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Development of Geospatial Information System Database for Banking Facilities within Gusau Metropolis, Zamfara State, Nigeria.

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Abstract: *The technological development and progress of geographical world is taking place in a very fast pace. This necessitates having a system capable of manipulating spatial and non-spatial data in digital form and giving the output in short time. GIS can be used by companies to site new locations to take advantage of previously underserved market. In recent years, the banking industry has been undergoing drastic changes, reflecting a number of underlying developments. Significant advancements in communication and information technology accelerated and broadened the dissemination of financial information and financial services and also increased the complexity. Another key impetus for change has been the increasing competition among a broad range of domestic and foreign institutions in providing banking and related financial services. Regulations are forcing the banks to adopt better operational strategies and upgrade their skills. All these factors throw more challenges to banking sector. Unfortunately, the distribution of these facilities in Gusau metropolis is quite uneven, which make customer waste time and fuel in getting access to such facilities. IKONOS satellite imagery (1m resolution) was geo-referenced and digitized showing the location of each and every banking facility in the study area. The geo-database was created using Ms Excel 2007, and ArcGIS 9.3 software. The database was queried and the results were analyzed. The results showed the locations of these facilities and how secured they are, by relating their distribution with that of the security agencies.*

Keywords*: IKONOS Satellite Imagery, ArcGIS 9.3 software, Georeference, Digitize, layout, Banking, Geodatabase.*

I. Introduction

Surveying is a science that deals with determining the relative position of points on or near the earth's surface. These points may be needed for construction to locate or layout roads, airfields and structures of all kind or for cultural, hydrographical, or terrain features for mapping. The earliest application of surveying was for establishing land boundaries. Surveying has also branched out to many fields that parallel the advancement of civil engineering and civilization. Surveyors may be called upon to appear in court to substantiate definite locations of various objects, such as those involved in major traffic accidents, maritime disasters, or even murder cases [1].

Geographic Information System (GIS) is an evolving, catchall phrase that initially referred to the management of information with a geographic component primarily stored in vector form with associated attributes. This definition quickly became too restrictive with advances in software and ideas about information management [2]. An advanced GIS system should be able to handle any spatial data, not just data tied to the ground by geographic reference points. The capacity to handle non-geographic spatial data was formerly the domain of the systems referred to as AM/FM (Automated Mapping / Facilities Management). Other non-geographic applications, such as interactive medical encyclopaedias that retrieve information based on the human form, should also be manageable by a robust system [3].

Zamfara State was created in 1996 with Gusau as the capital town. Within the former structure of Sokoto State, Gusau is the largest town in population size. Lafia metropolis stretches between latitudes 06º 37′ 00″-06º 43′ 00″ and between longitude 12º 08′ 30″-12º 12′ 30″. Figure 1, below is the satellite imagery for Gusau metropolis.

Figure 1: Image of Gusau District (NPC, 2009).

Developing GIS Tools to Integrate MCDMS Models for the Analysis of Bank Branch Closure has been reported [4]. In the research, MCDMS (Multi Criteria Decision Making Systems) methods have been integrated with a GIS to provide the means to prioritize branch closure procedures based upon a variety of different choice criteria and on the importance (weight) a decision maker might attach to these. The approach represents the methodology for the development of effective spatial decision support environment (SDSS) for branch bank rationalization by integrating MCDMS and GIS [5]. This decision making environment is designed to enable the decision maker to evaluate the applicability of the procedures and techniques in order to generate decision making scenarios and finally implement the decision process by re-evaluating different scenarios based on his/her own familiar concept and knowledge. This research primarily focuses on the methodology for developing a GIS-based Multi-Criteria Decision Making system (GIS-MCDMS) for application in the retail banking environment, rather than on the development of entirely new software to address this task.

Lack of comprehensive Geospatial Information system and database contribute to problems for individuals, government agencies and other organisations that frequently patronize the banking sector. The major problem is the waste of time and fuel by customers in visiting the banks in spaghetti fashion. Also, the inability to get accurate distances between banks is another problem. Also, lack of even distribution of ATM machines within the metropolis is another problem costumer encounter daily. The primary aim of this work is to develop a comprehensive GIS database for banking facilities in Gusau metropolis.

1.1 Map Making in GIS

GIS map making should transcend traditional cartography—roads, streams, and political boundaries along with map grids, scale bars, and legends may be sufficient for some maps but are not an adequate reflection of a fully featured GIS system. You should be able to incorporate a satellite or air photo image as the background for line and polygon data with transparent polygon filling to reveal the background through vector or CAD overlays. You should be able to incorporate enlarged insets and elements that tie the components at both map scales together [6].

1.2 Geographic Information System

Geographic information systems (GIS) or geospatial information systems is a set of tools that captures, stores, analyses, manages, and presents data that are linked to location(s). In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology. GIS systems are used in cartography, remote sensing, land surveying, public utility management, natural resource management, photogrammetry, geography, urban planning, emergency management, navigation, aerial video, and localized search engines [7].

1.3 Data for GIS applications

Data for GIS applications includes; digitised and scanned data, databases, GPS field sampling of attributes and remote sensing and aerial photography.

1.4 GIS Techniques and Technology

Modern GIS technologies use digital information, for which various digitized data creation method are used. The most common method of data creation is digitization, where a hard copy map or survey plan is transferred into a digital medium through the use of a computer-aided design (CAD) program, and geo-referencing capabilities. With the wide availability of ortho-rectified imagery (both from satellite and aerial sources), heads-up digitizing is becoming the main avenue through which geographic data is extracted. Heads-up digitizing involves the tracing of geographic data directly on top of the aerial imagery instead of by the traditional method of tracing the geographic form on a separate digitizing tablet (heads-down digitizing) [8].

II. Methodology

2.1 Data Used

The following were the data used; IKONOS satellite image (1m resolution), list of banks operating within Gusau metropolis and GPS receiver data.

