International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Concentration of Settlement in Vijayapura District Using Quadrats Technique

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Abstract: ***India is a country where nearly two-third of the population lives in rural areas and enlightens the rural areas is the lifeline of India. Before going to achieve this goal and utilize the full potentiality of village resources it is essential to explore rural areas in terms of their size, distribution and pattern of rural settlement. This paper examines the spatial point pattern settlements of rural communities in the Vijayapura District. The study consists of 698 villages with 10, 498 Sq Kms area. Spatial analysis was performed by using quadrate analysis and spatial autocorrelation of points. The associated physical environment was integrated with GIS to identify the patterns in the relationship of household locations affected by a particular facility.42 quadrates with one square inch map have been prepared by using the GIS software for the analysis of settlement concentration, in addition to this, Settlement concentration index and Average distance of settlements (spacing) have been found. The result of quadrats method shows the settlements variance mean ratio (VMR). If VMR value is < 1.0, the distribution pattern is regular, If VMR value is = 1.0, the distribution pattern is random, If VMR value is > 1.0 the distribution pattern is clustered, the result of VMR value of study area is8.73. Since the calculated value of the study area is greater than 1.0 this shows that the distribution of settlement is clustered in space. The concentration index values have been grouped under five categories. The first group values range between 0.01and 2.50 where none of the settlements exists in this group, the second group range 2.51 to 5.00 which consists 6 quadrats which includes 66 settlements from different taluks. This group stands fifth rank in Concentration Index ranking. The third group range 5.05 to 7.50 which contains 8quadrats, which105 settlements of different taluks of the Vijayapura district and it falls under fourth rank. The third range value is 7.51 to 10.00 comprises of 15quadrats, which includes 346 settlements of different taluk and it stands third rank in the concentration index groups. The fifth and sixth group value 10.01 to 12.50 and 12.51 to 15.00 having3quadrats, each and includes 84 and 89 settlements respectively and stands second and first ranks respectively. Although the spatial pattern of settlements in the Study Area is generally clustered, but in some taluks per square settlement densities kilometers is low for example the density of Tikotataluk is0.036sq. kms where as Muddebihal and Nidagundi taluks have greater settlement density i. e., 0.109sq. kms. As quadrats like Q-21, Q-30, Q-34, Q-35, Q-40 and Q-41 are high density quadrats which cover Vijayapura, part of Talikoti, small area of BsavanaBagewad, equal portion of Nidagundi and Muddebihal. The analysis shows that Vijayapura Tahsil having the highest concentration index and has the highest occupied area as well (42.27 Sq Km), with an index value of 4.723, which accounts 28.63 percent of the total occupied area. The lowest concentration index has been recorded in Tikota taluka with7.57 sq. km and the index value is 0.867 which contributes 5.127 percent of the total occupied area. Therefore, settlements are largely concentrated in favored sites where easy availability of ground water, rail and road tracks, fertile soil and accessibility to trading centers.***

Keywords: Spatial point patterns, Quadrats Analysis, GIS, GPS, Geospatial Database, Superimposed

1. Introduction

The geography of rural settlements is a recent sprout of the vulnerable trunk of Geographical Science (Majjid Hussain1998). Although the scientific methodology on various aspects of habitations was not developed until the present century. Its antecedents may be traced in important writings which developed gradually increasing attention to human habitations from geography first began its modern moorings in the 19th and 20thcentury.

Settlements are a concrete expression of human occupation of the earth's surface and they form an essential element of the landscape (Hagerstrand, 1957). These settlements are noted to exhibit certain distribution pattern over space. Several evolution and distribution models advanced by Bylund (1960), Morrill (1962), Chisholm (1962), Hudson (1969) and Christaller (1933) have explained how settlements evolved over time, space and the principlesfactors behind their distribution pattern. The theoretical advancement of these models, coupled with the empirical findings of authors like Dacey (1962) and Rayner and Golledge (1972), help establish three major settlement distribution patterns in the literature-regular, random and clustered.

The emergence of a given spatial pattern of settlements is ascribed to both physical and human factors. The physical factors have to do with the terrain and the distribution of natural resources – soil, water and mineral wealth that attract and influence settlement location. On the other hand, the human factors include cultural dictates and warfare, which influence cluster or disperse living as well as the rise, fall and migration of settlements respectively. Whatever the factors of location and pattern, analysis of spatial distribution of settlements is of great importance to both the geographers and planners. This is because the exercise gives an insight into the spatial character of settlements as important landscape elements and provides ample data for their planning and management.

A village is a clustered community for societies that practice agriculture, and a settlement refers to the sites where people live and work (Jin, 1988; Guo et al., 2012; Zhou et al., 2013, cited in Yang et. al., 2015). India is a country where nearly 68 per cent of the population lives in rural areas and enlightens the rural lifeline of India. However, very modest number of literatures available on rural settlement systems in contrast with the number of literatures appeared on urban systems. The settlement i. e., the place of habitation is one of the important aspects of study from the standpoint of planning and development of a region (Ghosh, 1992). To utilized the full potentiality of village resources and make wealthy progress it is very much crucial to explore rural areas in terms of their size, distribution and pattern of rural settlement as it helps us to know about the organization of rural settlement and speaks about the nature of soil, topography, socio-economic background of the culture group of a particular area (Singh, 1994). The general but overall idea of the organization of rural settlement also helps to plan the strategy of balanced rural development. In this paper, an attempt has been made to examine the rural settlement in terms of their size, distribution, and pattern in Vijayapura District, Karnataka.

2. Study Area

Vijayapura district forms a part of the northern Karnataka plateau, located in the central sector of the northern most portion of Karnataka State. The district lies between 16° 20' to 17° 28' North latitude and 75° 16' to 76° 28' east longitude. The district covers a geographical area of 10, 498 sq kms (2011). It has an extent of 143 sq. km. from north to south and 116 sq. km. from east to west. The Vijayapur district divided into twelve tehsils like Babaleshwara, BasavanaBagevadi, Chadachana, Devara Hipparagi, Indi, Kolhar, Muddebihal, Nidagundi, Sindgi, Talikoti, Tikota, and Vijayapura. There are 692 villages, 684 inhabited, 18 uninhabited and twelve statutory towns in the district. Vijayapura district is one of the largest districts in Karnataka before it was divided in 1997. Prior to 1997 the Vijayapura district was spread over an area of 17, 069 sq. kms. In the year 1997, the former Vijayapura district was divided into two districts namely Vijayapura and Bagalkot. Presently the Vijayapura district consists of five taluks namely Indi, Sindigi, Muddebihal, B. Bagewadi and Vijayapura. In 2017-18 seven newly added. It is surrounded by Gulbarga district on the east, Bagalkot district on south and Belgaum district on the South-West of Karnataka state and Sholapur district on its north and Sangli district on its North-West (Maharastra). According to the 2011 census Vijayapura district, has a population of 21, 77, 331, of which 11, 11, 022 and 10, 66, 309 were male and female respectively. The population density was 207 persons per square kilometer. Its population growth rate over the decade 2001-2011 was 20.38 per cent. (**Fig.1).**

