Spatial Governance and Analysis of Rural Health Infrastructure: The Case of Ondo State, Nigeria

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Abstract:- The governance of rural health infrastructure depends on the spatial decisions of local and health policymakers during the process of their provision. This study analysed fifty-one public rural health infrastructures in three Local Government Areas (LGAs) in Ondo State such as Akoko North West, Ondo East, and Irele. These LGAs were sampled randomly from the three Senatorial Districts in Ondo State using the Nearest Neighbour Analysis to determine if the existing locations were effectively governed. The findings show variations in the spatial patterns of the rural health infrastructures. The study suggested the provision of additional infrastructure in each LGA to address unequal access. It also recommended the designing of an infrastructure plan to guide future spatial decisions.

Keywords:- Rural, Health, Spatial, Governance, Distribution.

I. INTRODUCTION

Rural infrastructure, such as schools, hospitals, water wells, and roads, are vital for economic development in rural settlements. While the definition of "rural" varies by location, population, and occupation, rural settlements in Nigeria are considered to have fewer than 20,000 people (Li *et al*., 2022). Despite the importance of rural infrastructure, managing its provision requires attention. The processes policymakers use to coordinate rural infrastructure provision, funding, and maintenance constitute infrastructure governance (Clement *et al.*, 2023). Developing rural infrastructure has global importance because it strengthens rural economies and living standards, drawing investment for small and medium enterprises (Arifin *et al.*, 2020).

The International Geographical Union Commission on Geography of Governance (2019) states that rural governance refers to the process of coordinating the various physical, institutional, and socioeconomic aspects of a rural settlement. In Ondo State, Nigeria, healthcare infrastructure includes primary, secondary, and tertiary facilities. The Ondo State Primary Healthcare Development Agency (OSPHCDA) manages basic health centres, while the Ondo State Hospitals' Management Board oversees general hospitals. Medical centres and teaching hospitals fall under Federal or State government jurisdiction. In this study, rural health infrastructure refers to the primary health centres located in rural settlements within Ondo State. In 2012, a

bill established OSPHCDA to strengthen partnerships between the State Government and local communities in providing rural health infrastructure. Regardless of this legal framework, the governance of the provision of rural health infrastructure in Ondo State requires improvement. Accessibility remains inequitable, making it difficult for some rural households to access healthcare. Furthermore, proximity of health facilities to rural dwellings varies, affecting overall utilization (Rader *et al.*, 2022). The aim of this research is to spatially assess the effectiveness of rural health infrastructure governance in rural settlements in Ondo State.

➤ *Spatial Governance and Analysis*

Spatial governance involves planning and managing activities in space to ensure sustainable urban or rural development that supports the broader socio-ecological system and the health of all people living and working within it (Berisha *et al.*, 2021). Unfortunately, some spatial governance approaches cater only to certain groups, ignoring or harassing those whose ways of life differ from their vision (Nel *et al.*, 2021). The concept of spatial governance can improve accessibility to rural health infrastructure by collecting and analyzing spatial data to inform planning decisions. This form of governance collaborates with rural health stakeholders such as rural dwellers, village heads, Community-based Development Associations, health and local policymakers to manage infrastructure and land use (Berisha *et al.*, 2021).

Spatial analysis examines location-based relationships like proximity and adjacency to understand patterns in the rural landscape. Spatial analysis involves creating or extracting new information about planning objects like roads, schools, and health facilities (Lucendo-Monedero *et al.*, 2019). It assesses and models area data, evaluating suitability and capabilities which can be used to inform planning decisions. Complete Spatial Randomness (CSR) is a pattern generated under two assumptions: first, all locations have an equal chance of containing an event; and second, the events are distributed independently of one another (Banerjee & Abel, 2021). Nearest Neighbour Analysis studies this pattern by looking at the distances between each point and its closest neighbour (Huo *et al.*, 2023). It then compares these distances to the expected values for a random sample with CSR. The integration of spatial analysis has been used previously in locating facilities in rural settlements (Huo *et al.*, 2023). The essence of mainstreaming this method into infrastructure governance

is to ensure that the right location is designated for the right infrastructure during the process of its provision (Tuah *et al.*, 2022). Furthermore, the governance of the provisional locations of rural infrastructure is such that, the spatial decision of local and health policymakers influences the functionality of infrastructure provided.

