FIG Working Week 2023
28 May - 1 June 2023 Orlando Florida USA
Protecting Our World, Conquering New Frontiers

Generating Automated Land Use Taxes in Kano State, Nigeria Using Cadastral Records and Geospatial Information System

Adamu BALA (China) [1,3] and Zia-Ul-Haq Tukur BELLO [1,2] (Nigeria)

Presenter: Adamu BALA

[1] Department of Geomatics, Ahmadu Bello University, Nigeria
[2] Kano State Bureau for Land Management, Nigeria
[3] China University of Geosciences, Wuhan, China, P.R.

Organized By NSPS FIG International Federation of Surveyors
Diamond Sponsors esri THE SCIENCE OF WHERE Trimble

PRESENTATION OUTLINE

- INTRODUCTION
- MATERIALS AND METHODS
- RESULTS AND ANALYSES
- CONCLUSION

INTRODUCTION

- Kano municipal is one of the most populous and commercial hubs in Nigeria.
- A lot of business activities taking place in the area are spatially related to land records.
- Land uses tax collections generate revenue to a government which leads to good governance.

Introduction cont.

- Before now, existing methods of tax collection have been tedious, slow, time-consuming, and prone to errors and corruption, among other things.

- This paper explained how the cadastral survey records were utilized to generate land use charges for various land use categories.

- Adoption of this new method of land use tax collection has since its inception witnessed an upward inflow of land revenue generation in the State.

Introduction: study area

- The Kano State is one of the 36 States in Nigeria.
- The most populous state in the country (2006 Census).
- The Kano state was created in 1967; covers area of 20,131km² and Kano metropolis has 8 LGAs.

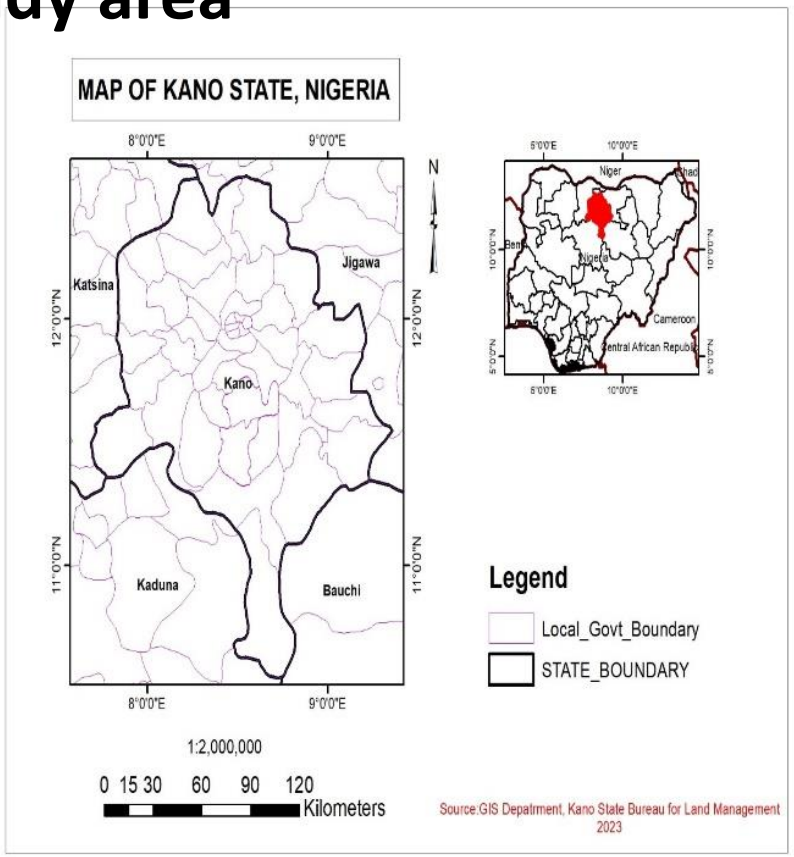


Figure 1: Map of Kano State, Nigeria

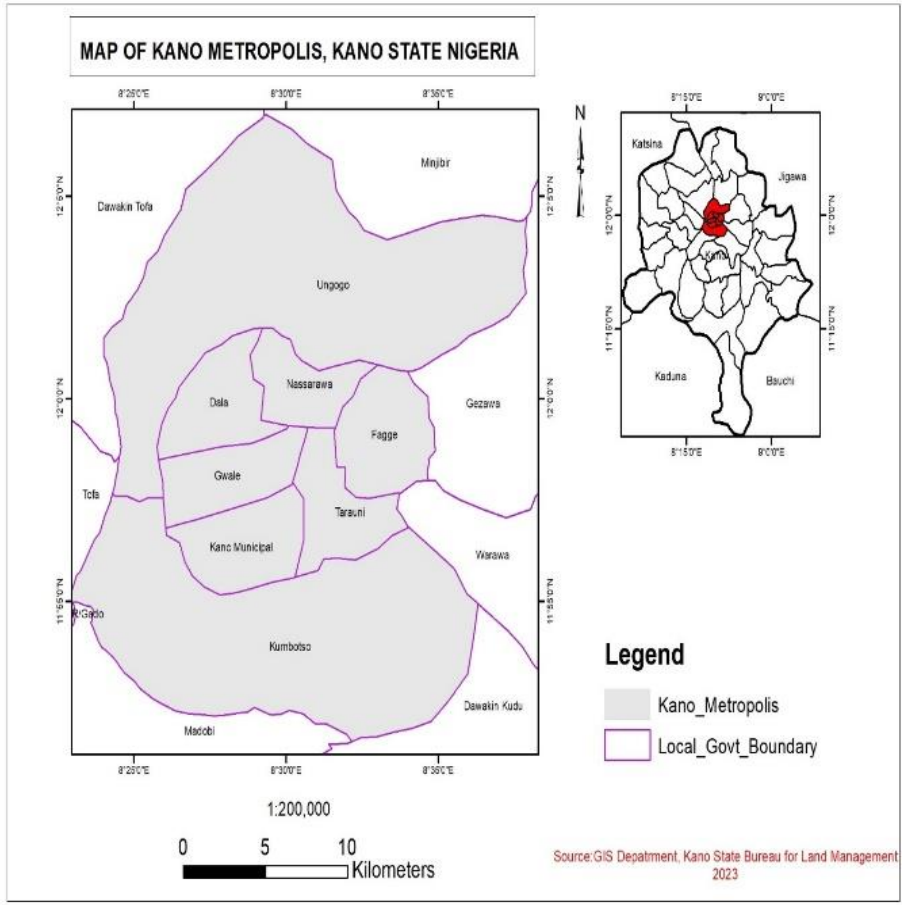


Figure 2: map of Kano Metropolis.

MATERIALS AND METHODS

- Materials in the data capture for the conversion of the data from analogue to digital formats respectively:

✓*Survey Plans;*
✓*Layout Composite Survey Plans;*
✓*Intelligent Chat Sheets;*
✓*Topographical Maps;*
✓*High-Resolution Satellite Imagery;*
✓*Scanners;*
✓*Computer Sets;*
✓*Digitizing Tablets;*
✓*Printers;*
✓*Esri ArcGIS 10.5,*
✓*Python IDLE (Pandas, Jupyter Notebook).*

MATERIALS AND METHODS cont.

