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1. Dynamics of Cropping Pattern and Diversification in Rajasthan during post-liberalization Period
2. Analysis and Mapping of Crimes Against Women in Rajasthan
3. Assessment of Suspended Sediments in Lake Udaisagar, Udaipur, Rajasthan
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6. Impact of Integrated Watershed Management Programme based on Four Waters Concept- A Case Study of Dudu Tehsil, Jaipur District
7. Status of Literacy at Tehsil Level in Rajasthan: An Analysis of Spatial Patterns and Disparities
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The Rajasthan Geographical Association

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नीलम शर्मा

Status of Literacy at Tehsil Level in Rajasthan: An Analysis of Spatial Patterns and Disparities

Urmi Sharma and Purnima Singh

Abstract

Literacy, the ability to 'read' and 'write' in any language, is an important measure of the developmental status of a nation. It provides the basal stratum for the multi-level educational pyramid, a major component of Human Development Index. Although the overall literacy rate of Rajasthan (66.11 percent in Census 2011) has increased by 5.70 percent over 2001, but it is still much below the national rate (74.04 percent). The dismal status of literacy in the State is manifest in its 33rd position among all the States and Union Territories in the country. It also lags behind on other parameters, viz. male, female, rural and urban literacy significantly. The present study undertakes a multifaceted investigation of the status and spatial patterns of literacy in Rajasthan based on the Census data of 2011 at tehsil level. Priority areas for policy making have also been identified. A robust methodology including cartographic, statistical and geospatial tools has been employed. General patterns and spatial variations in the literacy rates have been mapped using Choropleth method. Sopher's Disparity Index has been employed to quantify rural-urban disparity. Regions of significantly high and low literacy have been identified using Anselin's Local Moran's I and Getis-Ord Gi Hot Spot Analysis implemented in GIS environment.*

Results reveal high spatial variation in literacy with a clear north-east and south-west divide in the State, literacy levels being higher in the former. Western, southern and south-western parts of the State form a cold spot for rural-urban literacy hence need top priority in policy making.

Key Words: Literacy rate, Regional disparity, Hot spot analysis

Introduction

'Literacy is a bridge from misery to hope', aptly quoted by former UN Secretary-General Kofi Anan who believed that literacy is a bulwark against poverty. Though literacy itself is no education but it is a first step towards change. It is an instrument to empower individuals, communities, societies and nation. It is also an indicator of socio-economic development measured in the form

of literacy rate defined variably in different countries. A literate is a person at a certain age that can read, write and understand in any language.

On the global stage India stands at a moderate level of literacy which improved a lot since independence. But within the country, there is a huge variability among all its States.

As per census 2011 Rajasthan ranks

26th among all the 29 States in literacy with literacy rates below the national averages in all the categories viz. total, rural, urban, male and female literacy rates. It also accounts for the lowest female literacy in the country. Although the State has been praised for its efforts and achievements in increasing the literacy over the past years the high spatial variability in levels of literacy continues to mar the development scene of the State. A low rural literacy of 61 percent is a matter of investigation regarding the progress of rural areas where 75 percent of the State's population resides. The rural-urban divide is thus another attribute which requires investigation with regard to literacy in Rajasthan. The gloomy picture of literacy in Rajasthan is a reflection of its poor economic structure and social backwardness as the population that suffers from illiteracy is at the lowest socio-economic level in the society. The challenge is to elevate the status of literacy with paramount focus on regions which are lagging behind and simultaneous bridging of the disparity gap in the State. For effective implication of mitigation measures and policies, identification of regional variation and priority areas having lowest literacy or highest disparity is imperative.

The present study focuses on identifying spatial patterns of literacy in Rajasthan. The extent of regional disparity in literacy has also been examined across the State. Further the potential of statistical tools applied in Geographic Information System (GIS) environment to identify the priority areas for policy decisions have also been explored.

Objectives

- a) To analyze the status and spatial patterns of literacy in Rajasthan at tehsil level in

2011.

- b) To examine the regional disparities in literacy in terms of rural-urban divide.
- c) To identify the priority areas for policy making.

Study Area

Rajasthan is the largest state of India with a total of 244 tehsils and 33 districts (Fig. 1). The total population of the State is 6.86 crores which is approximately 5.6 percent of the country's total population. Major concentration of the population is in eastern part of the state as around 61 percent of its total area is desert in the west. Three-fourth of the total population lives in rural areas whose major dependency is on agriculture. Rest of the population in urban areas has concentration mainly in the eastern half of the State.

