

Spatial Distribution of Infrastructural Facilities in Delta State, Nigeria: A Qualitative Approach

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Abstract

The distribution of infrastructural facilities generally concludes that an even and inequitable spatial distribution of various public facilities exists, often with a concentration in urban centers and a scarcity in rural areas in Delta State. A major issue is the concentration of better-equipped and higher-level facilities (e.g. secondary and tertiary healthcare) in urban areas, leaving rural communities underserved and forcing residents to travel long distances for services. The study consistently recommend that government and planners focus on improving the number and distribution of facilities in underserved areas to ensure equitable access and achieve development goals, such as the Sustainable Development Goals (SDGs).

Keywords: Infrastructure, Facilities, Spatial, Qualitative-Approach, SDGs, Delta State.

Introduction

The acceleration of global urbanization and the sustained growth of urban populations have triggered multidimensional, social and ecological issues. Nigeria's urbanization rate had reached 54% by 2024, driving economic but intensifying socio-ecological challenges, such as social inequality, housing disparity, and inefficient public resource allocation (Atubi, 2025a; Edewor, 2021). In the fields of geography and planning, a comprehensive theoretical and practical framework has been established for the spatial layout and optimization of public service facilities (Peng et al, 2023; Chen et al, 2024; Qiu et al, 2022). Scholars have systematically explored this issue by constructing accessibility models, identifying factors influencing residents' satisfaction and analyzing the mechanisms through which social-economic factors interact with facility allocation (Yang et al, 2022; Chen et al, 2024; Li et al, 2024; Chan et al, 2023).

Spatial mapping of functional facilities is the process of using geospatial technologies to digitally identify, analyze, visualize the location and attributes of infrastructure to support efficient planning and operational decision-making. In Delta State, infrastructural facility show uneven and often, clustered patterns, with major concentrations in urban centers like, Asaba and Warri leading to significant rural-urban disparities in access, through some facilities like health centers often cluster around population thresholds for viability. While some services (health, finance, transport) show strategic dispersion (meaning strategic placement), others (education, religion) can appear random or clustered, with over all patterns sometimes reflecting unplanned growth and uneven development, necessitating better integrated planning to equitable service provision (Atubi, 2025a; Atubi, 2021e; Atubi, 2021c; 2021b).

Spatial patterns of facilities describe how services, infrastructure, and amenities (like schools, hospitals, markets) are arranged across an area, revealing concentrations (clusters), regular spacing (uniform), or random spreads, influenced by population, economics, and planning with analysis helping to identify inequalities and guide future development for better access (Atubi, 2019b; 2019c; 2019d). Spatial equality analysis is crucial for

urban design (Scheer, 2008; Krieger & Saunders, 2009). This is due to the fact that urban design is more than morphology and the distribution of building masses and the space between buildings, but also about serving the public interest through creating better spaces, for instance to create better amenities, clean environments, public spaces, accessible facilities, and good educational opportunities (Carmona, 2021; Israel & Frenkel, 2018).

The provision of and accessibility to basic infrastructure facilities mainly drive the development of villages. In the process of urbanization, the peri-urban villages provide necessary resources starting from land to labour to the urban areas. In essence, analyzing spatial patterns helps planners to understand "where" things are, "why" they are there, and "how" to improve their distribution for better public benefit. The mapping and assessment of facilities typically uses the tripartite technologies of Remote Sensing (RS), GIS, and Global positioning systems (GPS) (Atubi, 2004; Atubi, 2011f). Urban planning and infrastructure development in rapidly growing cities force persistent challenges regarding spatial equity and resource distribution. The equitable arrangement of socio-economic amenities constitutes a component of sustainable urban development, as uneven distribution often leads to exclusionary outcomes for vulnerable populations (Nicoletti et al, 2022).

