GIS and PPGIS: A Tool for School Mapping and Planning

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Abstract: *Geographic Information System (GIS) is an analytical tool capable to perform storing, spatial operations, spatial queries, data linkages, data matching, analysis, decision making output generation. Public participation Geographic Information System (PPGIS) pertains to the potential of using information and communication technology (ICT) to enhance public participation in spatial decision making. Education is an inherent part of any civil society. Proper educational facilities generate the high quality human resource for any nation. Therefore, government needs an efficient system that can help in analysing the current state of education and its progress simultaneously in decision making and policy framing. GIS can serve the mentioned requirements not only for government but also for the general public. In order to meet the standards of human development, it is necessary for the government and decision makers to have a close watch on the existing education policy and its implementation condition. School mapping plays an important role in school planning process. School mapping consists of building the geospatial database of schools that supports in the infrastructure development, policy analysis and decision making. The present research work is an attempt for supporting Right to Education (RTE) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA) programmes run by Government of India through the use of GIS and PPGIS.*

Keywords: GIS, PPGIS, School Mapping, School Catchment, RMSA.

Introduction:

Geographical Information System and Geo Imaging technology contributes and helps to planning and decision making process. It is not only visual tool but also a technology which helps to build infrastructure on top of the other information from various perspectives. Today location component of the data become very important. It is estimated that the eighty percent of the data contains spatial aspect (Klinkenberg, 2003). During the recent past, availability of location data have increased exponentially due to the growth in the field of remote sensing, Global Positioning System (GPS), GPS enabled smart devices, *etc*. This has resulted in the increase of the demand of GIS and web GIS. Now most of the people, facilities and phenomena can be reference by the location (Openshaw and Abrahart, 2000).

The Internet has partly changed the perception that GIS is an 'elite technology' (Pickles, 1995) and for some time now it has been possible to access GIS functionality over the Internet (Craig et al, 2002, Kingston et al., 2000). Not surprisingly, the Internet makes a well suited medium to facilitate broad-based participation in planning and decision making even in developing countries where Internet diffusion is growing rapidly, giving a wide range of people the opportunity to access and participate in the planning process (Hall and Leahy, 2005). Furthermore the diffusion of Open Source Software (OSS) technology including geospatial web services can be

highly customized and easily adapted to various applications, using Open Geospatial Consortium (OGC) standards.

The advancement in the field of geographical information systems (GIS) had contributed greatly to a number of studies dealing with measures of spatial access to educational facilities and resources. In developing countries, GIS and school mapping (SM) technique are often used to create the necessary conditions for achieving universal primary and secondary education (UPE and USE) and increasing access to educational facilities for socially disadvantaged populations (Hite 2008).

Rashtriya Madhyamik Shiksha Abhiyan (RMSA) is a Programme of the Government of India, implemented in partnership with the State Governments with the main objective to make secondary education a good quality available, accessible and affordable to all children in the age group of 14 to 18. The scheme seeks to enhance enrolment in classes IX and X by providing a secondary school within a reasonable distance of every habitation, to improve quality of education imparted at secondary level by ensuring all secondary schools conform to prescribed/ standard norms, to remove gender, socio-economic and disability barriers and to achieve universal access to secondary level education by 2017, i.e. by the end of the 12th Five Year Plan. The Programme was launched in 2009, started functioning in 2010.

This paper basically focuses on universalisation of access to education. Access to education can be of three kinds. Firstly**,** physical access, which emphasizes that geographical distance between schools and households, is to be minimized. Secondly, economic access, which implies the financial capacity of households to send children to schools even when facilities are easily accessible in a geographical sense. Thirdly, social access which means that social stratification based on caste, class and religion has implications for access available public provisions. Many educational planning problems such as physical accessibility to schools, redistricting schools, school performance and equity are geography-based. School Mapping (SM) techniques that integrate GIS and local communities have been effectively implemented in the school planning process (Govinda, 1999).