In spite of a large population base the total literacy rate of Rajasthan is pegged at 66.11 percent. Wide disparities in rural-urban and male-female literacies are also witnessed with urban literacy as 79.7 percent while rural literacy being 61.4 percent. Similarly, the male literacy in State is 79.2 percent whereas its female counterpart accounts for just 52.1 percent.

Methodology

Various statistics related to literacy has been derived from tehsil level Census 2011 data of Rajasthan. These statistics have been integrated with spatial data in GIS environment and choropleth maps have been generated in QGIS version 2.16. Spatial statistical tools have been employed in ArcGIS version 10.2.2 for further analyses. Major steps of methodological workflow may be summarized as under:

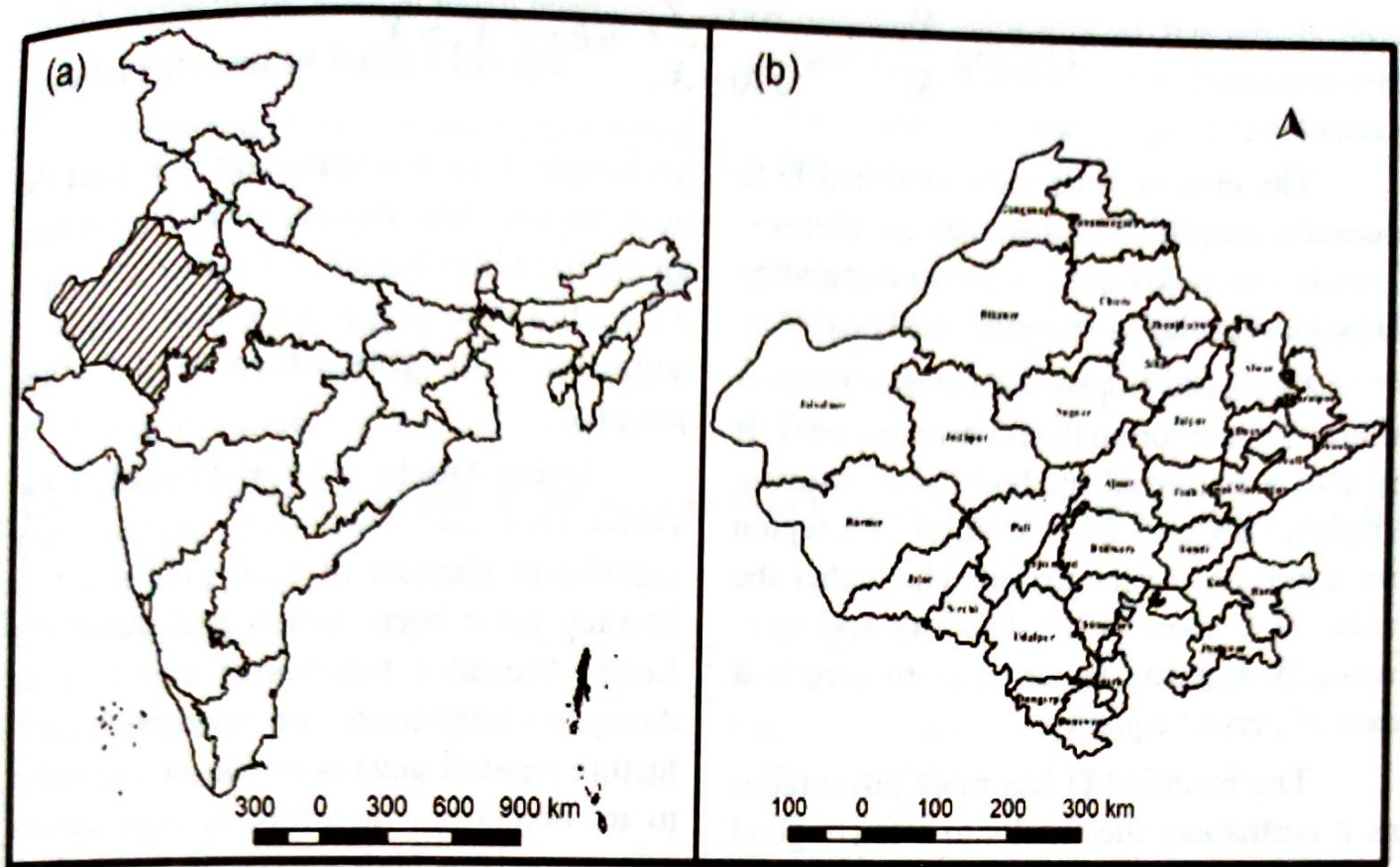


Fig. 1. Location of study area (a) Location of Rajasthan in India, and (b) District map of Rajasthan

Calculation of Literacy Rates

The working definition of literacy according to Indian census since 1991 follows literacy rate equal to the total percentage of the

population of an area at a particular time aged seven years or above who can read and write with understanding. The formula used is:

$$\text{Literacy Rate} = \frac{\text{Total Literate Population}}{\text{Total Population} - \text{Population}(0 - 6 \text{ years})} \times 100$$

Rural and urban literacy rates have also been calculated using the above formula.

