quantitative techniques, rank-size rule

INTRODUCTION

Urbanization is the oldest and one of the most pervasive processes of change that has helped to shape societies all over the world. Urbanization refers to a process in which an increasing proportion of an entire population lives in cities and the suburbs of cities (Husain, 2005). Urban growth is inevitable and occurs mostly due to natural increase, but migration is also a significant contributor to it. Urbanization is a dynamic, positive, and a desirable phenomenon, as it is conducive to economic growth, social change, and physical development (Sekar and Kanchanamala, 2011; Masek et al, 2000). In India, urbanization has been progressing post-independence. The level of urbanization in India is currently 31.16% in 2011. Urbanization in India is highly uneven, where some regions are highly developed while others are in very poor conditions. In Jammu and Kashmir, the percentage of urban population is 27.37% as per 2011 census, and in Kashmir Valley, the percentage of urban population is slightly higher with 31.6% of the population living in 46 urban centers (Census of India, 2011; Bhat and Kuchay, 2014; Malik, 2012).

The phenomenon of urban primacy was introduced by Mark Jefferson, who defined it as "A primate city is a leading city in its catchment region, disproportionately larger in demographic size and significance than any others in the urban hierarchy" (Jefferson, 1939). Its degree of primacy is measured by the proportion of urban population living in that city (Bardawaj, 1974; Yousuf and Shah, 2014). Rank-size distribution the remarkable regularity in city size distribution in any region and was introduced by Zipf. It is a commonly observed statistical relationship between the population sizes and population ranks of a nation's cities (Zipf, 1961).

The concept of near neighbor analysis was originally devised, in 1954, by plant ecologists Clark and Evans. This technique was conceived as a means of objectively

describing and analyzing plant distribution patterns, but over the years, it has been adopted by a number of other disciplines. In geography, it has been applied principally to urban and rural settlement patterns. Most of the work was undertaken in the United States in the beginning. Recently, attempts have been made to apply nearest neighbor analysis in other branches of geography as well. Nearest neighbor index (NNI) measures the deviation of any spatial pattern of the distribution of points from randomness. A random pattern is one, in which the location of each component point is totally uninfluenced by the location of the remaining points (Sarkar, 1991; Meynen, 1972; Sarkar, 1994; Bauder, 2002; Charron, 2008; Deka *et al.*, 2012; Fuhu, 1990; Singh, 1989; Bhat and Kuchay, 2014).

Significance of the Study

The analytical study of urban settlements with respect to their size and spacing has great significance in terms of regional development and urban planning. The nearest neighbor analysis uses the distance between each urban center and its closest neighbor in a layer to determine if the settlement pattern is random, regular, or clustered. Nearest neighbor analysis enables one to predict the average distance that would separate the urban centers from their nearest neighbors if the urban centers were located at random throughout an area. This expected distance can be compared with actual distances between the nearest neighbors. The present study is an attempt to apply the quantitative techniques of nearest neighbor analysis to the urban centers in Kashmir Valley to analyze the spacing and distribution pattern of urban centers in the area. Near neighbor analysis eventually proves useful in interpreting the factors and processes that created a particular pattern of settlement distribution in the region.

Study Area

The Kashmir Valley is situated in the Himalayas between the Zanskar Range and the Pir Panjal range in the Jammu and the Kashmir state of India. It has been formed by the river Jhelum and hence is also known as Jehlum Valley. The Kashmir Valley is located at an average altitude of 1850 m above sea level extending between 30°25' N and 34°45' N latitudes and 73°55' E to 75°35' E longitudes. The Valley covers a total area of 15440 sq. km and accounts for 6.9% of the total area of the state Jammu and Kashmir (222236 sq. km). The Valley is about 130 km long and 40 km wide and is surrounded by mountain ranges on all sides (Bamzai, 1961; Raza *et al.*, 1978; Bhat, 2008).

The following map shows the location of Kashmir Valley in the state of Jammu and Kashmir (Figure 1).

Objectives

The present study is based on the following objectives:

i. To analyze the spatial organizational pattern of urban centers in Kashmir Valley using primacy index (*PI*) and rank-size rule
ii. To identify the spatial distribution randomness of urban centers in Kashmir Valley using NNI.

