SPATIAL DISTRIBUTION OF BANKS AND CUSTOMERS' MOBILITY IN IBADAN NORTH LOCAL GOVERNMENT, OYO STATE: GIS APPROACH

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ABSTRACT: *The location of banks is a key consideration for customers' physical transactions. Customers consider a number of factors such as time, distance from workplace and residence, cost and convenience, in choosing their banks. Distance to and fro point of origin to a bank for physical transaction may discourage or encourage a customer in the selection of bank to opt for. This study therefore adopted Geographic Information System to map the location of the existing banks and to determine the spatial distributional pattern of banks in the study area through Average Nearest Neighbour Analysis. Also Road Network Analysis built in ArcGIS was used to determine the service area, shortest and alternative shortest routes to each bank in the study area. Also, structured questionnaires were used to obtain the perception of bank customers towards location of bank. This study therefore revealed that banks are clustered around commercial and institutional areas while less consideration were given to residential areas. Majority of the customers spends between 100 – 150 naira on transport to access their banks for physical transaction while 39% of customers trek to their respective banks. This study therefore suggest that residential areas should be considered in siting banks and there should be several meters in - between banks to reduce the rate of bank clustering in a particular area. Also, more roads should be constructed to allow ease of movement.*

KEYWORDS: Bank, locational pattern, Service area network, landuses and customers' mobility

INTRODUCTION

Spatial location and accessibility are crucial factors in selecting financial institution (Mylonakis, *et al.* 1998). Convenience is the overriding factor for bank selection by customers who considers closeness to residence or workplace. In other to stay competitive, banks agglomerate in Central Business District (CBD). Basically, such agglomeration could be done in at least two ways (Birkin, *et al*. 2002): by building branches in new locations or by acquiring an existing (e.g. competitor, partner, etc.) network (Khan et al, 2016). The former option is likely to be expensive and time consuming, and many banks resort to acquiring or partnering already established banks (Farhan, 2007).

In the last decades, the human society has modified itself mostly because the evolution of the information and computer technology, wide usage in big corporations, public national or local administrations, as well as private users (Droj *et al,* 2011). In Nigeria, facility efficiency has been the subject of discussion for years, and many planners have called for services to be sited in an area based on need and equity and not on mere population (Okafor, 2008). With the recent increase

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in the number of banks and the daily desire of the banks to efficiently provide services to their customers in order to meet up with the high competitive banking environment, it becomes increasingly crucial to measure the efficiency of banking institutions in terms of the spatial spread of their banks (Ogundele *et al*, 2013). This is because banking institutions that operate more efficiently, might expect improved profitability and a greater amount of intermediated funds mostly from ATM users of other banks (Berger, et al., 1993). The spatial pattern of banks has caused location inconvenience which has made large number of society to travel a long distance before customers could use their bank. The spatial distribution of banks can be ascertained using different techniques (Ogundele et al, 2013).

Customers sometimes face difficulty in choosing banks for their transactions to reduce time, distance, and associated cost, for overall convenience. Distance to and fro point of origin to a bank for physical transaction may discourage or encourage a customer in their bank selection. The longer the distance, the larger the transportation cost (Afolayan, 2011). Thus, in order to reduce the cost of distance to banks, people opt for the nearest bank to make transaction. This study is limited on the application of Geographic Information System in banking sector, while studies on banking institution largely ignore distance of the existing banks to other landuse such as residential areas. Virtually all the research on locational analysis of banking sector has always been accomplished through statistical approach which largely ignores distance cover from other landuse to banks for physical transaction. Few research with application of Geographic information System includes Ogundele *et al*, (2013). The researchers examined the locational efficiency of banks but did not considered distance covered by the customers to the nearby banks. Again, their service areas were determined through buffering instead of service area network developed through road network analysis. Also, Droj *et al,* (2011) examined the applicability of Geographic Information System in investments and banking sector in Romania but did not consider distance cover to and fro point of origin to the nearest bank just like Ogundele *et al*, (2013). Furthermore, none of these researchers examine number of banks existing on various landuse in their study area. In other to close this gap, this study therefore not only focused on assessing the spatial distribution and coverage areas of the existing banks in the study area, but also examine distance of the existing banks from various neighbourhood in the study area through Geographic Information System Approach. This study also examine the number of banks presence in various landuses in Ibadan North local government. Also in this study, perception of customers towards accessing banks for physical transaction is examined.

