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Assessing the spatial equity and accessibility of public primary schools in Obio/ Akpor local government area, Rivers State, Nigeria

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Abstract

This paper aims to investigate the spatial equity and accessibility of public primary schools in Obio/Akpor Local Government Area of Rivers State, Nigeria. The study analyzed the distribution of public primary schools and identified spatial disparities or inequities in accessibility to these schools. Both primary and secondary data sources were utilized to determine the spatial distribution of public primary schools and population distribution in the area. The results reveal that the distribution of public primary schools was uneven and not based on population distribution in the study area. To address this, the study proposes the establishment of more than 120 primary schools to ensure that each ward has an adequate number of schools to serve its population. The study recommends policy interventions to address these spatial inequities and ensure that all children, regardless of their geographic location, have equal access to education. The study seeks to promote spatial equity and ensure that all children in the study area have equal opportunities to access quality education.

Keywords: Spatial Equity; Accessibility; Public Primary Schools; Distribution; Population

1. Introduction

Investing in community facilities requires a significant amount of capital and may not yield immediate returns in the short term. Therefore, it is often the responsibility of the government to provide such facilities to ensure equal access for all members of society (Riddell & Tait, 2017). Education is fundamental to human development and a key instrument for effecting national development (UNESCO, 2015). In Nigeria, efficient school locations are critical for maximizing the welfare of the population and encouraging children to attend school. Physical planning professionals play a significant role in the provision and distribution of educational facilities (Olujimi & Daramola, 2013). Lack of access to primary education, particularly in rural areas, has contributed to high illiteracy levels in Nigeria (Ahmed, Ibrahim & Ahmed, 2017). Therefore, there is a need to review the existing distribution pattern of public primary schools and develop a reliable database for determining their spatial location and distribution. This will aid in policy formulation for the allocation of resources to public primary schools and physical development in the area.

1.1. Statement of the Problem

Access to quality education is a fundamental right for every child, and it is critical to the development and prosperity of any society. However, many factors affect access to education, including spatial inequity and uneven distribution of educational resources. In Obio/Akpor Local Government Area of Rivers State, Nigeria, there are concerns about the spatial equity and accessibility of public primary schools, and whether the current distribution pattern of schools is based on population distribution.

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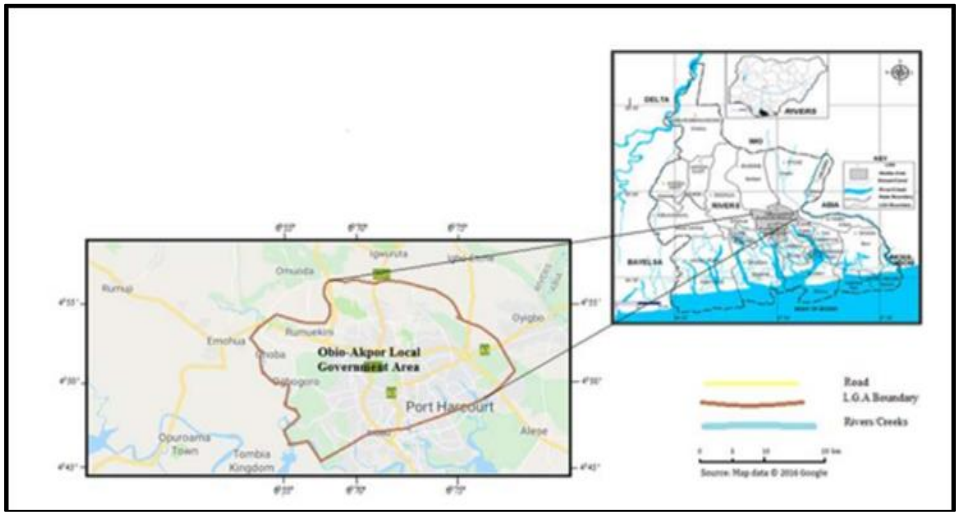
It is crucial to investigate these issues to ensure that every child in the area has equal access to education, regardless of their geographic location. A lack of access to primary education, especially in rural areas, has contributed to high illiteracy levels in Nigeria. Thus, it is essential to review the existing distribution pattern of public primary schools and develop a reliable database for determining their spatial location and distribution.

Aim and Objectives

This study aims to analyze the distribution of public primary schools in Obio/Akpor LGA and identifying spatial disparities or inequities in accessibility to these schools. The study seeks to determine the level of accessibility and spatial equity of public primary schools and investigate the role of population distribution in the provision and distribution of these schools. Additionally, the study will test the hypothesis that there is no statistically significant relationship between population distribution and primary school provision in the study area. The results of this study will provide valuable insights for policy formulation to ensure equal access to education for all children in Obio/Akpor LGA.

1.2. The Study Area

The study area is Obio/Akpor Local Government Area of Rivers State, Nigeria. This area is located in the Niger Delta region of Nigeria and is densely populated. It is likely to have a mix of urban and rural areas, with varying levels of infrastructure and accessibility to public services. The study specifically focuses on the spatial distribution of public primary schools in this area, and aims to identify any spatial inequities or disparities in accessibility to these schools.



