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Geo-spatial Analysis of Infrastructural Facilities in Selected Oil and Non – Oil Producing Areas of Akwa Ibom State, Nigeria

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abstract

Studies have shown that the significance of infrastructural facilities is dependent on their availability and spatial distribution. This study investigates the spatial distributional pattern of existing infrastructural facilities in twenty selected rural communities in the oil and non-oil producing areas of Akwa Ibom State. Spatial data were collected on the facilities through field inventory. The study adopted location quotient, Gini coefficient, and the standard score analytical techniques to analyse the spatial concentration, inequality, and infrastructure gaps in the study area. The results revealed a significant variation in the infrastructure distribution with varying degrees of locational concentration, deficiencies, and inequalities. The oil-producing area has four privileged communities, best served with education, health, and water infrastructure. About 51% of the population lives above the income poverty line. In comparison, the non-oil producing area has three privileged communities, best served with small-scale industry and commercial infrastructure. About 45% of the population lives above the income poverty line. It can be concluded that there is a spatial inequality in the provision and distribution of the infrastructural facilities between the oil and non-oil producing areas. The paper recommends enhanced infrastructure investment in underserved areas and an adherence to an optimal location standard to promote equity and spatial balance in the infrastructure provision.

Introduction

Infrastructure plays a pivotal role in most emerging economies and remains a core focus with high expectations and interest, because of its strong links with economic growth and poverty reduction (Ajakaiye and Ncube, 2010). It is envisaged that the sustainability of the environment and human life cannot be successfully achieved until the human settlement is economically, socially, and environmentally vibrant through adequate infrastructure provision (Udofia et al., 2013). Infrastructure has been conceptualised by Sunday et al., (2018) as a general term used to describe the overall facilities necessary for the functioning of human settlements and the realisation of primary, secondary, and tertiary productive activities. From a functional point of view, infrastructure facilitate the production of goods and services and the distribution of finished products (Ajibola et al., 2013). They are at the centre of household activities and are so supportive of human life, including the provision of basic needs such as food, water, shelter, education, housing, and health.

However, there is a renewed acknowledgement of the importance of adequate infrastructure provision. Davies et al. (2019) opine that infrastructure is as an enabler that directly or indirectly influence the attainment of about 72% of the overall targets of the Sustainable Development Goals. Six of the 17 Sustainable Development Goals have all of the targets influenced by infrastructure (SDGs 3,4,6,7,9 and 11). To this end, the critical nature of infrastructure in promoting economic growth has pushed the African Development Bank to make infrastructure provision and development a cornerstone in its development agenda with regional member countries to facilitate poverty reduction (Ojeifo and Ojeifo 2012). Also, in agreement with the importance of infrastructure, the African Development Bank [ADB] (2010) and Mabogunje (1993) advised that infrastructure provision should be adequate and on a self-sustaining bases.

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According to Energy Information Assessment, [EIA] (2019), Nigeria falls among the top three major oil producing countries in sub-Saharan Africa and the 11th in the world. Nigeria also has the second-largest proven oil reserves globally and the largest oil exporter on the continent, exporting approximately 2.08 million barrels of crude oil per day to the international market in 2019. In addition, Nigeria holds the largest natural gas (LNG) reserve on the continent and is ranked as the 5th largest exporter of natural gas globally (E.I.A., 2019). Besides, Nigeria is also the largest shareholder at the African Development Bank and an essential member of the ECOWAS region. Despite being a major player in the global oil market, Nigeria is reported to have the worst infrastructure deficit and lags behind its peers in almost all infrastructure indicators (Umar, Ogbu, and Ereke, 2019).

The dearth and decay of adequate infrastructure in an adverse social and economic growth is not only peculiar to Nigeria; instead, it is an African problem or, generally, a characteristic of a developing economy. Arguably, the gaps in infrastructural provision and distribution can be a global issue, but in Nigeria, the scale of the problem is extreme. The state of infrastructure in Nigeria is inadequate to simulate many business activities and growths (Akinwale, 2010). The situation becomes more ambiguous in the face of rational explanation when it is realised that the South-South Region that contributes significantly to the total revenue of the country is the worst hit by the non-provision of adequate infrastructure. In Nigeria, and in particular, Akwa Ibom State, inadequate infrastructure provision has undermined the hope of achieving most of the nation's Sustainable Development Goals.

Moreover, Nigeria cannot sustain the current population growth without enhanced infrastructure provision. Nigeria is currently the seventh most populous country globally, with its economy growing below the population growth rate. By 2050, there is the expectation that Nigeria will be the third most populous country in the world, only behind China and India (Davis et al., 2019). This is likely to exact profound demand for an increase in the infrastructure stock in the future so as to reduce the strain on the existing ones.

In Nigeria, as submitted by Akpan & Artser (2010), Akwa Ibom State is a major player in the oil sector. The state accounts for approximately 31.4% of

the nation's total daily crude oil production. As a result, the state receives the second-highest financial allocation based on the current 13% revenue allocation formula. However, the level of rural infrastructural development in the state is weak compared to the increased oil exploration and production. (Akpan and Atser, 2010).

Preliminary personal investigation and observation reveals that Akwa Ibom State has targeted the improvement of infrastructure metrics through various infrastructural investments in recent times. However, studies have shown that the effort is still ill-conceived, especially compared with the state's income level as the largest oil producer in Nigeria (Okafor, 2020). The reality is that the demand for infrastructure in the Akwa Ibom State is more than the current model and capacity of provision. While the impact of some infrastructure in the Akwa Ibom State can be felt in some core urban settlements, virtually all rural and coastal oil-producing communities are not beneficiaries of these infrastructural projects.

Moreover, one of the most challenging issues of policy making and implementation facing Akwa Ibom State is improving the standard of living of the people, particularly in the rural areas, and providing adequate infrastructure for the teeming population to meet the demand of businesses, households, and other uses. Adequate infrastructure provision underlies the economy's integration and helps with the spread of its benefits; thus, making human settlement inclusive, safe, resilient, and sustainable. The growth, development, functioning, and prosperity of human settlements depend on the extent to which infrastructure is adequately provided (Arimah, 2017).

Again, the problems of poverty become worrisome when considered in the context of the quantum and quality of infrastructure provision and distribution. It becomes even more sensitive when the need for equity has not explicitly been considered during the planning and distribution of infrastructure (Ndana et al., 2018). The current situation of infrastructure bias is a significant issue in understanding the process of infrastructure provision and its distribution in the Akwa Ibom State. It has led to the polarisation of infrastructure development in the state, such as the Villa Marina in Eket, Ewet Housing Estate, and the Shelter Afrique in Uyo.

Empirical studies such as Ekpeyong (2016), Atser and Udoh (2015), Enefiok and Ekong (2014), Ekanem and Nwachukwu (2014) and Akpan and Atser (2010) focused exclusively on the efforts and role of government and other infrastructure providers in providing infrastructure and service delivery in Akwa Ibom State without juxtaposing the provision with the distributional balance since infrastructure performance, and access is highly appreciated by its distribution in space. Besides, while the studies mentioned above investigated one or two variables of infrastructure, this study has extended its scope to include infrastructure categories and types. For instance, for public/private educational infrastructure category, (the types that includes primary schools, secondary schools, adult education centres, and skill acquisition centres); public/private water infrastructure category (pipe-borne, boreholes, and wells), public/private health infrastructure category (primary health centres, clinics, cottage hospitals, and General Hospital), public/private small-scale industry category (oil palm, cassava, and oil palm/cassava mill) and public/private commercial infrastructure category (banks and rural markets).

In the light of Akwa Ibom State being the largest oil-producing state in Nigeria and the continual receipt of far greater revenue from the federation accounts than any other state in the country, the main objectives of this study are to:

1. analyse the comparative inventory and analyse the spatial distributional pattern of the stock of the existing infrastructure between the oil and non-oil producing areas of the study area.
2. assess the gaps in infrastructure provision and income poverty threshold between the oil and non-oil producing areas of the study.

Theoretical Underpinning

The theoretical thrust of the study is anchored on the Spatial Welfare and Equity Theory

The Spatial Welfare and Equity Theory.

Adam Smith is credited with the development of the spatial welfare and equity theory in 1776. The spatial welfare and equity theory is fundamental in understanding this study because it portrays or defines the state of a society by the number of goods and services it produces and, principally, its equitable distribution among residents (Smith, 1994). Spatial Welfare and Equity theory is the process whereby the natural resources of a region are harnessed and used as a vehicle for growth and development. It argues the need for development agents or governments to assist and encourage welfare maximisation to avoid social, economic, and spatial inequalities (Amer, 2007). Spatial welfare and equity theory focuses and expounds on living a quality life while emphasising social justice and equity in distributing social services, infrastructure in this case, with a spatial dimension.

The spatial welfare and equity theory encourages the provision of adequate social services such as healthcare, housing, education, and water. However, the major assumption of the theory is that a spatially defined area can grow and develop if the natural resources are exploited and distributed. Sule (1991) submits that applying the theory to emerging economies in Africa will make basic planning units emerge, which will provide growth nerves at different locations, serving as an impulse of growth. Social welfare services like education, healthcare, water, electricity, and housing form a part of the social services that most communities have come to require and expect. They are mostly needed by those who cannot stand on their own as fully independent. However, according to Smith (1977), the main thrust of the spatial Welfare and Equity Theory is who gets what, where, and how (Figure 1).

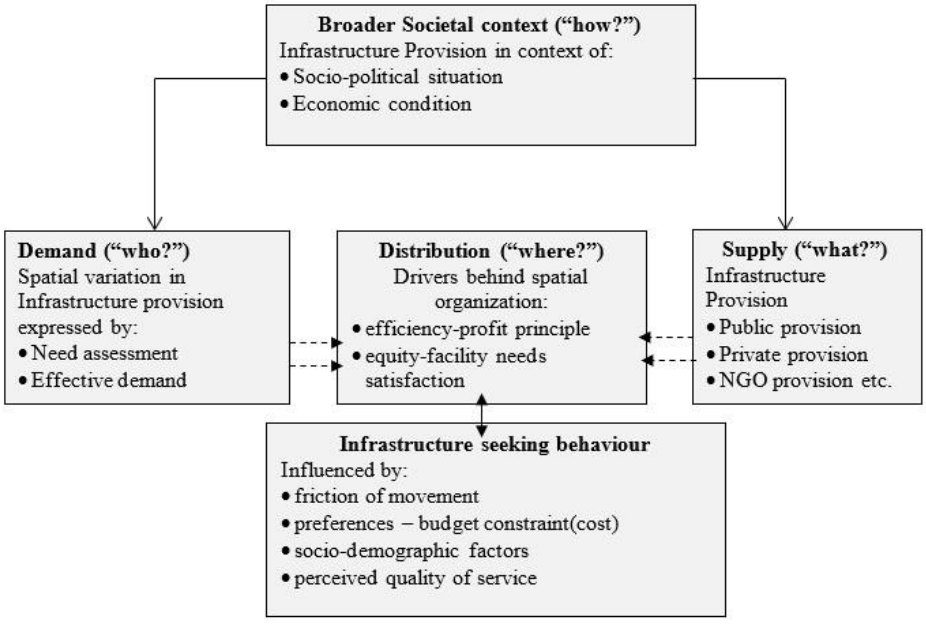

Figure 1: Schematic Representation of the Spatial Welfare and Equity theory modified after Smith (1977)

The "who?" in the context of this study are the beneficiaries or end-users of development, the "what?" are the infrastructural facilities, and the emphasis on "where?" brings into focus the spatial perspective of a location. The "how?" dimension is the functioning process of the economic and political system that influences how social welfare gets distributed. In addition, in evaluating the performance of the theory in the distribution of goods and services, Smith (1994) argues that the helpful starting point is to understand the principle of equality or what Hay (1995) calls social justice in service distribution. Equality has to do with being impartial, and a distinction is made by Amer (2007) between what he calls arithmetic equality and proportional equality. On the one hand, arithmetic equality has to do with perfect equality of treatment where the same quantity of services or benefits is provided to everybody, notwithstanding the circumstances.

