International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 7 Issue 5 Ver. IV || May 2018 || PP 52-58

Development of Prototype Model For Population Estimation: A Case Study of Udoka Housing Estate, Awka, Anambra State, Nigeria

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Abstract: *This study focused on estimating the population of Udoka Housing Estate, Awka, Anambra State using Remote Sensing (RS) data and Geographic Information System (GIS). Aerial photograph of the study area was used to digitize the features on the area. The data acquisition was in two phases; Geometric data was acquired through land surveying method with the aid of hand held GPS, while attribute data were obtained through social survey by oral interview method (questionnaire). Database creation and analysis were performed using ArcGIS 10.1. A census database was created with various attributes, exploring certain aspects of data planning and processes. The study concludes by suggesting the new ways through which the Society and agencies in census operations should explore to tackle the issue of population estimation.*

Keywords*: Census, Population, Remote Sensing and GIS*

Date of Submission: 07-05-2018 Date of acceptance: 22-05-2018

I. Introduction

Previous census conducted in the past 50 years in Nigeria was marred with controversies. Most of the controversies could be connected to the enumeration delimitation challenges and improper documentation.

The 1991 census conducted had little prudence and carefulness based on resources and expertise available, that of 2006 reflected a greater improvement on the methodology. This is because the data capturing activities were scientific. A critical study at the pre-census activities and the data input of the 1991 census revealed that, there is a fundamental need to upgrade the status of the organization's input data sets. This manifested in the previous censuses considering the very crude nature of how the primary datasets used in the past were generated.

Arnett (2005) defines census as a periodic count of the population. It is the process of obtaining information about every member for a population (not necessarily a human population). It can be contrasted with sampling in which information is only obtained from a subset of a population. Technological and Institutional issues adversely affected the way and manner census data were captured. It is against this backdrop that this research seeks to make fundamental and practical contribution to the process of census enumeration using a proto-type (a model) of Enumeration Area. This Enumeration Area information System can be applied to any census using basic geo-spatial data acquisition tools within an organization that has appropriate policies and Institutional framework on ground.

Population study is concerned not only with the population variables but also with the relationship between population variables such as social, economic, political, biological, genetic, geographical and interrelationship between those variables. It includes both qualitative and quantitative aspects of human population.

Population studies were not given much priority in the past. But at present days people of different field require the information about population, so its importance is increasing day by day. Population education is very important at present to be a successful sociologist, politician, administrator and environmentalist.

Census analysis is often not critically analyzed to bring out some of the basic and important attributes of census data information. This is usually due to non-availability of the required tools for carrying out such analysis. This research work suggests the use of geographical information system (GIS) and Remote Sensing as an integrating technology that gives geo-spatial distribution of the population. Remotely sensed data offers the means to measure spatial attributes of the urban landscape. In the past, researchers remain depended on "Aerial Photographs" because of their fine spatial resolution to get accurate data about size of houses and their volumes and consequently estimates of population (Adeniyi, 1983; Lo and Chan, 1980). In addition to that, remotely sensed data provide a wider spectral coverage (number of bands). Due to these advantages, there is a general trend towards using remotely sensed data and GIS for census studies.

GIS technology integrates common database operations, such as query and statistical analysis with maps. GIS manages location-based information and provides tools for display and analysis of various statistics, including population characteristics, economic development opportunities and vegetation types.

1.6 Study Area

Udoka Housing Estate, Awka is located along Onitsha/Enugu Express Road (opposite NNPC Mega Station) Awka, Awka South Local Government Area, Anambra State, Nigeria. The site lies approximately within latitudes 60 12' 19" N and 60 12' 39" N, and longitudes 70 03' 26" E and 70 03' 51" E. It is a medium density estate or layout planned, developed and managed by Anambra State Housing Development Corporation, Awka. The case study site has an area of about 15.188 Hectares and 111 parcels. Its location along Onitsha/Enugu Express Road on Ikwodiaku Hills in Awka makes the site conspicuous and fascinating.