Geographic Information System (GIS) is widely used and very helpful tool for decision making. In particular, effective locational decision requires the use of GIS network for ease of analysis (Khan et al, 2016). It equally makes the analysis simple and precise if the inputs are correct (Khan, 2013). Application of Geographic Information System in banking sector can be very supportive and cost effective to facilitate location based decisions for banking institutions. In selecting suitable site for bank allocation, data such as the concentration of commercial areas, traffic patterns, workplaces or living places of customers whose demographics and purchase behavior match banks' target customer profiles are very crucial.

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GIS provide interactive map presentation that, in conjunction with analytical tools, could be used to probe maps at various levels of specificity, a feature that is missing in paper maps as presented by Crossland et at, (1995). The spatial analysis tools and queries can be used in many different forms to answer questions or issues related to location. These questions include the distance between two locations and most suitable location for siting new bank.

The study area
This study was restricted to Ibadan North Local Government Area (LGA), the biggest in Ibadan metropolis. The local government falls between latitude 70'23'00" and 70 27'30" North and longitudes 3052'45" and 3056'00"East, bounded by Ibadan North West and North East local Government Areas. Ibadan North, which covers an area of 145.58km (Ayinnuola and Adekunle 2008), is predominantly a home for small, medium, and large scale commercial activities. It also serves as the center for most commercial organization headquarters, such as bank and the State Secretariat among others. Ibadan North Local Government is a host to many educational and research institutions in Nigeria including the University of Ibadan, the University College Hospital (UCH), the Polytechnic Ibadan, National Horticultural Research Institute (NIHORT), Federal School of Statistics and the Nigerian Institute of Social and Economic Research (NISER). The notable mode of transportation in the study area is road transportation, the rail line cut across the local government from Sango to Bodija and also hosts the former Ibadan Local Airport. This area covers wards from Beere roundabout through Oke-Are to Mokola in the South- West and Samonda to New Bodija in the South-East. Number of 46 selected banks were captured with the aid of GPS device in Ibadan North Local government area and their corresponding X and Y coordinates were taken and recorded. The financial institutions had a linear spread on the street level map of the area mostly especially from Bodija market down to Secretariat.
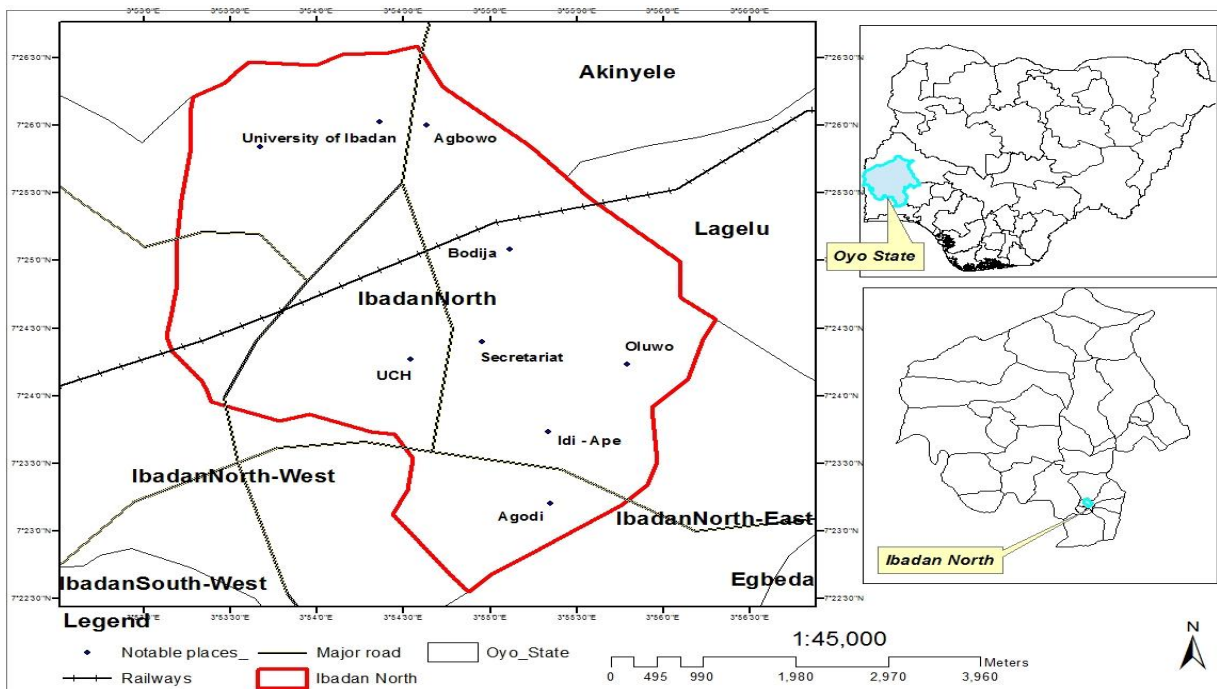
Source: Author's work
Figure 1: map of the study area (Ibadan North)