Sopher's Disparity Index (D)

Regional disparity in literacy is a manifestation of how large is the difference between the literacy rates of rural and urban populations of a region.

To calculate the disparity an index has been developed by David V. Sopher (1974) known as Sopher's Disparity Index. The formula is

$$D = \log \frac{X_2}{X_1} + \log \frac{100 - X_1}{100 - X_2} \quad \text{where } X_2 > X_1$$

Here X_1 and X_2 are two variables in percentages.

Kundu and Rao (1982) modified this formula as

$$D = \log \frac{X_2}{X_1} + \log \frac{200 - X_1}{200 - X_2} \text{ where } X_2 > X_1$$

The present work uses modified D to quantify rural-urban disparity in literacy. Tehsils which do not have urban population have been excluded from this analysis.

Generally, Sopher's Disparity Index is useful for measuring the relative disparity. It is also a preferred method for measuring disparity between two variables of a region for a particular time period. The higher the value of D more is the disparity and vice-versa. A disparity value equal to zero is a case of perfect equality.

The modified D has more advantages as it normalises the results to a fairly good extent. It is a better technique over calculating simply the difference between two absolute values as it gives different results with two sets of values for X_1 and X_2 with same absolute difference. For a given absolute difference between X_1 and X_2 low absolute values of X_1 and X_2 result in higher modified D than high absolute values of both the variables.

Modified D has been calculated for every tehsil and converted to percentage value. Disparity index for Rajasthan has also been derived in the same manner.

Mapping Spatial Patterns

Rajasthan tehsil boundary map has been generated as vector layer in QGIS and the literacy statistics has been joined to the boundary map for mapping various aspects of literacy.

Identifying Clusters of Low and High values of Literacy

The study of spatial data is not merely explaining the distribution through choropleth

technique. It is also important to extract the information from data about unique patterns of spatial phenomenon. The advanced tools of spatial statistics employed in GIS give significant insights which need further enquiry.

Using Anselin's Local Moran's I and Getis Ord G_i^* statistics, statistically significant clusters of total high and low literacy have been demarcated. Anselin's Local Moran's I (Cluster and Outlier Analysis) emphasizes on how much each feature (spatial unit) is similar or dissimilar to its neighbors in terms of high values surrounded by high values or low values surrounded by low values. The clusters of similar values (high-high; low-low) and dissimilar values (high-low; low-high) have been obtained.

Getis Ord G_i^* statistics (Hot Spot Analysis) identifies areas of concentration of high and low values known as hot spots and cold spots respectively. These hot and cold spots have been interpreted in terms of clusters of high and low values and statistical significance of the difference from mean value of the entire region.

Discussion and Analysis

Various aspects of literacy in the State exhibit clear spatial patterns. There is a notable spatial divide in level of overall literacy, rural literacy as well as urban literacy. Regions of high and low literacy correspond with district boundaries which underline regional disparities in level of socio-economic development in the State at district level. The following sections analyse the spatial patterns of total literacy, rural and urban literacy and the rural-

urban divide in the State at tehsil level.

Spatial Patterns of Total Literacy

Mean total literacy in the State at tehsil level is 63.38 percent with a standard deviation of 7.92 percent and coefficient of variation of 12.49 percent. Maximum and minimum literacy occurs in Jaipur tehsil of Jaipur district (82.68 percent) and Kotra tehsil of Udaipur district (26.57 percent)

respectively. Majority of the tehsils have literacy ranging between 50 to 80 percent with a few having extremely high or low literacy levels.

Descriptive statistics of various aspects of literacy in the State have been summarized in Table 1 and the distribution of those aspects has been grouped under various categories in Figure 2.

