A quantitative analysis of settlements in Hingna taluka of Nagpur district- A Remote Sensing and GIS approach.

Dr.Devashish Dhar (Mr)[1], Krishna Dhar[2] (Ms.) & Dr. Kalpana Deshmukh[3] (Ms.)

Abstract

The analytical study of rural settlements with respect to size and spacing of settlement has great significance in terms of regional development and spatial integrated planning inputs.

The spacing distribution of rural settlements was studied for 156 villages in the Hingna taluka of Nagpur district in central India using high resolution satellite imageries available in 'Google Earth'. Spatial statistical technique of 'nearest neighbour analysis' was used to study the randomness in the distribution of settlements. The methodology used in the study demonstrates cost effective and accurate means to study the spacing of settlements in rural environs. The results of the study provide vital inputs for evolving a development model for rural settlements by the local developmental authorities.

Introduction

Rural settlements are the most characteristic form of the cultural landscape. It is man-made habitat on the earth's surface and study of the distribution of rural settlements has occupied an important position in the historical development of geography. It is important that decision makers involved in rural development have at their disposal precise information to identify impact locations for concentration of services, nodes of transportation lines, growth centers, etc. which mainly influence the cost of services.

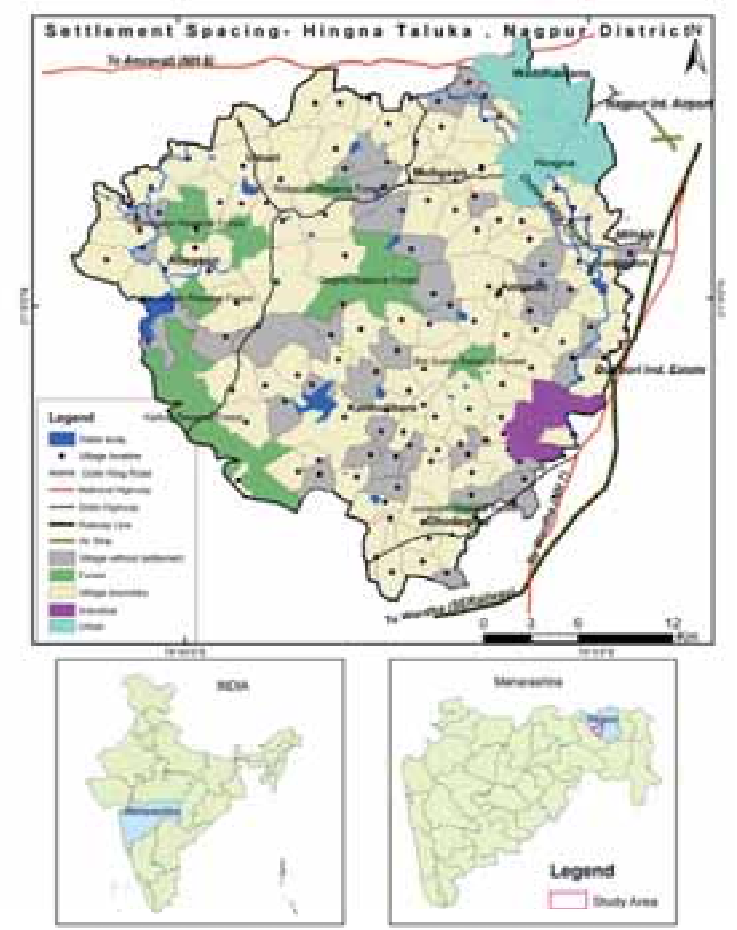
The main objective of this study is firstly to identify the spatial distribution randomness of rural settlement and factors influencing it and secondly demonstrate the effectiveness of the methodology used in similar studies of rural settlements.

The study area covering 156 villages is situated within the Hingna taluka of Nagpur district in the eastern part of Maharashtra state covering an area of 775 sq. km. The area is basically an agrarian, thickly populated and well connected with major roads and railway. However there are large portions of forested areas and a few water bodies within the study area. (Fig.1). The general topography in the area is represented by an undulating plateau typical of the Deccan traps with elevation varying from about 600m to 260m above msl.

The term distribution refers to the way in which human settlements are spread over the landscape. The pattern may be one of isolated homes, each separated by great distances, or the pattern may be random, regular or clustered. There are various factors and conditions responsible for different types of rural settlements. These are: physical features – nature of terrain, altitude, climate and availability of water, cultural and ethnic factors – social structure, caste and religion, and security factors – defense against thefts and robberies. Once formed, settlements may continue for centuries, long after the original advantages of the site have become irrelevant. However, it is extremely unlikely that the pattern of distribution of settlements will remain the same- villages shrink and grow, some disappear completely whilst entirely new ones are recreated.

