

## A Spatial and Correlational Analysis of Mining and Built-Up Area Expansion of Ramganjmandi City of Kota District, Rajasthan, India (2000-2018)

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### Abstract

Extraction of natural resources is one of the prime activities of economic importance on this human centred earth. Besides this, it also causes socio economic changes. Expanse of the mining area near a city often causes rise in its population which in turn leads to increase in the built-up area. With the trend of growth in population, settlement patterns also take their own shape creating its identity on the landscape. Settlement shows the way humans organize their living. This present paper focuses on settlement pattern, built-up area and mining area of Ramganjmandi tehsil in Kota district of Rajasthan in India. The economy of the area is mainly governed through mining and agriculture. The methodology adopted is Nearest Neighbour Analysis as given by Clark and Evans, 1954 for analysing the settlement pattern. The toposheet were mosaiced in Arc GIS and the geometry was calculated in the software itself. The index came out to be 0.39 showing a pattern of High Concentration. The expansion in the built-up area is caused due to increase in the residential requirements for skilled and unskilled population, area devoted to mining related industry and also the commercial area. In this paper a correlation has been established between the mining area and built up area from the year 2000 to 2018. LANDSAT satellite images have been used for the respective years. The mining area and built-up area has been digitized from the year 2000 to 2018 in arc map software for the tehsil. The geometry of the digitized area has been calculated in the software itself. The built-up area has increased from 2.24 km<sup>2</sup> in the year 2000 to 5.21 km<sup>2</sup> in 2018. A positive correlation has been observed between mining and built up area.