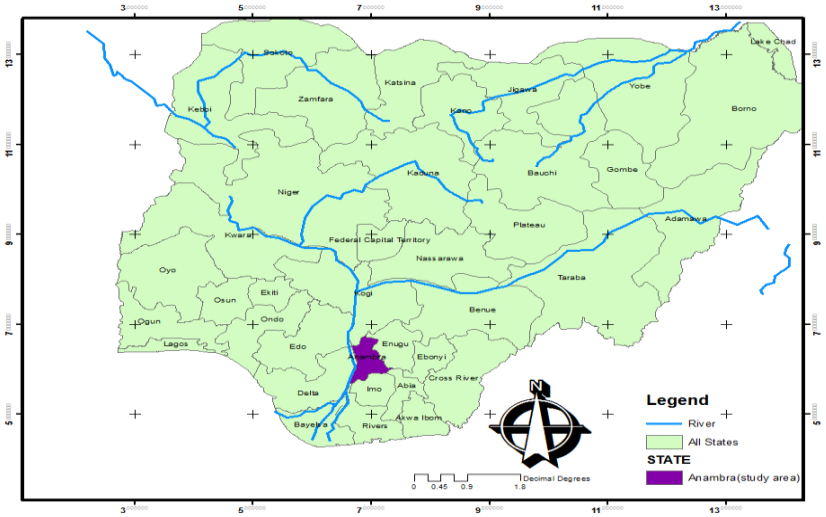

Fig1.1 Map of Nigeria showing Anambra State (Source: Extracted from the Administrative Block of Nigeria)

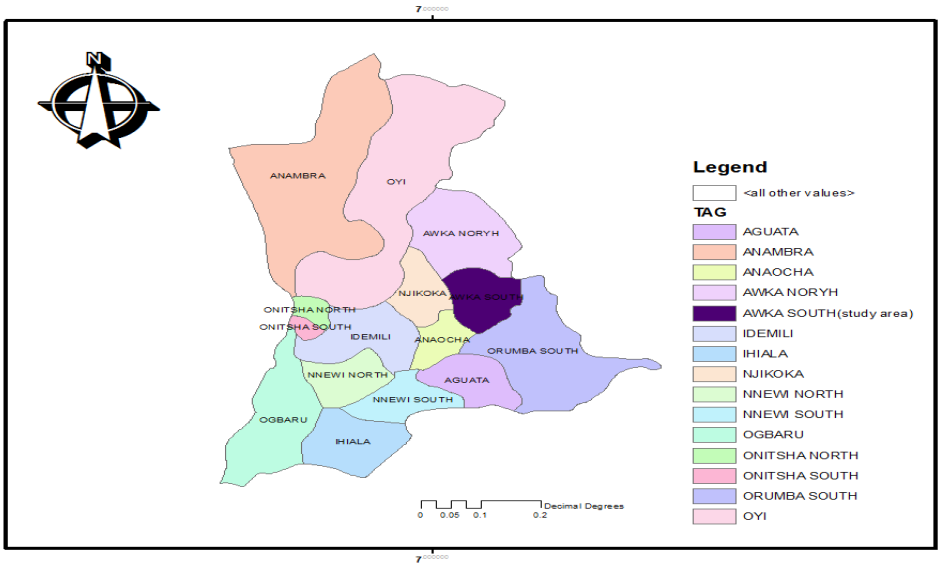

Fig 1.2 Map of Anambra State showing Awka south (Source: extracted from Administrative map of Nigeria)