Spatial governance of rural health infrastructure should stem from the perspective of functionality of its locations to encourage access to its services, and the quality of spatial decisions of policymakers which will influence the overall outcome of its provision, funding and maintenance (Yuan *et al.*, 2017).

II. RESEARCH LOCALE AND METHODOLOGY

➤ *Study Area*

Ondo State is a South-Western Nigeria State. It is located between the Latitudes of $5^0$45' and $7^0$48' and the Longitudes of $4^0$45' and $6^0$00' from the Greenwich Meridian. It is surrounded by other States such as Kogi, Edo, Delta, Ogun and Ekiti. Figure 2 indicates the locations of three Local Government Areas (LGAs) selected for the study in Ondo State, Nigeria. Ondo State is located at about 280 kilometres from Lagos State's former capital and covers 14,788 square kilometres. The National Population Commission of Nigeria recorded that the combined population of Akoko North West, Irele, and Ondo East LGAs, as well as neighbouring Ondo East and Irele areas, peaked at over 2 million. Population projections by the United Nations indicate the three LGAs (Irele, Akoko North West, and Ondo East) will reach over 2 million people from 1991 to 2021. Ondo State has a tropical rainforest climate with distinct dry and wet seasons in different areas and 1500 to 2000 mm of annual rainfall. The well-drained soil supports various crops, and the State has limestone, coal, petroleum and other geological resources. Agriculture, public service, and trading are the main socioeconomic activities according to Olugbamila and Adeyinka (2018). High demand exists in Ondo State for food products like vegetables and maize. Cocoa is a major crop cultivated by farmers in the study area.

➤ *Methodology*

The geographic coordinates of the locations of rural health infrastructure were obtained from the Ondo State Primary Healthcare Development Agency (Figures 3-5). Then, a ground truth exercise was conducted to verify the accuracy of the data from OSPHCDA. There are a total of 51 public rural health infrastructures across the three selected Local Government Areas (LGAs). Akoko North West has 21 RHIs, Irele has 14, and Ondo East has 16. The locations of the RHIs were mapped in ArcMap, revealing that 51 RHIs fall within the boundaries of the selected LGAs. Photos were taken to visually document the physical

locations of some of the Rural Health Infrastructures (Figures 1-2). The Nearest Neighbour Analysis tool was used to statistically analyze the distribution pattern (clustered, dispersed, or random) of the existing RHIs in the study area.

Fig 1 Primary Healthcare Centre, Fagbo, Ondo East LGA
Source: Author's Observation (2021)

Fig 2 Primary Healthcare Centre, Ode-Irele, Irele LGA
Source: Author's Observation (2021)