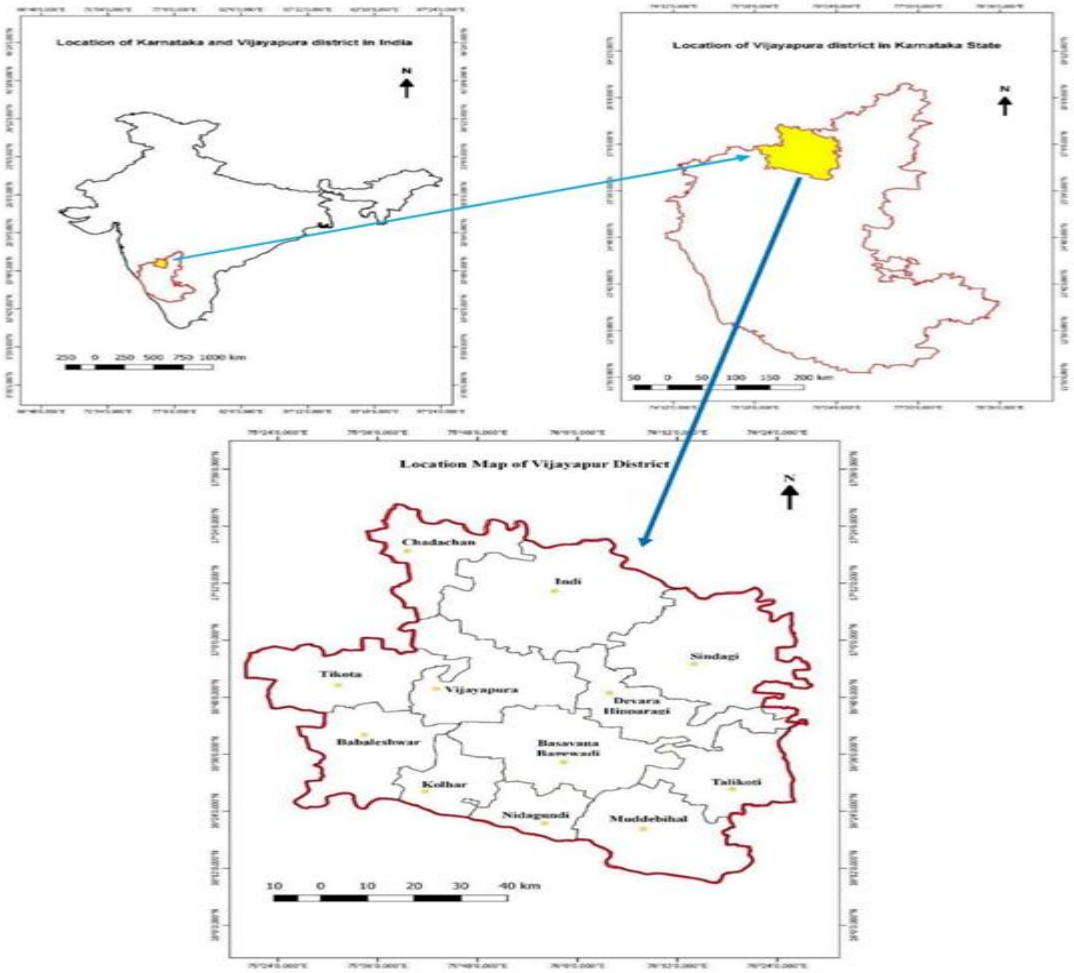


Figure 1

3. Objectives

In this paper, an attempt has been made to examine the spatial distribution of rural settlements in Vijayapura District. The objectives of study are-

1) To find out the size and distribution of rural settlements in terms of geographical area.
2) To examine the concentration of rural settlements by applying Quadrat analysis technique.
3) To evaluate the spacing and concentration index for the identification of types of rural settlements.

4. Methodology

The present investigation is based on secondary sources. Total number of settlements data has been collected from Gazette, Vijayapur (2020), population and taluka wise area data gathered from District at a glance (2020). Every village Cadastral data has been downloaded from The National Remote Sensing Center (NRSC) Bhuvan Software. The cadastral village data has been superimposed on the geo-referenced Topo sheet (1: 50, 000) published by Survey of India (SOI). For absolute positioning UTM coordinate system was adjusted as WGS-84. Thereafter, digitization and correction of every village border has been done with the help of Q-GIS and Google Earth Software (open-source software). Further, to examine the accuracy of village and taluka borders Q-GIS software has been implied and location point of every village has been extracted with the help of coordinate capture tool (Q-GIS) and GPS device, then point data were manually adjusted to corresponding field sketch map, road network, stream and ortho-photo imagery which were overlaid in Q-GIS software. Spatial point pattern analysis was performed using an extension Q-GIS and Google earth software. Total built-up area of each village and distance of each settlement have been calculated through calculate Geometry tool (Google earth).

Quadrat analysis embraces a variety of mathematical and statistical techniques which are designed to measure properties of point patterns. These techniques are of inherent interest to geographers because they provide answers to fundamental questions about the relationships between points in space. However, the first applications of the quadrat method appear in the literature of plant ecology, beginning with a paper by Gleason (1920). A quadrat is a frame, traditionally square, used in ecology, geography and biology to isolate a standard unit of area for study of the distribution of an item over a large area.
In addition to quadrat method Settlement concentration index and Average spacing of settlement methods have also been applied

5. Result and Analysis

Background of Quadrat Analysis
Quadrat analysis embraces a variety of mathematical and statistical techniques which are designed to measure properties of point patterns. These techniques are of inherent interest to geographers because they provide answers to fundamental questions about the relationships between points in space. However, the first applications of the quadrat method appeared in the literature of plant ecology, beginning with a paper by Gleason (1920). In plant ecology quadrat methods are used to analyze spatial properties of plant communities, but it is only recently that geographers have taken a serious interest in these techniques. Geographical point patterns which have been subjected to quadrat analysis include the distribution of shops in urban areas (Rogers, 1965, 1969 c), the distribution of karst depressions in a limestone region (McConnell and Horn, 1972), and the adoption of agricultural innovations by rural populations (Harvey, 1966).

