Spatial Distribution of Primary Schools in Ilorin West Local Government Area, Kwara State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author OOOM designed the study and wrote the proposal. Authors OOOM and POS collected Data. Authors POS and OSA prepared the data for Analysis. Author SAS performed the statistical analysis. Authors ATA, JOO and RAB managed the relevant literature searches. Authors OOOM and OSA wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The distribution of educational facilities in most part of Nigeria has been observed to be politically biased to the extent that a facility is over utilized while others are underutilized in an area. Location of schools should be based on factors such as population, proximity and economy efficiency for sustainable development. The study engages geospatial techniques to show spatial distribution of primary schools. The data used for this project were acquired from primary and secondary sources. The primary data were acquired through handheld Germin 60 Global Positioning System (GPS) receiver to capture the coordinates of primary schools. The secondary data used for this study include a high resolution image, administrative map and school data. Data analysis was carried out using Nearest Neighbor Analysis as the statistical tool in achieving the pattern of distribution of primary schools given as the observed mean distance (Do) between each feature over the expected mean distance (De) for the given features in a random pattern. School location, number

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of primary schools and the area in square-kilometer for each ward were the parameters used to determine the pattern of distribution of primary schools in the study area. However, the result of spatial pattern of distribution carried out in Ilorin West Local Government shows uneven pattern of distribution of schools in the following percentage. Well served 41.66%, marginally served 25%, under served 16.67% and not served 16.67% such that five (5) wards exhibit random pattern, three (3) Clustered pattern and two (2) Dispersed pattern of distribution.

1. INTRODUCTION

Educational facilities are crucial resources that enhance all-round development of man and his environs [1]. Educational infrastructure is an important aspect of infrastructures that needs to be earnestly developed in the society [1]. Accessibility to public facilities refer to the distance citizen must cover to receive the desired service. In other words, it is perceived as the extent at which services such as administration, education, and health are accessed by the targeted individuals to enhance the economy of the country. (China standard GB/T.50280.98 1998), [2] Education is an important part of public facilities since it provide services to the people and also impacts on individuals who do not have access to its use in the area.

The role of Education is of utmost important in our society. According to [3], the growth of education is essential to the development of economy around the world. World Bank opined that the Gross Domestic Product (GDP) of a country will increase 3% yearly as the level of education increases. Education is a basic human right, and is indispensable for the achievement of other human rights. Education contributes to every Nation by building the economy, therefore limiting poverty rate. It also enlightens the people, thereby making the citizens to abide with the norms of the society [4]. As reported by [5], education system is a complex organization of interactions amidst mutually dependent individuals, bodies and groups, aiming at achieving educational goals. The governments, religious groups, voluntary organizations, teachers, parents and the general public are all educational stakeholders.

Primary Education plays an important role in the life of every citizen and the nation at large. Nigeria is among other countries that concur to education as an undoubted means of fulfilling national development, thereby making private individuals, government and organizations to set up educational institute at all level to meet educational yearnings and wants of the citizens; although the expectation for equal distributions of educational infrastructure is a major challenge [19]. Primary education otherwise known as elementary education, which is usually received in primary school is the initial and compulsory stage of education. This type of education is different from infants' education received by parents and post primary education. It is compulsory for children to receive primary education in most countries, although it is acceptable for children to be home schooled at this stage of education. The major goals of primary education includes accomplishment of basic numeracy and literacy among pupils as well as building justification in arithmetic, science, geography, history and social sciences. The affiliated importance and the process employed to them are an area of sizable political debate [18].

Probably because Nigeria was Colonize by British, her education system has been modeled very closely after the British pattern. There are variations in the organization of the system because of different historical background, attitude, traditions as well as general difficulty of the communities [6].

Accessibility to education is defined as the measure of the extent to which a country is able to satisfy household/Community demand for education [7]. The ideal goal of government in providing services to maintain the capability of each neighborhood in both urban and rural areas, school planning is a type of facility planning, and the distribution of schools is determined by the availability and openness for people's schooling [8]. The practical importance of school location is based on the needs of the residents. The planning of the primary school is of vital importance for both urban and rural development. What keeps residents in metropolitan areas is accessibility, the potential for interaction, both social and economical, the possibility of getting from home to a multitude of destinations offering a spectrum of opportunities for work and play [9] Cited by [2].

