Inequalities in access to infrastructural amenities and sustainable development in Delta State, Nigeria

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Abstract

This paper examines inequalities in the access to infrastructure and its implications for sustainable development of the Delta State. A sample size of 2,521 was statistically determined from a population frame of 5,663,362. Using the level of confidence approach, a structured questionnaire was systematically administered to every fifth house along the major road based on random selection. Result of the analysis of variance (ANOVA) based on further analysis of the extracted components in the Principal Component Analysis (PCA) used as predictor or criterion variables shows that there is a significant variation in access to infrastructure across the three senatorial districts of the state at (F=527.305, p=< 0.001). Spatial variation in access to infrastructure resulted in spatial disparities in living standards within and between coastal communities. Deprivation in access to infrastructure is experienced more in the coastal communities of the Delta South compared to the Delta Central and Delta North. Some of these variations were caused by difference in distance to safe water, lack of accessible road network, poor housing and poor sanitation facilities because of multiple deprivations, poor terrain and lack of infrastructural development. Adequate infrastructure is a necessary condition not just for economic development but also sustainable development of the coastal communities. Therefore, an understanding of inequality in the access to infrastructure is vital to sustainable development of the coastal communities of Delta State, Nigeria.

Keyword: Inequalities in access to infrastructure, level of confidence approach, adequate infrastructure, sustainable development, Nigeria

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Introduction

Africa has the world's fastest growing population, inequality and the highest poverty rate (Development aid, 2021). Consequently, the challenge of increasing access to these services across sub-regions is compounded by the unequal distribution of existing access for households in African Countries (African Development Bank, 2018). The development of infrastructure in Africa is critical for fostering economic growth and improving the living standards of Africans and attainment of the Sustainable Development Goals (AFDB, 2018).

Between 2010 and 2018, inequalities in access to infrastructure service decreased across Africa. The Gini index for African counties as a whole was estimated at 0.422 in 2018, compared to 0.437 in 2016 and 0.453 in 2010 (AFDB, 2018). Access to infrastructural and basic amenities like drinking water, sanitation, electricity, housing, drainage and others are crucial to well-being as they contribute to physical and material comfort and quality of life. Virtually all human activities are dependent on infrastructure this is because infrastructure is crucial for the development and good infrastructure is essential in providing public services. It is further assumed that public access to these services is salient in sustaining development. The need for infrastructural development in any nation cannot be overemphasized due to the significant role not only economic growth but also general well-being of the people (Okinono, et. al., 2016).

Moreover, water insecurity and access problems are not confined to the global south. Emerging research indicates the alarming problems of insecure water access, quality, affordability and trust experienced by households in Canada and the United States (Patrick, 2011; Vandewalle, 2016; Pauli, 2019; Meehan, 2019; Meehan et al., 2020).

According to Besley and Ghatak (2006), it is important to examine inequality in access to public services in particular, given the well-documented links between public service provision and economic development. Equitable access to public services like electricity, sanitation and water infrastructure is crucial for improving well-being and expanding the productive capacities of individuals in societies.

SDG 1 focuses on access to good infrastructure for the provision of basic services and public service delivery such as health care services, education, roads, access to water, energy and electricity to everyone (Davies et. al. 2019). Although, SDGs 9 (Industry, Innovation and Infrastructure) require investment in infrastructure development in developing countries, by implication improvements in infrastructure from healthcare and education to access to energy, clean water and sanitation (The Economist Intelligence Unit Limited, 2019).

The major challenges to sustainable development in Nigeria include inadequate domestic water supply, poverty, poor human development initiatives, poor transportation network and environmental degradation (Jaiyesimi, 2016). The quality and coverage of infrastructure services like electricity, water, sanitation, telecommunications and transport have major impact on living standards and economic growth. Infrastructure provision is a major determinant of the location of economic activities and of the spatial pattern of development of the built environment (Ingram & Brandt, 2012). Sustainable development is development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs (Brundtland, 1987).

Looking into the future, rising incomes and rapid population growth are bound to increase future demand for infrastructure in Nigeria significantly. Over the next 23 years, Nigeria's population is expected to increase from the current estimate of 190 million to almost 330 million representing more than 70 % increase (Bello-Schunemann & Porter, 2017).

According to UN-Water/FAO (2007), almost a fifth of the world's population (1.2 billion) live in areas with physical water scarcity, 748 million people lack access to improved drinking water source, while 1.8 billion people are without safe drinking water. In 2012, 2.5 billion people had no access to improved sanitation facility. One billion people do not use any sanitation facility, defecating in the open, while the consequences for water and health are severe (UN-Habitat III, 2016).

The lack of water and sanitation facilities still constitutes one of the main housing deficits in urban areas; around 21 million households live in dwellings lacking at least one basic service. Inadequate sanitation is the main infrastructure problem affecting 13 % of households (almost 17 million). Around 8 million households lack piped water (and the quality of the water received by most households is not optimal). In 2009, the proportion of poor households lacking infrastructure was six times higher than that of high-income households, while there is almost no overcrowding or poor quality building materials in high-poor income households, these problems affect 16 % of urban poor households (Bouillon, 2012).

