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ABSTRACT

Constructions of properties located along major transport route are on high demand that the demands of such properties are two times higher than their supply in Onitsha. This study is aimed at modeling the value of estate properties in different locations at Onitsha using GIS and spatial autocorrelation technique. This aim was achieved through the following objectives; determine the types and patterns of building properties within the study Area, create a geospatial database of the study area, determine the spatial distribution of property values using spatial autocorrelation and predict values of properties in the study area in 2033. GIS analysis was carried out and proximity analysis was done to determine properties that are close to some amenities using Buffer in ArcGIS. The buffer queries produced maps and attribute tables. The result of the analysis showed the properties that are close to different amenities such as markets, schools, major roads, hospitals in the study area. Suggestions and recommendations were made from the result of the analysis and including government to consider taking more amenities to places like Okpoko, Awada to decongest the population in GRA, and housing 3-3.

Keywords: Estate, Property, GIS, Spatial Autocorrelation

1.1 Introduction

Real estate property is considered one of the three fundamental necessities of life from time immemorial. The fact remains that unlike food and clothing, real property is difficult to acquire. People need to be housed (shelter), as it is very essential and indispensable because it is the platform of all human activities. Hence, it plays a vital role in social, economic and psychological development of an individual, a state and a nation at large (Ibrahim, 2013). In view of the rapid urbanization coupled with rapid population growth, demand for rental properties has experienced an upsurge. According to Nikolaos, Dimitra and Agapi (2011), the market value of a real estate is affected by its location among other factors. The initial decision of every organized society, individual or firm is where to locate at a point in time. However, it is clearly understood that the factors that influence such an initial decision completely depend on the reason for the activity to be carried out on that desired location.

Location refers to the specific placement of a house which affects housing choices. Location is among the main determinants of residential property value. It has been realized that location could either be tangible or intangible in nature. Tangible location factors include accessibility, transportation closeness to central business districts, building codes, household preference, demand, supply, population increase, closeness to place of work, community facilities, utilities and services, components or elements that form part of a building structure, zoning regulation, subdivision regulations, environmental protection laws, waste dumpsites, planning restrictions, closeness to toxic or hazardous waste site real estate value (Kohlhase, 1991) and so on. On the other hand, intangible location factors are those attributes of location that are invisible in nature. They include race, crime, safety, religious inclination, cultural identity, native inclination, security, ethnic background, violent free areas, socio-economic background, and violent prone areas and so on.

The existing wealth of knowledge reveals that tangible location factors are the prime mover in determining the worth of land and landed property (Garrod and Willis, 1994; Anas, 2002). This is of course true, if someone looks at it critically and analyzes things in an advance manner. However, the value of landed property could also be determined by other intangible means. Rental values of landed property could be arrived at by looking at many indicators like accessibility, transportation,

nearness to school, place of work, place of worship, market, hospital, etc (Yinger, 1979; Wilhelmsson, 2000; Bowes, 2001). Furthermore, the value or worth of a real estate could be arrived at by looking at the public utilities, facilities and services that go a long way in providing a conducive atmosphere and convenient environment for healthy and comfortable living (Clark and Herrin, 2000; Espey and Kwame, 2001).

It has been found that adoption of new innovative technology such as Geographic Information System (GIS) in administrative system will deliver unusual results as well as enhance economic and administrative competiveness (Campbell, 1999). Thus, most of the quantitative geographical studies were carried out using GIS platform (Longley, 2000).

A GIS provides a means of managing information digitally and in a geographical context. Many property management decisions require consideration of location, geography and space. The technology is well suited to this, but constructing a GIS-based property information system that records the complex interests in land and property is a daunting task. The volume of spatial data is often enormous and the cost of establishing and maintaining a database will be prohibitive unless a means of utilizing existing resources can be developed. Historical property data can be hard to trace due to the poor quality and maintenance of some records, property interests are heterogeneous. There has been attempt to link the spatial location and regional scale objects information with GIS (Laurini and Thompson, 1992; Masser and Campbell, 1995; Obermeyer and Pinto 1994). Some authors conveyed the importance of GIS and spatial data handling at different applications with review on the future significant potential in new area of research (Goodchild, 1992).

The management of property information is not just about computer systems but about the spatial information (Laurini and Thompson, 1992). There are human, information and commercial issues to be considered while collecting spatial information, storing and using it for generating results (Longley et al, 1999). Even a project has been clearly specified and system and data requirements outlined, access to certain information may not be possible due to confidentiality constraints or legislative barriers. There comes the need of information strategy for GIS which needs to be linked with management plan for successful implications (Hendriks, 1998). Certain land and property spatial information is commercially and personally sensitive and must be handled accordingly. The spatial data must be worked carefully to avoid any positional inaccuracies (Kiiveri, 1997).

