EVALUATING THE ADHERENCES OF DEVELOPMENTS TO PHYSICAL DEVELOPMENT CONTROL STANDARDS IN ORI-AWO RESIDENTIAL AREA, OYO EAST L.G.A., OYO USING GIS TECHNOLOGY

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Abstract

This paper focused on evaluating the adherences of developments to Physical Development Control Standards using Geospatial Technology. Efforts were geared words assessing the compliance of developments in Ori-Awo residental area, Oyo East Local Government Area, Oyo, to road setback, and land use change of the existing buildings. Comparative Analysis were carried out between the current land use and the original town planning design of the same area in order to determine the differences between current developments and what it was designed to be. Space standards for physical developments in Oyo State were used as compliance standards. A downloaded, updated Google Earth Imagery and master plan were the basic data used. Database was designed, created and analyzed in ArcGIS 10.3 Software. The results showed maps as well as comparative analysis of recent developments and changes in the design of the study area. Contraventions, conversion or change of use as well as encroachment into public land were observed. 324 of the 616 total buildings contravene the airspace planning regulation. 24 buildings were changed from residential to mixed uses and 24 buildings violated the road setback standard. Conclusively, the result revealed that the original town planning design of the area had been thwarted. The results generated are relevant in physical development control standards by governmental agencies. **Keywords:** Adherence, Development, GIS, Database, Space Standard and Spatial Decision

1.0 Introduction

Cities have continued to grow but at a rate faster than the types of facilities initially installed. The rapid population growth and physical expansion of cities have been accompanied by unplanned urban sprawl, environmental pollution, deterioration, deficiencies in modern basic facilities such as water, electricity, hospitals, sewage, municipal and community facilities, and general urban decay. As increased urbanization exert more pressures on urban facilities, most Nigerian cities tend to have lost their pre-colonial original dignity, social cohesion and administrative efficiency of planning (Kolade, 1999). In Nigeria, development control requires special skill as a result of the daily problems the authorities are confronted with, which is ascribed to the absolute size and rate of increase of these settlements and the difficulty of the tasks involved. The problem ranges from non-implementation of the Nigerian Urban and Regional Planning Law (Decree No 88 of 1992, amended as No 18 of 1999), inadequate funding of physical planning programs, lack of planning tools, political intervention and manipulation by government officials, lack of public

enlightenment on physical planning programs, poor monitoring of planning schemes amongst others. The solution is the ability to realize positive results in the course of enforcement. The laws that will satisfy both private and public needs have to be harmonized into the present conditions in the building industry (Nduthu, 2013). GIS which is a tool that organizes, references, and collects multiple criteria of data sets bringing them into a common reference system for analytical and spatial operations can be used to aid decision making. It can also be used in developmental control and subsequent practice of urban and regional planning especially in the overall development of our town and cities. It is in the acquisition, management and presentation of spatial information in automated format (Burrough, 1986).

2.0 Problem Definition

The state of the physical environment, particularly urban centers, is a major global concern because the urban growth is being accompanied by enormous housing congestion, conversion of use, adjoining incompatible land uses and other physical developments problems. There is a need to assess, monitor and control the trend and the pattern of development because as they occur as uncontrolled development (slums and ghetto), they may mar the beauty and sustainability of the urban area.

It was observed that most developmental activities in Ori-Awo residential area, are not in conformity to the layout planning standards as indicated in the Master Plan. Hence, there is a need to identify and map the non-conformity uses so as to ensure that every development that takes place within the area is in accordance with the physical development planning standards.

3.0 Aim

The aim of this paper is to deploy GIS technology in evaluating the adherences of developments in Ori-Awo Residential Area, Oyo East Local Development Area, Oyo State to physical development control standards.

4.0 Objectives

In actualizing the aim of the paper the following objectives were considered:

i. Design of a database for the study area;
ii. Collection of attribute of entities in the study area i.e. Roads, Buildings, etc.
iii. Conversion of existing raster images to vector format;
iv. Database Creation for the Study Area
v. Perform spatial analyses to determine land uses that are not in conformity with physical control standards within the study area.

5.0 Study Area

Oyo is one of the largest towns in the Oyo state with an urban population of about 164,500 (1963 census), 275,034 (1991 census) and 236,400 (2006 census) and projected to be 736,072 (World Population Review, 2018). The town comprises of three Local Governments namely Atiba, Oyo East and Oyo West. Ori-Awo is a general name given to a community within Oyo East Local

Government which lies between longitudes 868000mE to 867200mE, and latitudes 605600mN to 607000mN within the projected Coordinate System, WGS_1984_UTM_Zone_31N. It is an extensive area which is rapidly developing.