- Methods of Data Sources, Acquisition, and Processing:

✓*Sources:*

- *Kano State Bureau for Land Management through the departments of Cadaster, Survey, and GIS*
- *the majority of data were in analogue formats*
- *were acquired mostly from ground/field survey, aerial photographs (photogrammetry), generated as far back as the 1970s and maintained*

METHODS cont.

✓ *Processing:*

- *The topo maps and layout composite survey plans were scanned with very high dots per inch pixel values.*
- *About fifty (50) thousand land parcels were captured and attributed.*
- *Various land use categories were assigned different rates,*
- *domain table of values was created to incorporate these rates and to appropriately assign them according to their land use purpose, location, density, etc.*

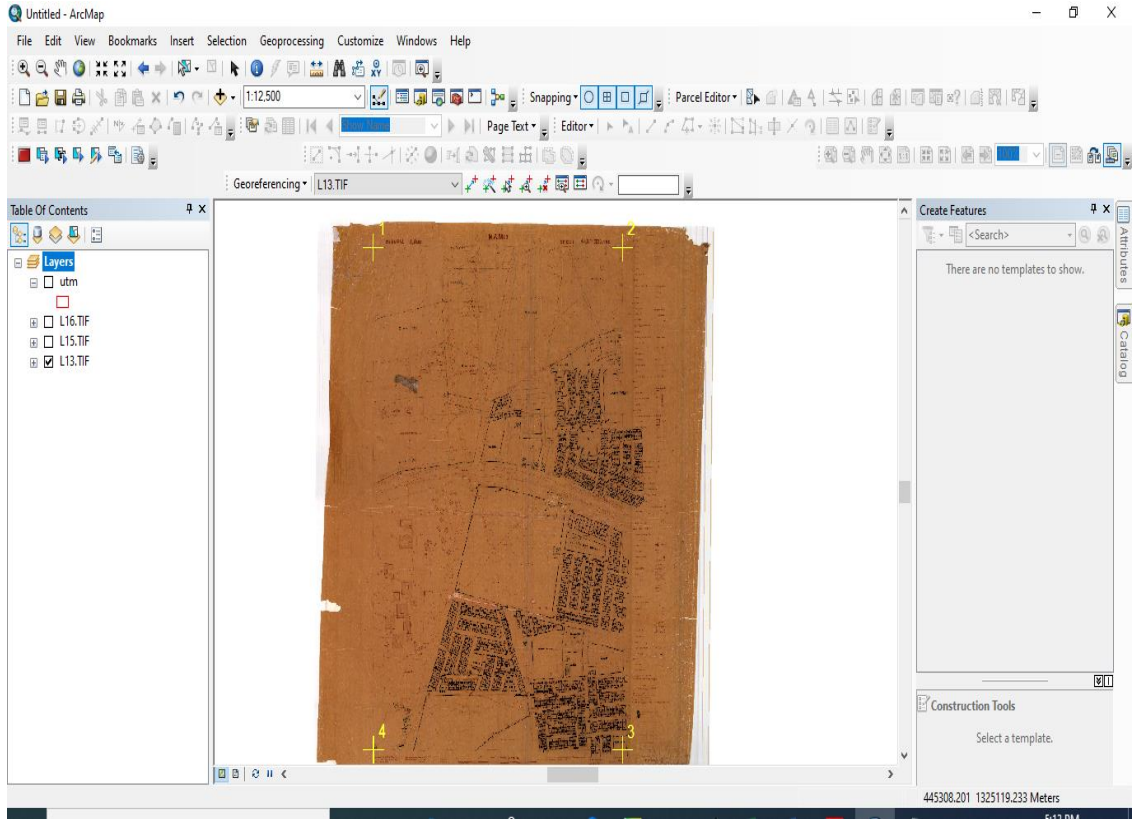


Figure 3: Scanned Sheet of Composite Survey Plan

METHODS cont.

✓*Processing:*

- *A comprehensive geospatial template map was generated and served to every parcel location as a demand notice.*
- *Land use charges from 1999 to 2015 were classified as recovery and calculated cumulatively; the year 2016 upward to date (2023) were calculated independently.*
- *The entire attribution process conformed with the geospatial database schema based on the name of the plot owner, plot no., location, etc.*

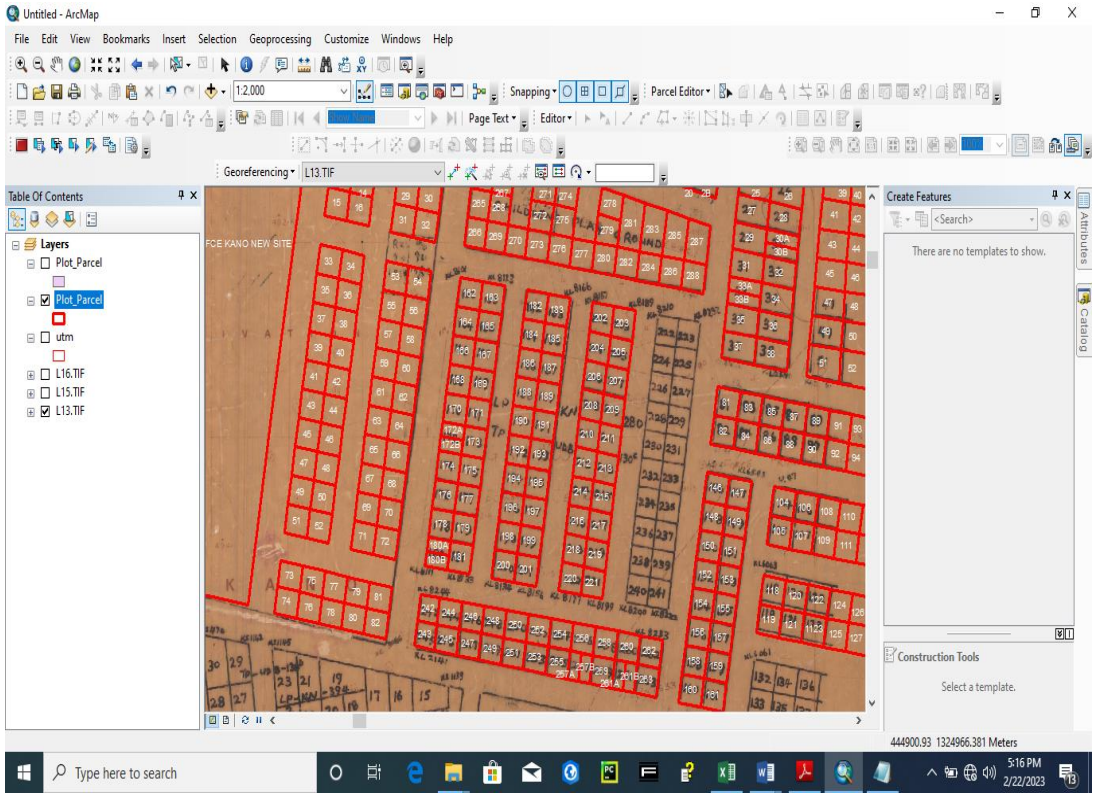


Figure 4: Digitized and Attributed Survey Data in ArcMap

METHODS cont.

