

# Identifying Inequality of School Facilities and Resource Distribution Problems in Abbottabad City, Pakistan through Geographical Visualization

Hashir Tanveer<sup>1</sup> Huayi Wu<sup>1</sup> Rafi-us-Shan<sup>2\*</sup> Hafsa Tanveer<sup>3</sup>

1. Liesmars, Wuhan University, 129 Luoyu Road, Wuhan, China, 430079

2. COMSATS Institute of Information Technology, Abbottabad Campus University Road, Tobe Camp Postal Code 22060 Abbottabad, KPK, Pakistan

3. Department of Sociology, Government college university Faisalabad, Allama Iqbal road, Faisalabad, 38000, Pakistan

## Abstract

Providing quality education in isolated areas is one of the major issues in recent times, mainly in the underdeveloped countries, especially in South Asia. As the population is increasing rapidly in Pakistan, the resources cannot meet the requirements of quality education. One such example is the Abbottabad District of Pakistan with 1900 schools in 51 union councils; the government educational authorities have not established any system for their proper management and monitoring. The main reason behind the lack of resource management is the absence of effective visualization systems as well as the distance of schools from the main city. Mapping schools geographically to visualize them for analysis and managing resources is an efficient and effective way to make better decisions. The purpose of this study is to geographically identify the inequality in distribution of school's facilities and resources that can help educational authorities to diagnose problems when making decision and managing schools. Use of static conventional paper methods has consistently lead to poor results, because it is difficult to manage large amounts of school. In this research, the complete educational data was calculated from both government and local resources and then properly arranged in a database. That database was then connected to a web server to represent it publicly on a web-based application. The resulting map represents the spatial distribution of schools, depicting the improper distribution of almost 25% of the schools in different areas of Abbottabad. This research provides evidence that using GIS aided decision support and recommendation system will facilitate in better resource planning for education in developing nations.

**Keywords:** Geographical Visualization, Resource Management, Geographical Distribution, Abbottabad.

## 1. Introduction

Many reforms have been introduced in the school sector by the Government of Pakistan among them the major attention was given to the management of schools ESR. (2004). The school-level education sectors in Pakistan face various challenges in 21<sup>st</sup> century. Due to the lack of administration and efficient models in the education system of Pakistan, the country lagged behind in achieving its Millennium Development Goals (MDG) for education. Now according to Sustainable Development Goals (SDG) new priorities has been introduced by the government of Pakistan to enhance/improve the quality education with help of educational sectors focusing on the management of schools ESR. (2004). According to Mathur P. (2005), management depends upon controlling the available resources to acquire the desired targets. "School Mapping" involves the process of identifying the communities and places where educational facilities reside, and requires systematic effort designed to locate educational facilities in such a manner that targeted age groups in the population can use services to their maximum advantage Kaufman RA, et al. (2002). To calibrate the actual needs of each school, comprehensive data is also essential, so that necessary facilities can be provided to each school. Location of each school is also a major concern, correct location can solve many geographical problems, which are being faced by schools nowadays. Mapping can help visualize the resources and estimate the effective resource planning. This forecasting is critical in education and health resource planning. In developing countries parents can't afford to send their kids in remote location which involve travelling via transport for walking / hiking through the tough terrain. Geographical Information System (GIS) models and spatial visualization of the location and spatial distribution of schools in a specific area introduce a better way for decision-support. GIS techniques together with the help of coordinates could be used to analyze the unused perfect location for educational body according to population ratio Lagrab W, Akinin N. (2015).

