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Investigation of the Spatial Locations of Post Primary Schools in Minna Metropolis

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Abstract
This project research investigated the spatial locations of public post primary schools in Minna metropolis and from the data acquired a database is to be created. The locations of the schools were obtained with a hand-held global positioning system (GPS) receiver which gave the coordinates of the schools, and the spatial analysis was done in ArcGIS 10.1 software with its spatial analyst tool. Thiessen Polygon tool was used to obtain the proximity of the schools; Average Nearest Neighborhood Spatial Statistical Analysis, and Spatial Autocorrelation (Moran's I) tool were used to show if the schools were distributed evenly or randomly. The result obtained, showed that the schools are not evenly distributed as most of the schools are clustered in some settlements. Also the locations of most schools are positioned along the major road. In conclusion, based on the results obtained, it was recommended that more public post primary schools should be constructed to match with the increasing trend in population of Minna metropolis.

Keywords: investigation, spatial locations, coordinates, distribution, settlements

1.0 Introduction
An answer of great necessity to humans and upon which the development of places could be hinged on, is the locations or positions of objects, resources or areas of possible fulfillment of human desires or expectation. Resources or areas of possible fulfillment of human desires (expectation) because of a key factor and a major bridge leading to human actions which is decision, is brought to bear. Objects with various geographical data or attributes could be managed in a system known as Geographic Information System (GIS).
GIS applications in regions of socio-financial, demographics, characteristic assets and urban arranging and transportation etc. could proffer solutions to GIS related problems in these fields or regions.
On the earth surface, the location of these objects or desired resources are not found on the same spot but separated by space which could be said that they are spatially apart in the field of surveying and geo-informatics. An object is said to be spatial when it possesses both x and y coordinates with a reference to a coordinate system. These x and y coordinates are a 2-dimensional data which could be referred to as spatial data or a geographic data. The displacement pattern of these resources upon the earth in space is known as spatial distribution and to show the manner in which these objects or resources are displaced, a technique is employed called spatial analysis**.**
Spatial analysis is the quantification of phenomena referenced in space. The study of methods to describe and explain a process that operates in space based on a sample of observations taken at particular locations is aimed at
1. Identifying and describing patterns
2. Identifying and understanding processes.

Besides other factors like cost of educating its citizens, making their educational institutions of standard, etc. a pivotal factor considered was to see how educational institutions of various levels could be located at points within communities, states or provinces so that majority of its citizens could get education and be educated. And this alone contributed to a large extent

to the developed nations' in their journey of transformation. And if Nigeria must have a new face of transformation, like other developed nations, the importance or relevance of spatial analysis in education cannot be over emphasized so as to reveal the true distribution pattern of its educational institutions in light of seeing how to make her citizens educated.

Education is the process of receiving or giving systematic instruction through various levels of educational institutions (Primary, Secondary, and Tertiary). Education is an instrument for political, economic, socio-economic and national development. In Nigeria, education is a big industry. Every year government spends huge amount of money on education. Formal education in Nigeria can be traced to 1942 and since its inception it has undergone a radical change (Omaze et al., n.d).However, education; a procedure of accepting or giving deliberate direction, particularly at institutions of various levels of education such as schools (primary and secondary) or tertiary institutions (colleges and universities). It is a practice that shows the transfer of knowledge from one man or generation to another

Post Primary Education

This is a level in the acquisition of education that is pre-tertiary and also an intermediary between the tertiary and primary levels of education. In Nigeria, it involves a six (6) year period which was divided into 2 categories known as Junior (JSS level i.e. JSS1-JSS3) and senior (SS level i.e. SS1-SS3).

A major objective of secondary education as stated in the national policy on education (FRN, 2004) is the preparation of the citizens for useful living within the society. Based on this objective, the schools should be able to produce people who are capable of taking up appointments in companies (Osam, 2006). Igwe in the Alvana (1979) described the school as a micro-society in a macro-society.

Relevance of Education

Education helps improve and use better techniques for high productivity in virtually every area of life. Practically, on a daily basis inventions of machineries of various sorts and kinds to meet diverse needs are made by scientists that are paid in billions of dollars who then produce these machines and write their manuals, if not, under usage of machines will be evidential.

A man is born and dependent on others at the early stages of his life but must undergo transition from that stage to the independent stage; for this to happen, education is the right tool. An educated man is one that has been equipped by education to be self-dependent and sufficient for the next generation to depend on him.