METHODOLOGY

Data

Both primary and secondary data were used in this study. Primary data includes the coordinates of all the banks in the study area. The coordinates were obtained through handheld GPS (Garmin 76 Universal Transverse Mercator) and structured questionnaires were divided into the number of banks in the study area and administered in each of the banks to customers at the entrance. The secondary data for this research includes the downloaded satellite imagery of the study area through Google Earth pro which was geo-referenced, mosaic and digitized in ArcMap environment. The satellite imagery of the study area was downloaded at the scale of 1: 30,000 showing various land use and land cover of the study area.

Table 1: Summary of data sources (primary and secondary sources)

	DATA	SOURCE
PRIMARY DATA	Coordinates (X,Y) of banks in the study area	Hand Held GPS (Garmin 76) and ground trothing
	Attribute data	Ground trothing and Questionnaires
SECONDARY DATA	Georeferenced satellite Imagery of the location.	Google Earth pro at the scale of 1:30,000

Source: Author's Compilation

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Sample frame, size and techniques

According to Oyo State Government 2017 population projection, Ibadan North has the population of 856,988. Yamane (1967) techniques for sample selection was used to derive the sample.

$$n = N/\{1 + (N * e^2)\}$$

Where n = sample size
N = Total population
e = error margin

From this formula, a total of 368 questionnaire were derived. This study made use of the purposive and accidental sampling technique. The purposive sampling technique was used to study the locational efficiency of bank in Ibadan north local government area; this location was chosen because it is where majority of banks are located and has more population compare to other local government in the Ibadan metropolis. And accidental techniques was adopted to administer the 368 structured questionnaires. The 368 structured questionnaires were divided into the number of banks in the study area and administered to each of the customers at the entrances of each banks.

Method of data conversion and analysis

The coordinates of the banks, obtained through hand held GPS, were transferred into ArcGIS 10.4 environment to determine the spatial distribution of banks in the study area whether it is clustered, random or dispersedly distributed in space, this was achieved through Average Nearest Neighbour Analysis in ArcGIS 10.4. The satellite imagery of the study area was downloaded from Google Earth pro and transferred into ArcGIS 10.4. Road, banks and buildings were digitized and overlaid, road network analysis of the study area and service area network of banks were developed through ArcGIS 10.4. Moreover, Average Nearest Neighbour Analysis in spatial statistics toolbox in ArcGIS 10.4 was used to determine the spatial distribution of banks in the study area. Descriptive statistics were used to analyse the perception of bank customers in the study area.

Cartographic Model

A cartographic modeling is a graphical representation of data and analytical procedure used in the study. It is geo-methodology for processing geo-data which build the spatial data (or map) as a variable in analysis. It is the process of linking or organizing basic analysis operation in a logical sequence such that the output from one is the input to the next. As shown in Figure 2, the cartographical model revealed the step by step procedure of combination of declared data (theme).