This study seek to model the value of estate property in different locations in Onitsha, Anambra state using GIS and spatial autocorrelation technique with a view to determining their pattern of distribution.

2.1 Materials and Methods

2.1.1 The Study Area

The study area is Onitsha city and its environs, which covers two local governments' areas of Onitsha North and South with a total population of 561,066 (NPC, 2006). The geographic location is approximately between Latitudes $06^{0}05^{1}20.89^{11}$N and $06^{0}13^{1}26.473^{11}$N and Longitude $06^{0}45^{1}20.604^{11}$E and $06^{0}52^{1}10.573^{11}$E. It occupies the eastern bank of the Niger River, covering some 50 square kilometers. Onitsha is strategically located and accessed through the east–west national main road from Lagos through Benin, which links the eastern north–south route via the Niger Bridge at Onitsha.

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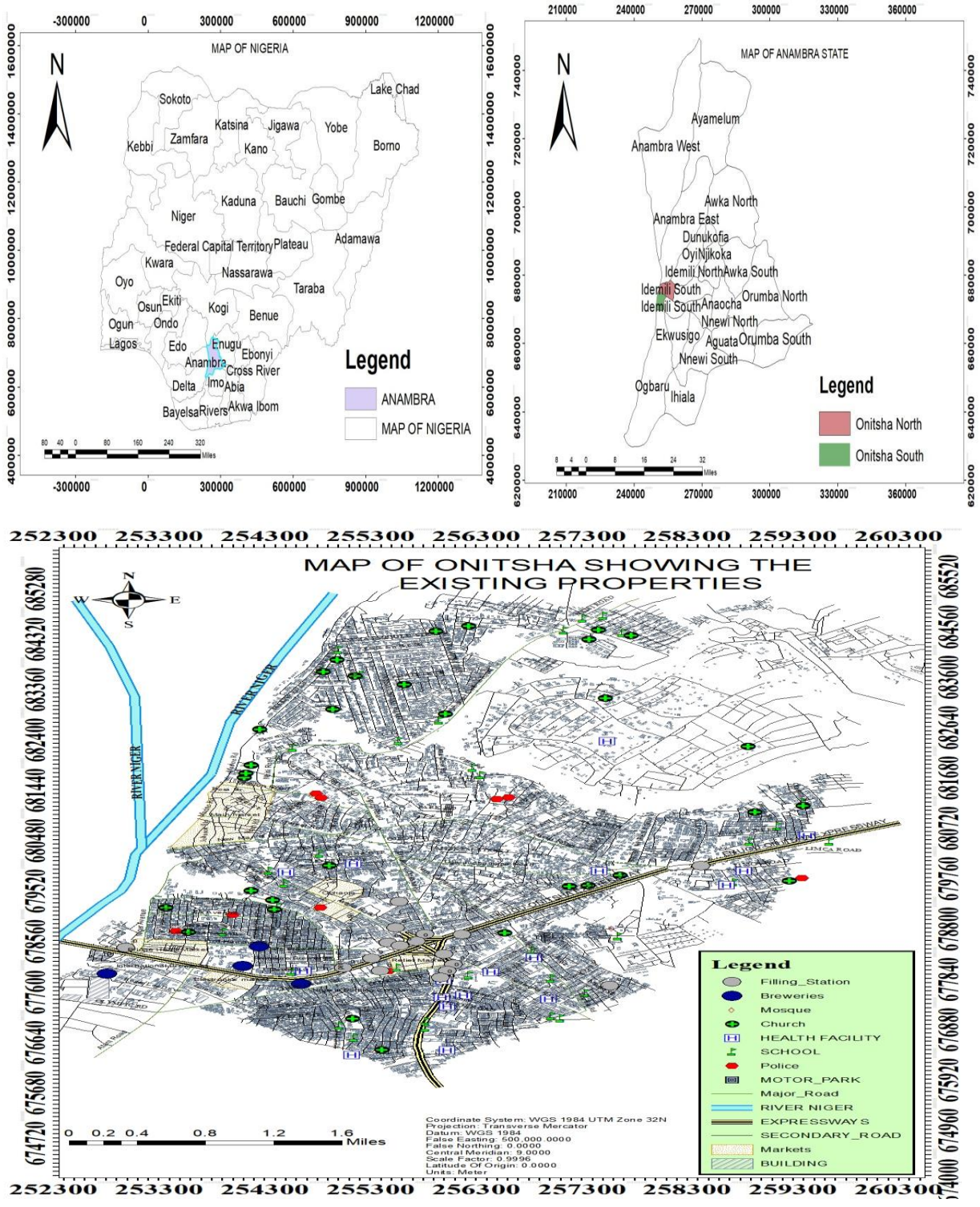