III. RESULTS AND DISCUSSIONS

The Average Nearest Neighbour tool in ArcMap 10.6 was used to statistically analyze the spatial pattern of existing rural health infrastructure locations (Figure 6). This tool measures the distance between feature centroid points to determine if an observed distribution deviates from a random expected pattern. The geographic coordinates of Primary Healthcare Centre locations in selected rural settlements across three sampled local government areas were obtained using GPS and input to the tool.
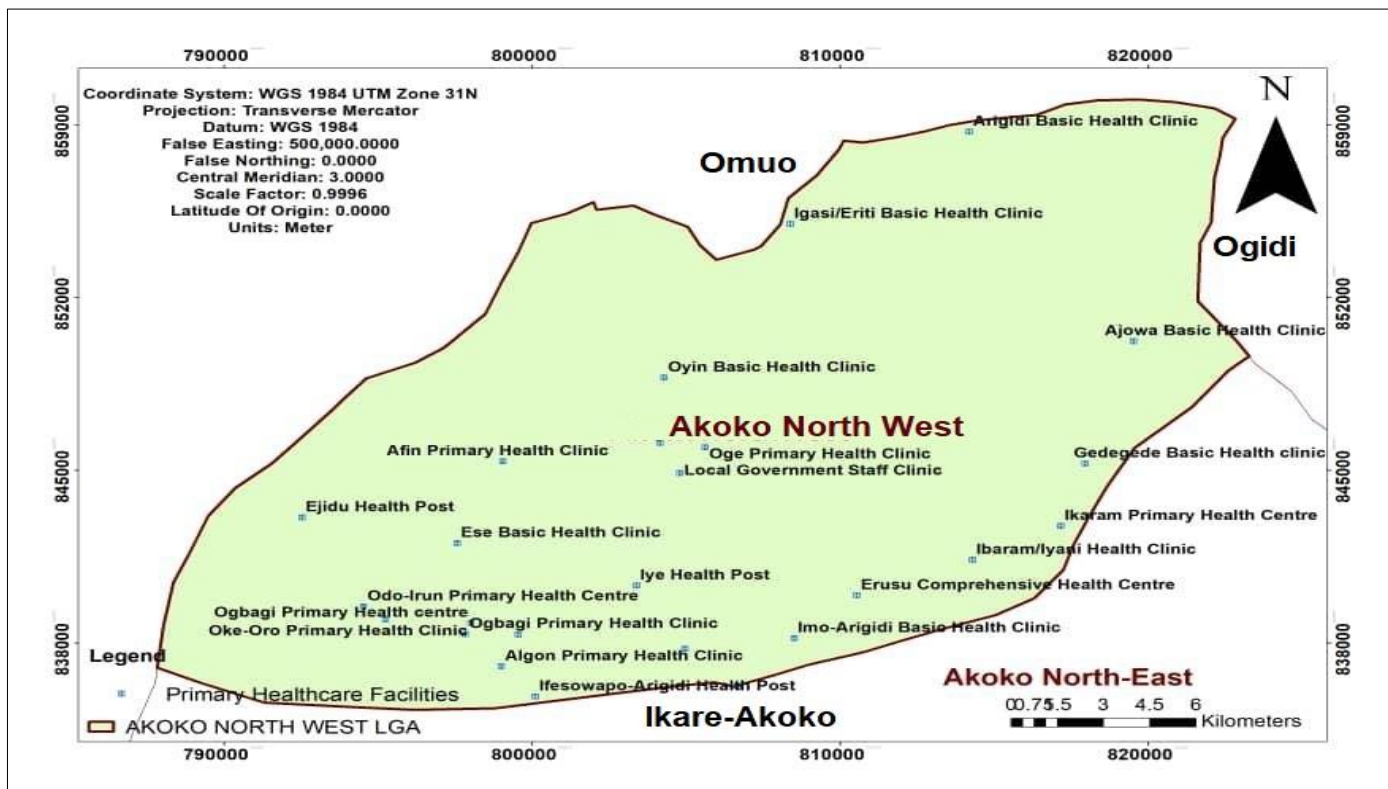

Fig 3 Existing Rural Health Infrastructures (RHIs) in Akoko North West LGA
Source: Author (2021)

Table 1 Geographic Coordinates of Existing RHIs in Akoko North West LGA

Title of RHI	Easting	Northing
Ejidu Health Post	5.65126	7.61898
Odo-Irun Primary Health Centre	5.66907	7.58629
Algon Primary Health Clinic	5.70948	7.56409
Ogbagi Primary Health centre I	5.70065	7.57996
Ogbagi Primary Health Clinic II	5.69896	7.57597
Oke-Oro Primary Health Clinic	5.67562	7.58142
Oge Primary Health Clinic	5.76994	7.64394
Oyin Basic Health Clinic	5.75800	7.66957
Imo-Arigidi Basic Health Clinic	5.79562	7.57385
Local Government Staff Clinic	5.76244	7.63457
Afin Primary Health Clinic	5.71038	7.63918
Ese Basic Health Clinic	5.69680	7.60929
Erusu Comprehensive Health Centre	5.81419	7.58941
Ibaram/Iyasi Health Clinic	5.84824	7.60214
Ikaram Primary Health Centre	5.87429	7.61446
Ajowa Basic Health Clinic	5.89612	7.68197
Gedegede Basic Health clinic	5.88162	7.63722
Igasi/Eriti Basic Health Clinic	5.79546	7.72557
Arigidi Basic Health Clinic	5.77621	7.7563
Iye Health Post	5.74945	7.59335
Ifesowapo-Arigidi Health Post	5.77526	7.54364