**KEYWORDS:** Settlement, Mining, Nearest neighbour Analysis, Built-up, GIS, Correlation

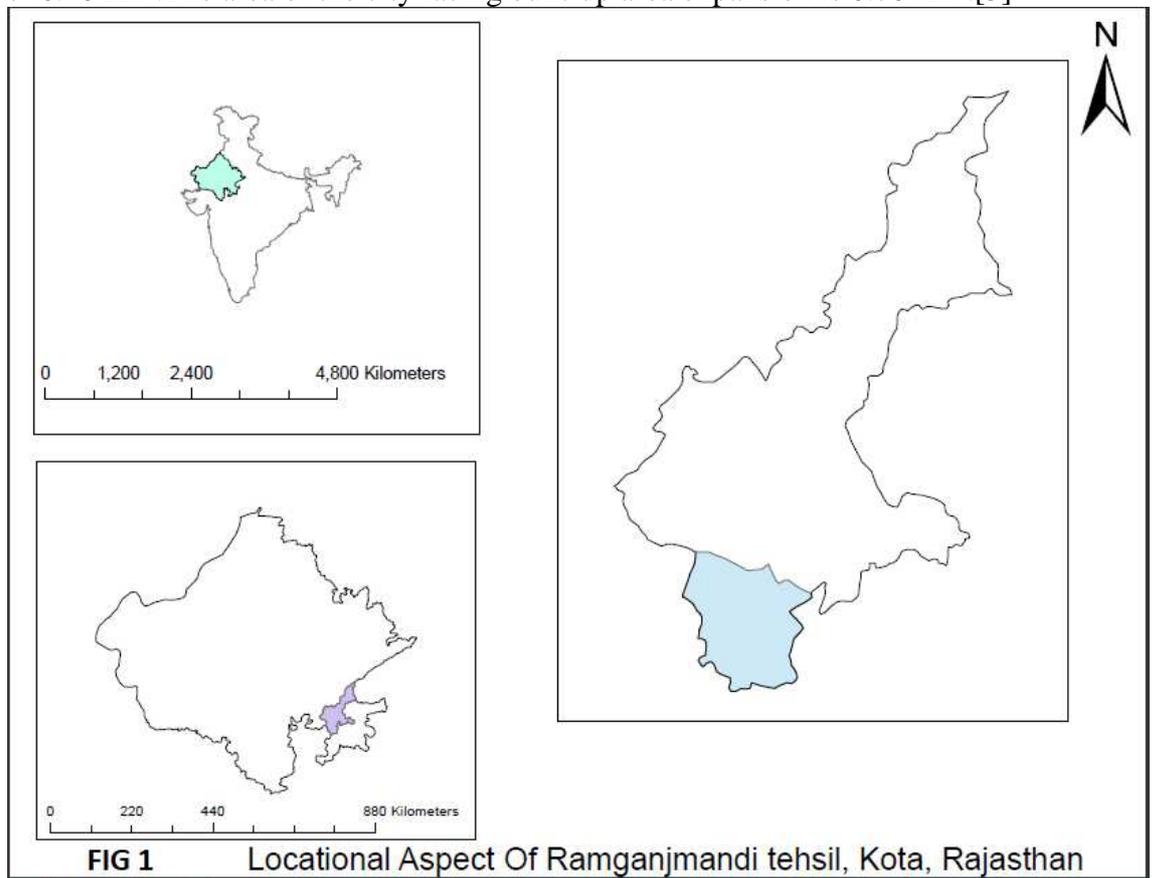
### INTRODUCTION

Human occurance over much of the earth has evolved from a subsistence stage to the organisational stage, which is based on a wide range of specializations of functions. Due to these changes which are social and economic in character the number of populations have increased in the recent years. [1]

Mining is a major stimulus to urbanisation, settlement patterns and population growth. Mining being an economic activity creates a footprint over land in terms of land use and land cover changes. Mining transforms agro-towns into specialised towns which have acquired structural and functional attributes. Mining enhances urbanization in many ways, such as the number of urban places increases, secondly it is major driving force to rural urban migration [1] The settlement patterns are often a signature of prevailing economic activity.

The built-up area expanse can be clearly correlated with expanse in the mining region. The study concentrates over the positive correlation of mining area and built up area. The other objective of the study is to analyse settlement pattern of the tehsil using nearest neighbour analysis. Indian cities have developed through the pull factors of any economic activity. Spatial relations are often created with the aid of an economic activity. The fundamental characteristic of any space is its pattern which is often governed through the prevailing activity. Settlements create facts on the ground. These are not merely physical facts but also moral ones. Any landscape is flexible in its characteristics, settlements reshapes these normative environments. [2]

Ramganjmandi is a tehsil of district of Kota in the state of Rajasthan, India. In the centre of the tehsil lies Ramganjmandi city. It is known as a stone city and coriander city. It is situated towards south of Kota on the Delhi-Mumbai broad gauge railway line. The latitudinal extension is  $24^{\circ}37' 30''\text{N}$  to  $24^{\circ}41' 30''\text{N}$  and the longitudinal extension is  $75^{\circ}54' \text{E}$  to  $75^{\circ}58' 30'' \text{E}$ . The total area of the tehsil is  $795.06 \text{ km}^2$  including  $48.88 \text{ km}^2$  of urban area and rural area of  $746.18 \text{ km}^2$ . The area of the city facing built-up area expansion is  $8.78 \text{ km}^2$ . [3]



Maharao shri Ramsingh began the process of settling down people in Ramganjmandi, nearly 100 years ago. Due to its geographical location the area started developing before independence. The soil of this area was fertile and suitable for the growth of cotton. Hence Cotton was cultivated extensively. The area was rich in mineral and agricultural resources like coriander, soya beans, sandstone, Kota stone etc. In this way this area grew and took the form of a 'Mandi' of trade and commerce. In the year 1912, Ramganjmandi was connected through railways. This led to its growth as an administrative centre. Kota stone, a form of limestone is mainly mined in the Ramganjmandi

tehsil of Kota district. In the year 2014-15 there were 52 mines in Ramganjmandi tehsil occupying an area of 1493.1 Hectares producing 2688508.01 tons of Kota stone or building stone. The total sale of the limestone is INR 4570463617(1700 per ton), generating the revenue of Rs. INR 455379000.00.