Statement of the Problem

A reliable database for post-primary institutions within Minna metropolis for easy assessment by the local or state governments, individuals and corporate organizations interested has not been achieved, mostly tied to either failure in keeping up-to-date or inadequate spatial information of the educational institution. The failure in possession of these reliable information and accurate knowledge of where the schools are located before establishing new schools, have led to a bias distribution of schools in this region and lack of schools in other region. This study intends to carry out investigation and proffer solution.

Aim

This project is aimed at investigating and showing the spatial pattern of post-primary schools in Minna metropolis in Niger state.

Objectives

a) To reveal the spatial distribution and analysis of pattern of post-primary schools in Minna metropolis using ArcGIS spatial analyst tools (Spatial Autocorrelation (Moran's I) and Average Nearest Neighborhood Spatial statistical Analysis).
b) To show proximity (Distance) of the post-primary schools to various settlements within Minna metropolis with the aid of theissen Polygon method.
c) To develop an updated spatial database and make available reliable information on post-primary schools in Minna metropolis, for effective management and decision making by government, co-oporate body and individuals to whom this information is of great interest.

Justification of the Study

In the development of Spatial Information System (SIS), Geographical Information System (GIS) is of great importance. The development of SIS of post-primary schools in Minna metropolis will serve in quite a number of roles; which are: interface creation for government, individuals and corporate bodies, ease in locating and fast tracking data assessment of post-primary schools in Minna metropolis and better decision making as regards locating schools suitably; picking a school that best suits a parent/guardian intending to enroll his/her ward with regards to location.

Scope of the Study

The study area is restricted to Minna metropolis and a map is used to find and create a database for post-primary schools in Minna metropolis. The study will investigate the problems associated with location of schools in the study area and proffer solutions.

Study Area

Minna is the capital of Niger State in Nigeria. Minna became the capital of Niger State in 1976 in the administration of Late Gen. Murtala Mohammed. It has a land mass area of 844 hectares and the population result as at the 2006 census revealed that Minna was quite populated. Minna has its geographical coordinates lying approximately between latitude 09°25' and 09° 40′ North of the Equator and longitude 06° 29' and 06º 35 East of Greewich Meridian. Minna has parts of Bosso and Chanchaga local government areas forming its settlement as state capital