Figure 2: The study area

2.1.2 Research Data

Data used for this study was mainly from Google Earth Image covering Onitsha, Anambra State. Other useful data was obtained from literatures and oral interview and through field capture. The data were derived from primary and secondary sources. The Primary data was gathered from three major neighborhoods within the metropolis by physical observation of property, and questionnaires administered on Estate Surveyors in real estate practice to collect data on property rents. The primary datasets obtained were; Estate Property Data (attributes and locations), information on values of properties in some areas, roads and oral interviews. Other data was Google Earth image of Onitsha on 2023

The secondary data set that was used was obtained through the digitizing of Google Earth Image, Data Processing and GIS Analysis which includes the following:

i. Image Georeferencing
ii. Proximity Analysis

Spatial Autocorrelation Analysis Model:

Spatial autocorrelation is tested with global Moran's *I* which measures the strength of correlations between the value of the analyzed variable in a given location and the value of the same variable in other locations. The presence of such correlations indicates that the variables are spatially clustered. A positive autocorrelation occurs when the values of the analyzed variable are similar (high or low) and form clusters. In contrast, a negative autocorrelation occurs when high values of the observed variable are located in the proximity of low values, and when low values of the analyzed variable are situated in the proximity of high values (Suchecki 2010).

The calculated values of Moran's *I*, including the expected value and variance, are presented in Table 1.

Table 1: **Global Moran's I Summary**

Moron's Index	0.328175
Expected Index	-0.083333
Variance	0.045845
z-score	1.921907
p-value	0.054617

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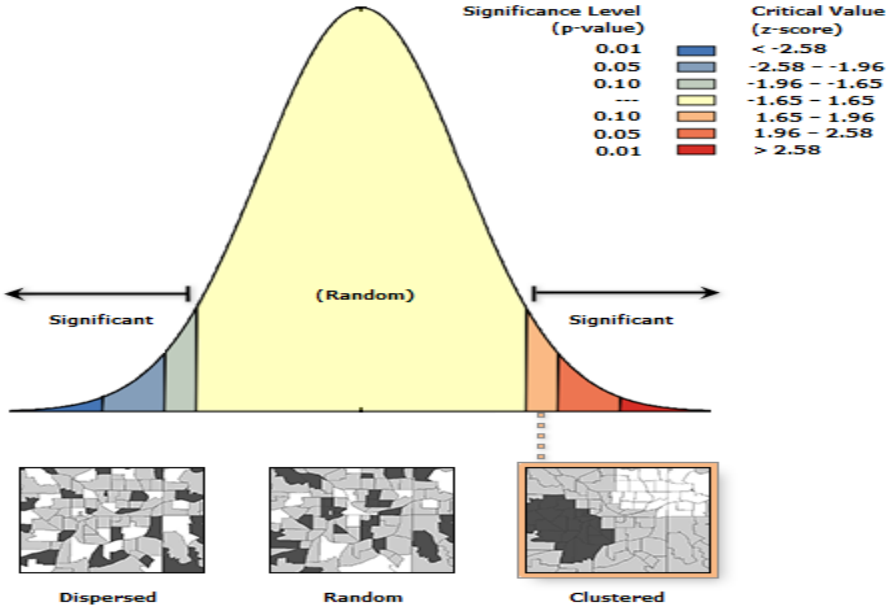

Fig.2**:** Probability density function of *Z(I)*.**(Source: Result of Author's Analysis, 2024)**

Map prediction was done using the geostatistical modeling and analysis was performed in the ArcGIS software using the kriging method.

3.1 PRESENTATION AND DISCUSSION RESULT

Nearness to hospital is assumed to increase accessibility to treatment facility. The distance of 500m to hospital was analyzed with the use of buffer analysis in ArcGIS 10.8 (See fig3).

