INFRASTRUCTURE DEPRIVATION IN THE SCHOOLS OF UTTAR PRADESH USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

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Abstract: *For ensuring quality education certain basic facilities needs to be ensured in the school compound to create an acceptable environment in which learning can take place. Deprivation in providing basic infrastructure facility may act as a major hurdle in human development. In the present paper, certain basic infrastructure indicators are identified and a composite infrastructure deprivation index of Uttar Pradesh is generated using GIS techniques. The present methodology not only quantifies the level infrastructure deprivation but also assesses the spatial patterns of deprivation. The results shows there is high deprivation in indicators like electricity, toilets for CWSN and hand washing facilities. Spatial pattern of deprivation which have been investigated through the use of GIS techniques, shows that districts adjoining developed capital region have low deprivation.*

Key Words: *Infrastructure deprivation, GIS, Spatial analysis, Inequality, Composite infrastructure deprivation index.*

1. INTRODUCTION:

In a country as large as and as diversified as India, deprivation/inequality in the distribution of infrastructure and resources is something that is obvious to happen. According to Peter Townsend (2009), "Deprivation may be defined as a state of observable and demonstrable disadvantage, relative to the local community or the wider society or nation to which an individual, family or groups belong". However, deprivation in the field of education for children is a major hurdle in the development of economy and human resource which may continue to grow in the future if no attention is paid to this issue. Children are the building blocks of the future. Having well educated, independent and constructively contributing individuals in a society/nation may put a nation on the roadmap of development. The present stress on Right to Education, education for all and quality education also points towards this. In the light of this, educational infrastructure automatically becomes a significant element. The United Nations Educational, Scientific and Cultural Organization monitoring report on attainment of Millennium Development Goals (MDGs) have also described infrastructure as a non negligible cost of achieving Education for All and 2 MDGs (UNESCO, 2003). If infrastructure is not sufficient or not maintained, there will be obstacles in education access and participation especially to the vulnerable groups in society. Of more than 124 million (UIS data, 2013) school age children out of school in developing countries, the vast majority come from one or more of the traditionally disadvantaged groups in society; rural, female and poor. The three major obstacles to their participation are too few places in schools, too little parental demand for education and too much discriminating treatment in society (Wadi, H, 1980).

Educational infrastructure is a much broader term which includes provisions or amenities for transmission of knowledge, information, technologies and conducive environment for learning. This may range considerably according to the investments/financial resources available. However, certain minimum standards have to be met in order to create an acceptable environment in which learning can take place, i.e. every school should have a building, separate classroom for separate grades, sufficient light and air inside the classrooms, usable toilet facilities, safe drinking water, and basic teaching aids such as blackboard and chalk, and reading and writing material in usable form (Bhatty, K., 1998).Many renounced scholars have examined infrastructures availability in schools/educational establishments. Shah et al (2013) have explored impact of physical facilities on quality of primary education in Khyber Pakhtunkhwa in Pakistanon the basis of the perception of teachers using primary data and has recognized physical infrastructure as serious and major concern as it directly affect the learners as well as teacher performances. Bhunia et al (2012) have assessed school infrastructure at primary and upper primary level in Paschim Medinipur, West Bengal using geospatial technology. Though, infrastructure availability in schools has been assessed using different methodologies, empirical assessment of deprivations in this field are not explored. Bhatty (1998) has discussed deprivation and quality of education of children, on the basis of survey of field investigations, which has adversely resulted in unfulfilling of basic right to education of human population in-spite of several government initiatives in this regard.

Empirical investigations are required to develop primitive indicators involving infrastructure specific basic facilities, to understand the distribution of disparity of their allocation in the State. Many scholars like Morris and

Liser (1977), Iyengar and Sudarshan (1982), Das and Nath (2007), Bhattacharjee and Wang (2011), Patra and Acharya (2011) have used weighted composite index to study deprivation in different areas. The same can be used in the cases of education infrastructure to identify various areas of deprivation in the region. Spatial aspects can be further studied in the mentioned methodology using geographic information system (GIS).