The inequalities in access to basic facilities exists between spatial units as they do between individuals (Henderson, Shalizi & Venables, 2001; Anderson & Pomfret, 2004; Kanbur & Venables, 2005). The spatial variation in availability and access to infrastructure results in spatial disparities in living standards both within and between regions and localities. Socio-spatial inequalities have been quantified across Australia (Baum & Gleeson, 2010) and growing inequality has been demonstrated (Gleeson, 2006). Hence, there is need for an understanding of the variation in access to infrastructural facilities and its implications to the sustainable development of the coastal communities of the Delta State, Nigeria, while the hypothesis, which states that access to infrastructure varies significantly among households in the study area was proposed.

In general, it is suggested that the provision of adequate infrastructure is a key element in reducing poverty, as it triggers a direct effect in the improvement in employment rates and wages when the economy grows and becomes more competitive. From the theoretical perspectives, Hirschman (1958) stated that public investment in infrastructure is vital for the social and economic development of a country, once it provides an attractive environment for private investments. Consequently, ensuring that the disadvantaged coastal communities have access to adequate physical and social infrastructure is germane as it enhances human capital development, improves health and life expectancy while addressing inequality, reducing poverty and multiple deprivations in Delta State.

This paper starts with an introductory section, followed by a review of relevant literature, next is a discussion of the research methodology followed by discussion of results. The paper ends with conclusion and policy implications of the study.

Literature Review

The study of social inequality has received the attention of geographers for decades now. Geographic social inequalities are evident in major cities where housing, food stores, basic services, healthcare and other infrastructure are generally more available to the wealthy urban dwellers than the urban poor (Musterd & Ostendorf, 1998). The evidence of spatial factors affecting social inequality, particularly in regards to access to resources and infrastructure, have been called “spatial inequality” where individual access is not equal (Lioyd, 2015). Often urban geographers see that neighborhoods themselves promote social inequality, as high crime rate and unemployment create negative perceptions and make it more difficult for individuals to aspire to improve their living condition (Knox & Pinch, 2010).

Wang, et.al., (2019), assessed geographic inequalities in the access to improved water and sanitation facilities among Nepalese households, using a cross section data obtained from Nepal Demographic and Health Surveys. The geographic categories used in the analyses were the developmental region, ecological zone and urbanicity. The authors discovered that proportion of households with access to improved toilet facilities across the three categories utilized was (5.6 % in 1996 and 40.5 % in 2016), water (19.3 % in 1996 and 27 % in 2016), facilities have increased steadily since 1996 with a great proportion of households still without access to the services.

Social inequalities are very serious in Senegal and manifest in significant disparities in access to health and educational services, employment opportunities and infrastructure among others, which are reinforced by the country's demographic imbalance, wherein 62 % of the estimated population of 13.9 million inhabitants comprises of young people under the age of 25 (Diene, 2014).

Archibong (2018) assessed the existence of persistent ethnic-group based inequality in access to public services in Nigeria, using a rigorous historio-graphical research to inform a general framework to explore the mechanisms through which horizontal inequalities might persist and empirically assessed the role of historical institutions in determining current unequal distribution of access to infrastructural services. Infrastructure can be grouped into two, which are hard and soft infrastructure; hard infrastructure is the physical infrastructure of roads, sewers, highways, bridges, electricity, railroads etc. while soft infrastructure deals with human capital and establishments (Fung, 2005; Oke, 2013).

According to Bello-Schunemann & Porter (2017), currently only 16 % of Nigeria's roads are paved, compared on average to the roads in the world's lower middle-income countries. Similarly, in 2016, 30 % of Nigeria's population had access to improved sanitation facilities compared to an average more than half of the population in the country's global income peers. The situation for the access to clean water and electricity is similar. In 2016, Nigeria had one of the lowest levels of access to improved basic infrastructure anywhere in the world, ranking 162 out of 186 countries.

Goldin (2017), studied investments in infrastructure, particularly clean water, sewage and electricity, as well as rural roads are essentially for growth, investment and achieving improved health outcomes. Moreover, Gaal & Afrah (2017) stated that Sahara Africa is the poorest region of the world despite recent noticeable increase in per capital income growth rates of the countries in the region. Thanks to decades of economic stagnation, poor standard of living, ethnic cleansing and tribal wars, political instability and environmental disasters which had not prioritized infrastructural development. Resources channeled to the provision of infrastructural services were largely inadequate and sub-optimal, diverted to less productive needs which are susceptible to corruption (Fatai, et. al., 2016).

The availability of infrastructural facilities and services as well as the efficiency of these services largely determined the success or otherwise of all other production endeavors. Investment in infrastructures such as energy, water, transportation and communication technologies promote economic growth and help to alleviate poverty and consequently improve the living conditions in developing countries (OECD, 2006).

Materials and Methods

A survey design was adopted using level of confidence approach, a sample size of 2,521 was statistically determined from a population of 5,663,362 (NBS, 2017). A structured questionnaire was systematically administered to every fifth house along the major road after the first house was randomly selected. This study covered all the 25 local government areas of delta state classified into 3 senatorial districts (Delta North, Delta Central and Delta South). Analysis was done hierarchically at the household level and across the three senatorial districts. In this study, data is derived from both primary source involving field survey using structured questionnaire on access to infrastructure such as (education facilities, housing, distance to safe water, sanitation and toilet facilities), while secondary data on the population, topographical map and road network was obtained from National Population Commission, Delta State Ministry of Lands and Survey respectively.