Source: Authors, 2023

Figure 1 Location Map of Nigeria, Rivers State showing the Study Area (Obio/ Akpor LGA)

1.3. Literature Review

The literature review for this study include the importance of education for social and economic development in developing countries, the relationship between population distribution and provision of public services, factors affecting spatial equity and accessibility of public primary schools, approaches and methods for assessing spatial equity and accessibility of public services, including GIS and spatial analysis techniques, and examples of studies or policies aimed at improving spatial equity and accessibility of public primary schools in Nigeria or other developing countries.

1.4. The Importance of Education for Social and Economic Development

Education has long been recognized as a crucial tool for social and economic development in both developed and developing countries. Education not only provides individuals with skills and knowledge but also contributes to the development of society as a whole. In developing countries, access to education remains a significant challenge due to factors such as poverty, inadequate infrastructure, and limited resources. This literature review aims to examine the importance of education for social and economic development in developing countries.

1.4.1. Importance of Education for Social Development

Education is critical for social development as it provides individuals with the skills and knowledge necessary to participate in society effectively. According to Halsey and Young (2013), education can enhance social mobility, reduce

inequality, and contribute to social integration. Educated individuals are more likely to engage in civic activities and contribute to the development of their communities. Furthermore, education promotes the development of critical thinking and problem-solving skills, which are essential for addressing societal challenges.

In addition, education has been linked to improved health outcomes and increased life expectancy. According to a study by Cutler and Lleras-Muney (2006), education is associated with lower mortality rates and reduced prevalence of chronic diseases. Education can also contribute to improved maternal and child health by increasing knowledge of health-related behaviors.

1.4.2. Importance of Education for Economic Development

Education is also critical for economic development as it contributes to the development of human capital. Human capital refers to the knowledge, skills, and abilities of individuals that contribute to economic productivity. According to Hanushek and Woessmann (2012), education is positively correlated with economic growth and development. Educated individuals are more productive and innovative, which contributes to economic development.

Education can also contribute to poverty reduction by increasing income-earning opportunities. According to a study by Psacharopoulos and Patrinos (2018), education is associated with higher wages and reduced poverty rates. Education can also promote entrepreneurship and economic self-sufficiency by providing individuals with the skills and knowledge necessary to start and run successful businesses.

1.5. Approaches to Promoting Education in Developing Countries

Several approaches have been proposed to promote education in developing countries. One approach is to increase public investment in education, particularly in areas with high levels of poverty and low access to education. According to a study by Patrinos, Psacharopoulos and Tansel (2011), increasing public investment in education is associated with improved access to education and increased enrollment rates.

Another approach is to address the root causes of poverty, such as by providing social safety nets or promoting economic development. According to a study by Glewwe and Muralidharan (2016), poverty reduction programs can improve access to education by reducing the financial burden on families and promoting economic self-sufficiency.

Finally, the use of technology and innovative approaches, such as distance learning or mobile learning, can also increase access to education in remote or underserved areas. According to a study by Wainaina and Juma (2014), mobile learning has the potential to increase access to education, particularly in rural areas.

1.6. The Relationship between Population Distribution and Provision of Public Services

There is a body of literature that suggests a relationship between population density and access to public services. According to Nana et al. (2018), access to public services such as health care, education, and water supply is often linked to population density, with services being more readily available in areas with higher population densities. Similarly, Ahmed et al. (2015) argue that population density plays a crucial role in the provision of public services in rural areas, where the distribution of services is often constrained by limited resources and infrastructure. This was still supported by Wang and Li (2020) who declared that population distribution is a significant factor in determining the provision of public services, particularly in rural areas. Low population density according to Wang et al., (2020) makes it more expensive to provide public services due to the high cost of infrastructure and service delivery. As a result, rural areas often have limited access to public services, including education, healthcare, and sanitation.

High population density increases demand for public services, which may lead to congestion, longer waiting times, and inadequate service delivery (Li and Zhang, 2019). On the other hand, low population density may result in underutilization of public services, leading to wastage of resources. Agyemang-Duah (2018) observes that policymakers often allocate resources based on population density, with higher population densities receiving more resources and attention than sparsely populated areas. Similarly, Kizito et al. (2019) note that population density is an important factor in the allocation of resources for the provision of public services, with densely populated areas receiving more resources and attention than sparsely populated areas.

1.7. Factors Affecting the Provision of Public Services

Several factors affect the provision of public services especially in rural areas. According to Wang and Li (2020), the level of economic development, geography, and distance are critical factors in the provision of public services. Economic

development influences the availability of resources for public service provision, while geography affects access to service delivery. Distance also affects the cost of service delivery and access to public services.

Moreover, studies have shown that social and cultural factors also influence the provision of public services in rural areas. For example, traditional beliefs and practices may affect the use of modern healthcare services, leading to underutilization of healthcare services (Murray and Lopez, 1996). Cultural beliefs may also affect education outcomes, such as the enrolment and retention of girls in schools (UNESCO, 2015).