On the other hand, proportional equality is simply providing service based on the people's needs. Davies (1968) calls it territorial justice and summarises that if the objective of providing services is to each according to his needs, then the distribution of services must be to each according to the population's need. Territorial justice is well-rooted in the principle of proportional equality and has a lot to do with securing a geographical match between resource allocation and resource needs (Amer, 2007).

Moreover, according to welfare economic theory, equity in the distribution of basic development needs is indicative of the degree of accessibility of the population to such services and facilities. The level of access to social facilities is directly proportional to the degree of fairness in the spatial distribution of the facilities. Accessibility in this context is the ease with which service or facility can be assessed. It is a tool that can be used to discover whether or not equity has been achieved (Talen and Anselin, 1998). The spatial welfare and equity theory is essential and central to development, and it is concerned with equality, fairness, and social justice (Anderson and O'Neil, 2006). It involves the degree of fairness and inclusiveness with which resources are distributed, opportunities afforded, and decisions are taken.

However, in applying this theory to this study, it is important to refer to its keywords which are "who?" gets "what?" "where?" and "how?" The spatial welfare and equity theory is important and it has been applied in this study to help elaborate and provide a framework that can explain the spatial distribution of the existing infrastructure in the study area and also bring to the bay the spatial planning for distributing services, in this context, the existing infrastructure, to a spatially dispersed population as it incorporates the geographic space as an element.

The Study Area

The study area is the Akwa Ibom State. This State was chosen because it is the largest oil-producing state in Nigeria, hence, the supposed infrastructural development assistance by governments and other stakeholders. The State was created on 23rd September 1987 out of the old Cross River State. It is located between latitudes $4^{0}00^{'}$N and $5^{0}45^{'}$N and longitudes $7^{0}25^{'}$E and $8^{0}25^{'}$E. It is bounded by the Cross River, Abia, and Rivers State towards the East, North, and West, respectively. In the south is the Bight of Bonny in the Atlantic Ocean, which accommodates most oil-producing facilities in the coastal state. It has thirty-one Local Government Areas with a total landmass of 7,249 km^2 and a 2016 projected population estimated at 5,482,177 (NBS, 2018). There are 119 clans and 2,664 villages.

Figure 2: The Studied Oil and Non-Oil LGAs (Author, 2022)

The State population covers about 3% of the total national population. (NPC, 2006). The State's climate is characterised by two seasons, the wet season, which lasts for seven months (April – October), and a short dry season (November – March), covered by dry dust harmattan winds. It is the 10th largest state in the country in terms of landmass. It accounts for about 128.64km of the coastline, which is about 13.4% of Nigeria's entire length. This stretches from Oron in the East, through Ibeno and Eastern Obolo in the South, to Ikot Abasi in the West (Figure 2).

The Studied Local Government Areas

This study is restricted to four Local Government Areas: Ibeno, Eastern Obolo, Nsit Atai, and Oruk Anam. While Ibeno and Eastern Obolo are oil producing Local Government Areas, Nsit Atai and Oruk Anam are core rural non-oil producing Local Government Area. The four local government areas fall under the eleven local government areas adjudged to be 100% rural (Ituen et al. 2016).

The Ibeno Local Government, which is headquartered at Upenekang, was carved out of the defunct Uquo-Ibeno LGA in 1999, a part of Eket LGA hitherto. The Ibeno local government occupies 1,200 km^2. It stretches from Okposo 1 at the eastern flank, bordering Mbo LGA and Bakassi Peninsula to the Atabrikang village on its west. It accommodates the Qua Iboe Terminal (QIT), owned and operated by Exxon Mobil. The onshore and offshore areas of Ibeno LGA are dominated by various oil operations that attract many indigenous and expatriate workers.

Eastern Obolo Local Government Area is located at the fringe between Imo and Qua Iboe Rivers estuaries. It occupies a 117,008 km^2 area and plays host to Oso condensate, the largest oil field in West Africa owned by ExxonMobil. Also, Okoro and Setu East fields in OML 112, operated by Amni International Petroleum Company, Total E&P, and Century Energy Company, are in the area.

Nsit Atai local Government is located at the southeast corner of the state. It covers a 134km^2 area and is bounded by Uruan LGA in the north, Okobo LGA in the east, and Ibesikpo Asutan LGA in the west. It is the smallest local government in population after the Ika local government and one of those with high poverty index according to the 2015 economic study report. The people are Ibibio with the Ibibio language as the primary spoken language. They are predominantly farmers and sundry traders.

Oruk Anam Local Government Area has boundaries in the North with Ukanafun and Abak; in the south by Ikot Abasi; Mkpat Enin in the East and Ukanafun in the West. It is one of the eight Annang speaking local governments created from the former Abak division. Naturally, it is rich in Agro-allied resources like palm oil and kernel, timber, cassava, and plantain. The inhabitants are mostly farmers, petty traders, and civil servants. The LGA is a major gateway to Port Harcourt and Aba; hence, there are many commercial activities, especially in Ekparakwa.

Materials and Methods

Sampling Technique

Twenty (20) communities, made up of ten (10) apiece in both oil and non-oil producing area were selected using stratified random sampling, for field inventory. The communities in the oil-producing areas are rural communities with oil multinationals terminal facilities, and exploration/exploitation activity occurs onshore/offshore while those in the non-oil producing areas are core rural areas like the oil-producing ones and are accessible from major towns and were within reach for investigation.

Data Sources and Methods of Data Collection

Field Inventory (Spatial Data)

The existing infrastructure were inventoried and their spatial positions (x, y coordinates) taken and recorded using a handheld GPS (Garmin 76 S Model). The infrastructure category inventoried as already pointed out includes public/private education infrastructure category (the infrastructure types includes primary schools, secondary schools, adult education centres, and skill acquisition centres), public/private water infrastructure category (pipe-borne, boreholes, and wells), public/private health infrastructure category (primary health centres, clinics, cottage hospitals, and General Hospitals), public/private small-scale industry category (oil palm, cassava, and oil palm/cassava mill) and public/private commercial infrastructure category (banks and rural markets) comprising a total of sixteen infrastructure types in all. These infrastructure were chosen because they contribute to human welfare and are essential to satisfy his basic needs of food, water, healthcare, and education. Moreover, these infrastructure are typical of the study area's local rural environment and culture and are in the World Bank development indicators.

These infrastructure, especially the health infrastructure categories were included in the study because according to Perrya and Gesler, 2000, primary health care centre is required per community of about 500 to 5000 people while a Local Government Area is expected to have a minimum of a general hospital.

This study is a comparative analysis of the distribution pattern of infrastructure stock profile between the oil and non-oil producing areas of Akwa Ibom State. Apart from the need for an intensive study of the distribution of the existing infrastructure, the comparative analysis is based on the premise of tracking the level of infrastructural stock profile and the spatial distributional balance that it exhibits between the two areas. The oil-producing Ibeno and Eastern Obolo Local Government Areas were so chosen because of their status as the only oil-producing L.G.A.s in the state, hence the expected level of infrastructural development, while the non - oil L.G.A.s of Nsit Atai and Oruk Anam were chosen because they are rural as the oil-producing ones and used as a control for comparing the infrastructure stock profile.

Key informant interviews (KII)

Key informant interviews were conducted on opinion leaders in the sampled communities to get more information on the stock of existing infrastructure.

Administrative Data

Information on the existing infrastructure and population of the study area was collected from the Bureau of Statistics of the Ministry of Economic Planning and Development, the National Population Commission, and the National Bureau of Statistics.

The Procedure for Data Analysis

The spatial distribution pattern was analysed comparatively with relevant geospatial statistical techniques of location quotient, Gini coefficient, and standard score analysis under three categories.

Spatial Concentration: Location Quotient (LQ)

This measures the relative spatial concentration of a facility to the population by comparing the community's percentage share of a facility with the percentage share of its population. If LQ > 1, it shows concentration, LQ < 1 shows deficiency and LQ = 1 shows sufficiency. It is given as:

$$LQ = \frac{Si}{S} \div \frac{Ni}{N} \quad \text{……(1) (Adefila, 2013)}$$

where;

Si= number of a variable in a unit area

S = total number of that variable in the region

Ni = population in a unit area

N = total population in the region.

Spatial disparity/Inequality: Gini Coefficient (G.C.): The Gini coefficient is an aggregate inequality measure that measures the inequality of a variable in a distribution. It ranges between 0 (perfect equality) and 1 (perfect inequality). It is given as:

$$G = 1 - \sum_{i=0}^{N} \left(\sigma_{y_{i-1}} + \sigma_{y_i}\right)\left(\sigma_{x_{i-1}} - \sigma_{x_i}\right) \ldots\ldots\ldots\ldots (2) \text{(Oguntade and Yusuph, 2007)}$$

Where;

G= Gini Index; σ_{x_i} = cumulative proportion of the population or land area in the region'

σ_{y_i} = cumulative proportion of infrastructure in a region and

N = number of communities.

The Gini coefficient is linked to the Lorenz curve and is considered for this study because it is a standard inequality metric incorporated into the World Bank Human Opportunity Index (Kiadari et al., 2011).

Identification of Gaps in Infrastructure Provision and Income Poverty Threshold.

The Standard score shows how far an item deviates from its distribution's mean. It gives a standardised score that is more appropriate and less biased. It was used in this study to bring out gaps in the provision of the infrastructure by ranking the communities based on their respective composite scores into categories of best served, and least served communities and infrastructure. The different infrastructure standard and composite scores (z score) were

mapped to show clarity and analytical appreciation of the distribution pattern revealed. It is given as:

$$Z = \frac{x-\mu}{\sigma} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$ (Adedayo and Afolayan, 2012)

Where; Z = standard score

x = observed value

σ = the standard deviation of the sample

μ = mean of the sample/population.

The income poverty threshold was analysed by comparing the income level of the oil and non-oil producing areas with the international extreme poverty threshold of 1.9 dollars (₦306 per dollar) as stated by the World Bank, (2020). This was to determine the population above or below the poverty line in the oil and non-oil producing areas.

Results

Classification of Inventoried Infrastructure Categories in the Oil and Non-oil Producing Areas

The inventoried infrastructure in both areas of study were categorized into education, health, water, small-scale industry, and commercial infrastructure. The oil producing area has more of education (60%), health (71%) and water infrastructure (52%) while the non- oil-producing area has more of small-scale industry (95%) and commercial infrastructure (64%) (Figure 3).

Spatial Location of Existing Infrastructure in the Oil and Non-Oil Producing Areas

The maps in Figure 4 to Figure 8 shows the spatial location of existing infrastructure.