Sample Size Determination

Using the level of confidence approach, the sample size was computed thus:

$$\frac{\text{Z values}^2\,(pxq)}{e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where; 1.96 = z values of 95 % level of confidence

P = 100 % - q

q = 100 % - p

e = allowable error in the estimate

n = sample size

Sample Size Computation

$$\frac{\text{Z values}^2(pxq)}{e^2}$$

$$\frac{1.96^2(50x50)}{2^2}$$

$$\frac{3.841\ (2{,}500)}{4}$$

$$= \frac{9{,}604}{4}$$

$$= 2{,}401$$

The sample size used for this research was further increased by 5 % to account for contingencies such as non-response or recording error as advised by Boynton & Greenhalgh (2004).

n+5 % =2,401+ 5/100
2,401 +120
= 2,521

Given that the proportion of population living below poverty line in the study area is unknown, 5 % error of estimate was used since this value is sufficiently large enough to guarantee an accurate prediction at 95 % confidence level.

Measurement and Indicators of Infrastructure

Conventionally, infrastructure has either been measured through supply-side physical indicators such as electricity generation capacity, kilometers of road, or demand side such as aggregate electricity and water connection rates (Straub, 2011). Table 1 presents the selected infrastructure such as housing, road network, energy source, safe water, sanitation and toilet facilities. Geographic access to infrastructure was determined using the following indices based on the Harmonised Nigeria Living Standard Survey (HNLSS, 2010).

Table 1: Indicators and Thresholds of Facilities

Variables/Infrastructure	**Thresholds/ Definitions**
Housing	Employment, energy, sanitation and waste disposal method, water source, remittances, ownership of asset
Employment Status of household heads, adults (18yrs)	Unemployed household heads and Unemployed adults above 18 years
Ownership of decent accommodation	Ownership of decent accommodation, while non- decent accommodation are considered deprived.
Road network (km)	Areas not accessible by roads and areas with less density of road networks.
Energy source	Households using firewood, candle, charcoal as source of lighting without electricity, solar and other improved sources, are considered deprived.
water source	A household is considered deprived if the household does not use piped water, tube well and well which are the improved sources and considered deprived if households travel over a considerable distance to fetch water (>500m)
Sanitation and Toilet Facilities	Household using unimproved sanitation facilities such as pit latrine, bucket toilet and hanging toilet (United Nations 2003).

Waste Disposal Methods	Households without improved sanitation facilities or poor waste disposal system (roadsides, drainage, bush).

Source: Harmonised Nigeria Living Standard Survey (HNLSS, 2010).

Study Area

Delta State is generally low-lying with an elevation of 500 feet (130 meters). Delta State has three seaports located in Warri, Sapele and Koko. The State is bounded by Ondo State to the northwest, Edo State in the north, Anambra State and Rivers State to the east, Bayelsa State to the south and on the southwestern flank is the Bight of Benin, which covers about 160 kilometers of the State's coastline. Delta State is ethnically diverse and heterogeneous. The State has a total land area of 16,842 km^2 with a population of 4,098,291 (males). 2,674,306, females). 2,024,085 (Federal Republic of Nigeria, Official Gazette, No. 24, vol. 94, 2009). Delta State relief varies from the north to the south and from the hinterland to the coast. It is highest at Agbor and Ubulu-Uku with an elevation of 110m and lowest at the coast with elevation of 23.8m above sea level. Politically, the State has 25 local government areas and 3 senatorial districts namely (Delta North, Delta Central and Delta South) for easy administrative purposes and easy accessibility (see Fig. 1).

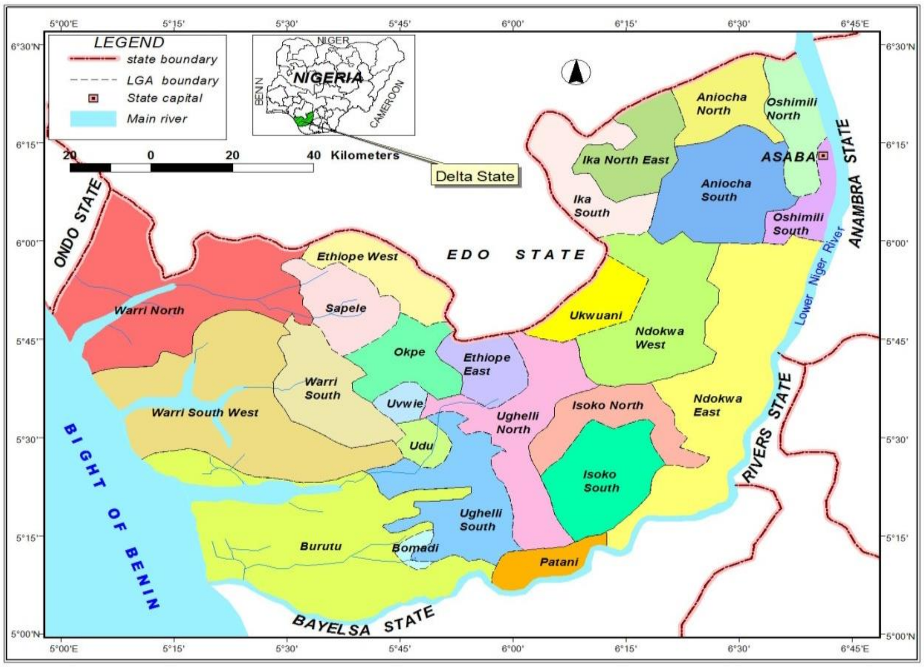

Fig. 1: Map of Delta State
Source: Ministry of Lands, Survey and Urban Development, Asaba (2020)

Results and Discussion

Road Distribution/Network

In general, Nigerian roads have been plagued by a number of problems among which are faulty designs, low carriage capacity, inadequate drainage systems, poor funding for road maintenance, which has significantly reduced the accessibility and utility of the roads.

