Géointelligence et Gouvernance des Territoires : Quel apport des Solutions de Géoinformation à la Gestion des Communes Africaines pour un Développement Durable ?

A WEB GIS APPLICATION FOR PROPERTY TAX MANAGEMENT IN LAGOS STATE, NIGERIA

By

Joseph Oloukoi and Precious Tesini Dombo

African Regional Institute For Geospatial Information Science and Technology (AFRIGIST),
Obafemi Awolowo Campus, Ile-Ife, Nigeria

OUTLINE

- AFRIGIST

- INTRODUCTION

- AIM AND OBJECTIVES OF THE PRESENTATION

- STUDY AREA

- METHODOLOGY

- RESULTS AND ANALYSIS

- CONCLUSION

AFRIGIST

Established in 1972 under the auspices of the UNECA as an educational "one-stop" solution institution that trains highly skilled manpower, and conducts research in geospatial information science and technology, and its applications.

Vision: *To be a leading Institution of Excellence providing one-stop solution for quality geospatial science training, education and research to generate critical capacity for sustainable development in Africa.*

Mission: *To contribute to rapid sustainable development of member states in particular and Africa in general, through the development of critical capacity for timely delivery and responsible use of appropriate geospatial information*

Membership: Benin[1], Burkina[2], Cameroon[3], Ghana[4], Mali[5], Niger[6], Nigeria[7] and Senegal[8]
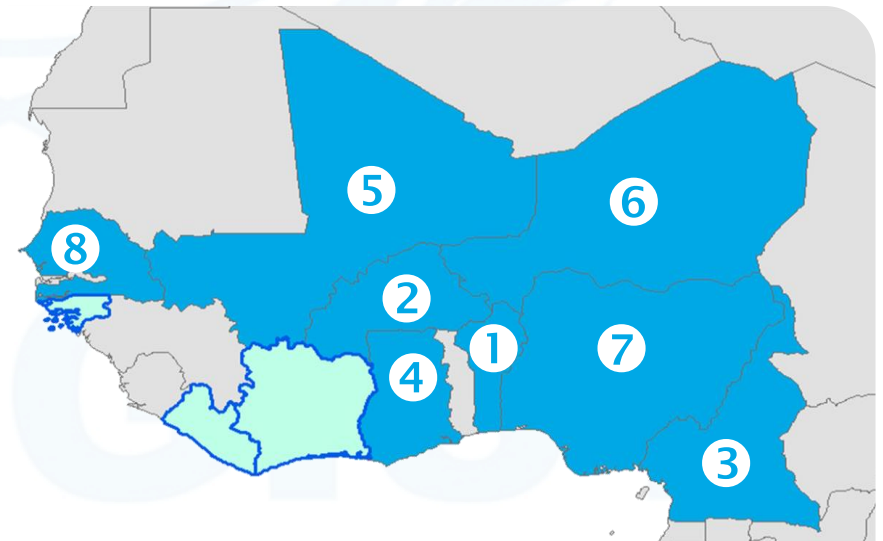
The membership is open to all African countries

AFRIGIST

Education, Capacity Building

Programmes	Duration
▪ **Technologist Diploma** (**TD**) in Geospatial information production and management. (French and English)	18 months
▪ **Postgraduate Diploma** (**PGD**) in Geospatial information Production and Management (Specialisation: Remote Sensing, Photogrammetry, Geographic Information Science) (French and English)	12 months
▪ **Professional Master (PM)** in Geospatial information Production and Management.(Specialization: Remote Sensing, Photogrammetry, Geographic Information Systems) (French and English)	12 months
▪ **Master** in Geo-information Technology (**MGIT**) in collaboration with Federal University of Technology Akure (FUTA) (English)	24 months
▪ **Master of Science** in Geo-information Science (**M Sc. GIS**) in collaboration with University of Abomey Calavi. (French)	24 months
▪ **Professional Master** in Geospatial Information Science and Land Administration (French and English)	12 months
▪ **Masters of Science (M Sc.)** in Geospatial Information Production and Management (English and French)	24 months
▪ **PhD** in Geospatial Information Science and Technology, and Sustainable Development in collaboration with University of Abomey Calavi. (French and English)	3 – 4 years

Education, Capacity Building

Proposed programmes

- MSc/PhD in Geodetic Science

- MSc/PhD in Hydrography and Marine Science

Availability of short term/customized courses (2 to 6 weeks)

INTRODUCTION

- Tax is a major source of government revenue all over the world.

- The government uses tax proceeds
  - to render its traditional functions, such as the provision of public goods, maintenance of law and order, defense against external aggression, and regulation of trade and business to ensure social and economic maintenance (Azubike, 2009).

- A tax system offers itself as one of the most effective means of mobilizing a nation's internal resources and it lends itself to creating an environment conducive to the promotion of economic development.

  - Thus, it is evident that a good tax structure plays multiple roles in the process of economic development of any nation

INTRODUCTION

- Currently, Property Tax details are without geospatial information in some African nations.

- The officials are unable to collect the Property Tax efficiently and hence fall short of the budget estimate year after year.

- If the tax details are maintained electronically and geo-spatially, the efficiency of tax collection can be improved.

- Due to a lack of total transparency and other factors, spatial dimensions of all the structures are not effectively maintained hence the need for a Web-GIS environment.

INTRODUCTION

• This research seeks to answer the following questions:

- Do residents in the study area pay property tax?

- Is there a spatial property geodatabase in the study area?

- Is there any designed property tax mobile application?

AIM AND OBJECTIVES

- The aim of the research is to develop a GIS real-time cloud-based municipal tax information system to enhance regular re-inspection and management of the tax base using a part of Lagos State as a study area. It is a purely academic and research exercise

- Specifically:
  - *analyze the tax situation of the study area,*
  - *create a spatial Property geodatabase of the study area,*
  - *design and implement a property tax mobile Application,*
  - *create an online dashboard for tracking property tax collection and tax evaders.*

STUDY AREA

The study area is bounded by Latitudes 6⁰ 36' N and 6⁰38' N and Longitudes 3⁰ 40' E and 3⁰ 42' 30" E.

Situated at the North-western part of Lagos State University Ojo (along the Badagri Expressway) bounded on the north and east by Ogun State.
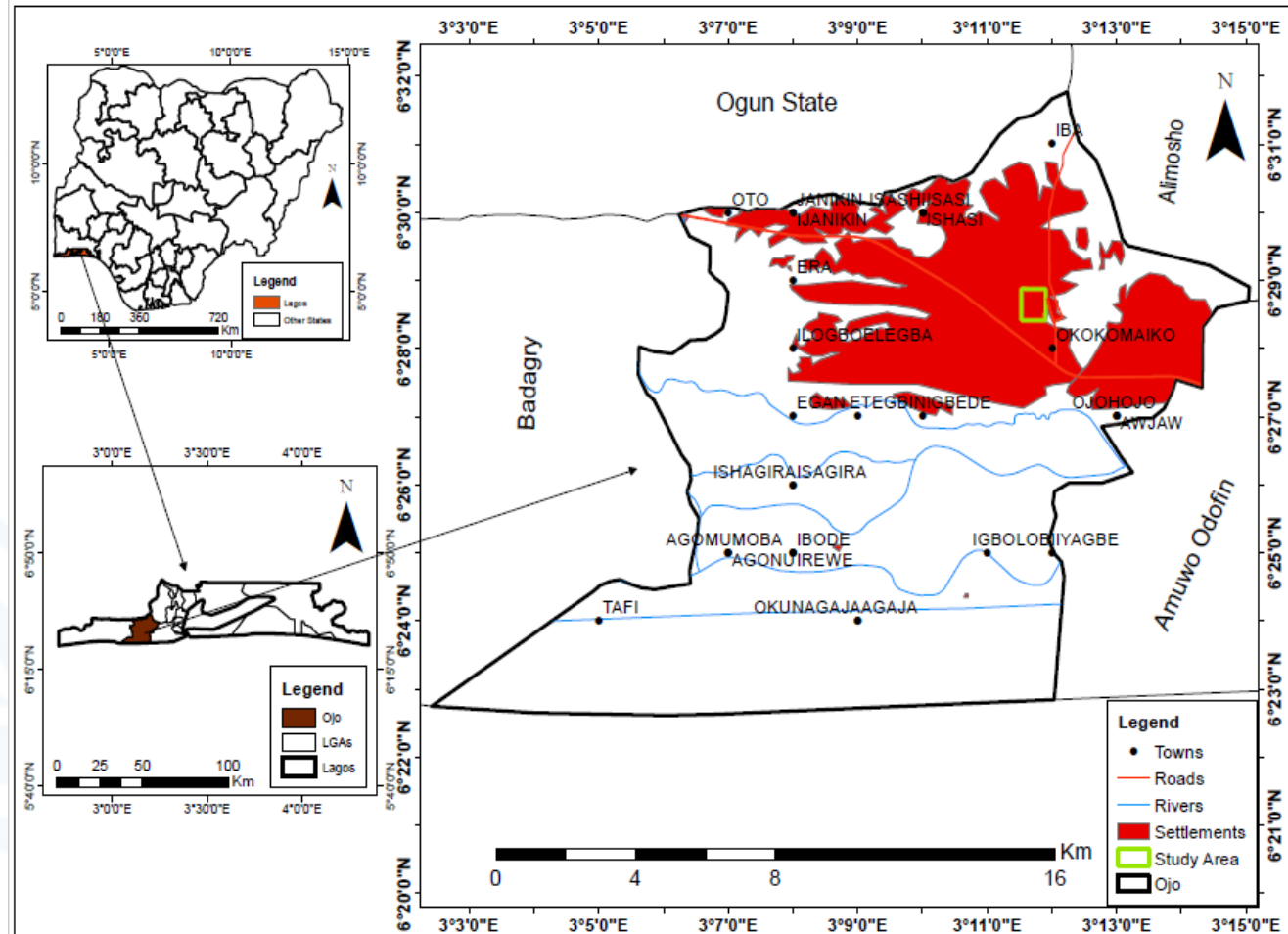
The study area falls within the Coastal Swamp and Lagoon geomorphic unit and is generally low-lying with elevation varying from 1 m to 8 m above the sea level.