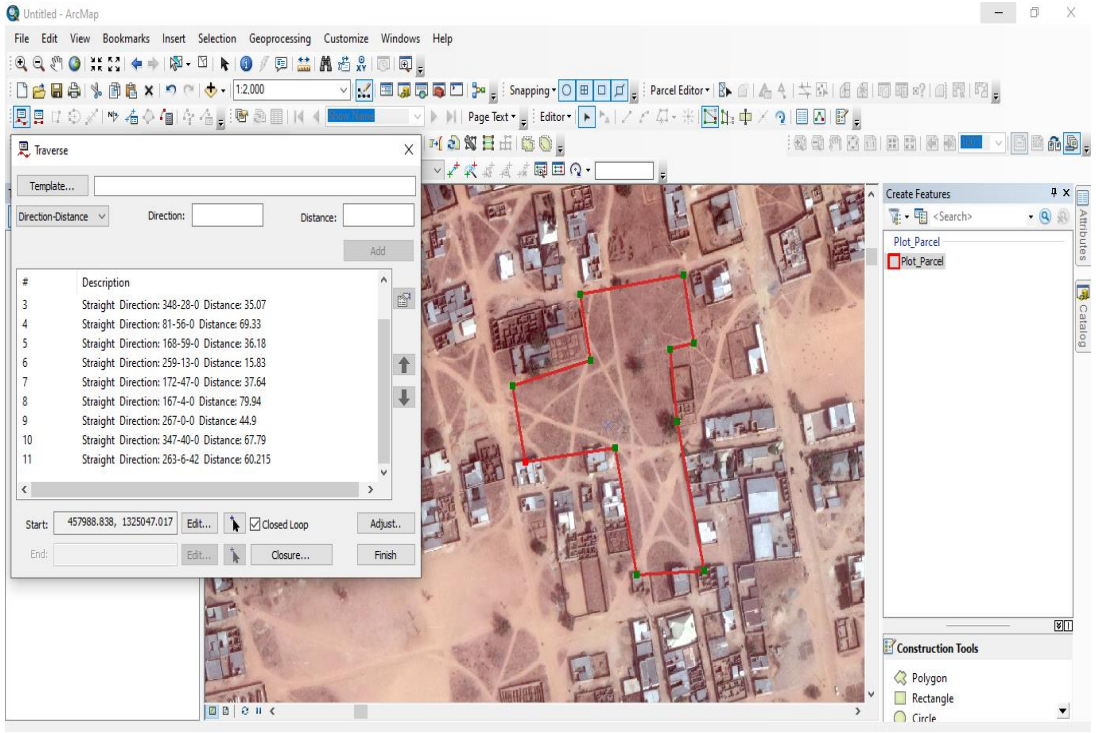


Figure 5: Scanned Sheet of Composite Survey Plan

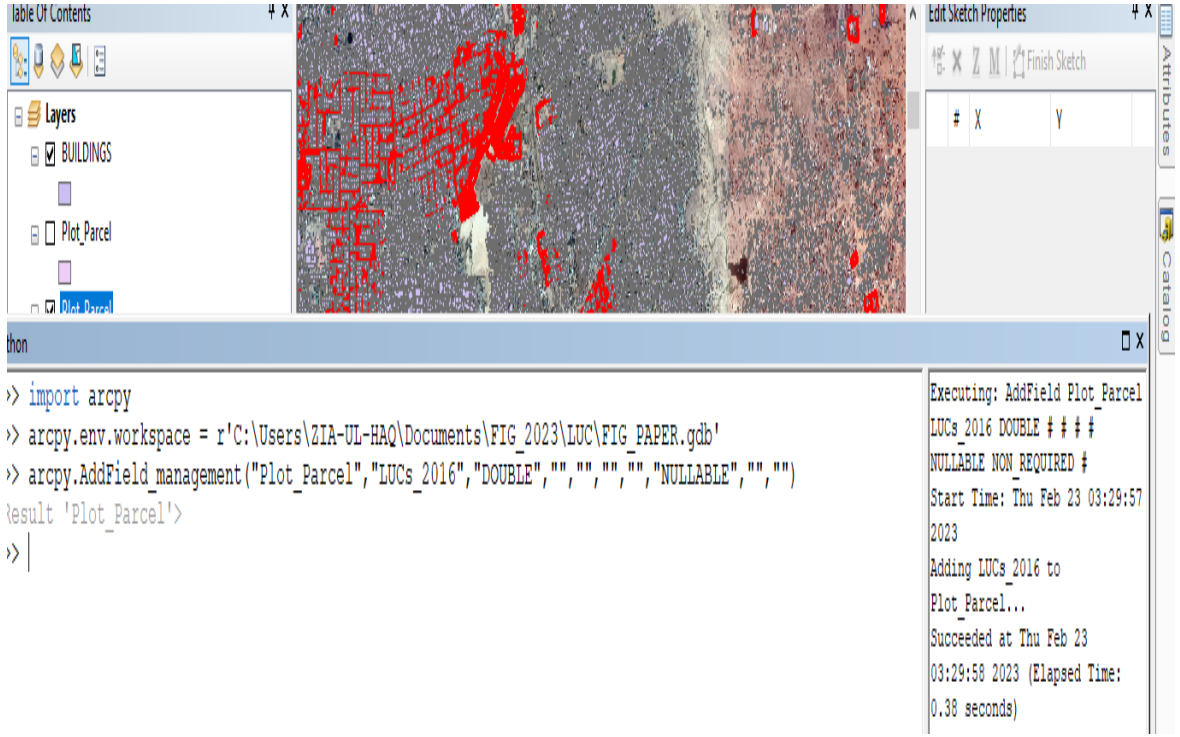


Figure 6: Result of Python Codes Used for Adding Attribute Field into the Database

METHODS cont.

- *With the inspection of the topology error, the parcels were then migrated into the LUC_Fabric.*
- *Algorithms (i)-(iv) were made and subsequently transformed into python programming codes.*
- *LUC = GR+TR+PT+IMDC ……(i)*
- *GR = Ground Rent*

  *= shape_Area(sqm) * Rate ……. (ii)*
- *TR = Tenement Rate*

  *= Property Value * 0.12%…… (iii)*
- *PT = Property Tax*

  *= Property Value * 0.15%……(iv)*
- *LUC is the total land use Charge for a particular year*
- *IMDC = Infrastructure Maintenance Charges are assigned fixed for residential areas, industries, and commercial land uses.*
- *0.12% for TR and 0.15% for PT were assigned for commercial and industrial land use types.*

METHODS cont.