1. Materials and methods

1.1. Settlement pattern-

The distribution pattern of the settlement is analysed according to the nearest neighbour analysis as proposed by Philip J. Clark and Francis C. Evans in 1954 which was originally used to describe the spatial pattern of the distribution of plants and animals. [4] The theory includes the calculation of observed distance and the expected distance. The main assumption is that the population which is in this case is settlement, is distributed randomly. The point file of settlements is generated over the open series map of the area which was georeferenced initially in Arc GIS 10.2.

The coefficient is calculated as R which is the ratio of observed distance and expected distance:

$$R = \frac{\bar{r}_O}{\bar{r}_E}$$

Here  $\bar{r}_O = \frac{\sum d}{N}$  and  $\bar{r}_E = \frac{1}{2\sqrt{A}}$

N, is the total number of settlements and A is the area of the administrative or any other division wherein one intends to know the pattern. The observed distance is calculated by measuring the distance between the settlements. R is then compared according to the following table:

VALUE OF R	DISTRIBUTION PATTERN	
0.00-0.09	Absolute concentration	
0.10-0.50	High concentration	
0.51-0.99	Clustered pattern	
1.00-1.19	Random pattern	
1.20-1.49	Approaching Uniform	
1.50 and above	Dispersed	

TABLE 1: Rn SCALE FOR NEAREST NEIGHBOUR ANALYSIS

1.2. Correlation between built up area and mining area

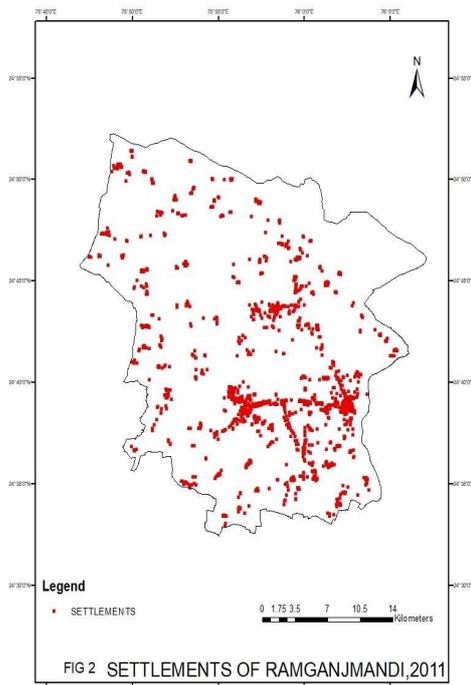
The mining area and built-up area of the tehsil is digitized on the scale of 1:500 in Arc GIS 10.2 software. The Landsat image has been downloaded for the year 2000 and 2011 and 2018. The digitized area has been calculated in the software. In order to establish a correlation between the two aspects Karl Pearson Method of correlation has been used. [5]

The coefficient is defined as follows:

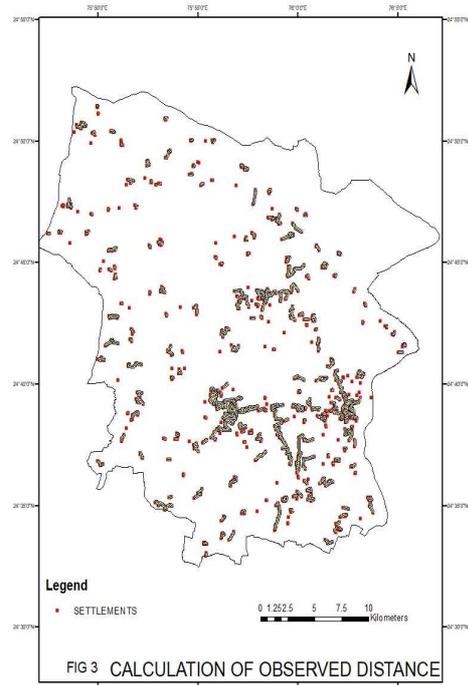
$$r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}}$$

## 2. Results and Discussions

### 3.1 Settlement pattern



source: United States Geological Survey



source: United States Geological Survey

The settlement map is created for the year 2011 (Fig 2).