GIS is a widely used and efficient tool which provides comprehensive framework and organization and management of data (spatial and non-spatial) to describe the distribution of data in the geographic space and analyze the spatial patterns of the data. In the present paper, the weighted deprivation index of infrastructure deprivation in schools is calculated in GIS environment to classify the districts as per their level of deprivation and also assess spatial trends in the distribution of infrastructure deprivation. The term 'infrastructure deprivation' is used to specify the educational infrastructure dimension under consideration. Accordingly, the composite index calculated on the basis of selected indicators is termed 'Infrastructure Deprivation Index'. The indicators selected for categorization are the availability of school building, classrooms, drinking water, sanitary facilities (toilets for girls, boys and children with special needs, hand washing facility) and electricity supply has been chosen to facilitate examination of disparity in facilities related to school education across the districts. The objectives of the study area as under:

2. OBJECTIVE OF THE STUDY:

The paper is planned to achieve the following objectives:

(i) To quantify districts of the State on the basis of physical infrastructure deprivation in schools.
(ii) To assess deprivation with regard to various facilities.
(iii) To identify spatial trends in the distribution of infrastructure deprivation in the State using GIS techniques.

3. STUDY AREA:

The state of Uttar Pradesh is located in the northern part of the country, with Uttaranchal/Uttarakhand and Nepal touches its northern borders; Rajasthan, Delhi, and Haryana in the west;Jharkhand, Chhattisgarh and Madhya Pradesh in the south and Bihar in the east. According to Statistical Department U.P. & Directorate Census, Lucknow, it has 75 districts and802 development blocks with and area of 2,40,928 Square km. According to 2011 census, the population of the State is 19,95,81,477with highest population density in the country of 820 person per Km^2. According to the census of India, the literacy rate of the State is 69.72 percent which has increased from the 2001 by approx. 13 percent (56.27 percent). It is a substantial progress but still well below the all-India average of 74.04 per cent in 2011.

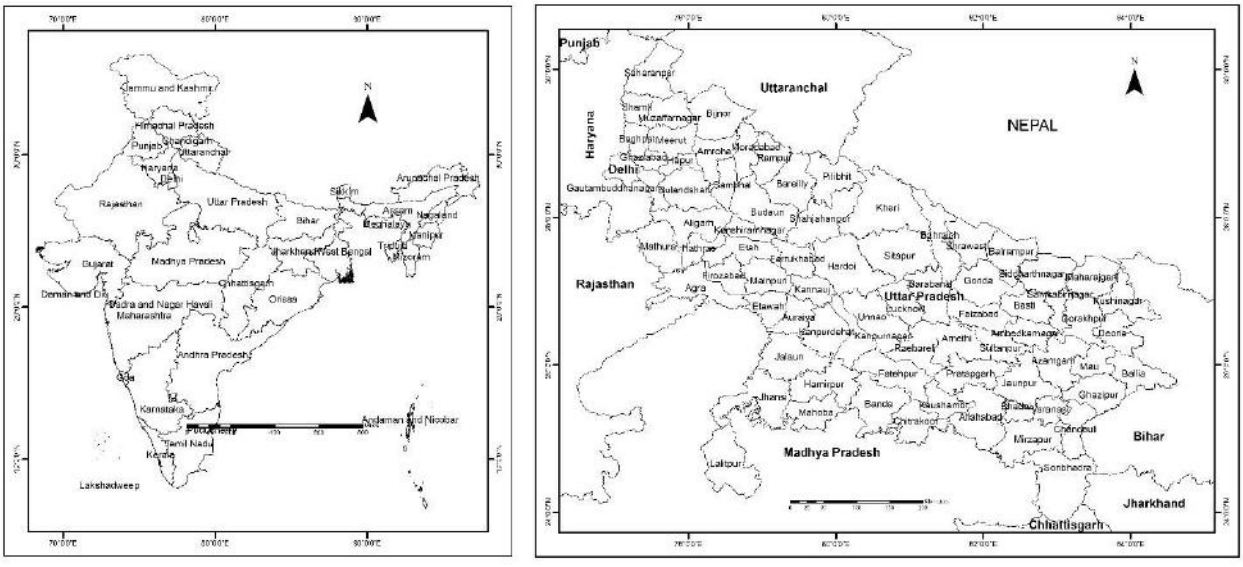

Figure 1: Location of Uttar Pradesh

Uttar Pradesh has been the birth place of Indian civilization due to its fertile plains, social and economic progress. And this is one of the reason that people belonging to diverse ethnic, religious and social groups have immigrated and settled here. However in present it is one of the backward and poverty stricken state in the country. Poverty is subjectively related to factors like education, health, skill and training, sanitation and electricity, assets, access to basic services and access to infrastructure. Deprivation is a significant causal and resultant characteristic of poverty in Uttar Pradesh and its association with gender and caste is a deeply rooted reality in the States interior and backward regions. The realities are noticeable in the segregated hamlets where many of the lower castes live on the