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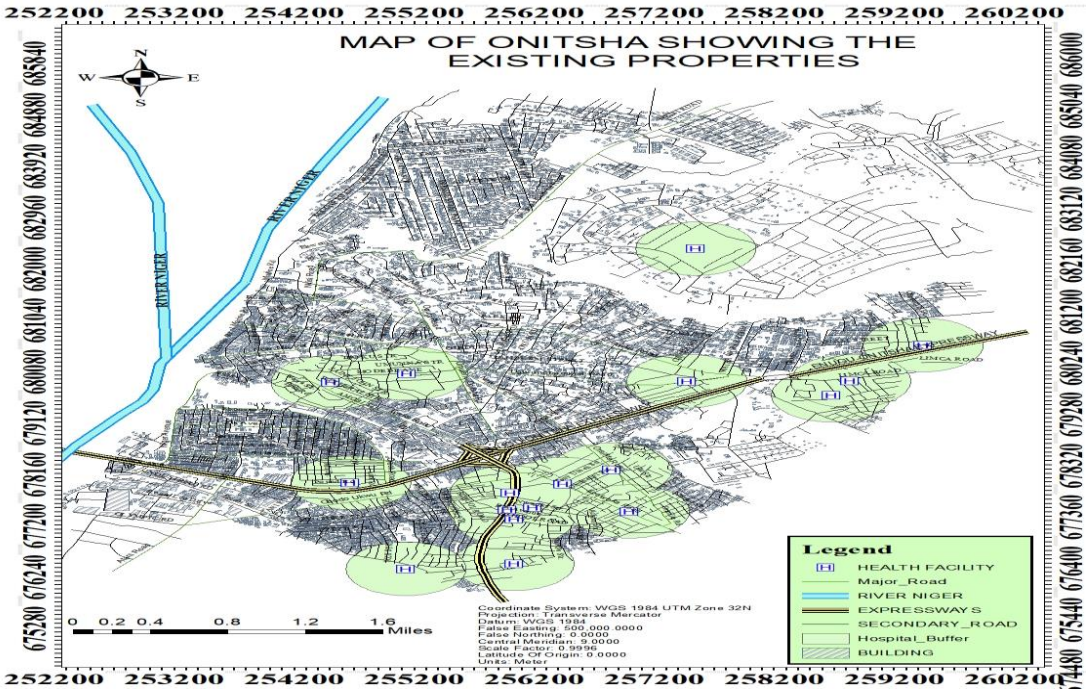

Fig.3: Result of buffer analysis of 500m from the hospital Distance to Schools

Accessibility to school was also considered. Since the property which is near the good quality of school is favorable choice for the residential land development. Here, using the proximity in ArcGIS, buffer analysis of 500m to schools was analyzed as shown in fig. 4.

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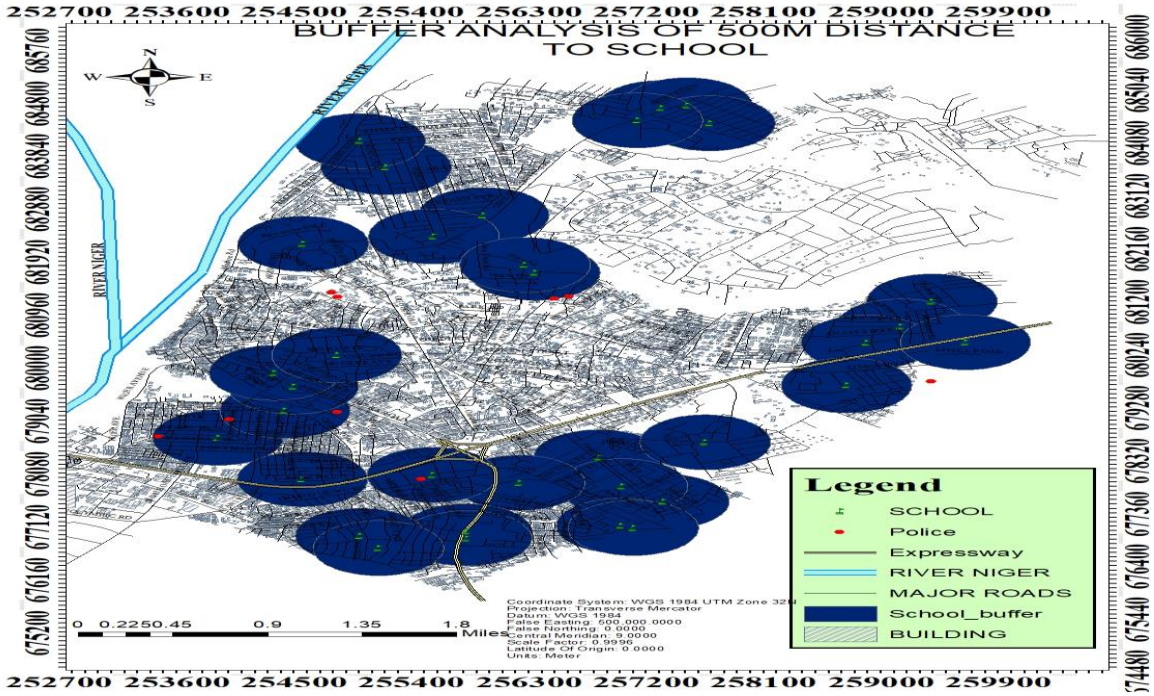