The Average Nearest Neighbor Analysis (ANNA) is a concept that was originally developed by plant ecologists Clark and Evans in 1954 towards the distribution of various developed plant species over the earth surface. The method indicates the degree to which any observed distribution deviates from what may be expected, if the distributions of points are random [13]. Average Nearest Neighbor tool measures the distance between each feature centre and its nearest neighbor's centre location then averages all these nearest neighbor distances. If the average nearest neighbor ratio is < 1, the pattern exhibits clustering. If the ratio is > 1, the trend is toward dispersion and is random when =1. The average nearest neighbor ratio calculated as the observed mean distance all over the expected mean distance [17].

The goal of government both in urban and rural areas is to provide services and enable adequate accessibility to all. Due to inadequate planning with poor consideration to spatial factor, accessibility to vital public infrastructure particularly schools have remain an issue and contribute to the underutilization of most schools in the study area. This problem calls for adequate study and development of spatial model that would guide in the distribution and allocation that will provide adequate and comfortable accessibility to the students. In line with this, the study examined the spatial distribution of primary schools in Ilorin West Local Government Area of Kwara State, Nigeria.

2. THE STUDY AREA

Ilorin West Local Government Area (LGA) of Kwara State lies within 4°28′10″E, 8°34′28″N and 4°35′35″E, 8°24′09″N. It has a total land area of about 105 square kilometers and a population of 364,666 as at 2006 census with population density of 3501 per. square kilometer. Ilorin West serves as host for the state capital administrative headquarters with major markets such as Oja-Oba, Oja-Tuntun, and Mandate. The Local Government consist of Twelve (12) electoral wards (Adewole, Ajikobi, Alanamu, Badari, Baboko, Magaji-Nngeri, Ogidi, Oko-erin,Oloje, Ojuekun/Sarumi, Ubandawaki and wara/Osin/ Egbejila) as shown in Fig. 1.
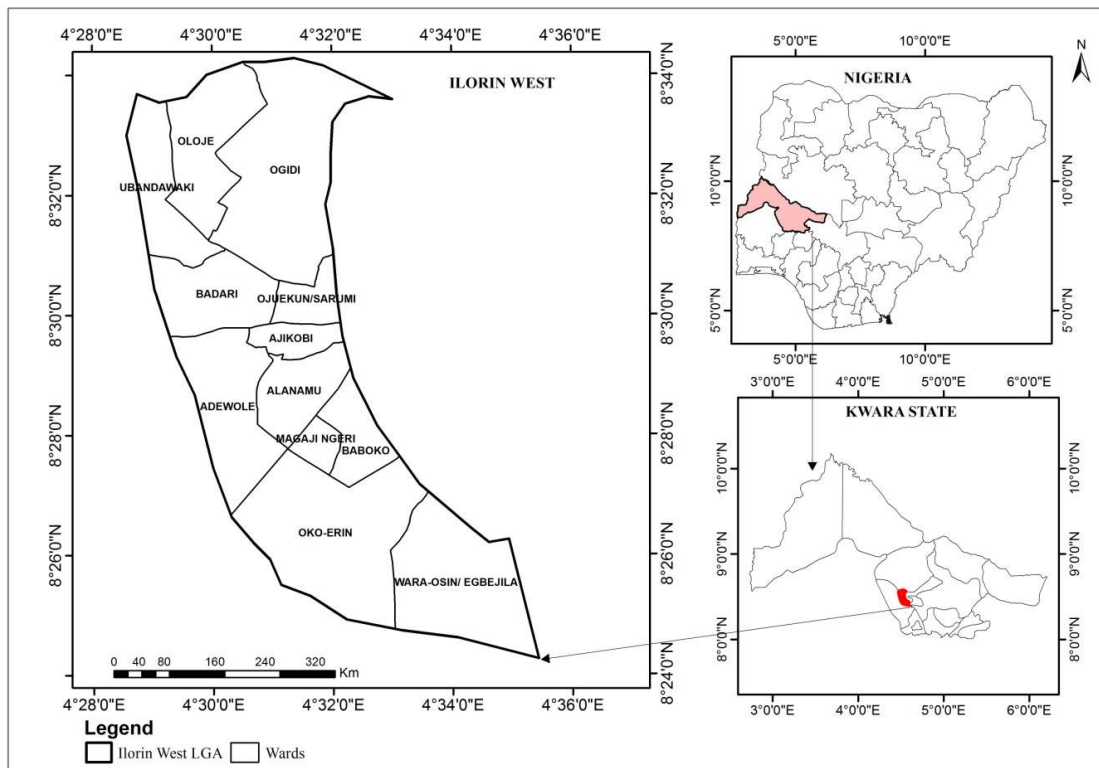