Table 1. Descriptive statistics of literacy rates (a) total literacy, (b) rural literacy and (c) urban literacy

Attribute	Statistics						
	Mean	Min.	Max.	St. Dev.	C.V.	Skewness	Kurtosis
Total Literacy	63.38	26.58	82.69	7.92	12.49	-0.523	1.69
Rural Literacy	60.96	26.58	79.12	7.37	12.09	-0.578	1.79
Urban Literacy	76.93	22.36	89.37	6.59	8.57	-3.14	24.96

Source: Statistics generated in SPSS software

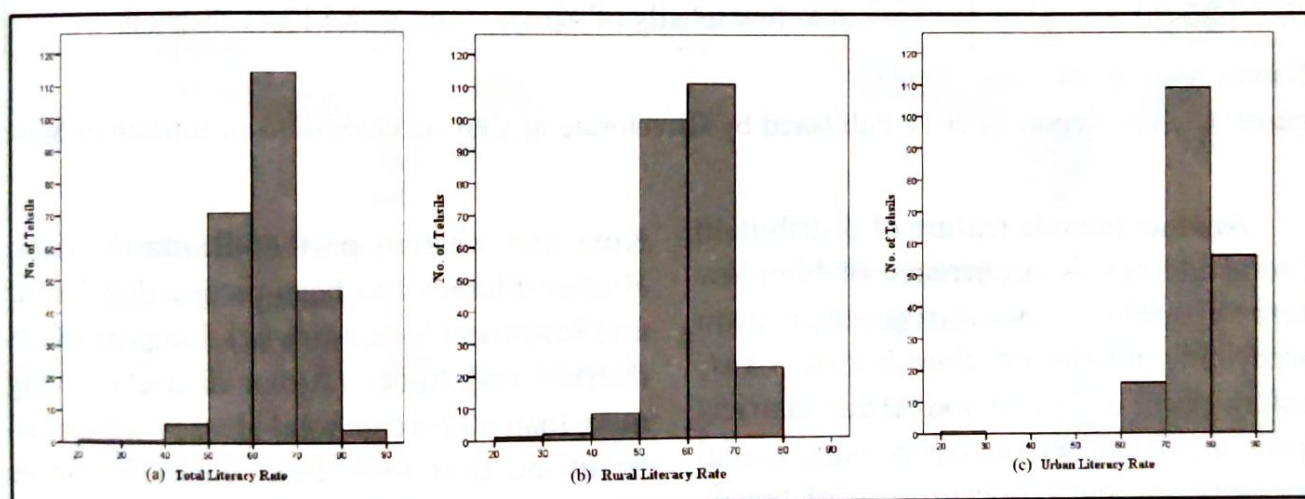


Fig. 2. Distribution of literacy rates at tehsil level in Rajasthan (a) total literacy, (b) rural literacy and (c) urban literacy

Figure 3 (a) illustrates the spatial distribution of tehsils across various levels of total literacy. Figure 3 (b) shows the spatial variation of total literacy from tehsil level mean in terms of z-scores. Results of cluster and outlier analysis and hot spot analysis have been shown in Figure 3 (c) and (d) respectively. Levels of total literacy manifest a clear north-east and south west divide wherein the tehsils

located in Ganganagar, Hanumangarh, Jhunjhunu, Sikar, Jaipur, Alwar, Bharatpur and Dhaulpur districts in northern and eastern part of the State have literacy higher than the average. On the other hand, western and south-western part of the State comprising Jaisalmer, western part of Bikaner, Jodhpur, Barmer, Sirohi and Jalore districts invariably have below average literacy.

Table 2. Total literacy rates at tehsil level in Rajasthan and their main regions

S.N.	Range (%)	No. of Tehsils	Main Regions and Districts
1.	20-30	1	(Kotra*) Udaipur
2.	30-40	1	Udaipur
3.	40-50	6	Southern and South-Western districts of Jalor, Sirohi, Banswara, Barmer and Pratapgarh
4.	50-60	70	Major tehsils of Jaisalmer, Bikaner, Jodhpur, Barmer, Sirohi, Jalore and scattered tehsils of central, southern and south-eastern regions
5.	60-70	115	Clusters of these tehsils are confined to Ganganagar, Hanumangarh, Churu, Nagaur and Tonk, Dausa, Karauli, Dhaulpur, Sawai Madhopur districts mainly in Eastern half of the State
6.	70-80	47	North-eastern and south-eastern regions with scattered tehsils of Jodhpur, Bikaner, Pali, Bhilwara and Girwa being district headquarters of their respective districts.
7.	80-90	4	Countable few tehsils of Ajmer, Jaipur and Kota districts

*Names in italic are tehsil names.