METHODOLOGY

- **Data types and sources**

  – The sources of data are primary and secondary data.

    - The primary source involves interviewing with the use questionnaire, to collate the property information in the study area.

    - A drone is been deployed to ascertain features and for the purpose of getting a high-resolution image of the study area for delineation and database creation.

    - The secondary data are ancillary data like population, topo map and the master plan of the study area collected from the various agencies in the state.

Primary Data types and sources

S/N	DATA TYPE	DATA SOURCE/DEVICE	SPECIFICATIONS	PURPOSE
1	Coordinate Points	GPS	Garmin, etrex10 3m accuracy	To capture coordinate points of the study area
2	High-Resolution Image	Phantom 4 DJI Drone	Depends on flight height	To capture high-resolution Image to extract building Footprints of the study area
3	Survey	Collector for ArcGIS, Survey123 (HandHeld Devices)	Mobile Devices	To gather Vital information about Features on Ground

Secondary Data types and sources

DATA TYPE	SOURCE	SCALE	OBJECTIVES
Topo Map	OSGOF	1:50000	Administrative Boundary
Master Plan	Lagos State Planning Unit		To validate land use information
Population Data	Nigerian Population Commission Board	N/A	To ascertain the population of the study area

Software Used

- Collector for ArcGIS
- Operational Dashboard for ArcGIS
- Web App Builder for ArcGIS (AppStudio for ArcGIS, Qt Creator Android Studio)
- ArcMap 10.7.1
- Window 10 Operating System

Analysis of the tax situation of the study area

- **Identification and Delineation of properties within the study area of taxation**
  - Reconnaissance survey was done to identify buildings and structures as well as land use land cover parameters

  - The UAV was flown across the parcels in the study area: Several Ground Control Points (GCPs) were recognized of which it was used to set the flight plan.

  - Images derived from the drone are mosaicked using DJI GS Pro, PIX4D Mapper and Agisoft Photo-Scan software, and then exported to ArcGIS 10.7 where the Buildings are delineated.

  - Well-placed control points were used to define the location using map coordinates from the deferential GPS which was used to georeference the drone image, for precise accuracy and measurements of the image on ArcMap 10.7,

  - The image was then aligned and projected to Coordinate System: WGS 84 UTM zone 31N, Projection: Transverse Mercator. Datum: WGS 1984.

Analysis of the tax situation of the study area

- Each Delineated features are updated via the attribute table on ArcGIS 10.7 thereby creating a geodatabase for all parcels including information of individuals or occupants using that parcel of Land.

- A questionnaire was designed with the use of ArcGIS Survey123 which collected data on the go and sent such data to the online database

- The drone data is then matched with a questionnaire (location-based) based on parcels and properties found in the study area to ascertain features that would be taxed.

Flow chart for analyzing the tax situation
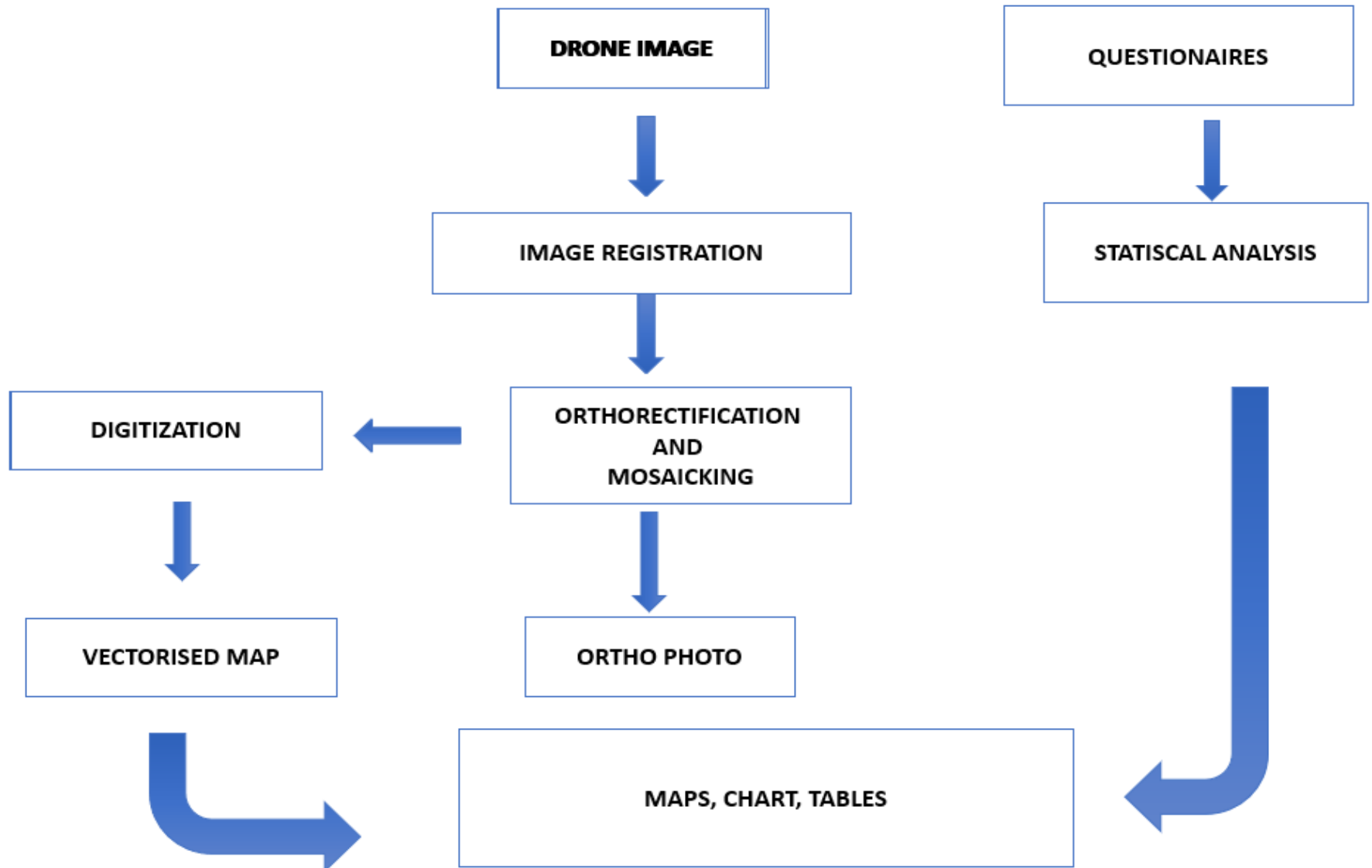
## Spatial property Geodatabase of the study area

- Creation of a Geodatabase" using ArcMap 10.7

- The spatial property geodatabase was created from the drone data and the use of ArcGIS survey123.

- The drone data is converted into vector data by digitizing the orthorectified drone image, then data gotten for questionnaires were now computed using ArcGIS 10.7.