Quadrat analysis involves the evaluation of the point distribution by examining how its density (expressed as number of points per quadrat) changes over space. The density of settlement is measured by Quadrat analysis and then compared with the density of the same settlements with theoretically-constructed, random pattern to see if the point distribution in question is more clustered or more dispersed than the random pattern. This method required constructing a regular square grid (quadrat) covering the study area and counting the number of quadrats according tothe number of points in each square and then constructing a frequency distribution of the number of quadrats based on the number of points within them.

Quadrat analysis compares this frequency distribution with that of a known pattern, generally a random pattern (generated from a Poisson distribution). The choice of the quadrat size can greatly affect the analysis, where large quadrats produce a coarse description of the pattern. If the quadrat size is too small then many quadrats may contain only one event or they might not contain any events at all. Once the quadrats have been drowned on the map, recorded the number of points, X, in each quadrant. Some points may appear to fall on the boundary of a quadrat; however, since points are considered dimensionless such points are recorded as being inside of quadrats. We use this information in constructing a table in which we record the frequency of occurrence of quadrat with a given number of points. As a rule of thumb, the area of a square is twice the expected frequency of points in a random distribution. Thus, the size of quadrats is 2A/r, when A is the area of study and r is the number of points in the distribution. The variation in quadrat size for each Taluk is shown in Figure 2.

Spatial distribution of settlements by using Quadrat Analysis:

In the quadrat analysis, first the area is divided into a large number of quadrats of identical dimension with the help of following equation.

$$\text{Variance } (\sigma) = \frac{\sum(x-0)^2 xf}{n-1}$$

Whereas f denotes total number of quadrats.

X shows number of points in each quadrat in counted and totaled.

Q depicts observed frequency distribution of quadrats.

Σ indicates the expected frequencies for each level of points Variance are then computed from Poisson model.

A casual inspection of the spatial distribution of settlements in the study area, suggests a fairly even spread. The quadrat count statistical analysis is computed to determine the pattern of settlement distribution in the area. The number of settlements per unit area was determined by imposing 400Km^2 size quadrat (1Sq inch = 400Sq Km) on the settlement map of the study area (Fig: 2). The Variance (σ) and the variance mean ratio (VMR) were calculated for the data (Tab: 1). The result yields a VMR value of 8.73. Since the calculated value is greater than 1.0 this shows that the distribution is clustered in space.

Table 1: Calculation of Variance and Variance Mean Ratio

Settlement Per Quadrat (X)	No. of Quadrat (f)	Xf	Variance (σ) for No. of Settlements per Quadrat
0	7	0	1850.71
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	3	18	315.8
7	2	14	171.5
8	2	16	136.46
9	0	0	0
10	2	20	78.38
11	0	0	0
12	1	12	18.15
13	1	13	10.63
14	0	0	0
15	2	30	3.18
16	2	32	0.14
17	2	34	1.1
18	0	0	0
19	1	19	7.51
20	3	60	41.96
21	1	21	22.47
22	0	0	0
23	0	0	0
24	3	72	179.72
25	1	25	76.39
26	1	26	94.87
27	1	27	115.35
28	1	28	137.83
29	0	0	0
30	1	30	188.79
31	0	0	0
32	2	64	495.5
33	0	0	0
34	0	0	0
35	1	35	351.19
36	0	0	0
37	0	0	0
38	0	0	0
39	1	39	517.11
40	0	0	0
41	0	0	0
42	0	0	0
42	0	0	0
44	0	0	0
45	0	0	0
46	0	0	0
47	0	0	0
48	1	48	1007.43
Total	42	692	5822.17

Source: Computed by Authors – 2022

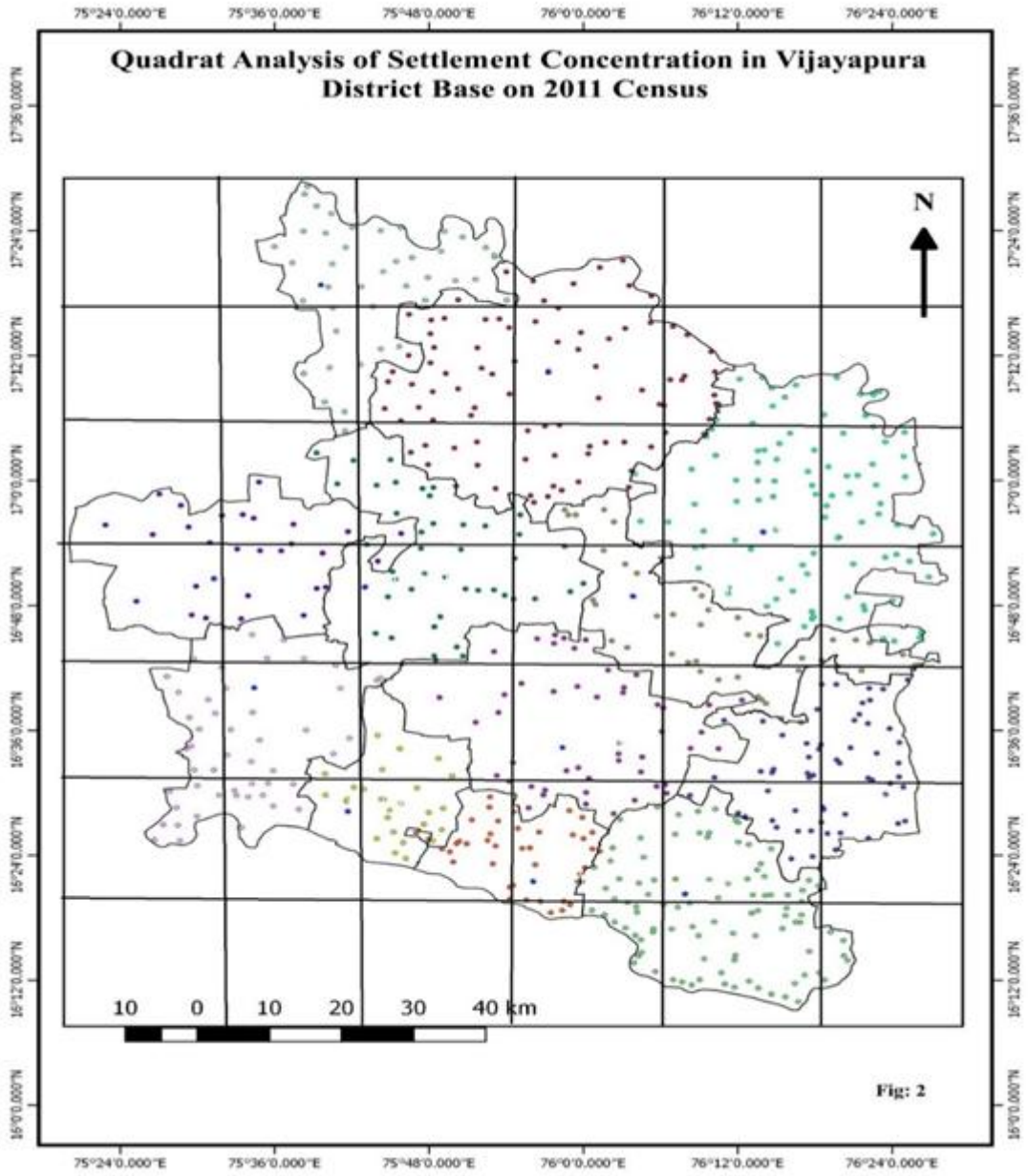
Mean Density (O) $= \frac{\Sigma xf}{\Sigma f} = \frac{692}{42} = 16.47$