The use of GPS-based survey databases emerges as a dynamic mapping tool to share and map statistical data and information, which could be easily uploaded on the internet or intranet for both public and private access Lagrab W, Akinin N. (2015). While storing a huge amount of data also leads to inappropriate handling, controlling and processing which then results in wastage of time for authorities. Use of GIS in developing countries leads towards mapping of educational facilities to support decision making process especially in the Ministries of Education Pascual CM, et al. (2004). School Mapping is the dynamic process of identifying

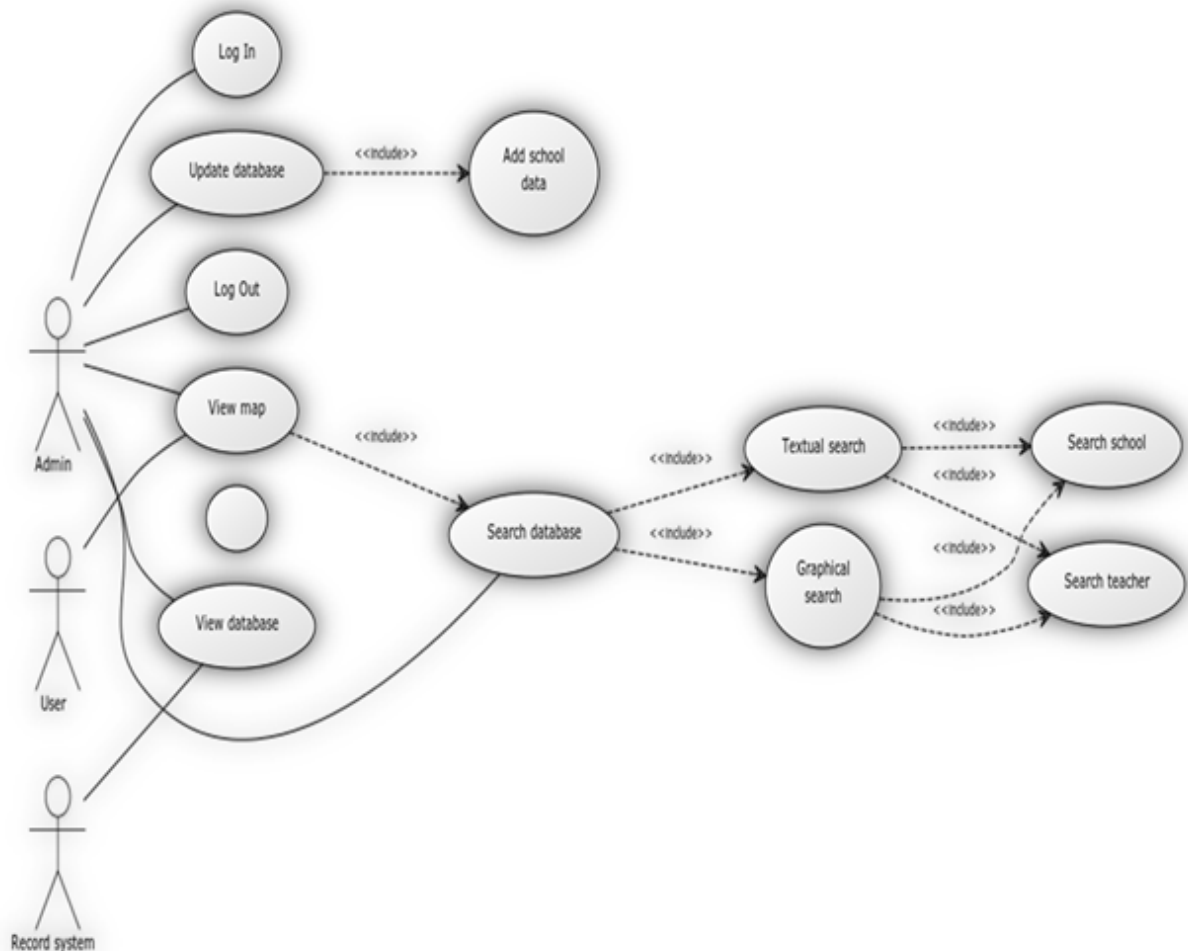
logically and systematically the communities and sites where educational facilities provided in the plan are to be located. As educational facilities have been synonymous with schools, the terms have been rather narrowly conceived as school-mapping Singhal, A. (2004).

