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Analysis of Spatial Distribution of Government Secondary Educational Institutions in Ife Central, Ile-Ife, Osun-State, Nigeria

[1]Odediran Omotayo O., [2]Ehisienmhen Nicholas O., [3]Aribilola Toba R., [4]Olaoluwa Idayat.A, [5]Aluma Collins C., [6]Hena Charles B., [7]Benson Adeyinka G., [8]Isa I., [9]Ogunmola Pius.O., [10]Ogunleye Funmilayo D., [11]Adeyemi Samson S., [12]Ashiru Kolawole. S.
[1-12]Advanced Space Technology Application Laboratory (ASTAL); National Space Research and Development Agency, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract: Any nation's economic, social, and cultural empowerment depends greatly on its formal education system. However, the poor distribution of educational facilities in underdeveloped nations has made access more challenging in terms of both time and distance. Schools are frequently placed incorrectly because no scientific method is used in their placement. The spatial distribution of schools in the Lugbe neighbourhood of Abuja and their accessibility to students were the main subjects of this study. Primary information for this study came from the point locations of schools, which were located using a handheld GPS, and a shapefile of the study area, which was created from Google Earth imagery. The road network, which was derived from Open Street Map, and the Google Earth imagery, which served as a base map for gathering data on residential areas and other landmarks, were examples of secondary data. The spatial distribution was examined using tools for spatial statistics like point distance and nearest neighbour. The findings indicated that schools within the locality are unevenly distributed across the geographical region and are more concentrated within a specific zone at a distance of not more than 2 km from one another. Additionally, 10 schools were located within a 1000-meter radius of a market, which is inappropriate because the market place negatively impacts the learning environment of the schools through traffic and noise pollution. The network analysis method was used to investigate how easily accessible schools are from residential areas. Schools shouldn't be more than 2 km away from students, according to UNESCO. An extensive number of students have lower accessibility to schools because they must travel twice the distance recommended by planning guides, according to the network analysis, which found that more than 80% of schools are located more than 2 km from students' homes. As a result, the majority of residents do not have adequate access to secondary school education, according to the overall results, which showed that neither national nor international standards were followed when deciding where to locate schools. This study demonstrated that remote sensing and geographic information systems are a cutting-edge method for decision-makers and analysts to evaluate a wide range of socioeconomic issues. By supplying details about the secondary school accessibility situation right now and assisting in future planning, it aims to promote academic excellence.

Keywords: *Spatial Analysis, Distribution, Education, Institution*

I. INTRODUCTION

Formal education is widely recognized as a crucial driver of social and economic development in both developed and developing countries (Li, Gong, & Yue, 2014). However, developing countries often face unique challenges in ensuring access to education, which requires the implementation of effective policies. For instance, the distribution of schools is an important aspect of education infrastructure that can significantly impact students' access to education in terms of time and cost (Marshad, 2005). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has highlighted the crucial role of education in promoting economic development worldwide, with the World Bank estimating that a 3% annual increase in a country's GDP can be attributed to rising levels of education (UNESCO, 2006). Education is a fundamental human right that provides access to a range of social, economic, political and cultural benefits. By promoting diversity, reducing poverty and inequality, and fostering respect for the rule of law, education can contribute to building stronger societies (World Bank, 1996). The education system is a complex organization that involves a range of stakeholders, including governments, religious groups, voluntary organizations, teachers' associations, teachers, parents, and the general public (Taiwo, 1980). In Nigeria, for example, the government recognized the importance of secondary education in providing the skills needed for the country's workforce and established the Universal Basic Education program. This program aimed to provide students with both literary and functional technological skills to prepare them for the workforce (Cildado et al., 2001). Overall, education infrastructure plays a critical role in promoting economic development and ensuring that all individuals have access to the benefits that education can provide.

Nigeria's educational system has undergone several changes in policies and programs over the years. While some of these changes may appear desirable on paper, meaningful planning, initiation, and implementation have been uncertain, which can be detrimental, particularly since the future of Nigerians depends on the quality of education its citizens receive (Ogunkoya& Ojo, 2015). Nigeria is a signatory to various international treaties and covenants, such as the International Covenant on Economic, Social and Cultural Rights and the African Charter on Human and Peoples' Rights, which underscore the importance of education. These treaties establish the right of every person to basic education (Article 13 International Covenant on Economic Social and Cultural Rights).