Road distribution in the coastal communities across the three senatorial districts as shown in figure 2 revealed that Geographical Information System (GIS) analyses was utilized to generate spatial query(ies), fields like road types were converted to a thematic map. The total length was measured in kilometers and the area in square kilometers was calculated using ArcGIS 10.1 for subsequent analysis. Figure 2 shows that the road length of 3,003.7 km was for major roads out of 11,698.6 km total road length which represents 25.7 % of total road length, while the tracks represents 8,678.3 km (74.33 %) of total length of road in the study area. This uneven distribution of major road networks shows that roads are highly concentrated in the Delta North and Delta Central respectively compared to Delta South. This result suggests that the Delta North and Delta Central are highly concentrated with systems of road networks, which make the senatorial districts more accessible by road.

Consequently, there is improved access to more social infrastructure, while road network is sparsely distributed in Delta South, which predicts inadequate or lack of access to social infrastructure and a reflection of low level of social infrastructure development. It is further suggested that the prevalence of multiple deprivation and lack of geographic access to infrastructure such as: accessible and good roads, housing, safe water, improved sanitation and safe energy was established in the coastal communities of Delta South (see Figure 2). This result corroborates the findings of Africa Infrastructure Development Index (AFDB/AIDI, 2018) that importance of access to basic infrastructure on welfare is clear, while the challenge of increasing access to these services is compounded by unequal distribution of existing access for households in African countries.

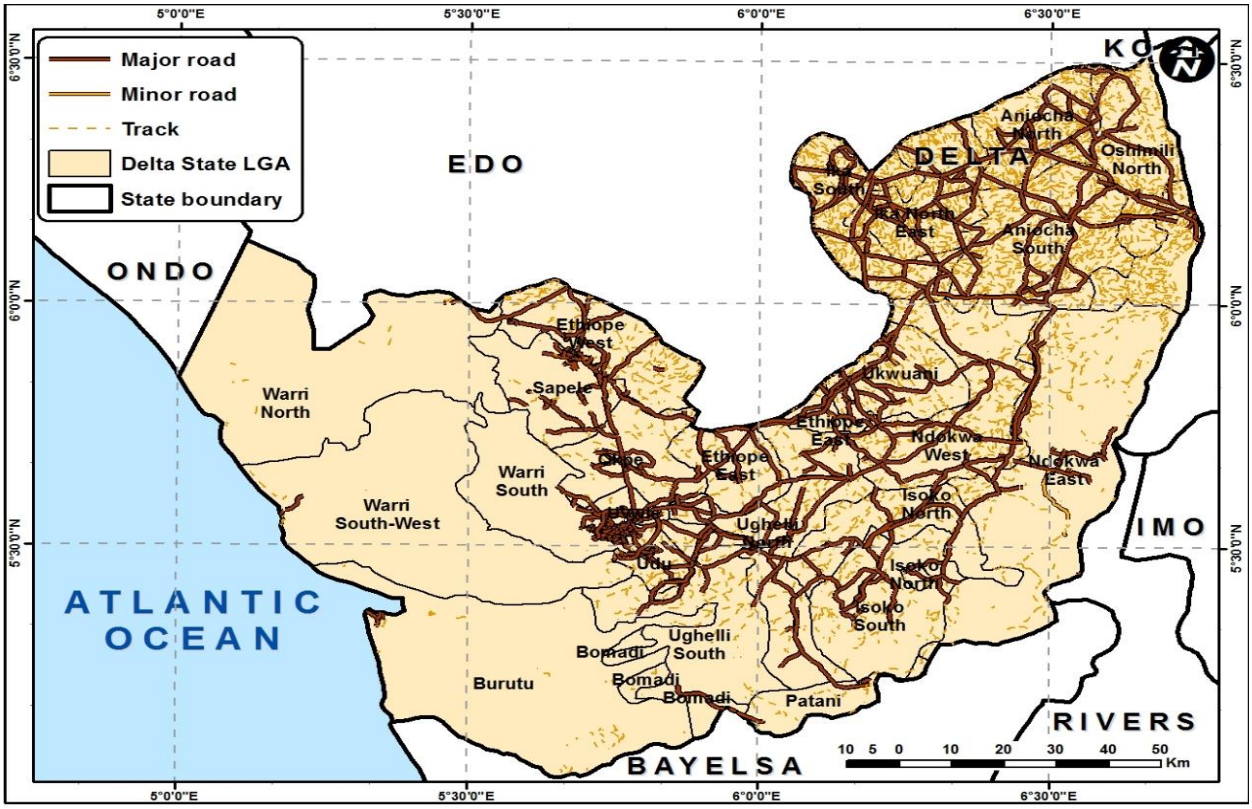

Fig. 2: Road Network in Delta State
Source: Authors Field Data Analysis, 2020

Access to Safe Water

Figure 3 shows that sources of water for the inhabitants of the Delta State are diverse but borehole and piped water dominated the major water sources in Delta North and Delta Central. In all, 459 households representing (53.8 %) of sampled households in Delta North Senatorial District use piped water in their homes, followed by 312 (32.5 %) in Delta Central and 190 (18.9 %) in Delta South. However, 206 (40.6 %) of households in Delta Central use open wells followed by 193 (38.0 %) of households in Delta North and 109 (21.5 %) of households in Delta South. The variations observed are also statistically significant at 0.05 significance level with the calculated value of 144.169 greater than tabulated value of 18.307.