Five major types of spacing patterns can be easily identified as clustered, agglomerated or nucleated, semi-clustered or fragmented, hamleted, and dispersed or isolated. A statistical technique i.e. Quantitative Method of 'Nearest-neighbor statistics' is used for determining the randomness of distributional pattern of rural settlements. Its principle is based on a comparison of the straight line distances separating points from their nearest neighbor points with the distances which might be expected if these points were distributed in a random manner within the same area.

1-Project Coordinator, UNODC, Afghanistan, 2- Teacher, Modern School, Koradi Unit, Nagpur, 3- Head, Dept. of Geography, Dhanwate National College, Nagpur.



Methodology

The Village boundaries within Hingna Taluka of Nagpur districts were digitized and mapped in a GIS environment. The administrative boundaries of village settlements were transferred and overlaid on high resolution satellite imageries using *'Google Earth'* which is available free on internet domain. The features of the extent of settlements, water bodies and roads were delineated from the satellite imageries and added to the map. The villages without any settlements were recorded as well. The nearest distance between the village settlements was measured using the *'ruler'* tools in *'Goggle Earth'*. The update map was exported to GIS for further analysis and map display.

The nearest neighbor statistic is derived by—

Rn = 2.dm. √(N/A)

Where, **Rn** = nearest neighbor statistic, **dm** = mean observed nearest neighbour distance between points, **N** = number of points, and **A** = area concerned

Fig1. Location distribution of settlements

The computed values of **Rn** lie on a continuous scale which ranges between 0 and 2.15, and where, 0 denotes complete clustering, 1.00 denotes random scatter and 2.15 denotes complete regularity, i.e., each point equidistant from six other points.

The nearest neighbor will produce a distribution pattern continuum as per the distribution patterns shown in Fig. 2

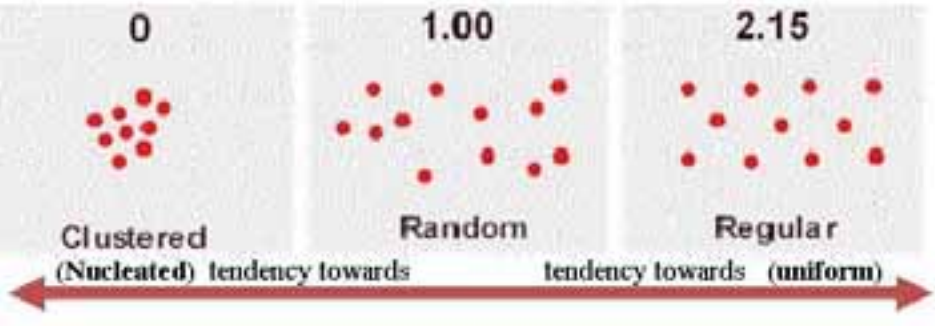


Fig 2. Scale of distribution pattern from nearest neighbor analysis

Results

The study area constitutes large portion of forest land where the settlements are fewer. A test for spatial disparity in the distribution of rural settlements was carried out for both including as well as excluding the forest areas in order to understand their influence on the randomness of distribution of settlements.

Using the nearest neighbor formula **Rn = 2.dm. √(N/A) the randomness was calculated as below.**

Study Area	Area (Sq.km)	dm=D/N	Rn
Including forest area	697	161.42/156= 1.034	0.928
Excluding forest area	775		0.979

It is interesting to know that the results for the test of distribution are similar in case of whether forest areas are considered or otherwise. The **Rn** calculated for both these cases are close to '1' and lie in the middle portion of the random scale indicating a random distribution of the settlements. (Fig.2)

However, there is a possibility that this pattern has occurred by chance. Using the graph of probability (fig.3), it is apparent that the values of **Rn** must lie inside the shaded area before a distribution of random can be accepted as significant. Values lying in the shaded area at the 95% probability level show random distribution. The plotting of derived values of randomness on the graph confirms that the **Rn** values of (0.979 and 0.928) have a significant element of randomness with number of villages at 156.