2.2 Hardware

The following are the hardware used; an HP laptop Computer system, an HP LaserJet Printer and Garmin 12XL Handheld GPS receiver

2.3 Software

The following are software used; Esri ArcGIS9.2 (used for carrying out this work), Geocalc (used for coordinates transformation) and Microsoft office (used for typing of the project).

2.4 Field Work

The execution of this research involves some fieldwork. This Include:

i. GPS Recordings: All the banks in Gusau metropolis were coordinated using handheld **GPS (GARMIN 12XL).** The GPS has accuracy of 5 to 10 meters depending on the satellite available and the geometry of those satellites at any point in time.
ii. Enquiry of data about each bank through distribution and collection of Questionnaires.

2.5 Geo-referencing

Four points UTM coordinates were used to geo-reference the satellite image obtained.
Procedures for geo-referencing a Map include the following steps;

- Add the raster dataset you want to geo-reference.
- Click on geo-referencing toolbar and click on Fit to Display.
- Click on Control Point tool to add control point.
- To add the control points, click the mouse pointer on a known location on the raster dataset, then right click and left click, and input X and Y coordinates values of that point.
- After adding the four control points, you can examine the residual error for each link and the Total RMS error by clicking on the View Link Table tool. If satisfied with the registration, then stop registering links.
- Click on Georeferencing toolbar and click Update Georeferencing to save the transformation information with the raster dataset.

2.6 Digitising

(i) Shape files for various layers were created using ArcCatalog so that they can be edited after it is dragged to the ArcMap.
(ii) Then ArcMap was launched and the saved layers (shape files created) were dragged from ArcCatalog to ArcMap so that they can be seen in the list items. The shape files for layers and other data exported were also created. When this is completed a colour is assigned to the layer.

2.7 Plotting of Coordinates on the Base Map

The coordinates of each is typed in Microsoft excel and saved as word 97-2003 document so that it can be plotted in the ArcMap environment. The table containing the x,y coordinates can be added to the map in ArcMap through the following steps;

- Click the Tools menu on the standard toolbar and click Add XY Data.
- Click the table dropdown arrow and click on a table containing the x,y coordinate data.

- Click the X Field dropdown arrow and click the containing x-coordinate values.
- Click the Y Field dropdown arrow and click the field containing y-coordinate values.
- Click on Edit to define the coordinate system and units represented in the x and y fields.
- The X,Y coordinate automatically transforms to the coordinate system of the data frame

2.8 Adding Data in ARCMAP

The following procedures were adopted;

- Launch ArcMap
- Click the "add data" button on the standard toolbar
- Click the "look in" drop down arrow and navigate to the folder that contains the data source.
- Click the data source and click add.

ArcMap creates a new layer on the map that regenerates the data source.

2.9 Adding Data to Attribute Table in ARCMAP

The procedures adopted were as follows;

- Launch ArcMap
- Right click the layer and click "open attribute table"
- Click on option and click "add field"
- A dialog box appears on the screen. Enter the name (data) and then click OK.
- Click on "start editing"
- Enter data in the field created
- Click "stop editing"

2.10Query Building

Performing queries on GIS database is an essential part of most GIS projects. Queries offer methods of data retrieval, and can be performed on data that are part of GIS database, or new data produced as a result of data analysis. Queries are useful at all stages of GIS analysis for checking the quality of data and results obtained. The query was carried out using the query builder. This was carried out as follows

i. The query builder tool is accessed by clicking on 'selection' on the menu bar and the dialog box appears, 'select by Attributes' is clicked on.
ii. The query expression is built by either typing it in or clicking on the required fields, operators and values in the dialog box.

Query 1: Highlight of banks

Query format:

- SELECT*FROM ALL_FEATURES_Merge WHERE:

"TYPE" = 'BANK' (see figure 3 and 4)

Query 2: Highlight of security agencies

Query format:

- SELECT*FROM ALL_FEATURES_Merge WHERE:

"TYPE" = 'SECURITY AGENCIES' (see figure 5 and 6)

Query 3: Highlight of ATM machines

Query format:

- SELECT*FROM ALL_FEATURES_Merge WHERE:

"TYPE" = 'ATM MACHINE' (see figure 10 and 11)