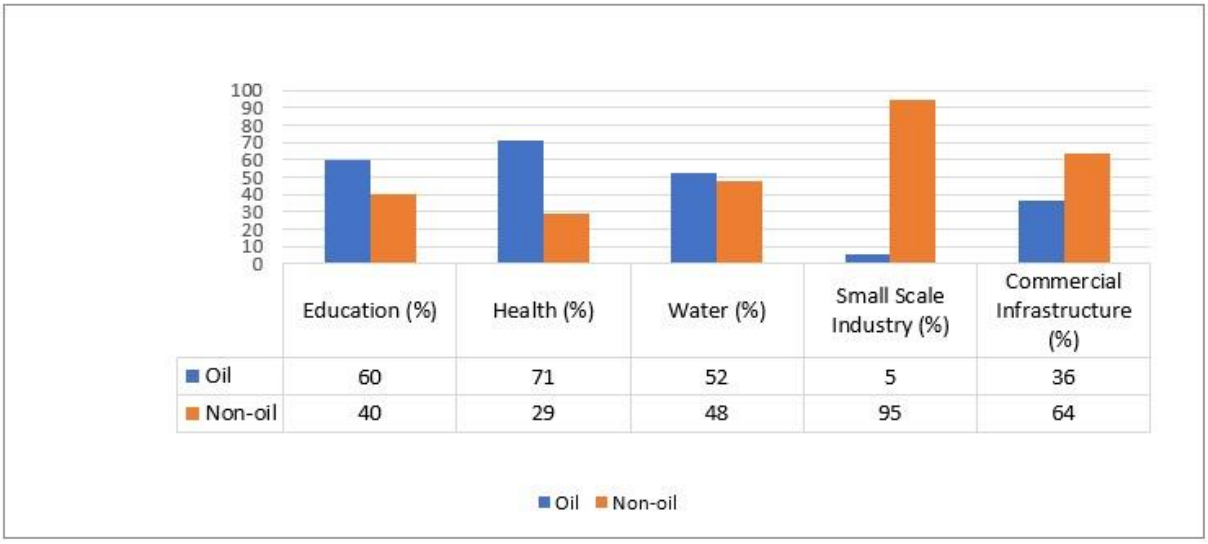

Figure 3: Categories of Infrastructure
Computed from field surveys (2022)

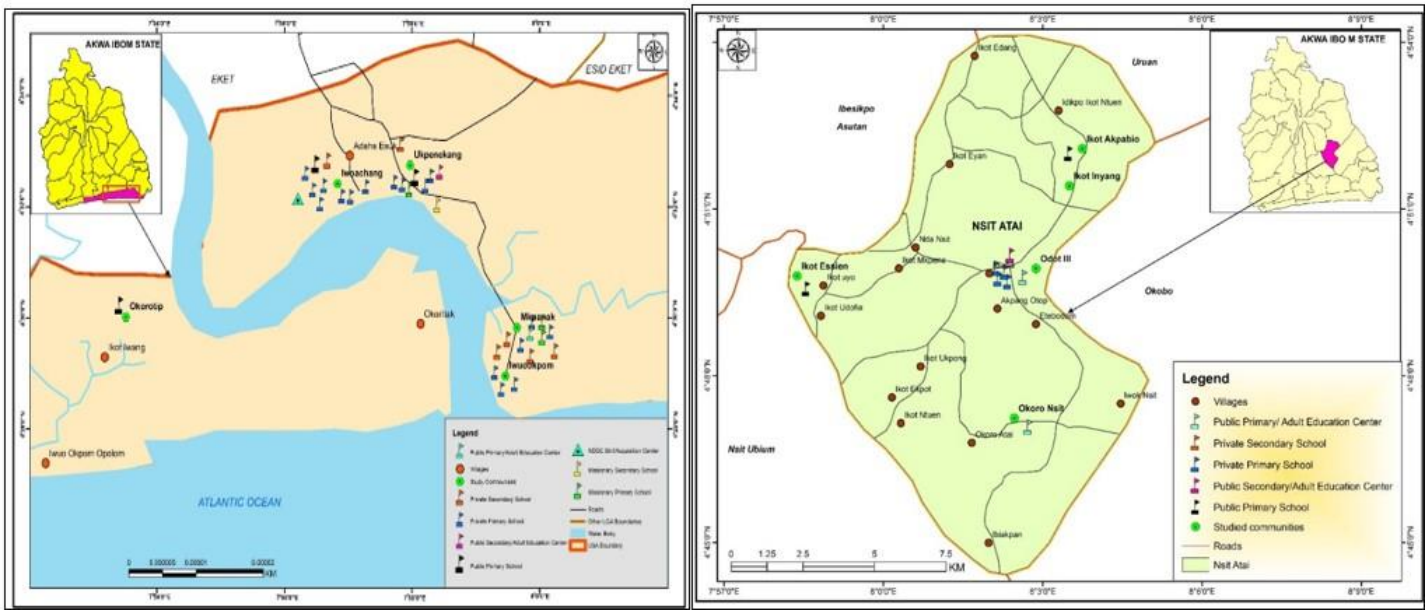

Figure 4: Public/Private Education infrastructure in the oil and non-oil producing areas
Source: Author, (2022)

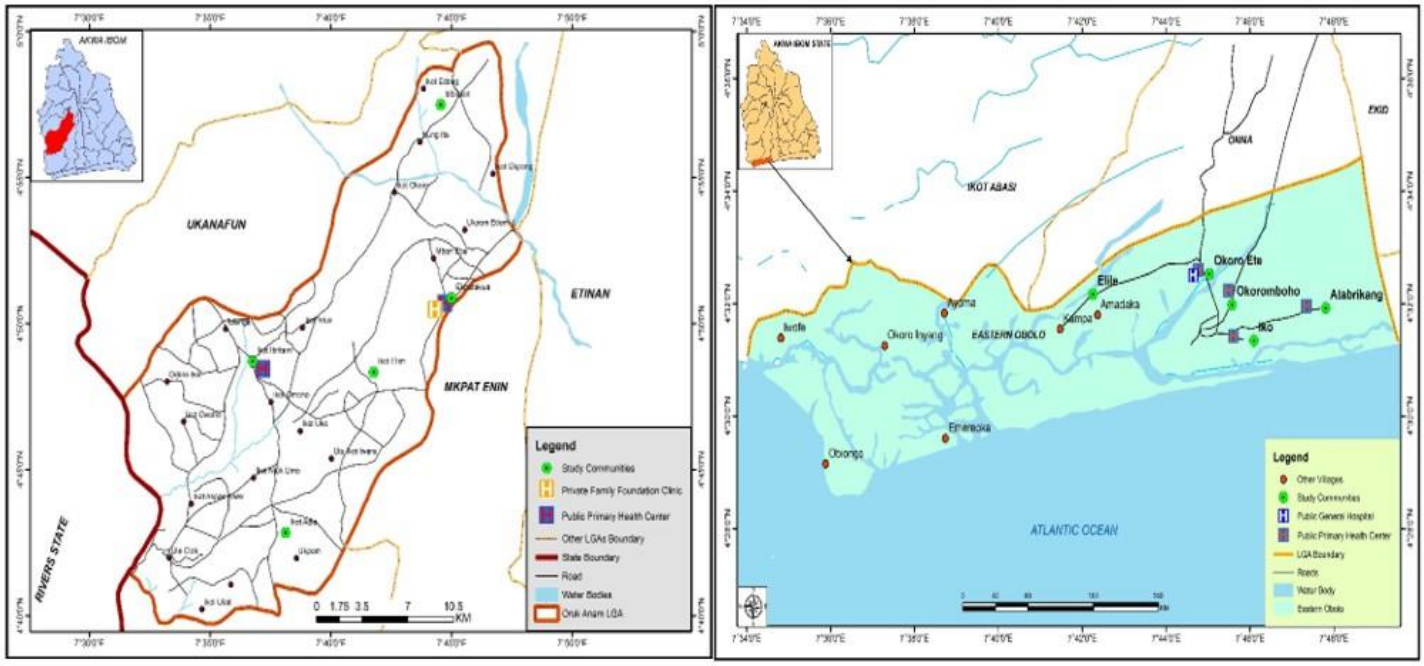

Figure 5: Public/Private Health infrastructure in the oil and non-oil producing areas
Source: Author, (2022)

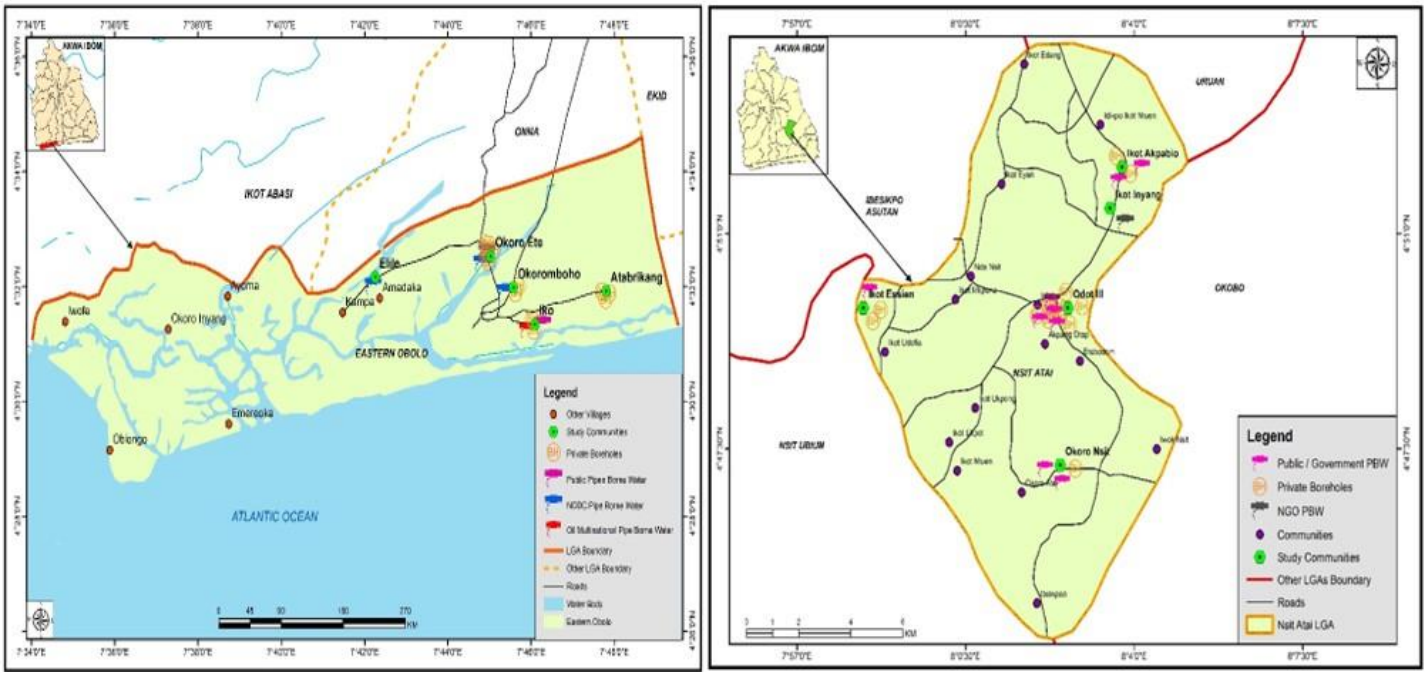

Figure 6: Public/Private Water infrastructure in the oil and non-oil producing areas
Source: Author, (2022)