- These computed data are further processed into ArcGIS geodatabase as they are linked with the storing of all information such as parcel ID, names and information of taxpayers, information about their properties, etc. **All these data would be embedded properly into the geodatabase so that it could be queried at any time**

Flow chart for spatial property Geodatabase of the study area
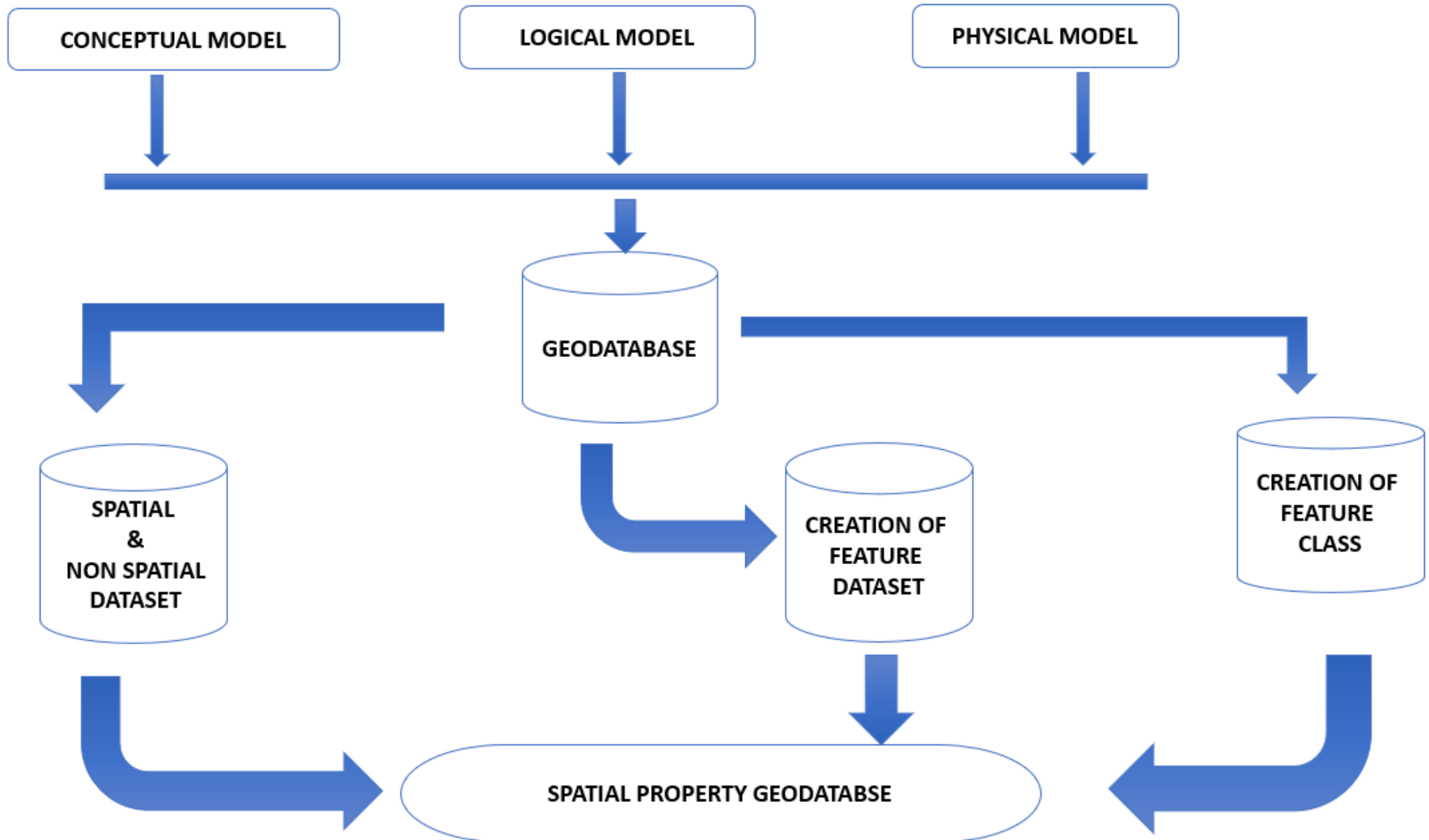
Design and implementation of a property tax management mobile application

- The property tax management mobile application was designed using App Studio for ArcGIS alongside Android Studio for the finalization of the application.

- The application is designed using java and Python Programming language for query purposes
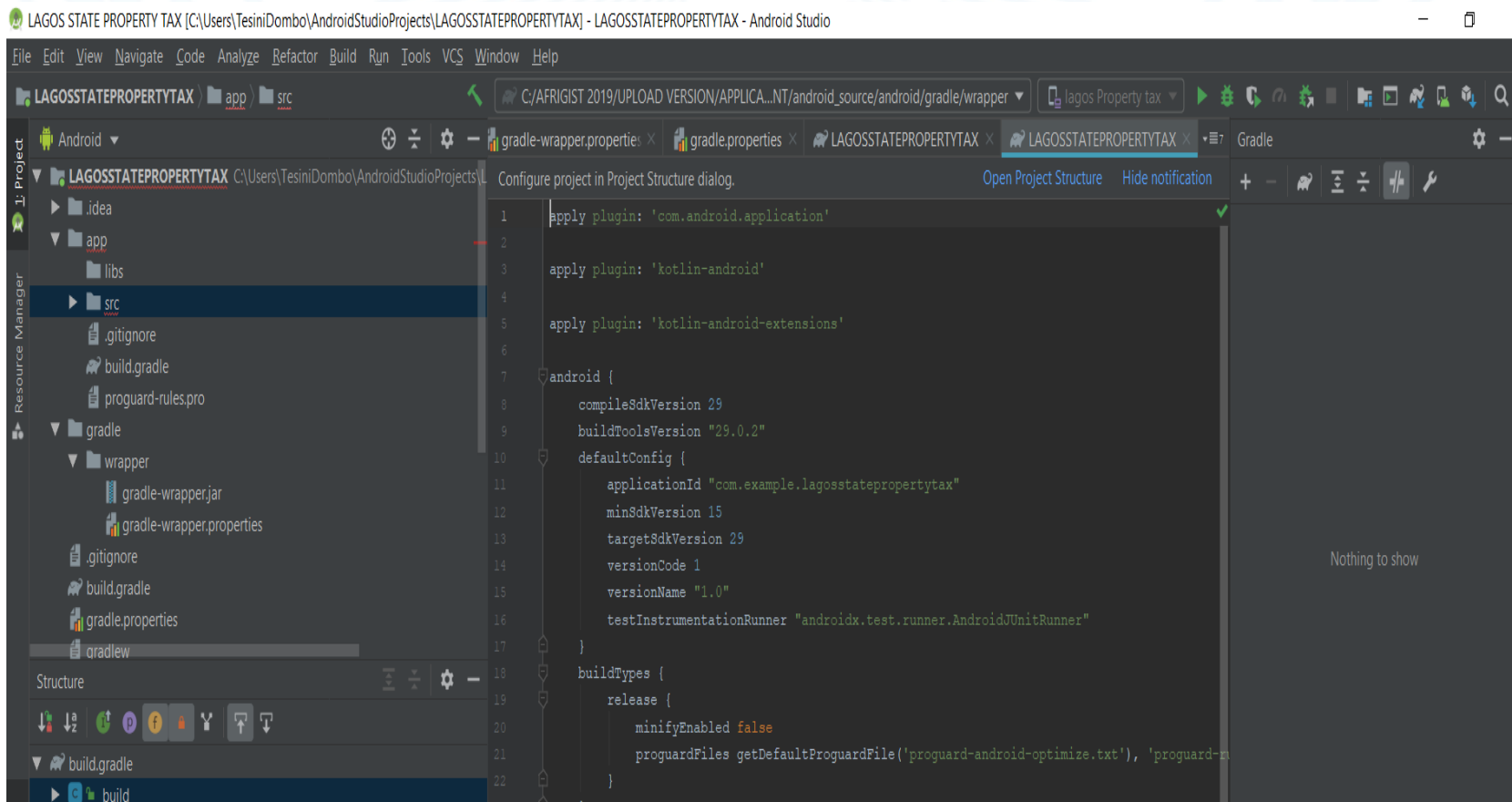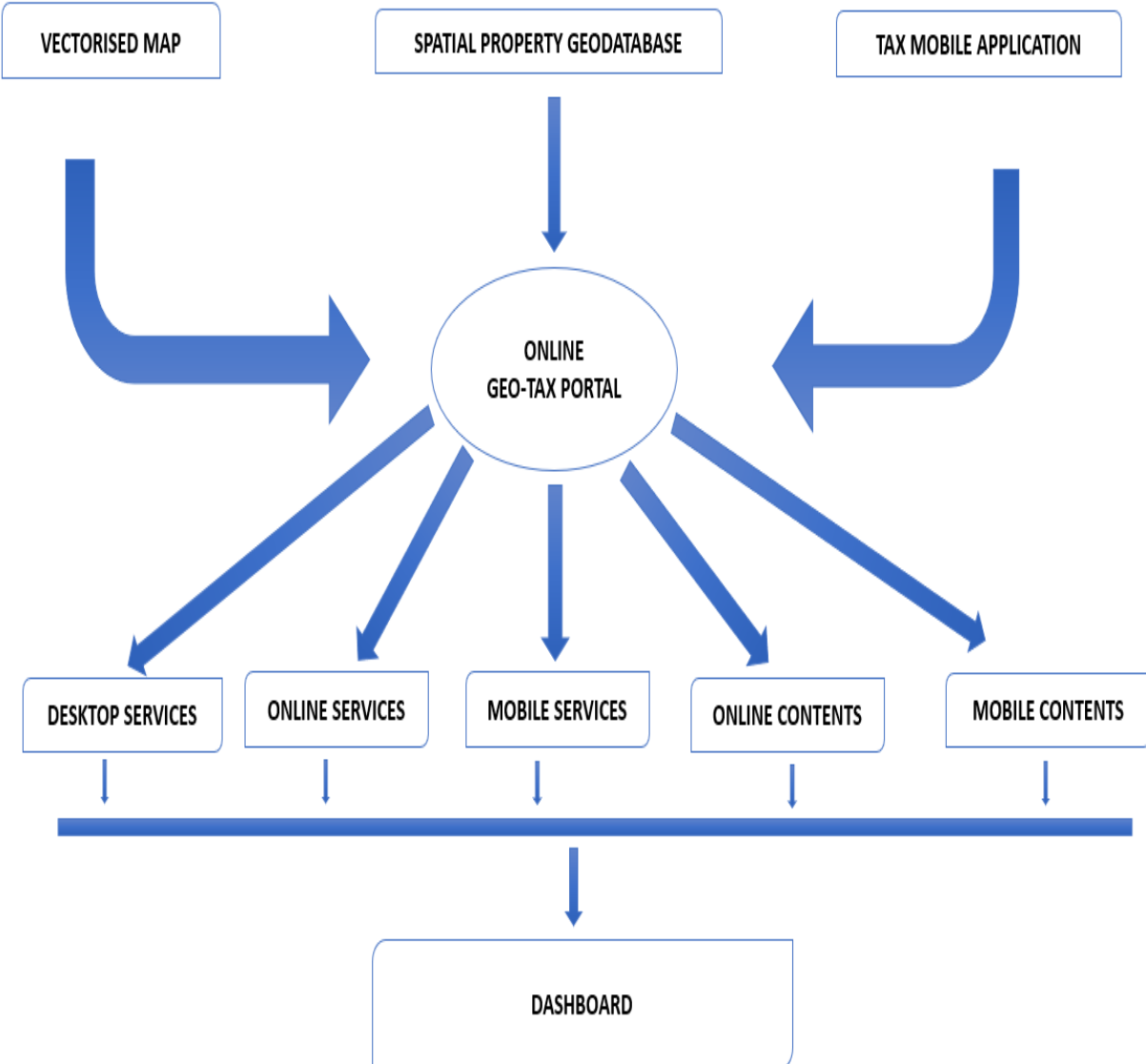
Creation of an online dashboard for tracking property tax collection and tax evaders