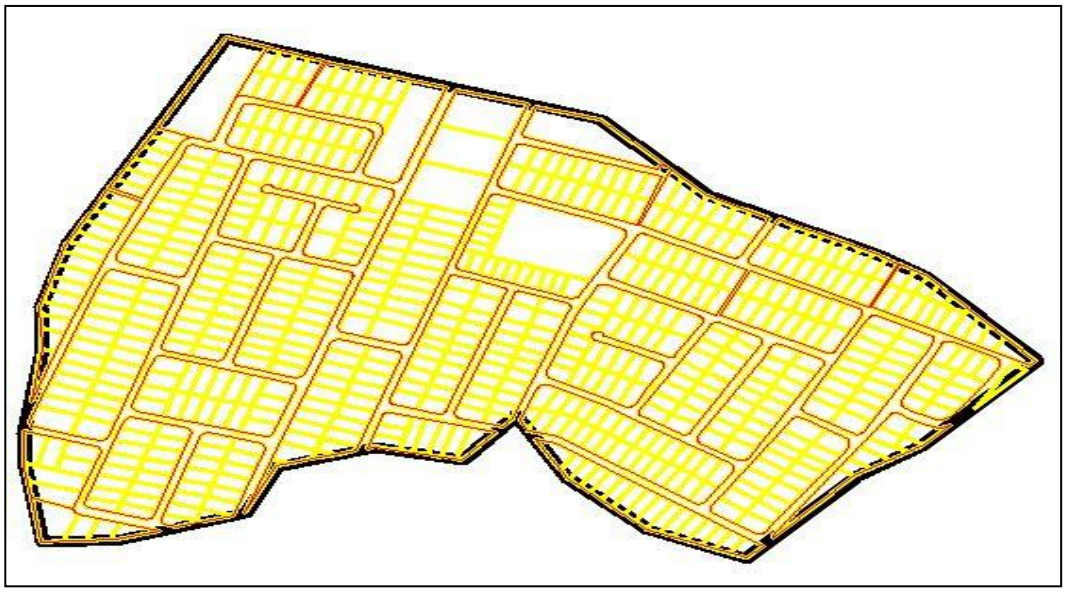

Figure 1: The Study Area

6.0 Methodology

6.1 Database Design Database design is categorized into three stages, i.e. the conceptual design, logical design and –the physical design phase. In database design, there is need for reality, which is referred to as the phenomenon that actually exists, including all aspects, which may or may not be perceived by individuals and can be used for a particular application or group of applications (Kufoniyi, 1998).

6.1.1 Conceptual Design: This is a representation of human conceptualization of reality. At this stage of the database design, decisions were made on how the view of reality will be represented in a simplified manner and still satisfy the information requirements of the users. The following entities were identified: Parcel, represented as Polygon feature, Access roads, represented as line feature. Buildings, represented as polygon and Block as Polygon