fringes of rural villages; often distant from community services such as, schools, health centres, public hand-pumps, and shops that distribute subsidized grains and similar is the condition of girls who never enrol in school. Social inequities are reflected in inequities in the distribution of productive assets and infrastructure(World Bank, 2002: iii).

4. DATA AND METHODOLOGY:

Data Source

The source of data for the study is from U-DISE 2014-15 data published by NUEPA, New Delhi. The report along with several other district level information regarding school education, also provides data on the number of schools having physical infrastructure availability in district-level and State level under school building, classrooms, drinking water, sanitary facilities (toilets for girls, boys and children with special needs, hand washing facility) and electricity supply.

Methodology:

Infrastructure Deprivation Index:

The Infrastructure Deprivation Index used in the present paper is explained as below. Let x_{nk} represent the percentage of schools in the districts enjoying the k^{th} facility in the n^{th} district of the state, where n = 1, 2,....., 75districts in the State, and k = 1, 2, 3….8 for the indicators taken i.e., school building (k=1), electricity supply drinking water (k =2), classrooms (k =3) and drinking water (k =4), Girls toilet (k=5), Boys toilet (k=6), toilet for CWSN (k=7) and Hand washing facility (k=8).

Let max(x_k) stand for the percentage of schools in a given district which has the best coverage of the k^{th} facility (k = 1, 2, 3,…8) in entire State and min(x_k) represent the percentage of schools in the district that has the worst coverage of the k^{th} facility (k = 1, 2, 3….8) in the entire State.

The deprivation indicator (DI) for the k^{th} facility in the n^{th} district of the State is given by,

$$DI_{nk} = \frac{\max(x_k) - x_{nk}}{\max(x_k) - \min(x_k)}$$

The value of DI_{nk} varies from zero to one, where the value of 1 implies that the given district is most deprived in comparison to the best district in the country in the k^{th} facility. The reverse is true for a value of0.

To evaluate the Infrastructure deprivation index, it is assumed that all the indicators are not equally important. Instead of using simple average of the indicators for index construction, weighted average method adopted by various scholars like Morris and Liser (1977), Iyengar and Sudarshan (1982), Das and Nath (2007) is used. The weights calculated are related to the variance of DI_{nk} across the districts, as given by Iyengar and Sudarshan (1982). Specifically, the weights are calculated as:

$$W_k = \frac{C}{\sqrt{Var(DI_{nk})}}$$

Where C is a normalizing constant, defined as:

$$C = \left[\sum \frac{1}{\sqrt{Var(DI_{nk})}}\right]^{-1}$$

The choice of the weights in this manner would ensure that large variation in any one of the indicators would not overly dominate the contribution of the rest of the indicators and distort the inter-district comparisons (Iyengar and Sudarshan, 1982; Bhattacharjee and Wang, 2011). The weights to be assigned are calculated using the method proposed by Iyengar and Sudarshan (1982) as shown in Table 1.

Table 1: Weights associated with k_{th} facilities.

Buildings (W_1)	0.127828
Electricity (W_2)	0.135371
Classrooms (W_3)	0.128134
Drinking water (W_4)	0.102937
Girls Toilet (W_5)	0.119126
Boys Toilet (W_6)	0.148306
Toilet for CWSN (W_7)	0.147215
Hand washing facility (W_8)	0.091082

Calculation of the index in GIS environment:

The deprivation indicator (DI_{nk}) and the weights (W_k) calculated are then transferred to the GIS environment. The weighted index of deprivation (infrastructure deprivation index) for the n^{th} district of the State is given by:

$$IDI = W_1 \times DI_{n1} + W_2 \times DI_{n2} + \ldots\ldots\ldots + W_8 \times DI_{n3}$$

Where, W_k represents the weight associated with the kth basic facility (k = 1, 2, 3…8).