Fig. 1. Ilorin West Local Government area, Kwara state, Nigeria

3. MATERIALS AND METHODS

The data employed for this study were acquired from primary and secondary sources. The primary data was obtained using handheld Germin 60 Global Positioning System (GPS) receiver to capture the coordinates of primary schools. The secondary data used include a high resolution image, administrative map and school data. The administrative map was scanned, geo referenced, and thematic features such as road network, political wards boundary, and other existing infrastructures were extracted using onscreen digitizing. GPS coordinate of schools, schools data (Names and address), were properly geo-coded and integrated into ArcGIS database. All digitized thematic data were updated with google earth image. The data analysis was carried out using nearest neighbor analysis [10]. School location, number of primary schools in each ward and the total area in kilometer were used to determine the pattern of distribution of primary schools in the study area. Analysis was done in the ArcGIS environment (Spatial Statistics) to obtain the result of Nearest Neighborhood analysis. The GPS locations of the schools were coded and integrated in the GIS environment. The total number of schools and the total area in kilometer square were used as the variables to get the result of the pattern that exist in the study area while the school locations, number of schools and the area in kilometer square for the specific ward were used to achieve the pattern of distribution that exist in the individual wards of the local government.

3.1 Spatial Distribution Analysis of Primary School

The Nearest Neighbour Analysis which examine the distance between each point and the closest point to it and measures the extent to which a particular pattern is clustered (nucleated), Random and Regular (uniform) and the Manhattan distance method which measures the distance between two points along axes at right angles were used to determine the spatial pattern of distribution of primary schools in the study area. The Manhattan method was more suitable over the Euclidean method that measure the distance between two points along a straight line.

The Nearest Neighbour formula is given as:

$$R_n = 2đ\sqrt{n/a}$$

Where

- R_n = the nearest neighbour index
- a = the size of the study area (Ilorin West Local Government area)
- $đ$ = the mean distance between the primary schools
- n = the total number of primary schools.

Therefore,

When Rn = 0. The pattern is clustered. This means that all the points are close to the same location.
When Rn = 1. The pattern is random. Meaning the observation does not follow any pattern and
When Rn = 2.15. The pattern is regular. This means that there is an accurate regular pattern where each point is equidistant from its neighbors.

4. RESULTS AND DISCUSSION

4.1 The Spatial Distribution Pattern of Primary Schools

A total of 129 primary schools were identified in the study area across the 10 political wards out of the total 12 political wards of the local government.