In the context of primary education, higher population densities are often associated with a higher number of schools, as resources are allocated based on population density. According to Antwi et al. (2018), the distribution of primary schools in Ghana is influenced by population density, with schools being more prevalent in areas with higher population densities. Similarly, Mohammed (2015) notes that population density plays a significant role in the distribution of primary schools in Nigeria, with schools being more prevalent in areas with higher population densities.

1.8. Factors Affecting Spatial Equity and Accessibility of Public Primary Schools

Several factors affect spatial equity and accessibility of public primary schools.

- Distance: The distance between schools and students' homes has been identified as a significant factor affecting the spatial equity and accessibility of public primary schools. In rural areas, where schools are often far from residential areas, students may have to travel long distances to attend school, resulting in high transportation costs and limited access to education. (Baker & Lynch, 2017)
- Transportation: The availability and quality of transportation infrastructure also play a significant role in the spatial equity and accessibility of public primary schools. Poor road networks and lack of public transportation in rural areas can make it difficult for students to access schools, particularly during the rainy season when roads may be impassable. (Gupta & Roy, 2017)
- Socio-economic status: Students from lower socio-economic backgrounds often face greater barriers to accessing public primary schools, as they may not have the financial resources to pay for transportation, uniforms, or school supplies. This can lead to a lack of spatial equity in access to education, with disadvantaged students being less likely to attend school than their more affluent counterparts. (Omona, 2016)
- Quality of education: The quality of education provided by public primary schools can also affect spatial equity and accessibility. Schools that provide higher-quality education may attract students from a wider catchment area, leading to greater spatial equity in access to education. Conversely, schools that provide poor-quality education may discourage students from attending, resulting in spatial inequities in access to education. (Baker & Lynch, 2017)
- Gender: Gender is also an important factor affecting spatial equity and accessibility of public primary schools, particularly in developing countries where cultural norms may restrict girls' access to education. In such settings, girls may face greater barriers to accessing schools than boys, resulting in spatial inequities in access to education. (Ertürk & Karaköse, 2020)

1.9. Approaches and Methods for Assessing Spatial Equity and Accessibility of Public Services

Assessing spatial equity and accessibility of public services, including public primary schools, can be achieved through various approaches and methods. In recent years, geographic information systems (GIS) have been widely used for this purpose, alongside other spatial analysis techniques.

GIS is a computer-based tool for managing and analyzing spatial data, which can be used to identify areas of need and guide decision-making. For instance, a study by Adelekan and Abiodun (2017) used GIS to assess the accessibility of public primary schools in Lagos State, Nigeria, and found that schools were not equitably distributed across the state, with some areas having a higher concentration of schools than others.

Another commonly used approach is the Average Nearest Neighbour Analysis (ANNA), which assesses the spatial pattern of point data (such as the location of schools) relative to the distribution of the population. ANNA can provide insights into the clustering or dispersion of public primary schools within a given area, and help identify areas of need or areas where schools may be oversupplied. For example, a study by Hagan and Wallace (2019) used ANNA to analyze the spatial equity of primary schools in Ghana and found that schools were clustered in urban areas, leading to unequal access to education for children in rural areas.

Moran's I is another spatial analysis technique commonly used to assess spatial patterns of data. Moran's I calculates the spatial autocorrelation of a variable, which is a measure of how similar the values of the variable are at nearby

locations. Moran's I has been used to assess the spatial equity of public services, including schools, in various contexts. For example, a study by Atubi and Eze (2017) used Moran's I to assess the spatial equity of primary schools in Delta State, Nigeria, and found that there were significant disparities in school distribution across the state.

Other spatial analysis techniques such as spatial regression analysis, kernel density estimation, and network analysis can also be used to assess the spatial equity and accessibility of public services, including public primary schools.

1.10. Examples of studies or policies aimed at improving spatial equity and accessibility of public primary schools in Nigeria or other developing countries

There have been several studies and policies aimed at improving spatial equity and accessibility of public primary schools in Nigeria and other developing countries.

One example is the "Universal Basic Education" (UBE) policy in Nigeria, which was established in 1999 to provide free and compulsory education to all children at the primary and junior secondary school levels (between the ages of 6 and 15). The policy also aimed to reduce regional and gender disparities in access to education.

Another example is a study conducted in rural Malawi by Jacoby and Skoufias (1997), which examined the impact of school proximity on primary school enrollment. The study found that the probability of enrollment was higher for children living closer to schools, indicating the importance of improving spatial equity and accessibility of schools.

A third example is a study conducted in rural Ethiopia by Alemu and Lindstrom (2013), which used GIS to measure the distance between households and schools and assess the spatial equity of primary education. The study found that there were significant spatial inequalities in access to primary education, with children in remote areas having limited access to schools.

In another study, Mberu and Penuel (2011) analyzed the spatial distribution of schools in Kenya using Average Nearest Neighbour Analysis and found that there were significant disparities in the distribution of schools. They recommended that policies aimed at improving spatial equity should focus on building schools in areas with the highest need and prioritizing the most disadvantaged populations.