In Nigeria, "basic education" refers to education from the primary level up to the first three years of secondary school (Aluede, 2006). Despite this recognition of the importance of education, Nigeria's education system faces various challenges, including inadequate funding, inadequate educational infrastructure, and a lack of qualified teachers, among others (Ogunkoya& Ojo, 2015). These challenges have contributed to

low educational outcomes in the country, with Nigeria ranking low in international education indices. To address these challenges, policymakers need to adopt a more holistic approach to education that considers all aspects of the educational system, including funding, infrastructure, and human resources, among others. By doing so, Nigeria can improve educational outcomes and provide its citizens with the quality education they need to thrive in a globalized world.

Nigeria is a signatory to international treaties and covenants that recognize education as a fundamental human right and oblige the government to promote and provide education to its citizens (CESCR). Despite this, the provision of basic education in Nigeria has been hindered by poor implementation and execution, with initiatives such as the Universal Primary Education (UPE) scheme of 1976 and the Universal Basic Education (UBE) scheme of 1999 failing to achieve their objectives due to corruption and poor implementation (Aluede, 2011; Olupohunda, 2011). Although the Nigerian Federal Constitution recognizes the right to education, it is not enforceable, as these rights are provided for as directive principles of state policy (1999 Constitution). Section 18(3) of the Constitution stipulates that the government shall make efforts to reduce illiteracy by providing education as soon as practicable. However, it is up to each state government to provide basic education to its citizens based on the availability of resources within the individual state. To fulfil the provisions of Section 18(3) of the Nigerian Constitution, the Federal Government provides annual budgetary allocations to the states for the development and provision of quality education to their citizens. However, while some states make efforts to provide education, others are lagging behind, and extreme cases of violations of the right to basic education have been reported across various states of the federation (Weekly Trust, 2011). Some students still study under trees and dilapidated buildings, and the state government does not take these issues seriously. The need for the Federal and State Governments to prioritize the provision of basic quality education to their citizens is imperative (Ogunkoya& Ojo, 2015). It is essential to address issues of maintaining and providing basic education, as failure to do so will have severe consequences for the future of Nigeria's citizens and their ability to compete in a globalized world.

Geographers have long been interested in the spatial aspects of phenomena, including the distribution of essential goods and services. In the context of education, understanding the spatial distribution of schools is crucial for enhancing access and utilization. Several studies have been conducted in Nigeria to analyse the spatial distribution of educational facilities, including the location of public educational facilities (Olamiju& Olujimi, 2011), the spatial distribution of secondary schools in Bida Town (Musa & Mohammed, 2012), and accessibility to secondary schools in Ogun State (Ogunyemi et al., 2014). These studies have revealed inequalities in the distribution of schools and low levels of utilization in certain areas.

Several studies have highlighted the importance of understanding the spatial distribution of schools in Nigeria to enhance their access and utilization. Adejuyigbe (1973) noted that low patronage of schools in Nigeria could be attributed to factors such as distance and type of facility available. To address this challenge, relevant studies have been conducted in recent years, including Olamiju and Olujimi's (2011) analysis of public educational facilities in Nigeria, Musa and Mohammed's (2012) examination of the spatial distribution of secondary schools in Bida Town, and Ogunyemi et al.'s (2014) analysis of accessibility to secondary schools in Ogun State.

educational facilities for promoting access and utilization, this study aims to analyse the accessibility of government secondary educational institutions in Ife Central, Osun State using GIS techniques. The findings of this analysis can inform educational development and planning, and ultimately improve the standard of living of the urban populace in the study area. Similar studies have been conducted in other regions of Nigeria, including Kaduna State (Abbas, 2012), Bida Town (Musa & Mohammed, 2012), Ogun State (Ogunyemi et al., 2014), and Ilorin West (Mustapha et al., 2015), which have highlighted the need for equitable access to education and the potential benefits of using GIS for analysing the spatial distribution of educational facilities.

In this study, we will examine the spatial distribution of government secondary educational institutions in Ife Central, Osun State to identify any gaps or inequalities in access to education. By employing GIS techniques, we aim to provide insights into the adequacy of educational infrastructure in the area and identify potential areas for improvement. These findings can inform educational development and planning, and ultimately improve the standard of living of the urban populace in the study area. The use of GIS in this study is particularly relevant, as it provides an appropriate method for analysing the spatial distribution of educational facilities (Mustapha et al., 2015).

AIM

The aim of the study is to analyse the spatial distribution of government secondary schools using GIS techniques and identify any gaps or inequalities in access to education.