On the basis of the above mentioned equation, a weighted composite map of IDI is generated in the ArcGIS by taking weights mentioned in the table 1. The value of the index suggests the status of infrastructural deprivation in a district computed for all the indicators taken together. A score near 0 is an indicator of availability of basic facilities, which implies very low level of deprivation and value of 1 is an indication of poor availability of basic facilities i.e.a high level of deprivation (Iyengar and Sudarshan, 1982).Such an index facilitates comparison of the level of deprivation amongst the districts of a State.

5. RESULTS AND DISCUSSION:

Deprivation Index of individual facility: The deprivation index values for various parameters taken for the present study are shown in table 1. The spatial patterns of deprivation of various infrastructure parameters are individually depicted in figure 2 and 3. Table 1 shows the percentage of districts having deprivation index in different categories of 0 to 1. In the case of basic infrastructure, maximum number of districts i.e. 6.7%, are showing highest deprivation (0.75 – 1) is seen in drinking water availability. Whereas, 5.3 percent of the districts are having high deprivation in electricity. In case of school buildings and schools without classrooms, 2.7 percent of the districtshave very high deprivation of 0.75 to 1.In case of deprivation range of 0.50 to 0.75, about 49.3 percent of districts are deprived in terms of electricity.

Table 2: Deprivation index of infrastructure parameters in the State (showing percent of districts in a particular category of DI)

Deprivation Index	Basic Infrastructure				Sanitation Facilities			
	Buildings	Drinking water	Electricity	Schools without classrooms	Girls Toilet	Boys Toilet	Toilet for CWSN	Hand washing facility
0-0.25	86.7	54.7	12.0	89.3	88.0	93.3	1.3	14.7
0.25-0.5	9.3	30.7	33.3	5.3	6.7	2.7	5.3	32.0
0.5-0.75	1.3	8.0	49.3	2.7	1.3	2.7	24.0	20.0
0.75-1	2.7	6.7	5.3	2.7	4.0	1.3	69.3	33.3

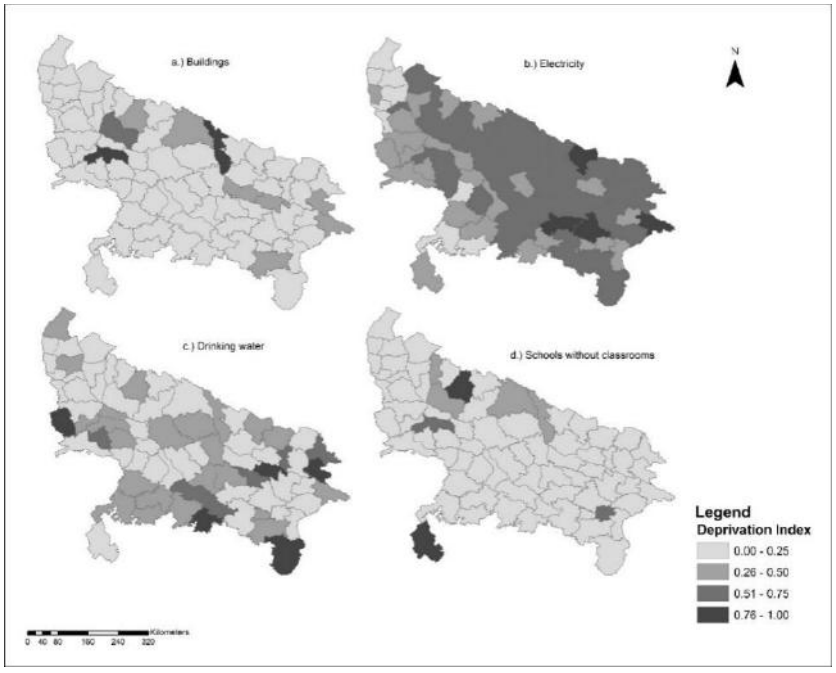

Figure 2: Spatial patterns of deprivation of basic infrastructure parameters

In case of sanitation facilities, maximum number of districts i.e. 69.3 percent, have high deprivation in regard to toilet facilities for children with special needs. 33.3 percent of the districts are having high deprivation in hand washing facilities. Another noteworthy finding is seen in case of infrastructure facilities for girls and boys. It is noted

that there is 6.0 percent high deprivation in case of availability of girls' toilet whereas in case of availability of toilet facilities for boys, 1.3 percent of the districts are deprived.