The nearest neighbor analysis for the spatial distribution of primary schools in the study areas revealed a clustered pattern (see Fig. 2.) for the overall distribution of primary school in Ilorin West local government, while the spatial distribution pattern in the following specific wards shows Clustered pattern: Baboko ward, Badari ward and Ogidi ward. Alanamu and Magaji-Ngeri wards shows dispersed distribution while Ojuekun/Sarumi, Adewole, Oko-Erin, Ajikobi and Wara-Osin/Egbejila wards exhibit Random spatial distributions respectively. The two wards (Oloje and Ubandawaki) with no primary school at all were left out in the analysis. The Clustered pattern of distribution observed in the study area shows that there is uneven distribution of primary schools in Ilorin west local government as a whole. This indicates that most of the primary schools are located in the urban areas of the local government, which is urban biased as a result of high population density. It can also be said that most primary schools in Ilorin west local government are more profit oriented instead of the public benefit because most of the school are private owned who tend to target the populated (urban) areas for sighting the school for financial benefit.
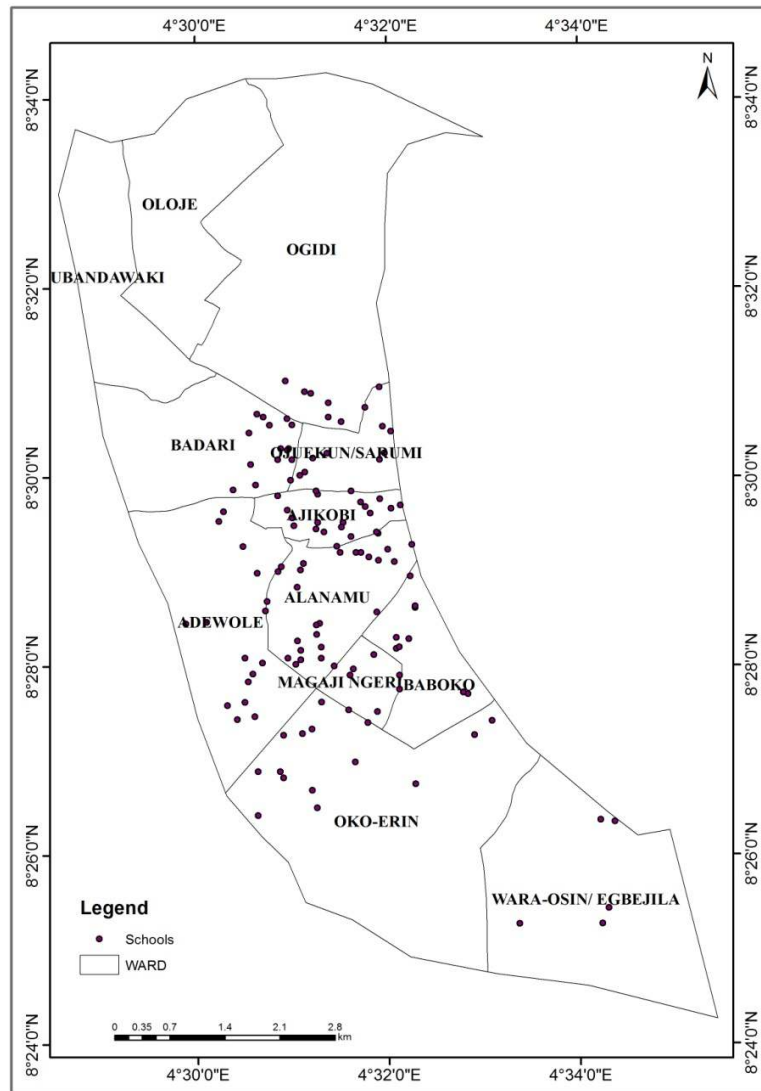
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Fig. 2. Spatial distribution of primary schools

The Nearest Neighbor Ratio NNR in most of the wards is higher than the Z-Score. The implication of the NNR value higher than the Z score is that the pattern is more dispersed than clustered. There is an uneven spatial distribution of primary school in (Ilorin West Local Government) the study area with NNR of 0.77 and Z-Score of -5.14. (See Fig. 2). Similar cases where NNR is higher than the Z-score could also be observed in the following wards. Adewole Ward with NNR of 1.08 and Z-Score of 0.65 (Fig. 2a), Baboko Ward with NNR of 0.70 and z-score is -1.88 (See Fig. 2d), Badari ward with NNR of 0.67 and Z-Score of -2.56 (Fig. 2e), Ogidi Ward with NNR of 0.46 and Z-Score of -2.69 (Fig. 2g), Oko-Ein Ward with NNR of 1.04 and Z-Score of 0.37

(Fig. 2h) and Ojuekun/Sarumi Ward NNR of 1.06 and Z-Score of 0.50 (Fig. 2i) respectively. The highest density of schools per unit area in the local government was found in Badari, Ojuekun/Sarumi, Ajikobi, Alanamu, Adewole, Magaji-Ngeri, Baboko and Oko-Erin wards which are main urban areas in the local government. The least primary school density is found in Wara-Osin /Egbejila and Ogidi wards which have rural status.