Fig. 4: Result of Buffer Distance of 500m to Schools

Accessibility to the major road is attached high value by household in locating where to live. It is assumed that real estate values increase with nearness to the major road. The proximity analysis tool in ArcGIS was used to carry out this analysis using a buffer distance of 200 meters close to major roads as shown in fig 5.

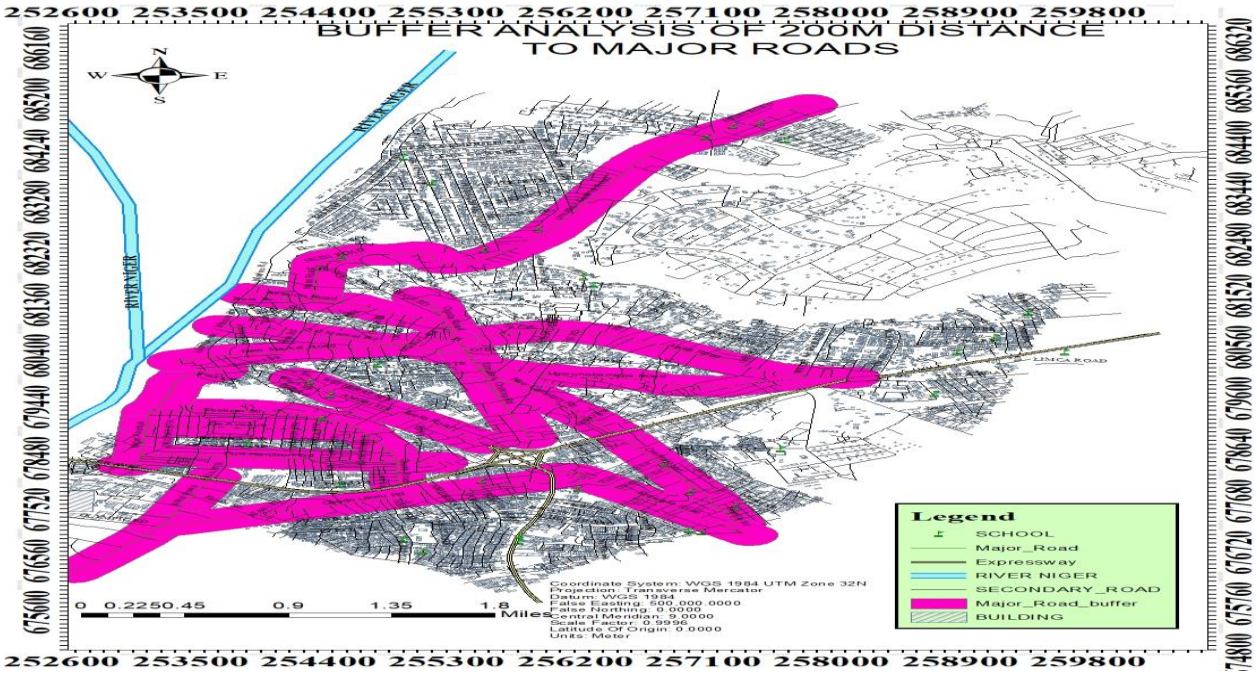

Fig. 5: Result of the Buffer Analysis of 200m Close To Major Roads

Same measurement of accessibility to school has been used to measure 500m distance to police station and market. The aim was know if residents prefer to live close to the police stations and markets, probably for security or proximity to market reasons. The results of the analysis are presented in fig 6 and 7 respectively.