Key Theoretical Frameworks

- **Central Place Theory (CPT):** propounded by Walter Christaller (1933), CPT suggests that facilities (central places) exist to provide goods and services to surrounding populations (trade areas). Higher-order facilities have larger service ranges and population thresholds, while low-order facilities are more numerous and widely distributed.
- **P-Median Model:** A location - allocation model used to find the optimal location for a set number of facilities to minimize the total distance or travel time for users.
- **Market Area Analysis:** focuses on defining the geographic areas from which a facility draws its customers, considering factors like competition and maximum travel distance (Atubi, 2021e).
- **Growth Pole Theory:** used in analyzing the distribution of infrastructural facilities in developing regions, suggesting that facilities are often clustered in certain "poles" of development, influencing surrounding areas.
- **Uneven Distribution:** Numerous studies find that facilities, particularly healthcare and educational institutions, are not evenly distributed across urban and rural areas. This often results in concentrations in core urban areas and under serviced peripheral or rural regions (Atubi 2021b; Atubi, 2011c).
- **Accessibility and Social Equity:** The primary concern in the literature is how spatial distribution impacts accessibility. Poor distribution can lead to long travel time, high transport costs, and congestion in some facilities while others are underutilized (Atubi, 2011d; Atubi, 2012d; Atubi 2019c; 2025b).
- **Influencing Factors:** The distribution patterns are shaped by various factors:
 - ✓ **Population Size/Density:** The primary driver; facilities tend to locate where more people live.
 - ✓ **Transportation Network:** Road conditions and the density of public transport significantly affect accessibility and, thus, facility location decisions.
 - ✓ **Economic Factors:** commercial activity and average housing prices can influence where facilities are viable and necessary.
 - ✓ **Government policies/Interests:** planning decision and political interests heavily dictate the location of public Infrastructure.

Spatial distribution of infrastructural facilities in Delta State

Spatial Distribution of Facilities in Delta State

This section presents the facilities (Electricity, health, water, secondary and primary schools, roads and markets) maps and discusses their spatial context in Delta state.