Fig. 3 below shows the percentage distribution of schools served across the wards of the local government where some wards were well served, marginally served, under served and not served.
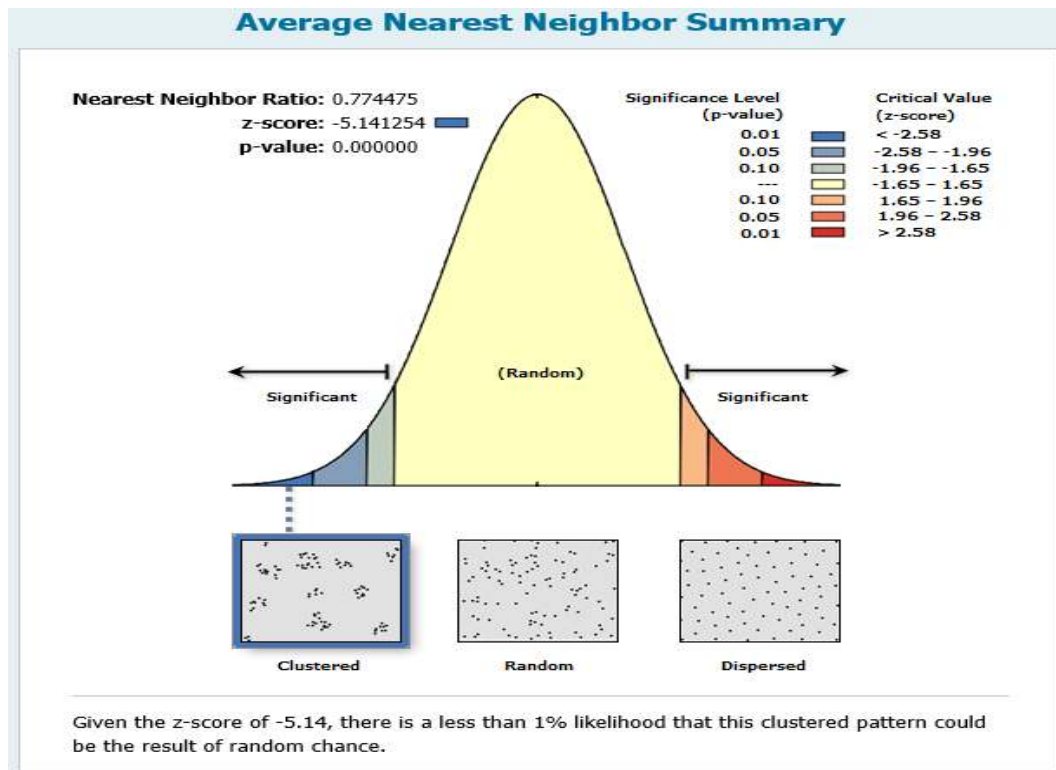
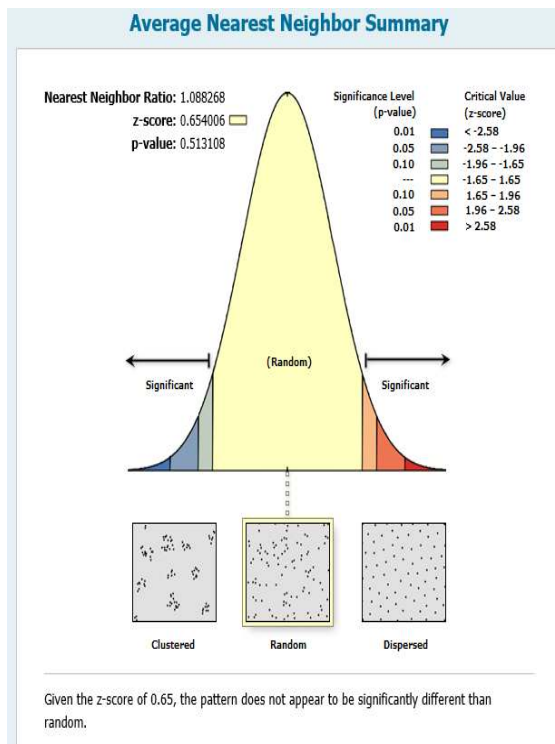**Fig. 3. ANN of primary schools in Ilorin West Local Government**
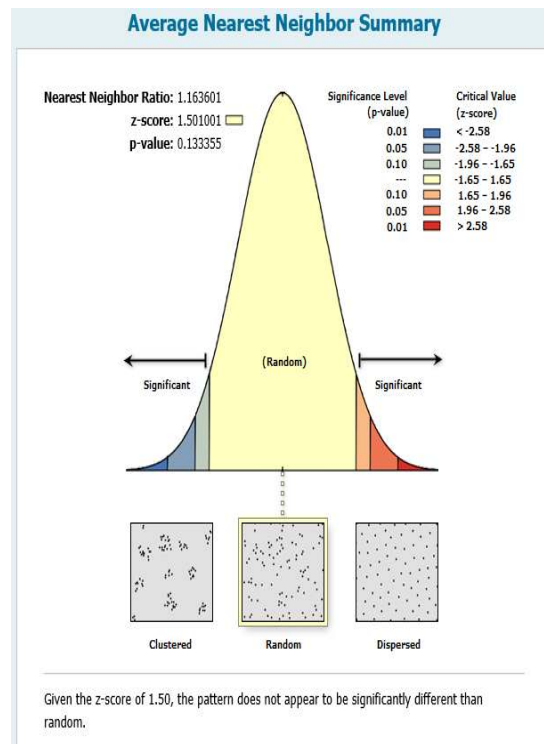