Source: Census Report of 2011 Published by Directorate of Census Operation in Rajasthan State

Another notable feature of distribution of total literacy is occurrence of high/low literacy pockets. A contiguous region comprising tehsils of Jhunjhunu, Sikar, western parts of Jaipur and Alwar districts form a significant hotspot representing spatial concentration and co-occurrence of tehsils with similarly high levels of literacy (Figure 3 c), wherein the overall literacy is invariably above 70 percent. Two hot spots comprising Kumher, Nadbai, Bharatpur and Rupbas tehsils of Bharatpur district, and Padampur, Karanpur, Ganganagar and Sadulshahar tehsils of Sriganganagar district indicate high levels of literacy in the entire surrounding region (Figure 3 d).

Similar hot spot exists in south-eastern part of the State also comprising tehsils of

Kota and western part of Baran districts. Highest literacy has been recorded in Jaipur and Sanganer (Jaipur district), Ladpura (Kota district) and Ajmer (Ajmer district) having more than 80 percent total literacy which can be attributed to their urban character. Some tehsils comprising district headquarters viz. Jodhpur, Bikaner, Bhilwara and Girwa also have relatively high literacies. Table 2 provides distribution of areas comprising various categories of total literacy.

Occurrence of more or less contiguous cold spot of total literacy comprising tehsils of Jaisalmer, Barmer, Jalore, Sirohi, parts of Pali, Udaipur, Banswara and Pratapgarh districts underlines the dismal state of literacy in the entire region. The situation is most grave in region comprising and surrounding