Variance Mean Ratio (VMR) $= \frac{\sigma}{0} = \frac{142}{16.26}$ VMR = 8.73

Variance (σ) $= \frac{\sum(x-0)^2 xf}{n-1} = \frac{12682.99 \times 42}{42-1} = \frac{5822.17}{41} = 142$

Quadrat Count Analysis Decision Rule:

- If VMR is < 1.0, the distribution pattern is regular
- If VMR is = 1.0, the distribution pattern is random
- If VMR is > 1.0 the distribution pattern is clustered



Source: Computed by Authors-2022

Settlements Concentration by Quadrat Technique

The concentration of settlements in the Vijayapura district was examined by using quadrat method. The scale of the map is 1 square inch equals to 10 square kilometers. Square of grids having equal size are drawn on the map of the study areaand thus, 42 pieces of quadrats (grids) have been produced on the study area map.1 sq inch quadrat represents 400 Square kilometers (Fig.2) area. Thus, the total area of all the quadrats approximately 16, 800 square kilometers. Further, settlements are counted in every quadrant and listed, and also counted quadrat didn't have any settlements. Out of 42 quadrats seven quadrats don't have a settlement, the remaining quadrats have settlements. The numbers of settlements lying in each quadrat were counted and concentration index was calculated with help of the following formula:

$$C = \frac{Ns + Au}{At} X\ 100$$

Where C denotes the level of concentration of settlement

Ns shows the total number of settlements in the quadrat

Au depicts the total Occupied area in the quadrat and

At is the total area of the tahsil.

This level of concentration was computed for every quadrat and the results are given in Table.2

Table 2: Settlement Concentration in Vijayapura District – Quadrat Method

Quadrats No.	Area of Each Quadrats in Sq Km	No. of Points (Settlements) in Each Quadrats	Built of Area of Each Quadrats (Sq Km)	Quadrats Did not have settlements	$C = \frac{Ns + Au}{At} X\ 100$
Q-1	0	0	0	1	0
Q-2	213	13	3.69	0	7.84
Q-3	273	20	2.38	0	8.2
Q-4	141	6	1.08	0	5.02
Q-5	0	0	0	1	0
Q-6	0	0	0	1	0
Q-7	0	0	0	1	0
Q-8	152	7	0.95	0	5.23
Q-9	400	30	3.42	0	8.36
Q-10	400	15	6.04	0	5.26
Q-11	234	19	1.47	0	8.75
Q-12	116	6	0.78	0	5.84
Q-13	209	6	1.77	0	3.72
Q-14	261	10	1.2	0	4.29
Q-15	400	20	1.93	0	5.48
Q-16	400	28	3.87	0	7.97
Q-17	400	25	7.39	0	8.1
Q-18	355	27	3.34	0	8.55
Q-19	269	7	2.07	0	3.37
Q-20	400	16	3.69	0	4.92
Q-21	400	24	39.41	0	15.85
Q-22	400	21	4.93	0	6.48
Q-23	400	26	5.58	0	7.9
Q-24	309	24	2.39	0	8.54
Q-25	144	10	0.95	0	7.6
Q-26	400	15	3.51	0	4.63
Q-27	400	12	3.79	0	3.95
Q-28	400	19	3.42	0	5.61
Q-29	400	24	3.36	0	6.84
Q-30	312	32	3.3	0	11.31
Q-31	97	8	1.42	0	9.71
Q-32	202	16	3.57	0	9.69
Q-33	392	32	4.19	0	9.23
Q-34	400	48	6.77	0	13.69
Q-35	400	39	4.15	0	10.79
Q-36	216	17	4.15	0	9.79
Q-37	0	0	0	1	0
Q-38	0	0	0	1	0
Q-39	0	0	0	1	0
Q-40	117	17	1.17	0	15.53
Q-41	339	35	3.51	0	11.36
Q-42	148	8	1.48	0	6.41

Source: Computed by Authors-2022

The analysis was carried out for all the 42 quadrats. Out of 42 quadrats seven quadrats namely Q-1, Q-5, Q-6, Q-7, Q-37, Q-38 and Q-39 don't have settlements and the rest of quadrats have settlements which were counted and listed in table.3. Quadrats wise concentration of settlements is analysis. Quadra-2 and 3 covered maximum portion of the Chadachan taluk of study area which consist of 13 and 20 settlements and the concentration index value is 7.84 and 8.20respectively. The quadrat-4 with 6 (CI 5.02) settlements extend over Chadachan and part of the Indi taluk. Quadrat-8 has 7 (CI5.23) settlements of the Chadachan taluka. Quadrat-9 covers part of the Indi and part of the Chadachan taluk which includes 30 (CI 8.36) settlements. Quadrat-10 covers the maximum area of Indi taluk with 15settlements and CI is 5.26.

The Quadrat-11 extends over the area of Indi and Sindagi taluk, compring19settlements (CI 8.75) and quadrat-12 and 13 covers the maximum area of Sindagi and Tikota taluk which have 6 (CI 5.84) and 6 (CI 3.72) settlements respectively. Quadrat-14 lies on the maximum part of Tikota and Vijayapura and some portion of Chadachan taluk which includes 10 (CI 4.29) settlements. Quadrat-15 covers almost equal parts of Vijayapura and Indi taluk of study area which have 20 (CI 5.48) settlements.