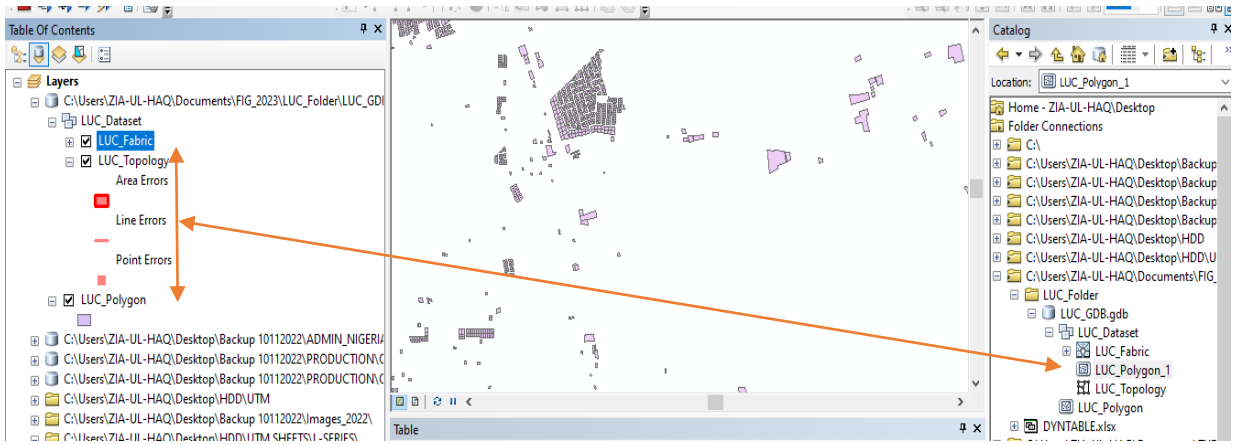


Figure 7: Connection of Folder, geodatabase, Feature Class Dataset, and Topology in ArcMap

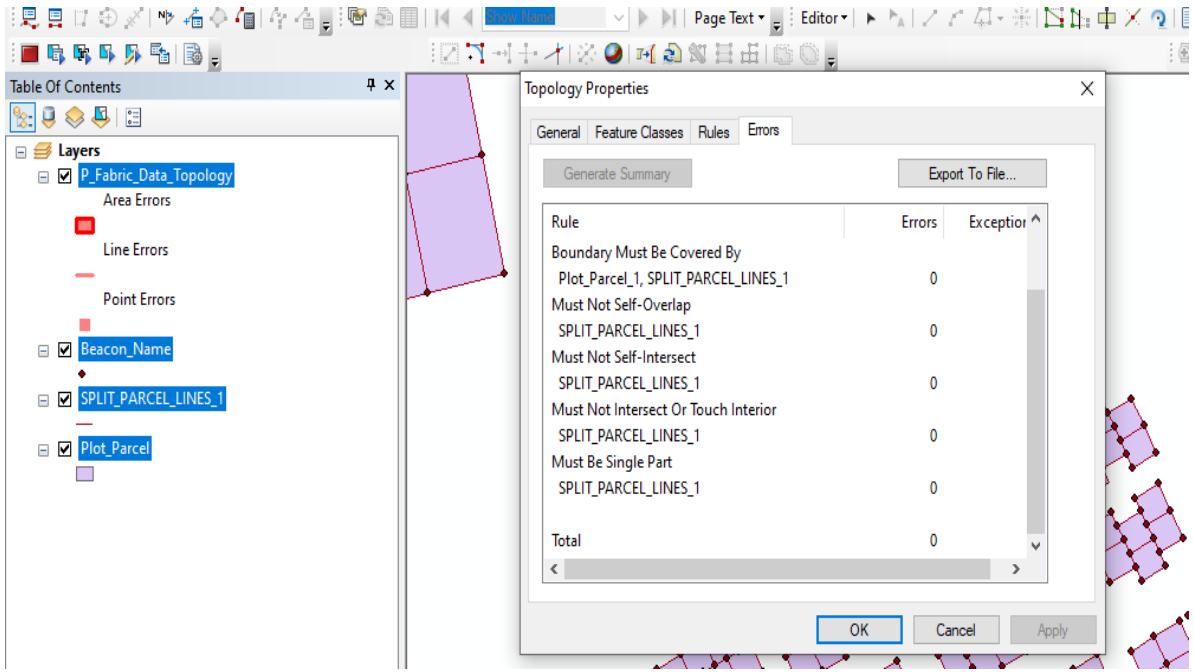


Figure 8: Zero Error Topology used in the Data Processing

RESULTS AND ANALYSES: Computation of land use charges as a medium for Land tax generation

