Mapping of Elementary Educational Infrastructure in India: A State and District Level Analysis

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Abstract - Education plays an important role in a country's development process. Indian education system comprises the elementary, secondary and tertiary levels. Over two decades India registered a significant growth in the educational infrastructure at tertiary level of education but elementary and secondary levels of education are struggling with low accessibility of infrastructure and resources. This is affecting the quality of education particularly at elementary level of education which is responsible for growth in secondary and tertiary education. The assessment of infrastructure across the country is very difficult due to regional inequalities and economic diversities. This paper is an attempt to map accessibility of infrastructure at elementary level of education at district and state level in India. For mapping and analysis, advance computation techniques like GIS and contour mapping techniques are used. A novel technique and algorithm was developed to represent the data in various formats in the qualitative way; to the knowledge of the authors this

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novel representation of data is hitherto unreported in the open literature. Analysis confirms that there are regional inequalities in the accessibility of required infrastructure and in some states the situation is pathetic despite various government initiatives.

**Keywords** - Elementary education, GIS, Mapping, Contours

**INTRODUCTION**

In the past two decades India achieved sustained high growth and has made progress on all fronts despite a population of over 1 billion. India is in now the midst of a historic transformation. It has emerged as a global power and a leading player in information technology, telecoms and business outsourcing and development of educational infrastructure, with the world’s fourth largest economy in purchasing power parity terms. However, India registered a rapid growth over the last two decades but over 300 million people living below the poverty line and wide regional disparities. This reflects the gloomy side of Indian economy which retards inclusive growth and infrastructure. Although, resources generated from recent growth are being invested into a set of very ambitious programs to deliver services to the poor. These programs -- to provide elementary education, basic health care, health insurance, rural roads and rural connectivity, and other services -- aim at realizing the fundamental rights of the people. To achieve the set programs India needs to expand educational infrastructure particularly at the level of elementary education as about 35 per cent of the population falls under the age of 15 years.

To accommodate the potential students, elementary education infrastructure in India is very poor and the condition is much worse in rural schools. Most of the schools have shortage of basic infrastructure such as lack of blackboards, drinking water, separate toilets for girls, shortage of classrooms, boundary walls/fencing to be addressed. According to Planning Commission about 50 per cent (of schools) do not have a boundary walls and separate toilets for girls, 60 per cent do not have electricity and 88 per cent do not have a computer. Shortage of teachers was also serious issue as a number of teaching posts are vacant. Hence, India’s elementary education
system faces numerous challenges. To achieve the universal elementary education government is making a lot of efforts that requires huge resources and to increase spending on education to 6 per cent of GDP, but actual spending was around 4 per cent for the last few years.

India has made a phenomenal growth in the education system at elementary level in spite of paucity of resources. The elementary education is very critical as enrolment at elementary level lays down the foundation and feeds for secondary and higher education. Enrolment at elementary level of education has increased considerable but infrastructure is not increased at the pace of enrolment and regional disparities are observed in the expansion of infrastructure. Therefore, there is a need to map the existing gap in infrastructure development and policy issues to cope with the emerging issues of educational development.

**OBJECTIVES OF THE STUDY**

After nineties secondary and higher education is undergoing structural changes due to the process of globalisation. The post nineties period witnessed a considerable increase in the infrastructure at tertiary level. So, to fulfil the need of higher education 100% enrolment at elementary education is desirable. This resulted growth response to the demand generated by the expansion of elementary education. But there has not been any fundamental change in the structure and organisation of elementary education system which lags in the quality also. In India nearly 90 per cent of schools at elementary level are run by government, most of them are situated in rural areas and lack the average criteria for quality education. The low learning achievement problem in India is mostly due to poor infrastructure such as shelter-less school building, insufficient building, high pupil-teacher ratio, traditional methods of teaching and high absentee rate. This required a comprehensive mapping of the existing infrastructure to analysis the gap in different states. Therefore, the objective is to provide a broad mapping of the existing infrastructure across the country.