The Online dashboard for tracking property tax collection and evaders is designed and developed with the use of ArcGIS Operational Dashboard.

This capability is hosted on the cloud as data from the mobile application are synchronized in real-time with the dashboard.

The dashboard connects to the mobile application and other sources of data to display information as charts maps and figures in real-time.

VECTORISED MAP

SPATIAL PROPERTY GEODATABASE

TAX MOBILE APPLICATION

ONLINE GEO-TAX PORTAL

DESKTOP SERVICES

ONLINE SERVICES

MOBILE SERVICES

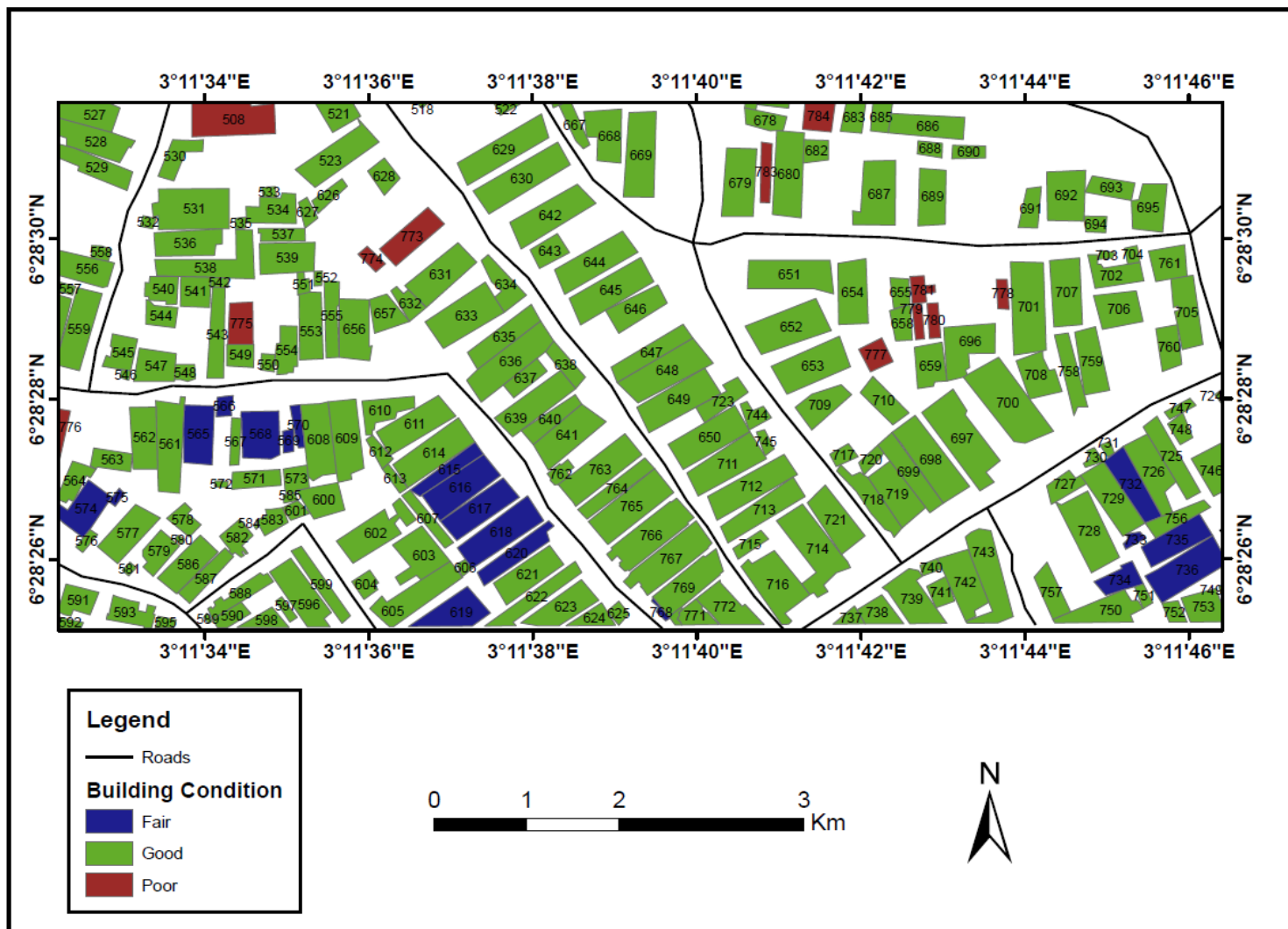ONLINE CONTENTS

MOBILE CONTENTS

DASHBOARD

ANALYSIS OF THE TAX SITUATION OF THE STUDY AREA

From the drone image, there are properties that are built on every plot of lands of which some are:

- completed,
- uncompleted,
- Abandoned.