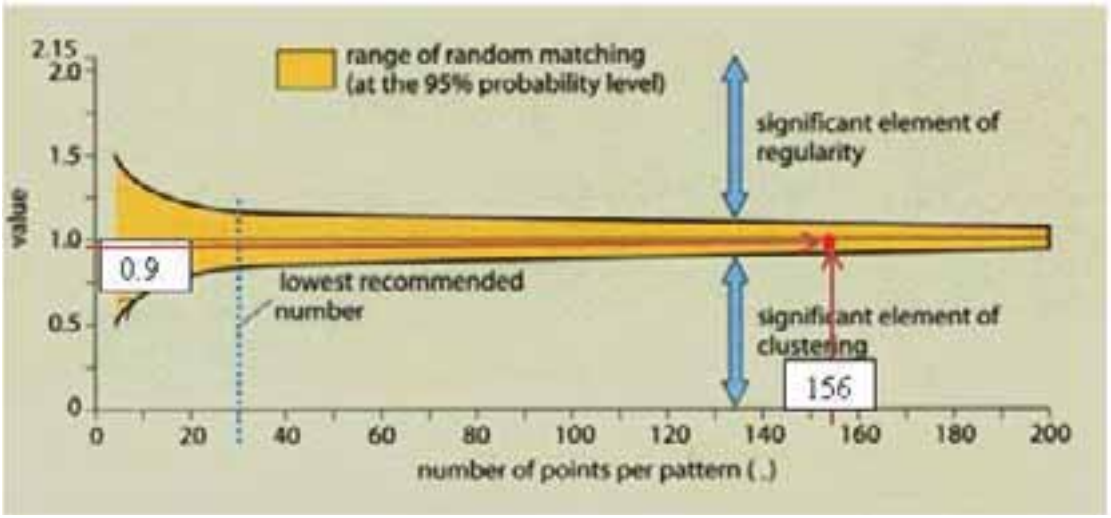


Fig 3. Range of random match

Conclusion

The results of the randomness derived from 'Nearest *Neighbors Analysis (Rn)'* for Hingna Taluka of Nagpur district reveals that spatial distribution of settlements is a random pattern. The absence of a regular topography and productive agricultural area is mainly, responsible for a random distribution pattern of rural settlements. The presence of 45 *'Rithi'* villages (Villages without settlements) could be an additional factor contributing to a random distribution of rural settlement in the study area. The forested areas do not contribute significantly to the random distribution scale since they are not evenly distributed in the area under investigation but rather aggregated in the western portion of the study area. The settlements with random distribution of this kind are unable to harness the advantage and form themselves into a formidable group by adopting some rural development programmers in their communities. The Local development authorities would find the results of the study useful to consider while

formulating strategies for development programs in such rural settings. The methodology adopted in the study is cost effective and simple in terms of using state of art technology of Remote Sensing and GIS in studying geo-spatial aspects of the rural habitats. The cost of satellite imageries in the present study is completely eliminated with the effective use of 'Google Earth' available free on the internet.

Bibliography

1. Barnes J A and Robinson A H (1940): A New Method for the Representation of Dispersed Rural Population, Geog. Rev., Vol – 30, pp134.

2. Chauhan V S (1972): Rural Settlements in Upper Yamuna Khadar Region in India, in Selected Papers Vol – III, 21st International Geographical Congress, National Committee for Geography, pp 49 – 60.

3. Hudson John C (1969): A Location Theory for Rural Settlement, Ann. Assoc. Am. Geog., Vol – 59, No. 2, June 1969, pp365 – 381.

4. Meynen E (1972): Universal Decimal Classification for Settlements, in Selected Papers Vol– IV, ibid, pp. 398 – 400.

5. Pinder D A and Witherick M E (1972): The Principles, Practice and Pitfalls of Nearest Neighbour Analysis, Geography, Vol – 57, pp 281.6.

6. Prasad A (1972): the Types of Rural Settlements in Chhotanagpur Plateau, in Selected Papers Vol – III, ibid, pp207 – 211.

7. Roy B K (1972): Cartographical Application in the Mapping of Morphogenesis and Economic Data of Settlements in India, in Singh R L (ed. 1972): ibid.

8. Sarkar A (1991): Tendency of the Urban Settlement Patterns in West Bengal, 1901 – 1981, Ind. Jour.Lands.Sys.Ecol.Stud, Vol –14, No.– 2, pp 50 – 55.

9. Sarkar A (1994): Size and Spacing of Urban Settlements in West Bengal, 1901 – 1981, Ind. Jour. Lands.Sys. Ecol. Stud., Vol – 17, No. – 2, pp 53 – 61.

10. Schott C (1972): Settlement Development in the Atlantic Provinces of Canada, in Selected Papers Vol– III, ibid, pp 223 – 228.

11. Singh R L (ed. 1972): Rural Settlements in Monsoon Asia, Proceedings of the IGU Symposia at Varanasi and Tokyo, National Geographical Society of India, Varanasi

12. Sinha V N P (1972): Evolution of Settlements in Chhotanagpur, India, in Selected Papers Vol – III, ibid, pp 262 – 264.

13. Tamaskar B G (1972): The Sites of Rural Settlements on the Sagar – Damoh Plateau, in Singh R L (ed. 1972).

14. Verma R V (1972): The Evolution of Rural Settlements in Avadh, India, in Selected Papers Vol – III, ibid, pp305 – 315.

15. Wonders W C (1972): Dispersed Rural Settlement Patterns in Alberta, Canada, in Selected Papers Vol – III, ibid , pp342 – 349.

16. Worthington B D R and Gant R (1975): Techniques in Map Analysis, Macmillan Education Ltd., London