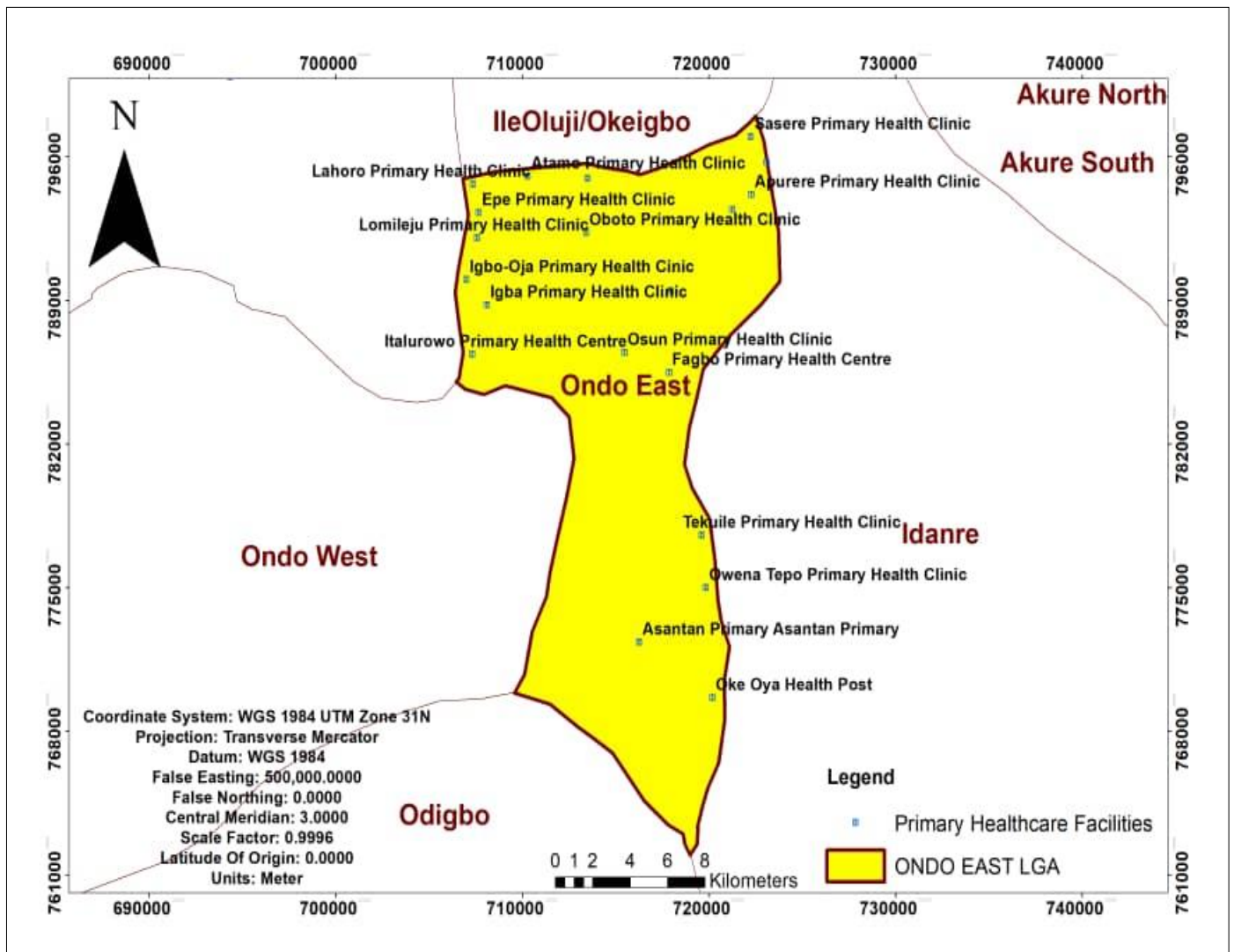Source: Author's Fieldwork (2021)