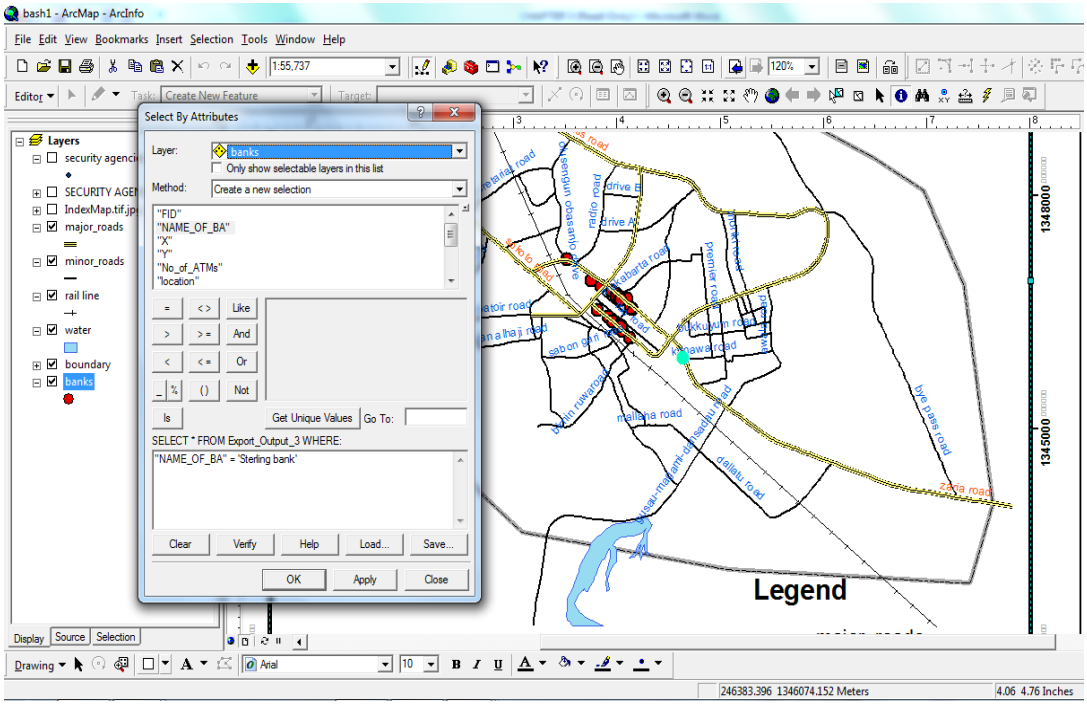


Figure 2: Display of typical query format in ArcGIS 9.2

2.11Output and Prints

After map composition, from the view menu a layout was created and grid lines generated over the area extent. A layout makes it easy to produce quality maps with arcGIS9.2. with a layout one can assemble all the components needed to appear on a map arranged together to get a desirable output and then print out when needed.

III. Results and Analysis

3.1 Results

The figures 3 - 11 display the distribution and location of banks, ATM machines, security agencies and road network within Gusau metropolis respectively. The results can help in decision making concerning the banking sector.

Selected Attributes of banks

FI	NAME_OF_BA	X	Y	No_o	location	Area	Websites	Islamic	Zero_	MINMD
0	Zenith bank	246245	134677	2	sani abacha way	tudun wada area	www.zenithbanknigeria.	NO	YES	1000
1	GTbank	246297	134673	2	sani abacha way	Tudun wada	www.GTBnigeria.com	NO	YES	1000
2	Sterling bank	247210	134591	1	zaria road	samaru	www.sterlingbank.com	NO	YES	1000
3	Access bank	246322	134631	2	J B Yakubu road	Canteen area	www.accessbanknigeria	NO	YES	1000
4	Intercontinental bank	246342	134629	2	J B Yakubu road	Canteen area	www.intercontinentalban	NO	YES	1000
5	First bank	246383	134625	2	J B Yakubu road	Canteen area	www.firstbanknigeria.co	NO	YES	1000
6	Afribank	246447	134667	1	sani abacha way	tudun wada area	www.afribank.com	NO	YES	1000
7	U B A	246097	134683	3	park road	Canteen area	www.ubanigeria.com	NO	NO	1000
8	Fidelity bank	245626	134718	1	umaru musa yaradua way	central area	www.fidelitybank.com	NO	YES	1000
9	Skye bank	246195	134643	1	J B Yakubu road	Canteen area	www.skyebank.com	NO	YES	1000
10	Fin bank	246248	134637	1	J B Yakubu road	Canteen area	www.finbank.com	NO	YES	1500
11	U B A	246038	134652	2	J B Yakubu road	Canteen area	www.ubanigeria.com	NO	NO	1000
12	unity bank1	246351	134633	2	J B Yakubu road	Canteen area	www.unitybanknigeria.c	NO	YES	1000
13	union bank	246379	134631	1	J B Yakubu road	Canteen area	www.unionbanknigeria.c	NO	YES	1000
14	unity bank 2	246480	134617	1	J B Yakubu road	Canteen area	www.unitybanknigeria.c	NO	YES	1000
15	bank phb	245959	134690	2	umaru musa yaradua way	central area	www.bankphbnigeria.co	YES	YES	1000
16	diamond bank	246307	134670	2	sani abacha way	Tudun wada	www.diamondbanknigeri	NO	YES	1000
17	FCMB	246342	134670	2	sani abacha way	Tudun wada	www.fcmb.com	NO	YES	1000
18	oceanic bank	246362	134666	2	sani abacha way	Tudun wada	www.oceanicbank.com	NO	YES	1000
19	NACB	246513	134654	0	sani abacha way	Tudun wada	www.nacb.com	NO	yes	0
20	Stanbic IBTC	246498	134655	1	sani abacha way	Tudun wada	www.sibtc.com	yes	yes	1000