Objectives of the Study:

The objectives of this study are,

- To focus on the concept of Geographic Information System.
- To focus on the role of GIS as a planning tool. .
- To analyse the role of PPGIS in educational planning.
- To assess advantages and disadvantages of PPGIS.
- To have a general idea on concept, processes and need of school mapping.
- To shade light on GIS based analysis under RMSA project.

Research Questions:

The study addressed the following questions,

- What the role GIS plays in educational planning?
- What is the role of PPGIS in educational planning?
- How can the public be involved in school planning?
- What are the objectives of school mapping?

- Why school mapping is a suitable planning tool?
- Which methodology had adopted for school mapping under RMSA?

Design of the Study:

The researcher has reviewed previously published academic literature, including journal articles, conference proceedings, NGO publication, policy and government documents, best practice manuals and handbooks, press/popular media report on GIS, PPGIS, School Mapping, and RMSA. To collect concepts, information, and opinion related to this study the researcher was adopted the analytical descriptive approach.

Plan of the Study:

The study has conducted in four main parts,

1. First Part: Geographic Information System (GIS): An overview
2. Second Part: Public Participation Geographic Information System (PPGIS): An overview
3. Third Part: School Mapping: Basic Concepts
4. Fourth Part: GIS Based Analysis for Planning School Locations under RMSA

1. First Part: Geographic Information System (GIS): An overview

GIS is a collection of tools and techniques that works on the geospatial data and is used in the analysis and decision making. GIS is required for very diverse fields from government to common public, from commercial to social service, from science to defence. According to Bolstad (2012), GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information whereas Burrough (1986) defined GIS as a powerful set of tools for storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes. GIS is a system that works on the spatial as well as attribute data.

1.1 Brief history of GIS:

Most contemporary efforts at mapping social and physical space, including GIS applications, acknowledge Dr. John Snow's 1855 map of the Soho, London cholera outbreak of 1854. While the actual origins of GIS are somewhat in dispute, most commentators assert that the Canada Geographic Information System (CGIS) of circa 1965 was the first. Most early efforts at GIS were seen as cost-effective technical solutions to relatively mundane administrative problems, such as planning of urban transportation routes. In the 1970s, the potential of digital computers to facilitate the analysis of geographic information emerged (Goodchild, 2006). The technology revolution of the mid-1970s facilitated the explosive emergence of sophisticated GIS solutions by virtue of the rapid development of relational database management systems (RDMS) and the precipitous fall in cost of computing power with the introduction of mini- and micro-computers (Maguire, Goodchild, and Rhind, 1991; Forseman, 1998). Earlier GIS were clearly oriented at 'GIS as a tool' to national, military, and intelligence community applications. Later on during 1980s democratically oriented GIS use in community-based decision-making (Pickles, 1995).

1.2 GIS as a Tool for Educational Planning:

De Grauwe (2002) identifies the following possibilities for GIS to improve educational planning:

- GIS helps to make the presentation of data more attractive than traditional static maps.

- Projecting tabular data onto maps helps in recognizing unanticipated situations which, when noticed, call for closer examination.
- Through considering geographical (spatial) factors, the analysis becomes finer and more precise, increasing the likelihood that ensuing strategies will be more pertinent.
- More flexible assistance can be provided in prospective planning at multiple levels or units of analysis: national, regional, provincial/ district, and local (De Grauwe, 2002).
- Expanded holistic representation and exploration of the contexts of schooling, which are otherwise very difficult to contemplate in educational planning and management through the direct and dynamic use of multiple sources of influential data, such as those found in census, transportation, utilities, health care, land use, and agricultural databases.
- Increased public appeal and utility;
- Extensive control of scale of complexity, and flexibility in how much data are displayed or explored at a given time, with changes in unit of analysis virtually limitless and immediate; and
- Dynamic ability to facilitate 'what if' analysis, exploratory inquiry, and creation of planning and management scenarios (Hite and Hite, 2004)

2. Second Part: Public Participation Geographic Information System (PPGIS): An overview

A public participation geographic information system (PPGIS) is meant to bring the academic practices of GIS and mapping to the local level in order to promote knowledge production by local and non-governmental groups. The idea behind PPGIS is empowerment and inclusion of marginalized populations, who have little voice in the public arena, through geographic technology education and participation. PPGIS uses and produces digital maps, satellite imagery, sketch maps, and many other spatial and visual tools, to change geographic involvement and awareness on a local level. The term was coined in 1996 at the meetings of the National Center for Geographic Information and Analysis (NCGIA) (Schuurman, 2008).