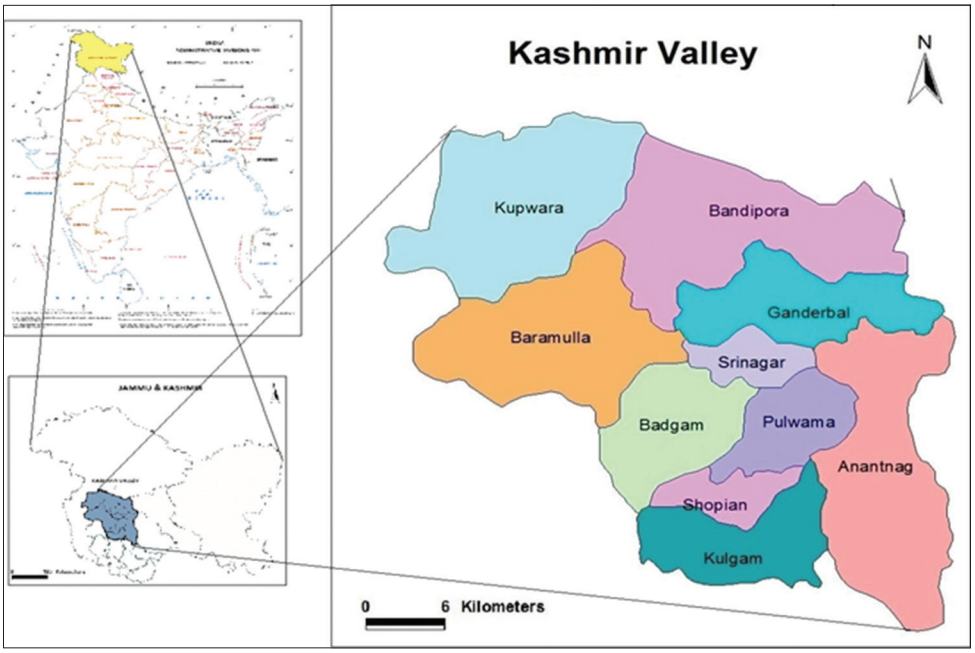

Figure 1: Location of Kashmir Valley. Source: Generated from SOI toposheets, 1971

DATABASE AND METHODOLOGY

The study area was delineated using Survey of India toposheets J/2, J/3, J/4, J/6, J/7, J/8, J/9, J/11, J/12, J/14, J/15, J/16, K/9, K/13, K/14, K/15, N/3, N/4, N/7, N/8, N/12, O/1, O/2, O/5, O/6, O/10 for the year 1971 at 1:50,000 scale. The spatial organizational pattern of the urban centers in Kashmir Valley was worked out in ArcGIS 9.3 software by integrating toposheet data with the base map in geographic information systems environment. Census of India (2011) data was also used in the study for analyzing the district wise distribution of the urban centers in Kashmir Valley.

The spatial organization of the settlements has been analyzed by rank-size rule and *PI*. *PI* was calculated using the formula:

$$PI = \frac{P1}{P2} \tag{1}$$

Where, *P*1 is the population of largest city and *P*2 is population of the second largest city. In case of three cities, *PI* was calculated using:

$$PI = \frac{P1}{P2 + P3} \tag{2}$$

Where, *P*3 is population of the third largest city (Jefferson, 1939).

Rank-size rule is an empirical regularity found in the urban system of many countries of the world. This regularity is more evident in many of the advanced countries and many of the countries which have an old urban tradition. According to this rule, the population of a town is related to its rank in the following form of Pareto's distribution.

$$P_r = KR^{-b} \tag{3}$$

Where, P_r is the population of the town whose rank is *R*. *K* and *b* are the constants (Zipf, 1961). This relationship gets transformed into linear form after taking log on both sides:

$$Y = a - bX \tag{4}$$

Where, $Y = \log P_r$, $X = \log R$, and $a = \log K$. Thus, if on a double log paper, the population (P_r) of towns of an area are plotted on Y-axis and their ranks (*R*) are plotted on X-axis, we will get a scatter diagram which will closely form a straight line having a negative slope. Statistically, this regularity can be examined by fitting a regression line of log P_r on log *R*. The regression coefficient of this line reflects the degree of primacy in the entire urban system and the coefficient of determination may be taken as a measurement of its goodness of fit to the system of rank-size regularity (Mahmood and Raza, 2008; Berry, 1961).