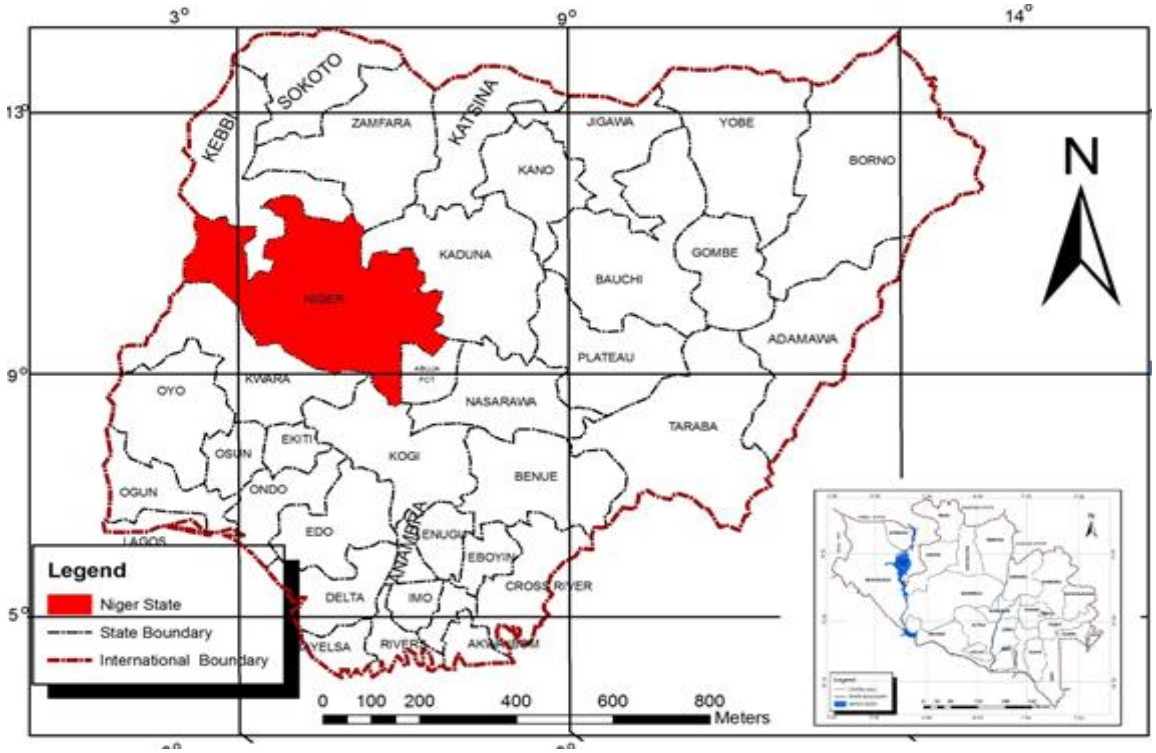

Fig. 1: Locational Map of Niger State

Literature Review

Kucerova and Kucera (2012), in their research work titled "Changes in the Spatial Distribution of Elementary Schools and their Impact on Rural Communities in Czechia in the Second Half of the 20th Century," used GIS to study the spatial distribution of elementary schools in Czechia in the second half of the 20th century mainly due to the change in the spatial distribution of elementary schools in the area. The study concluded that there was a decrease in the number of elementary schools in large population areas.

Lagrab and Akinn (2015), in their study revealed the competence of GIS technology as a tool to test for redistribution of kindergarten and propose better location of kindergarten by applying standardized criteria by studying and analyzing based on spatial distribution of kindergarten. At the end of the study, conclusions made were that the GIS has the ability to analyse the current locations of educational services to be addressed and spatial analysis based on GIS could be used to improve the distribution of educational services, and developing proposals for distributing the new kindergarten to help the decision-makers make deliberate scientific decisions which could rest on the fact that the educational facilities must be placed in locations far from the land uses that could have an influence on the quality of education, and the health and safety of children achieve an equitable, fair distribution of educational services.

Richard and Ogba (2016) studied the selecting of suitable site among several settlements without secondary school for citing new secondary school in Andoni L.G.A. River State, Nigeria. They recommended that the condition for citing new secondary school is that it should be built close to settlements without secondary school, to curb secondary school dropout. They also recommended that government at the local level should collaborate with state government to provide bridges across rivers and creeks to link settlements with secondary schools Fabiyi and Ogunyemi (2015), in their research, aimed to examine the spatial distribution, social and economic accessibility levels to post-primary institutions and also to identify the factors associated with the observed pattern in Yewa south local government area, in the south-western part of Nigeria. In conclusion, a dispersed patterned result was acquired on the basis of overall assessment of spatial distribution in the areas. Also, clustered patterned was obtained for nine (9) electoral wards while in llaro ward a dispersed pattern was also revealed. Students especially in public post-primary institution have to cover as far as 5 kilometers every school day to receive education. At the end of the study it was recommended that spatial re-engineering and reorganization of post-primary school should be done so as to improve the access of educational facilities by people living within the environs.

Aliyu *et al. (2013*), in their paper gave the results of the study at Yola North Local Government Area of Adamawa State, Nigeria to see the spatial distribution patterns and mapping of post-secondary schools and formation of a database. They established that Surveying and mapping is the bedrock of all physical and socio-economic development of all nations. The study revealed exploits of GIS technology in terms of database design and creation and has proved to be more efficient than other manual approaches. The database produced can show a momentary look as to how the attribute and spatial data were related. Quite a few queries done proved that GIS is able to manipulate data when environmental problems are to be solved.

Alfred et al.(2015), studied the effective management of private and post primary school facilities in Mubi North LGA of Adamawa state, Nigeria; their research developed

a geodatabase with the use of GIS as a tool. The result which was the creation of a database was to be used to assist in providing users with a good knowledge of a working environment; effectiveness in efficient management of schools' resources and for easy query of information of necessity for administration of schools.

David et al. (2011), in their research sought to manage distribution of national examination centers in Pumwami and central divisions, Kenya, with the use of geospatial technologies by aiming to employ GIS with qualities of lower cost per unit, high speed in retrieval of information, minimum storage facilities requirements and ease in data sharing. Attribute data of schools (Primary, Secondary), Police stations and Roads were stored in the geodatabase created; also constructed was a geodetic network. At the end of their result and based on their findings, it was recommended that a geodatabase created can be a link to Kenya National examination Council (KNEC) and other education sector related databases, and there should be new distribution centre in Pumwani division to ease the distribution constraint or impediment.