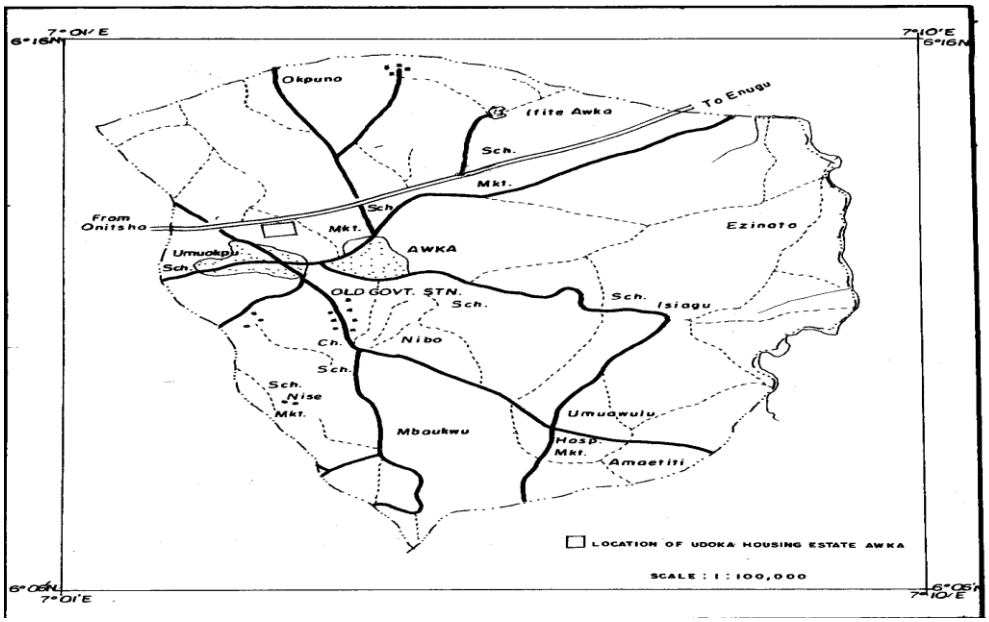

Fig. 1.3 Map of Awka showing Udoka Housing Estate Awka.
(Source: extracted from administrative map of Nigeria)

II. Methodology

The aerial photograph of Awka Capital City was acquired and area of interest extracted out. Features within the study area were digitized using Arc GIS10.1 Software. Buildings were digitized as polygon while roads were digitized as linear entity. Attribute database of the buildings were created. The road name, building types, number of males/females, number of children, road status, and road condition were used to create the database. Questionnaires was carried out to determine the (i) buildings that are residential, (ii) buildings that are commercial, (iii) buildings that are bungalows, (iv) buildings that are duplex, (v) number of bungalows that have number of people >= 6 (vi) number of duplex that have number of people >= 6

III. Results And Discussions

The Statistical analysis performed in this study includes the analysis done on number of buildings in the part of the estate, the type of buildings, the estimated number of males, females and people below the age of 18. The part of the estate containing the area of study has an area of about 15.188 hectares. From the data gotten from the field, there were about 74 duplexes and about 31 bungalows. The study area is majorly a residential estate but there are a few commercial buildings gotten from the questionnaire. The sample size was determined using Taro Yamane formular for determining sample size at 95% confidence level and P = 0.05%.

$n = N/1+ N (e)^2$… eqn 1

where n = sample size

N = population

e = the level of precision (0.05)

I = theoretical constant

Therefore: $\frac{110}{1 + 110 (0.05)^2} = 87$

About 95 questionnaires were distributed and 88 were retrieved which was used for the analysis.

Table 1.1 and 1.2 shows the total number of occupants and the total population of people in different building types in the Study Area. These are further illustrated in figure 3.1 and 3.2 respectively.

Table 1.1: Table showing estimated total of occupant category

OCCUPANT CATEGORY	ESTIMATED TOTAL IN THE STUDY AREA
Male	198
Female	179
Below 18 (Children)	199

Table 1.2: Table showing total population of people in different building types

Building Type	**DUPLEX**	**BUNGALOW**
Estimated total population of people in buildings	403	173