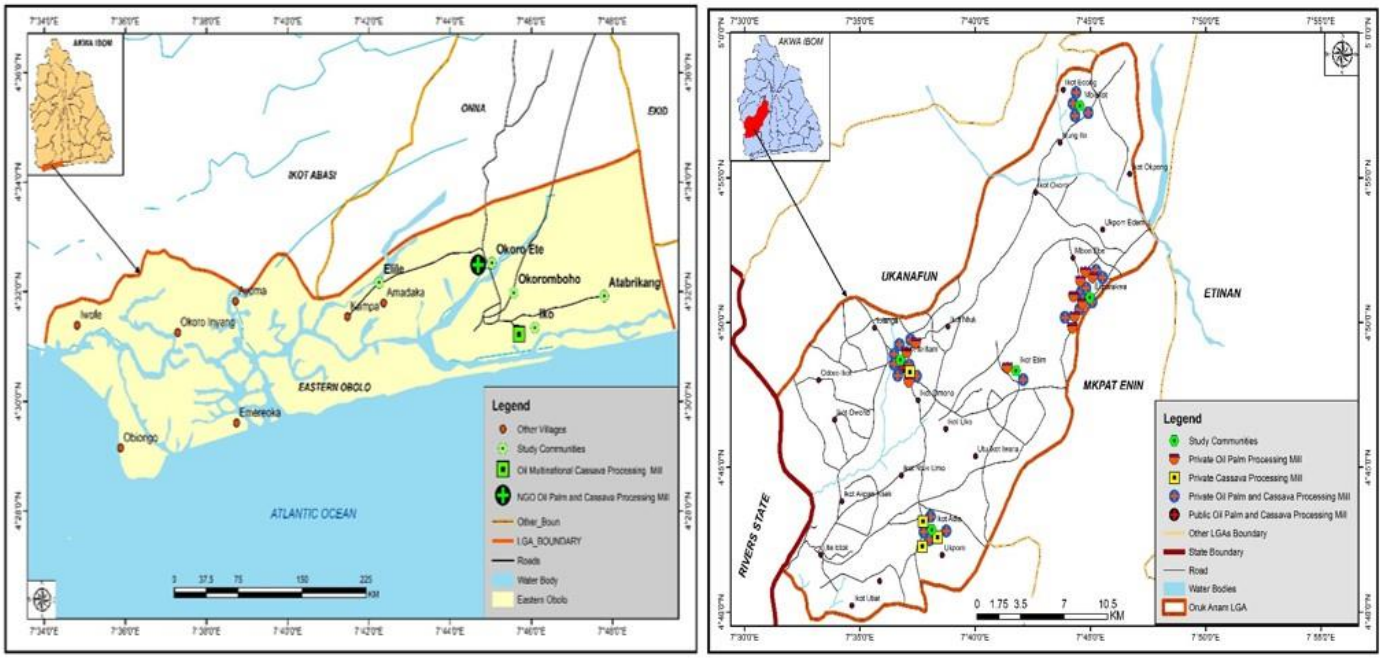

Figure 7: Public/Private Small-Scale Industry infrastructures in the oil and non-oil producing areas
Source: Author, (2022)

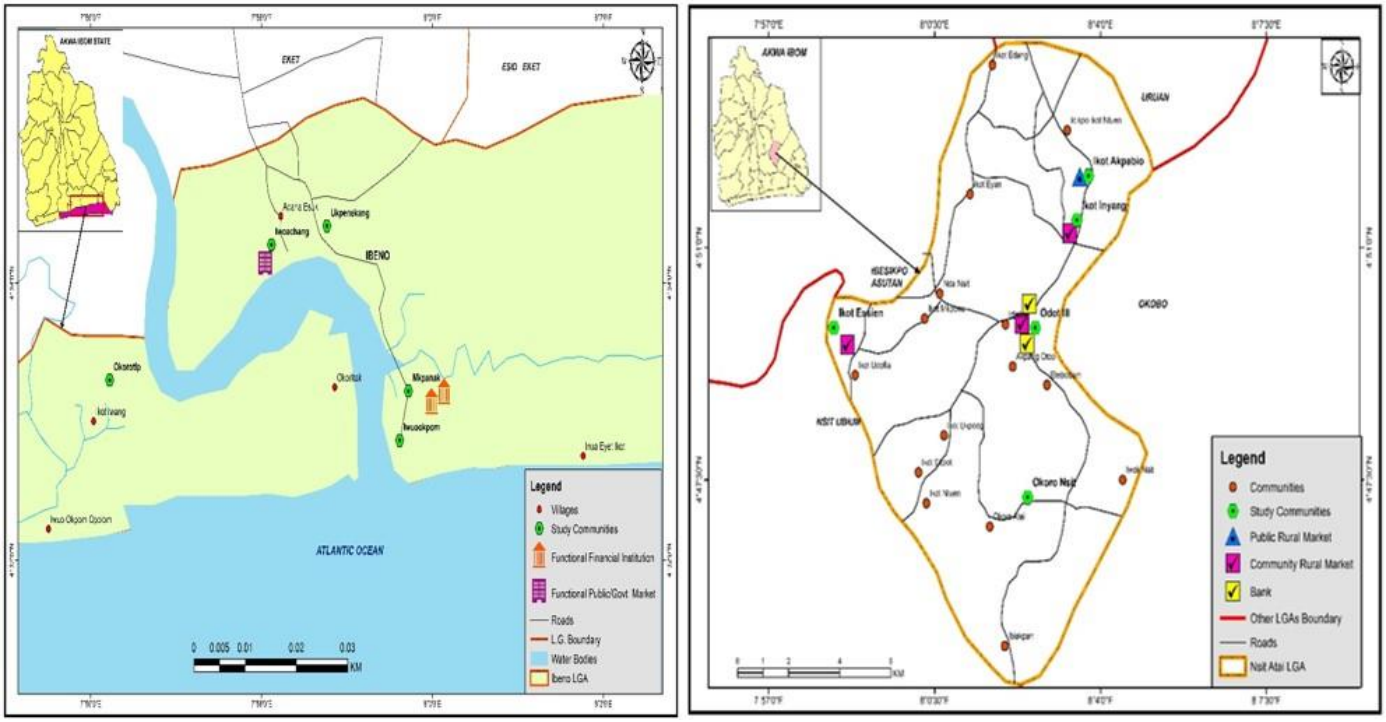

Figure 8: Public/Private Commercial infrastructure in the oil and non-oil producing areas
Source: Author, (2022)

Spatial Concentration of the Infrastructure in the Oil and Non-Oil Producing Areas

All the sixteen infrastructure types studied were not concentrated (marginally advantaged) in both the oil and non-oil producing areas. Concentrated infrastructure types in the non-oil producing areas were in 2 to 8 infrastructure types while that of the oil producing areas was in 2 to 6 infrastructure types. (Table 1). Aggregately, in the non-oil producing areas, 25.8% of the existing infrastructure types were concentrated (marginally advantaged), 13.2% were deficient (marginally disadvantaged) while 61% were unavailable. In the oil-producing areas, 23.3% of the infrastructure types were concentrated (marginally advantaged),13.8% were deficient (marginally disadvantaged), while 62.9% were lacking (Table 2). Mkpanak, the host of ExxonMobil oil multinational in the oil-producing region, had a fair share (sufficient) in borehole infrastructure, while Ekparakwa, a commercial community in the non-oil producing area, had a fair share (sufficient) in adult education infrastructure, all with an LQ of 1. Ikot Etim in the non-oil producing area was the most marginally disadvantaged community, with no concentration of the sixteen infrastructure types investigated (Table 1). This is possibly due to inadequate provision of the infrastructure as evident from a submission by the youth leader of the community thus:

"*.... in summary, we are lacking in infrastructure. The federal government skill acquisition centre, which has been under construction for more than ten years, has long been abandoned for quite some time now. I do not understand why they started the project in the first place. We would have reaped enormous rewards if it is completed…..* (Youth leader, Oil-Producing Area).

In the oil-producing area, six infrastructure types were concentrated in Okoromboho. They include all educational infrastructure types, primary health centre, and borehole. Five infrastructure types were concentrated in Mkpanak, Iwuoachang, and Okoroette. They include a secondary school, an adult education centre, clinic, well, and bank in Mkpanak. In Iwuoachang, there was a primary school, skill acquisition centre, primary health centre, borehole, and market, while there was an adult education centre, a primary health centre, general hospital, oil/cassava mill, and market in Okoroette. Moreover, four infrastructure types were concentrated in Iwuokpom, namely, primary school, borehole, pipe-borne water and a well. Meanwhile, three infrastructure types each were concentrated in Upenekang, Okoroutip, and Atabrikang. Two infrastructure types each were concentrated in Iko and Elile. Concentrated in Upenekang were cottage hospital, pipe-borne water, and oil palm mill. Primary health centre, pipe-borne water, and well were concentrated in Okoroutip, while primary school, health centre, and borehole were concentrated in Atabrikang. In Iko, a primary health centre and market were concentrated, while in Elile, primary school and pipe-borne water were concentrated (Table 1).

In the non-oil producing areas, eight infrastructure types were concentrated in Odot 111. They include primary school, secondary school, adult education centre, primary health centre, borehole, pipe-borne water, market, and bank. Six infrastructure types were concentrated in both Ikot Ibritam and Mbiakot. They are primary school, primary health centre, boreholes, pipe-borne water, oil-palm mill, and oil/cassava processing mill in Ikot Ibritam and primary school, secondary school, adult education centre, borehole, oil/cassava mill, and market in Mbiakot. However, while five infrastructure types were concentrated in Okoro Nsit and Ikot Adia, four were concentrated in Ekparakwa. An Adult education centre, a primary health centre, pipe-borne water, cassava mill, and an oil/cassava mill were the five infrastructure types concentrated in Okoro Nsit, and primary school, borehole, well, cassava mill and oil/cassava mill were the five infrastructure categories concentrated in Ikot Adia. The four infrastructure types concentrated in Ekparakwa include a secondary school, a clinic, borehole, and oil palm mill. Moreover, three infrastructure types were concentrated in Ikot Inyang, including pipe-borne water, oil palm mill, and market, while two infrastructure types were concentrated each in Ikot Akpabio and Ikot Essien, namely, pipe-borne water and market in Ikot Akpabio and oil palm mill and market in Ikot Essien. (Table 1).

The above result for infrastructure type concentration using the location quotient technique is consistent and in line with the empirical works of Borana and Yadav (2017), Hanif et al. (2015), Sanni (2010) and Akpan and Atser (2010) which all investigated the infrastructure growth pattern in development. The result indicates that the study areas are characterized by communities that are very low and weak in infrastructure concentration.

Table 1: Communities by Location Quotient Values

	Infrastructure Categories	Education Infrastructure				Health Infrastructure				Water infrastructure			Small Scale Ind.			Commercial		
	Infrastructure Types	Pri. Sch	Sec. Sch	AEC	SAC	PHC	Clinic	CH	GH	BH	PBW	Well	OPM	CPM	OCPM	Market	Bank	Infrastructure types with LQ >1
Oil Producing Area	Okoromboho	1.73	2.46	7.37	14.74	3.28	0	0	0	0.91	1.05	0	0	0	0	0	0	**6**
	Mkpanak	0.84	1.69	1.02	0	0.45	4.07	0	0	1	0.73	2.03	0	0	0	0	4.07	**5**
	Iwuoachang	1.29	0.46	0	2.75	1.22	0	0	0	1.18	0.79	0	0	0	0	1.83	0	**5**
	Okoroette	0.95	0.90	2.69	0	1.20	0	0	5.38	0.83	0.77	0	0	0	16.67	3.59	0	**5**
	vuokpom	3.70	0	0	0	0	0	0	0	5.81	4.49	10.48	0	0	0	0	0	**4**
	Upenekang	0.70	0.99	0.99	0	0.44	0	1.99	0	0.80	1.14	0	3.98	0	0	0	0	**3**
	Okoroutip	0.66	0	0	0	2.49	0	0	0	0.35	1.60	5.61	0	0	0	0	0	**3**
	Atabrikang	2.09	0	0	0	7.88	0	0	0	3.28	0	0	0	0	0	0	0	**3**
	Iko	0.70	0.99	0	0	1.32	0	0	0	0.37	0.85	0	0	0.18	0	3.96	0	**2**
	Elile	1.07	0	0	0	0	0	0	0	0	1.30	0	0	0	0	0	0	**2**
Non-Oil Producing Area	Odot III	2.09	1.47	2.51	0	2.20	0	0	0	1.04	2.93	0	0	0	0.78	1.26	8.80	**8**
	Ikot Ibritam	1.53	0	0.76	0	1.34	0	0	0	1.27	1.07	0	1.07	0.89	1.26	0.76	0	**6**
	Mbiakot	1.43	5.01	4.29	0	0	0	0	0	1.58	0	0	0	0	3.54	4.29	0	**6**
	Okoro Nsit	0.96	0	2.88	0	5.03	0	0	0	0.26	2.68	0	0	6.70	2.96	0	0	**5**
	Ikot Adia	1.49	0	0	0	0	0	0	0	1.03	0	15.63	0	7.81	1.84	0	0	**5**
	Ekparakwa	0.50	2.34	1	0	0.88	3.51	0	0	1.43	0.23	0	1.64	0	0.83	0.50	0	**4**
	Ikot Inyang	0	0	0	0	0	0	0	0	0	1.69	0	1.69	0	0	3.63	0	**3**
	Ikot Akpabio	0.63	0	0	0	0	0	0	0	0.35	1.77	0	0	0	0	1.89	0	**2**
	Ikot Essien	0.66	0	0	0	0	0	0	0	0.36	0.92	0	2.79	0	0.41	1.97	0	**2**
	Ikot Etim	0.59	0	0	0	0	0	0	0	0.65	0	0	0.83	0	0.36	0	0	**0**