Figure 3: Attributes table of banks

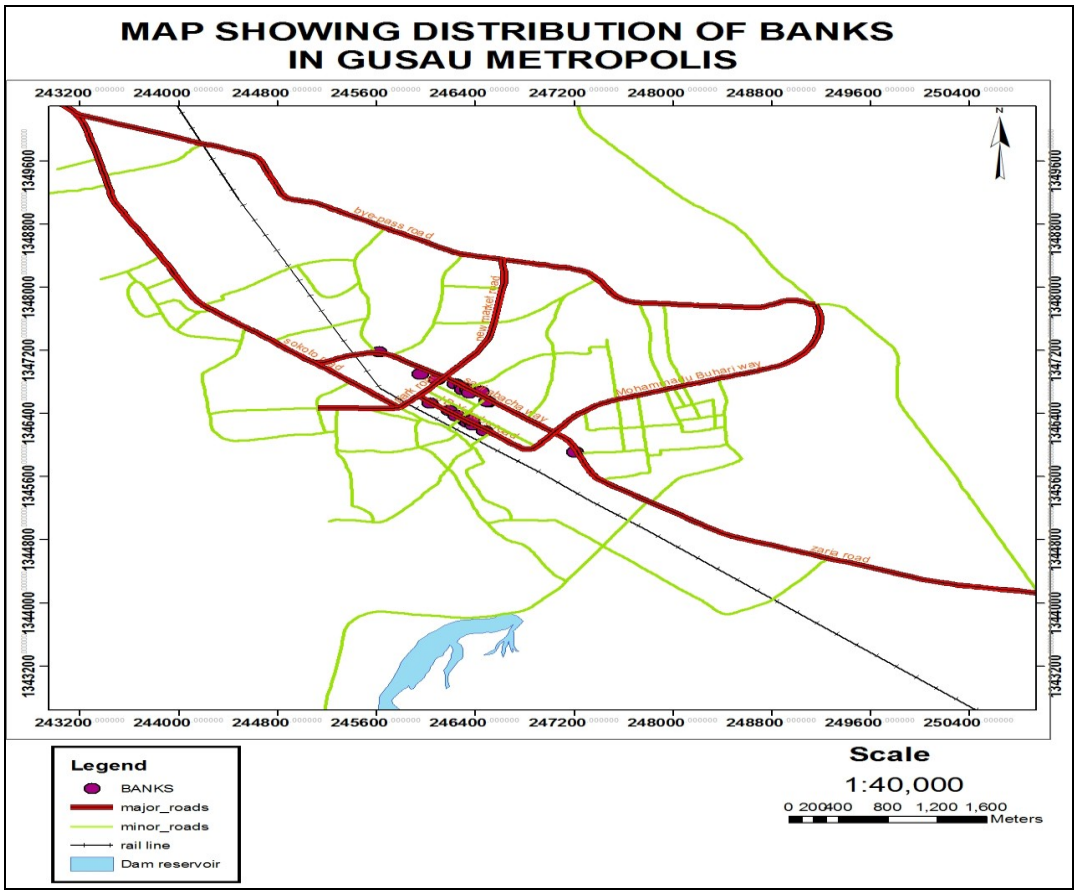


Figure 4: Distribution of banks within Gusau metropolis

	name	X	Y	location	district	Shape *
▸	central poice station	246082	1346772	police road	canteen area	Point
	NSCDC	246014	1346838	umaru musa yaradua way	central area	Point
	tudun wada police station	247407	1346230	bukkuyum road	tudun wada	Point
	state fire service	247861	1345218	zaria road	samaru area	Point
	central market fire service	246094	1347616	radio road	central area	Point
	zamfara police command headquaters	248683	1348397	kaura namoda road	unguwar gwaza	Point
	mortgage police station	246499	1345321	mortgage road	mortgage area	Point
	zamfara mobile police command	250648	1344903	bye pass 2 road	bye pass	Point