Fig. 3a. ANN of schools in Adewole ward
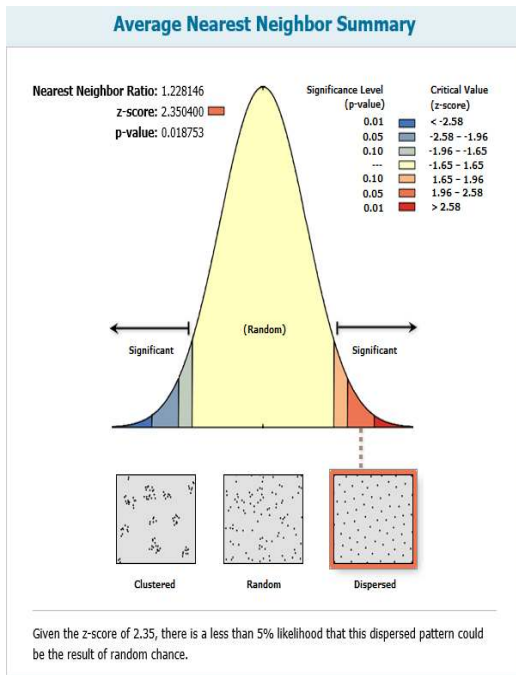

Fig. 3b. ANN of schools in Ajikobi ward

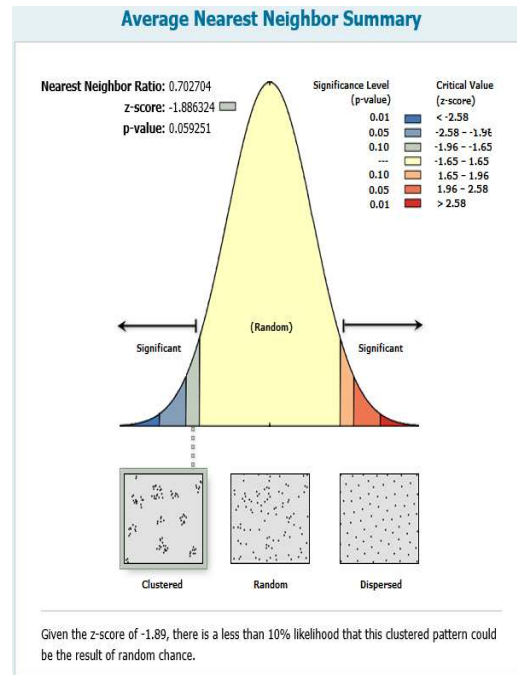**Fig. 3c. ANN of Schools in Alanamu Ward**

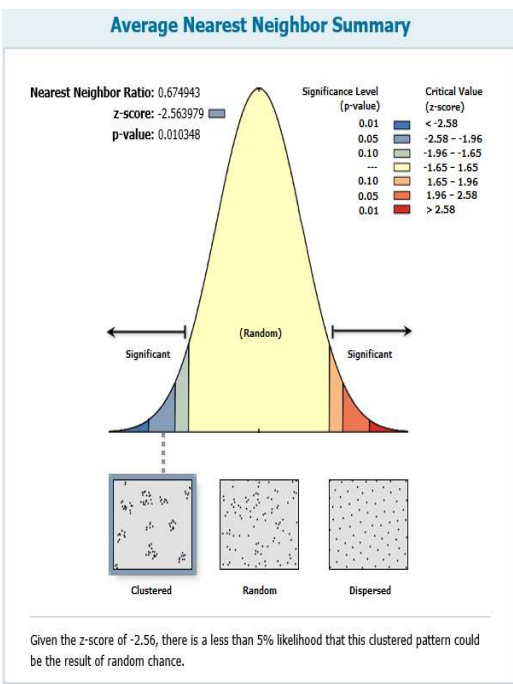**Fig. 3d. ANN of Schools in Baboko Ward**