2.1 PPGIS for Educational Planning:

PPGIS, which attempts to create and facilitate democratically oriented GIS use in community-based decision-making, has the potential to influence educational planning positively in a number of ways. Among other benefits, PPGIS provides the lens through which the substantial challenge of the decentralized-centralized interplay in planning can be more effectively conceptualized and facilitated.

PPGIS emerged in the late 1980s as a result of democratically oriented socio-political concerns that the early adopters of GIS were national ministries, military operations, and intelligence contexts (Pickles, 1995; Goodchild, 2006). Since PPGIS evolved as an effort to enable democratic participation in creating and using GIS, the definitions of public and participation have been central to its vision (Schlossberg and Shuford, 2005; Elwood, 2006, 2008; Ghose, 2007). Consequently, significant effort has been made to develop textured and creative ways of conceptualizing, thinking about, and identifying what specific public should be included, and at what particular levels of participation. Educational planning can benefit from a serious review and evaluation of these PPGIS efforts.

2.2 PPGIS: Advantages

The most obvious benefits are:

- Participation, empowerment, inclusion of local spatial knowledge and interests, higher degree of "ownership" of the process
- Skills development, and capacity-building
- Maps and pictures have great visual impact value – can be very convincing.
- Adding proper GIS brings in geo-referencing which is necessary for many legal and planning & policy applications.
- The added value of GIS is described above (e.g. storage & communication).

2.3 PGIS: Constraints

But, PGIS is:

- Time-consuming - to determine which stakeholders who should participate (especially in P3DM)
- Can create potential to increase the number and scale of (local) conflicts,
- Technologically confusing for some participants (elderly, etc.)(IIED, n.d.).

3. Third Part: School Mapping: Basic Concepts

School mapping is a set of techniques and procedures used to identify future needs in education at the local level and to plan for measures to be taken to meet them. Numbers of people, even in the Ministries of Education, misinterpret the expression "school mapping". Many think, in fact, that it merely denotes marking on a large-scale map the location of existing schools, distinguished by appropriate symbols. This exercise, while very useful, is nevertheless only a first stage in preparing a school map. The school map should be much more than this: it should be a forward-looking and dynamic vision of what the educational services, with their premises, teachers and equipment should be in the future so as to enable educational policy to be implemented.

3.1 School Mapping As a Planning Tool:

The term school mapping seemingly implies that the exercise is confined to location of schools. This is not true. School mapping is an exercise useful to rationally allocate educational facilities of any type related to any level of education. According to available accounts, school mapping originated in France in 1963 (Caillods, 1983; Da Graça, 1998; Govinda, 1999; Galabawa et.al. 2002). School mapping is a normative approach to the micro-planning of school locations. It is an essential planning tool to overcome possibilities of regional inequalities in the provision of educational facilities. It means that, a. School mapping incorporates spatial and demographic dimensions into the educational planning process, b. Location of educational facilities depends on the norms and standards prescribed by the authorities.

3.2 Need of School Mapping In Developing Countries:

School mapping is also used to investigate and ensure the efficient and equitable distribution of resources within and between school systems when large scale reform or significant expansion of an educational system takes place (Caillods,1983). SM (particularly in developing countries) is most often used to facilitate one or more of six functions:

- Create the necessary conditions for achieving universal primary and secondary education (UPE and USE),
- Increase access for females and members of other traditionally under-represented socio-economic groups,

- Promote the equitable distribution of educational benefits within and between different regions and populations,
- Improve the quality of educational efforts,
- Optimise the efficient use of existing capital, human and financial resources, and
- Organise, coordinate and rationalise efforts at technical, vocational, and post-secondary education (Caillods, 1983; Varghese, 1997).