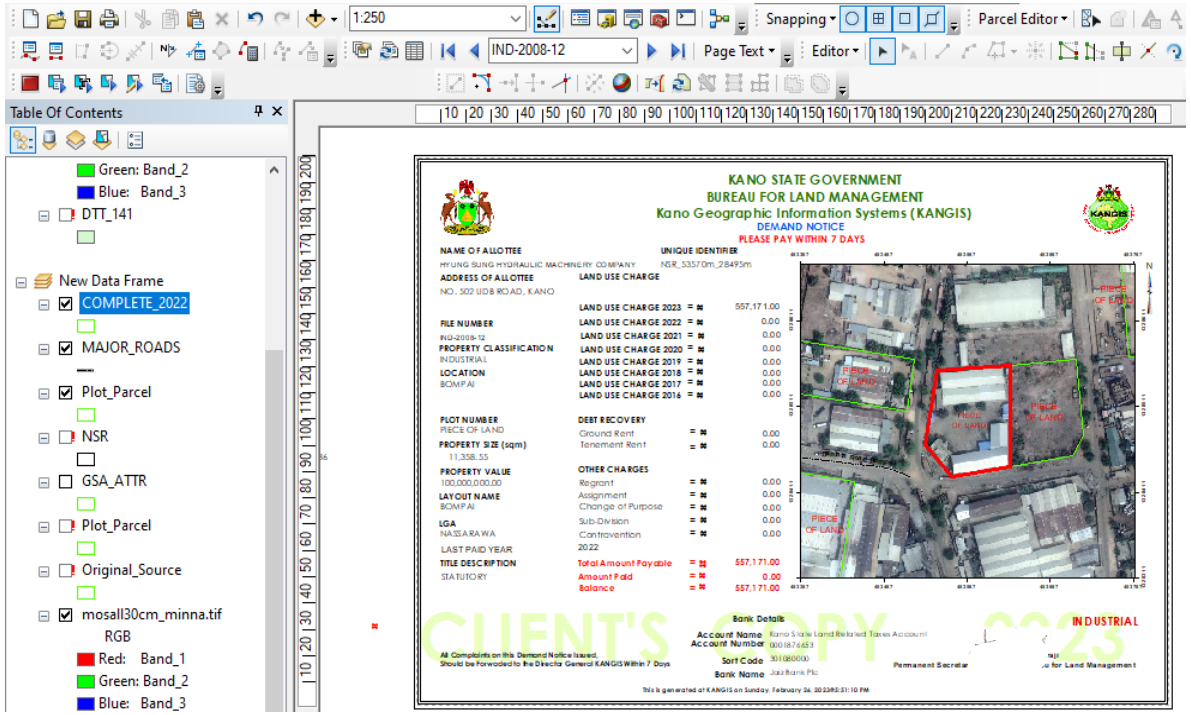


Figure 9: Automated Land Use Charge Computation Template/Map

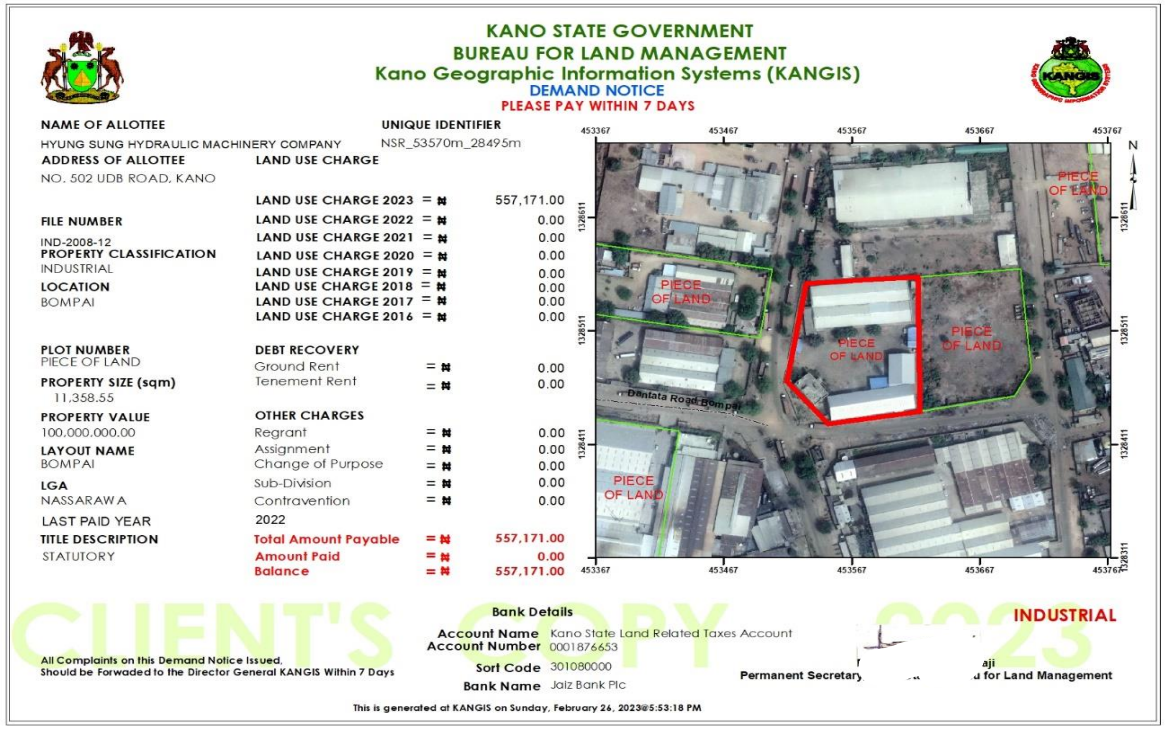
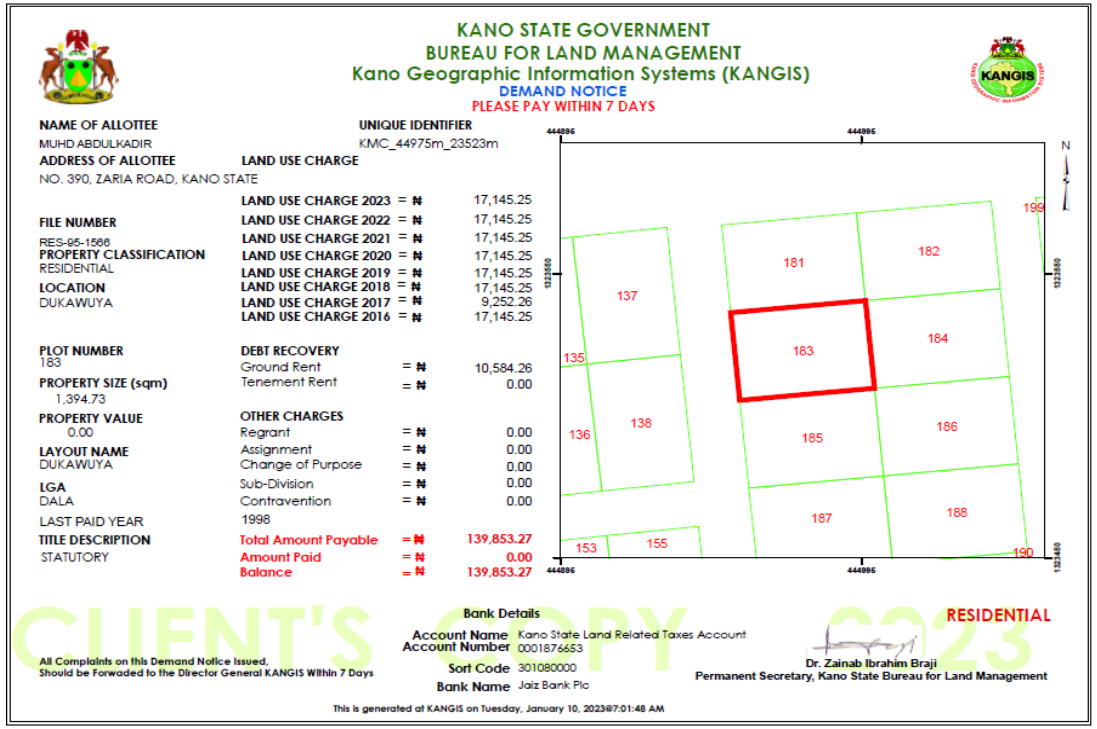


Figure 10: Sample of Demand Notice Generated for Industrial Property for the Year 2023

RESULTS AND ANALYSES: Computation of land use charges as a medium for Land tax generation



KANO STATE GOVERNMENT
BUREAU FOR LAND MANAGEMENT
Kano Geographic Information Systems (KANGIS)
DEMAND NOTICE
PLEASE PAY WITHIN 7 DAYS

NAME OF ALLOTTEE: MUHD ABDULKADIR
UNIQUE IDENTIFIER: KMC_44975m_23523m
ADDRESS OF ALLOTTEE: NO. 390, ZARIA ROAD, KANO STATE
FILE NUMBER: RES-95-1566
PROPERTY CLASSIFICATION: RESIDENTIAL
LOCATION: DUKAWUYA
PLOT NUMBER: 183
PROPERTY SIZE (sqm): 1,394.73
PROPERTY VALUE: 0.00
LAYOUT NAME: DUKAWUYA
LGA: DALA
LAST PAID YEAR: 1998
TITLE DESCRIPTION: STATUTORY

LAND USE CHARGE

LAND USE CHARGE 2023	= ₦	17,145.25
LAND USE CHARGE 2022	= ₦	17,145.25
LAND USE CHARGE 2021	= ₦	17,145.25
LAND USE CHARGE 2020	= ₦	17,145.25
LAND USE CHARGE 2019	= ₦	17,145.25
LAND USE CHARGE 2018	= ₦	17,145.25
LAND USE CHARGE 2017	= ₦	9,252.26
LAND USE CHARGE 2016	= ₦	17,145.25

DEBT RECOVERY

Ground Rent	= ₦	10,584.26
Tenement Rent	= ₦	0.00

OTHER CHARGES

Regrant	= ₦	0.00
Assignment	= ₦	0.00
Change of Purpose	= ₦	0.00
Sub-Division	= ₦	0.00
Contravention	= ₦	0.00
Total Amount Payable	= ₦	139,853.27
Amount Paid	= ₦	0.00
Balance	= ₦	139,853.27

Bank Details
Account Name: Kano State Land Related Taxes Account
Account Number: 0001876653
Sort Code: 301080000
Bank Name: Jaiz Bank Plc