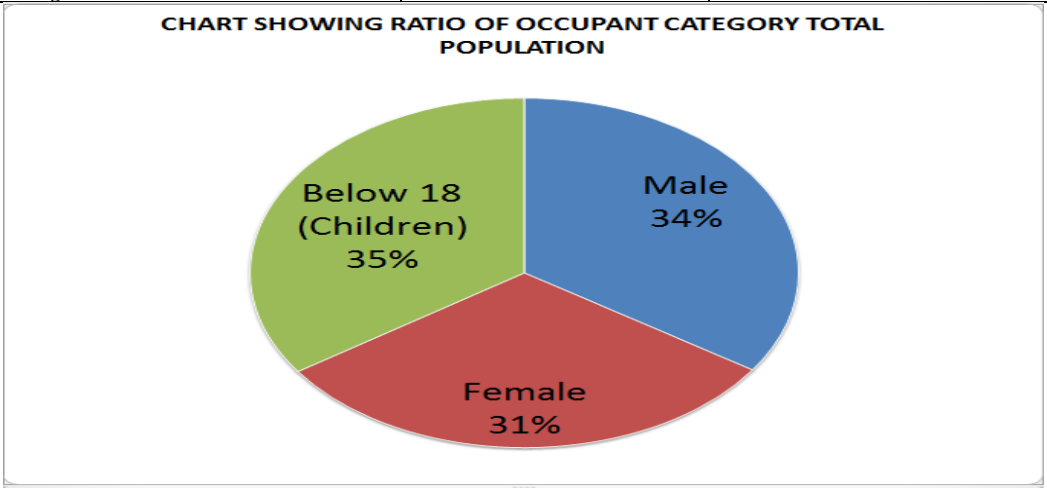

Fig 3.1: Pie chart showing ratio of occupant category to total population.

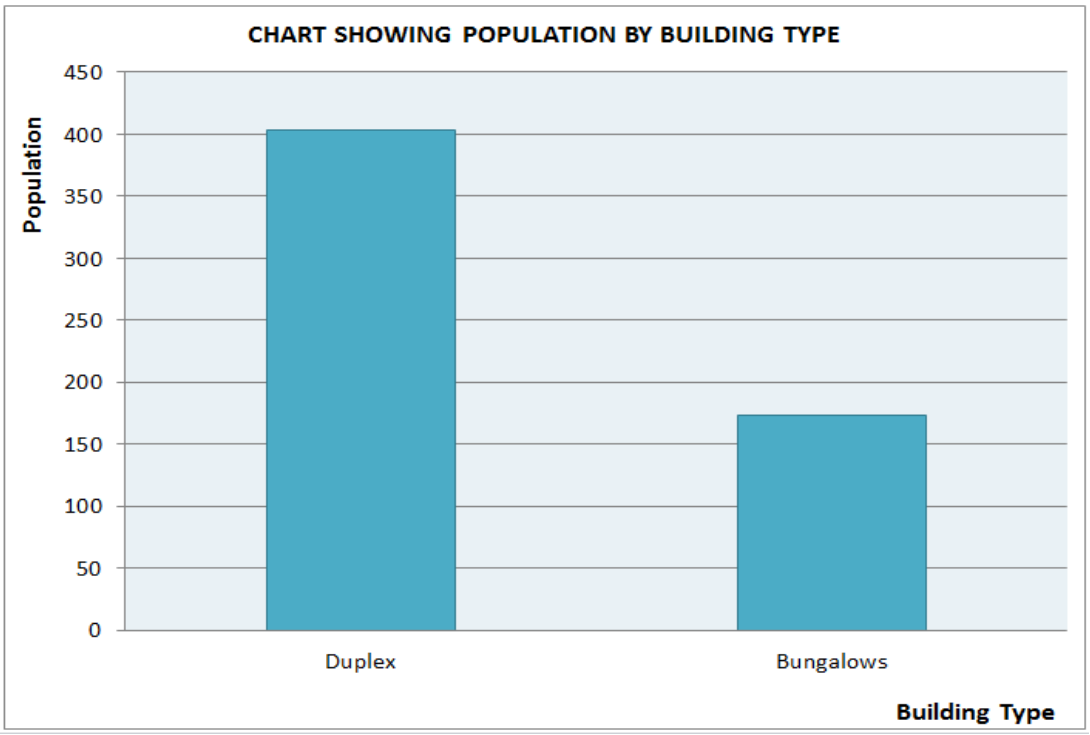

Fig 3.2: Chart showing population by building type

3.2 Population Density

Population density is a measurement of population per unit area or unit volume; it is a quantity of type number density. It is frequently applied to living organisms and most of the time to human. It is expressed as number of people per square kilometer.