Figure 5: Attributes table of security agencies within Gusau metropolis

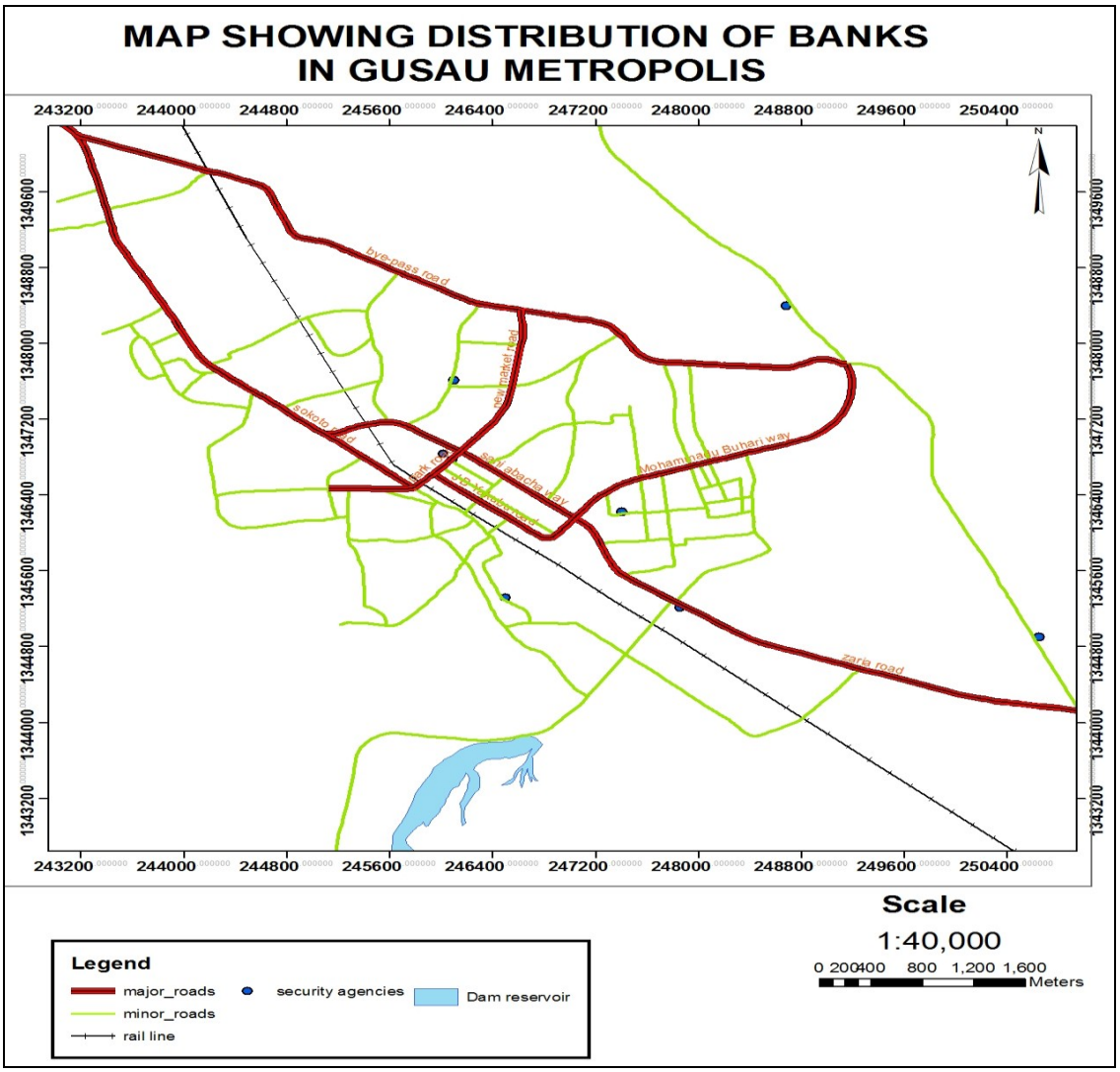
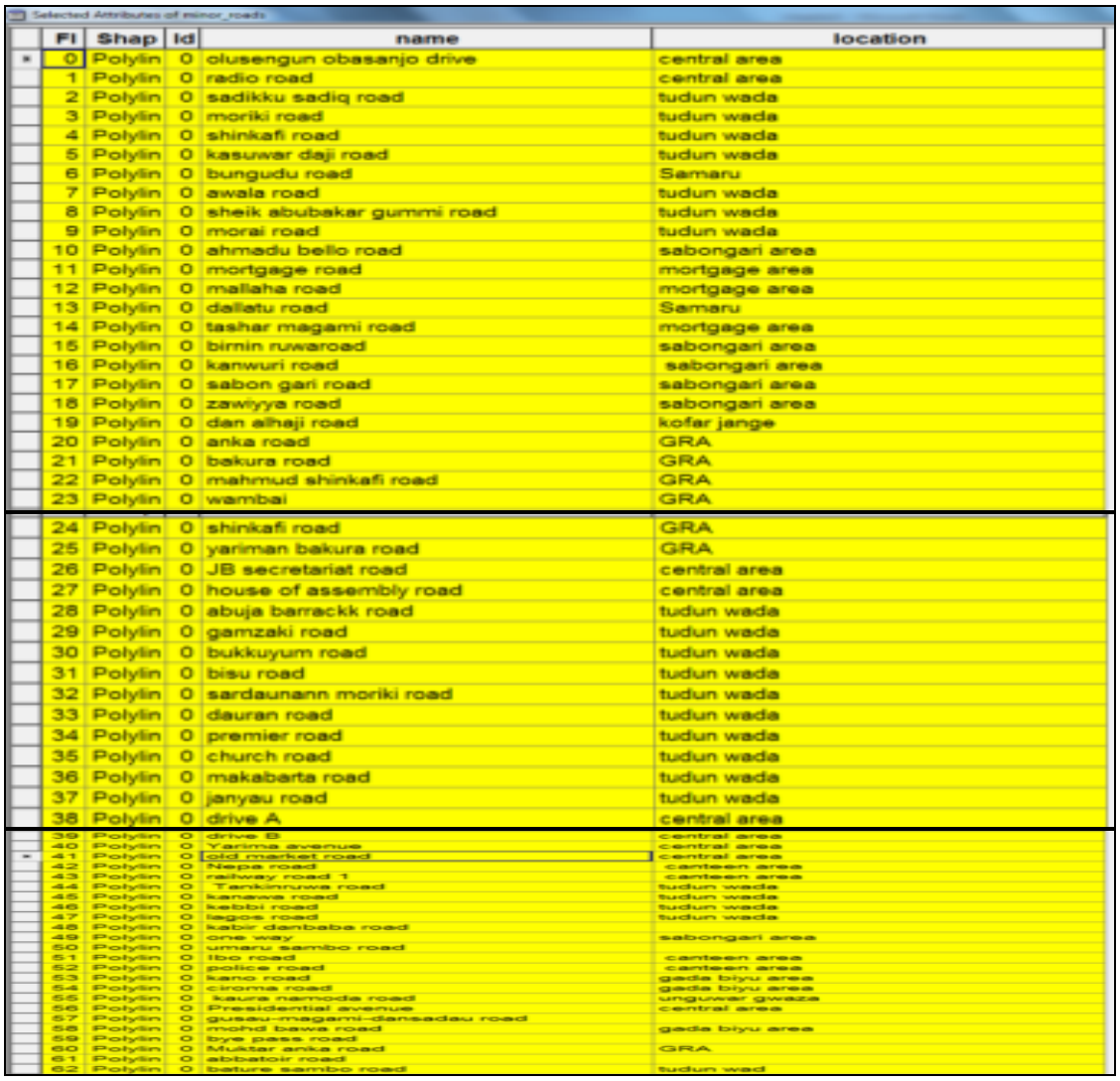


Figure 6: Distribution of security agencies within Gusau metropolis

Selected Attributes of major_roads

	FI	Shap	Id	name	location
	0	Polyli	0	umaru musa yaradua way	central area
	1	Polyli	0	zaria road	samaru area
	2	Polyli	0	sani abacha way	tudun wada area
	3	Polyli	0	J B Yakubu road	canteen area
*	4	Polyli	0	park road	canteen
	5	Polyli	0	sokoto road	G R A
	6	Polyli	0	old market road	kofar jange
	7	Polyli	0	Mohammadu Buhari way	tudun wada
	9	Polyli	0	new market road	unguwar dallatu
	8	Polyli	0	bye-pass road	janyau