Spatial Distribution of Electricity in Delta State

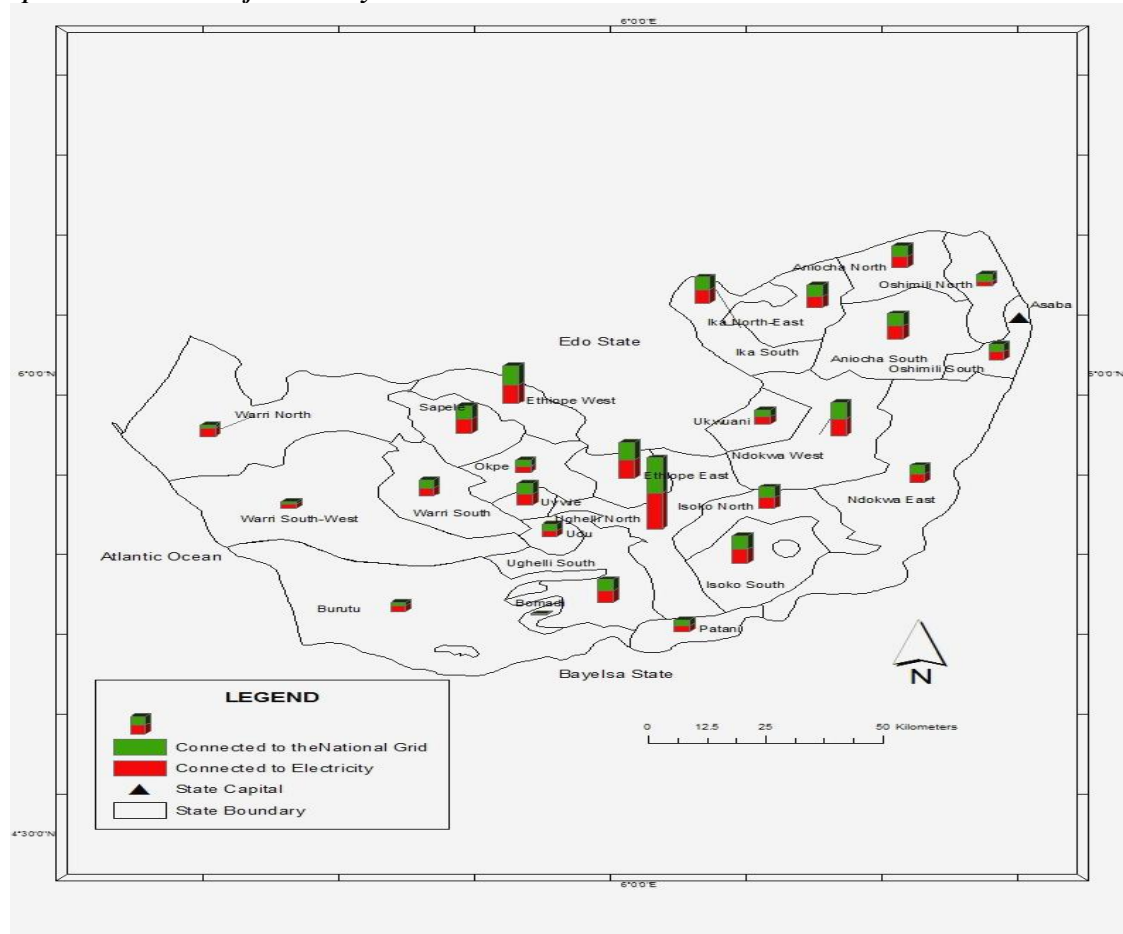


Figure 1. Map of Electricity Distribution in Delta State

Figure 1, showed that most of the communities in the 25 Local Government Areas (LGA) of Delta State are connected to the national grid. However in Bomadi LGA, it is the LGA headquarter Bomadi that is connected to national grid, and in Burutu LGA, 10 communities are connected to the national grid. This abysmal connection is precipitated by the swampy nature of the terrain of the two LGAs. In terms of rural electrification, it is being practiced by three LGAs, these LGAs and communities where practiced are: Burutu (Sekebolou, Yokri, Odinodi and Ogulaha); Warri North (Ogbinbiri, Ogbudugbudu, Opuama, Polopubor, Asigborodo, Ogheye, Jakpa and Gbokoda); and Warri South west (Escravos, Ogidigben and Ajudiabo). This rural electrification scheme in these LGAs was established to boast electricity supply in these communities because of their difficulty terrain. Delta State also housed three power generating plants; these are Sapele Power Station at Ogorode, Sapele. Okpai Power Station at Okpai, and Delta-Ughelli Power Station at Ughelli. These power plants served as the major sources of power generation and supply in Delta state. Other source of power supply in the state is solar energy. This is found in all the LGAs in the state, most especially to power water project and street light. Despite the power station, the state is still bedevilled with epileptic power supply.