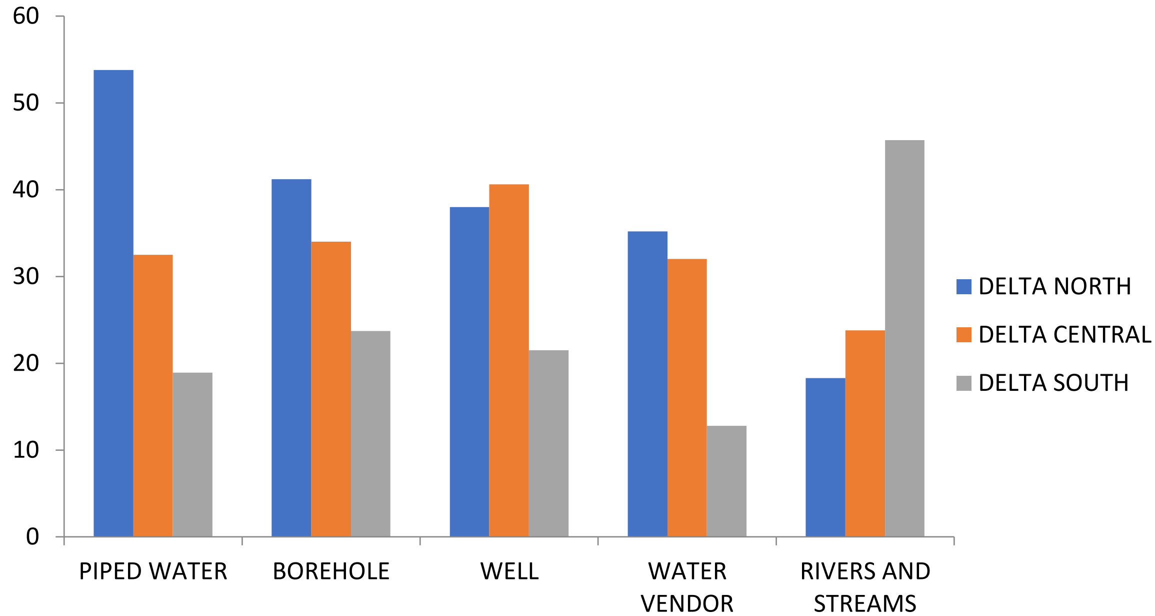

Fig. 3: Distribution of Water Sources
Source: Authors Field Data Analysis, 2020

Distance to Water Source

Fig. 4 shows that the distance covered in search of water differs at the senatorial district levels. For instance, 608 representing (24.1 %) of households in Delta Central had access clean water within their compounds, followed by 181 (7.2 %) in Delta South and 146 (5.8 %) in Delta North. On the other hand, 110 households representing (4.4 %) of households in Delta Central walk up to 300 meters in search of safe clean water followed by 101 (4.0 %) in Delta South and 32 (1.3 %) in Delta North. The variations observed are also statistically significant at 0.05 significance level with the calculated value of 136.910 greater than tabulated value of 18.307.