OBJECTIVE

i. Analyse the spatial accessibility of these schools within the study area
ii. To identify the route network influence on the school pupils

STUDY AREA

Ife Central is a local government area located in Osun State, Nigeria. The area is home to several communities, including the city of Ile-Ife, which is regarded as the ancestral home of the Yoruba people. The area has a rich cultural and historical heritage, and is known for its traditional art, craft, and festivals. In terms of education, Ife Central is home to several government secondary educational institutions, which are essential for promoting access to education and improving the standard of living of the urban populace. The study area of this analysis on the spatial distribution of government secondary educational institutions in Ife Central, Osun State will focus on these institutions, analysing their spatial distribution and accessibility to identify any gaps or inequalities in access to education.

Table 1.1: Study area map

Names	Longitude	Latitude
Oduduwa college	4.56038000	7.49146833
St. Davids Grammar School	4.54868500	7.48979500
Anglican central High school	4.55702000	7.48935167
Ife girls' high school	4.54396667	7.49227667
Moremi high school	4.54548167	7.51229000
Oluorogbo high school	4.54911667	7.50137000
Oranmiyan Grammar school	4.55237500	7.49424667

II. METHODOGY

Table 3.1 list of the datasets used in the research and their sources.

S/N	Data	Data type	Sources
1	Schools	Point Shapefile	Google Earth Grid 3 Ground truthing (GPS fieldwork).
2	Residential areas	Point shapefile	Grid 3
3	Roads	Line shapefile	Grid 3
4	Ife-central boundary	Polygon shapefile	Grid 3

A. Methodology Flowchart

1. Methods of Data Processing and Analysis

The methodology used in this research is divided into stages namely buffering, network analysis, average nearest neighbor analysis Spatial query by location. The methods were used in achieving the objectives of the analysis which includes identifying locations and mapping out the spatial distribution of all Secondary educational institutions in Ife-central.

Table 3.2 below shows the tools used in achieving each objective in the evaluation of accessibility to schools.

Table 3.2 Data processing, methods and results

OBJECTIVES	METHODS	PROCESS
Objective one	Visualization of converted GPS points into shapefiles.	Adding XY points from tables to the software and exporting as a shapefile, creating a database for storage.
	Average nearest neighbor analysis, mean, center and median center.	The use of spatial statistics tool in ArcMap to run the average nearest neighborhood analysis, mean and median centers.
Objective two	Buffering	Creating a radius of 2 km around the schools sing the buffer tool to check for proximity
Objective three	Spatial query by location	The number of buildings in the buffered zones were divided by the total number of schools, the answer gotten is further divided by the total number of houses in the study area. The answer is multiplied by 100

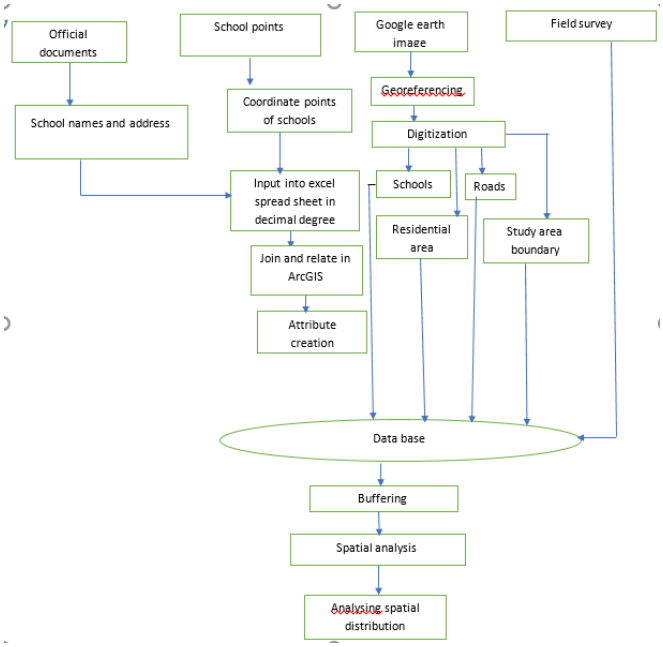

Figure 4.3 showing the growth rate of the study area from 2002 to 2022.

2. Data Preparation

The school coordinate's locations gathered using hand-held GPS are recorded in table format and exported as XY data in the software. These were converted to point shapefile containing information about the schools.