It is mathematically expressed as

$$\text{Population density} = \frac{\text{Total population}}{\text{Area}}$$

Total population of study area = 576

Area = 15.188 hectares = 0.15188 square kilometers

Therefore population density = $\frac{576}{}$ =3792.468sqkm.

0.15188

Some sample queries were carried out to test the effectiveness of the database created. For example, figure 3.3 and 3.4 shows the result of query to know the building type that are used for commercial and residential purposes respectively.

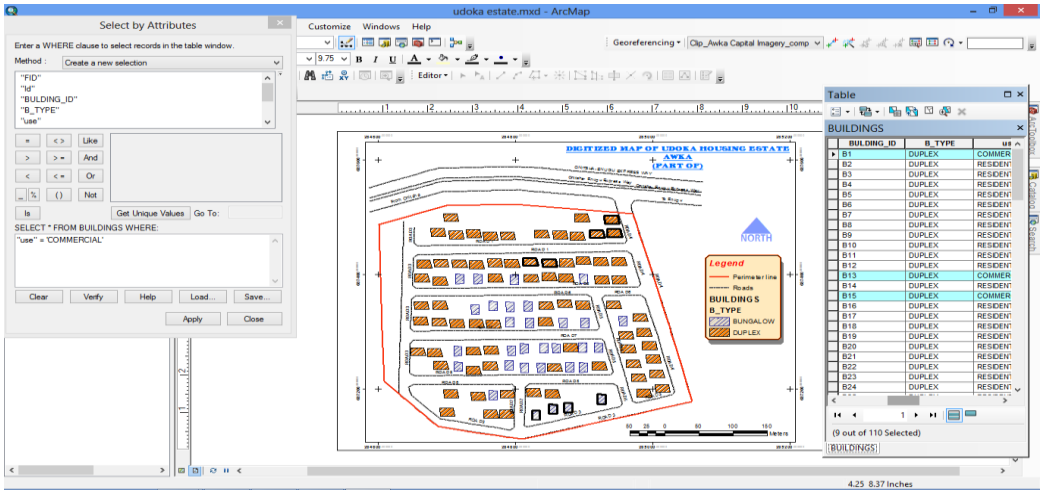

Fig. 3.3: Result of query showing building use= commercial

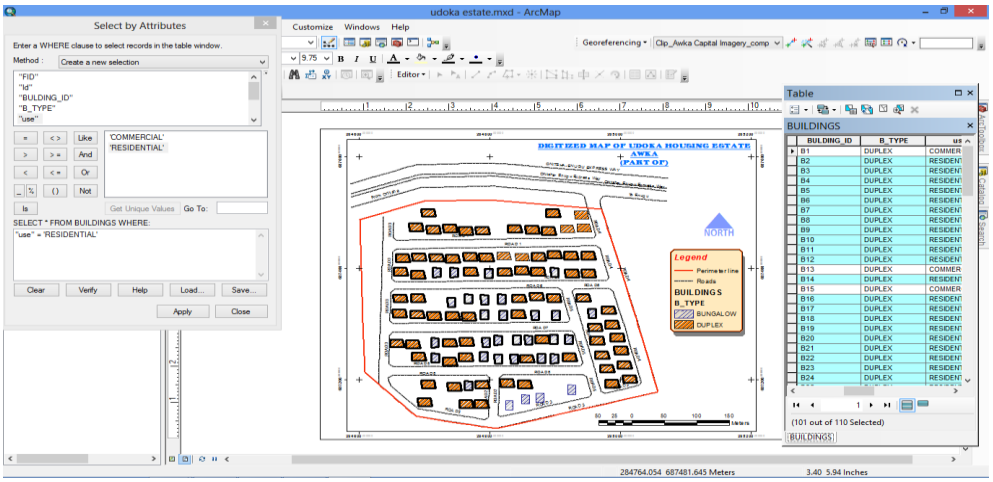

Fig 3.4: Result of Query Showing Building Use= Residential

Figure 3.5 and 3.6 shows the type of buildings that are duplex and bungalow respectively.