The spatial distribution randomness of urban centers in Kashmir Valley was identified using the quantitative technique of nearest neighbor analysis. The NNI was calculated using the formula:

$$R = \frac{\overline{D_o}}{\overline{D_r}} \tag{5}$$

Where, *R* is the near neighbor index, $\overline{D}_0$ is the actual mean distance between nearest neighbors and $\overline{D}_r$ is the expected mean nearest neighbor distance, and is given by:

$$\overline{D_r} = \frac{1}{\sqrt{\frac{N}{A}}} \tag{6}$$

Where, *N* is the number of towns and *A* is the area of the place.

The value of *R* ranges from 0 to 2.15, where 0 signifies clustered distribution of urban centers, 1 signifies random distribution of urban centers while 2.15 signifies uniform distribution of urban centers. If the value of *R* falls between 0 and 1, the distribution pattern of the settlements may be explained as approaching cluster, while if the value falls between 1 and 2.15, it means the urban centers are approaching uniform distribution pattern (Rossbacher, 1986; Mahmood and Raza, 2008; Clark and Evans, 1954; Pinder and Witherick, 1972) (Figure 2).

The standard error of the expected mean distance is given by:

$$\sigma \overline{D_r} = \frac{0.26126}{\sqrt{N^2/A}} \tag{7}$$

The test was carried for the null hypothesis that the urban settlements are randomly distributed in Kashmir Valley. To test the significance of this null hypothesis, the statistic Z was used which is given by:

$$Z = \frac{\overline{D_0} - \overline{D_r}}{\sigma \overline{D_r}} \tag{8}$$

RESULTS AND DISCUSSION

The total urban population of 2.05 million persons of Kashmir Valley is distributed unevenly in the 46 urban centers. The urban centers are also unevenly distributed in the different districts of the Valley as shown in Figure 3. Anantnag district has the highest number of towns (12) but accommodates only 13.8% of the total urban population of the Valley with the level of urbanization of 25.6%. Kupwara district has the lowest percentage of urban population (3.5%) and the lowest share of the urban population of the Valley (1.6%) owing to its accessibility