Source*: Computed from Field surveys (2018)* *AEC = Adult Education Center *SAC =Skill Acquisition Center *PHC = Primary Health Center
* CH=Cottage Hospital *GH=General Hospital *BH = Borehole *PBW = Pipe Borne Water *OPM = Oil Palm Mill *CPM = Cassava Processing Mill
* OCPM = Oil and Cassava Processing Mill

Table 2: Summary of Location Quotient Values by Communities

	Classification	Description
Oil Area	LQ >1 in 2 – 6 infrastructure	Elile, Iko, Atabrikang, Okoroutip, Upenekang, Iwuokpom, Okoroette, Iwuoachang, Mkpanak, Okoromboho
	LQ = 1	Mkpanak (Borehole)
	% Concentrated	23.3%
	% Deficient	13.8%
	%Not available	62.9%
Non-Oil Area	LQ >1 in 2 – 8 infrastructure	Ikot Essien, Ikot Akpabio, Ikot Inyang, Ekparakwa, Ikot Adia, Okoro Nsit, Mbiakot, Ikot Ibritam, Odot111
	LQ = 1	Ekparakwa (Adult Education Center)
	L.Q. <1	Ikot Etim
	% Concentrated	25.8%
	% Deficient	13.2%
	%Not available	61%

Source: Computed from Field Survey (2022)

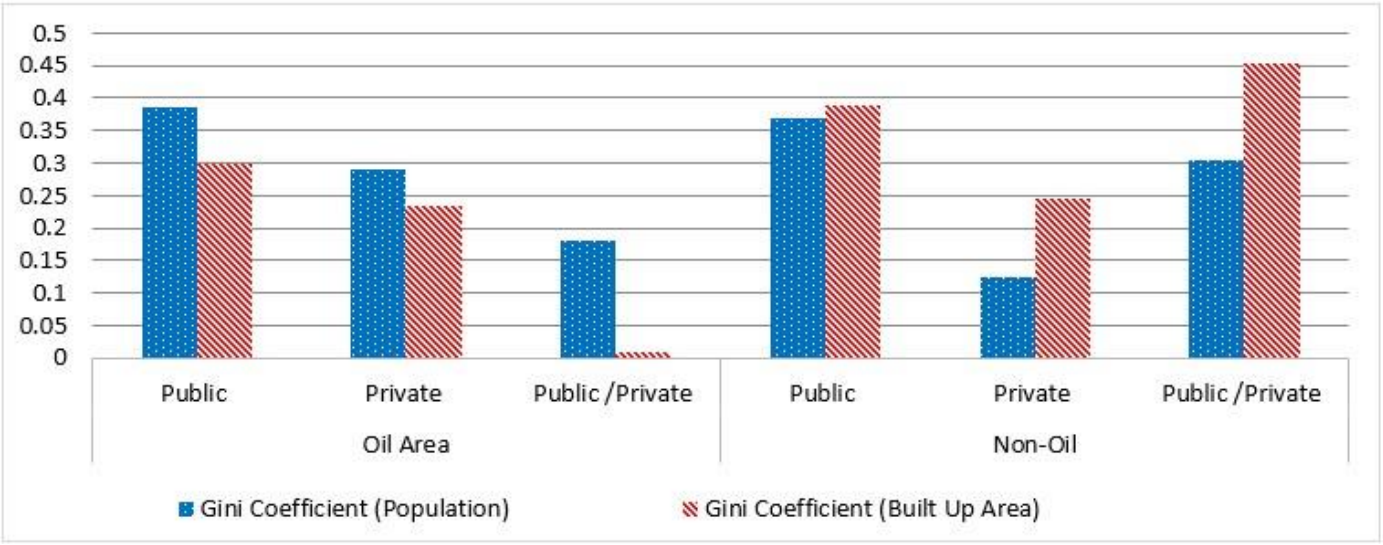

Figure 9: Concentration indices for education infrastructure
Source: Computed from Surveys (2022)

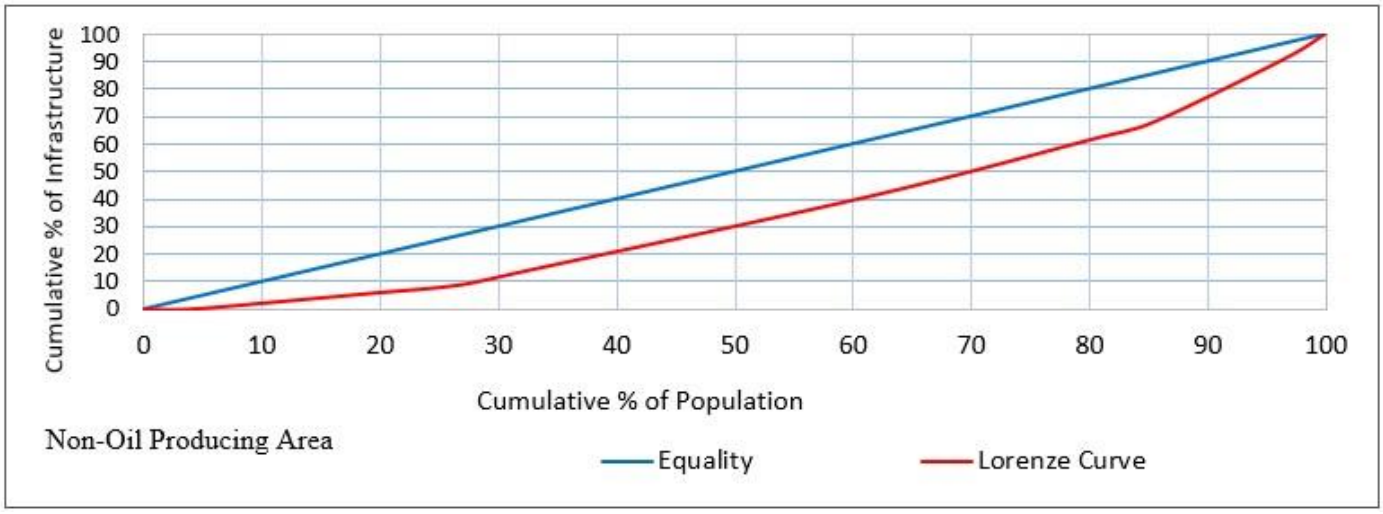

Figure 10: Lorenze curve for education infrastructure in non-oil producing area
Source: Computed from Surveys (2022)

For the combined distribution of health infrastructure, the non-oil producing areas have higher inequality than the oil-producing areas. All indices of the Gini coefficient assessed under population and built-up areas are higher (Figure 11). This is clear given that about 40% of the population of the non-oil producing area lacks access to health infrastructure (Figure 12). It may be because the non-oil producing area has just five (5) health infrastructure compared to twelve (12) health infrastructure in the oil-producing area.

Moreso, there is inequality exists in the distribution of all water infrastructures in both areas of study, as all indices are far from zero. However, the oil-producing areas have higher inequality than the non-oil producing areas, with higher Gini coefficient indices assessed both under the population and built-up area (Figure 13). The oil-producing area has a higher population, with 60% of the population having access to less than 50% of the infrastructure (Figure 14), even though the inventory confirms that it has more water infrastructure than the non-oil producing areas. The inequality in access to water infrastructure in the study area is consistent with the works of Akpan and Artser, 2010 who found out that about 58% of communities investigated in Akwa Ibom state had less than five boreholes while the poorest condition was observed in 24% of the investigated communities.

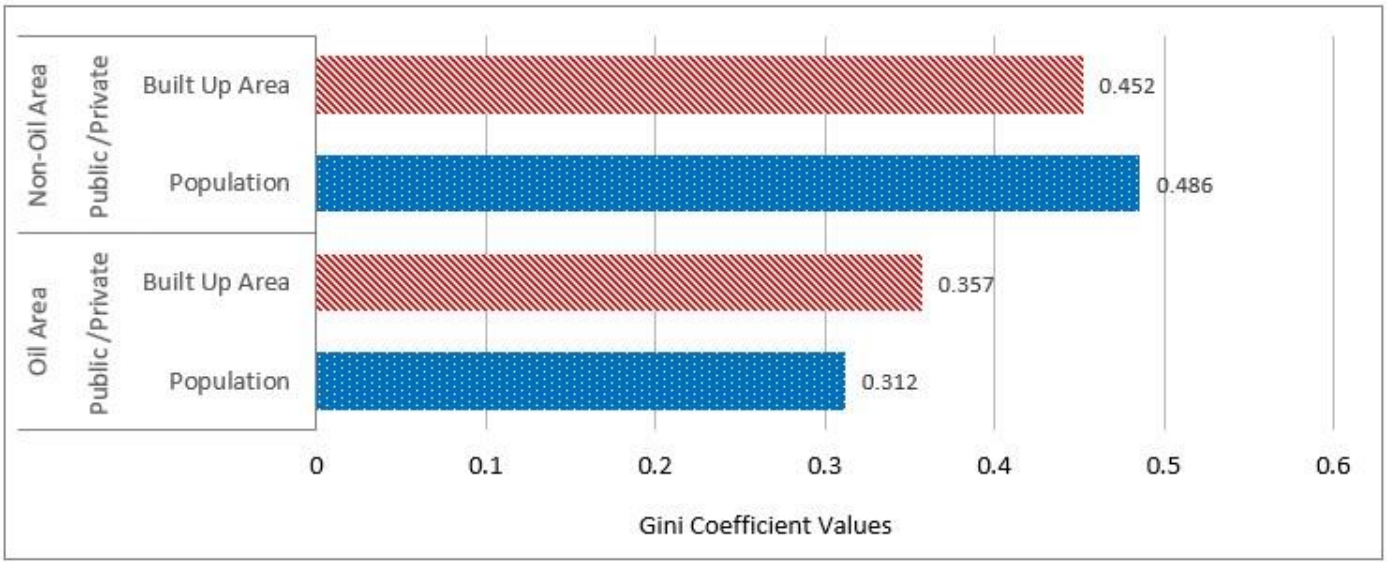

Figure 11: Concentration indices for health Infrastructure
Source: Computed from field survey (2022)