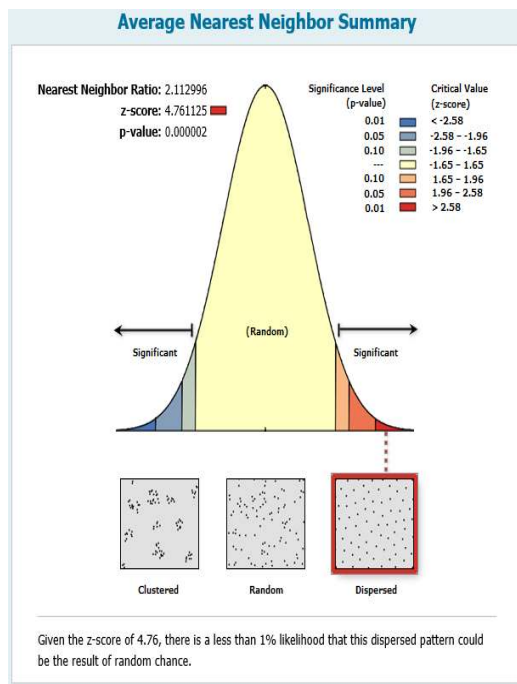**Fig. 3e. ANN of Schools in Badari Ward**
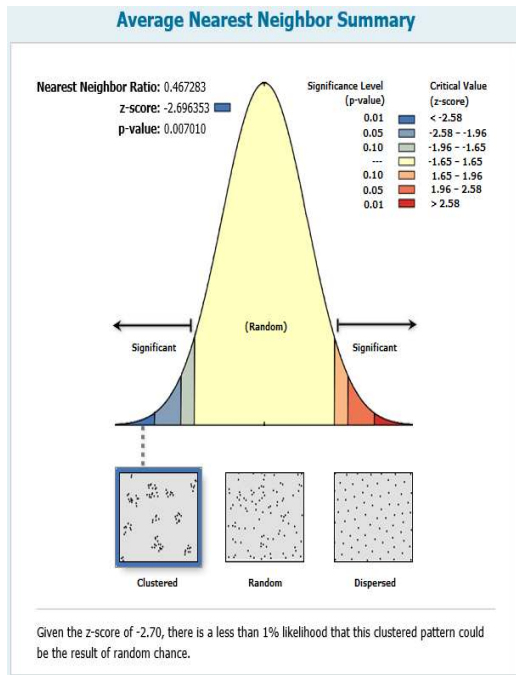

Fig. 3f. ANN of Schools in Magaji-Ngeri Ward

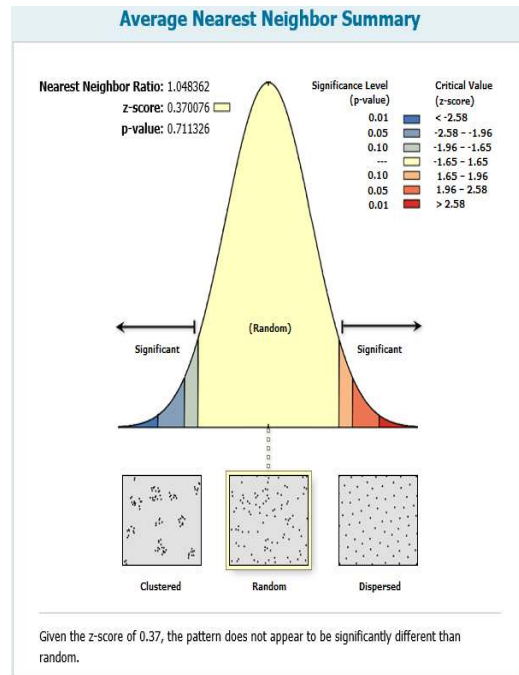**Fig. 3g. ANN of Schools in Ogidi Ward**
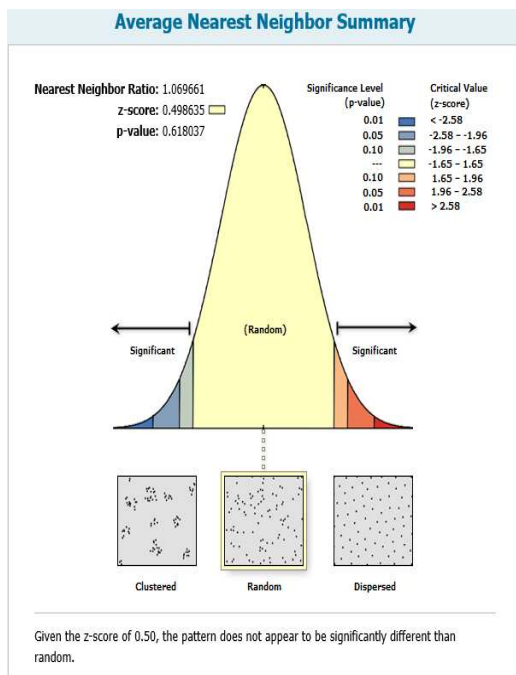
Fig. 3h. ANN of Schools in Oko-Erin Ward
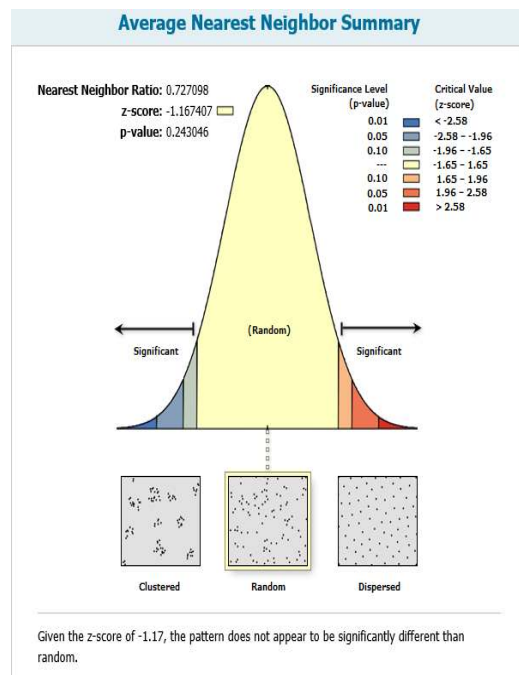
Fig. 3i. ANN of Schools in Ojuekun Ward