2.0 Materials and Methods

The methodology for this research includes:

1. **Reconnaissance**
   A tour of post Primary schools in Minna was undertaken.It was done to get a true idea/view of secondary schools In Minna, and to get basic information about them. Reconnaissance has two (2) facets, which are; Office Reconnaissance and Field Reconnaissance.
2. **Data Acquisition**
   Data was acquired based on the two (2) types of data, which are:

Primary data: The primary data is got by direct contact from first hand sources by means of survey, observation or experimentation. Names of Schools, locations, population (staff and students), were got from the State Ministry of Education and the various schools. This research case also involved:

(i) Field Observation using handheld GPS device to get the centre coordinates of schools.

(ii) Personal Interview was used to get information about students and staff population, etc.

Secondary data: Other information collected for purposes of gaining insight into the research problem from other sources (i.e published materials) are categorized as secondary data. In this research it involved:

- List of public post primary schools in Minna, from Niger State Ministry of Education.
- Satellite image of Minna, from DataNet Consult, Minna.
- Population of students in each of the pubic post primary school in Minna, from the schools.

Data Processing

The processing of data for this research includes the use of the following softwares:

-ArcGIS 10.1. : - The data obtained were processed with the following GIS analyst tools mentioned below

a. Thiessen Polygons
b. Average Nearest Neighborhood Spatial statistical Analysis
c. Spatial Autocorrelation (Moran's I)

- -Microsoft Word 2007.
- -Microsoft Excel 2007.

Data Base Formation

A database is facility that aids for the collection, management, manipulation and storage of data. A database was created in the ArcGIS software environment based on the data received from the Niger state Ministry of Education where the students' population information of the schools formed the database facility. The data base involving rows and columns also contained resultant information from the field survey. This information included also the names of the schools, students' information (such as total number of students in each class, number of males and females in each class of the schools, total number of students of each school as at 2014-2015 academic year),categories that classified the schools as either combined (i.e. junior and senior),junior alone or senior alone, total number of male students as that year; also for that of females in each of the schools in Minna's settlement which could serve as a tool for decision making and can be stored for future references.

Spatial data Query

Querying in GIS is a form of requesting or making inquiry in line of or as regards GIS data. With the use of queries, questions about data from the table of content can be asked; selection of specific data from numerous data with different attributes can be filtered out with ease.

The database created for the sake of the research could be queried to make available answers to some of the following questions, for instance, in relation to the twenty (20) schools considered.

a. How many were the students in each school?
b. How many male or female students were in each of the school?
c. How many schools have over 500 pupils in a particular class level?

Data Gathered

The data gathered includes; population data of schools from the Niger State Ministry of Education coordinates of schools from a handheld GPS receiver. These are the names of the public post primary schools given by state's ministry of Education.

Bosso Secondary school, Minna.
College of Arts and Islamic Studies,Tudun Fulani,Minna.
Day Secondary School Chanchaga A

Day Secondary School Chanchaga Minna B
Day Seconday School,Maitumbi Minna.
Hilltop Model School.
Model Day Secondary School,Tudun Fulani.
Niger State School For Special Education,Minna.
Ahmadu Bahago Secondary School,Minna.
Day secondary School,Tunga Minna.
Government Day Secondary School, Minna.
Government Girls Day Secondary School, Bosso Road.
Government Day Secondary School (Farther O Connell), Minna.
Woman Day College.
Zarumai Model School.
Government Girls Secondary School,Old Airport,Minna.
Kwasu Junior Secondary School,Dutsen Kura,Minna
Gbangbapi Junior Secondary School (Sauka Huta).
Day secondary School Limawa Minna.
Day Junior Secondary School,Barkin Sale.