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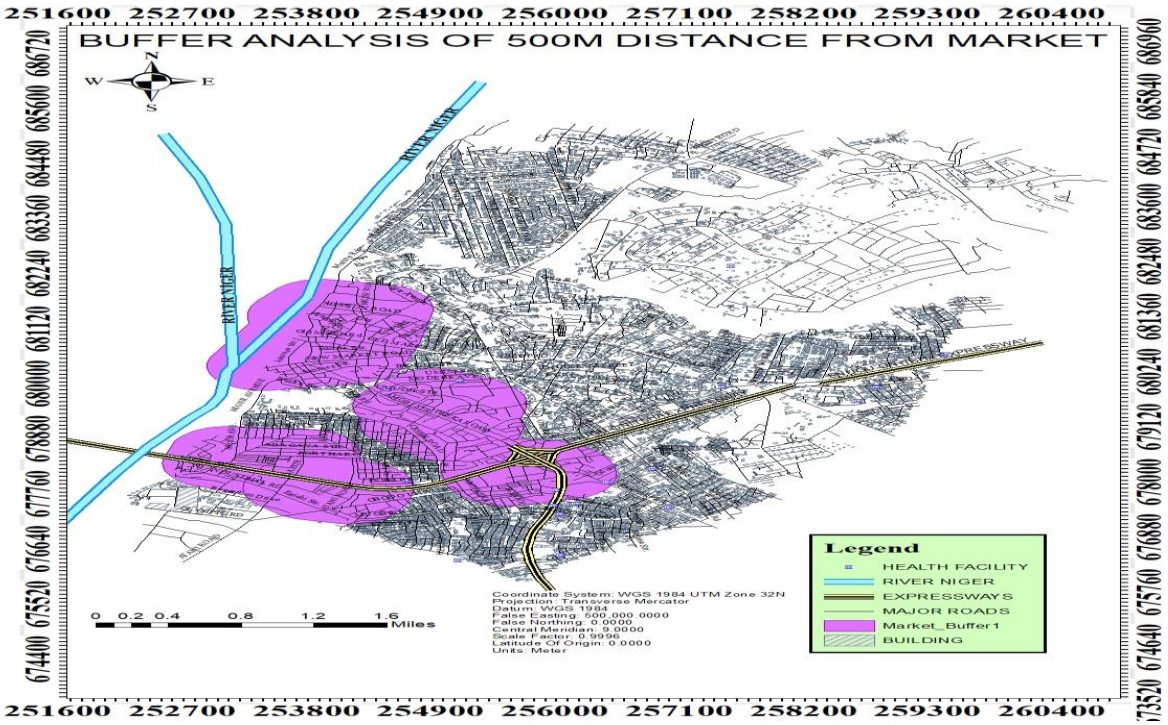