Building Condition of the Study area

260 properties that were been mapped, 233 buildings covering 86% of the total properties mapped were in good condition, while 20 buildings had a fair condition with 8% and 17 buildings had 6% which were in a poor state
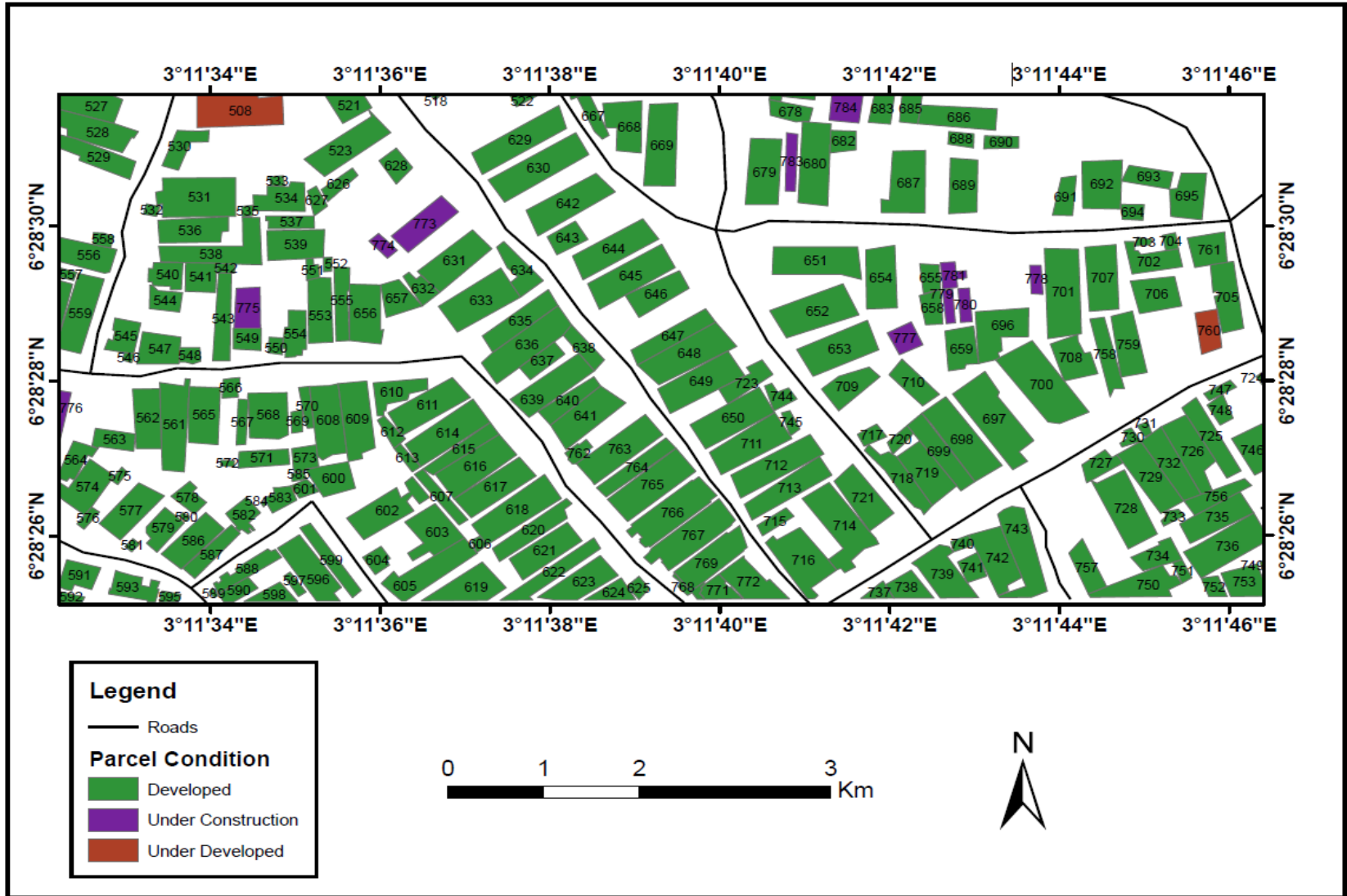
LAND USE TYPE IN THE STUDY AREA

The study area is majorly a residential area accounting for

- Residential: 208 parcels,
- Mixed: 29
- Abandoned:14 and
- Commercial: 9 parcels
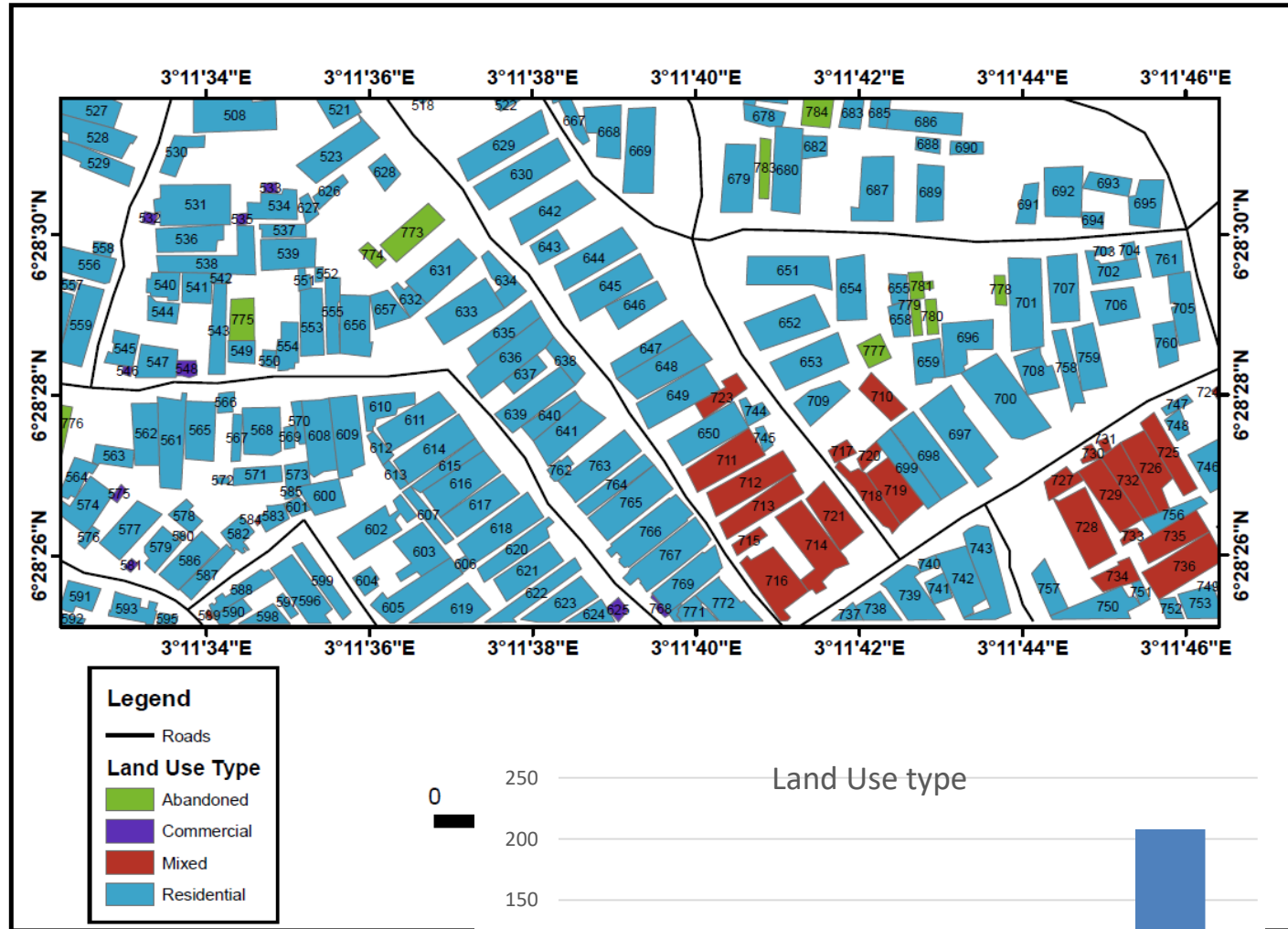
# PARCEL CONDITION OF THE STUDY AREA

241 parcels are developed, 14 parcels are under construction while 5 parcels are underdeveloped. With these statistics, the study area is seen as an area with huge potential for property tax income revenue

TAX PAYMENT STATUS OF THE STUDY AREA

From the result of the survey, it was discovered that only a handful paid tax out of the 260 parcels that were mapped
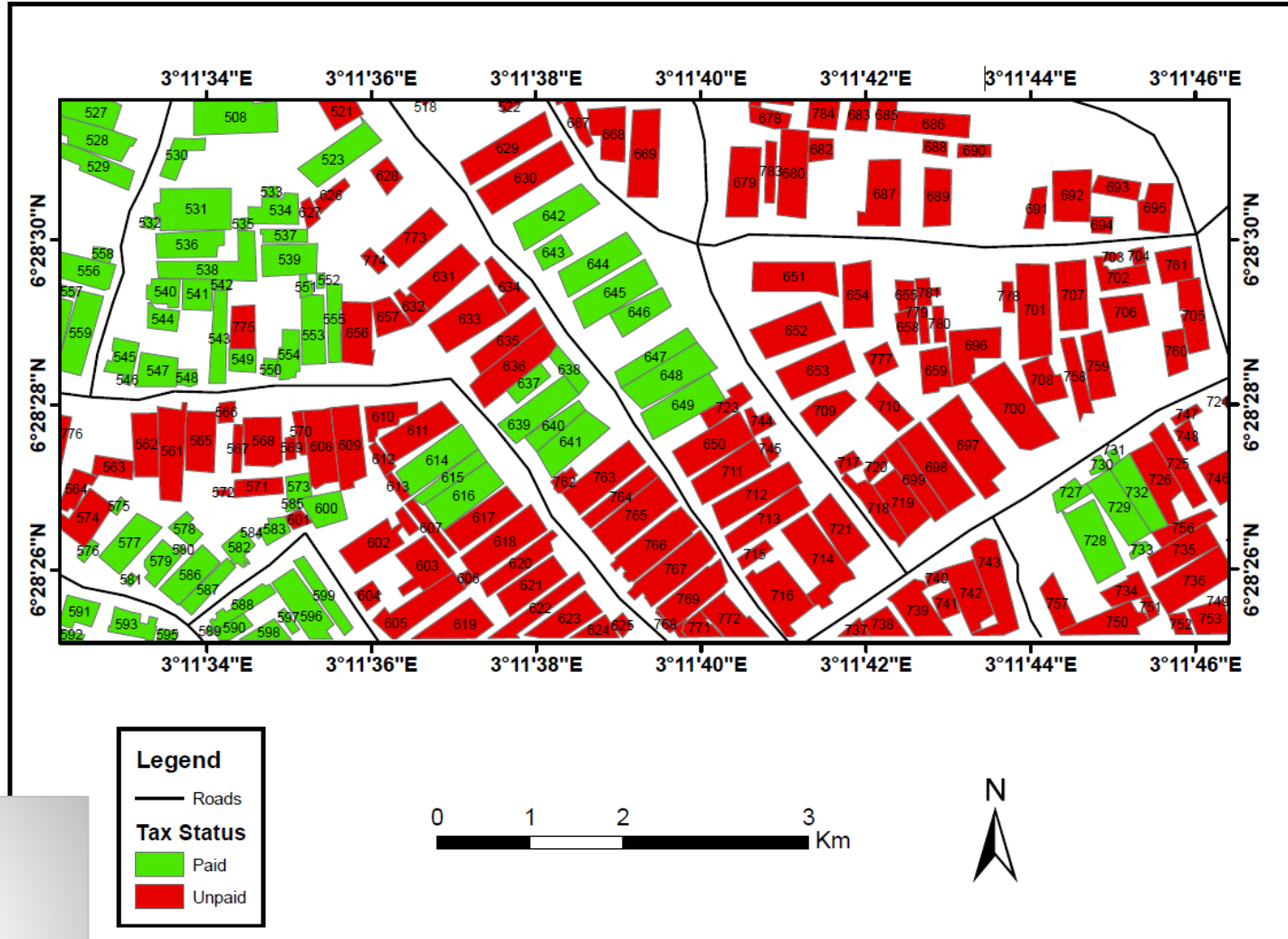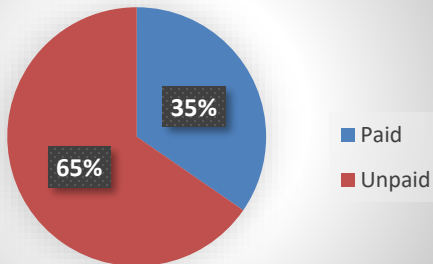
SPATIAL PROPERTY GEODATABASE