Figure 7: Attributes of major roads in Gusau metropolis



Selected Attributes of minor_roads

FI	Shap	Id	name	location
0	Polylin	0	olusegun obasanjo drive	central area
1	Polylin	0	radio road	central area
2	Polylin	0	sadikku sadiq road	tudun wada
3	Polylin	0	moriki road	tudun wada
4	Polylin	0	shinkafi road	tudun wada
5	Polylin	0	kasuwar daji road	tudun wada
6	Polylin	0	bungudu road	Samaru
7	Polylin	0	awala road	tudun wada
8	Polylin	0	sheik abubakar gummi road	tudun wada
9	Polylin	0	morai road	tudun wada
10	Polylin	0	ahmadu bello road	sabongari area
11	Polylin	0	mortgage road	mortgage area
12	Polylin	0	mallaha road	mortgage area
13	Polylin	0	dallatu road	Samaru
14	Polylin	0	tashar magami road	mortgage area
15	Polylin	0	birnin ruwaroad	sabongari area
16	Polylin	0	kanwuri road	sabongari area
17	Polylin	0	sabon gari road	sabongari area
18	Polylin	0	zawiyya road	sabongari area
19	Polylin	0	dan alhaji road	kofar jange
20	Polylin	0	anka road	GRA
21	Polylin	0	bakura road	GRA
22	Polylin	0	mahmud shinkafi road	GRA
23	Polylin	0	wambai	GRA
24	Polylin	0	shinkafi road	GRA
25	Polylin	0	yariman bakura road	GRA
26	Polylin	0	JB secretariat road	central area
27	Polylin	0	house of assembly road	central area
28	Polylin	0	abuja barrackk road	tudun wada
29	Polylin	0	garnzaki road	tudun wada
30	Polylin	0	bukkuyum road	tudun wada
31	Polylin	0	bisu road	tudun wada
32	Polylin	0	sardaunann moriki road	tudun wada
33	Polylin	0	dauran road	tudun wada
34	Polylin	0	premier road	tudun wada
35	Polylin	0	church road	tudun wada
36	Polylin	0	makaberta road	tudun wada
37	Polylin	0	janyau road	tudun wada
38	Polylin	0	drive A	central area
39	Polylin	0	drive B	central area
40	Polylin	0	Yarima avenue	central area
41	Polylin	0	old market road	central area
42	Polylin	0	Nepa road	canteen area
43	Polylin	0	railway road 1	canteen area
44	Polylin	0	Tankinruwa road	tudun wada
45	Polylin	0	kanawa road	tudun wada
46	Polylin	0	kebbi road	tudun wada
47	Polylin	0	lagos road	tudun wada
48	Polylin	0	kabir danbaba road	
49	Polylin	0	one way	sabongari area
50	Polylin	0	umaru sambo road	
51	Polylin	0	Ibo road	canteen area
52	Polylin	0	police road	canteen area
53	Polylin	0	kano road	gada biyu area
54	Polylin	0	cironna road	gada biyu area
55	Polylin	0	kaura namoda road	unguwar gwaza
56	Polylin	0	Presidential avenue	central area
57	Polylin	0	gusau-magami-dansadau road	
58	Polylin	0	mohd bawa road	gada biyu area
59	Polylin	0	bye pass road	
60	Polylin	0	Muktar anka road	GRA
61	Polylin	0	abbatoir road	
62	Polylin	0	bature sambo road	tudun wad