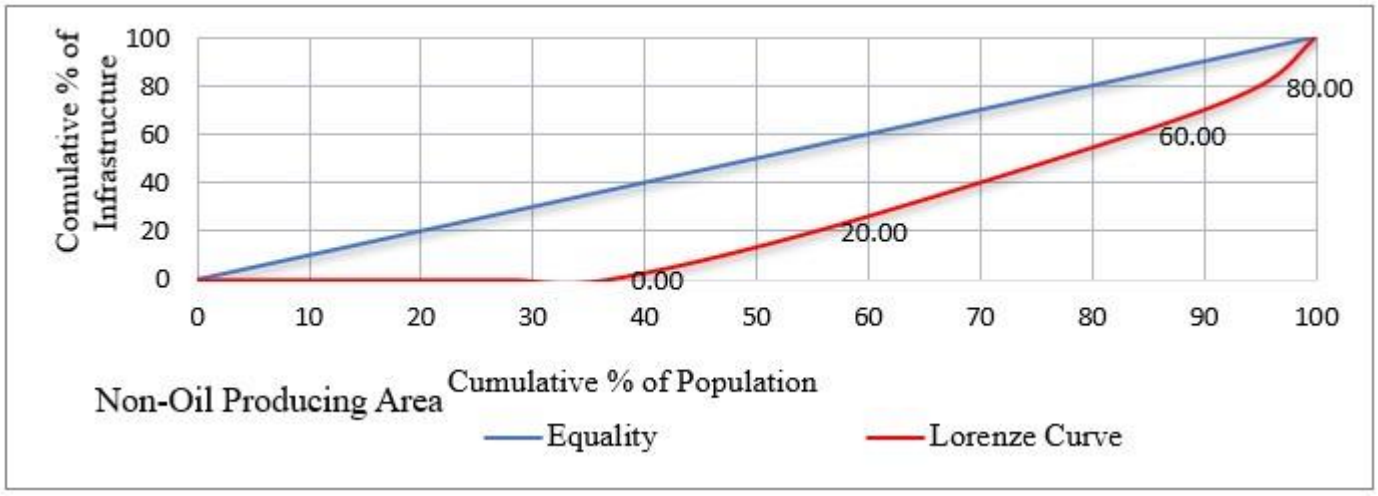

Figure 12: Lorenze Curve for health Infrastructure
Source: Computed from field survey (2022)

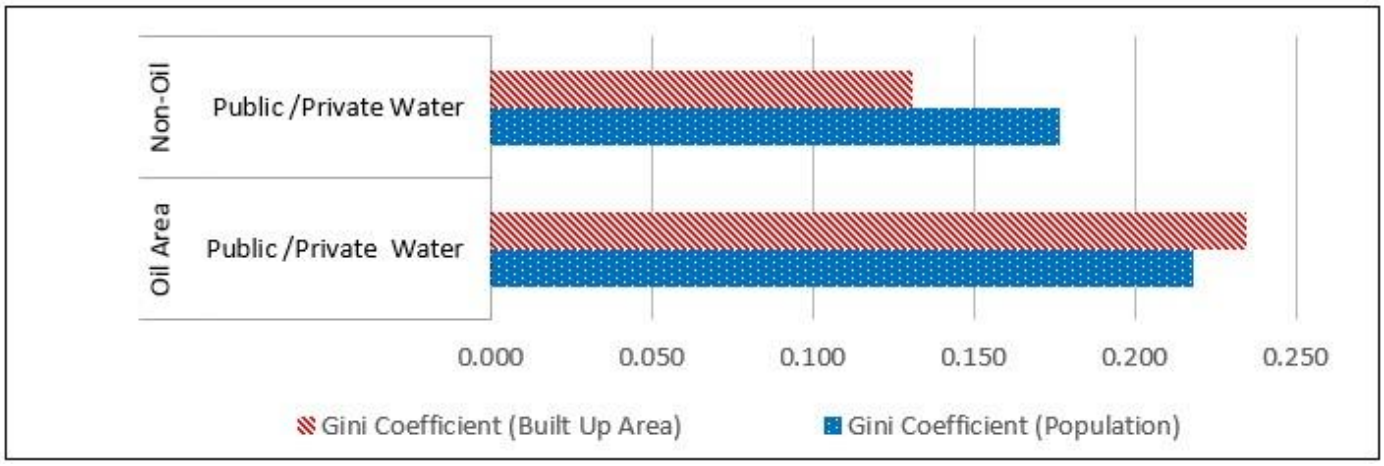

Figure 13: Concentration indices for water infrastructure
Source: Computed from Surveys (2022)

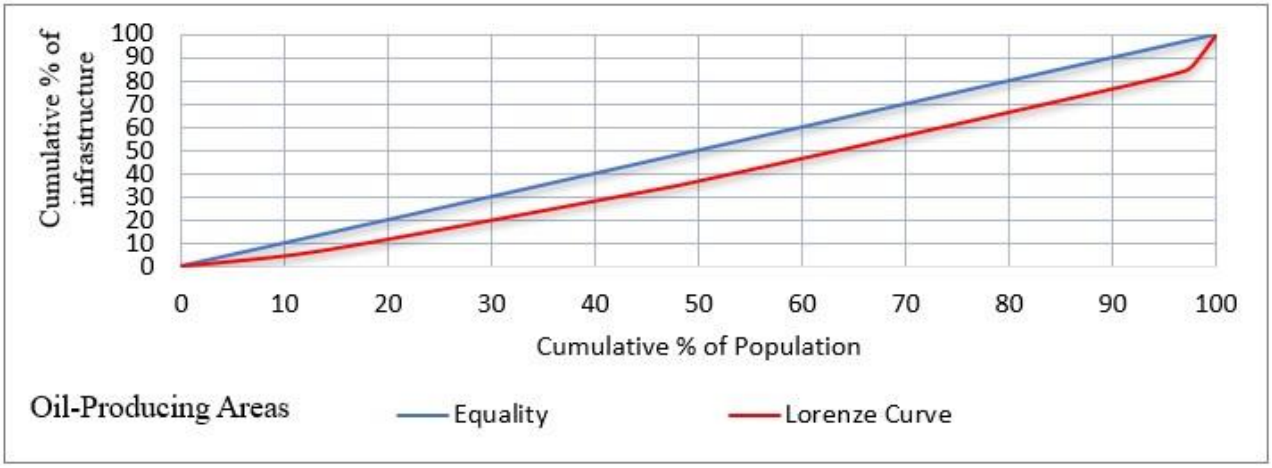

Figure 14: Concentration indices for water infrastructure
Source: Computed from Surveys (2022)

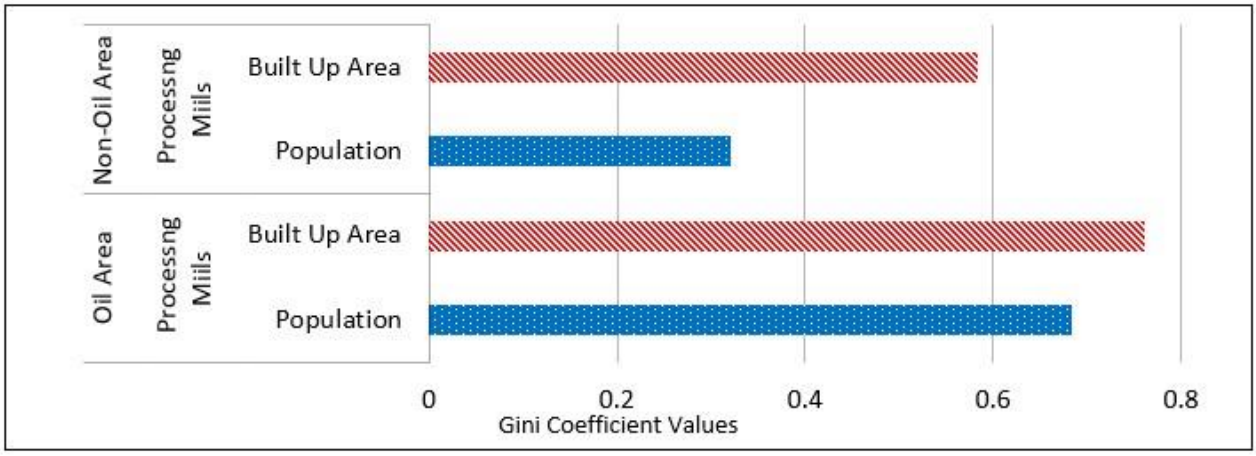

Figure 15: Concentration Indices for Small scale industry infrastructure
Source: Computed from Surveys (2022)

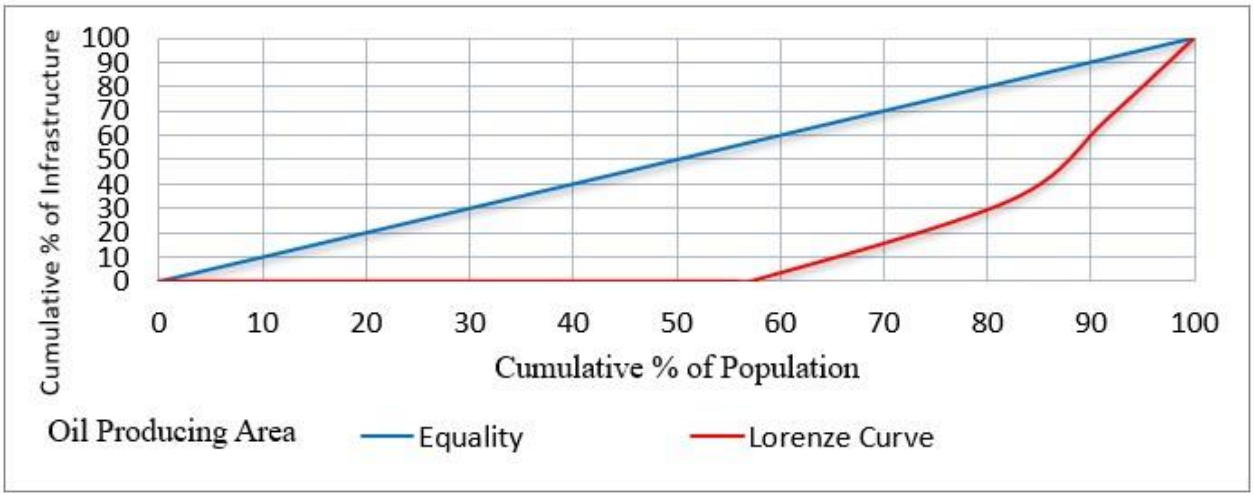

Figure 16: Lorenze curve for Small Scale infrastructure
Source: Computed from Surveys (2022)

Furthermore, the oil-producing areas have a higher inequality in small-scale industry infrastructure distribution, with a higher Gini coefficient index assessed under the population and built-up area than the non-oil producing areas (Figure 15). Over 50% of the oil-producing area population cannot access small scale industry infrastructure (Figure 16). This is because in the oil-producing areas, according to the inventory carried out, the number of small-scale industries under study are just two, compared to the population.

Finally, Figure 17 shows that the Gini index of market infrastructure assessed under the population and built-up area in the oil-producing areas is higher than those in the non-oil producing area. It implies a higher inequality in the oil-producing area, which has only three (3) market infrastructure compared to seven (7) available in the non-oil producing areas. The oil and non-oil producing areas are approaching perfect inequality in bank infrastructure distribution, with indexes closer to 1.0. In addition, Figure 18 indicates that 40% of the oil-producing area population cannot access all the commercial infrastructure, compared to the non-oil producing area. Only three (3) markets and one bank are available in the oil-producing area, which cannot serve all the people.