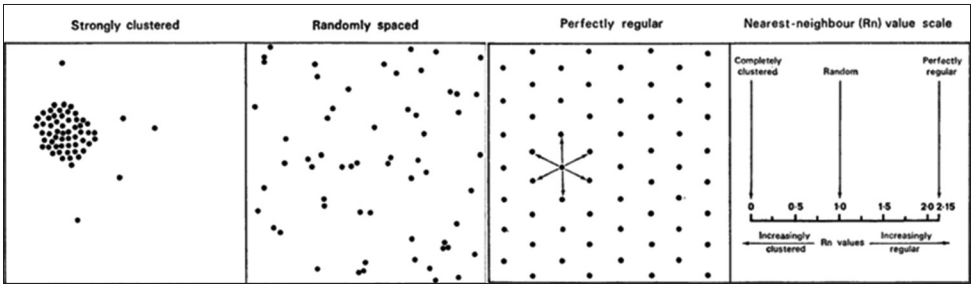

Figure 2: Nearest neighbor value scale. Source: Pinder and Witherick, 1972

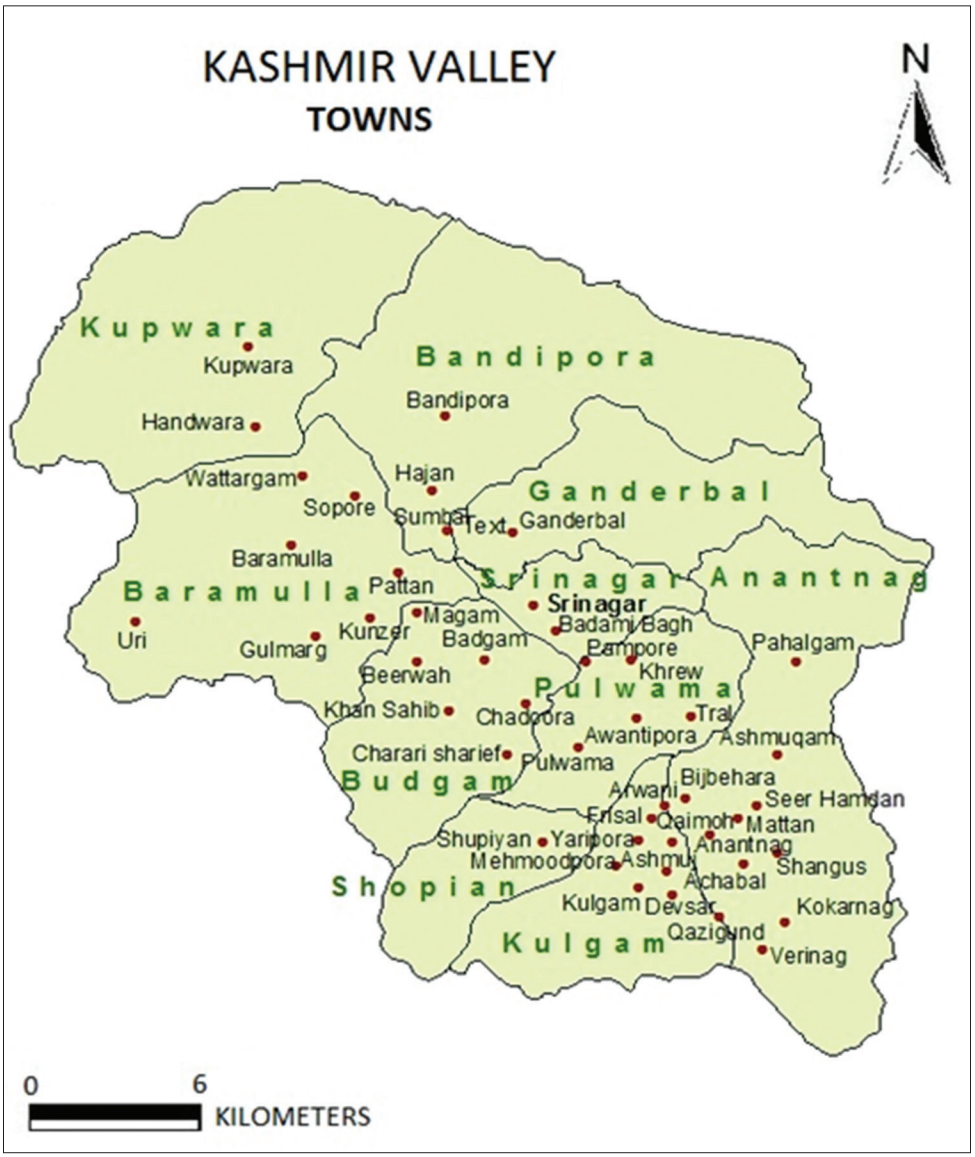

Figure 3: Spatial distribution of urban centers in Kashmir Valley. Source: Compiled from SOI Toposheets, 1971 and Census of India Data, 2011

and hill topography. The newly formed district of Kulgam ranks third (18.5) among the districts as far as the level of urbanization in the Valley is concerned. This is because among the newly declared 12 towns in 2011, 6 are from Kulgam district only. The lowest number of urban centers is found in Shopian and Ganderbal districts where the respective district headquarters are the urban centers as they have recently been declared as separate districts (Census, 2011).

Table 1 shows the distribution of population, population density, and the number of households and household density in the different towns of Kashmir Valley. In terms of areal extension, the urban centers range from the smallest town Pattan (0.28 km^2) to the largest town Srinagar (278.6 km^2) indicating a huge difference in the size of the urban centers. In terms of population, Srinagar city again ranks first inhabiting 1.21 million people while Kunzer is the smallest urban center with a population of 1890. Population density is found to be highest in Pattan (69772 persons/km^2) and lowest in Gulmarg (242 persons/km^2). The number of households ranges from 183,998 in Srinagar city to merely 77 households in Gulmarg town and the household density ranges from around 10 households/km^2 in Gulmarg to 7454 households/km^2 in Pattan town of Kashmir Valley.

Table 1: Distribution of population and households in the urban centers in Kashmir Valley (2011)