Figure 8: Attributes of minor roads within Gusau metropolis

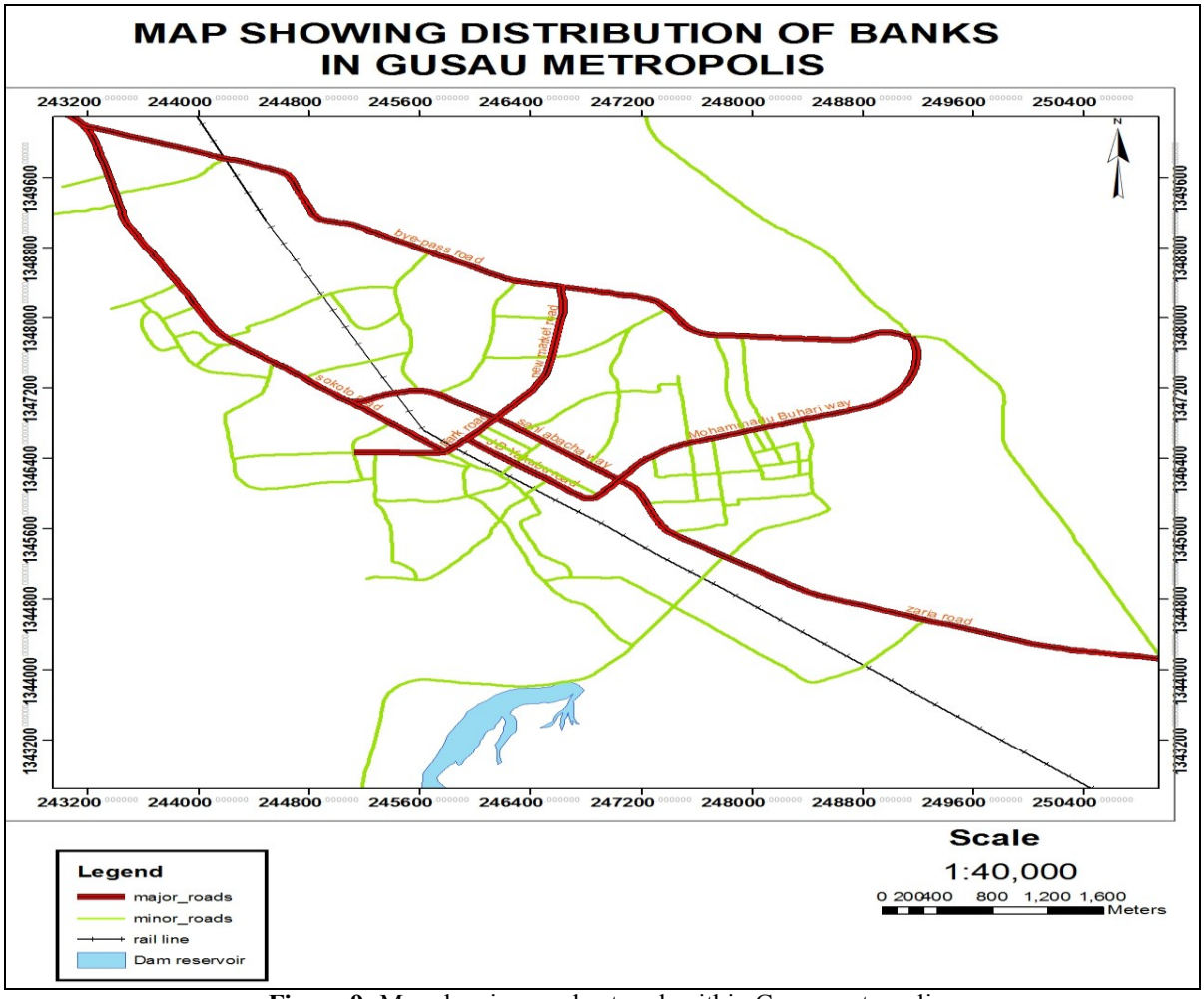


Figure 9: Map showing road network within Gusau metropolis

	FI	Shap	NAME_OF_BA	X	Y	No_of_ATMs	location	Area
	0	Point	Zenith bank	246245	134677	2	sani abacha way	tudun wada area
	1	Point	GTbank	246297	134673	2	sani abacha way	Tudun wada
	2	Point	Sterling bank	247210	134591	1	zaria road	samaru
	3	Point	Access bank	246322	134631	2	J B Yakubu road	Canteen area
	4	Point	Intercontinental bank	246342	134629	2	J B Yakubu road	Canteen area
	5	Point	First bank	246383	134625	2	J B Yakubu road	Canteen area
	6	Point	Afribank	246447	134667	1	sani abacha way	tudun wada area
	7	Point	U B A	246097	134683	3	park road	Canteen area
	8	Point	Fidelity bank	245626	134718	1	umaru musa yaradua way	central area
	9	Point	Skye bank	246195	134643	1	J B Yakubu road	Canteen area
	10	Point	Fin bank	246248	134637	1	J B Yakubu road	Canteen area
▶	11	Point	U B A	246038	134652	2	J B Yakubu road	Canteen area
	12	Point	unity bank1	246351	134633	2	J B Yakubu road	Canteen area
	13	Point	union bank	246379	134631	1	J B Yakubu road	Canteen area
	14	Point	unity bank 2	246480	134617	1	J B Yakubu road	Canteen area
	15	Point	bank phb	245959	134690	2	umaru musa yaradua way	central area
	16	Point	diamond bank	246307	134670	2	sani abacha way	Tudun wada
	17	Point	FCMB	246342	134670	2	sani abacha way	Tudun wada
	18	Point	oceanic bank	246362	134666	2	sani abacha way	Tudun wada
	20	Point	Stanbic IBTC	246498	134655	1	sani abacha way	Tudun wada