Spatial visualization is also very significant as far as the evaluation of results are concerned i.e. it can identify schools individually as well as collectively. It can help solve many problems regarding visualization and utilization of resources in both urban and rural areas of the district.

## 2. Collecting and Arranging data.

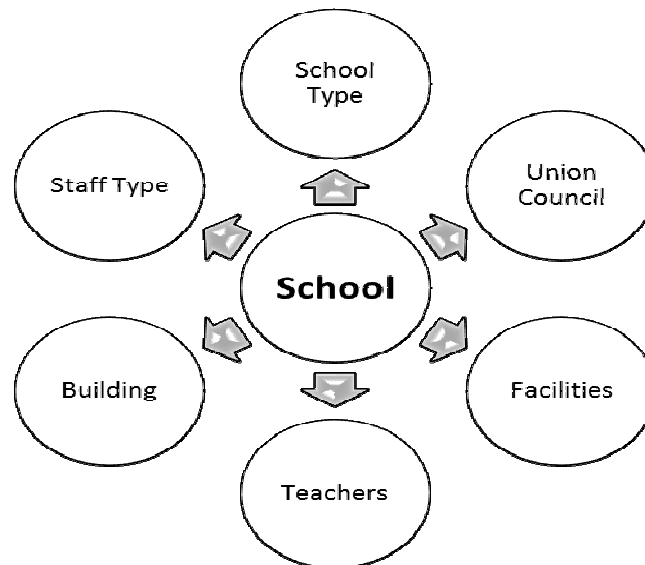
Abbottabad is a big district containing 51 union councils having 1900 public schools. Collecting a huge amount of data was a big issue. Detailed data of schools that includes number of students, teachers and other facilities obtained from District Education Office (DEO). GPS coordinates were collected with the help of a governmental organization Independent Monitoring Unit (IMU) (2015) and placed on the exact location of specific schools in the district of Abbottabad. Collected data merged into a local database, that particular local-database was then connected to a web-server so that authorities could easily understand the different visual perspectives on the website.

Multiple database queries permit a better understanding of school distribution both as a group and individually. Figure 1. is a Unified Modeling Language (UML) - Use Case Diagram that shows the structure of database and system. A Use Case Diagram provides a dynamic perspective of the system as a whole; and enables collation of internal and external database requirements. Thus, when we evaluate the system, its functionalities are prepared.



**Figure 1.** Use Case Diagram It provides multiple ways of modification depending on the degree of access. Official personnel have authority to access modify data according to the requirements. While visualization and search of desired school and information related to that is allowed for both public and official user.

Figure 2 is a Class Diagram, which shows the static view of system and applications. A class diagram is used for visualizing, describing and documenting different fields of a system.