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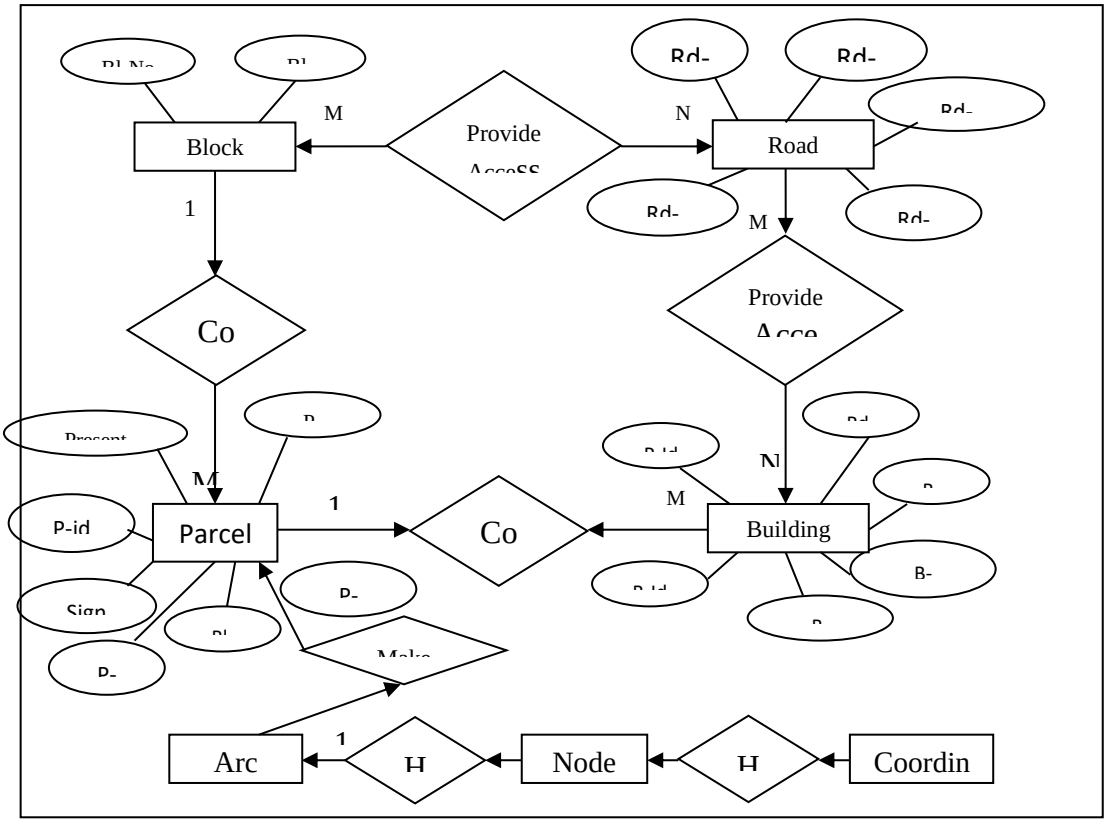

Figure 2: Entity Relationship diagram of the study area

6.1.2 Logical Design

The conceptual data model will be transformed into data structure capable of being represented in the computer. In a relational data model, data will be separate in the tables. Each table contain item of data called fields object (attribute of entities). The logical design is meant to provide redundancy-free data set. Each fact is stored only once in the database, the output of this stage will be on data structure. Relational database management system is utilized to facilitate the logical data model, the following entities are road, parcel, building and blocks.

ROAD (**Rd_No**, Rd_name, Rd_Status, Rd_Class, Rd_Lenght)
PARCEL (**P_Id**, Design Use, P_Area, BI_No, Present_Use)
BLOCK (**BI_No**, BI_Area)
BUILDING (**B_Id**, B_ Status, B_Use, P_Id, Rd_NO, B_Type)

Table 1: Road and its attributes

IDENTIFER	DESCRIPTION
Rd_No	Road Identification
Rd_Name	Road Name
Rd_Status	Road Status
Rd_length	Road Length
Rd_Type	Road Type

Table 2: Parcel and its attributes

IDENTIFER	DESCRIPTION
P_Id	Parcel Identifer
Design_Use	Design_Use
P_Area	Parcel_Area
BI_No	Block_Number
Present_Use	Present_Use

Table 3: Building and its attributes

IDENTIFER	DESCRIPTION
B_Id	Building Identifier
B_Status	Building Status
B_Area	Building Area
B_Use	Building Use
B_Type	Building Type
P_Id	Parcel Identifier
Rd_No	Road Identifier

Table 4: Block and its attributes

IDENTIFER	DESCRIPTION
Bl_No	Block Identification
Bl_Area	Block Area

6.1.3 Dataset Required

Attribute data were collected through social survey and direct interview with residence of the area. Information about some of the residents were also elicited from the Oyo East Local Government

The secondary data include: Downloaded Google Earth Imagery of the study area which was updated via field survey. Space standard for physical development in Oyo East LDA, was used to check compliance of physical development control standards in the study area

6.1.4 Physical Design

This stage is referred to as the implementation stage. It involves the representation of the data structure in a format of the implementation software. This include definition of field i.e. field name, field type, and field width. This is known as data integrity, rules that must be obeyed before data is acceptable as records.