3.0 **Results and Discussion**

Results

Data obtained was analyzed using the GIS analyst tools earlier mentioned that could be found in the ArcGIS software which were

- Thiessen Polygons: shows proximity of post primary schools to various locations. Each of the enclosed polygons has barely a sole point input feature. Any point within any of the polygons is closer to its related point (i.e. in this case post primary school) than to any other point input feature. This proximity tool splits the area covered by the point features into what is known as either Thiessen or proximal zones. These zones become representations of areas of which points in these areas are nearer to its related input point features than to another input point

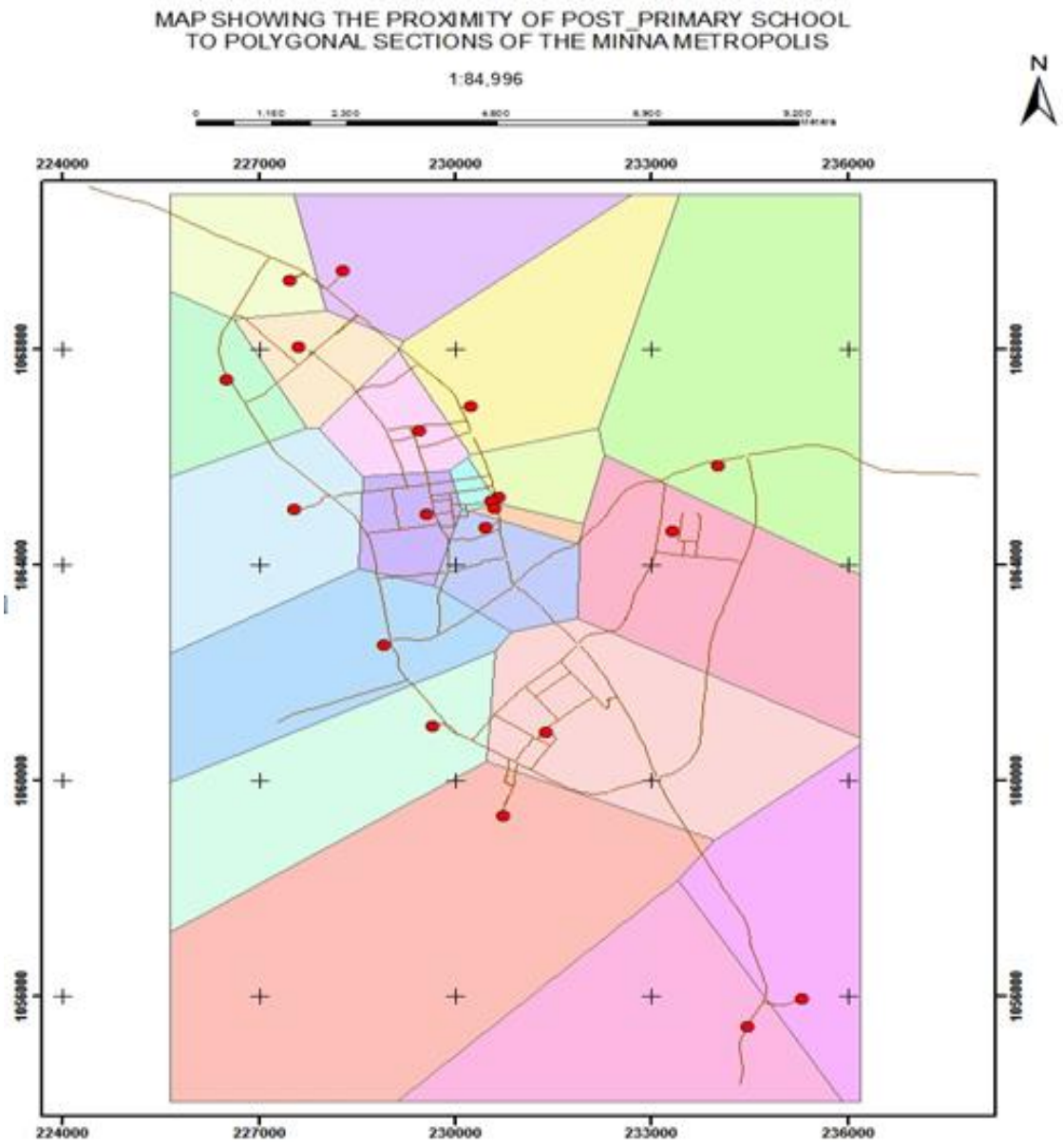

Fig.2: Map Showing Proximity of schools using Thiessen Polygons

- Average Nearest Neighborhood Spatial statistical Analysis: The Settlement is randomly distributed from the statistical analyst tool used having the P-value of 0.866