The total number of settlements are 1272, the area of the tehsil is 746.18 km<sup>2</sup> and the Observed distance is 192.697 kms (Fig 3).

$$R = \frac{r\bar{O}}{r\bar{E}}$$

$$r\bar{O} = \frac{\sum d}{N} = 192.697/1272 = 0.15$$

$$r\bar{E} = \frac{1}{2\sqrt{\frac{N}{A}}} = 1/2\sqrt{\frac{1272}{746.18}} = 0.38$$

$$R = 0.15/0.38 = 0.39.$$

While we compare the value of R from table 1 we find a settlement Pattern of High Concentration. Z test is conducted to check the significance of the settlement pattern at 5% level of significance where

$$Z = \frac{r\bar{O} - r\bar{E}}{6 r\bar{E}}$$

$$6 r\bar{E} = 0.26136/\sqrt{N/A}$$

$$0.26136/\sqrt{1272/746.18} = 0.121$$

$$Z = 0.15 - 0.38/0.121 = 1.90$$

The table value of Z at 5% level of significance is 2.58. The value of Z score is tested at 5% level of significance. The calculated value is less than 2.58, hence the distribution pattern is significant (Fig 4).

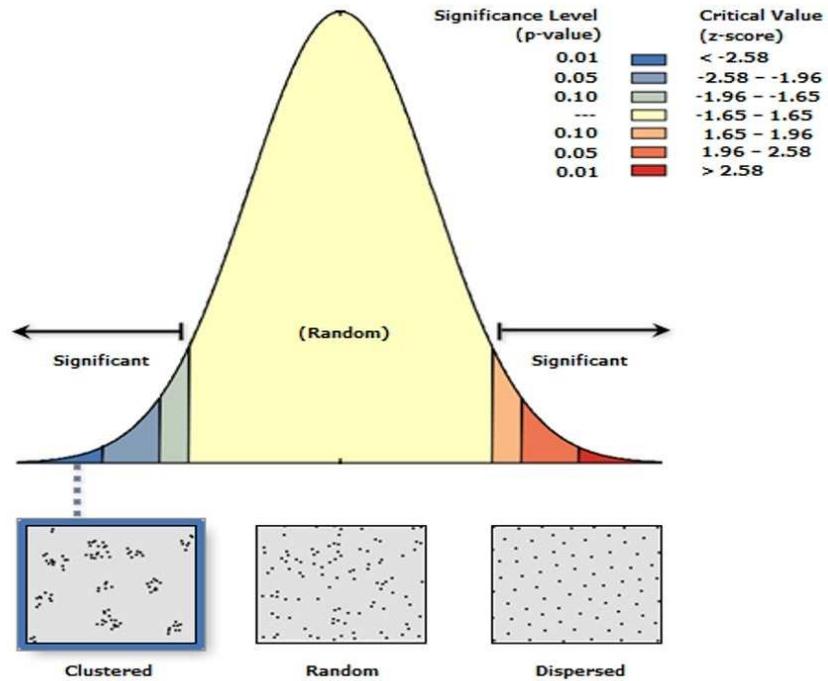
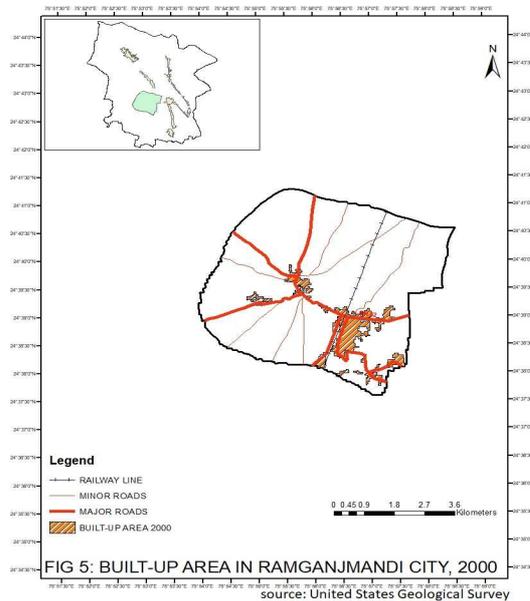