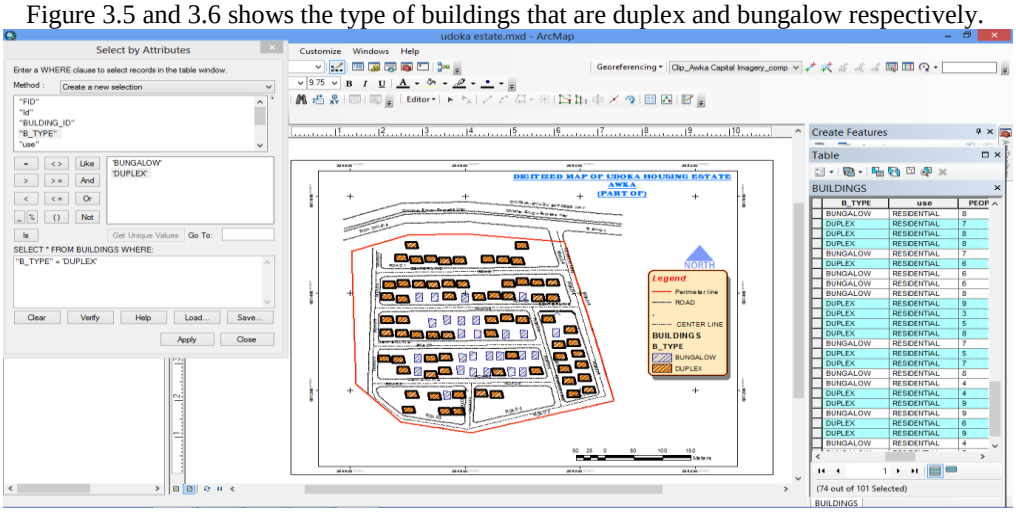

Fig 3.5: Result of Query Showing Building Type = Duplex

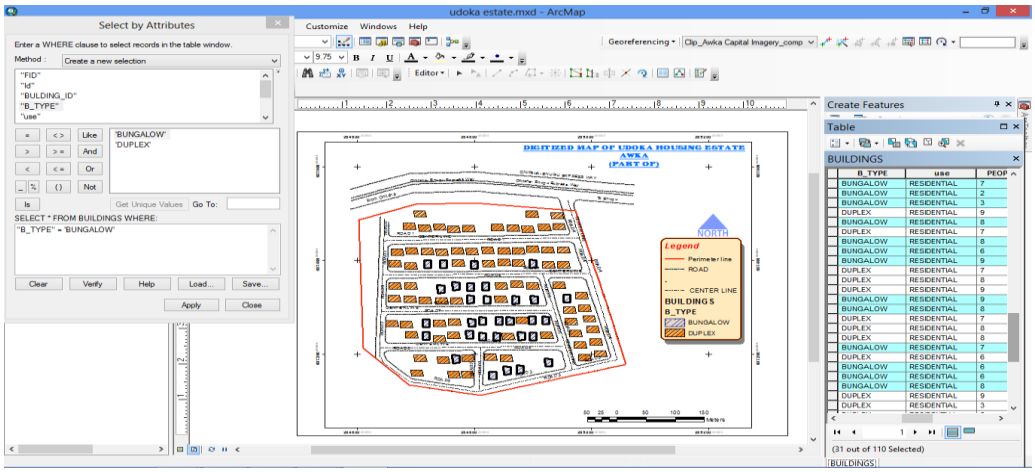

Fig 3.6: Result of query showing "Building_Type" = 'Bungalow'.

The importance of these queries as shown in figure 3.5 and 3.6 is to determine the number of buildings that are duplex and bungalow. By knowing the estimated number of occupants in a duplex or bungalow, this can be multiplied by the total number of duplex or bungalow in the area to obtain the estimated number of people in the area. Figure 3.7 and 3.8 shows the result of query showing number of bungalows and duplex having number of occupants greater than and equal to six (6).