Fig.6: Buffer analysis of 500m distance from different markets

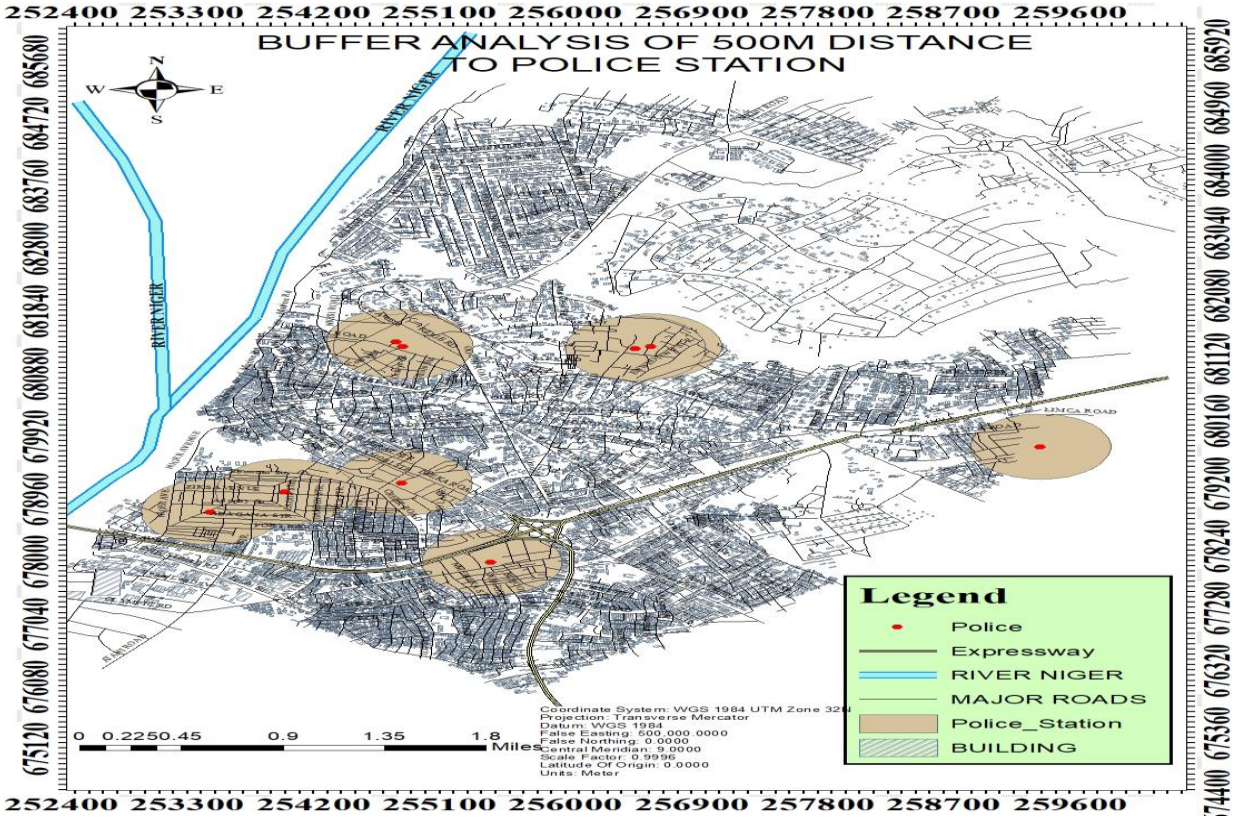

Fig.7: Buffer Analysis of 500 meters distance from police stations

The values of properties were predicted to the year 2033 using the kriging method in ArcGIS environment and the result is presented in fig 8.

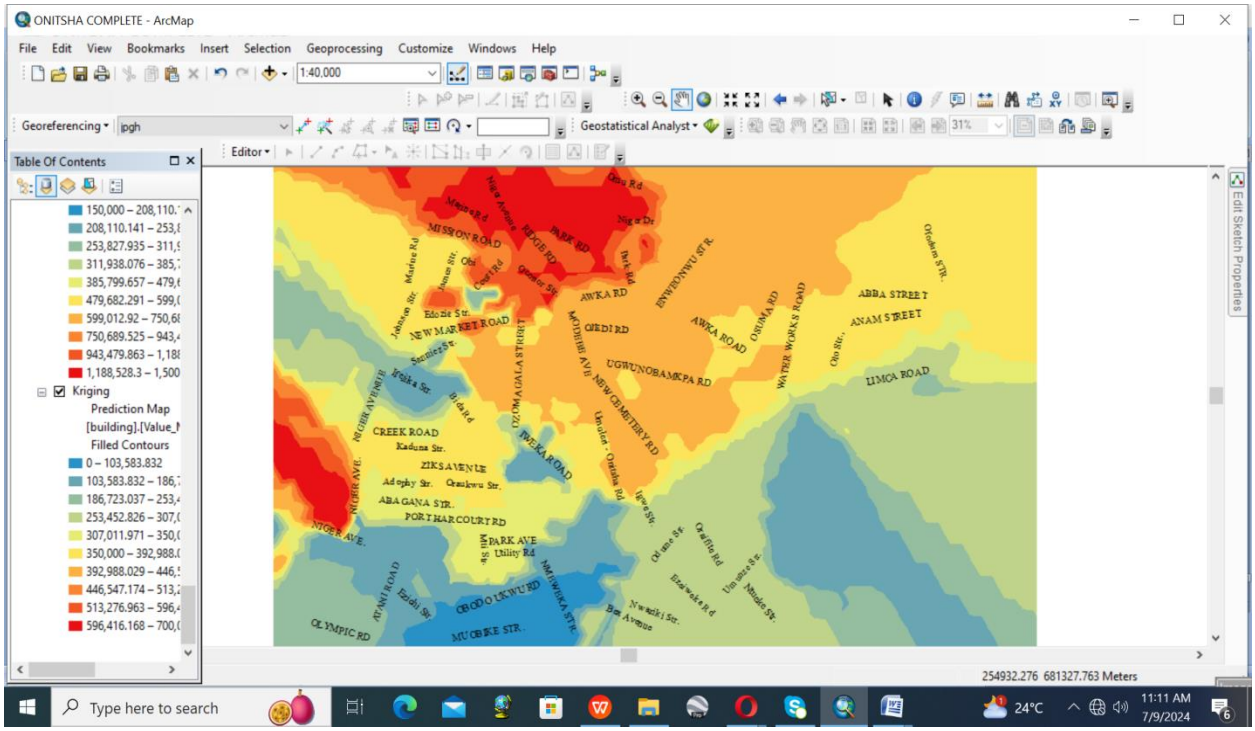

Fig. 8: Shows the prediction map for spatial distribution of properties in Onitsha

The result shows that the areas with red, orange, and yellow will experience high development while areas with blue and green color will experience lower development.