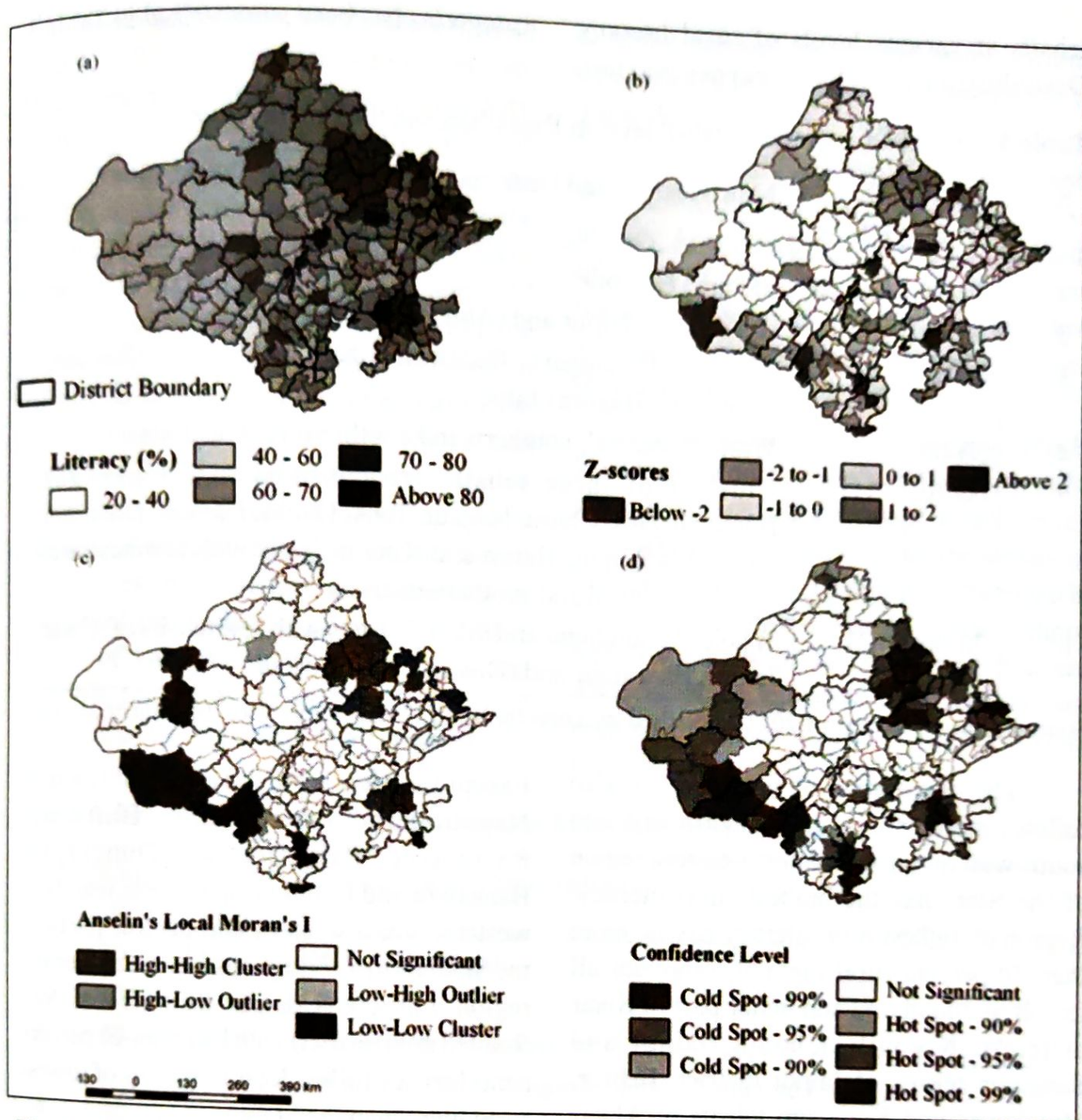


Fig. 3. Distribution of total literacy rates at tehsil level (a) total literacy, (b) Z-Scores of total literacy, (c) Anselin's Local Moran's I and (d) Getis-Ord G_i^* values rendered according to statistical significance

Barmer, Jalor and Sirohi (Figure 3 d) wherein the overall literacy hovers around a dismal 40 to 50 percent. Existence of significant cold spots in Bhilwara and Jhalawar districts reveal an overall low level of literacy in these districts too.

Spatial Patterns of Rural Literacy

The average rural literacy of Rajasthan at

tehsil level is 60.96 percent with a standard deviation of 7.37 percent. Rural literacy in individual tehsils ranges from 26.58 percent in Kotra (Udaipur district) to 79.12 percent in Behror (Alwar). It is less than average in more than 50 percent of tehsils which underlines the overall low level of literacy in the rural areas of the State (Table 1 and 3). Figure 4 (a) shows the spatial distribution of

tehsils at various levels of rural literacy. Distribution of tehsils across various categories has been summarized in Table 3

Table 3. Rural literacy rates at tehsil level in Rajasthan and their main regions

S.No.	Range (%)	No. of Tehsils	Main Regions and Districts
1.	20-30	1	(Kotra) Udaipur
2.	30-40	2	(Lasadia) Udaipur and (Abu Road) Sirohi
3.	40-50	9	Tehsils of Pratapgarh, Jhalawar, (Chauhtan) Barmer, (Reodar) Sirohi and (Bagora) Jalor
4.	50-60	100	Western, central, southern and south-western districts
5.	60-70	111	Clusters of these tehsils are confined to Ganganagar, Hanumangarh, Churu, Nagaur, Tonk, Dausa, Karauli, Dhaulpur, Sawai Madhopur, Baran and Kota districts with few scattered tehsils in central and southern districts
6.	70-80	21	Whole of Jhunjhunu and Sikar districts with few tehsils of Alwar, Jaipur, Bharatpur and (Digod) Kota districts

Source: Census Report of 2011 Published by Directorate of Census Operation in Rajasthan State

The distribution of rural literacy also follows more or less similar north-east and south-west divide where north-eastern region of the State has the highest rural literacy. Region of highest rural literacy having more than 70 percent rural literacy comprises all tehsils of Jhunjhunu and major part of Sikar districts. Kotputli, Chomu, Jaipur and Sanganer tehsils of Jaipur district, Behror, Mandawar and Kotkasim tehsils of Alwar district, Kumher, Bharatpur, Nadbai and Rupbas tehsils of Bharatpur district and Digod tehsil of Kota district are other regions having more than 70 percent rural literacy. Ganganagar, Hanumangarh, Churu, Jaipur, Alwar, parts of Bharatpur, Dhaulpur, Karauli, Dausa and Kota districts form a notable contiguous region having relatively high rural literacy (higher than the State average). Besides to it regions having 60 to 70 percent literacy occurs in Baran and Bundi districts comprising tehsils adjoining Kota district.

Except for a few scattered tehsils of Bikaner, Nagaur, Jodhpur, Ajmer, Bhilwara, Rajsamand, Pali, Udaipur, Dungarpur, Bansawra and Pratapgarh districts tehsils of western, south-western and central parts of the State form a contiguous low rural literacy region. Lasadia (Udaipur district) and Abu Road (Sirohi district) with less than 40 percent rural literacy follow Kotra in terms of lowest rural literacy in the State.

Spatial Patterns of Urban Literacy

The marked rural urban divide in literacy in Rajasthan is manifest in the large difference in the mean rural and urban literacy. Wide disparity also exists in the distribution of urban population in the State. Out of total 244, 62 tehsils of Rajasthan are entirely rural, i.e. do not have urban population. On the other hand few districts –Ganganagar, Churu, Jhunjhunu and Sikar have substantial urban population in all tehsils.