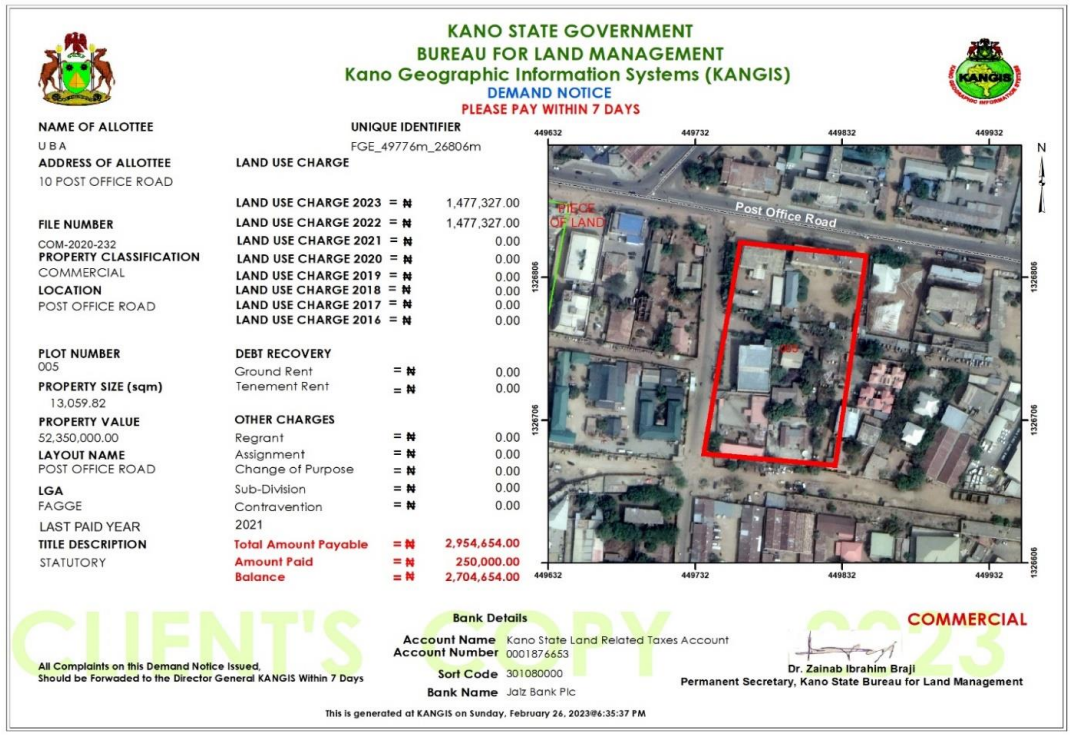
All Complaints on this Demand Notice Issued, Should be Forwaded to the Director General KANGIS Within 7 Days

RESIDENTIAL

Dr. Zainab Ibrahim Braji
Permanent Secretary, Kano State Bureau for Land Management

This is generated at KANGIS on Tuesday, January 10, 2023@7:01:48 AM

Figure 11: Sample of Demand Notice Generated for Residential Property Recovery for Several Years.



KANO STATE GOVERNMENT
BUREAU FOR LAND MANAGEMENT
Kano Geographic Information Systems (KANGIS)
DEMAND NOTICE
PLEASE PAY WITHIN 7 DAYS

NAME OF ALLOTTEE: U B A
UNIQUE IDENTIFIER: FGE_49776m_26806m
ADDRESS OF ALLOTTEE: 10 POST OFFICE ROAD
FILE NUMBER: COM-2020-232
PROPERTY CLASSIFICATION: COMMERCIAL
LOCATION: POST OFFICE ROAD
PLOT NUMBER: 005
PROPERTY SIZE (sqm): 13,059.82
PROPERTY VALUE: 52,350,000.00
LAYOUT NAME: POST OFFICE ROAD
LGA: FAGGE
LAST PAID YEAR: 2021
TITLE DESCRIPTION: STATUTORY

LAND USE CHARGE

LAND USE CHARGE 2023	= ₦	1,477,327.00
LAND USE CHARGE 2022	= ₦	1,477,327.00
LAND USE CHARGE 2021	= ₦	0.00
LAND USE CHARGE 2020	= ₦	0.00
LAND USE CHARGE 2019	= ₦	0.00
LAND USE CHARGE 2018	= ₦	0.00
LAND USE CHARGE 2017	= ₦	0.00
LAND USE CHARGE 2016	= ₦	0.00

DEBT RECOVERY

Ground Rent	= ₦	0.00
Tenement Rent	= ₦	0.00

OTHER CHARGES

Regrant	= ₦	0.00
Assignment	= ₦	0.00
Change of Purpose	= ₦	0.00
Sub-Division	= ₦	0.00
Contravention	= ₦	0.00
Total Amount Payable	= ₦	2,954,654.00
Amount Paid	= ₦	250,000.00
Balance	= ₦	2,704,654.00

Bank Details
Account Name: Kano State Land Related Taxes Account
Account Number: 0001876653
Sort Code: 301080000
Bank Name: Jaiz Bank Plc

All Complaints on this Demand Notice Issued, Should be Forwaded to the Director General KANGIS Within 7 Days

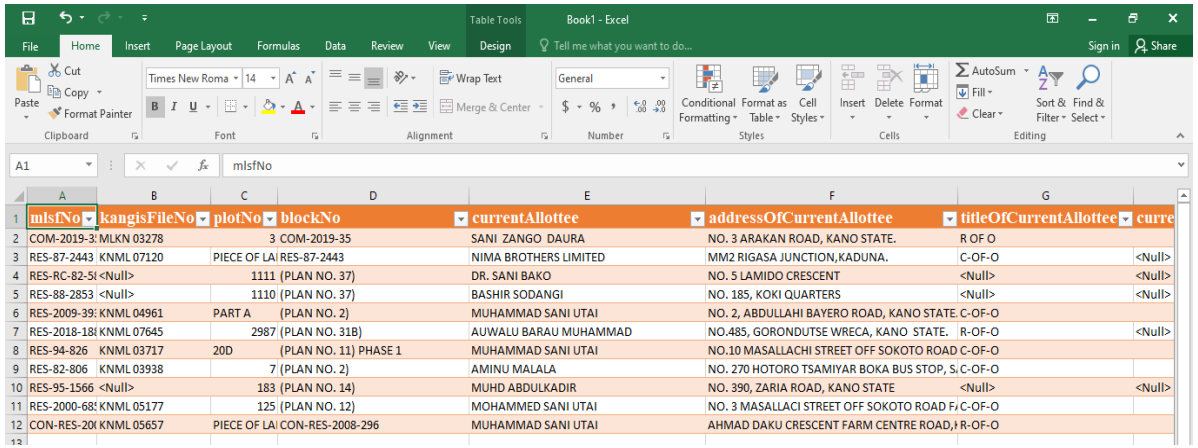
COMMERCIAL

Dr. Zainab Ibrahim Braji
Permanent Secretary, Kano State Bureau for Land Management

This is generated at KANGIS on Sunday, February 26, 2023@6:35:37 PM

Figure 12: Sample of Demand Notice Generated for commercial Property Recovery from 2022-2023 Years.