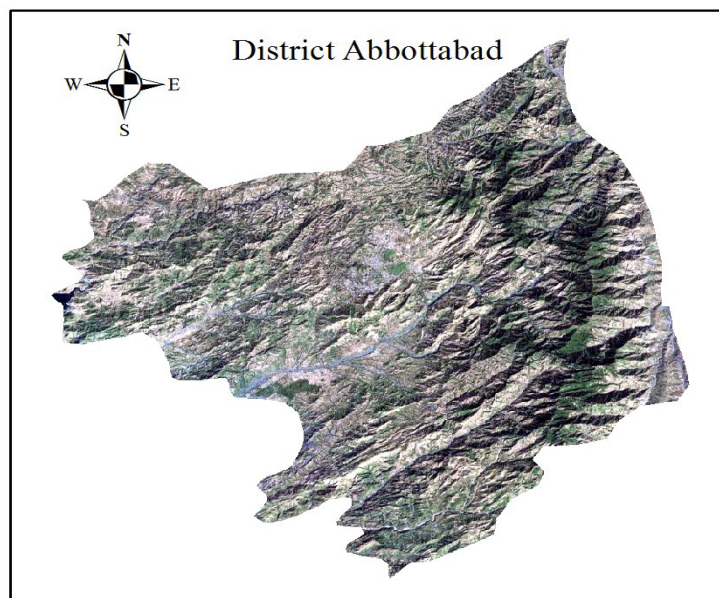
**Figure2.** Class Diagram

In a parent-child relationship of a class, all the common attributes are kept in parent classes and the extra/unique attributes are added in child/sub classes. By doing this, we avoid redundancy in all classes. Fields are representing which type of school it is while union council field represent the schools in different areas of the city. Building and facility indicates the types of each school building and facilities provided in schools. However, type of staff at different scales and number of teachers in schools is also provided in the fields.

### 3. Representation of Data

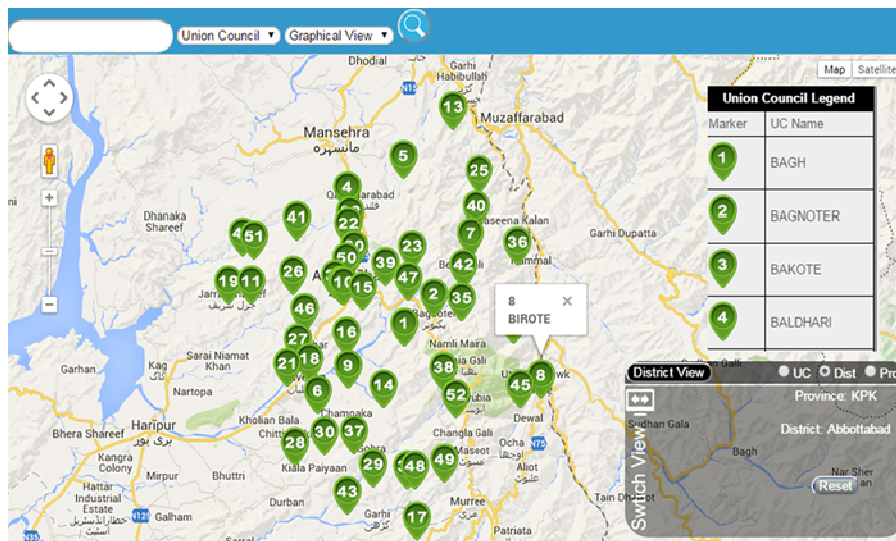
All the data stored in the database can be visualized in multiple ways. These multiple views are elaborated for the visualization of the distribution of schools in each union council in the district. Description of views relates to the interest of both public and administrative level user. A public user can understand and a view at the school of their interest while an administration level user can look up as a whole for better understanding of the area and distribution of facilities.

Fig 3 showing the Bing-Satellite view of Abbottabad district. The district consists of different kind of terrains, which contains high mountains, river, forest area and land. District Abbottabad have 51 Union Councils in total.



**Figure 3.** Bing-Satellite View of District Abbottabad A georeferenced satellite image depicts the whole area of district Abbottabad which has different terrains. Almost 40% of the district is hilly area.

Fig. 4 shows all the union councils on maps on their exact location. Figure exhibits exact coordinates of each union council along with their names and number on map.

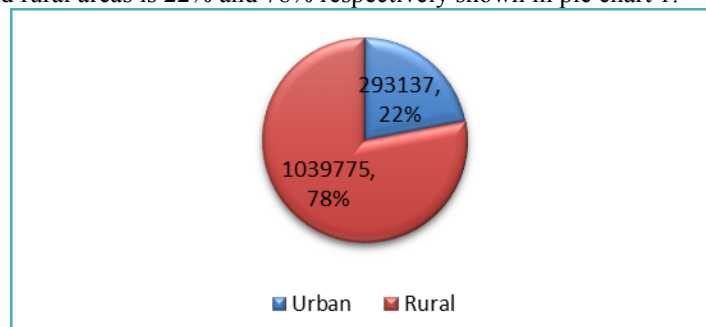


**Figure 4.** Distribution of Union Councils in District Abbottabad using GPS coordinates

The web view of the whole district using GPS coordinates on the map. This website is for public and official bodies to diagnose the school distribution in the more efficient way.