Mean urban literacy in the State at tehsil level is 76.93 percent which is approximately 16 percent higher than its rural counterpart. Although urban literacy in the State is considerably higher than rural literacy the level is considerably low as compared to the national average of 85 percent. Lower standard deviation and C.V. (6.59 and 8.57 percent respectively) indicates relative homogeneity or lesser spatial variation in literacy in urban areas as compared to the rural ones. High negative skewness and kurtosis of 24.96 underline the concentration of tehsils on higher end of the literacy scale (Table 1). Although urban literacy rate ranges from an exceptional low of 22 percent in Hindoli of Bundi district to 89.37 percent in Girwa of Udaipur district, but excluding Hindoli the rate varies between 60 to approximately 90 percent in all other tehsils.

Detailed account of regions under various categories of urban literacy has been given in Table 4.

A regional pattern suggesting an east-west divide can be observed for urban literacy. Aravalli region seems to form a divide of areas of relatively high and low urban literacy. Majority of tehsils having less than average urban literacy are located in or west of Aravalli region (Figure 4 b).

Like total and rural literacy, tehsils located in the north-eastern and northern parts of the State outstand in terms of urban literacy rates too. Notably majority of the tehsils of Udaipur, Banswara, Dungarpur, Pratapgarh, Chittorgarh, Jhalawar, Baran, Bundi, Jodhpur and few tehsils of Jaisalmer and Bikaner districts which have low rural literacy, are regions of concentration of highest urban literacy rates.

Table 4. Urban literacy rates at tehsil level in Rajasthan and their main regions

S.N.	Range (%)	No. of Tehsils	Main Regions and Districts
1.	20-30	1	(Hindoli) Bundi
2.	30- 60	-	None
3.	60-70	16	Scattered few tehsils of Bikaner, Nagaur, Barmer, Jalor, Sirohi, Karuali, Hanumangarh, Jaipur, Tonk and Dhaulpur districts
4.	70-80	108	Cluster of this category is found in Jhunjhunu, Sikar, Churu and Nagaur districts and scattered tehsils in almost all districts except south-western and southern regions.
5.	80-90	57	Eastern part of Aravali with major tehsils of Southern districts of Udaipur, Banswara, Dungarpur, Pratapgarh and Chittorgarh with few tehsils of Jaipur, Dausa, Jhunjhunu, Tonk, Jhalawar and Kota districts.

Source: Census Report of 2011 Published by Directorate of Census Operation in Rajasthan State