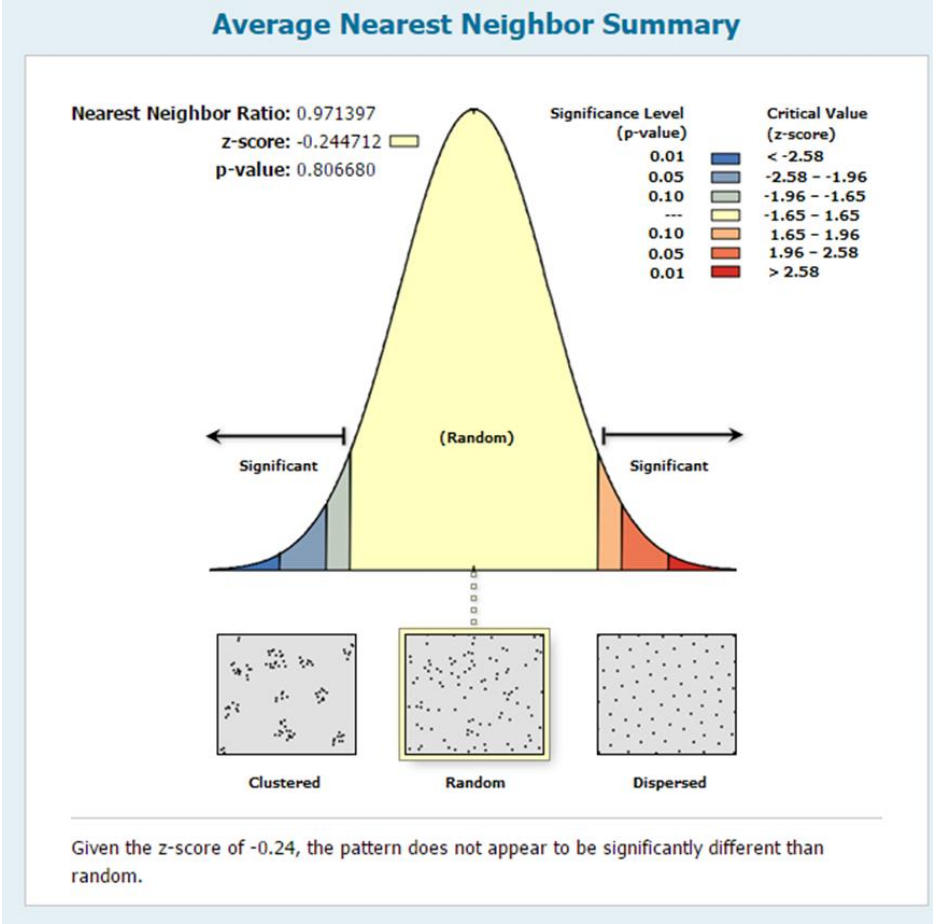

Fig. 3: Results of Spatial Analysis using Average nearest Neighborhood Spatial statistical

Analysis

- Spatial Autocorrelation (Moran's I): The distribution of the post-primary schools is Random according to Moran's I Statistical report with a P-value of 0.2739