3.3 Major Objectives of School Mapping Under Rashtriya Madhyamik Shiksha Abhiyan (RMSA):

Rashtriya Madhyamik Shiksha Abhiyan is a unique educational programme which has been designed in such a way to respond effectively to the emerging demands of our society and rapid developments that are taking place due to liberalization Privatization and Globalization. This is clearly the next step after universalizing elementary education. Universalisation of Access, Quality improvements, Equity, Institutional reforms and Strengthening of resource institutions are key strategies to achieve the target of Universalizing secondary education.

School mapping techniques help us to identify the most appropriate locations of schools or their alternatives so that maximum no of children can be benefited from the same level of investment and to reduce regional inequalities in the educational facilities. Following are the major objectives of the school mapping,

- To identify most appropriate location (Habitation or Village) for opening of new/ upgraded Secondary School.
- To identified most appropriate location (Habitation or village) to open alternatives of new school.
- To identify the location for opening of alternatives to formal school.
- To level out existing disparities in the distribution of educational facilities.
- To create equality of educational opportunities.

4. Fourth Part: GIS Based Analysis for Planning School Locations under RMSA:

One of the greatest challenges for educational planners and administrators has been to equalize educational opportunities for all, to provide easy access to educational facilities to all children. If all habitation / villages are to be provided with a school than the question of equality does not arise. But in real life situations we locate schools in such villages so that other habitations and villages also benefit. How do we decide on the village/ habitations where schools are to be opened so as to ensure equality of educational opportunities? The answer of this question /issue is found at the centre of any discussion of School Mapping, GIS and/or PPGIS that attempts an honest inclusion of decentralized participants at any scale.

4.1 Methodology of School Mapping Under RMSA using GIS:

School mapping under RMSA project of Government of India involves following steps,

Specification of norms standards & catchment area:

- Norms for opening of new schools
- Distance/Population/Difficult area
- Norms for teacher.

Diagnosis of exiting educational facilities:

- Information on literacy Rate, enrolment rate, retention rate, dropout rate etc is useful to prepare school specific plan.
- Assessment of existing educational facilities like number of Teachers, Teacher pupil ratio, infrastructure facilities like building, blackboard, water, toilet, electricity playground in selected area or schools.

Projection of future child population:

- Assessment of the number of children which is to be enrolled.
- Future projection of child population in the catchment area is needed to know the number of new Schools to be opened or upgraded, number of teachers to be requited.

Deciding the location of schools:

- School mapping exercise does not decide the site to construct schools. It only indicates the most appropriate habitations/ village where school are to be opened.
- Finding appropriate sites is to be done in consultation with villagers, engineers and education authorities.

Assessing the requirements or facilities in schools:

- Assessment of requirement of facilities in new school and in existing schools includes requirement of infrastructure facilities and teaching learning materials.

Estimation of financial assistance required:

- Based on the requirement of facilities cost estimates can be made and proposal can be made for funding.

Prioritization of assessed requirement & facilities in the schools according to financial resources:

- Based on the available budget for every year proposal can be made.

Conclusion:

The application of GIS as educational decision support system summarizes the phases and process of building the decision through GIS in India. GIS is creating the innovative ways for the analysts and decision makers to critically examine the diverse range of social and economic problems. The present paper illustrates how the GIS can be helpful for school mapping and planning of education and also in locating the probable places.

The study recommend for the use of referenced data on educational institutions they can be very useful while using school mapping to ensure efficient and equitable distribution of schools and educational resources, they are also useful for the determination of efficient route(s) for effective school supervision. Secondly, a unit should be provided which will be responsible for data collection and analysis and staff training for the use of GIS in the Education Management Information System (EMIS).

The paper attempted to show how GIS could be use in the planning process and decision-based using the technology. As a result of its capabilities, the use of GIS technology in decision making in all spheres in our

country has become inevitable. This paper provides the framework of the application of GIS in the education field, in particular, school mapping and their geospatial analysis required for the success of Right to Education (RTE) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA) programmes of Government of India.

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