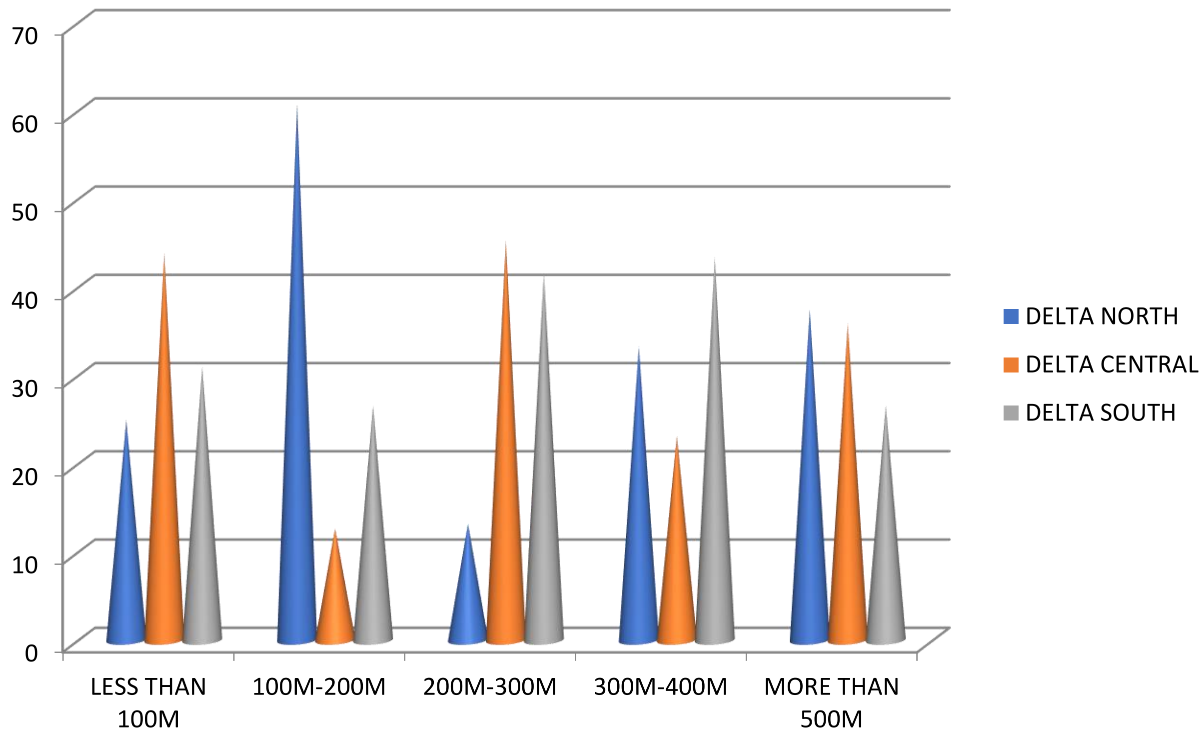

Fig. 4: Distance to Water Source
Source: Authors Field Data Analysis, 2020

Access to Toilet Facilities

Access to improved sanitation facilities refers to the proportion of the population using improved toilet facilities. Fig. 5 depicts that the distribution across the senatorial district level in Delta State implies that 870 (43.2 %) of households in Delta North make use of water closet followed by 628 (31.2 %) of households in Delta Central and 518 (25.7 %) of households in Delta South. However, 398 households representing (15.7 %) of sampled households in the study area used unimproved toilet facilities such as pit-latrine, bush and river, while the variations observed are also statistically significant at 0.05 significance level with the calculated value of 44.987 greater than tabulated value of 15.507.

This study reveals that some households do not have access to improved toilet facilities, while a large population practice open defecation in rivers, bushes and poorly constructed toilet facilities, which is a reflection of poor access to toilet facilities, sanitation and low level of development as shown in plate 1. Poor knowledge and awareness of sanitation and routes of infection, as well as contamination of domestic water with human fecal organisms (Karkey, et. al., 2016; Wardrop, et. al., 2018).

Plate 1: Toilet Facility of a Coastal Community in Delta South.
Source: Authors Fieldwork, 2020

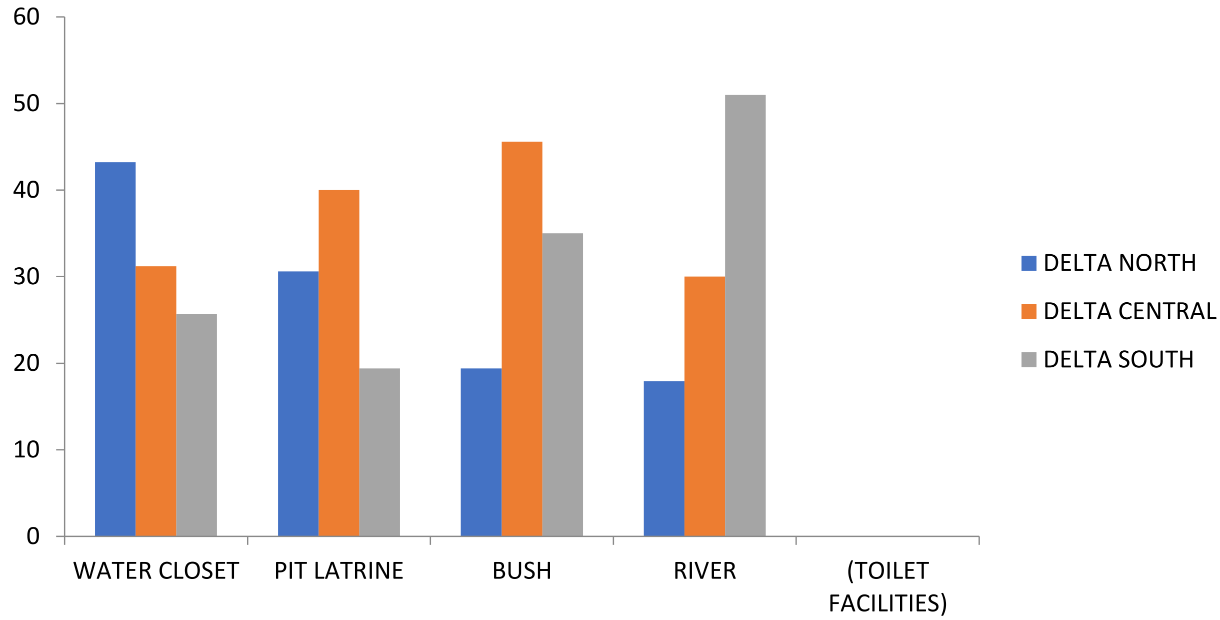

Fig. 5: Access to Toilet Facilities
Source: Authors Field Data Analysis, 2020

Access to Improved Energy

Inadequate access and availability of electricity aggravates poverty, inequality and hampers revenue generation (International Energy Agency, 2014). Table 2 shows that 2,067 households representing (82.0 %) of sampled households in the state make use of electricity as major source of energy. On the other hand, 454 households representing (18.0 %) of sampled households make use of unimproved sources of energy such as sawn dust and firewood which is a reflection of lack of access to improved energy source of their choice. At the senatorial district level, 637 households representing (30.8 %) of those who make use of electricity as source of energy are from the Delta North, 887 households representing (42.8 %) of those who make use of electricity are from Delta Central, while 546 households representing (26.4 %) of those who make use of electricity are from Delta South. The variations observed are also statistically significant at 0.05 significance level with the calculated value of 17.774 greater than tabulated value of 5.991. In a panel of studies, it is reported that electricity consumption improves human development (Niu et. al., 2013) and is crucial for improving the well-being of people in developing countries (Mazur, 2011).