RESULTS AND ANALYSES: Computation of land use charges as a medium for Land tax generation



	A	B	C	D	E	F	G	
1	mlsfNo	kangisFileNo	plotNo	blockNo	currentAllottee	addressOfCurrentAllottee	titleOfCurrentAllottee	curre
2	COM-2019-3	MLKN 03278	3	COM-2019-35	SANI ZANGO DAURA	NO. 3 ARAKAN ROAD, KANO STATE.	R OF O	
3	RES-87-2443	KNML 07120	PIECE OF LA	RES-87-2443	NIMA BROTHERS LIMITED	MM2 RIGASA JUNCTION,KADUNA.	C-OF-O	<Null>
4	RES-RC-82-5	<Null>	1111	(PLAN NO. 37)	DR. SANI BAKO	NO. 5 LAMIDO CRESCENT	<Null>	<Null>
5	RES-88-2853	<Null>	1110	(PLAN NO. 37)	BASHIR SODANGI	NO. 185, KOKI QUARTERS	<Null>	<Null>
6	RES-2009-39	KNML 04961	PART A	(PLAN NO. 2)	MUHAMMAD SANI UTAI	NO. 2, ABDULLAHI BAYERO ROAD, KANO STATE	C-OF-O	
7	RES-2018-18	KNML 07645	2987	(PLAN NO. 31B)	AUWALU BARAU MUHAMMAD	NO.485, GORONDUTSE WRECA, KANO STATE.	R-OF-O	<Null>
8	RES-94-826	KNML 03717	20D	(PLAN NO. 11) PHASE 1	MUHAMMAD SANI UTAI	NO.10 MASALLACHI STREET OFF SOKOTO ROAD	C-OF-O	
9	RES-82-806	KNML 03938	7	(PLAN NO. 2)	AMINU MALALA	NO. 270 HOTORO TSAMIYAR BOKA BUS STOP, S	C-OF-O	
10	RES-95-1566	<Null>	183	(PLAN NO. 14)	MUHD ABDULKADIR	NO. 390, ZARIA ROAD, KANO STATE	<Null>	<Null>
11	RES-2000-68	KNML 05177	125	(PLAN NO. 12)	MOHAMMED SANI UTAI	NO. 3 MASALLACI STREET OFF SOKOTO ROAD F	C-OF-O	
12	CON-RES-20	KNML 05657	PIECE OF LA	CON-RES-2008-296	MUHAMMAD SANI UTAI	AHMAD DAKU CRESCENT FARM CENTRE ROAD,	R-OF-O	

Figure 13: A Sample of GIS Attribute Data Converted to Excel Format.

Year	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
2016	42,125,253.25	47,258,129.35	47,584,365.27	11,232,522.55	52,954,354.26	64,157,369.60	53,512,324.27	41,825,821.32	43,254,125.35	42,546,198.23	35,456,874.25	31,354,125.24	**513,261,462.93**
2017	103,258,124.26	133,158,369.21	121,258,124.25	101,965,253.32	111,145,354.32	135,425,432.21	122,148,365.29	163,396,357.12	175,125,369.32	176,128,365.25	157,125,842.36	115,321,654.84	**1,615,456,611.75**
2018	162,543,252.15	172,358,125.32	185,353,655.23	169,354,663.15	149,326,523.25	171,235,254.36	168,369,654.13	169,253,215.23	174,257,258.36	192,125,425.39	159,252,365.12	168,369,458.35	**2,041,798,850.04**
2019	201,565,321.32	221,369,547.25	213,258,658.21	199,853,325.19	164,235,974.25	161,587,369.25	156,789,412.36	147,258,456.21	124555369.14	184258147.36	112,425,981.25	114254874.01	**2,001,412,435.80**
2020	149,857,354.25	168,258,456.32	108,023,254.21	72,129,354.27	56,542,542.36	51,973,652.14	49,727,233.93	69,158,355.12	166,354,268.97	141,465,298.57	195,367,194.81	209,458,365.14	**1,438,315,330.09**
2021	201,435,932.35	221,152,323.25	207,369,789.25	214,125,987.36	200,158,978.84	190,000,789.27	177,259,374.69	174,597,125.28	102,654,369.21	101,141,125.39	106,021,215.02	112,601,665.07	**2,008,518,674.98**
2022	125,963,125.24	198,528,325.14	156,235,321.14	139,325,125.01	137,325,241.20	151,252,369.21	158,255,245.21	145,085,243.22	124,758,369.21	119,842,365.24	177,185,369.31	157,588,453.35	**1,791,344,552.48**
2023	135,369,125.24	120483528.27											**255,852,653.51**

Figure 14: Table of Land Use Charge Tax from the Year 2016 To 2023 (Source: Account Department, KSBLM).

RESULTS AND ANALYSES: Computation of land use charges as a medium for Land tax generation

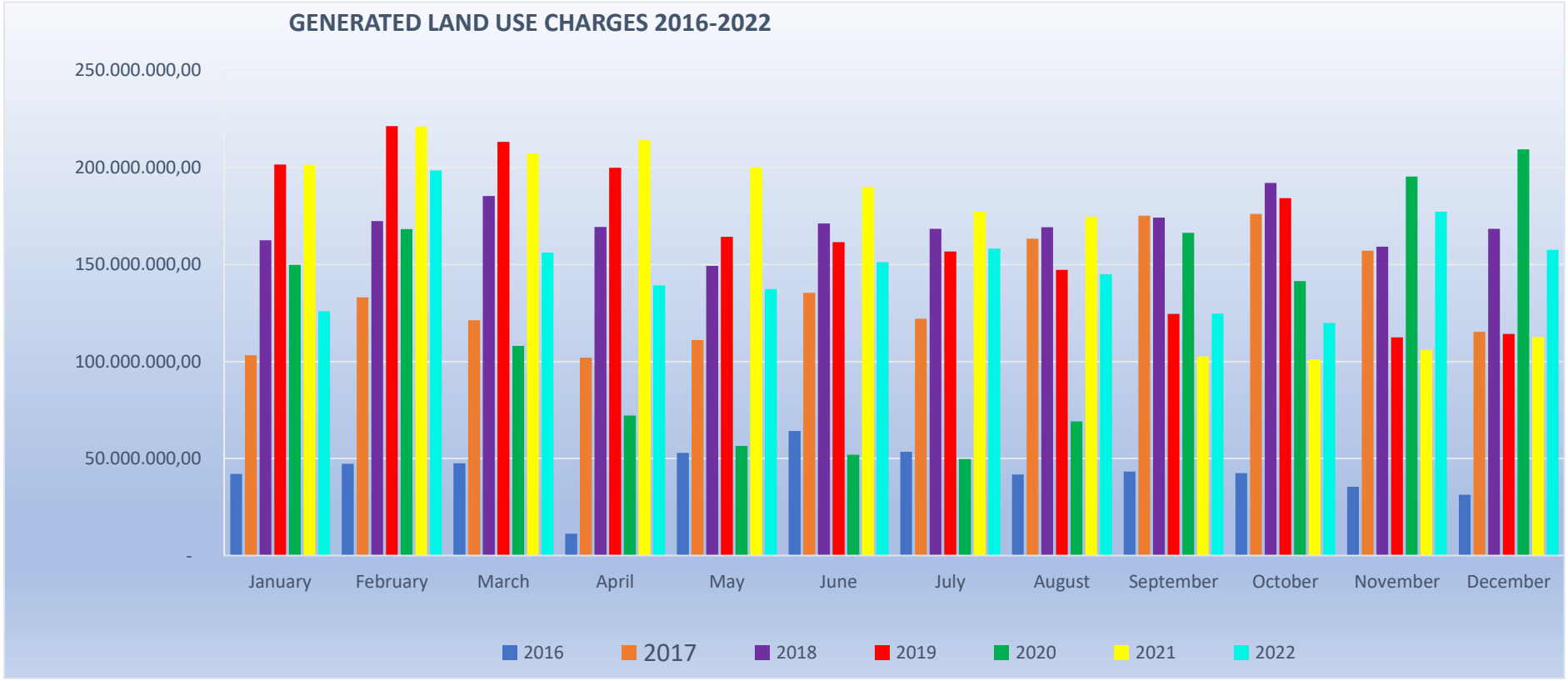


Figure 15: Statistical Chart of Monthly Land Use Charge Tax from the Year 2016 to 2022.