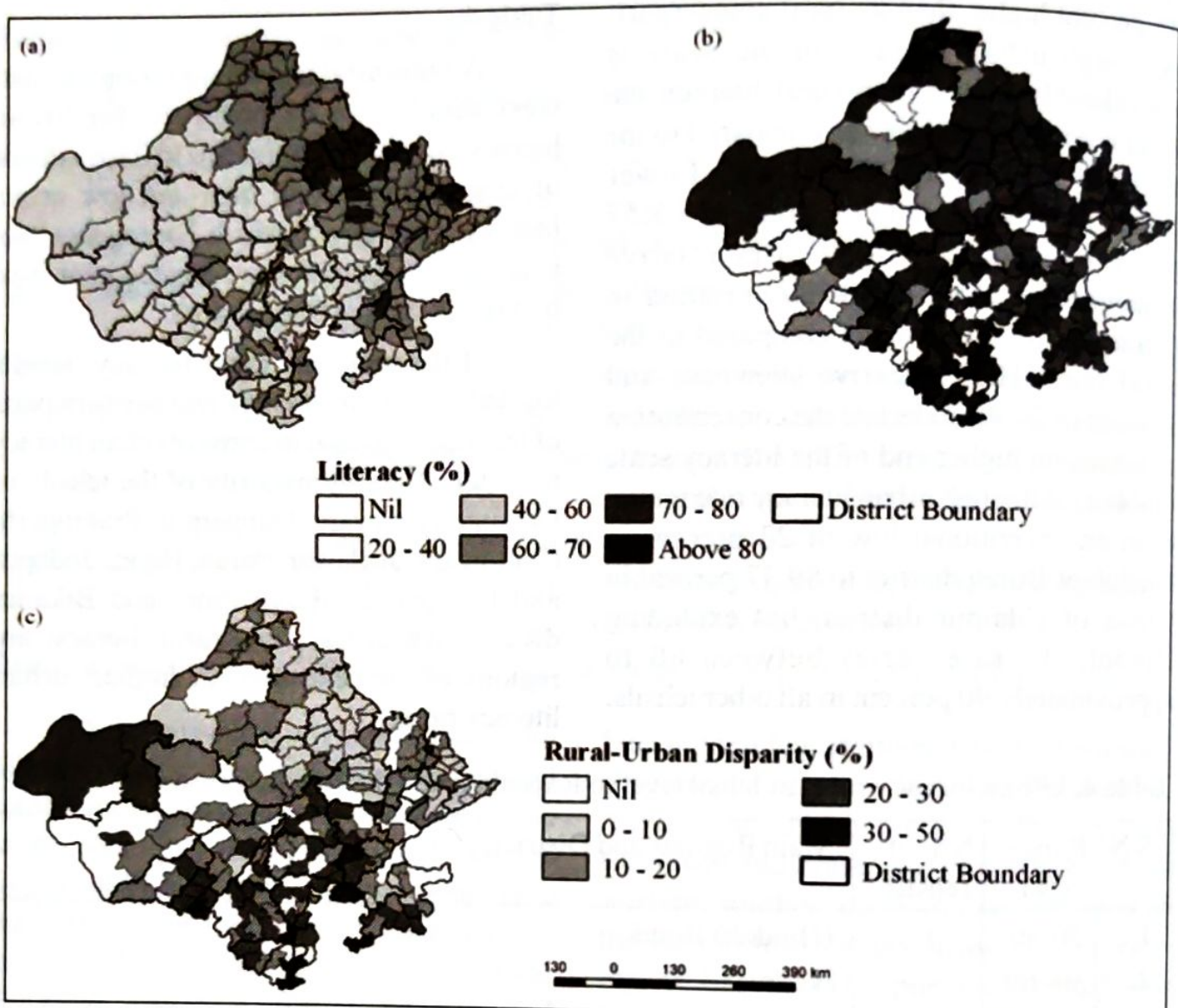


Table 5. Rural-urban disparity levels in literacy at tehsil level in Rajasthan and their main regions

S.N.	Range (%)	No. of Tehsils	Main Regions and Districts
1.	0-10	55	Nawalgarh (Jhunjhunu), Churu Sikar, Jaipur, Alwar, Bharatpur, Karauli, Dhaulpur, Dausa, Kota, Baran, Nagaur, Pali, Ganganagar, Hanumangarh, Bikaner
2.	10-20	70	Ganganagar, Hanumangarh, Bikaner, Jaipur, Tonk, Dausa, Alwar, Bharatpur, Swai Madhopur, Karauli, Kota, Bundi, Baran, Jhalawar, Ajmer, Nagaur, Pali, Jodhpur, Jalor, Barmer, Udaipur, Rajsamand, Bhilwara, Banswara, Dungarpur, Chittorgarh
3.	20-30	40	Jaisalmer, Jalor, Sirohi, Barmer, Udaipur, Rajsamand, Bhilwara, Banswara, Dungarpur, Chittorgarh, Pratapgarh, Pali, Jhalawar, Baran, Kota, Ajmer, Tonk
4.	30-50	7	<i>Hindoli</i> (Bundi), Banswara, Chittorgarh, Sirohi, Pratapgarh, Jhalawar

Source: Census Report of 2011 Published by Directorate of Census Operation in Rajasthan State

Conclusion

Rajasthan has a long way to go to reach a satisfactory level of literacy. Marked regional divide in literacy rates underline the gross imbalance in level of human resource development in the State. Regions of high total, rural as well as urban literacy are spatially concentrated in northern and north-eastern part of the State whereas the status in remaining region specifically the tehsils of districts located in western, south-western and southern Rajasthan is dismal. These cold spots of low literacy deserve immediate attention in future policy plans. With 75 percent of the total population as rural, the State substantially lags behind in providing adequate educational facilities to its rural population. Poor rural literacy regions – districts comprising central, western and southern parts of State - need tailored policies drafted in accordance with local conditions. The urban literacy rates though at higher ends

for overall State also need a careful consideration in view of the low literacy rates in south- western tehsils of Rajasthan.

The regional disparity is an expression of balanced development of a region. The large rural-urban divide in literacy in major part of the State requires explicit appraisal on part of policy makers. The low disparity regions as a result of both low rural and urban literacy rates also need priority attention for improving the overall literacy.

The results may be further correlated with drop-out rates in schools, infrastructure facilities provided, funds allocated for education by the government, gender bias, economic and social milieu of the region and other factors affecting literacy rate directly or indirectly in the State.

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Urmi Sharma

Assistant Professor,
Department of Geography
MLS University, Udaipur.

Corresponding Author

Dr. Purnima Singh

Assistant Professor
Meera Girls' College, Udaipur