Table 5: ROAD TABLE AND DATA DECLARATION

S/No.	Field Name	Data Type	Data Width	Description
1	Rd_No	Short Integer		Road Identification
2	Rd_Name	Text	20	Road Name
3	Rd_Status	Text	10	Road Status
4	Rd_Class	Text	6	Road Length
5	Rd_Lenght	Double		Road Type

Table 6: PARCEL TABLE AND DATA DECLARATION

S/No.	Field Name	Data Type	Data Width	Description
1	P_Id	Short Integer		Parcel Identifer
2	Design_Use	Text	20	Design_Use
3	P_Area	Double	12	Parcel_Area
4	BI_No	Short Integer		Block_Number
5	Present_Use	Text	20	Present_Use

Table 7: BUILDING TABLE AND DATA DECLARATION

S/No	Field Name	Data Type	Data Width	Description
1	B_Id	Short Integer		Building Identifier
2	B_Status	Text	10	Building Status
3	B_Area	Double		Building Area
4	B_Use	Text	15	Building Use
5	B_Type	Text	15	Building Type
6	P_Id	Short Integer		Parcel Identifier
7	Rd_No	Short Integer		Road Identifier

TABLE 8: BLOCK TABLE AND DATA DECLARATION

S/No	Field Name	Data Type	Data Width	Description
1	Bl_No	Short Integer	6	Block Identification
2	Bl_Area	Double	18	Block Area

7.0 Database Creation

The tables were created and populated in ArcGIS 9.3 and the attribute tables were linked with geometric data.

Table 9: PARCEL ATTRIBUTE TABLE CREATED IN ArcGIS 10.3

Table

PARCEL

FID	Shape *	Id	Design_Use	Present_Us	P_Area	P_ID	Bl_No
0	Polygon	0	Residential	Residential	569.325192	20	1
1	Polygon	0	Residential	Residential	690.562114	20	4
2	Polygon	0	Residential	Residential	776.398469	18	6
3	Polygon	0	Residential	Residential	719.618588	16	7
4	Polygon	0	Residential	Residential	747.12503	8	11
5	Polygon	0	Residential	Residential	713.643832	8	12
6	Polygon	0	Residential	Residential	661.551233	7	10
7	Polygon	0	Residential	Residential	817.786725	6	8
8	Polygon	0	Residential	Residential	816.023264	5	9
9	Polygon	0	Residential	Residential	899.632039	4	5
10	Polygon	0	Residential	Residential	912.897073	3	2
11	Polygon	0	Residential	Residential	840.814498	2	2
12	Polygon	0	Residential	Residential	919.338176	1	3
13	Polygon	0	Residential	Residential	921.189987	9	1
14	Polygon	0	Residential	Residential	872.627512	11	1
15	Polygon	0	Residential	Residential	861.726201	10	15
16	Polygon	0	Residential	Residential	820.56492	9	13
17	Polygon	0	Residential	Residential	696.524222	14	20

1 (0 out of 616 Selected)

BUILDING | BLOCK | PARCEL

7.0 Spatial Operations

The spatial data acquired in this paper were linked to the attribute data and used to demonstrate how GIS as an analytical tool is used to answer the basic generic questions of; "what is where", "where is what", and "what is the pattern?".

7.1 Criteria used for GIS analyses

In assessing the level of compliance to town planning standard within the study area; two major important planning standards were selected because they are the most obvious within the study area. These are reflected in the series of spatial analysis carried out in the course of this work. These criteria are highlighted below:

1. Setback: The analysis helps in verifying if the adequate road setback was observed by the developers. In achieving these, a buffer of 6m was created around the access road; the buffer road layer was overlaid on the building layer so as to depict buildings that encroached into road struck. (Source: Space standard for physical development in Oyo State, 2011)
2. Airspace: This was done by creating a 3 meters buffer inside each plot. The buffered area of the plot will serve as a template for every developer in observing space around building. And it will also help the planning authority detect if the proposed development observes the required space. (Source: Space standard for physical development in Oyo State, 2011)