Name of the urban center	Population (persons)	Households (Nos.)	Area (km^2)	Population density (persons/km^2)	Household density (Nos./km^2)
Achabal	17,556	2470	3	5852	823
Aishmuqam	6519	1011	4	1630	253
Anantnag	150,592	17611	37.71	3993	467
Arwani	11,815	1582	7.27	1625	218
Ashmuji Khalsa	5567	1016	6.59	845	154
Awantipora	12,647	1083	5	2529	217
Badami Bagh	22,214	3324	5.9	3765	563
Budgam	15,338	2258	10.08	1522	224
Bandipore	37,081	5584	13.4	2767	417
Baramulla	71,434	11725	23.98	2979	489
Beerwah	8192	946	5	1638	189
Bijbehara	22,789	3098	3.74	6093	828
Chadura	6482	792	3.65	1776	217
Charar-i-Sharief	11,533	2098	0.8	14416	2623
Devsar	9765	1394	0.43	22709	3242
Duru Verinag	22,968	3133	8	2871	392
Frisal	5132	851	1.27	4041	670
Ganderbal	28,233	3989	7.72	3657	517
Gulmarg	1965	77	8.1	243	10
Hajan	13,239	1781	18.3	723	97
Handwara	13,600	2011	8.5	1600	237
Khansahib	2630	352	4.3	612	82
Khrew	9851	1343	21.9	450	61
Koker Nag	6553	900	3	2184	300
Kulgam	23,584	4106	12.8	1843	321
Kunzer	1890	306	1.4	1350	219
Kupwara	21,771	1934	4.1	5310	472
Magam	5470	807	2.3	2378	351
Mattan	9246	1384	2.5	3698	554
Mehmood Pora	10,910	1944	7.55	1445	257
Pahalgam	9264	966	18.08	512	53
Pampore	21,680	3389	8.05	2693	421
Pattan	19,538	2087	0.28	69779	7454
Pulwama	18,440	2483	8	2305	310
Qazigund	9871	1363	6.5	1519	210
Quimoh	13,138	2221	7.01	1874	317
Seer Hamdan	8233	1335	2.5	3293	534
Shangus	7875	1208	2	3938	604
Shupiyan	16,360	2553	5.44	3007	469
Sopore	71,292	11192	18.9	3772	592
Srinagar	1,206,419	183998	278.6	4330	660
Sumbal	15,041	2233	17.93	839	125
Tral	17,844	2356	0.6	29740	3927
Uri	9366	970	4.9	1911	198
Watra Gam	7015	932	6	1169	155
Yaripora	12,123	2205	8.21	1477	269
Total	2,050,065	302401	630.29	3253	480

Source: Compiled from Census of India Data, 2011

Primate City Pattern

The urban system in Kashmir Valley is dominated by a primate city pattern with an extremely strong phenomenon of urban primacy. Srinagar city occupies the central position in the Valley and has enjoyed the urban primacy in the region throughout its existence (Bhat, 2008). The city is the largest urban center in terms of areal coverage and population size and is experiencing the highest growth rates among all Himalayan urban centers.

Srinagar being the primate city is 8 times larger than the second largest urban center in the Valley. At the state level, the index of primacy calculated for two urban centers (Srinagar and Jammu) comes out to be 1.99. At the regional level, the *PI* calculated for two largest urban centers of Kashmir Valley comes out to be 8.01 (Srinagar and Anantnag). The population of Srinagar is 2 times larger than the population of Jammu city, 8 times larger than the population of Anantnag, 16 times larger than the population of Baramulla, and 17 times larger than the population of Sopore (calculated using Census Data, 2011).

Rank-size Distribution

The occurrence of rank-size distribution pattern is associated with economically advanced countries with an integrated system of cities and Kashmir Valley is not in conformity with the rank-size rule. The comparison of figures from the Table 2 reveals that the expected and actual populations are not the same. Most of the urban centers (about 30) have a population which is more than the expected population, while others have lesser population than expected. The average discrepancy between the actual and expected populations of the urban centers expressed as a percentage of its actual size reveals 27.82%, the average that the urban centers would have to increase or decrease to fit into the rank-size rule. The percentage error in predicting the population of an urban center from rank-size rule expressed as a percentage of the expected population shows an average 25.24% for the region as a whole.