Residential areas in the study area were identified as origin locations. These were stored as .kml layer in Google Earth and imported into the GIS software as point shapefiles. The coordinate projection WGS 1984 UTM Zone 31N. Also, the road shapefile was downloaded from Grid 3, and was clipped to study area shapefile. The same process/procedure was done for the residential areas. The analysis is centered on government secondary educational facilities, reason they were selected and exported as a shapefile to be analyzed.

3. Analyzing Patterns and Mapping Geographic Distributions

The analysis measures the average distance from each point in the study area to its nearest point. The spatial statistics used in the analysis (Average nearest neighbor) helps to answer the questions of how the features are distributed, the pattern created by features, location of the clusters, differentiating the patterns and clusters of variables and comparing them, and to determine their relationship. Also, in order to identify their geographic distribution, the mean center tools were used. In order to achieve the objective of modeling the spatial pattern, these statistics can be used to explain and compare distribution of features. The mean center tools help to identify the geographic center location of the schools. It maps the average x and y coordinates of the data. Evaluating accessibility is based on proximity of the school locations to residential areas (Oloko-Oba *et.al.*,2016)

Average nearest neighbor is used in this analysis to compute the average distance to each features closest neighbor. For each point in turn, the distance to the closest other point (nearest neighbor) is calculated and averaged over all points. The point pattern analysis represents a basic form of dealing with distribution of homogenous points i.e., schools. A nearest neighbor index is often produced to describe the degree of spatial clustering using the average distance from every point to its nearest neighbor point. (An increased neighbor index

depicts dispersion while reduced nearest neighbor index depicts clustering). The size of the region in which the points are distributed is a great factor. This means that region or area is taken into account when measuring the index. The value of Nearest Neighbor Index, z-score and p-value are the output values. If the NN1 is less than 1, the distribution pattern of the high schools in the study area is categorized as clustering; if the index is more than 1, the trend is toward dispersion. If the p-value is less than the significance level α, the spatial pattern is regarded as spatially (clustered or dispersed); when the z-score is positive, the pattern is dispersed, otherwise, it is clustered. (Hong Zhou, 2012).

IV. RESULTS AND DISCUSSIONS

A. Spatial Distribution

The following maps show the geographic location of the schools and residential areas within the study area boundary.

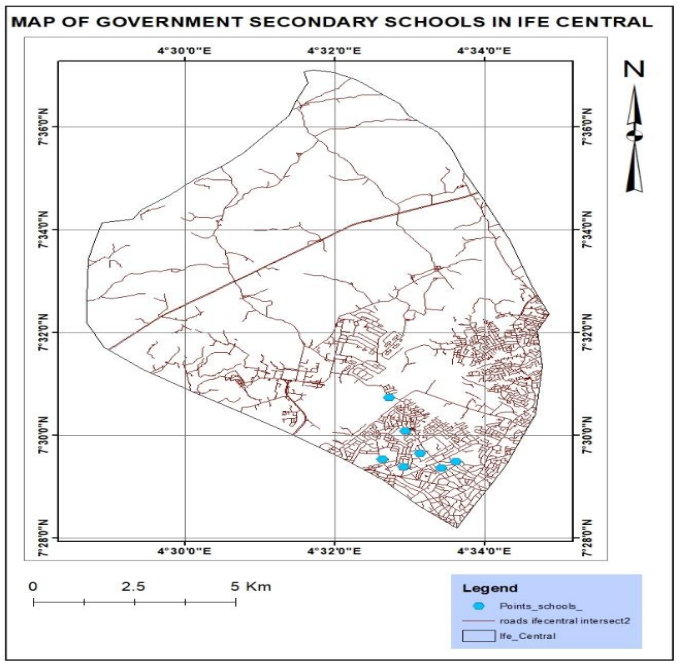

Fig. 4.1 Geographic location of government owned secondary educational institutions in Ife Central local government area.