The spatial property geodatabase was first developed on Microsoft Access and then connected with the ArcGIS platform. The Entity relation between tables was connected and generated

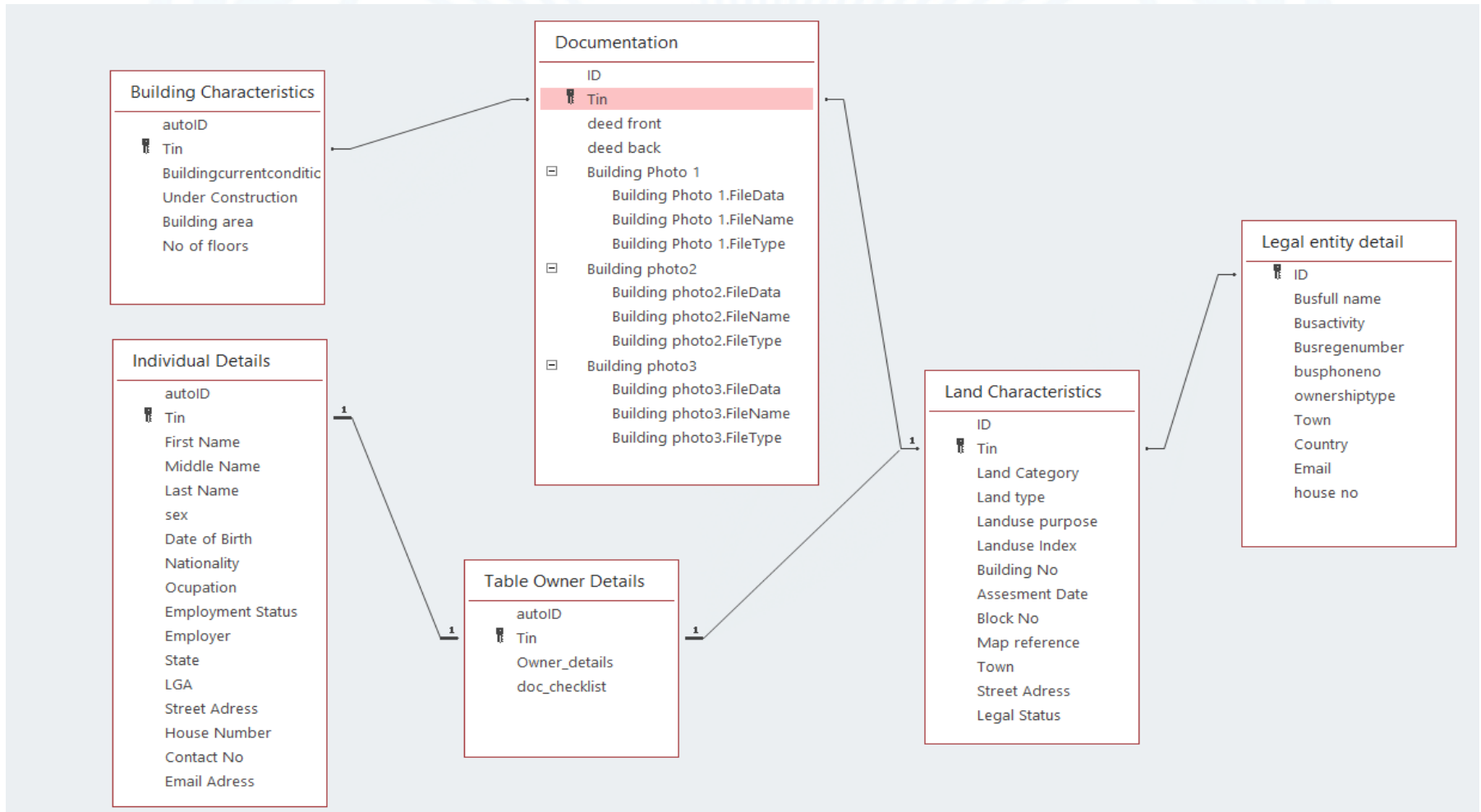# Attribute geodatabase of the study area

FID	Shape *	OBJECTI	Contacts_	State_of_	Site_Cond	Conditn_C	Number_	Building_C	Mixed_U	Land_use_t	Resd_Ty	Site_own	Sex	URL	OBJECTID	Area	Shape_Le	Shape_Ar	Tax_Statu	Taxpaid_N
0	Polygon	507	080632292	Lagos	Underdevel	Fair	5	Fair		Residential		Ali Muhamm	M		0	0	0.000459	0	Paid	500
50	Polygon	565		Enugu	Developed	Fair	5	Fair		Residential		Bulus Tafar	F		0	0	0.000603	0	Pending	0
51	Polygon	566		Enugu	Developed	Fair	2	Fair		Residential		Grace Ayo	F		0	0	0.000251	0	Pending	0
53	Polygon	568		Enugu	Developed	Fair	8	Fair		Residential		Pere Ignatiu	M		0	0	0.000571	0	Pending	0
54	Polygon	569		Enugu	Developed	Fair	8	Fair		Residential			M		0	0	0.00023	0	Pending	0
55	Polygon	570		Edo	Developed	Good	5	Fair		Residential			M		0	0	0.000357	0	Pending	0
59	Polygon	574		Edo	Developed	Fair	3	Fair		Residential			M		0	0	0.000609	0	Paid	1230362
60	Polygon	575		Edo	Developed	Fair	3	Fair		Commercial			F		0	0	0.000166	0	Paid	1230362
99	Polygon	615		Bayelsa	Developed	Good	5	Fair		Residential			M		0	0	0.000629	0	paid	0
100	Polygon	616		Bayelsa	Developed	Good	5	Fair		Residential			M		0	0	0.000715	0	Paid	0
101	Polygon	617		Lagos	Developed	Good	5	Fair		Residential			M		0	0	0.000697	0	Unpaid	0
102	Polygon	618		Lagos	Developed	Good	5	Fair		Residential			M		0	0	0.000785	0	Unpaid	0
103	Polygon	619		Lagos	Developed	Good	5	Fair		Residential			M		0	0	0.000684	0	Unpaid	0
104	Polygon	620		Lagos	Developed	Good	5	Fair		Residential			M		0	0	0.000716	0	Unpaid	0
206	Polygon	732			Developed		4	Fair	Residential	Mixed					0	0	0.000679	0	Paid	0
207	Polygon	733			Developed		6	Fair	Residential	Mixed					0	0	0.000218	0	Paid	0
208	Polygon	734			Developed		6	Fair	Residential	Mixed					0	0	0.000444	0	Unpaid	0
209	Polygon	735			Developed		2	Fair	Residential	Mixed					0	0	0.000631	0	Unpaid	0
210	Polygon	736			Developed		5	Fair	Residential	Mixed					0	0	0.000752	0	Unpaid	0
241	Polygon	768			Developed		5	Fair		Commercial					0	0	0.000234	0	Unpaid	0
4	Polygon	514	080632292	Lagos	Developed	Good	3	Good	Residential	Mixed		Taiwo Yes	M		0	0	0.000431	0	Paid	35000
5	Polygon	517	080632292	Lagos	Developed	Good	2	Good		Residential		Adelamo A	M		0	0	0.000622	0	Paid	10000
6	Polygon	518		Lagos	Developed	Good	5	Good		Residential		Kunle Taiw	M		0	0	0.000884	0	unpaid	0
7	Polygon	520		Lagos	Developed	Good	2	Good		Residential		Segun Arin	M		0	0	0.000431	0	Paid	120032
8	Polygon	521		Lagos	Developed	Good	8	Good		Residential		Tafar Alfa	M		0	0	0.000466	0	Unpaid	60000