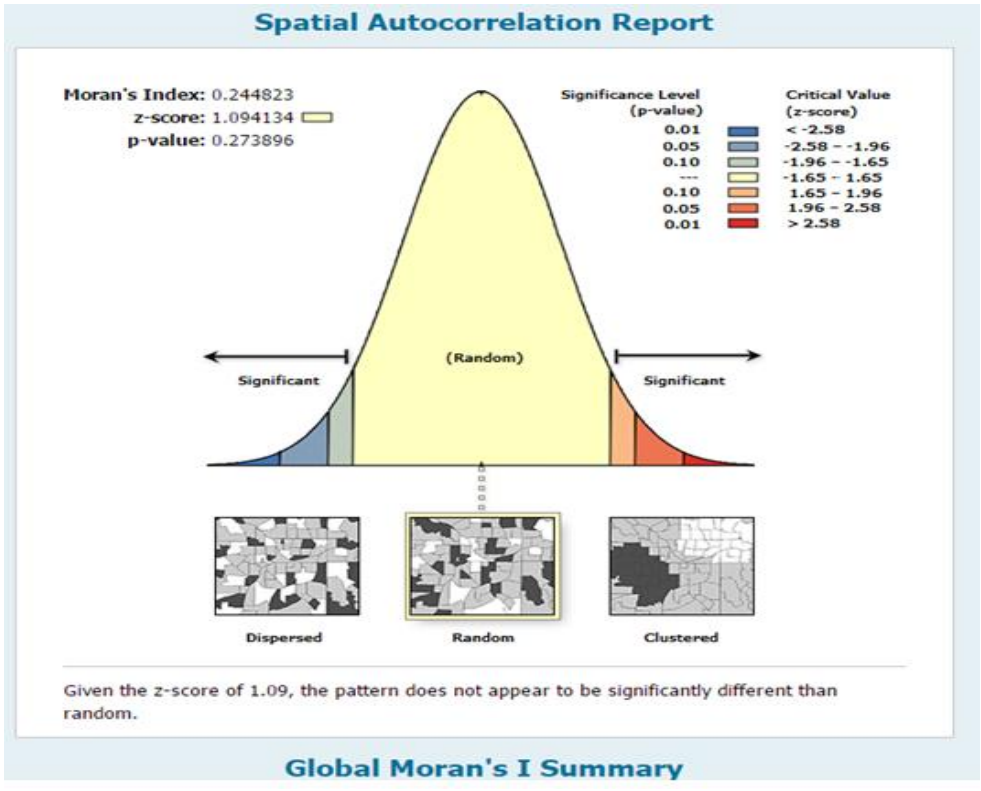

Fig.4: Showing Result Analysis using Spatial Autocorrelation (Moran's I)

Discussion

It was discovered through the research that most of the well-populated schools were clustered and were along major roads or close to these roads which cause noise pollution and nuisance to the students when learning.

It was also discovered that some schools are with either poor or no definite boundary wall (i.e fence), therefore, determining the extent of school's land was quite difficult to ascertain. This shows that security for the schools is poor because anything and anyone can enter the schools' environment at any time. Also to control students' movement will be difficult because they could leave school at any time they want.

Some schools had poor roads accessing them (for instance, Gbangbapi Junior Secondary School (Sauka ka Huta)) and the schools with high population have their students always endangered because the schools are close to busy major roads in Minna metropolis.

Some of the schools had little or no maintenance activities carried out of recent, therefore, not conducive for the students of schools. E.g. some schools don't have windows and so in a raining season, when it rains, water could enter the classes and disrupt the teaching.

Discussion of Results

The research resulted in availing a digital spatial map of the study area that showed the distribution and location of post primary schools and some neighborhood settlements (Fig. 2). GIS Analyst tools of ArcGIS 10.1 version was used to analyze the data which showed proximity using polygons and also showed that the public post primary schools in Minna were randomly distributed (i.e. analysis from Moran's I Spatial Autocorrelation) and the settlements are also random (i.e. Analysis from Average Nearest Neighborhood Spatial statistical Analysis). A database containing relevant information was developed and queries could be carried out not just the information about spatial location of schools but also information about the number of students in each class level of the schools, how many schools have over 500 pupils in a class level, total number of students in each of the schools; also to know which school admitted same sex only or both sexes and total number of students in the school records of the ministry of education as at the 2014-2015 academic year.

With this development of a database, the stress and issues arising from handling and mismanaging data (i.e. loss of files) could be decreased; easy creation, access, manipulation and detailed analysis to portray specific information could be less difficult which is of enormous help to decision makers and those of whom these information will be of great interest.

Conclusion

GIS has proven to be a tool of great importance to this research and other researches reviewed earlier as regards to development of cities and places and have given an opportunity for close monitoring of development trends of places.

In this research, GIS was used in pinpointing the location and distribution of public post primary schools that have been earlier discussed, which showed the unevenness in distribution of these schools; positioning of major and populated schools along a linear feature (major roads) which is always busy and can endanger the lives of the students in these schools and some others established close to roads which could cause noise pollution and be a nuisance to the students and teachers during class teachings.

GIS, a better alternative that can be given to the government, cooperate bodies and people of whom education is of great interest as a tool in adopting a stipulated criteria of 500m that would aid better distribution of schools that will keep up with the increase in population and development trend in the state, define and monitor accurate and precise boundary for the schools and to ensure proper siting of schools which will grant the citizens smooth access to the right of getting educated.

Recommendations

a) GIS should be used as a support tool to aid in making decisions and policies regarding educational institutions and assessing their facilities.
b) GIS professionals should be employed at the state's education board as that will aid keeping up to date information about schools.
c) Access to GIS information about Schools should be made available to the public e.g. through the internet.
d) For even distribution of schools in the state, GIS analyst tools can be used to know and monitor the distribution of schools in relation to the increase in population trend in Minna.
e) The government should have future plans to building more schools to cope with the increasing trend in population of Minna metropolis and the current schools should be maintained and managed properly.

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