**MATERIALS AND METHODS**

Infrastructure in elementary school comprises several components such as school boundary wall, availability of drinking water, blackboard and
students-teacher ratio etc. There are around 1.2 million elementary schools (MHRD, [http://education.nic.in/stats/statpub.asp](http://education.nic.in/stats/statpub.asp)), and to map the entire school system is not a simple task. So, for mapping and analyse the required attributes, Aser 2005 School level data was used. The used data was based on random sample survey conducted by Assessment Survey Education Research (ASER)\(^1\) which comprises 9500, with an approximate of 20 schools per district were covered, across India. All rural districts were be surveyed. The collected data was divided into different attributes containing information about schools of each district. The purpose of the survey was to get reliable estimates of available infrastructure in schools at the district level i.e. books, library, water and toilet facility, mid-day meal, etc. The sample size was determined at a precision of 5% and confidence of 95% level. For mapping and analysis the required attributes Geographical and Information System (GIS) and contour mapping techniques were used. Data was analysed using advance computational techniques. The methodology adopted for mapping geographical co-ordinates and location is as follows:

(i) **Mapping of GIS Data**

A Geographical Information System (GIS) captures, stores, analyzes, manages, and presents data that are linked to location that integrates statistical analysis and database technology. The GIS system are used in Remote Sensing, land surveying, natural resource management, geography, navigation and describes any information system that integrates stores, edits, analyzes, shares, and displays geographic information\(^2\). The GIS data for India’s border boundary was obtained from SAS repository, in the format of geographical co-ordinates (Longitude and latitude) of all the Indian state boundaries, available at National Institute of Science Technology and Development Studies (NISTADS), New Delhi. The co-ordinates were extended in the Cartesian coordinate systems that provide the mechanism for describing the geographic location and shape of features using x- and y-values. Locations of geographic objects were defined relative to the origin as (0,0), using the notation (x, y), where x refers to the distance along the horizontal axis and y refers to the distance along the vertical axis Figure-1a and b illustrate the notation (4,3) records a point that is four units over in x and three units up in y from the origin\(^3\).
All the district level data in geographical co-ordinate system was acquired from Mapmyindia website\textsuperscript{5}. A total number of 1371 districts were covered. The district data was positioned on the boundary data as shown in Figure-2.

(ii) **Contour Mapping**

As discussed in the sample size estimation a total number of 9500 schools with an approximate of 20 schools per district were covered. Since the data set is very large it may represent a lot of congestion (Figure 1c). Therefore, for simplification data on all the schools was averaged in one district to represent the district value of that region. The parameter was mapped against each district and the longitude/latitude co-ordinates were fetched from the district data file for corresponding mapping. The contour mapping was done using the Surfer\textsuperscript{®} contour mapping software as per the following procedure:

1. Indicators of various school infrastructures like, library facility,
students’ attendance, teachers attendance etc was estimated in percentage from the sample data synchronized with the district data. The data sheet contained three variables i.e. the longitude, latitude and the value of parameter in percent.

2. Surfer grid file was converted using the longitude and latitude as x and y data and school indicator as the contour data.

Analytical results

The contours were plotted for the various parameters viz. attendance of students, attendance of teachers and headmasters, library facilities in the schools, boundary wall (present or not present), usable rooms, toilet facility, clean water availability and mid-day meal facility as the percentage. The presence of students/teachers/headmasters, ratio of attendance versus total strength was computed in percentage for the average taken from class I to VIII (elementary level).

Attendance of students

Figure 2a, presents the data on attendance of students in schools as percentage of the total enrolment from class 1 to 8. The colour coding is given on the map, referencing that code the status of the attendance in the schools at the particular location was realized. The blue colour represents the percentage strength of attendance. The density of colour signifies high attendance ratio to poor attendance i.e. from 95% to 25 %. The similar results were presented for Sarva Shiksha Abhiyan programme, a government of India flagship scheme, meant for education to all children upto the age of 14 years (Figure-2b) and the results are comparable with the earlier study. The average attendance rate of the students in the present study shows 71.44% students attend the schools at elementary level while the earlier study indicates that overall average attendance rate of students was 68.5% and 75.7% at primary and upper primary levels respectively.

It can be observed that most of north-east and north central India has the problem of attendance of the students at the elementary level. On the other hand the map also indicates that the districts in the south and north-west have very good attendance of students.
Attendance of teachers

Figure 2c, represents the attendance of teachers in schools at district level in India. The analysis indicates that North-East and North and Central India have attendance of teachers below 30%. The analysis provide reasonable estimates and comparable with past studies (Figure-2d; Eswaran, S and Singh, A., 2008, reference 7). The analysis describes that the attendance of teachers was about 81.0% attendance of teachers in the schools. However, reference 6 shows that teachers’ presence was very good in most of the schools having attendance of teachers about 60.0%. The present computation illustrates 74% attendance of the teachers in overall elementary level. One of the reasons could be for this lower attendance that elementary teachers have several administrative assignments which are time bound. These assignments are a part of various government policies and the participation of teachers is very high. Further, the study the teachers’ participation in in-service training programmes and their engagement in non-professional work contribute significantly to their absence in school6,7.