4.1 Conclusion

Availability of infrastructures such as accessible roads, electricity, pipe borne water and other amenities facilitates the provision and occupation of residential housing accommodation in the study area. Provisions of infrastructure determine the rental value of residential housing accommodation in the study area. This study has demonstrated the effectiveness of GIS in modelling rental values of properties in the study area. The study revealed that areas such as GRA, Housing Estate will experience high rise in property values in the year 2033.

5.1 Recommendations

Based on the result of the analysis, findings and discussion, the following recommendations are made:

(i) The study reveals that values of properties in places like GRA, Housing Estate are on higher rate due to provisions of basic, adequate and functional amenities. Therefore, this study recommends that government should provide basic, adequate and functional amenities like constant electricity supply, good road network, water supply, good schools, good sewage disposal, refuse dumping site in places like Awada, Nkpor, Okpoko.

(ii) The study observed that the values of old buildings in the area are on a lower rate compared to the values of newly constructed ones. Therefore it is recommended that the owners of those buildings should endeavor to renovate their properties to the best standard.

(iii) The study also reveals that, those buildings with water supply have higher value than those ones with no water supply. Therefore, the study strongly recommends that the owners of those properties should include water supply in the renovation of their properties in other to earn more value.

(iv) This study also recommends that the government should enhance the access to buses and transit options, improve transportation, utilities and public services

References

Anas, A. (2002). Residential Location Markets and Urban Transportation: Economic Theory, Econometrics and Public Policy Analysis. New York Academic Press.

Borcard, D., Legendre, P., & Drapeau, P. (1992). Partialling out the spatial component of ecological variation. *Ecology*, *73*(3), 1045-1055

Bowes, R.D. (2001). Identifying the Impacts of Rail Transit Stations on Residential Property Values. Journal of Urban Economics, 50(1), 1-25.

Campbell, H. (1999): Institutional consequences of the use of GIS. Geographical Information Systems, 2.

Clark, D.E. & Herrin, W.E (2000). The Impact of Public School Attributes on Home Sale

Prices in California, Growth and Change. A Journal of Urban and Regional Policy, 31(3), 385 - 407.

Ekenta, E. (2010). Basic Theory and Application of Modern Valuation; Alheri Books, Port Harcourt, Nigeria

Epsey, M. & Kwame, O. (2001). Neighborhood Parks and Residential Property Values in Greenville, South Carolina. *Journal of Agricultural and Applied Economics, 33(3).*

Garrod, G. & Willis, K. (1994). An Economic Estimate of the Effect of a Waterside Location on Property Values; *Environmental and Resource Economics*, 4, 209 - 217.

Griffith, D. A. (2009). Spatial autocorrelation. *International encyclopedia of human geography, 2009*, 308-316.

Ibrahim, T. Akogun (2013) Impact of Location On Property Value And Business Development In Ilorin Metropolis, Nigeria. International Journal of Current Research, .5(10), .2735-2738.

Kohlhase, J. (1991). The Impact of Toxic Waste Sites on Housing Values. Journal of Urban Economics, 30, 1-26.

Longley, P. (2000): Spatial Analysis in the New Millennium, Annals of the Association of American Geographers, Vol. 90 (1), pp. 157- 165.

Nelson, A. (1999). Transit Stations and Commercial Property Values: A Case Study with Policy And Land-Use Implications. *Journal of Public Transportation, 2(3), 77-93.* Accessed online on June 15th 2022

Nikolaos .K.,Dimitra .V. and Agapi .X. (2011). Real Estate Values and Environment: A case Study on the Environment on Residential Real Estates Value. *International Journal of Academic Research,* 3(1), *861-868.*

Suchecki, B. (ed.). (2010). *Ekonometria przestrzenna. Metody i modele analizy danych przestrzennych*. C.H. Beck, Warszawa.

Wilhelinsson, M. (2000). The Impact of Traffic Noise on the Value of Single-Family Houses. *Journal of Environmental Planning and Management, 43(6), 799 - 815*. Accessed online on June 15th 2022