The quadrat-16 lies on part of four taluks such as Vijayapura, Devara Hipparagi, Indi and Sindagi which includes 28 settlements and CI is 7.97. Quadrat-17 covers the maximum area of Sindagi and some part of Indi taluk with25 settlements (CI 8.1), and quadrat-18 covers area of entire on Sindagi taluk, having 27 (CI 8.55) settlements. The quadrat-19 lie on a large area of Tikota and some portion of Babaleshwara taluk and covers, 7 (CI 3.37) settlements.

Quadrat-20 covers the maximum portion of Tikota and a small part of the Babaleshwar and Vijayapura together accounts, 16 settlements and CI 4.92. The quadrat-21 lie on most parts of Vijayapura and some parts of Tikota and Basavana Bagewadi taluks which consists of24 settlement sand 15.85CI. Quadrat-22 covers the maximum part of Vijayapura and Devara Hipparagi and a small portion of Basavana Bagewadi taluks with 21settlements and CI 6.48. The quadrat-23 & 24 lie on the maximum area of Sindagi taluk and minimum area of Devara Hipparagi covering 26 (CI 7.90) and 24 (CI 8.54) settlements respectively.

The quadrat-25 covers the area of Babaleshwar taluk with 10 (CI 7.60) settlements. Quadrat-26 covers a large portion of Babaleshwar taluk and small part of Kolhar taluk, which includes 15 (CI 4.63) settlements. Quadrat-27 covers equal parts of Kolhar and Basavana Bagewadi and a small part of Babaleshwar, which includes 12 (CI 3.95) settlements. The quadrat-28 lie on Basavana Bagewadi with 19 (CI 5.61) settlements. Quadrat-29 covers part of Basavana Bagewadi, Devara Hipparagi and Taikoti taluks covering an area of 24settlements and6.84 CI.

Quadrat-30 lies on the maximum part of Talikoti and small part of Devara Hipparagi taluks which include 32 (CI 11.31) settlements. The quadrat-31 lie on Babaleshwar taluk, with 8 (CI 9.71) settlements. Quadrat-32 covers both Babaleshwara and Kolhar taluka, which includes 16 (CI 9.69) settlements. Quadrat-33 lies on the maximum part of Kolhar and Nidagundianda small part of Basavana Bagewadi taluk, which includes 32settlements 9.23CI. The quadrat-34 covers equal parts of both Nidagundi and Muddebihal and a small part of Basavana Bagewadi, taluks, with 48 settlements and 13.69 CI. Quadrat-35 and 36 cover on equal part of Muddebihal and Talikoti and maximum part of Talikot and small part of Muddebihalhaving39 (CI 10.79) and 17 (CI 9.79) settlements respectively. Finally, quadrat-40 lies on a small portion of Nidagundi and maximum portion of Muddebihal, which includes 17 (CI 15.53) settlements. The quadrat-41 & 42 cover the maximum area of Muddebihal taluk, with 35 (CI 11.36) and 8 (CI 6.41) settlements respectively.

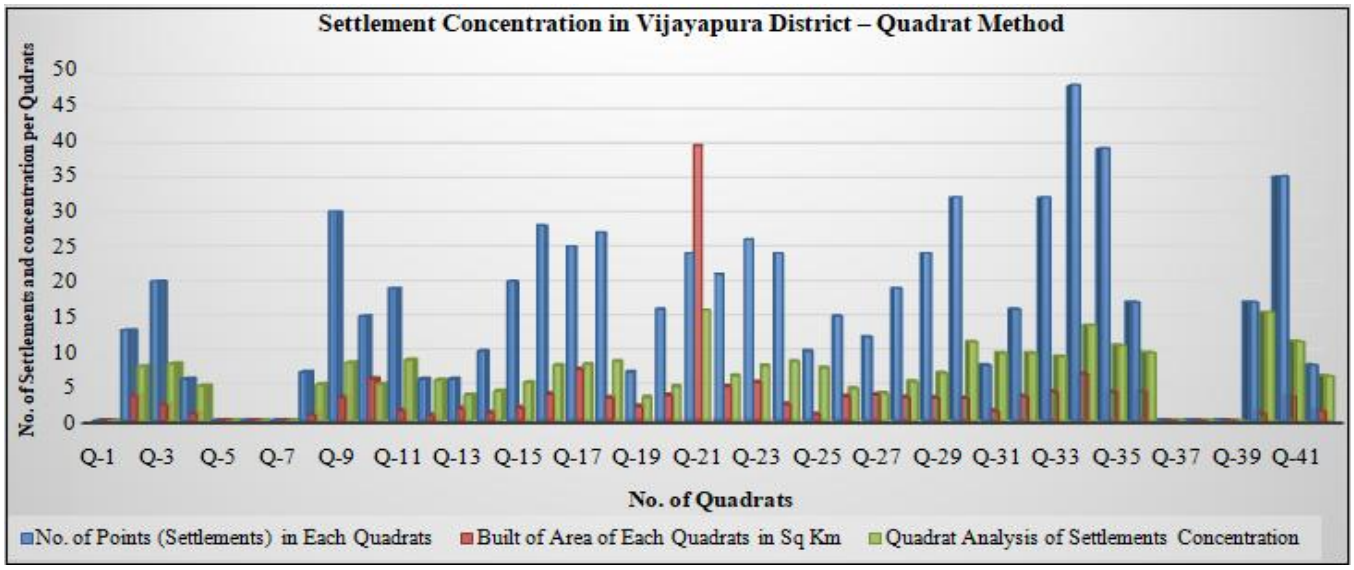


Figure 3
Source: Author`s Analysis, 2022

Table 3: Settlement Concentration Index inVijayapura district: using quadrat method

S. No.	Concentration Index	No. of Quadrats	No. of total settlements	Name of the Quadrats (Q)	Rank
1	0.01 TO 2.50	0	0	-	-
2	2.51 TO 5.00	6	66	Q-13, Q-14, Q-19, Q-20, Q-26, Q-27	V
3	5.01 TO 7.50	8	105	Q-4, Q-8, Q-10, Q-12, Q-15, Q-28, Q-29, Q-42	IV
4	7.51 TO 10.00	15	346	Q-2, Q-3, Q-9, Q-11, Q-16, Q-17, Q-18, Q-22, Q-23, Q-24, Q-25, Q-31, Q-32, Q-33, Q-35	III
5	10.01 TO 12.50	3	84	Q-30, Q-36, Q-41	II
6	12.51 TO 15.00	3	89	Q-21, Q-34, Q-40	I

Source: Extracted from Fig.2 and computed by the author

Table-3 and Fig.4 show the concentration index value, number and name of the quadrat and number settlements in each group. The concentration index values have been grouped under five categories. The first group range between 0.01and 2.50 where none of the settlements exists, the second group ranges from 2.51 to 5.00 which consists 6 quadrats covering66 settlements from different taluks. This group stands fifth rank in Concentration Index ranking. The third group range 5.05 to 7.50 which contains 8quadrats, with 105 settlements of different taluks and it falls under fourth rank. The third group range7.51 to 10.00 comprises of 15quadrats, with346 settlements of different taluk and it stands third rank in the concentration index groups. The fifth and sixth group value 10.01 to 12.50 and 12.51 to 15.00 each having3quadrats, and includes 84 and 89 settlements and stands second and first ranks respectively.