Figure-2: Presence of students and teachers in percentage and the data validation with reference 6.
Library facilities and mid-day meal availability

Figures-3a & 3b, illustrate the accessibility of libraries and availability of mid-day meal in elementary schools.

Library is a vital component of any education level as they serve as knowledge source for the students. It was observed that facility of libraries in elementary schools in India is not good across the India. In some states like Jammu & Kashmir, north-east, West Bengal, Orissa, Bihar, Jharkhand, and Maharashtra the access of library facilities are very poor. The similar pattern was found in the context of mid-day meal. Mid-day meal is a scheme which provides meal to all the students attending the class upto the age of fourteen years in all elementary schools in India. The scheme was launched to promote SSA scheme which has provision free and compulsory elementary education to all the children. In the case of availability of mid-day meal and facility of library, the survey was conducted in the form of yes or no. Therefore, integer 1 was assumed for available and 0 for not available. The average computation was carried out for all the classes and the districts. The district level value was then used for computation of contour maps.

Rooms and boundary walls

Availability of usable rooms and boundary wall are also other very significant issues for cater education. The problem of schools building and boundary wall is not so good in several elementary schools in India. The issue of boundary wall is very severe that most of the schools do not have boundary walls. The Figure-3c, high lights that only some western part and some southern part of Indian schools have boundary walls while rest of schools do not have boundary. Further, a majority of school do not even have proper schools building particularly in rural areas. The analysis indicates that only 30% of the schools have schools building (Figure-3d).
Figure-3 Mapping of school infrastructure at district level
Availability of drinking water and toilets

In the case of both availability of drinking water and toilets, the status is more or less similar to that of school boundary walls and building. Figure-3e & 3f, shows that only 30% schools have the facility of drinking water while over 70% schools do not have the facilities of toilets. Analysis signifies that only some part of western and southern part of India have the facility of toilets in elementary schools. Similarly, some part of north east states has the facility of toiletry.

DISCUSSION

India has a large population in the age group of 6-14 years which constitutes about 60 million. To accommodate this cohort population in schools is a challenging job for India due to lack of infrastructure. The lack of infrastructure suggests that either government didn’t put enough money in infrastructure or the money put was not utilized properly. Further, to assure education to all children up to the age of 14 years Indian parliament passed a bill “Right to Education”, which itself had repercussion of massive education infrastructure development. Government of India launched a flagship scheme Sarva Shksha Abhyan particularly meant for increase infrastructure up to elementary education. The results in this paper shows lack of infrastructure at elementary level of education and the condition is more shocking in rural areas however enrolment is increased and dropout is declined. Infrastructure element such as availability of toilets, electricity, book bank, and computers is very feeble. There are no black boards and drinking water in some schools. It is evident from a study conducted under Sarva Shksha Abhyan for the attendance of students and teachers for various states of India has shown that student’s attendance rate for overall India was 68.5% and 68.5% for primary and upper primary levels respectively6. In case of teachers attendance the attendance rate was 81.7 and 80.5 for both levels respectively7. The present study also provides the similar results; where teacher’s presence is consistently better than the students’ attendance. The report also elaborates the reason for the children’s and teachers’ as the lack of adequate facilities, shortage of teachers and requirement of children for their parents for the household chores. There is a general observation in the Figure 3 that the infrastructure facilities at the schools in most of India are
inadequate to an extent. On one hand there are facilities like mid-day meal scheme which are implemented at a national level and the data also shows positive implementation. On the other hand the very basic infrastructure for example like the “boundary wall” is not there in most of schools (partially in west and mostly in east of India).

The biggest reason for poor infrastructure could be low investment in elementary education which is about 50 per cent of the total expenditure on education. This percentage needs to increase substantially as enrolment is increasing after elementary education has become a fundamental right. So, for improving access and quality in elementary education increase in funding is required. State governments must increase investment in elementary education in addition the central scheme such as Sarva Shksha Abhyan. It also imperative because the thrust on elementary education over the last two decades and the growing aspirations of poor communities resulting increase in the enrolment at elementary level of education. However, the poor quality of the schools and their basic physical infrastructure often lead to children dropping out of the school system without learning. An emphasis on food, livelihood and health guarantees is therefore simultaneously required to level out the initial disadvantages of the poor in the educational sphere stemming from malnourishment, poverty, and health-related debility.

The results which are visual depiction of the sample data using high end IT solution, like GIS mapping and advanced algorithm are in general agreement with the other studies conducted by various agencies. The present paper will help policy makers to rethink how the Indian school infrastructure could be redeveloped using these techniques.

**LITERATURE CITED**

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