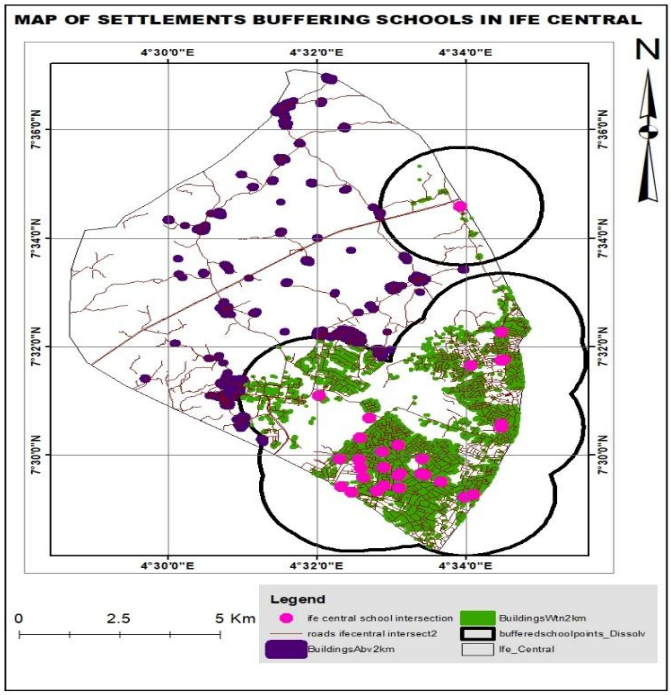

Fig 4.2 Map showing 2km buffered zones, with schools and settlements within and beyond the zones.

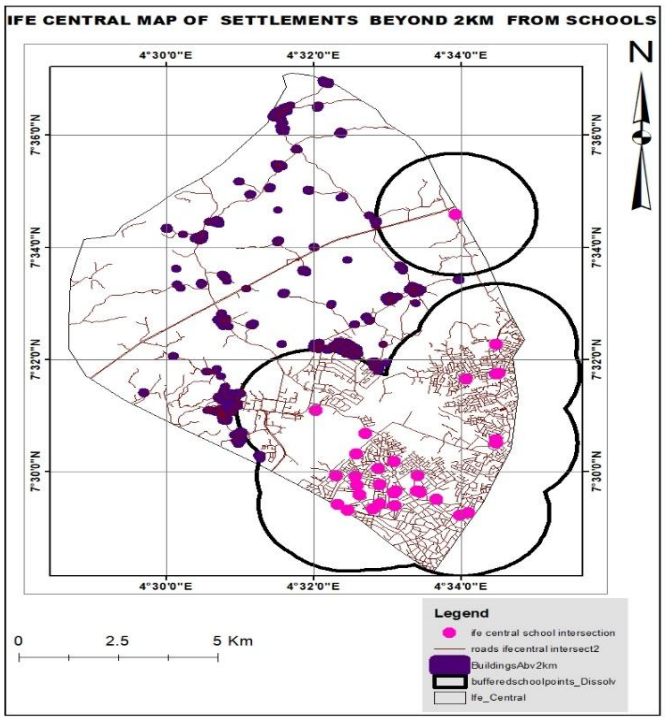

Fig 4.3 Map showing the settlements beyond 2km buffered zones.

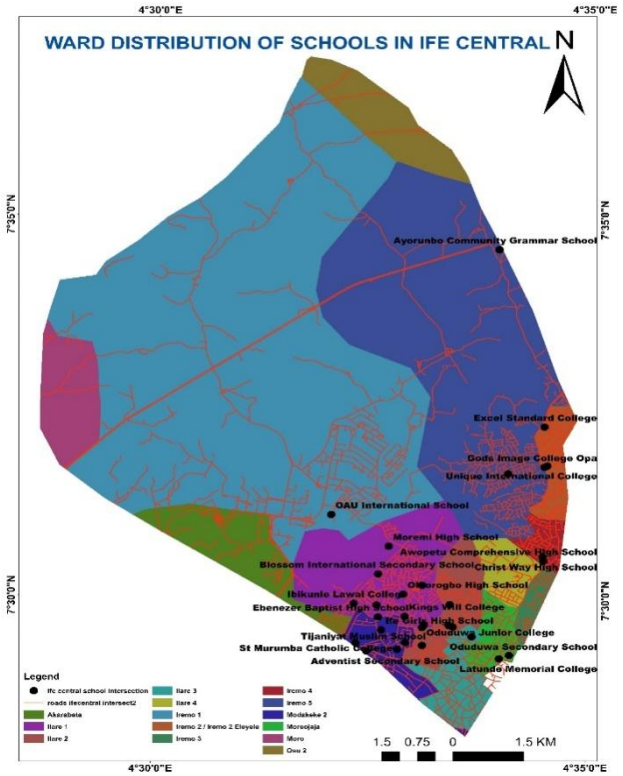

Fig. 4.4 Map showing ward distribution of schools in the study area.

Fig. 4.5 Map showing schools and settlements within the 2km buffered zones.