Spatial Distribution of Health Institution

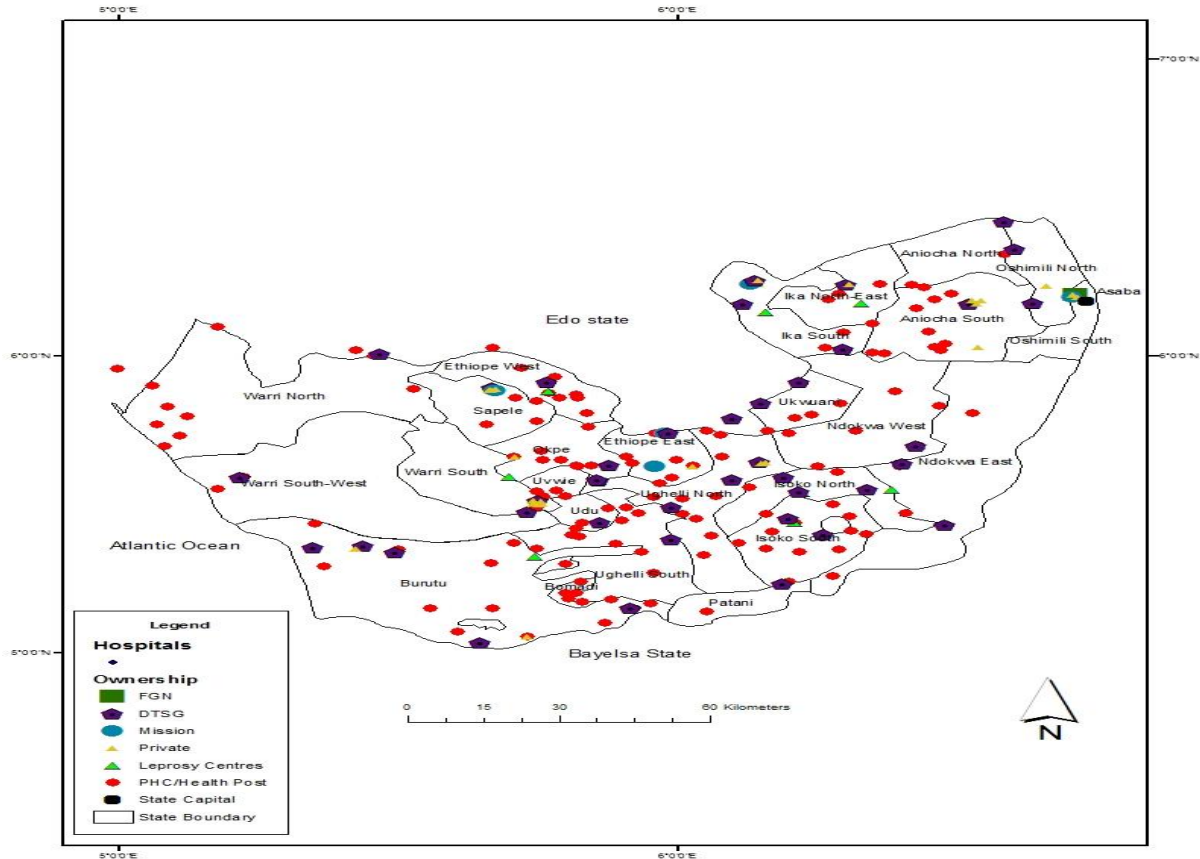


Figure 2. Spatial Distribution of Health Facilities in Delta State

There are 54 state government owned hospitals in the state, with at least one in each LGA (see figure 2). And these are directly managed by the hospital management board which, for administrative convenience, has been grouped under eight medical zones. These are Agbor, Asaba Akwukwu-igbo, Bomadi, Kwale, Ogwashi-Uku, Oleh, Sapele and Warri medical zones. Out of the 54 hospitals, four with 100 beds each, have been designated central hospitals (Warri, Sapele, Ughelli and Agbor central hospitals), state hospital in LGA headquarters are called general hospitals, while those sited in places other than LGA headquarters and which generally have 30 beds capacity each are known as government hospitals. There many Primary Health Centres (PHC) (538 maternal health centres, medical health centres, and maternity homes) run by the LG councils which complement the effort of the state government to bring health care delivery services. Also there are numerous private hospitals and clinics (over 1109) that runs 24 hours health services in the state. Added to the above, is the Delta State University teaching hospital located at Oghera in Ethiope West LGA, and the Federal Medical Centre located at Asaba the state capital. All these served the health needs of Deltans and those of neighbouring states.

Water facilities in Delta State

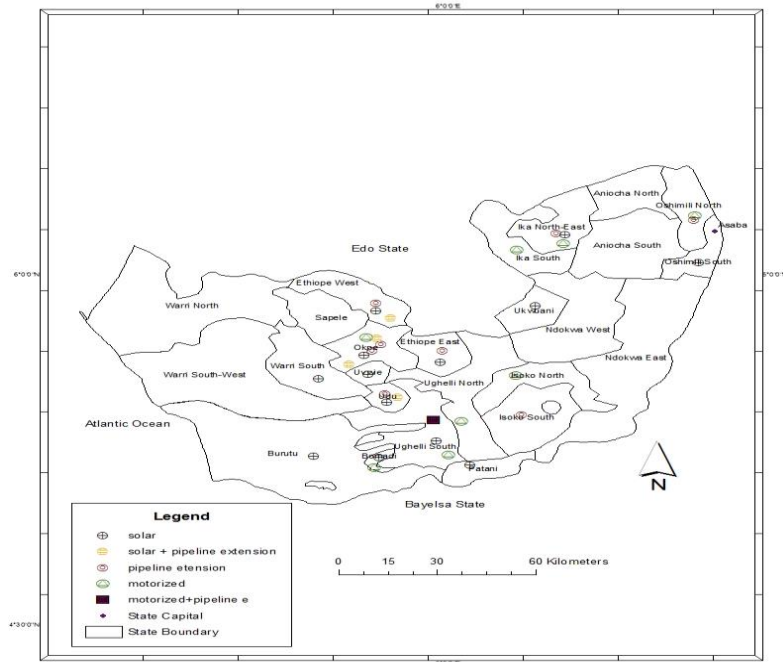


Figure 3. Distribution of Water Facilities in Delta State

Delta state is blessed with abundant water resources that are characterized with surface and groundwater sources. The dominant water sources for domestic water uses are further subdivided as surface (rivers, streams and coastal water bodies) and groundwater (well and boreholes). The rainwater formed the main source of replenishing all the other water sources in the state, and served as one of the main source of water supply in the Delta north LGAs. On the other hand, the boreholes water supply is the dominant source of water for domestic uses in the state, because of this the state government, private individuals, oil companies, and non-governmental organization periodically drill and site boreholes in most of rural communities of the state, to the extent that there is virtually no community in the