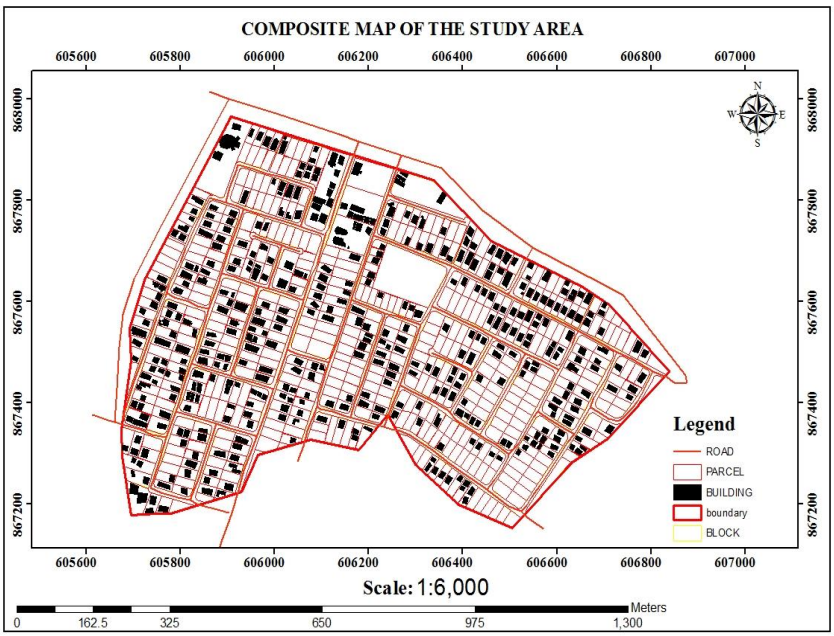

Figure 3: Composite map of the study area

7.2 Buffering Operation (to determine compliance to road setback)

Buffering operations helps in creating zone of distance. This analysis was carried out to identify or define an area within a specified distance around a feature. It helps in selecting features within a specified distance of a feature. A buffer of 6 meters was created on either side of the access roads in the study area. This will help in indicating the road setback.