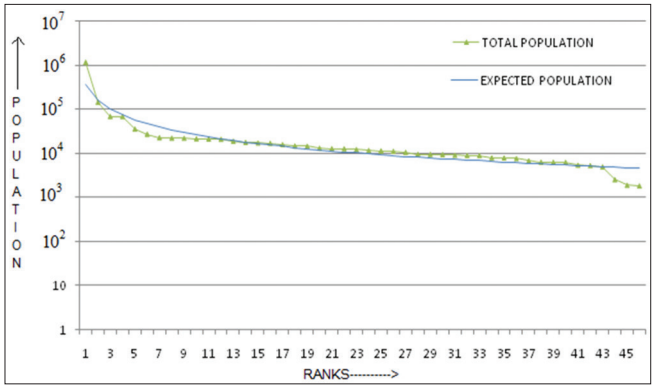

Figure 4: Rank-size relationship among Kashmir towns

Figure 4 shows the rank-size relationship in the urban centers, and it is clear that the curve is not in conformity with the rank-size rule. The extreme values between the larger and small urban centers have no coordination. The primate city is increasing sharply while the three smallest towns are falling sharply. The middle portion is more or less in conformity with the linear equation. The deviations are greater for Srinagar, Baramulla, Bandipora, Ganderbal, Kulgam, Duru Verinag, Bijbehara, Mattan, Kunzer, Gulmarg, and Khan Sahib. The rest of the urban centers shows deviations which are <30% with more or less conformity.

Near Neighbor Analysis

The distribution of urban centers in Kashmir Valley is highly uneven, and a huge variation in their spacing is reflected by the distance of the urban centers to their respective nearest neighbors. The range of spacing varies from 33 km between Uri and Baramulla to only 3 km between Frisal and Arwani. The average distance of spacing between the settlements in the Valley is 9 km, while the expected mean nearest neighbor distance is computed to be 18 km. A comparison of the average distance of spacing reveals that the hypothetical distance exceeds the actual distance by 50%. The average distance of the urban centers with their nearest neighbors is indicated in Table 3.

Taking the null hypothesis of random distribution of urban centers in Kashmir Valley, the NNI (i.e. the ratio of the actual mean distance between nearest neighbor points in the area to the mean expected distance of random distribution of the same number of points in the same area) comes out to be 0.5 indicating the urban settlements in Kashmir Valley are clustered, which will be true only when the mean expected distance is significantly different from the actual distance. The test of significance reveals a standard deviation of 0.71, and the value of Z statistic is calculated to be −11.98. Since the value is < 2.58, it is statistically insignificant even at 5% level of significance. Hence, the null hypothesis of random distribution of urban centers be accepted and the spatial distribution of the towns in the Valley exhibits a random distributional pattern.

CONCLUSION

Kashmir Valley is currently the most urbanized area in the Indian Himalayan region. However, it is still predominantly

Table 2: Application of rank-size rule to urban centers in Kashmir Valley

Name of urban center	Total population	Ranks (R)	Reciprocal of rank	Expected population	Difference between actual and expected population	Percentage difference to estimated population	Percentage difference to actual population
Srinagar	1,206,419	1	1.00	377,162	829,257	219.87	68.74
Anantnag	150,592	2	0.45	170,817	20,225	11.84	13.43
Baramulla	71,434	3	0.28	107,475	36,041	33.53	50.45
Sopore	71,292	4	0.20	77,363	6071	7.85	8.52
Bandipore	37,081	5	0.15	59,951	22,870	38.15	61.67
Ganderbal	28,233	6	0.12	48,676	20,443	42.00	72.41
Kulgam	23,584	7	0.10	40,814	17,230	42.22	73.06
Duru Verinag	22,968	8	0.09	35,038	12,070	34.45	52.55
Bijbehara	22,789	9	0.08	30,626	7837	25.59	34.39
Badami Bagh	22,214	10	0.07	27,152	4938	18.19	22.23
Kupwara	21,771	11	0.06	24,350	2579	10.59	11.85
Pampore	21,680	12	0.05	22,045	365	1.66	1.68
Pattan	19,538	13	0.05	20,118	580	2.88	2.97
Pulwama	18,440	14	0.04	18,485	45	0.24	0.24
Tral	17,844	15	0.04	17,083	761	4.45	4.26
Achabal	17,556	16	0.04	15,869	1687	10.63	9.61
Shupiyan	16,360	17	0.03	14,807	1553	10.49	9.49
Budgam	15,338	18	0.03	13,870	1468	10.58	9.57
Sumbal	15,041	19	0.03	13,039	2002	15.35	13.31
Handwara	13,600	20	0.03	12,297	1303	10.60	9.58
Hajan	13,239	21	0.03	11,630	1609	13.83	12.15
Quimoh	13,138	22	0.02	11,028	2110	19.13	16.06
Awantipora	12,647	23	0.02	10,482	2165	20.66	17.12
Yaripora	12,123	24	0.02	9984	2139	21.42	17.64
Arwani	11,815	25	0.02	9529	2286	23.99	19.35
Charar-i-Sharief	11,533	26	0.02	9112	2421	26.58	21.00
Mehmood Pora	10,910	27	0.02	8727	2183	25.01	20.01
Qazigund	9871	28	0.02	8372	1499	17.91	15.19
Khrew	9851	29	0.02	8043	1808	22.48	18.36
Devsar	9765	30	0.02	7737	2028	26.21	20.77
Uri	9366	31	0.02	7453	1913	25.68	20.43
Pahalgam	9264	32	0.01	7187	2077	28.90	22.42
Mattan	9246	33	0.01	6939	2307	33.25	24.96
Seer Hamdan	8233	34	0.01	6706	1527	22.77	18.55
Beerwah	8192	35	0.01	6487	1705	26.27	20.81
Shangus	7875	36	0.01	6282	1593	25.36	20.23
Watra Gam	7015	37	0.01	6088	927	15.22	13.21
Koker Nag	6553	38	0.01	5906	647	10.96	9.88
Aishmuqam	6519	39	0.01	5733	786	13.71	12.06
Chadura	6482	40	0.01	5569	913	16.39	14.08
Ashmuji Khalsa	5567	41	0.01	5414	153	2.82	2.74
Magam	5470	42	0.01	5267	203	3.85	3.71
Frisal	5132	43	0.01	5128	4	0.09	0.09
Khan Sahib	2630	44	0.01	4995	2365	47.34	89.91
Gulmarg	1965	45	0.01	4868	2903	59.63	147.74
Kunzer	1890	46	0.01	4747	2857	60.19	151.18
Total (Σ)	2,050,065	--	3.5	1,336,449	1,032,453	1160.81	1279.66
Mean ($\bar{x}$)	44,567	-	-	29,053	22,445	25.24	27.82