#### 4. Visualization of Schools

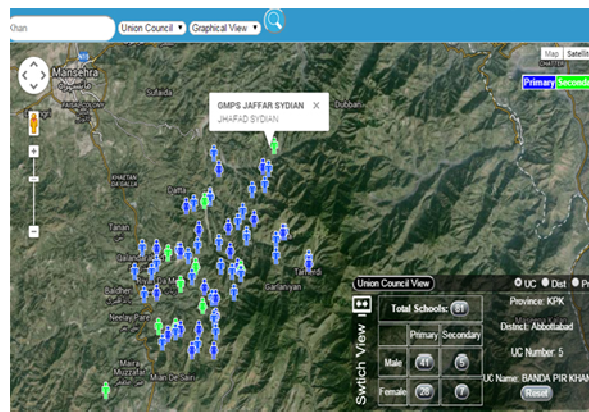
Mapping all the schools allows users to understand the distribution of schools and resources regarding location, infrastructure and facilities in detail required to manage comprehensively according to the population. Ratio of population in urban and rural areas is 22% and 78% respectively shown in pie chart 1.



**Pie-Chart 1.** Population ratio of District Abbottabad

Pie-Chart shows the number of population and percentage in rural and urban areas in District of Abbottabad.

Most of the areas in Abbottabad District contain hills and mountains, that brings up an important issue of accessing schools in those areas. Geographical visualization helped in recognizing those areas. Visualization gives users the opportunity to analyze the distribution of schools individually and collectively and help authorities in planning for major problems regarding trouble in traveling during harsh winter season. School mapping supports a double function of securing greater quality of education opportunities and at the same time helps decision-makers more effectively rationalize the use of existing facilities to optimize the limited material and manpower resources Sabir MM, Sabir MA. (2014). In fact, it will help to remove to the problem of “Ghost Schools”. Ghost Schools is the term used for those schools that do not exist physically but appear only on paper records. Finite resources of schools include infrastructure, building, water, transport and electricity are insufficiently and poorly managed leading to the waste of these resources and should be of utmost concern Dennis AR. (1990). Fig 5 shows the exact location of each school in a particular union council on map using GPS coordinates along with the complete details of resources in a particular school facility.



**Figure 5.** School Mapping using GPS

Schools of a specific union council are exhibited in this figure using their exact GPS coordinates. Each school has a name on it with complete detail of resources. This clearly shows that many of the schools are in the hilly areas, which causes many problems regarding transport, electricity and health facilities. Students and teachers have difficulties while traveling long distance to schools due to hilly path especially in cold harsh weather.