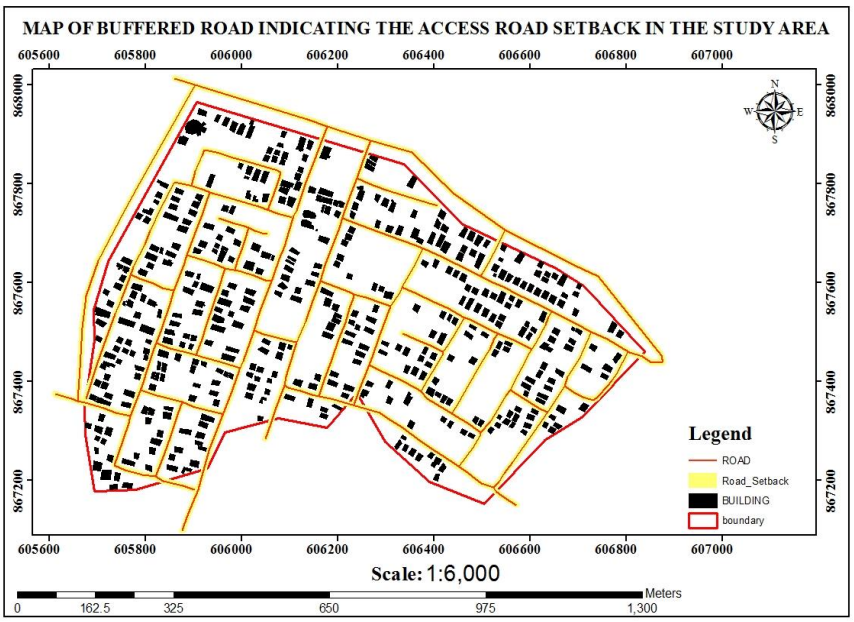

Figure 4: Map of buffered roads indicating the access road setback

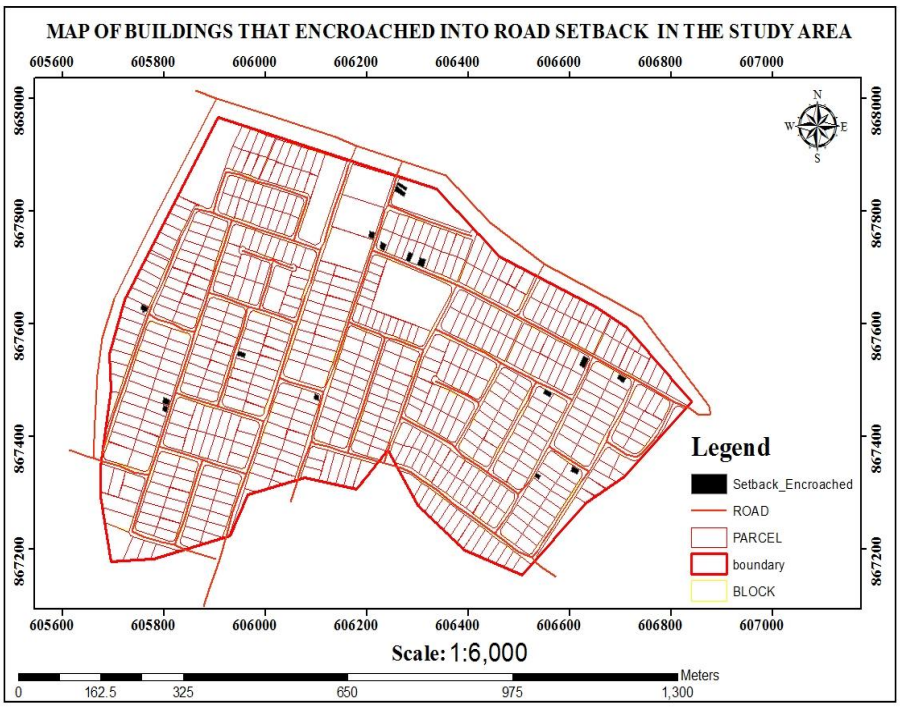

Figure 5: Map of buffered roads indicating the access road setback

7.3 Buffering Operation to determine Airspace standard

Parcels were buffered inwardly at 3meters to establish airspace standards. (Source: Space standard for physical development in Oyo State, 2011).