- The database is populated accordingly from the field data derived through the survey. A total of 260 parcels were registered into the geodatabase with fields based on information's needed from the parcel
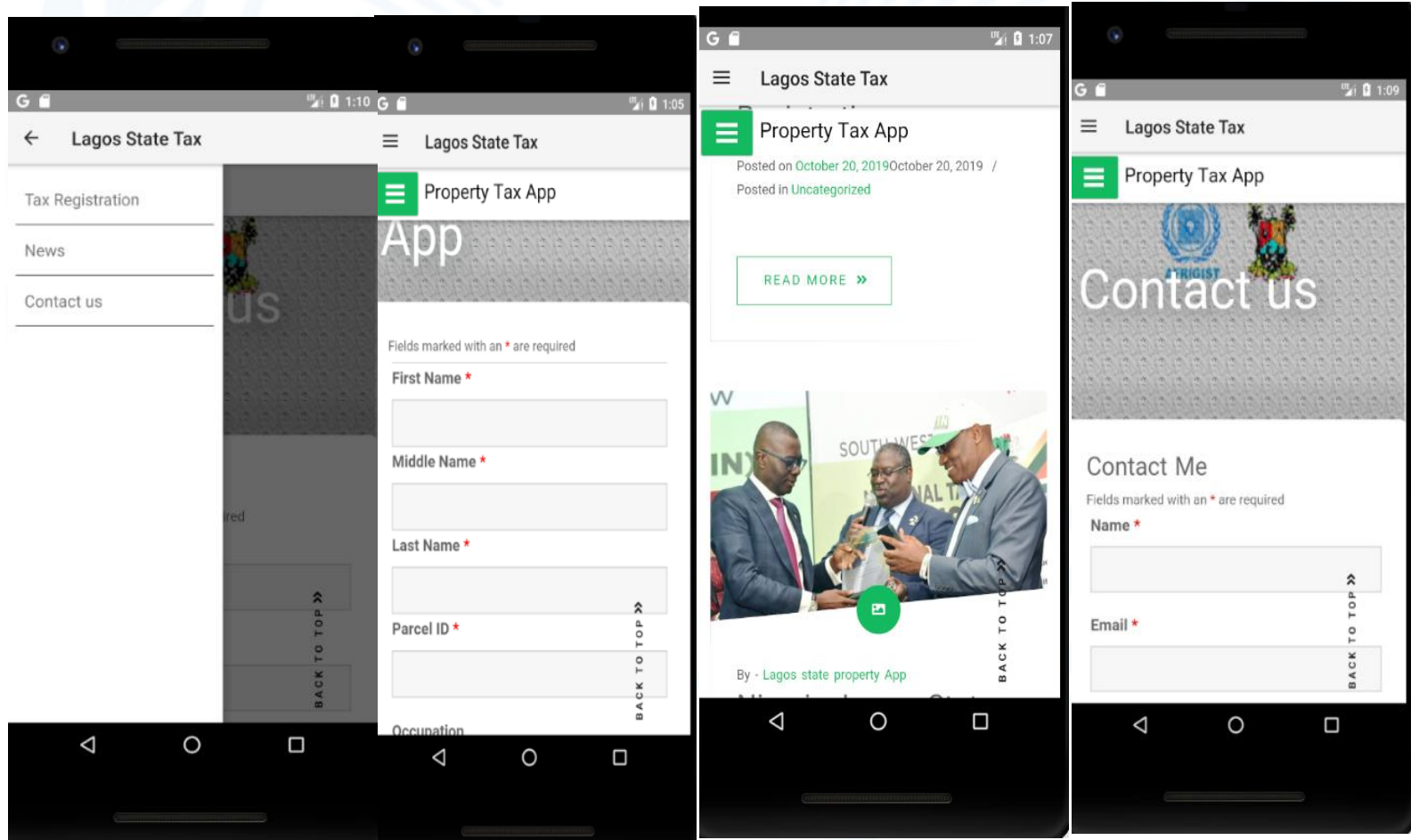
DESIGNING AND IMPLEMENTATION OF PROPERTY TAX MOBILE APPLICATION
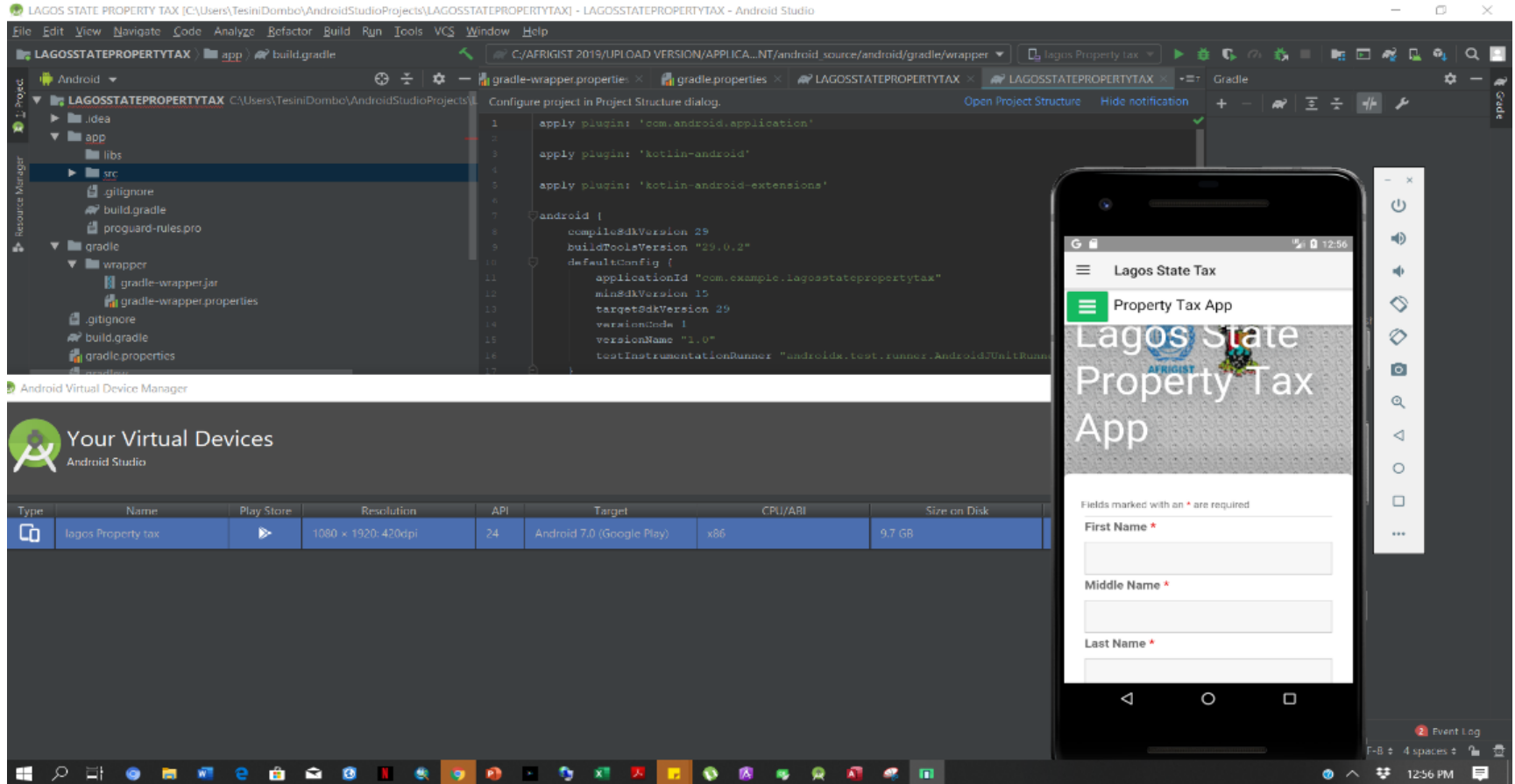
Android virtual device turned on to test the code