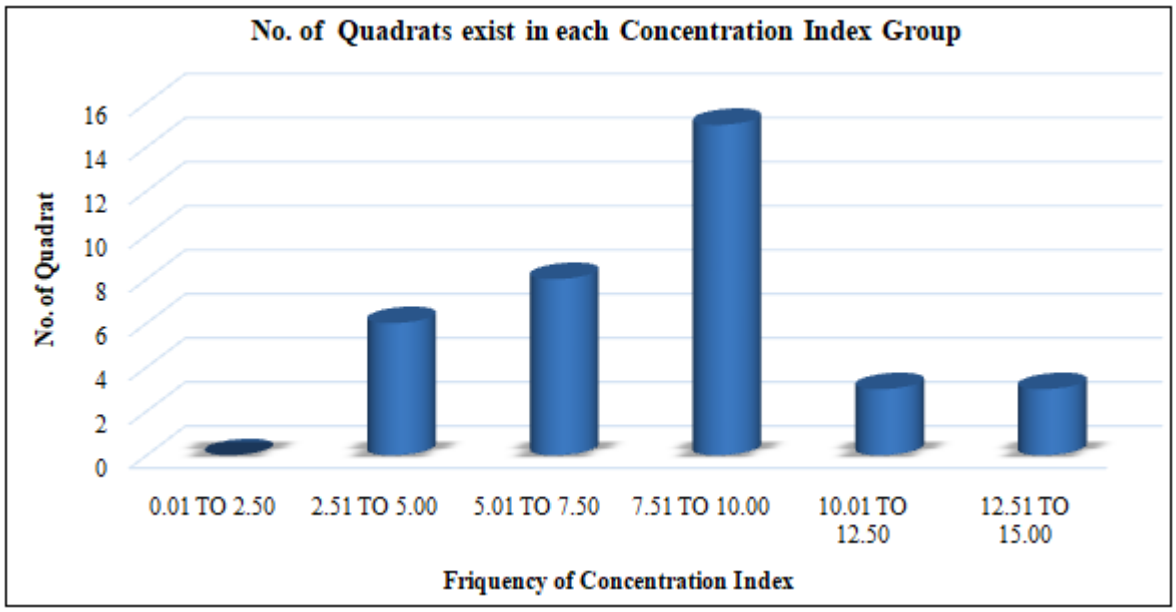


Figure 4
Source: Computed by Author-2022

Although the spatial pattern of settlements in the study area is generally clustered, settlement densities per square kilometers are slightly vary over space. Tikota taluk having least Settlement density (0.036) Muddebihal and Nidagundi taluk depict greater settlement density i. e., 0.109 sq. km. Q-21, Q-30, Q-34, Q-35, Q-40 and Q-41show high density of settlement, these quadrats cover Vijayapura, part of Talikoti, small area of BasvanaBagewad, equal portion of Nidagundi and Muddebihal, some part of Talikoti and maximum part of Muddebihal taluk of the study area. Low density falls in Q-13, Q-14, Q-19 and Q-20 quadrats which cover maximum part Tikota taluk and Q-26 and Q-27 cover part of Babaleshwara taluk and part of Kolhar and Basavana Bagewadi taluks of Vijayapura (Table.4 & Fig.3).

Table 4: Settlement Densities by Area

S. No.	Taluks	Area in Sq Km	No. of Settlements	Density per Sq Km
01	Babaleshwar	853	51	0.060
02	Basavana Bagewadi	941	50	0.053
03	Chadachan	689	42	0.061
04	Devara Hipparagi	733	46	0.063
05	Indi	1546	88	0.057
06	Kolhar	461	28	0.061
07	Muddebihal	934	102	0.109
08	Nidagundi	395	43	0.109
09	Sindagi	1434	98	0.068
10	Talikoti	744	58	0.078
11	Tikota	873	31	0.036
12	Vijayapura	895	46	0.051

Source: Computed by Authors-2022

A method of spatial arrangement of point locations examines the frequency of points occurring in various parts of an area. A set of quadrats of cells (usually squares but not always) is superimposed on a study area and the number of points in each cell is determined. By analyzing the distribution of cell frequencies, the point pattern arrangement can be described.

The analysis shows that Vijayapura Tahsil having the highest concentration index has the highest occupied area i. e., 42.27 Sq Km and, index value is 4.723, which accounts 28.63 percent of the total occupied area. The lowest concentration index has been recorded in Tikota taluka i. e., 7.57 sq Km, and index value is 0.867, which amounts 5.127 percent of the total Occupied area. Therefore, settlements are largely concentrated in favored sites which have easy availability of ground water, rail and road tracks, fertile soil and accessibility to trading centers. (Fig: 4).

Similarly, Nidagundi (1.787) and Muddebihal (1.433), two other south west and south west taluks having fertile soil, fair availability of water for agriculture as well as human beinglead to higher concentration. But Muddebihal has more villages than compared to other taluks. These taluks recorded moderate geographical area and more number of settlements as a result high density i. e.934 Sq. Km.

Tikota, Indi, Devara Hipparagi, Basavana Bagewadi, Babaleshwara, Chadachan, Kolhar, Sindagi and Talikoti show lesser degree of concentration i. e., 0.867, 0.959, 1.018, 1.045, 1.067, 1.070, 1.074, 1.085 and 1.230 respectively. In these taluk`s the Occupied area is relatively smaller and the settlements are situated further apart. It has been observed in the field studies that on account of large number of settlements occupying a greater area of fertile, arable soil, endowed with low portable water-table in all

talukas except river belt villages and taluka`s the concentration of settlements is very close which denotes that every inch of land is used for economic activities.