**5. Findings and Discussion:**

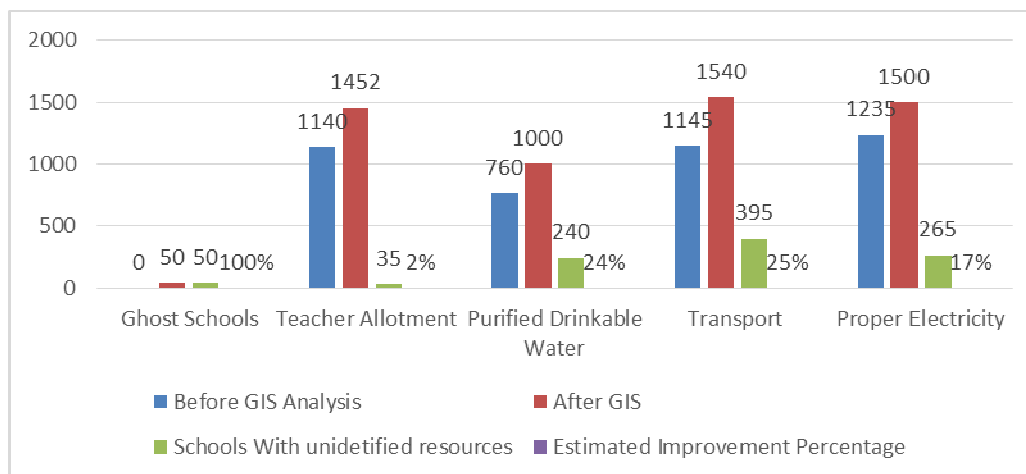
An extensive analysis, and comparison between the data from Independent Monitoring unit(IMU) and District Educational Office (DEO) in relation with the geographical visualization has been performed in urban and rural areas. According to Sabir MM, Sabir MA. (2014), school mapping be used as basis to improve digitized maps by incorporating the new data elements. This will also enhance the usability of these maps for purposes of planning, policy and decision-making. However, hard copies of these maps should be disseminated to the potential users for their information and use. The results of survey using spatial allocation showed that 25% of schools are in high hilly areas where authorities face many difficulties to provide enough facilities and yet waste resources to do so. As a result, authorities do not pay much attention to these schools.

Many schools exceed the distance of more than 1500 meters; it means that children require around 40-minute walk getting to their school in the hilly area. Therefore transport is an essential requirement for these schools. Geographical visualization helped in finding the location of schools that requires electricity and drinkable water. Study has found that a certain number of teachers are allotted to schools far from their residence. There is need of GIS based distribution and accessibility analysis to overcome these problems of schools in different areas, because the population is more on the plain areas as compared to the hilly areas. Furthermore, these tracks on hilly areas are not easy for children to walk, which could lead to unfortunate mishaps. Providing facilities like health care, electricity and water is also very difficult in such places. Table 1. Exhibits the findings of total number of schools and number of schools with complete resources, this data was obtained as a result of our efforts to understand the geographical allocation of schools. The potential for improvement can be assessed by analyzing resources geographically, using a GIS based system.

**Table1. Estimated percentage to be achieved**

Resources	Total Schools with particular resources in Paper Records	Total Schools after geographical Survey	Identified Schools without/incomplete resources	Estimated Improvement Percentage
1- Ghost Schools	0	50	50	100 %
2- Teacher Allotment	1390	1425	35	2.45 %
3- Transport	760	1000	240	24 %
4- Purified Drinkable Water	1145	1540	395	25 %
5- Proper Electricity	1235	1500	265	17 %

**Graph 1.** Shows the estimated percentage that can be achieved in solving this real-world problem using GIS approach.



**Graph 1.** Estimated improvement Percentage

Blue bar in graph shows number of schools with particular resources in paper records. Orange bar shows the actual amount of resources required for schools after geographical survey. Grey bar shows the number of schools with unidentified resources. Yellow bar shows the amount of percentage that can be achieved using GIS.

## 6. Conclusion

Results depicted that geographical survey evaluate and determined many inequality problems in distribution of school facilities in Abbottabad City. Major problems of electricity, transport and especially Ghost schools has been identified in many isolated areas. Geographical GIS analysis can improve the ways of mapping, visualizing and analyzing schools. It can help in developing proposals for distribution of schools and educational resources, also it can enhance the efficiency of decision-making. Whereas, Abbottabad has a fast growing population, the city requires an efficient GIS planning system for school infrastructure to meet this fast growth and to overcome serious problems. A future phase of this study would be adding complete data of population of each union council to have an extensive distribution and accessibility analysis of schools for better decision making. Also, to improve the standards of reserving land for building new school, distribute resources more efficiently and promote this model to provincial level. With help of public participation this research can help to improve the quality of transparency and level of accountability in our education system.

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