State without a borehole as a means of water supply to its inhabitants. These boreholes are either motorized, solar or electric powered (see figure 3). The state ministry of water resources development took innovative steps by giving priority to solar power water system to minimize the problem of breakdown of hydraulic equipment. Nevertheless, the rivinerine area of the state (Warri, Koko, Ughelli, Patani, Sapele etc) uses well water added to the boreholes. There is also pipeline and pipeline extension in Oshimili North, Ika North, Ika south east, Ika south, Ethiope West, Ethiope East, Udu, Isoko South etc LGAs of the state. The urban/rural water board worked to ensured that potable water is available to all part of the state. There are major water schemes like those of Warri/Effurun, Sapele, Ughelli, Agbor and Ibusa that have been reactivated and expanded to serve the growing needs of the people of these areas.

Spatial Distribution of Secondary and Primary Schools in the State

This section discusses the secondary and primary statistics in the state

Spatial Distribution of Secondary Schools

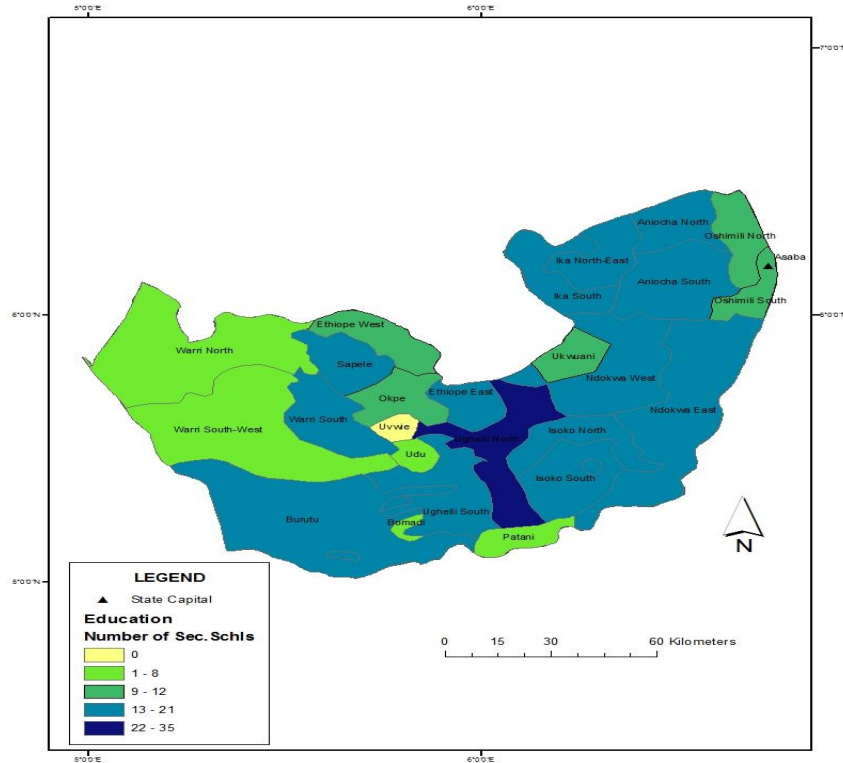


Figure 4. Numbers of Secondary Schools in Delta State

Delta State occupies a frontline position in the country’s education, and the state ministry of lower/basic education is in charge of the responsibility of handling the secondary and primary schools in the state. The state has over 369 public secondary schools and numerous private secondary schools. The post primary education board supervises the secondary schools, and also the state ministry of education runs schools for the handicapped and women education centres located at Ozoro, Warri, and Agbor. Generally there are many secondary schools in each LGA which span 8-35. For instance [Figure 4](#), showed that Ughelli North LGA had the highest numbers of secondary schools in the state (22-35), and Bomadi, Patani, Udu, Uvwie, Warri North and South LGAs had 1-8 secondary schools each being LGAs that had the lowest number of secondary schools. Ethiope West, Okpe, Ukwane, Oshimili North and South LGAs housed 9-12 secondary schools each. The other LGAs housed 13-21 secondary schools. However there are state model schools in some LGAs that have boarding facilities and at least one Institute for Continuing Education (ICE) that prepares pupils for NECO/WASC and Higher School Certificate (HSC) examinations.