2. Methodology

This study employed both primary and secondary data sources. The primary data collection involved field surveying and collection of survey coordinates of the public primary schools in the study area. The secondary data sources included literature review, reports from the Rivers State Ministry of Education (Open Education Data, 2022), the Rivers State Universal Basic Education Board and population data from the National Population Commission (NPC,1991; Vanguard, 2018). The data collected were analyzed using descriptive statistics, such as mean, standard deviation, and frequency distribution and percentages, to determine the spatial equity and accessibility of public primary schools.

3. Results and Discussions

3.1. Establishment of Public Primary Schools and their Coordinates in Obio/Akpor LGA

Table 1 provides information on existing public primary schools and their spatial locations in Obio/Akpor Local Government Area. The table is composed of six columns which are wards, serial code, name of school, community; coordinate (eastings) and coordinates (northings).

The schools are grouped into wards, with each ward having several schools. The table shows the serial code (OB1, OB2, to OB55) which are assigned to each school for identification purposes, name of the school, community where the school is located, and the coordinates (eastings and northings) of each school. The coordinates given are in the format of Universal Transverse Mercator (UTM), which is a standard system used to specify locations on the earth's surface. These coordinates can be used to locate each school on a map or to calculate the distance between two schools.

The community column provides the name of the community where the school is located, such as Rumuewhara, Rumunduru, Eliozu, etc. The wards column groups the schools based on their location in the local government area. For example, Ward 1 has four schools, while Ward 14 has five schools. In terms of names of school for example, Ward 1 has four schools listed, namely Community Primary School II, Oro-Igwe; State Primary School, Oro-Igwe; Community Primary School, Eliozu; and Community Primary School, Elimgbu. The coordinates for Community Primary School II,

Oro-Igwe, are 282937.8 (eastings) and 539043.35 (northings). Similarly, the table provides information for other schools in different wards of the Obio/Akpor LGA.

Generally, Table 1 is divided into 17 wards, and each ward has several schools listed with their serial code, name, community, coordinate (eastings), and coordinate (northings) totaling 55 public primary schools.

Table 1 List of Public Primary Schools and their Coordinates in Obio/Akpor LGA

Wards	Serial Code	Name of School	Community	Coordinate (Eastings)	Coordinate (Northings)
Ward 1	OB1	Community Primary School II, Oro-Igwe	Rumuewhara	282937.8	539043.35
	OB2	State Primary School, Oro-Igwe	Rumunduru	282473.67	541662.56
	OB3	Community Primary School, Eliozu	Eliozu	280417.68	538102.05
	OB4	Community Primary School, Elimgbu	Elimgbu	284190.55	539046.38
Ward 2	OB5	Community Primary School, Okporo	Rumuodara	282137.81	536398.56
	OB6	Community Primary School, Iriebe	Iriebe	291288.2	538657.77
Ward 3	OB7	Universal Primary Education, Rumuokrushi	Rumuokwurushi	284476.45	537414.38
	OB8	All Saints Primary School, Rumuokrushi	Rumuokwurushi	284476.45	537414.38
	OB9	State Primary School , Rumuokrushi	Rumuokrushi	284582.16	536605.23
	OB10	State Primary School , Atali	Atali	284168.32	539273.53
Ward 4	OB11	Community Primary School, Rumuobiakani	Rumuobiokani	281626.21	5348403
Ward 5	OB12	Community Primary School, Elelenwo	Elelenwo	286060.91	534862.93
	OB13	State Primary School,Elelenwo	Elelenwo	286089.91	534946.71
Ward 6	OB14	Community Primary School, Oro-Evo	Rumurolu	283344	534998.56
	OB15	State Primary School , Oro-Evo	Rumurolu	283344	534998.56
	OB16	State Primary School , Oginigba	Oginigba	282402.37	534056.1
Ward 7	OB17	Acs Bori-Camp	Rumuokoro	278906.84	536148.19
	OB18	State Primary School , Okoro-Nu-Odo	Rumuokoro	277815.14	538198.43
	OB19	State Primary School, Eligbolo	Eliogbolo	279752.98	538112.06