Fig 4 Existing Rural Health Infrastructures (RHIs) in Ondo East LGA
Source: Author's Fieldwork (2021)

Table 2 Geographic Coordinates of Existing RHIs in Ondo East LGA

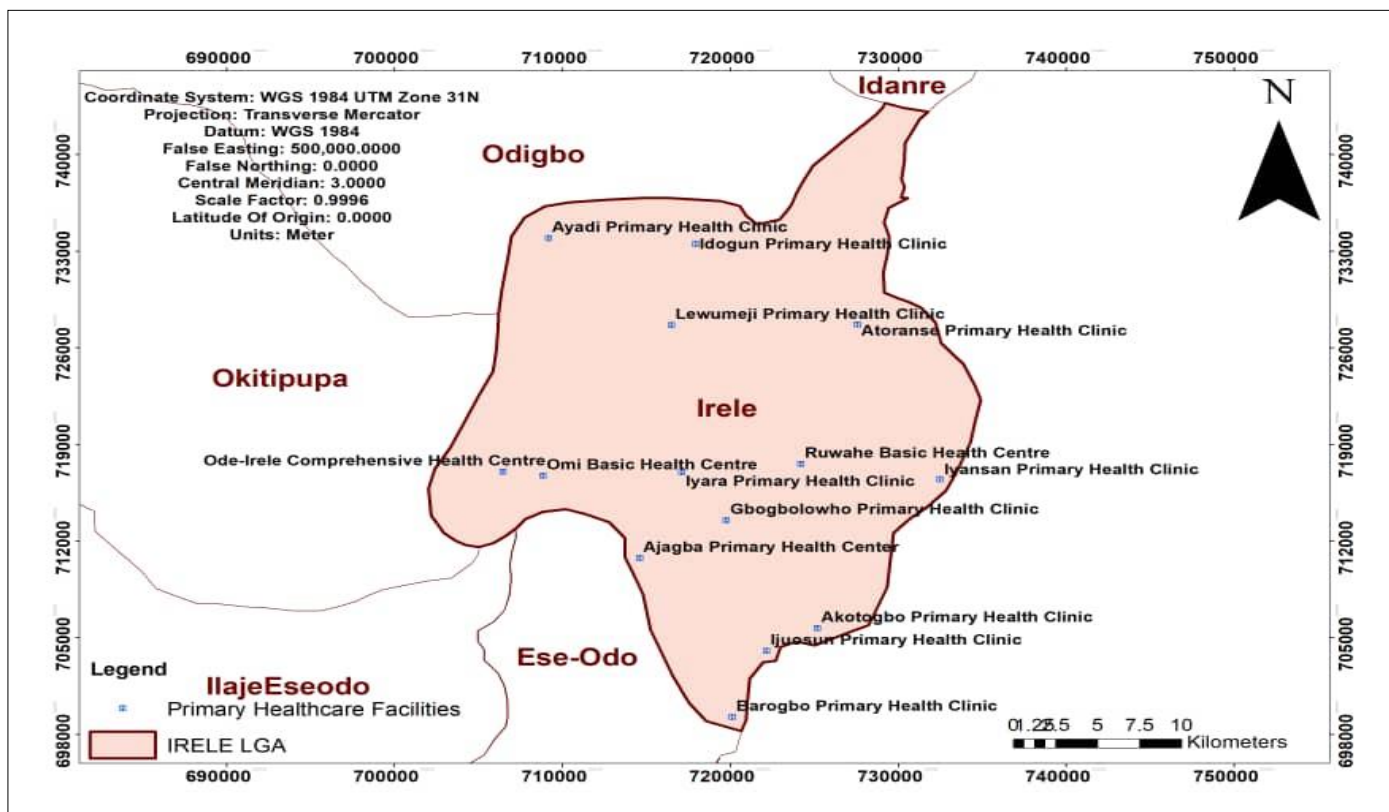| Title of RHI	Easting	Northing
Igba Primary Health Clinic	4.88437	7.13197
Igbo-Oja Primary Health Cinic	4.86326	7.13254
Italurowo Primary Health Centre	4.86507	7.11075
Oboto Primary Health Clinic	4.93263	7.16372
Apurere Primary Health Clinic	5.01279	7.18002
Sasere Primary Health Clinic	4.96996	7.20822
Owena Tepo Primary Health Clinic	5.0127	7.00331
Tekuile Primary Health Clinic	4.98805	7.02998
Asantan Primary Health Centre	4.95752	6.98312
Oke Oya Health Post	4.99977	6.95599
Atamo Primary Health Clinic	4.80159	7.18763
Epe Primary Health Clinic	4.77575	7.16864
Lahoro Primary Health Clinic	4.81406	7.19253
Lomileju Primary Health Clinic	4.81782	7.15728
Fagbo Primary Health Centre	4.97252	7.10179
Osun Primary Health Clinic	4.95097	7.11081