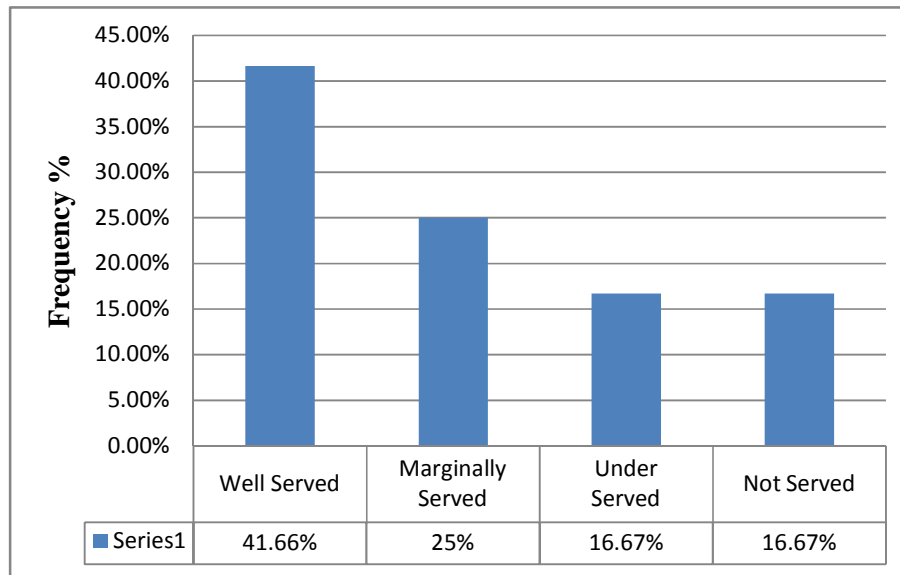**Fig. 3j. ANN of Schools in Wara-Osin Ward**

Fig. 4. Percentage distribution of schools served in different wards

5. CONCLUSION

The study portrays the use of average nearest neighbor analysis in determining the pattern of distribution of primary schools in the study area. The study shows that the distribution of primary schools in the study area is clustered (uneven). The clustering pattern shows urban biasness in the distribution of schools which is a signal of huge differential and paucity in the distribution of primary schools among the various ward. It is therefore, important that government and other stakeholders strive to ensure that distribution of schools is even across the Local Government for easy accessibility. The use of GIS technology as a planning tool can be employed to enhance the location of educational infrastructure for equivalent distribution. The process employed in this study about spatial distribution was limited to the availability of primary schools rather than the rate of usability. Further studies would be needed to determine the rate of accessibility and effective utilisation of those schools.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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