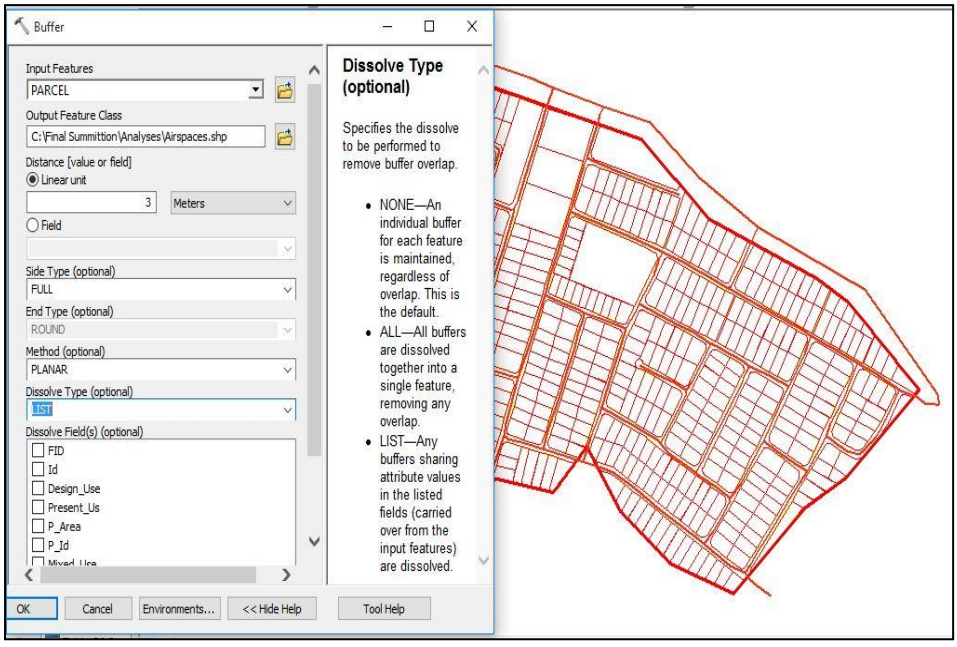

Figure 6: Buffer operation at 3meters to determine Airspace standard

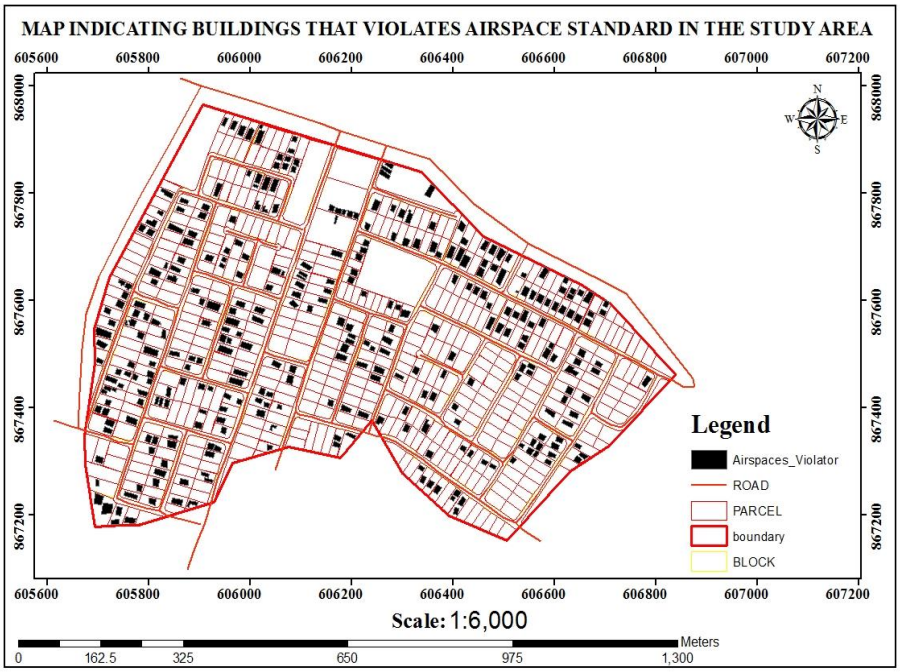

Figure 7: Map of parcel that contravenes the airspace standard

8.0 Spatial Database Query

8.1 Detecting Conversion of Land Use

Multiple criteria analysis was generated as follows:
SYNTAX: "Parcel" where". Design – Use" = 'Residential' AND "Present Use" = 'Mixed'

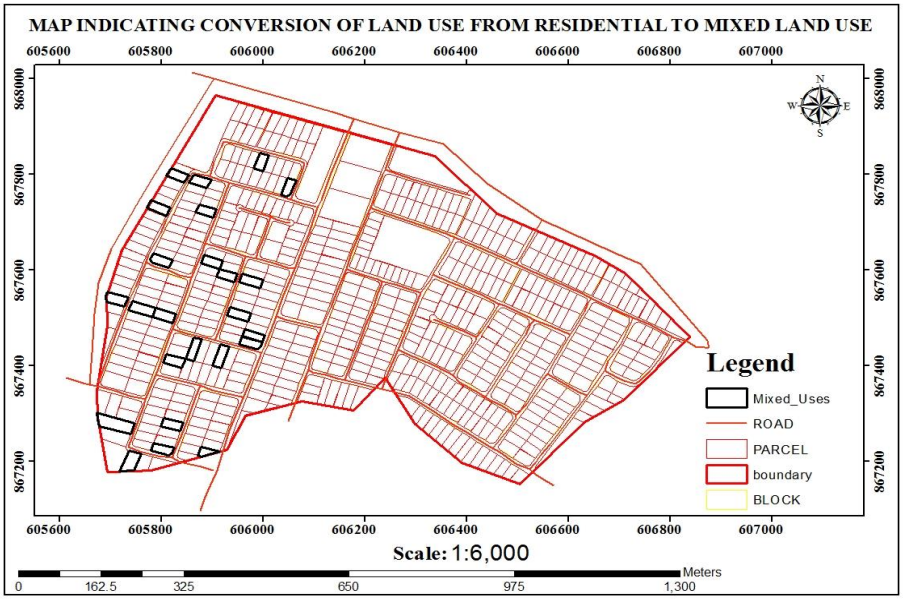

Figure 8: Map highlighting the parcel that were designed to be residential uses but are now mixed uses

9.0 Conclusion

The study has highlighted the use of GIS as a geospatial technology to evaluating the adherences of developments to Physical Development Control Standards with a focus on assessing the level of compliance of developments in Ori-Awo residental area, Oyo East Local Government Area, Oyo, to road setback, and land use change of the existing buildings.

Investigation to determine the level of physical developments vis a vis level of compliance to standards for physical developments in the study area has revealed there is an appreciable level of non-compliance which calls for concern and redress by all relevant stakeholders. The original town planning design of the area had been thwarted. The information generated from this research would help the government and necessary stakeholders in decision making on how to address the challenges posed by the development.

10.0 Recommendation

Based on the observations made in the course of study, the following recommendations are hereby made;

1. The GIS as a tool should be integrated into physical development control as this will help eliminate the lapses which often trail the conventional practice.
2. Physical developments in Nigeria should be assessed from time to time and Town planning designs updated from time to time using the methods demonstrated in this study. This is because it was observed that there was no update in the planning design of Ori-Awo Residential Area, Atiba LGA, Oyo, since the first design was made.
3. Government should strive to sensitize the members of the public on the importance of a well-planned environment and issues pertaining physical development control as this will encourage developers to be complaint with the town planning regulations in their development implementation.

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