Ward 8	OB20	Community Primary School II, Rumuomasi	Rumuomasi	280474.77	534646.85
	OB21	State Primary School , Rumuomasi	Rumuomasi	280830.98	534753.72
	OB22	State Primary School , Airforce Base, Rumuomasi	Rumuomasi	280713.55	535080.83
Ward 9	OB23	State Primary School , Eliparanwo	Elioparanwo	273670.81	534520.69
	OB24	Community Primary School, Eliparanwo	Elioparanwo	273670.81	534520.69
Ward 10	OB25	Community Primary School, Rumueme	Rumueme	276179.89	533817.07
Ward 11	OB26	State Primary School , Rumueme	Rumueme	276164.09	533787.1
Ward 12	OB27	State Primary SchoolI, Rumuopara	Rumuigbo	274504.73	538665.14
	OB28	State Primary SchoolI, Rumuapara	Rumuapara	276813.75	535764.9
	OB29	State Primary SchoolII, Rumuapara	Rumuapara	276761.88	535671.85
	OB30	Community Primary School, Rumorosi	Rumuorosi	2781002	535413.12
	OB31	State Primary School , Nkpolu-Rumuigbo	Rumuigbo	275997.44	539374.81
Ward 13	OB32	State Primary SchoolI, Olanada	Rumuola	277578.96	534584.14
	OB33	State Primary SchoolII, Olanada	Rumuola	277557.71	534544.28
	OB34	Community Primary School, Rumuokwuta	Rumuokwuta	276548.41	535275.34
Ward 14	OB35	State Primary School , Eneka	Eneka	282326.14	541688.41
	OB36	State Primary School III, Eneka	Eneka	282326.1	541688.33
	OB37	Community Primary School II, Eneka	Eneka	282473.67	541662.56
	OB38	Community Primary School, Rukpokwu	Rukpokwu	277851.36	542403.37
	OB39	State Primary School , Rukpoku	Rukpokwu	278326.98	542529.25
Ward 15	OB40	Community Primary School, Rumuoekini	Rumumuekini	271993.12	540879.02
	OB41	State Primary School/Rumuosi	Rumuosi	271742.42	540107.89
	OB42	Universal Primary Education, Choba	Choba	267820.92	541408.88
	OB43	State Primary School , Choba	Choba	267613.65	540286.81

	OB44	State Primary School , Alakahia	Alakahia	270016.00	540566.00
Ward 16	OB45	State Primary School , Ozuoba	Ozuoba	270392.56	538847.46
	OB46	State Primary School, Rumuokparali	Rumuokparali	268413.14	538360.52
	OB47	Community Primary School, Ogbogoro	Ogbogoro	270308.29	536765.86
	OB48	Community Primary School, Egbelu-Ogbogoro	Ogbogoro	273330.87	534060.81
	OB49	Camps, Rumuokwachi	Rumuokwachi	270281.29	537769.35
Ward 17	OB50	Model Primary School Mgbuoshimini	Mgbuoshimini	275493.00 ,	531591.18
	OB51	Community Primary School, Rumuolumeni	Mgbuoshimini	273237.55	532179.66
	OB52	State Primary School , Rumuolumeni	Rumuolumeni	273116.23	532148.22
	OB53	Community Primary School,Rumuolumeni	Rumuolumeni	273233.15	532182.39
	OB54	Community Primary School, Nkpor-Rumuolumeni	Nkpor-Rumuolumeni	273356.7	5305601.00
	OB55	Community Primary School, Nkpor-Mgbuodohia	Mgbuodohia Rumuolumeni	275005.36	529769.88

Source: Authors' Field Survey, 2022

3.2. Analysis of Existing PPS Distribution Pattern Based on Mean Deviation

Table 2 presents the distribution of PPS (public primary schools) in Obio/Akpor LGA by wards based on mean and mean deviation. The last two columns of the table show the mean of X1 (number of schools per ward) and the mean deviation from this mean.

Mean deviation is a statistical measure of dispersion that indicates how much, on average, each observation deviates from the mean. From the table, we can see that the total number of public primary schools in Obio/Akpor LGA is 55, and the average number of schools per community (X1) is 3.2. This shows that there is a significant variation in the number of schools across communities and wards, as evidenced by the mean deviation of 1.3. The mean deviation of 1.3 therefore indicates that the average distance of each ward's number of schools from the mean number of schools per community (3.2) is 1.3.

The mean deviation of 1.3 affirms that there is an unequal distribution of schools in Obio/Akpor LGA, which could have implications for education access and outcomes for children living in different communities and wards.

Table 2 Distribution of PPS in Obio/ Akpor LGA by Wards

Wards in Obio/Akpor LGA	**Communities**	**Number of Schools(X)**	**(X-X1)**
WARD 1	Rumuewhara, Eliozu, Rumunduru and Elimgbu	4	0.8
WARD 2	Eliowhani, Rumuodara and Iriebe	2	1.2
WARD 3	Rumuokwurusi and Atali	4	0.8
WARD 4	Rumuodomaya and Rumuobiakani	1	2.2
WARD 5	Elelenwo	2	1.2

WARD 6	Woji, Rumurolu, Rumuibekwe, Rumuogba and Oginigba	3	0.2
WARD7	Rumuokoro, Rumuagholu. Elieke, Awalama, Eligbolo, Rukpakwusi, Bori-camp	3	0.2
WARD 8	Rumuomasi	3	0.2
WARD 9	Rumuepirikom and Elioparanwo	2	1.2
WARD 10	Rumueme – Oro-owo, Oro Agbolu, Eligbam, Oroazi, Rumuchida, Ngbu-osimini	1	2.2
WARD 11	Rumueme-Rukpakani, Federal Housing Estate, Oro-ogologo	1	2.1
WARD 12	Rumuigbo (Rumuomoi, Nkpolu, Mgbuadu, Mgbesilaru and Rumuorosi)	5	1.8
WARD 13	Rumuadaolu, Rumuola and Rumuokwuta (Mgbuoba)	3	0.2
WARD 14	Rukpokwu and Eneka	5	1.8
WARD 15	Choba, Rumuosi, Rumuekini, Alakahia and Rumuolaogu	5	1.8
WARD 16	Ozuoba, Ogbogoro, Rumuokwachi, Rumuokparali and Rumualogu	5	1.8
WARD 17	Rumuolumeni (Mgbuakara, Minikpiti, Azumini, Okemini Mgbuosimini, Naval Base Okemini, Iwofe, Mgbu-Odihia, Nkpor-Rumuolumini, Mgbuoshimini Rumuolumini).	6	2.8
	Total	55	22.5
	Mean of X1	3.2	-
	Mean Deviation	-	1.3