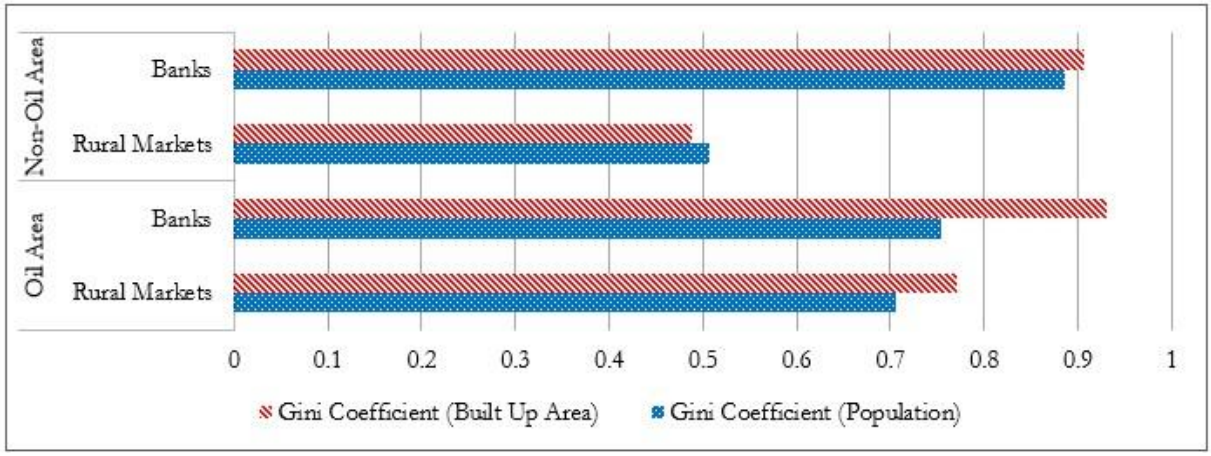

Figure 17: Concentration indices for commercial infrastructure
Source: Computed from field surveys (2022)

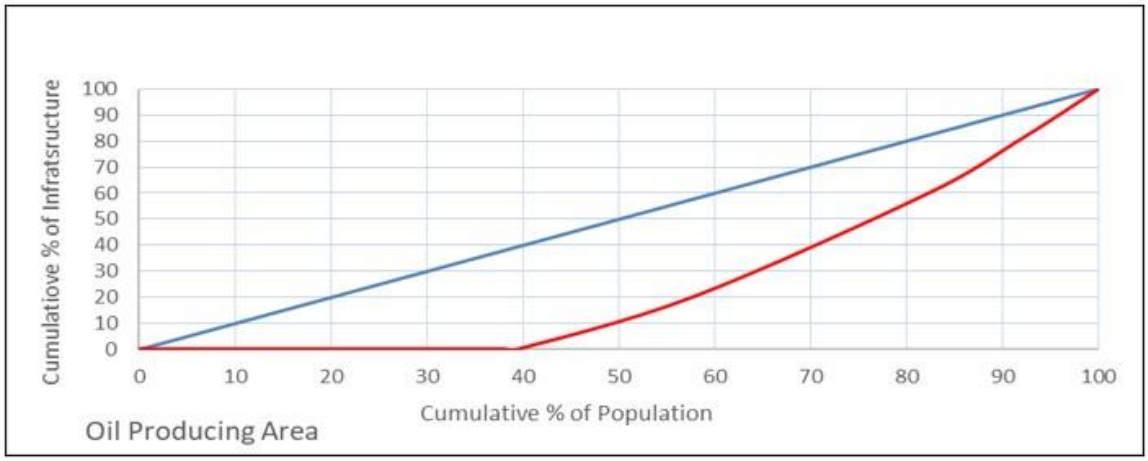

Fig 18: Lorenze curve for commercial infrastructure
Source: Computed from surveys (2022)

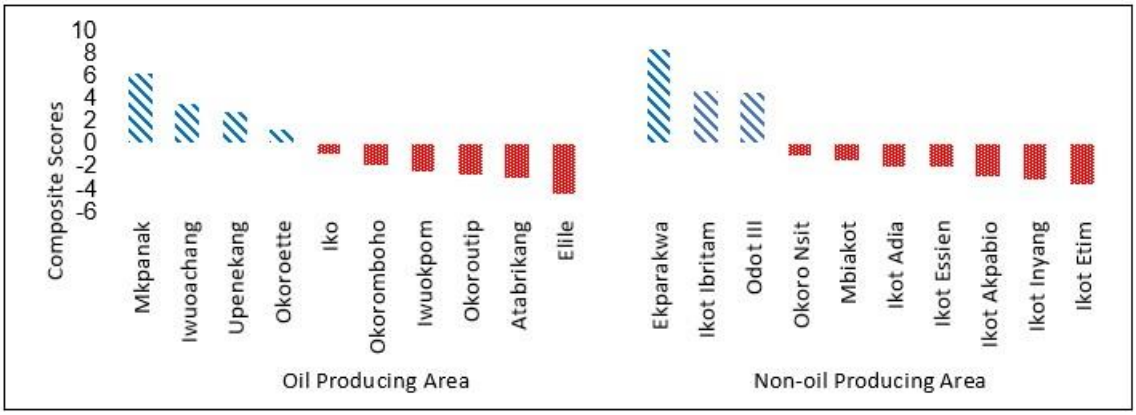

Figure 19: Best served and least served Communities
Source: Computed from field surveys (2022)

Gaps in Infrastructure Provision and Income Poverty Threshold in the Oil and Non-Oil Producing Areas

Aggregately, figure 19 shows that the oil-producing area, led by four best served communities, which includes Mkpanak (6.28), Iwuoachang (3.5), Upenekang (2.81), and Okoroette (1.24) in their composite scores rank. Also 51.6% of its population live above the income poverty line (above ₦306 per dollar) as depicted in figure 20. Conversely, the non-oil producing area has three best-served communities, which includes Ekparakwa (8.27), Odot111 (4.62), and Ikot Ibritam (4.51) in their composite scores rank and 45% of its population live above the income poverty line (above ₦306 per dollar). On the one hand, explaining their privileged position in the oil producing area, Mkpanak is best served because it is the host to various oil multinational companies. Upenekang and Okoroette are oil-producing LGAs headquarters, while Iwuoachang is an adjoining community to Upenekang. On the other hand, in the non-oil producing area, Odot 111 and Ikot Ibritam are best served arguably because they are LGAs headquarters while Ekparakwa is a commercial nerve centre.

However, the percentages of the population living above the income poverty line in both the oil and non-oil producing areas as shown in figure 20, clearly explains the impact of the existing infrastructure on the standard of living of the people as more people live above the poverty line in oil producing area that is best served with infrastructure than the non-oil producing area which is least served with infrastructure.

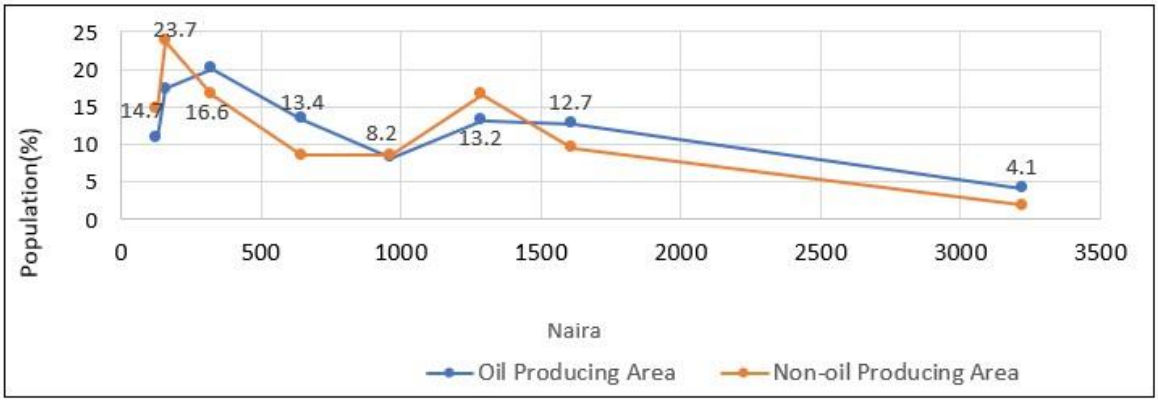

Figure 20: Income poverty threshold
Source: Computed from field surveys (2022)

Again, based on the standard scores, figures 21 and 22 below depicts that the oil-producing area is best served with education, health, and water infrastructure.

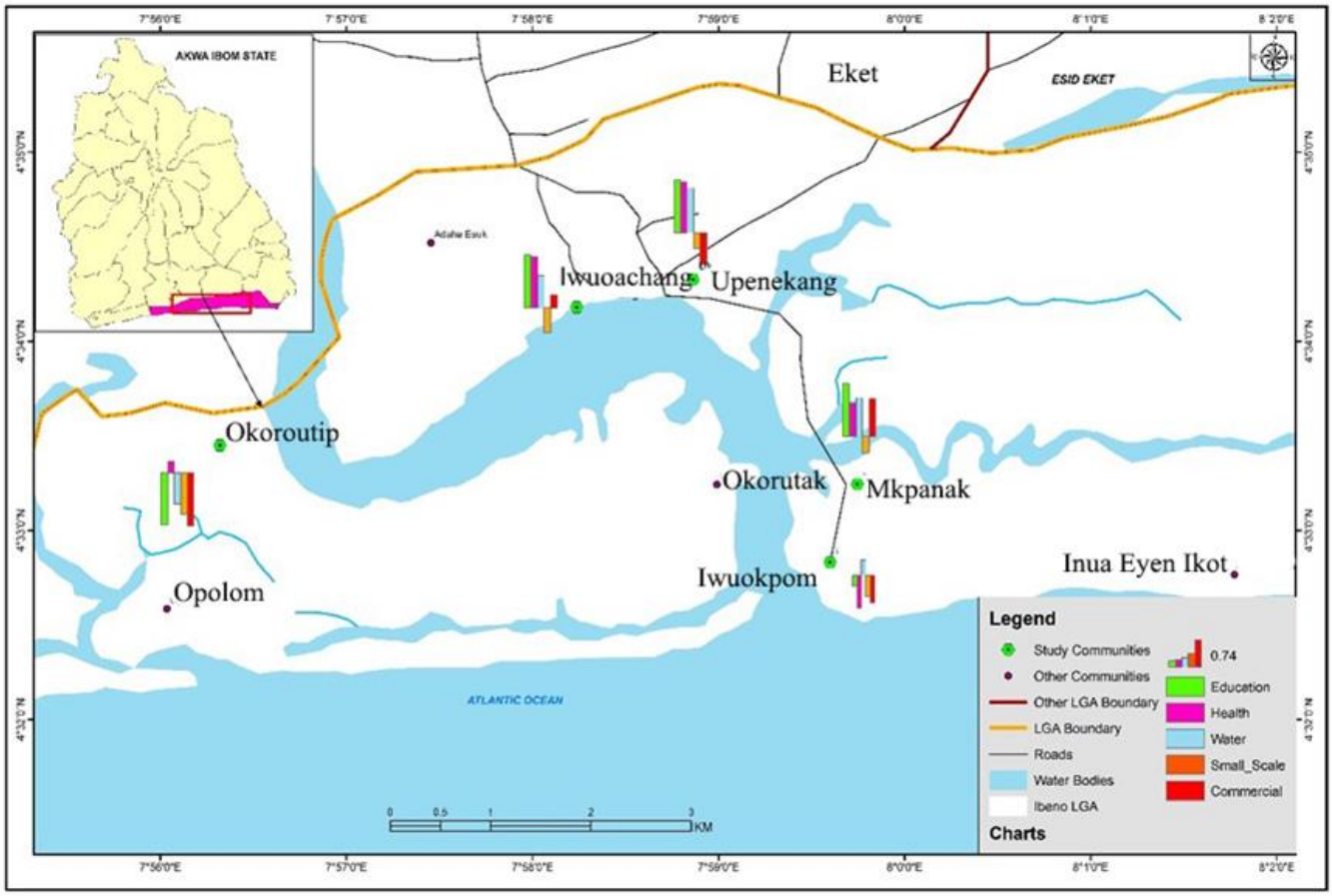

Figure 21: Best served and least served infrastructure in oil producing Ibeno LGA
Source: Computed from field surveys (2022)