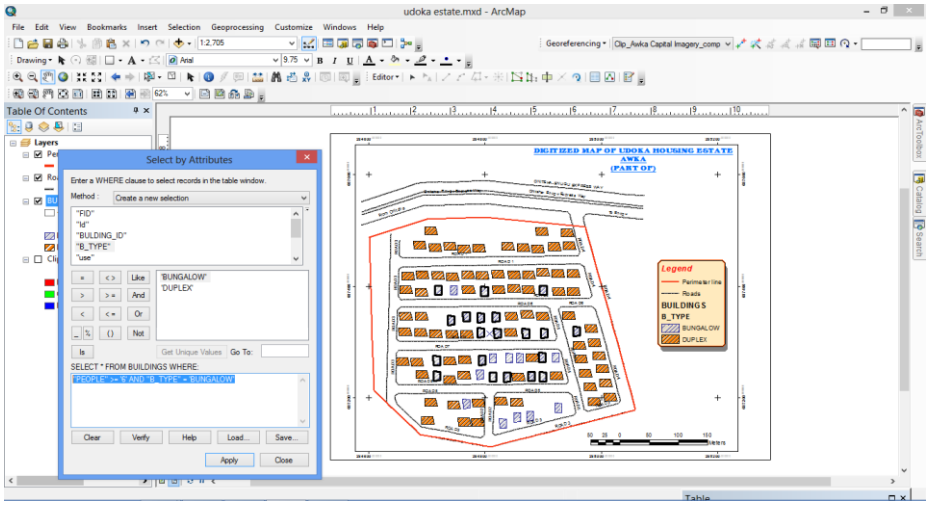

Fig 3.7: Result of query showing the number of bungalows that have number of People >= 6

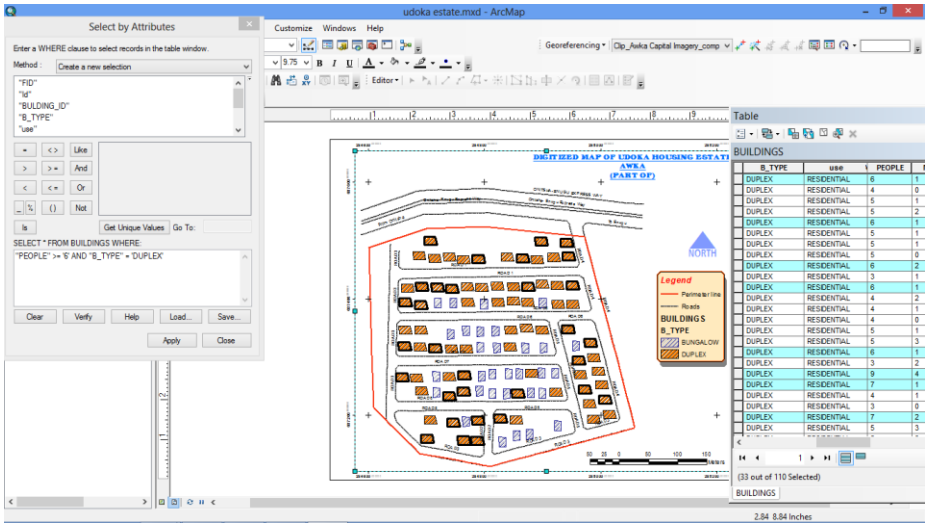

Fig 3.8: Result of query showing duplex that have number of people >= 6

IV. Conclusion And Recommendations

4.2 Conclusion

Population estimation has been a major challenge in most developing countries. This study applied GIS and remote sensing in estimating the population of Udoka Housing Estate Awka, Anambra State. An aerial photograph was used to obtain information about the study area and GIS was used to perform analysis on the dataset to determine and classify buildings into bungalows, duplex and through ground truthing and questionnaire to determine purpose of buildings, age of male/ female above and below 18 years was achieved. Maps were produced indicating the population by building type, percentage of occupants to total population, total number of bungalows, duplex.