The codes developed and run were been complied with and built to come out with an app with the interface having their options namely tax Registration, News and Contact Us.
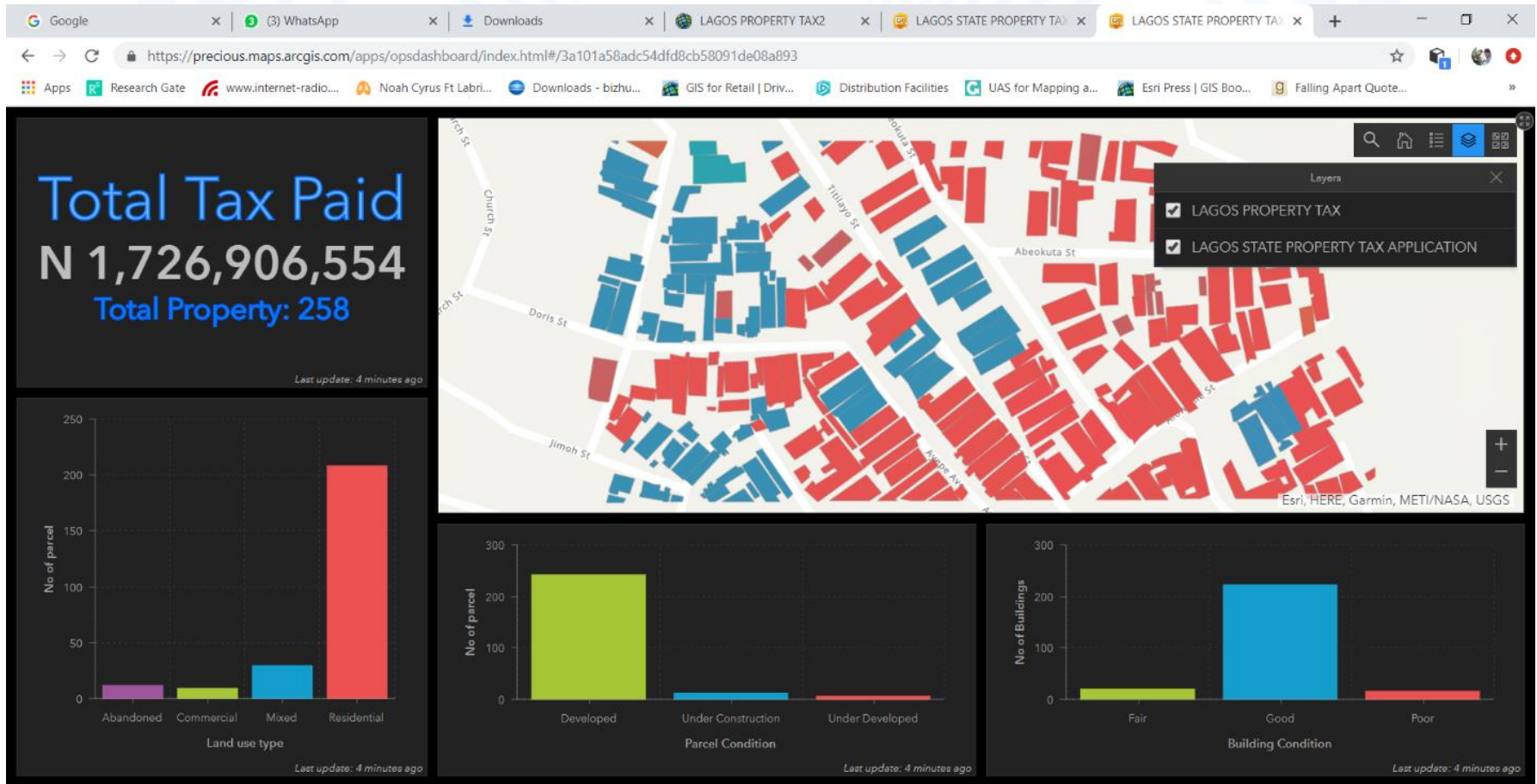
DESIGNING AND IMPLEMENTATION OF PROPERTY TAX MOBILE APPLICATION

**Property Tax mobile application interfaces**

The Tax options make the form available to users where they can fill in their information

ONLINE DASHBOARD CREATION FOR PROPERTY TAXPAYERS AND EVADERS

A dashboard synchronized with the mobile app developed is used for proper management and monitoring of tax pay. The image displays majorly text, charts, and maps in which the text shows the total tax paid over a period of time and the total number of properties that we're able to generate the taxers and evaders over the cloud and in real-time.

Operational dashboard for tax monitoring showing Basemap
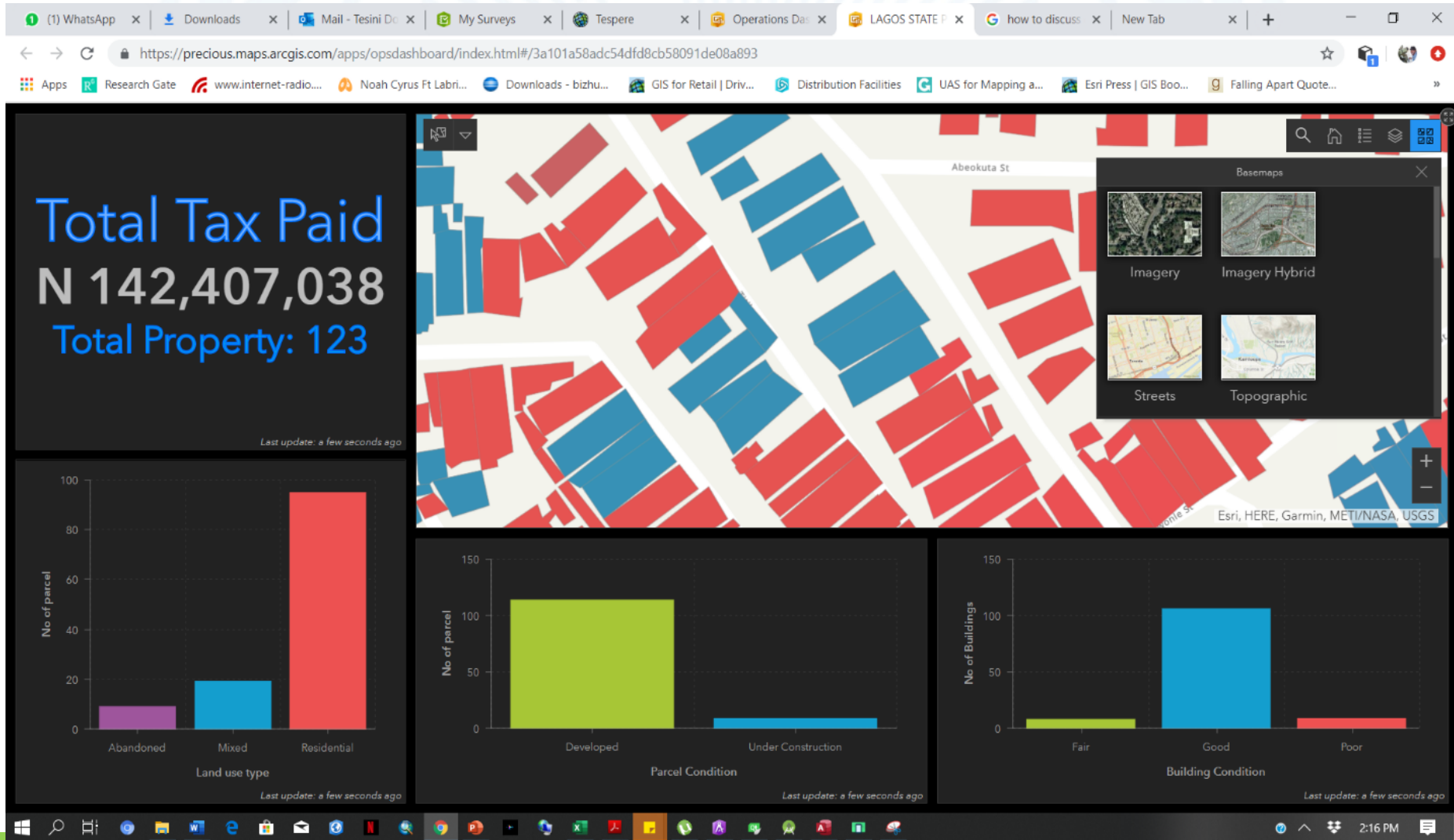
The Dashboard also has the capability of switching base maps interfaces from road maps to high-resolution google earth imagery including the Layers that can be or should be displayed

CONCLUSION

- The presentation develops a Geographic Information System (GIS) that is a real-time and cloud-based municipal tax information system for Lagos State.

- GIS has proven to be a powerful tool in the collection of taxes (land rates) and tracking taxpayers thus assisting in raising revenue collection. This is shown by locating the tax defaulters where they are geographically located and other related details that prove to be useful.

- GIS, with proper goodwill from the workers, can improve revenue collection and subsequently increase in service provision (water, sewer lines, roads, schools, social amenities, etc).

- Also for this system to work efficiently, there is a need for the free flow of information from lands office in relation to the new land development (land subdivision), to update the geodatabase.

THANK YOU