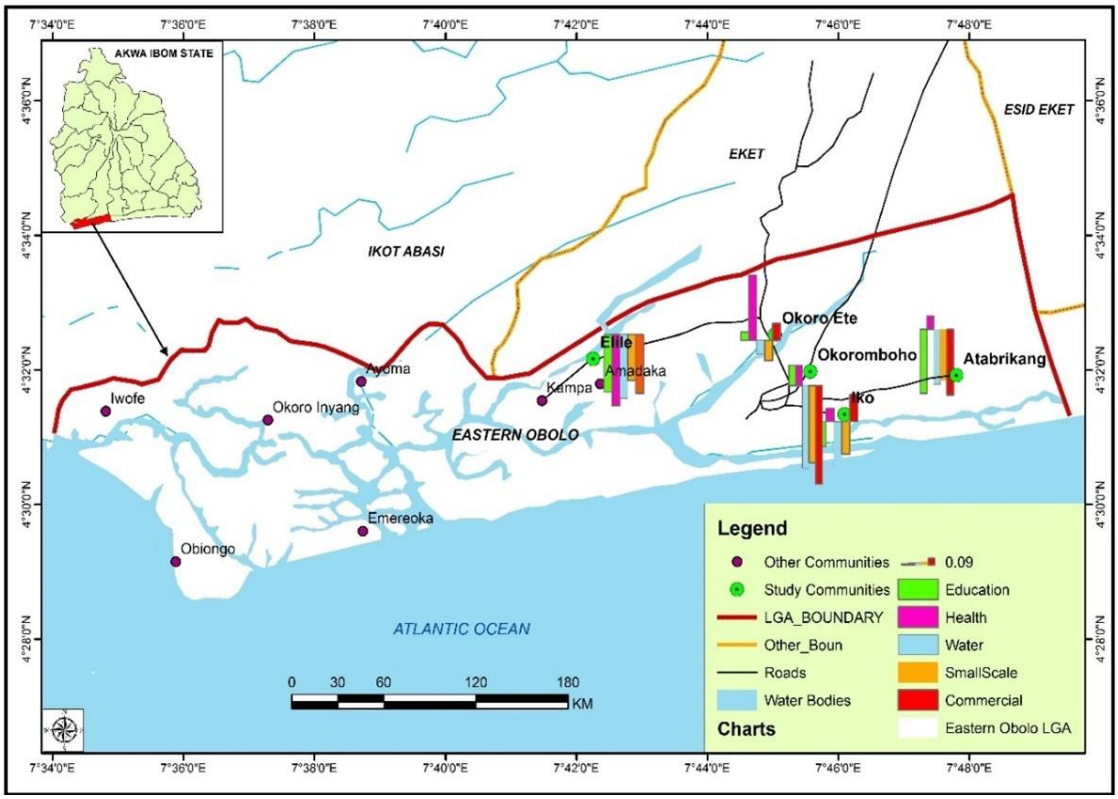

Figure 22: Best served and least served infrastructures in oil producing Eastern Obolo LGA
Source: Computed from field surveys (2022)

And figures 23 and 24 shows that the non-oil producing area is best served with small-scale industry and commercial infrastructure. (Figures 23 and 24).

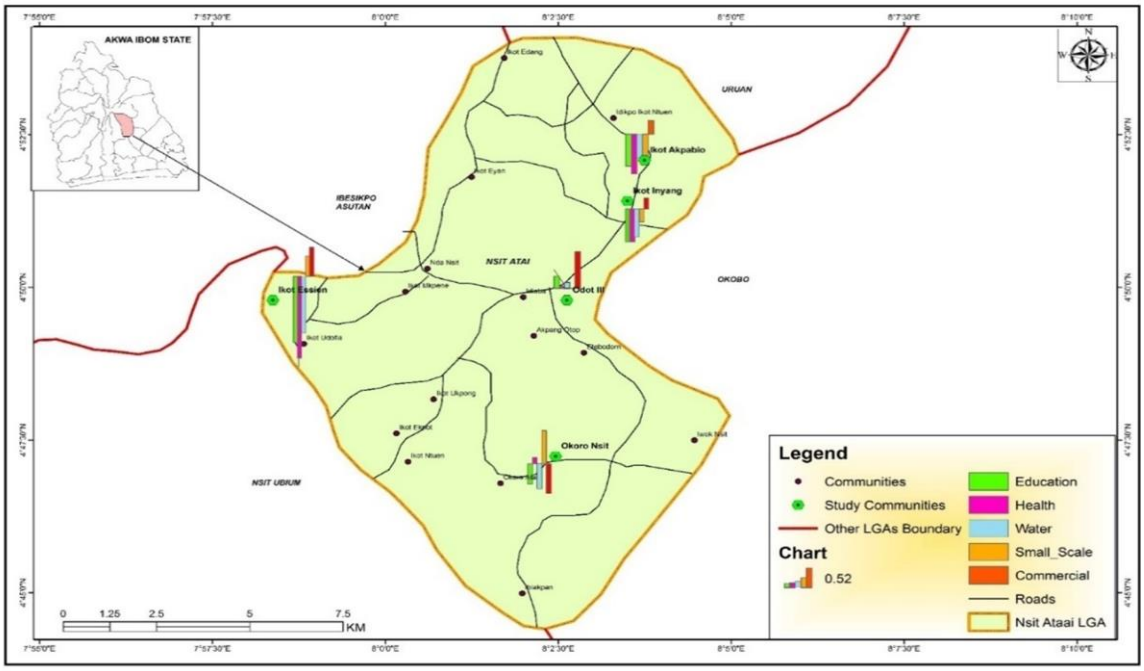

Figure 23: Best served and least served infrastructure in non-oil producing Area Nsit Atai LGA
Source: Computed from field surveys (2022)

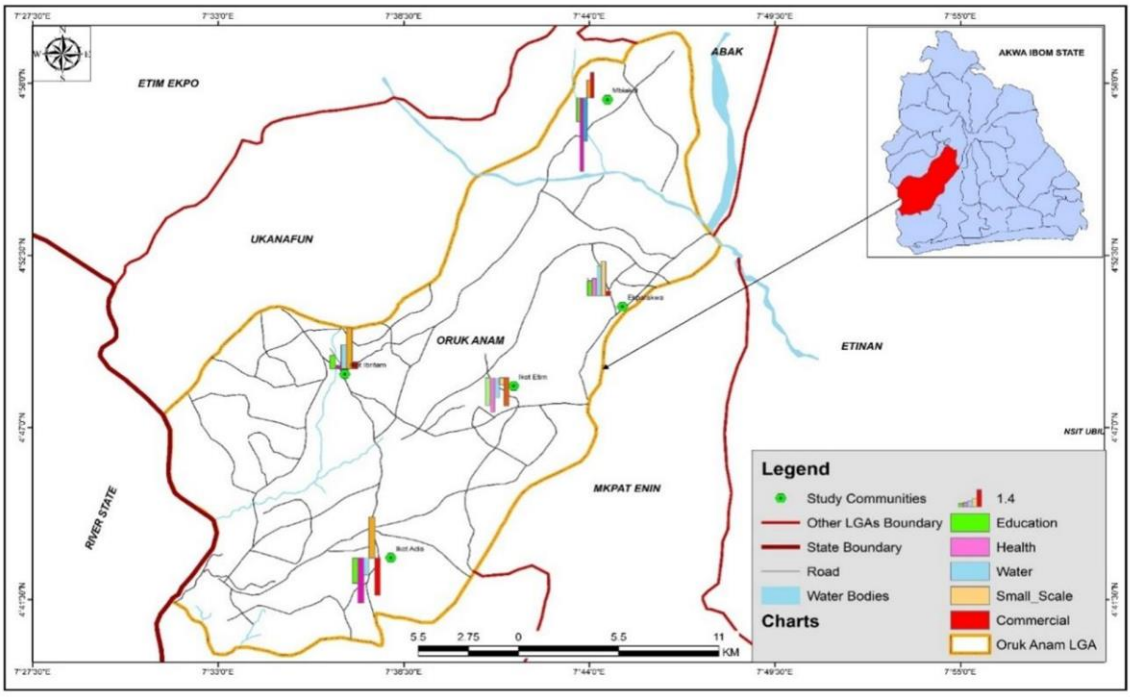

Figure 24: Best served and least served infrastructure in non-oil producing Oruk Anam LGA
Source: Computed from field surveys (2022)

Discussion of Results, Conclusion and Recommendations

The study of infrastructure concentration, inequality and provision gap is not new. There is a plethora of studies on the inequalities and access to infrastructural facilities in Nigeria and in Akwa Ibom State. Studies such as Aigbokhan 2000; Erubami and Young 2003; Oyekale et al. 2004, who employed different methodologies, all established that inequality in the provision and distribution of resources and in the context of this study, infrastructure, is increasing and has led to a growing dimension of poverty.

The equitable distribution of infrastructure is essential to development and pertinent in the achievement of the sustainable development goals. The study infused geospatial techniques and indigenous knowledge in studying the infrastructure provision of the oil and non-oil producing which showed varying degrees of locational concentration, deficiencies, and inequalities in the oil and non-oil communities of Akwa Ibom State, Nigeria.

Generally, from the preceding analysis, it is clear that, the overall concentration of the stock of the infrastructure distribution is weak and low, while the inequalities are high. A greater percentage of the infrastructure is unavailable and some are deficient in both areas of study. This reveals a lead-lag relationship and a discernible imbalance in the infrastructure concentration and distribution in both the oil and non-oil producing areas studied. The consequence of these phenomena is that communities may not meet the basic standard of living hence, there is a need for proper planning during infrastructural provision and an enhanced and comprehensive positive discrimination policy for infrastructure investment in the deprived areas of the study.

These phenomena of deficiencies and inequalities have theoretical and planning/empirical implications. Theoretically, it corroborates the standpoints by previous empirical works of Atser and Udoh (2015), Akpan and Artser (2010), Adefila (2013), and Adedayo and Yusuf (2012) that deficiencies and inequalities revealed in the infrastructural provision and distribution efforts are a consequences of policy failures. Currently, there is no workable infrastructure development policy and plan for the study area. However, through the Akwa Ibom State Government, the Ministry of Economic Development and Deep Seaport is currently drafting the State Economic Development Plan. Moreover, with proper engagement with government and development stakeholders, the findings of this study can be translated into actionable policies in the development plan, which will consider the provision of resilient infrastructure, social development and improvement in the overall wellbeing of the people in the areas studied. No society succeeds without a plan. The plan should guide the short-term, mid-term, and long-term planning of the study area through adequate infrastructure provision and also serve as a guide for infrastructure providers and development agents.

The knowledge of the basic needs of the end-users is critical in developing realistic planning recommendations that will appropriately reflect what development recipients want. Therefore, infrastructure provision is not expected to be demand-driven, with a top-down approach to delivery. Instead, provision must rely on the initiatives and ideas of the people. Having a knowledge of the perceived infrastructural needs in both areas of study, according to Ogun (2010), can be effective in mitigating poverty. This could explain why most people in the study areas are under the income poverty line. Hence, the first step towards creating an improved living standard for the people, especially at the grassroots, is to match their basic infrastructural needs with the services provided.

Again, since a mere increase in the provision of infrastructural facilities in an area does not necessarily translate into increased infrastructure coverage, a location-allocation modelling framework is recommended in solving the problem of coverage and optimality in service delivery. In addition, existing infrastructure should be frequently inventoried to foster maintenance culture. There is also the need to encourage self-help activities in these communities. Since policy failures indicate that the government and other development donors cannot provide all infrastructure, self-help activities with different community development associations will be realistic in mobilising resources for infrastructure provision. Many rural communities in Sub-Saharan Africa have used self-help efforts to provide infrastructure for their communities.

Furthermore, further study is recommended to investigate the extent to which NGOs and other infrastructure providers have contributed to the provision of infrastructure in both oil and non-oil producing areas. Moreso, a consideration should be given to how long oil and gas exploitation has occurred in the selected communities, especially the oil producing ones. This could provide further insights into the extent of development the presence of oil-producing companies has brought

Disclosure Statement

There was no conflict of interest reported by the authors.

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