RESULTS AND ANALYSES: Computation of land use charges as a medium for Land tax generation

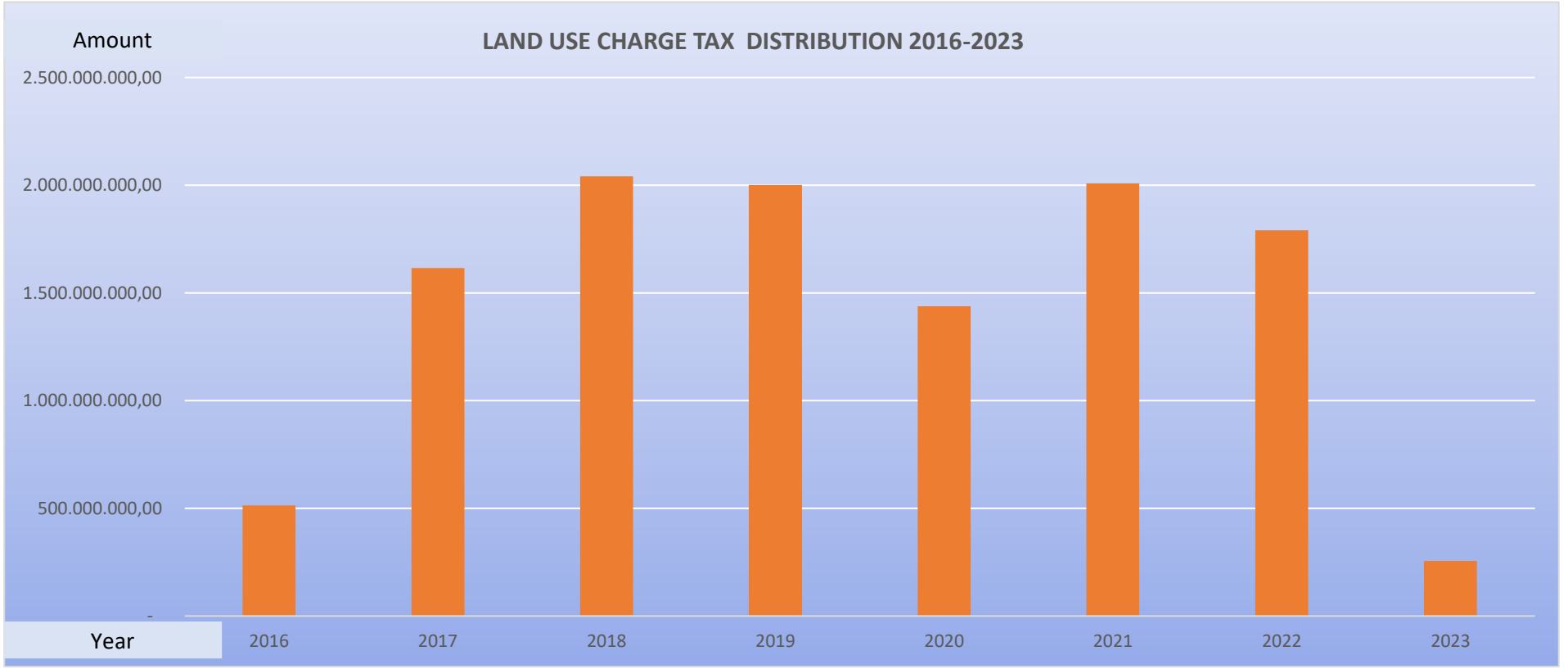


Figure 16: Statistical Chart of Annual Land Use Charge Tax from the Year 2016 to 2023.

RESULTS AND ANALYSES: Analysis and discussion

- The analyses show an upward flow of land uses revenue from the year 2016 to 2022.
- The year 2017 marked the beginning of the increase, which significantly increased from ₦513,261,462.93 to ₦1,615,456,611.75, three times as much as the year 2016.
- The year 2017 witnessed a further increase in land use tax generation from ₦1,615,456,611.75 recorded in 2017 to ₦2,041,798,850.04 in 2018.
- There was a slight decrease from ₦2,041,798,850.04 in 2018 to ₦2,001,412,435.80 in 2019, resulting in a deficit of ₦40,386,414.24, however, it was an excellent result.

RESULTS AND ANALYSES: Analysis and discussion

- The 2020 recorded ₦1,438,315,330.09, an all-time low land use tax generation in comparison with the year of automation, (2017). This was of course due to the COVID-19 pandemic and lockdown of all activities in the state, the nation and the entire globe.

- Interestingly, the first quarter of the year 2020 started very well. Importantly, with the declaration of ease on the lockdown in the state and the nation, the figures rose from September to December of the same year 2020.

- In 2021, the figures in land use tax revenue generation returned to ₦ 2,008,518,674.98, this must have included some land use tax recovery that was defaulted in the 2020.

RESULTS AND ANALYSES: Analysis and discussion

- ✓ Finally, in 2022, the land use tax charges were reduced to less than two billion nairas to about ₦1,791,344,552.48. Despite this drop in the figures generated for the year 2022, it was very significant as most of the payments made were only for the current year 2022 with less recovery of the previous years' land use charges.

- ✓ The 2023 was just beginning, and only ₦255,852,653.51 amount was generated as of February 2023, which is statistically inadequate for any inference.

- ✓ It should be noted that enforcement for land use tax generation was not initiated in the year 2023 and this was due to proximity to the election period and the government was most probably avoiding the public threat of losing votes.

CONCLUSIONS

- This paper has significantly demonstrated the digital power of geospatial tools in the conversion and processing of cadastral survey records for the automation of Land use tax generation in Kano state.

- Using cadastral record and GIS, Automated Land Use Charge Computation Template/Map; Geospatial Database for Land-Related Taxes; and Spatial Data Transformation/Conversion (Analogue to Digital) for Cadastral Records were achieved.

- The techniques show an upward inflow of land revenue generation from 2017 to 2023, while the year 2016 was used as a benchmark to show the magnitude of revenue generation before the start of this automation technique.

CONCLUSIONS cont.

- The findings revealed a rise in revenue generation at 400% increment from 2016 to 2023.
- The technique has proven to be very fast, efficient, and reliable for the computation of all land-related taxes using complex mathematical algorithms embedded in the python.
- It eliminated the difficulty in the identification of properties at their various locations for issuance of demand notices via the map/template.
- The same technique can be applied anywhere as far land use tax generation is concerned.

Thank you for listening

Any ?