rural with only 31.6% of the population living in urban areas. The urban population is unevenly distributed in the 46 urban centers which, in turn, are unevenly distributed in the Valley. The area is characterized by the strong urban primacy of Srinagar city which is 8 times larger than the population of Anantnag town, 16 times larger than the population of Baramulla, and 17 times larger than the population of Sopore town. The application of the rank-size rule to the urban centers in Kashmir Valley reveals that the relationship among the urban centers is not in conformity with it. The nearest neighbor analysis for urban centers in Kashmir Valley reveals that the spatial distribution pattern of the towns is a random one exhibiting no specific pattern. The study also reveals that there is a strict relationship between a number of towns and the nearest neighbor distances. With the increase in the number of towns, the hypothetical mean distance and the actual mean distance between the town's decreases. The speed of city gathering is strongly affected by political and economic factors.

Table 3: Distance between urban centers and their nearest neighbors

Name of town	Distance between urban centers (nearest neighbor) (km)	Deviation of distance from mean (9 km)	Deviation of distance from hypothetical distance (18 km)	Rank according to population size	Distance rank from near neighbor
Srinagar	7	2	11	1	29.50
Anantnag	5	4	13	2	37.50
Baramulla	13	4	5	3	6.00
Sopore	10	1	8	4	15.00
Bandipore	15	6	3	5	3.00
Ganderbal	11	2	7	6	10.00
Kulgam	6	3	12	7	34.00
Duru Verinag	7	2	11	8	29.50
Bijbehara	4	5	14	9	42.00
Badami Bagh	7	2	11	10	29.50
Kupwara	14	5	4	11	4.50
Pampore	8	1	10	12	24.50
Pattan	8	1	10	13	24.50
Pulwama	12	3	6	14	7.50
Tral	10	1	8	15	15.00
Achabal	6	3	12	16	34.00
Shupiyan	14	5	4	17	4.50
Budgam	11	2	7	18	10.00
Sumbal	8	1	10	19	24.50
Handwara	12	3	6	20	7.50
Hajan	8	1	10	21	24.50
Quimoh	6	3	12	22	34.00
Awantipora	10	1	8	23	15.00
Yaripora	5	4	13	24	37.50
Arwani	4	5	14	25	42.00
Charar-i-Sharief	10	1	8	26	15.00
Mehmood Pora	6	3	12	27	34.00
Qazigund	4	5	14	28	42.00
Khrew	9	0	9	29	20.00
Devsar	4	5	14	30	42.00
Uri	33	24	15	31	1.00
Pahalgam	22	13	4	32	2.00
Mattan	4	5	14	33	42.00
Seer Hamdan	4	5	14	34	42.00
Beerwah	9	0	9	35	20.00
Shangus	6	3	12	36	34.00
Watra Gam	10	1	8	37	15.00
Koker Nag	7	2	11	38	29.50
Aishmuqam	9	0	9	39	20.00
Chadura	10	1	8	40	15.00
Ashmuji Khalsa	4	5	14	41	42.00
Magam	8	1	10	42	24.50
Frisal	3	6	15	43	46.00
Khansahib	10	1	8	44	15.00
Gulmarg	11	2	7	45	10.00
Kunzer	8	1	10	46	24.50
Total (Σ)	412	154	454	-	-
Mean ($\bar{x}$)	8.96	3.34	9.87	-	-