Spatial Distribution of Primary Schools

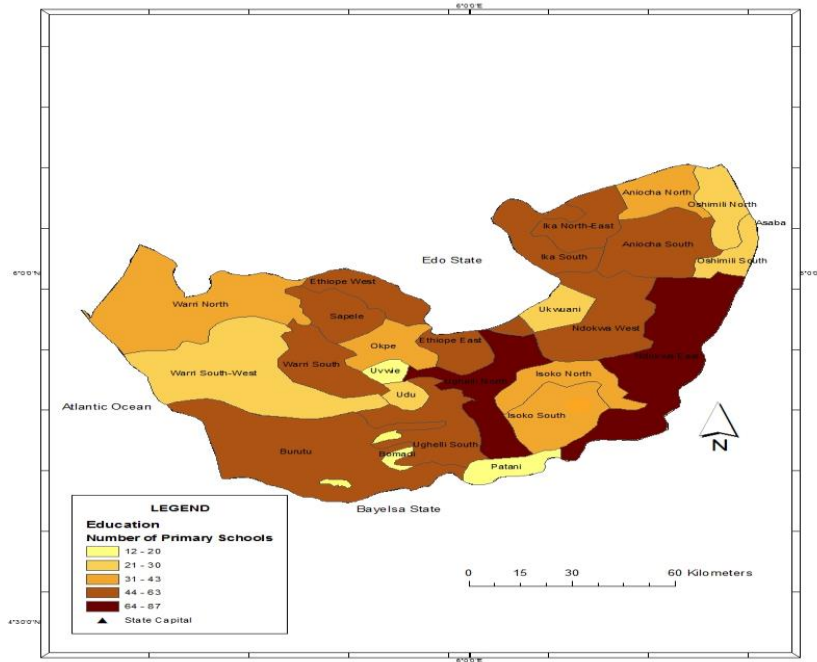


Figure 5. Number of Primary Schools in Delta State

Generally there are 1120 primary schools in the state, and span 12-87 schools in each LGA. Figure 5, showed that Ughelli North LGA had the highest numbers of primary schools in the state (64-87), and Bomadi, Patani, Uvwie LGAs had the lowest number of primary schools (12-20) each. Warri South West, Ukwani, Oshimili North and South LGAs housed 21-30 primary schools. Warri North, Okpe, Isoko North and South and Aniocha North LGAs housed 31-43 primary schools each. The other LGAs housed 44-63 primary schools. The state also housed numerous private primary schools in each of these LGA.