Table 2: Electrical Energy

Energy Source	Senatorial Districts							
	Delta North		Delta Central		Delta South		Total	
	No	%	No	%	No	%	No	%
Electricity	637	30.8	884	42.8	546	26.4	2,067	82.0
Not Electricity	172	37.9	146	32.2	136	30.0	454	18.0
Total	809	32.1	1030	40.9	682	27.1	2,521	100

Source: Authors Field Data Analysis, 2020

Sanitation and Waste Management Methods

Most people in towns and cities in Nigeria dispose of their solid waste in unhygienic ways at unapproved sites. Unhygienic living condition and usage of contaminated water for drinking and domestic usage have long term negative impacts on nutrition and overall health status especially of children (Kumar, et. al., 2011; Adane, et. al., 2017). Fig. 6 shows that 659 households representing (26.1 %) of sampled households dispose their wastes using trucks provided by the government, 435 (17.3 %) use private contractors, 385 (15.3 %) dump their wastes at roadsides, while 358 (14.2 %) use truck pushers. A significant proportion of households in the Delta North 329 representing (49.9 %) dispose their wastes in government trucks followed by 170 (25.8 %) of households in the Delta Central and 160 (24.3 %) of households in Delta South.

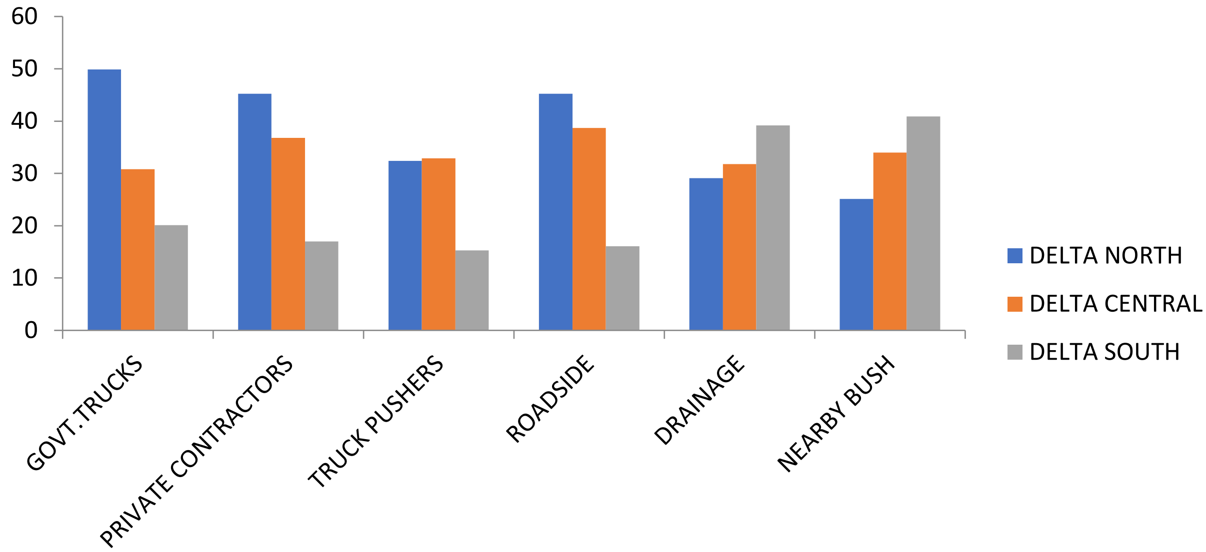

Fig. 6: Method of Waste Disposal
Source: Authors Field Data Analysis, 2020

Determinants of Variation in Access to Infrastructure

Availability and access to infrastructure is key to the socio-economic and sustainable development of the coastal communities of the Delta State. Access to infrastructure is measured as the dependent variable while the independent variables are represented by the high component loadings of the extracted principal components in table 3.

Test of Hypothesis

The result of the hypothesis that access to infrastructure varies significantly among households in the study area is significant at ($p<0.001$). At first, principal component analysis (PCA) was used to reduce the observed variables into smaller number orthogonal components, which together accounted for 57.5 % of the total variations in the variables observed and reducing the effects of multicollinearity. Then, the principal components were used as a predictor or criterion in subsequent analyses to determine the level of variance using ANOVA (see Table 3).