Table 5: Talukwise Concentration of Settlement in Vijayapura District Method

S. No	Tahsils	Occupied Area (Sq. Km)	Total Area of Tahsil (Sq. Km)	Total No. of Settlements	Concentration	
					Index	Rank
01	Babaleshwar	9.10	853	51	1.067	VIII
02	Basavana Bagewadi	8.94	941	50	1.045	IX
03	Chadachan	7.37	689	42	1.070	VII
04	Devara Hipparagi	7.46	733	46	1.018	X
05	Indi	14.82	1546	88	0.959	XI
06	Kolhar	4.95	461	28	1.074	VI
07	Muddebihal	13.38	934	102	1.433	III
08	Nidagundi	7.06	395	43	1.787	II
09	Sindagi	15.56	1434	98	1.085	V
10	Talikoti	9.15	744	58	1.230	IV
11	Tikota	7.57	873	31	0.867	XII
12	Vijayapura	42.27	895	46	4.723	I

Source: Author`s Analysis, 2021

The analysis shows that Vijayapura Tahsil reported highest concentration index as it occupied highest geographical area (42.27 Sq. Km). The index value and percent of the total area occupied by this tahsil is 4.723, and 28.63 respectively. The lowest concentration index i.e.7.57 sq Km and occupied area (0.867) has been recorded in Tikota taluka, which accounts 5.127 percent of the total Occupied area. Therefore, settlements are largely concentrated in favored sites which have easy availability of ground water, rail and road tracks, fertile soil and accessibility to trading centers. (Fig.5).