REFERENCES

Bamzai PN. Geography of Jammu & Kashmir, State. Jammu: Light and Life Publishers; 1961. p. 6-18.

Bardawaj RK. Urban Development in India. New Delhi: National Publishers; 1974.

Bauder H. Neighborhood effects and cultural exclusion. Urban Stud 2002;39:85-93.

Berry BL. National Unity and Disunity. Bloomington, Indiana: Principia Press; 1941.

Bhat MS. Urban System in Himalayas. New Delhi: Dilpreet Publishing House; 2008. p. 137-45.

Bhat MS, Kuchay NA. Analysis and simulation of urban expansion of Srinagar city. Trans Inst Indian Geogr 2014;36:110-21.

Bhat MS, Kuchay NA. Urban sprawl of Srinagar city and its impact on wetlands - A spatio-temporal analysis. Int J Environ Bioenergy 2014;92:122-9.

Charron M. Neighbourhood Characteristics and the Distribution of Crime in the City of Saskatoon; Crime and Justice Research Paper Series; Statistics Canada Catalogue No. 85-561-MIE. No. 12. Ottawa. 2008.

Clark PJ, Evans FC. Distance to nearest neighbour as a measure of spatial relationships in populations. Ecology 1954:35;445-52.

Deka J, Tripathi OP, Khan ML. Urban growth trend analysis using Shannon entropy approach – A case study in North-East India. Int J Geomatics Geosci 2012;2:1072-8.

Fuhu R. GIS Supported Analysis on City Gathering in China. University of Tokyo: Institute of Industrial Science; 1990. p. 109-15.

Husain M. Human Geography. Jaipur: Rawat Publications; 2005. p. 366-96.

Jefferson M. The law of primate city. Geogr Rev 1939;29:126-32.

Mahmood A, Raza M. Statistical Methods in Geographical Studies. New Delhi: Rajesh Publications; 2008. p. 71-5.

Malik MI. Spatio-temporal analysis of urban dynamics in Kashmir valley (1901-2011) using geographical information system. Int Multidispl Res J 2012;2:21-6.

Masek JG, Lindsay FE, Goward SN. Dynamics of urban growth in Washington, DC. metropolitan area 1973-1996 from landsat observations. Int J Remote Sens 2000;21:3473-86.

Meynen E. Universal Decimal Classification for Settlements, in Selected Papers. Vol. 4. 1972. p. 398-400.

Pinder DA, Witherick ME. The principles, practice and pitfalls of nearest neighbour analysis. Geography 1972;57:281-6.

Raza M, Ahmad A, Mohammad A. The Valley of Kashmir - A Geographical Interpretation. Vol. 1. New Delhi: Vikas Publishing House; 1978. p. 2-12.

Rossbacher LA. Nearest neighbour analysis: A technique for quantitative evaluation of polygonal ground patterns. Geogr Ann 1986;68A:101-5.

Sarkar A. Size and spacing of urban settlements in West Bengal, 1901-1981. Indian J Lands Syst Ecol Stud 1994;17:53-61.

Sarkar A. Tendency of the urban settlement patterns in West Bengal, 1901-1981. Indian J Lands Syst Ecol Stud 1991;17:50-5.

Sekar SP, Kanchanamala S. An analysis of growth dynamics in Chennai metropolitan area, institute of town planners. Inst Town Plan India 2011;8:31-57.

Singh A. Digital change detection techniques using remotely sensed data. Int J Town Plan 1989;10:989-1003.

Yousuf T, Shah SA. An analysis of urban primacy in Himalayan settlements: The case of Srinagar city of Jammu & Kashmir. Int J Rec Sci Res 2014;5:1670-4.

Zipf GK. City size distribution and economic development. Econ Dev Cult Change 1961;9:573-88.