Table 3: Principal Component Analysis

All Variables	Components						
	1	2	3	4	5	6	7
Gender	0.041	0.086	0.005	0.018	-0.006	0.868	0.071
Highest Education of Household Head	-0.392	0.406	-0.381	-0.005	-0.426	0.023	0.056
Marital Status of Household Heads	-0.109	0.091	0.714	0.051	-0.019	0.092	-0.031
Source of Water for Household	0.625	0.356	0.127	0.213	0.115	-0.063	0.058
Distance to Water Source	0.331	-0.250	-0.272	-0.031	-0.456	-0.170	0.190
Sanitation and Toilet Facilities	0.772	0.004	-0.003	-0.097	0.014	0.127	-0.017
Method of Waste Disposal	0.687	-0.007	-0.170	-0.129	-0.257	-0.051	-0.031
Age at marriage	0.036	0.050	0.240	0.527	0.101	-0.178	-0.068
Number of Children	0.042	0.217	0.699	0.294	-0.011	-0.057	-0.057
Employment Status of Households	0.126	0.008	-0.026	-0.719	0.214	-0.161	-0.116
Adults above 18yrs Unemployed	0.062	0.737	0.097	0.052	0.104	-0.080	0.001
Ownership of Assets	-0.001	-0.260	0.084	-0.266	-0.286	0.330	-0.053
Loss of livelihoods	-0.069	-0.096	-0.432	0.357	0.376	0.214	-0.401
Ill Health	-0.011	-0.054	-0.078	0.093	0.142	0.091	0.854
Location	-0.080	-0.601	-0.120	0.047	-0.022	-0.152	0.075
Consumption Expenditure	-0.045	0.550	0.156	0.494	0.000	-0.080	0.076
Financial Independence	-0.059	0.086	-0.119	-0.143	0.611	-0.111	0.242
Eigen Values	1.777	1.714	1.583	1.433	1.155	1.086	1.034
Variance (%)	10.451	10.085	9.309	8.431	6.793	6.389	6.081
Cumulative Explanation (%)	10.451	20.537	29.846	38.277	45.069	51.458	57.540

Source: Authors Field Data Analysis, 2020

Based on the component loadings, the variables are grouped accordingly with their designated components, while principal components 1, 2, 3, 4, 5, 6 and 7 explained 10.451 %, 10.085 %, 9.309 %, 8.431 %, 6.793 %, 6.389 % and 6.081 % of the total variance respectively. The first principal component correlates with three of the original variables: unimproved sanitation method of waste management and unhealthy water with a component loading of 0.772, 0.687 and 0.625 respectively. This first component can be viewed as a measure of access to improved sanitation.

The second principal component is correlated with three variables with high component loadings namely: unemployed adults with a component loading of 0.737, consumption expenditure with component loading of 0.550 and location of households with a component loadings of -0.601. Poor access to infrastructure increases with increasing component loadings on unemployed adults, while lack of access to infrastructure decreases with accessible location of each household with a negative component loading of -0.601, which implies that poor access to facilities decreases with improved access to good and accessible locations. The third principal component correlates with marital status and number of children with component loadings of 0.714 and 0.699 respectively. The third principal component suggests that household size influences access to good infrastructure by households.

The fourth principal component correlates positively with a component loading of 0.527, which could be measured as age of household heads and this fourth principal component correlates negatively with employment status of household heads with a negative component loading of -0.719, which implies that poor access to infrastructure reduces with increased employment and wellbeing of household heads.

The fifth principal component correlates with a high component loading of 0.611 measured as the financial dependency by households, which implies that dependency on financial support reduces access to infrastructure because of inability to afford and pay for the bills required to access the facilities. The sixth principal component correlates with a high component loading of 0.868 measured as gender of household heads. The seventh principal component correlates with a high component loading of 0.854 measured as health status of household heads which implies that health condition of a household head also influences access to infrastructure.

Analysis of Variance (ANOVA)

Table 4 shows the result of the summary of analysis of variance (ANOVA) based on further analysis of the extracted components in the principal component analysis (PCA) used as a predictor or criterion variable. The result shows that the contribution of the criterion variable to the variations in access to infrastructure is statistically significant at (F=527.305, p=< 0.001).

Table 4: Summary of ANOVA

Model	Sum of Square	Df	Mean square	F	Sig.
1 Regression	1212.186	7	173.169	527.305	0.001
Residual	824.624	2511	.328		
Total	2036.811	2518			

a. Dependent Variable). Access to Infrastructure
b. Predictors). (Constant), REGR component score 1, REGR component score 2, REGR component score 3,REGR component score 4, REGR component score 5, REGR component score 6, REGR component score 7

Source: Authors Field Data Analysis, 2020

Conclusion and Policy Implication

This study has examined inequality in access of households to infrastructure or social amenities in the Delta State. Results from the analysis of variance (ANOVA) based on further analysis of the extracted components in the principal component analysis (PCA) used as predictor or criterion variable shows the contribution of the high component loadings to the significant variations in access to infrastructure at (F=527.305, p=< 0.001). Some of these variations are caused by differences in access to infrastructure due to distance to safe water, lack of accessible road network, poor housing, poor sanitation and poor toilet facilities. This implies that spatial variation in access to infrastructure brings about spatial disparities in living standards among the coastal communities.

Consequently, there is hindrance of individual efforts and contributions to socio-economic development and ultimately sustainable development of the communities. Adequate infrastructure is required not just for economic development but also sustainable development of the coastal communities. An understanding of inequality in access to infrastructure is, therefore, critical to sustainable development of the Delta State in particular and South-Southern Nigeria in general.

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