Figure 10: Attributes of all the ATM machines in Gusau metropolis

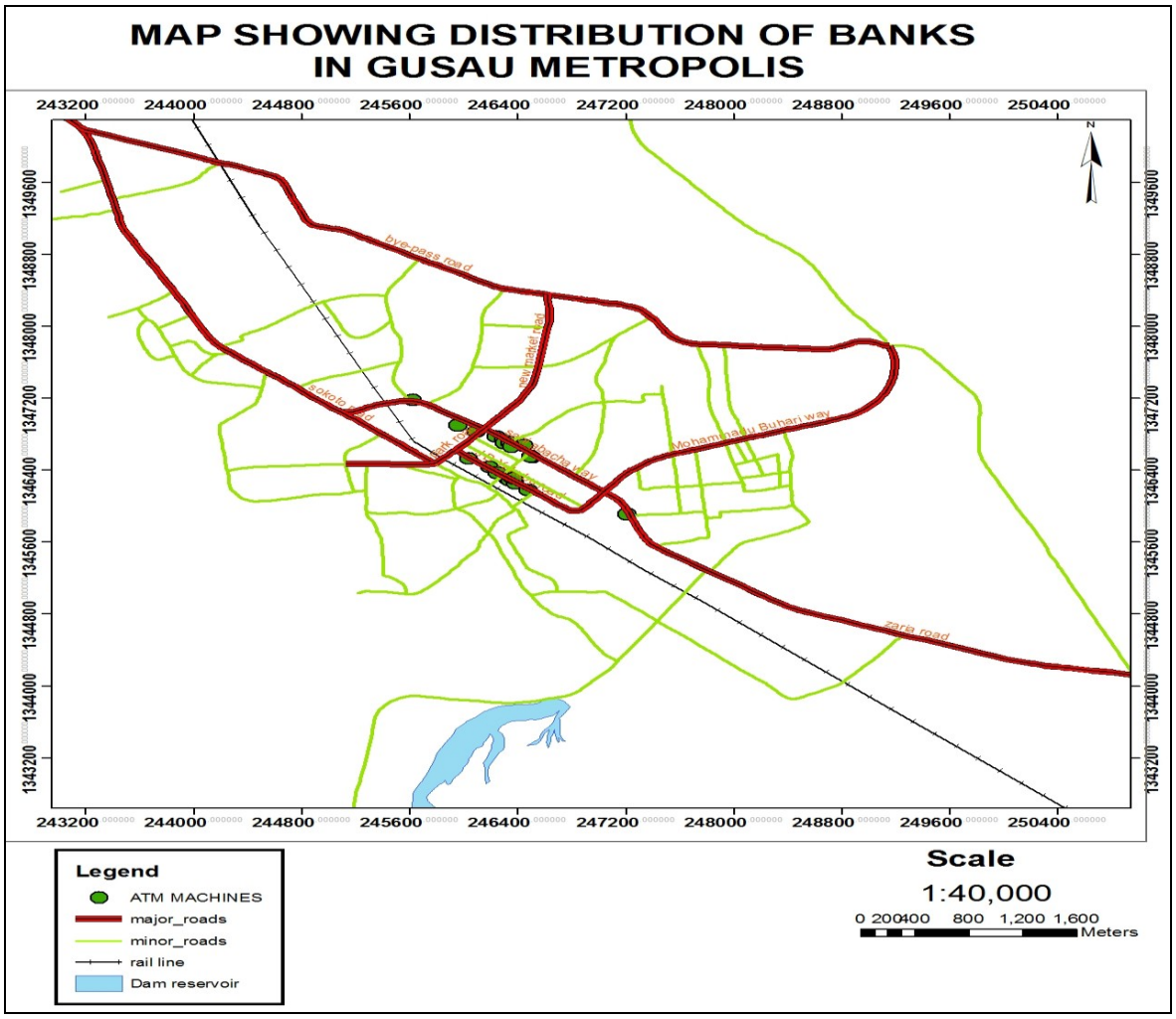


Figure 11: Distribution of ATM machines in Gusau metropolis

IV. Analysis

From figure 3 - 11, it is observed that there are 21 banks in the area of study. Also, there are 8 securities and fire services agencies evenly distributed within the metropolis. The results show clearly that there are more banks on Sani Abacha way and J B Yakubu road with 8 and 9 banks respectively as shown in Table 1. It can also be seen from the distributions that the banks have very high security as they are located near the central police station; the fire services are also very close to the area where the banks are located. On the other hand, majority of the banks have 2 ATMs within the banking area.

Table 1: Percentage of banks on major roads

ROAD	NO OF BANKS	NO OF ATMs	PERCENTAGE
Sani Abacha way	8	12	38.0
J B yakubu road	9	14	42.8
Park road	1	3	4.8
Zaria road	1	1	4.8
Umaru Musa Yaradua way	2	3	9.6

V. Conclusions

The report shows evidently the extent to which GIS aids in providing geographically referenced data necessary for inventory and monitoring of development process. This study also exposes the competition involved in the banking sector to capture and control market and business by residing very close to their clients with the sole interest of maximizing profit, by exploiting every business and market elements at their disposal. Although the banks well located, there is lack of even distribution of ATM machines within the metropolis which makes customers residing in extreme ends waste time and fuel in getting access to cash.

VI. Recommendation

ATMs are meant to ease the problems of bank transactions, thus ATMs should be made available and evenly distributed all over the metropolis, and these ATM stations should be open to the public for 24hrs.

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Appendix: Final Map

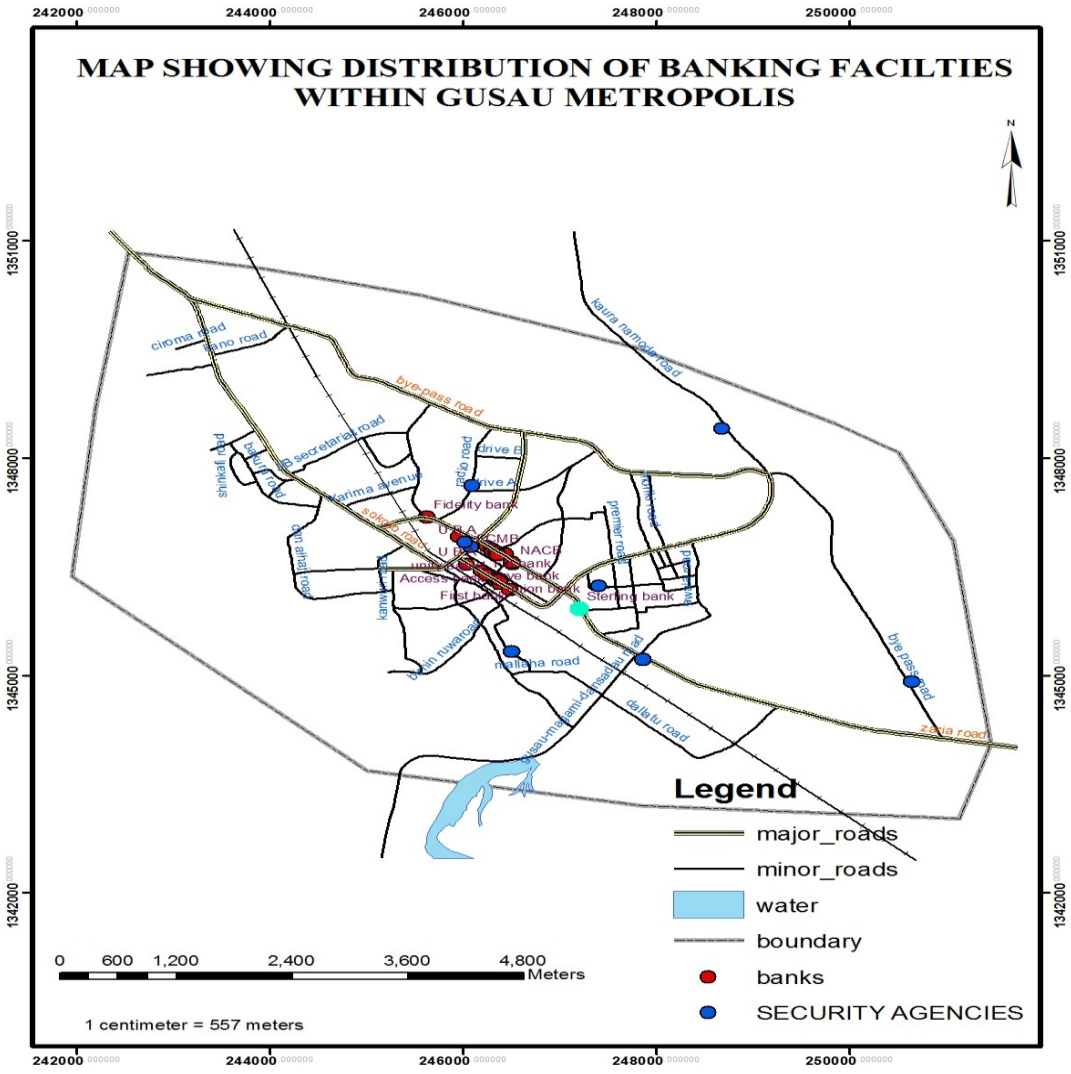

Figure 12: Distribution of Banks Facilities and Security Agencies within Gusau Metropolis