FIG 4 Z SCORE TEST

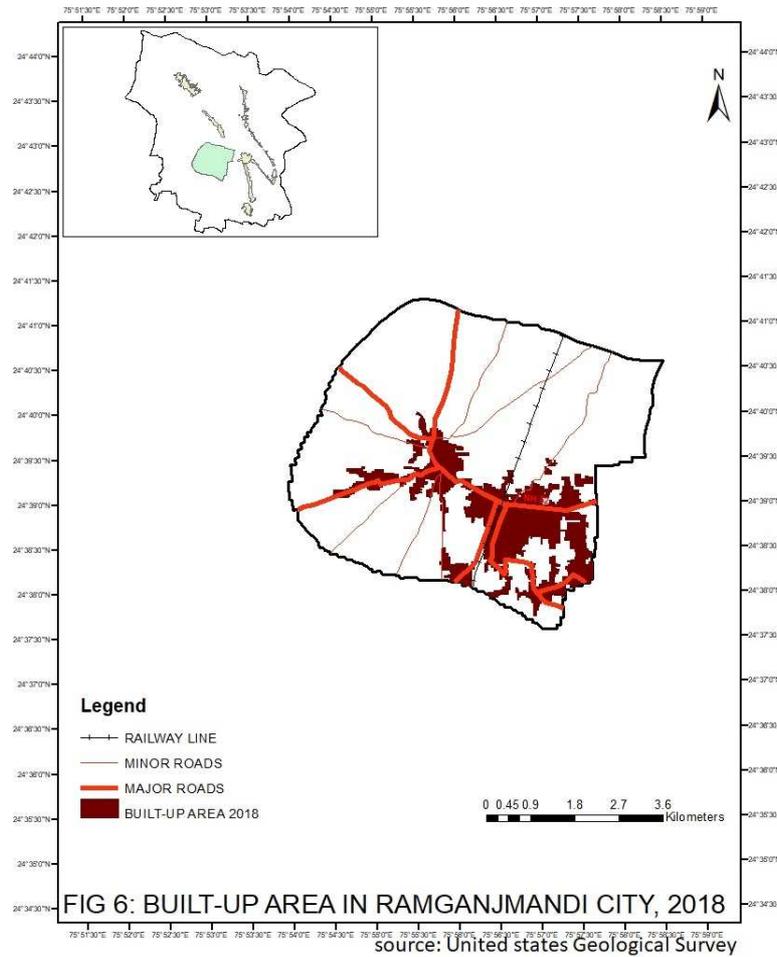
### 3.2 Correlation between mining and settlement

The built-up area for the year 2000 is 2.24 km<sup>2</sup> in the Ramganjmandi city. The major areas include kherabad, Ramganjmandi and Kumbhkot. The growth is seen majorly along NH12(Fig 5). The growth appears in a star shape manner. The expansion begins from the eastern part of the city which is nearer to the mining belt of the Tehsil. The built-up area increased to 5.21 km<sup>2</sup>.



The major increase is due to the formation of residential colonies such as Redas colony, Krishna Colony, HS colony. The Built-up area expansion is seen in Kherabad portion and Bishanya kher. Industrial area has been built up

to the south of Kherabad.



The built-up area just doubled from the year 2000 to 2018. Limestone or regionally popular Kota stone mining is attributed to this growth in the Built-up area. The mining belt includes Julmi, Kumbhkot, Satalkheri, Suket, Khemaj, Udpura, Kamalpura, Chechat. The mining area is 17.548 km<sup>2</sup> in the year 2000. The area expanded to 24.205 km<sup>2</sup> in the year 2018. The mining area increased by 6.657 km<sup>2</sup>. The expansion is seen in Chechat and Fatehpur region. A decline is seen in Suket region. The major economic activity undergone in the area is mining of Kota stone, sandstone. There is a positive change in the Built-up area which is 2.97 km<sup>2</sup> (Fig 6). Residential areas for the working staff, miners have grown in the city due to the expansion the mining. The change in the mining and built up area is depicted through change map for the year 2000 and 2018 (Fig 7).