Facilities in Delta State Owned Secondary Schools

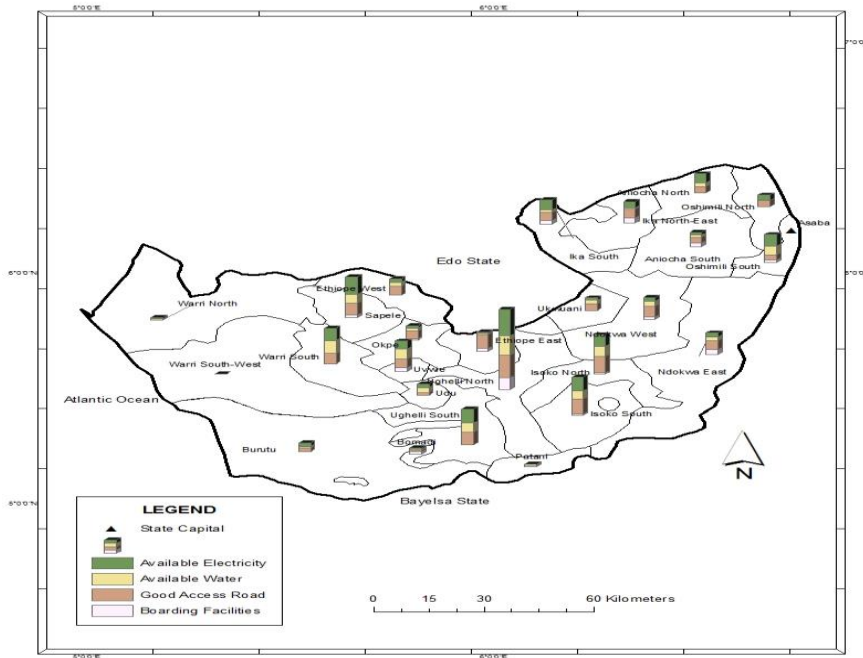


Figure 6. Available Facilities in Delta State Secondary Schools

Figure 6, showed that most of the secondary schools in the state are connected electricity supply, good access road and availability of water used for drinking and sanitary purposes. However there are state model schools that have boarding facilities in some LGAs in the state. However in Warri North and South West and Patani LGAs that are water logged and swampy in nature has poor road system, but the state government periodically carried routine maintenance on these roads to make them accessible for the pupils and the publics.

Population of Teachers in Primary Schools

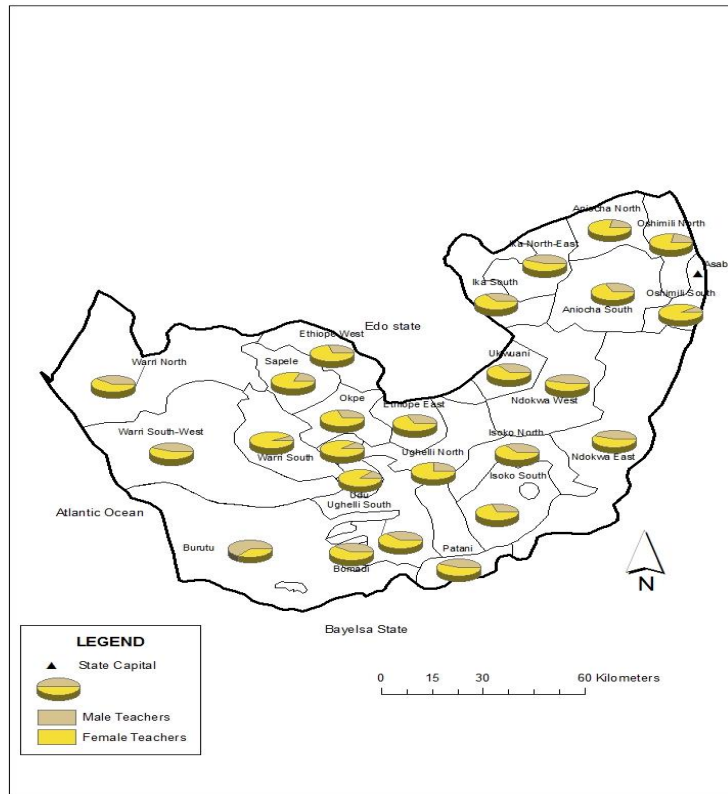


Figure 7. Number of Primary School Teachers in Delta State

Delta State has a total number of 15778 primary teachers; out of which 10996 are females and 4782 males. This indicates that there are more female teachers than male teachers in the state owned primary schools. In the LGAs, Warri North has the lowest numbers of primary school teachers (185), and Ughelli North had the highest numbers of primary school teachers (1253). While the male distribution range from 53 male teachers in Oshimili South LGA to 421 male teachers in Burutu LGA, the female distribution ranges from 109 female teachers in Warri North LGA to 1073 female teachers in Warri South LGA (see figure 7).

Recommendations for Future Planning

The literature consistently advocates for:

- Upgrading existing facilities in disadvantaged zones
- Encouraging the establishment of facilities in underserve rural areas
- Involving local communities in planning and implementation to ensure facilities meet local needs.
- Utilizing data-driven, GIS-based planning to optimize facility layouts and achieve a better match between resources and population needs.

Conclusion

In conclusion, the spatial distribution of facilities in Delta State shows unevenness and disparity, with key infrastructure like health, education, and transport often exhibiting dispersed (strategic/ planned) or clustered (demand-driven) patterns, yet overall pointing to inequitable access between urban Centers (like Asaba; Warri) and rural areas, necessitating integrated planning and targeted investment to balance provision and improve

residents' quality of life. In essence, Delta State faces challenges in equitable infrastructure distribution, demanding data-driven GIS approaches to guide future planning for better service delivery.

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