Source: Authors' Field Survey, 2022

3.3. Existing Distribution Pattern of PPS by Wards' Population in Obio/Akpor LGA

To analyze the existing distribution pattern of public primary schools in Obio/Akpor local government area, we can start by examining Table 3, which provides information on the wards, communities, population, and number of public primary schools (PPS) in each ward. The table indicates that the existing 55 public primary schools in the 17 wards of Obio/Akpor LGA are serving a total number of 1,776,147 people.

Table 3 Wards, Coverage, Population and Number of PPS in Obio/Akpor LGA

Wards	**Communities**	**Population**	**Number of Schools**
WARD 1	Rumuewhara, Eliozu, Rumunduru and Elimgbu	61096	4
WARD 2	Eliowhani, Rumuodara, Nmgbuesilari and Iriebe	58670	2
WARD 3	Rumuokwurusi and Atali	133982	4
WARD 4	Rumuodomaya and Rumuobiakani	85980	1
WARD 5	Elelenwo	57181	2
WARD 6	Woji, Rumurolu, Rumuibekwe, Rumuogba and Oginigba	168388	3
WARD 7	Rumuokoro, Rumuagholu. Elieke, Awalama, Eligbolo, Rukpakwusi, Bori-camp	114593	3
WARD 8	Rumuomasi	126950	3
WARD 9	Rumuepirikom and Elioparanwo	58313	2

WARD 10	Rumueme – Oro-owo, Oro Agbolu, Eligbam, Oroazi, Rumuchida, Ngbu-osimini	146191	1
WARD 11	Rumueme-Rukpakani, Federal Housing Estate, Oro-ogologo	75655	1
WARD 12	Rumuigbo (Rumuomoi, Nkpolu, Mgbuadu, Mgbesilaru and Rumuorosi)	90968	5
WARD 13	Rumuadaolu, Rumuola and Rumuokwuta (Mgbuoba)	161597	3
WARD 14	Rukpokwu and Eneka	72083	5
WARD 15	Choba, Rumuosi, Rumuekini, Alakahia and Rumuolaogu	142534	5
WARD 16	Ozuoba, Ogbogoro, Rumuokwachi, Rumuokparali and Rumualogu	150226	5
WARD 17	Rumuolumeni (Mgbuakara, Minikpiti, Azumini, Okemini Mgbuosimini, Naval Base Okemini, Iwofe, Mgbu-Odihia, Nkpor-Rumuolumini, Mgbuoshimini Rumuolumini).	71740	6
	Total	1776147	55

Source: NPC, 1991; Authors' Field Survey, 2022

Table 3 provides the distribution of the 55 number of public primary schools in the 17 wards population (1776147) of Obio/Akpor Local Government Area (LGA). The distribution of schools in the wards is as follows:

WARD 1 has 4 schools, serving a population of 61,096 people. WARD 2 has 2 schools, serving a population of 58,670 people. WARD 3 has 4 schools, serving a population of 133,982 people. WARD 4 has only 1 school, serving a population of 85,980 people. WARD 5 has 2 schools, serving a population of 57,181 people. WARD 6 has 3 schools, serving a population of 168,388 people. WARD 7 has 3 schools, serving a population of 114,593 people. WARD 8 has 3 schools, serving a population of 126,950 people. WARD 9 has 2 schools, serving a population of 58,313 people. WARD 10 has only 1 school, serving a population of 146,191 people. WARD 11 has only 1 school, serving a population of 75,655 people. WARD 12 has 5 schools, serving a population of 90,968 people. WARD 13 has 3 schools, serving a population of 161,597 people. WARD 14 has 5 schools, serving a population of 72,083 people. WARD 15 has 5 schools, serving a population of 142,534 people. WARD 16 has 5 schools, serving a population of 150,226 people. WARD 17 has 6 schools, serving a population of 71,740 people.

While some wards have as many as five or six schools, others have only one or two. The highest number (6) of PPS is located in Ward 17, which has a population of 71,740. The least number (1) of PPS is located in Wards 4, 10, and 11, which have populations of 85,980, 146,191, and 75,655, respectively. Wards 1, 2, 3, 5, 6,7, 8, 9, 13, 14, 15, and 16 have two to five PPS each, with populations ranging from 58,670 to 168,388. On the other hand, WARD 12 and WARD 17 have more schools compared to their population.

The distribution of public primary schools against the wards population in the Obio/Akpor local government area appears to be uneven. This uneven distribution of schools may result in some areas having more schools for pupils/students than other wards. Furthermore, there seems to be no clear pattern in terms of the relationship between the population size and the number of schools in each ward. This is not different from the uneven distribution shown by the mean deviation.