The correlation is calculated as under

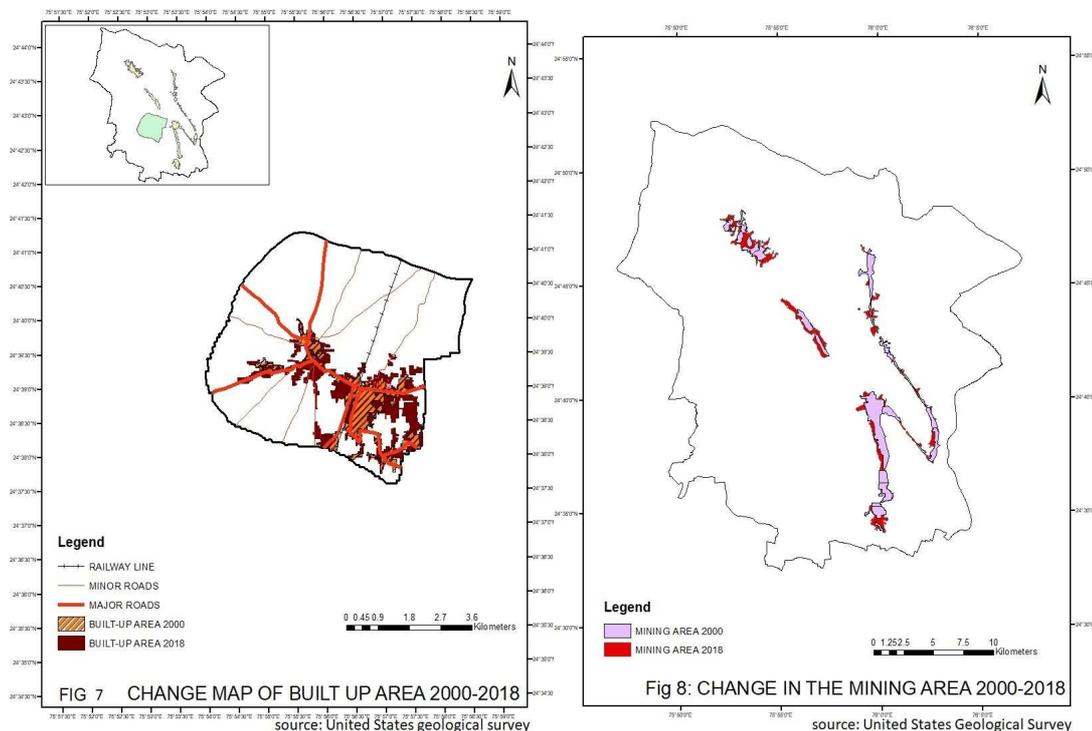
$$r = \frac{\sum xy}{\sqrt{\sum x^2 + \sum y^2}}$$

$$r = 9.885 / \sqrt{4.41 + 22.157}$$

$$R = 9.885 / 9.884$$

$$r = 1.000$$

The Statistics shows a perfectly positive relation between the mining and the Built-up area.



#### 4.CONCLUSIONS

From the study it can be concluded that any spatial phenomenon is clearly interlinked with ongoing economic activity. The settlement pattern is of High concentration according the above study which is often seen in the areas dominated by activities like mining. The area has been experiencing an increase in the mining belt from 2000 to 2018. The mining activity of Kota stone and sandstone has increased by more than 6 km<sup>2</sup>. The Built- up area has doubled to 5 km<sup>2</sup>. A positive correlation is seen between the economic activity prevailing and clustering of the settlements.

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