Source: Author's Fieldwork (2021)

Fig 5 Existing Rural Health Infrastructures (RHIs) in Irele LGA
Source: Author's Fieldwork (2021)

Table 3 Geographic Coordinates of Existing RHIs in Irele LGA

Title of RHI	Easting	Northing
Ajagba Primary Health Center	4.92346	6.42512
Gbogbolowho Primary Health Clinic	4.98715	6.45084
Akotogbo Primary Health Clinic	5.033889	6.367222
Barogbo Primary Health Clinic	5.003479004	6.301330566
Ijuosun Primary Health Clinic	5.01544	6.35731
Ode-Irele Comprehensive Health Centre	4.866944	6.483056
Ayadi Primary Health Clinic	4.89207	6.63602
Atoranse Primary Health Clinic	5.05814	6.57896
Iyara Primary Health Clinic	4.96331	6.48236
Ruwahe Basic Health Centre	5.02732	6.48759
Idogun Primary Health Clinic	4.97127	6.63197
Lewumeji Primary Health Clinic	4.95809	6.57882
Iyansan Primary Health Clinic	5.11748	6.46346
Omi Basic Health Centre	4.88854	6.48057

Source: Author's Fieldwork (2021)

ArcGIS mapped the locations of all primary healthcare centres in selected rural settlements for the study. This allowed for geo-referencing analysis. In Akoko North West, the Nearest Neighbourhood Analysis of Rural Health Infrastructure (RHI) locations showed an Observed Mean Distance (OMD) of 2220.4007 metres and an Expected Mean Distance (EMD) of 1995.0178 metres. The Nearest Neighbourhood Index (NNI), the ratio of OMD to EMD, was 1.112973. The z-score of 1.080625 indicates randomly distributed RHIs in the LGA. In Ondo East LGA, the OMD was 2531.9997 metres, EMD was 2574.5389 metres, and NNI was 0.983477. The z-score of -0.122424 indicates random RHI distribution. In the third LGA, OMD, EMD and NNI were 4973.0241 metres, 3645.5254 metres, and 1.364145 respectively. The z-score of 2.698053 indicates dispersed RHI distribution.