To address this imbalance, it may be necessary to redistribute schools across wards to ensure that each ward has access to adequate public primary school based on population. The mean deviation and population standard could be used to guide this redistribution, with wards with fewer schools receiving more schools and those with more schools receiving fewer. This would help to ensure that all children in Obio/Akpor LGA have access to quality education.

3.4. Hypothesis Result

Spearman's rank correlation coefficient was used to determine the strength and direction of the relationship between population size and the number of public primary schools in Obio/Akpor LGA.

Table 4 Relationship between Population and Number of PPS in Obio/ Akpor LGA

Wards in Obio/Akpor LGA	Projected Population 2021	No. of Schools(X)
WARD 1	61096	4
WARD 2	58670	2
WARD 3	133982	4
WARD 4	85980	1
WARD 5	57181	2
WARD 6	168388	3
WARD 7	114593	3
WARD 8	126950	3
WARD 9	58313	2
WARD 10	146191	1
WARD 11	75655	1
WARD 12	90968	5
WARD 13	161597	3
WARD 14	72083	5
WARD 15	142534	5
WARD 16	150226	5
WARD 17	71740	6
Total	1776147	55

Source: Authors' Field Survey, 2022

The formula for Spearman's rank correlation coefficient is:

$$\rho = 1 - (6\sum d^2 / n(n^2 - 1))$$

Where:
ρ is the rank correlation coefficient
d is the difference between the ranks of corresponding values of the two variables
n is the sample size

Using the data provided in Table 4, we can calculate the rank correlation coefficient as follows in Table 5:

Table 5 Spearman's Rank Correlation Coefficient Computation

Population Rank	School Rank	d	d^2
4	12	-8	64
3	16	-13	169
8	12	-4	16
6	17	-11	121
2	16	-14	196
13	14	-1	1
10	14	-4	16

9	14	-5	25
5	16	-11	121
16	9	7	49
14	9	5	25
7	7	0	0
1	5	-4	16
12	5	7	49
11	5	6	36
15	5	10	100
17	1	16	256

Source: Authors' Field Survey, 2022

$$n = 17$$

$$\sum d^2 = 1193$$

Using the formula for Spearman's rank correlation coefficient, we get:

$$\rho = 1 - (6\sum d^2 / n(n^2 - 1)) \; \rho = 1 - (6 * 1193 / 17(17^2 - 1)) \; \rho = 1 - (6 * 1193 / 17(288)) \; \rho = 1 - (7146 / 139392) \; \rho = 1 - 0.0512 \; \rho = 0.9488$$

The rank correlation coefficient (ρ) is 0.9488.

The Spearman's rank correlation coefficient (ρ) of 0.9488 indicates a very strong positive relationship between population size and the number of public primary schools in Obio/Akpor LGA. This means that as the population size increases, the number of public primary schools also tends to increase. The p-value of less than 0.05 suggests that the relationship is statistically significant, indicating that the results are unlikely to have occurred by chance. Therefore, we can reject the null hypothesis and conclude that there is a significant relationship between population size and the number of public primary schools in Obio/Akpor LGA.

Subjecting same (Table 4) to regression analysis, the regression equation is Y = -1.05249 + 0.00011X.

The coefficient of determination (R-squared) is 0.9247, which indicates that approximately 92.47% of the variation in the number of schools can be explained by the population size. The p-value for the slope coefficient is 2.27e-13, which is less than 0.05. This indicates that there is a statistically significant relationship between population size and the number of schools. The slope coefficient (0.00011) is positive; indicating that as the population size increases, the number of schools also tends to increase.

Therefore, we can conclude that there is a significant positive relationship between population size and the number of public primary schools in Obio/Akpor LGA, based on both the correlation and regression analyses. This means that the redistribution of schools across wards should be based on the wards' population.

3.5. Proposal for Spatial Equity and Accessibility of PPS Based On Wards' Population

Obateru (2014) and Basorun (2017) stated that a community neighbourhood of 5,000 populations is the standard for the allocation of a primary school. Wazzan (2017) stated that the distribution of primary schools should be based on 10,000 populations for a ward. Based therefore on the planning standard of 1:10,000; the estimated demand in number of public primary schools for Obio/Akpor LGA could be calculated.

Using this standard of 1 school per 10,000 populations for each ward, the number of schools required per ward is shown on Table 6.

Table 6 shows the following:

WARD 1: 6 schools (population of 61,096), WARD 2: 6 schools (population of 58,670), WARD 3: 13 schools (population of 133,982), WARD 4: 9 schools (population of 85,980), WARD 5: 6 schools (population of 57,181), WARD 6: 17 schools (population of 168,388), WARD 7: 11 schools (population of 114,593), WARD 8: 12 schools (population of 126,950), WARD 9: 6 schools (population of 58,313), WARD 10: 14 schools (population of 146,191), WARD 11: 7 schools (population of 75,655), WARD 12: 9 schools (population of 90,968) ,WARD 13: 16 schools (population of 161,597), WARD 14: 7 schools (population of 72,083), WARD 15: 14 schools (population of 142,534), WARD 16: 15 schools (population of 150,226), and WARD 17: 7 schools (population of 71,740),

From the table, we can see that the number of PPS per 10,000 populations varies by ward, ranging from one to six. The total expected number of PPS for the LGA is 175; the existing number of PPS in the LGA is 55, which is 120 less than the expected number. This means that the difference between the expected and existing PPS per ward ranges from 1 to 14, with a total difference of 120. This indicates a significant shortage of PPS in the LGA.