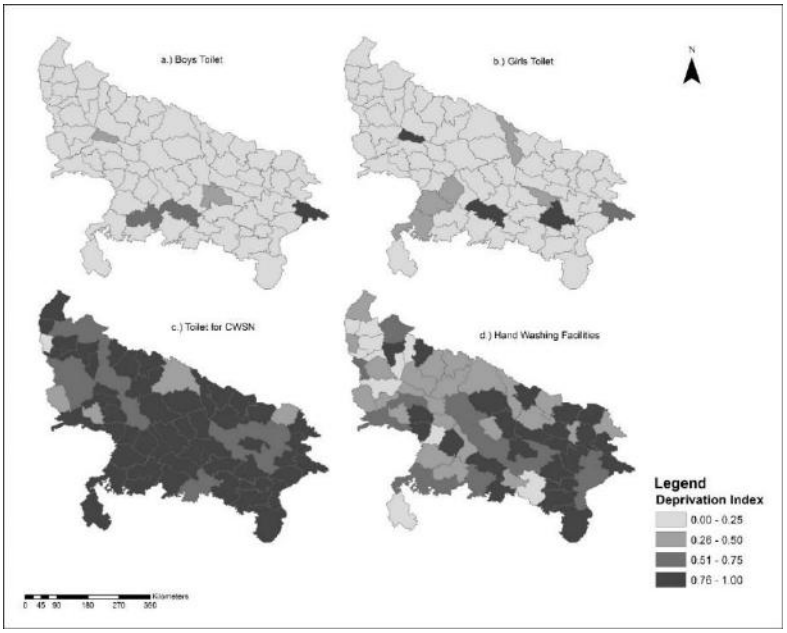

Figure 3: Spatial patterns of deprivation of sanitation related infrastructure parameters

Infrastructure Deprivation Index*:* The composite Infrastructure deprivation index map is shown in figure 4.Table 5 shows the number and percent of districts in each category of IDI. The range of IDI is 0.065 to 0.611.The composite infrastructure index map of the State is classified using standard deviation classification method to assess the variability in IDI from the mean. It is evident form the figure and the table that there are two districts, i.e. Muzaffarnagar and Baghpat, having very low deprivation in the school infrastructure. This category of very low deprivation is calculated in comparison to the present range of IDI in the State.29.3 percent of districts have low deprivation index. Majority of the districts in State (42.7 percent) are in the range of average IDI. Twelve districts (16 percent) have high deprivation whereas seven districts (9.3 percent) have very high deprivation.

Table 3: Categorization of Infrastructure Deprivation Index

Classification range	Number of districts	Percent to total	Districts
<-1.5 Standard Deviation (Very low)	2	2.7	Muzaffarnagar, Baghpat
-1.5 – -0.5 Standard Deviation (Low)	22	29.3	Agra, Aligarh, Allahabad, Auraiya, Bijnor, Bulandshahr, Farrukhabad, Firozabad, Gautam Buddha nagar, Ghaziabad, Hapur, Hathras, Kannauj, Kanpurnagar, Maharajganj, Meerut, Moradabad, Pilibhit, Rampur, Saharanpur, Sambhal, Shamli
-0.50 – 0.50 Standard Deviation (Average)	32	42.7	Amroha, Azamgarh, Balrampur, Banda, Barabanki, Basti, Bhadoi, Budaun, Chandauli, Chitrakoot, Etawah, Ghazipur, Gonda, Gorakhpur, Hardoi, Jhansi, Kaushambi, Kheri, Kushinagar, Lalitpur, Lucknow, Mahoba, Mainpuri, Mathura, Mau, Pratapgarh, Raebareli, Santkabirnagar, Shahjahanpur, Shrawasti, Sitapur, Unnao
0.50 – 1.50 Standard Deviation (High)	12	16.0	Ambedkarnagar, Faizabad, Hamirpur, Jalaun, Kanpurdehat, Kanshiramnagar, Mirzapur, Raebareli, Siddharthnagar, Sonbhadra, Sultanpur, Varanasi
>1.5 Standard Deviation (Very High)	7	9.3	Bahraich, Ballia, Bareilly, Deoria, Etah, Fatehpur, Jaunpur