Overall, RHIs were not uniformly distributed across the study area. This implies ineffective governance in locating rural health infrastructure, making healthcare access difficult for some rural households. As Tuah *et al.* (2022) reported, poor location is a major rural infrastructure management challenge. The findings indicated the non-existence of a RHI plan to guide proposed future locations. According to Yuan *et al.* (2017), lacking a plan discourages the definition of rural health infrastructure problems.
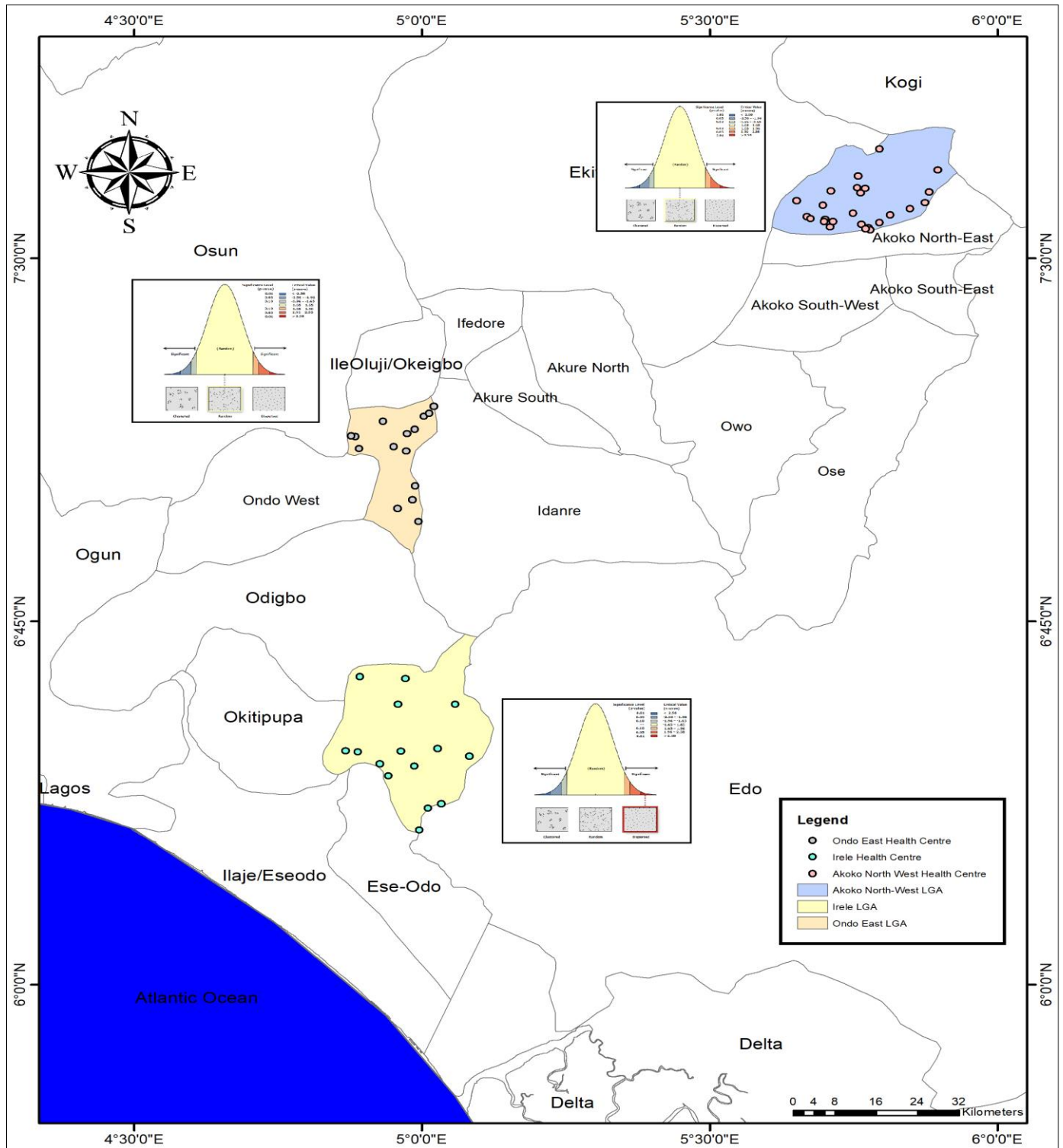
Fig 6 Nearest Neighbour Analysis for Rural Health Infrastructure
Source: ArcGIS Version 10.6 digitised by Author (2023)

IV. CONCLUSION AND RECOMMENDATIONS

The spatial analysis of rural health infrastructure revealed that the distribution of rural health infrastructure reflects the quality of spatial governance and health policymakers' decisions on their location. Effective consultation and participation of policymakers and rural dwellers can improve the quality of spatial planning decisions regarding the locations of rural clinics and hospitals. The study concluded that areas lacking health facilities should be prioritized for new infrastructure, while regular monitoring and inspection of existing RHIs is needed to identify maintenance needs or determine if additional facilities are required. To guide future planning and operations, the study recommended developing a comprehensive rural health infrastructure plan for equitably funding, maintaining, and expanding health facilities in Ondo State.

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➢ *About the Authors*

Idris, Omeiza David holds a membership with the Nigerian Institute of Town Planners and is currently a Lecturer in the Department of Urban and Regional Planning at Abubakar Tafawa Balewa University, Bauchi.

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