This standard would ensure that each ward has an adequate number of schools to serve its population. However, other factors, such as the availability of resources, the condition of existing schools, and the quality of education provided, should also be taken into consideration when determining the distribution of schools.

Table 6 Expected Number of PPS Per Wards in Obio/Akpor LGA

Wards	**Communities/ Neighbourhoods in Obio /Akpor LGA**	**Projected Population 2021**	**Number of Schools (X1)**	**Expected No. Of PPS per 10,000**	**Difference b/w Expected and Existing PPS**
WARD 1	Rumuewhara, Eliozu, Rumunduru and Elimgbu	61096	4	6	2
WARD 2	Eliowhani, Rumuodara, Nmgbuesilari and Iriebe	58670	2	6	4
WARD 3	Rumuokwurusi and Atali	133982	4	13	9
WARD 4	Rumuodomaya and Rumuobiakani	85980	1	9	8
WARD 5	Elelenwo	57181	2	6	4
WARD 6	Woji, Rumurolu, Rumuibekwe, Rumuogba and Oginigba	168388	3	17	14
WARD 7	Rumuokoro, Rumuagholu. Elieke, Awalama, Eligbolo, Rukpakwusi, Bori-camp	114593	3	11	8
WARD 8	Rumuomasi	126950	3	12	9
WARD 9	Rumuepirikom and Elioparanwo	58313	2	6	4
WARD 10	Rumueme – Oro-owo, Oro Agbolu, Eligbam, Oroazi, Rumuchida, Ngbu-osimini	146191	1	14	13
WARD 11	Rumueme-Rukpakani, Federal Housing Estate, Oro-ogologo	75655	1	7	6
WARD 12	Rumuigbo (Rumuomoi, Nkpolu, and Rumuorosi)	90968	5	9	4
WARD 13	Rumuadaolu, Rumuola and Rumuokwuta (Mgbuoba)	161597	3	16	13
WARD 14	Rukpokwu and Eneka	72083	5	7	2
WARD 15	Choba, Rumuosi, Rumuekini, Alakahia and Rumuolaogu	142534	5	14	9
WARD 16	Ozuoba, Ogbogoro, Rumuokwachi, Rumuokparali and Rumualogu	150226	5	15	10

WARD 17	Rumuolumeni (Mgbuakara, Minikpiti, Azumini, Okemini Mgbuosimini, Naval Base Okemini, Iwofe, Mgbu-Odihia, Nkpor-Rumuolumini, Mgbuoshimini Rumuolumini).	71740	6	7	1
	Total	1776147	55	175	120

Source: NPC, 1991; Authors' Field Survey, 2022

4. Conclusion

In conclusion, this study highlights the issue of spatial inequity and accessibility of public primary schools in Obio/Akpor Local Government Area of Rivers State, Nigeria. The findings reveal that the distribution of public primary schools is uneven and not based on population distribution, and this has lead to disparities in access to education. The proposed solution of establishing more than 120 primary schools to serve each ward's population is a step towards promoting spatial equity and ensuring that all children in the study area have equal access to quality education.

Recommendations

Based on the literature reviewed and the output of the analysis, the following recommendations can be made to improve the spatial equity and accessibility of public primary schools in developing countries like Nigeria:

- Increase funding for education: Adequate funding for education is necessary to improve the quality of education in public primary schools. Governments in developing countries should increase their investment in education to provide more resources for school infrastructure, learning materials, and teacher training.
- Implement policies to promote equitable distribution of schools: Policies should be implemented to promote the equitable distribution of schools across different regions and populations. This can be achieved by using data and GIS technology to identify areas with inadequate school coverage and prioritize the building of new schools in these areas.
- Increase access to technology: Technology can be used to improve the quality of education and provide equal opportunities for all students. Governments should invest in technology infrastructure and provide training to teachers on how to use technology to improve teaching and learning.
- Conduct regular assessments of school facilities and resources: Regular assessments of school facilities and resources are necessary to identify areas of need and prioritize investments. Governments should develop a system for regular assessments of school facilities and resources to ensure that all schools have the necessary resources to provide quality education.
- Increase community involvement in education: Parents and communities should be involved in the planning and implementation of education policies to promote accountability and improve the quality of education. Governments should create platforms for community involvement in education policy development and implementation.

Overall, improving the spatial equity and accessibility of public primary schools in developing countries will require a concerted effort from governments, educators, and communities. The recommendations above provide a starting point for addressing the challenges faced in providing quality education to all students, regardless of their location or socioeconomic status.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest regarding this study.

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