If spatial patterns of the IDI distribution are to be explored (figure 4), it is observed that majority of low deprivation districts are concentrated in the north-west corner of the State. However, the high deprivation districts are dispersed in rest of the States. The reasons for concentration of low deprivation are that these regions are adjacent to the developed

National Capital Region. Whereas the dispersed high deprivation in infrastructure facilities are results of the lack of proper implementation of government policies or due to facilities in these interior regions.

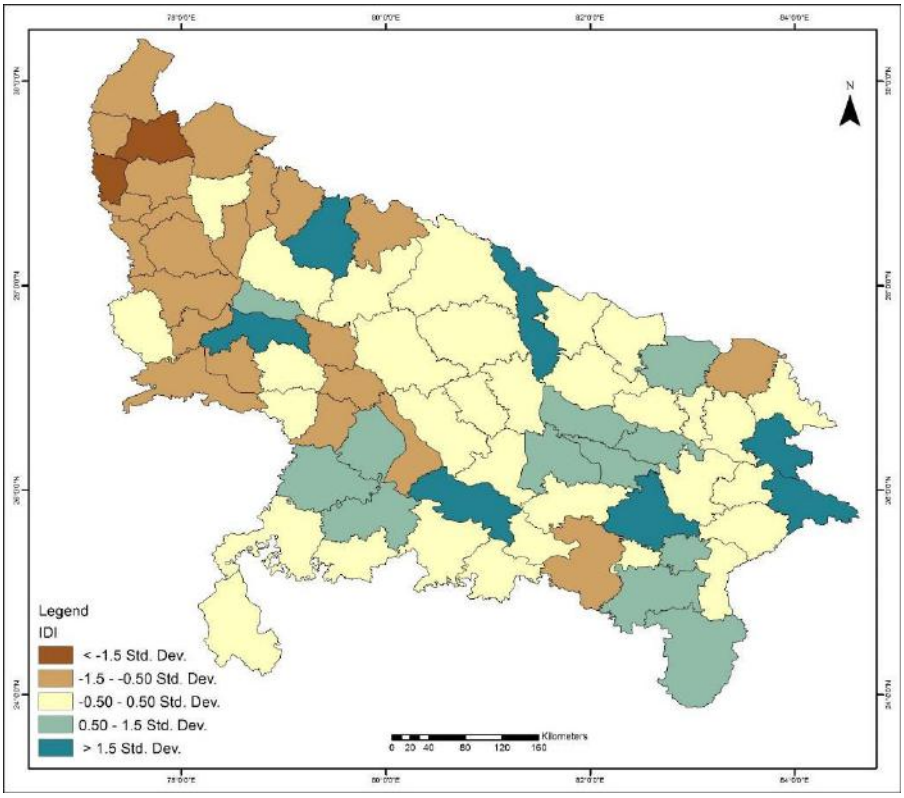

Figure 4: Composite infrastructure deprivation index of Uttar Pradesh

6. CONCLUSION:

According to the Sustainable development goals and Millennium development goals, inclusive and quality education has been given utmost importance. Educational infrastructure is an important parameter to ensure the quality of education. The indicator constructed from this research is grounded on fundamental amenities like presence of school building, classrooms, drinking water, sanitary facilities (toilets for girls, boys and children with special needs, hand washing facility) and electricity supply. The applicability of GIS techniques also assist in identify any spatial pattern of deprivation in the region. The study leads to the results that high deprivation exists in infrastructure like electricity, toilets for CWSN and hand washing facilities and there is low deprivation in some essential infrastructure facility like drinking water and toilet facility for boys and girls. However the significance of these parameters indicates towards the seriousness of the situation. The spatial pattern of deprivation which have been investigated through the use of GIS techniques, shows that districts adjoining developed capital region have low deprivation. Further study can be done in regard to study the various parameters influencing the causes of deprivation in educational infrastructure.

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