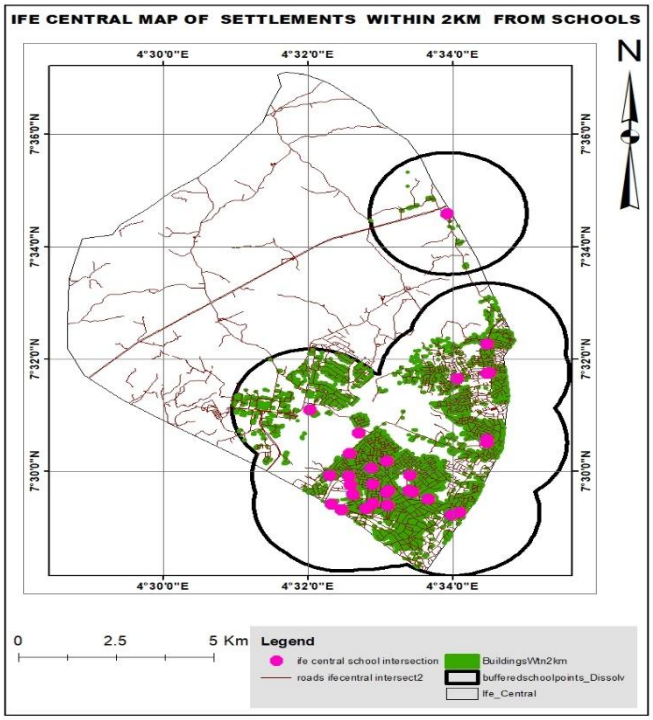

Fig. 4.5 Map showing schools and settlements within the 2km buffered zones.

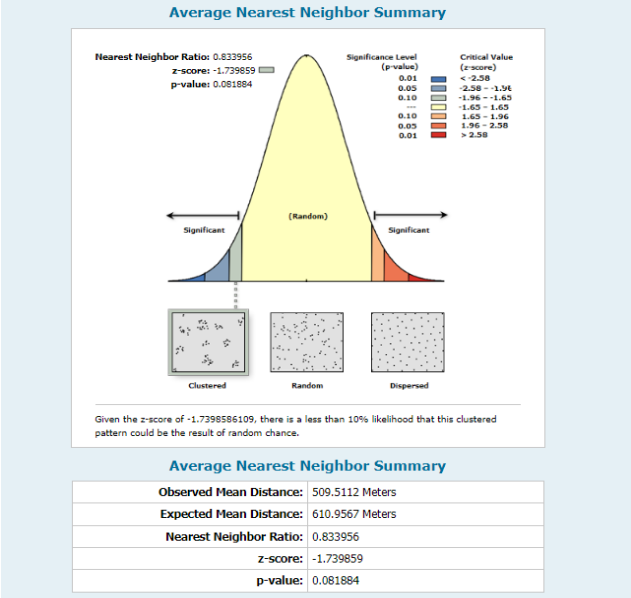

Fig 4.6 Average nearest neighbor curve.

1. Average Nearest Neighbor

Average nearest neighbor: this was done to determine to determine if there was any statistically significant level of clustering or dispersal of the schools within the study area boundary. The average nearest neighbor index shows the clustering or dispersion of features. It is expressed as the ratio of the Observed Mean Distance to the Expected Mean Distance. The expected distance is the average distance between neighbors in a hypothetical random distribution. If the index is less than 1, the pattern exhibits clustering, if the index is greater than 1, the trend is toward dispersion or clustering. My analysis showed an index of 0.833956, thus signifying a clustered distribution of the schools.

CONCLUSION

GIS and remote sensing have proved to be an innovative way for analysts and decision makers to critically examine the diverse range of socio-economic problems. In this study it supported the assessment of the spatial distribution of schools through direct viewing and the use of statistical and other analytical tools. This study will help zonal authorities and ministry of education to visualize the location of secondary schools on the map and also consider the accessibility when siting new schools.

RECOMMENDATIONS

Based on the result of the research, the following recommendations are made:

- Measures should be put in place to ensure schools are more evenly distributed within the study area, putting the minimum distance apart from one another into consideration
- Zonal authorities should have a strong enforcement on the criteria for site suitability for new schools
- School should be located in the neighborhood centers in order to achieve the 2km minimum distance from most of the residential buildings.
- Literature research has shown that improper distribution of schools is not only peculiar to the study area, but also a large number of communities. This calls for fore more appropriate planning of school distribution on a much broader geographic region.

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