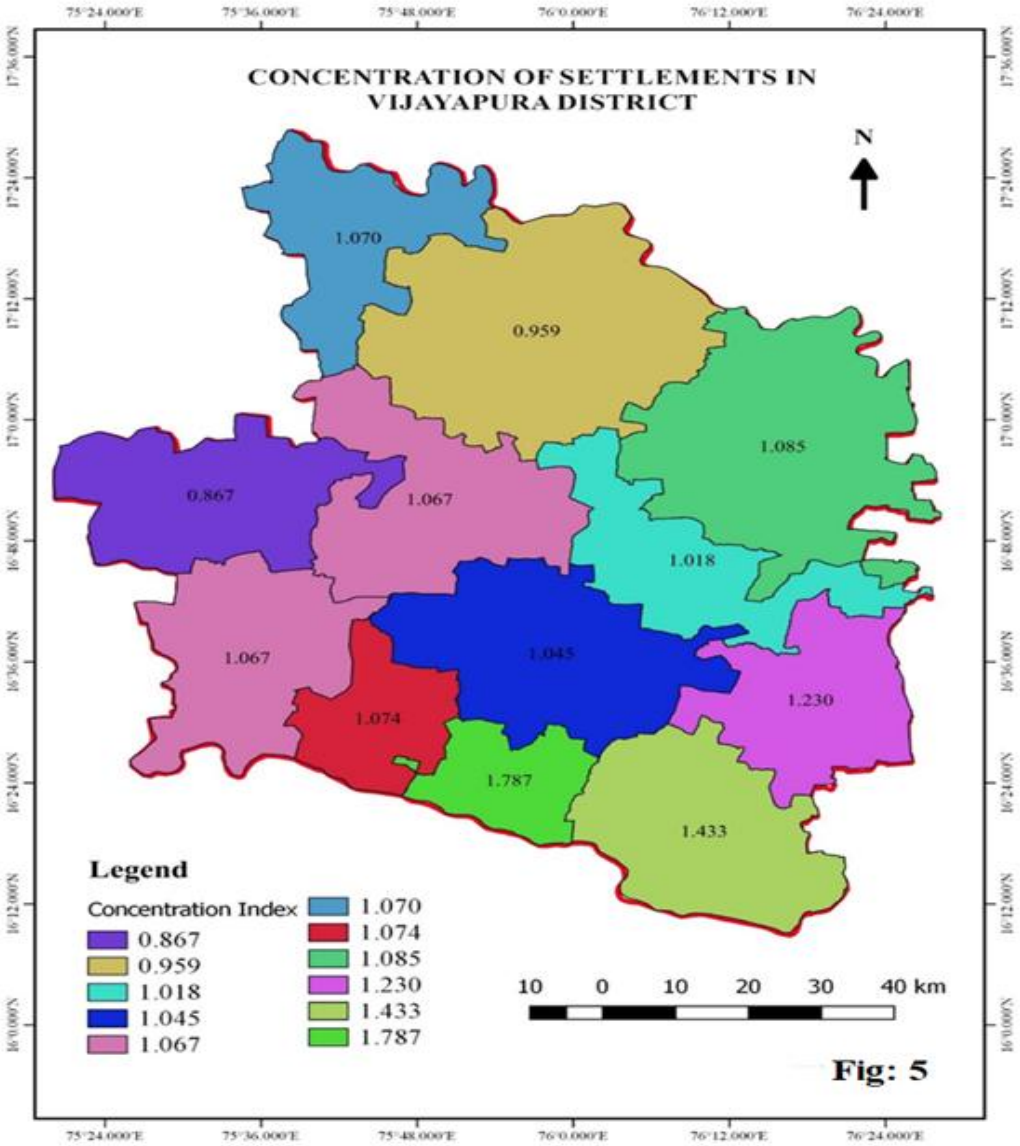


Fig: 5

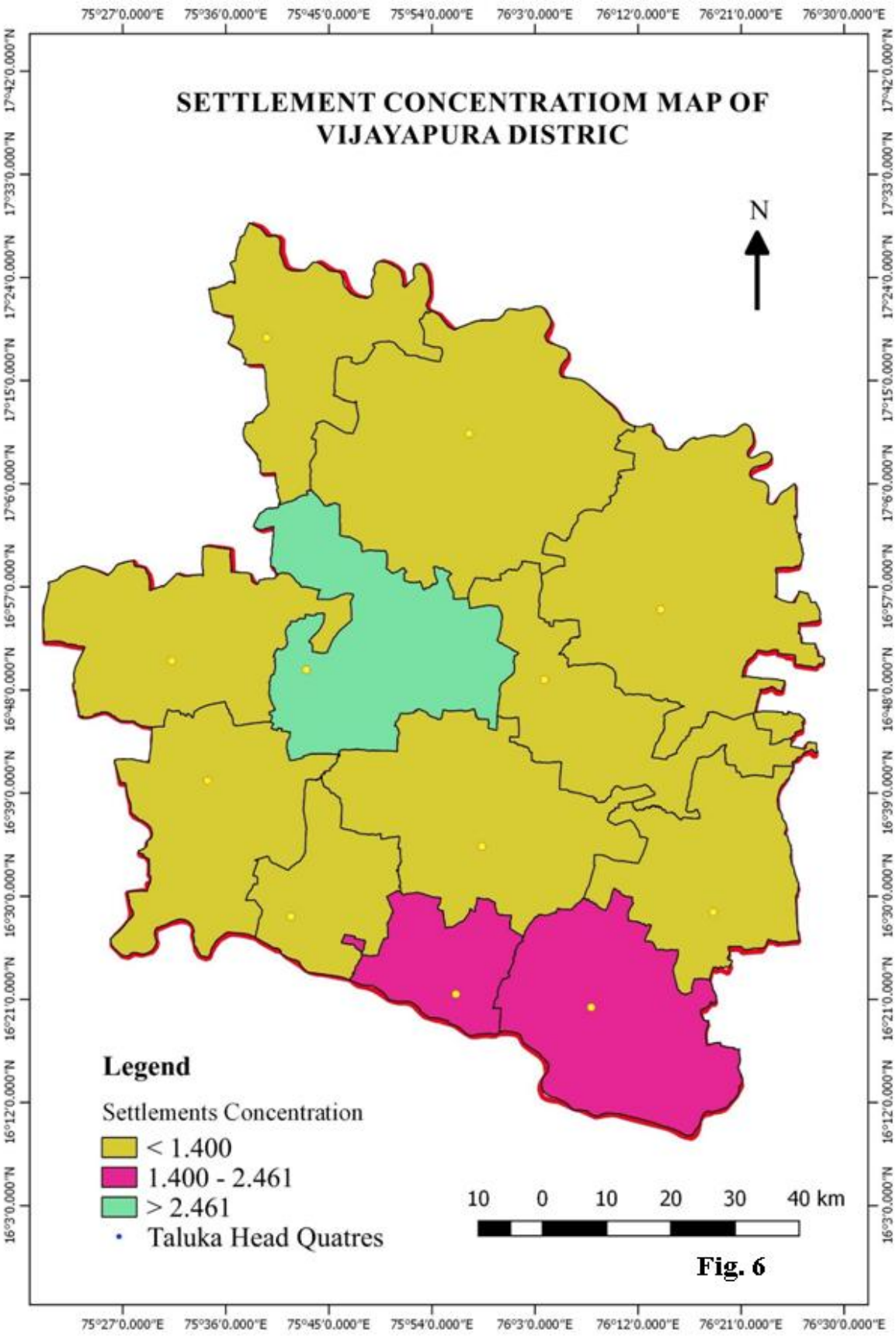


Fig. 6

6. Conclusion

It can be concluded that the spatial pattern of settlements in the Study Area is approaching towards clustered which has been found with the help of quadrat analysis and the variable mean ratio (VMR) is > 1. The spatial pattern of settlement is varying from one tahsil to other some Taluks namely Chadachan and Talikoti indicate VMR < 1which indicates regular pattern. Settlement density per square kilometers in the study area is lesser as compared to the density of settlements in Karnataka state. According to the results of Quadrat method four taluks namely Babaleshwar,

Chadachan, Talukto and Nidagundi show low concentration of settlements with CI 2.51 to 5.00 and six taluks such as Muddebihal, Sindagi, Basavab Bagewadi, Indi, Devera Hippargi and Kolar recorded moderate settlement concentration with CI value 7.512 to 10.00, in this group there are 360 villages exists. No taluks found in the high range with CI value more than 10. The settlement density in the study area shows high density with density. Two taluks namely Bijapur and Shindagi indicate high density, five taluks show moderate density and low density reported in Tikota and Chadachan.

References

[1] Adinarayana, J., Raj, F. J., and Sharma, V. (2004). Village level information system – a tool for decentralized planning at district level in India, International Journal of Environmental Informatics, 4 (2): 56-64.
[2] Ahmad, E (1952): "Rural Settlement Types in Uttar Pradesh", Annals of Association of American Geographer, Vol.42, pp.223-246
[3] Hagget, P. (1965): "Locational Analysis in Human Geography", Edward Arnold, London
[4] Ismael, A. K. (2013). Settlement size and its effect on Sustainable Rural Development: A Case Study of Erbil, Kurdistan Region/Iraq. Journal of Economics and Sustainable Development.4 (20), ISSN 2222-1700 (paper), ISSN 2222-2855 (online). pp.139-147.
[5] Lal K., Kumar D., Kumar A. (2017), Spatiotemporal landscape modeling of urban growth patterns in Dhanbad Urban Agglomeration, India using geoinformatics techniques. Egyptian Journal of Remote Sensing and Space Science, 20 (1), 91–102. DOI: https: //doi. org/10.1016/j. ejrs.2017.01.003
[6] Mandal, R. B. (2001): "Introduction to Rural Settlements", Concept Publishing Company, New Delhi
[7] Majumdar K. L., and Sinha R. L. P. (1992), "A GIS based Information System for Regional Planning – A Case Study for Bharatpur District" Govt. of India, SAC, Ahmedabad, TCPO, New Delhi.
[8] Mitchell. K, (2007): Quantitive Analysis by the Point-Centered Quarter Method, Department of Mathematics and Computer Science Hobart andWilliamSmithColleges, Geneva, Switzerland.
[9] Mukarjee, A. B, (1969): "Spacing of Rural Settlements in Andrapradesh-A Spatial Interpretation, " Geographical Outlook, Vol. VI, p.3.
[10] Pore, A. V. and Lokhande (2011b): "Density of Rural Settlements in Kolhapur District of Maharashtra", Interlink Research Analysis, Vol. III, Issue: III, pp.79-84.
[11] Singh, L. R., (1958): "Rural Settlements in the Tarai Region of Uttar Pradesh", National Geographer, Vol.2, PP.7-26.
[12] Singh, R. L. (1961): "Meaning, Objectives and Scope of Settlement Geography", National Geographical Journal of India, Vol. VII, Part-1, pp.12-13
[13] Singh, R. L. (1994). Geography of Settlement. Rawat Publication. ISBN 81-7033-209-5.
[14] Singh, K. N., Singh, R. P. B., & Singh, D. K. (1975). Geographical Dimension of Rural Settlements. Proceedings of I. G. U. Varanasi Symposium, Dec.1-7, (1975).

Website

[15] https://bhuvan.nrsc.gov.in/home/index.php#Contact
[16] https://earth.google.com/web
[17] https://projects.datameet.org/indian_village_boundaries/