4.3Recommendation

Remote sensing and GIS technology is slowly becoming cost effective, easy to use, and a viable technology that can produce fast, reliable, and low-cost alternative for population estimation. Therefore, the following are recommended:

1. This study should be extended to other areas of Anambra state.
2. Multi-temporal satellite remote sensing imageries should be used to estimate the population of the area.

References

[1]. Adeniyi, P. O. (1983). An aerial photographic method for estimating urban population. *Photogrammetric Engineering and Remote Sensing, 49: 545-560*.

[2]. Bastin, L. *(1997).*Comparison of Fuzzy C-mean Classification, Linear Mixture Modeling and MLC Probabilities as Tools for Unmixing Coarse Pixels. *International Journal of Remote Sensing,18(17):3629-3648.*

[3]. Bern, S. (2012). GIS and the Cloud. A new Paradigm for Managing Municipal Spatial Information.*Presented at the MISA 2012 Conference, Harrison Hot Springs, B. C., Canada.*

[4]. Donnay, J.P. (1999). Use of remote sensing informationin planning. *In:Stillwell, J., Geertman,*

[5]. *S. and Openshaw, S. Geographic Information and Planning, Springer, Berlin*, 242-260.

[6]. Donnay, J.P., Barnsley, M.J. and Longley, P.A. (2001).Remote sensing and urban analysis. In:

[7]. Donnay, J.P. Barnsley, M.J. and Longley, P.A. (eds.), *Remote sensing and urban analysis*. Taylor and Francis, London, pp. 3-18.

[8]. Eze, C. G. (2009). Application of Remote Sensing and Geographic Information System for Creation and Management of Enumeration Areas in Enugu State, Nigeria. Ph.D Dissertation Submitted to the Department of Surveying and Geo-informatics, NnamdiAzikiwe University, Awka, Nigeria.

[9]. Fajar, Boedi, Syaiful, (2014).Detection Settlements and Population Distribution Using GIS And Remotely Sensed Data, In The Surrounding Area ofMerapi Volcano, Central Java, Indonesia. *International Journal of Emerging Technology and Advanced Engineering*

[10]. Fang Qiu, Kevin L. Woller, and Ronald Briggs (2003). Modeling Urban Population Growth from Remotely Sensed Imagery and TIGER GIS Road Data Photogrammetric *Engineering & Remote Sensing (69) 9, 1031–1042.*

[11]. Guiying Li and QihaoWengUsing (2005*)*.Landsat ETM_ Imagery to Measure Population Density in Indianapolis, Indiana, *USA Photogrammetric Engineering & Remote Sensing 71(8), 947–958.*

[12]. Hofmann-Wellenhof, B., Lichtenegger, H. and Collins, J. (2001), *Global Positioning System, Theory and Practice.*

[13]. Rostam S. (2013). Estimation of Urban Population by Remote Sensing Data. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 4(6):565-569*

[14]. Samuel NiiArdeyCodjoe (2007).Integrating Remote Sensing, GIS, Census,and Socioeconomic Data in Studying the Population–Land Use/Cover Nexus in Ghana*: A Literature UpdateAfrica Development*,. (XXXII) 2, 197–212.

[15]. Yagoub M.(2006). *Application of remote sensing and Geographic Information Systems (GIS) to population studies In the gulf: a case of al Ain city (UAE). Journal of the Indian society of remote sensing*, 34, 1

[16]. Zha, Y., Gao, J., Ni, S. (2003). Use of Normalized Difference Built-up Index in Automatically

[17]. Mapping Urban Areas from TM imagery. *International Journal of Remote Sensing, 24(3):583-594.*

Ejikeme, J.O., " Development of Prototype Model For Population Estimation: A Case Study of Udoka Housing Estate, Awka, Anambra State, Nigeria "International Journal of Engineering Science Invention (IJESI), vol. 07, no. 05, 2018, pp 52-58