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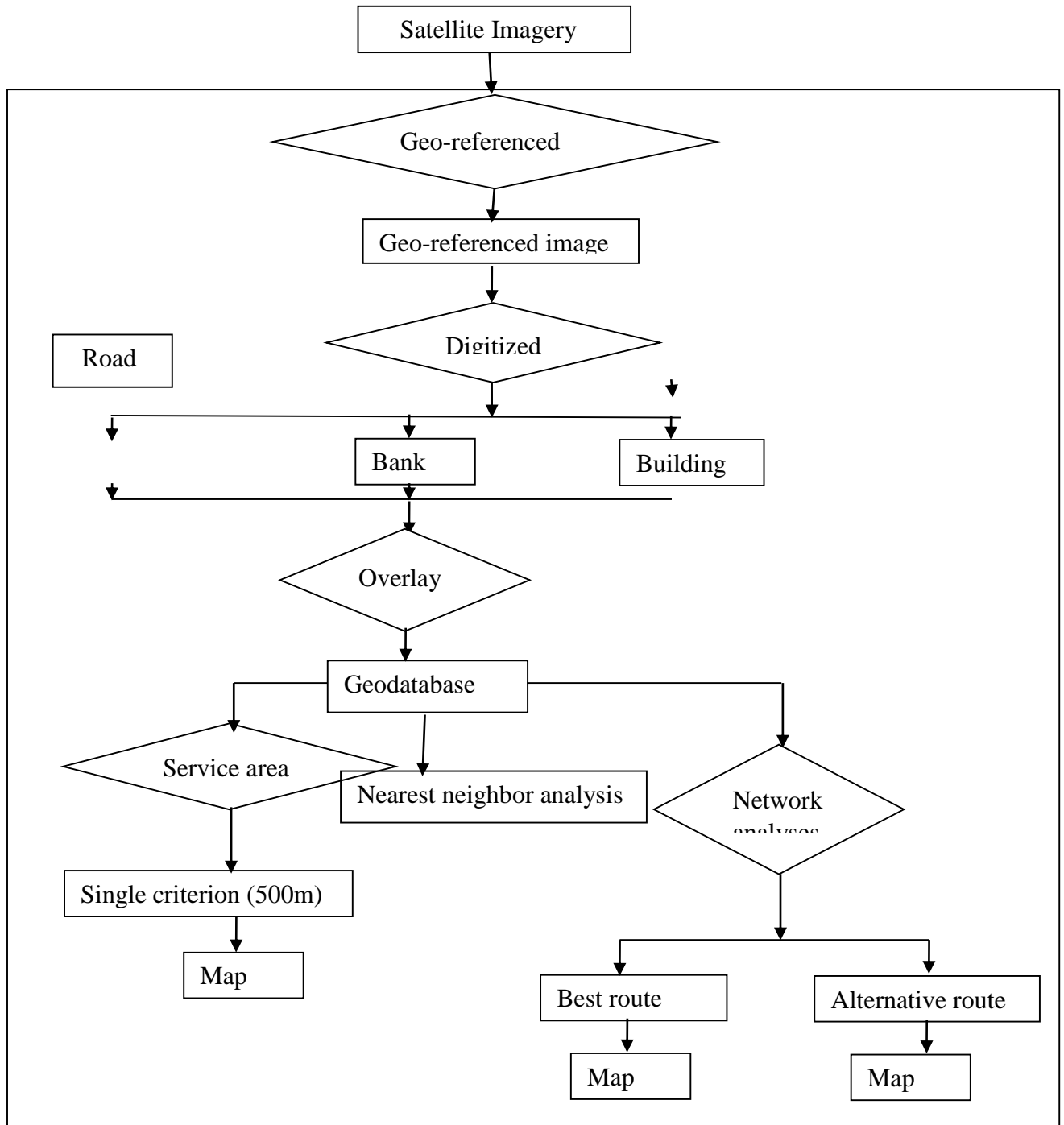
Source: Author's work

Figure 2: cartographic Modelling

ANALYSIS AND FINDINGS

The analytical power of Geographical Information System (GIS) used in this study encircles the combination of spatial and aspatial data especially in a multi- criteria situation. Road network analysis and service area network were developed for the ease movement of the customers. Average Nearest Neighbour Analysis in spatial statistics toolbox in ArcGIS 10.4 was used to determine the spatial distribution of banks in the study area. This shows a spatial distribution of bank in different land uses so as to have a better view on how banks are located in Ibadan north local government area. Table 2 presents the percentage of banks located in different land uses.

Table 2: Names, address and coordinates of banks in the Ibadan North

Bank_

FID	Shape *	Id	Bank_Name	Address	X	Y
0	Point	0	STANBIC IBTC	UCH	600362.44551	817829.117398
1	Point	0	ECOBANK	AGodi Gate	601824.02440	818104.487463
2	Point	0	FIRST BABK	Mokola	598404.10159	818125.918756
3	Point	0	FIRST BANK	UI	600031.02776	822506.369183
4	Point	0	GTBANK	UI	600092.41122	822691.313303
5	Point	0	FCMB	UI	600088.17788	822705.600832
6	Point	0	POLARIS BANK	UI	600043.72779	822686.28621
7	Point	0	FIDELITY	Bodija	600472.35365	822098.910035
8	Point	0	ACCESS BANK	Bodija	600494.57869	822076.684991
9	Point	0	FIRST BANK	Bodija	600600.41224	821761.301026
10	Point	0	GTBANK	Awolowo, Old Bodija	599848.59719	819910.603054
11	Point	0	GTBANK	Favours junction	600568.2653	820031.253295
12	Point	0	UBA	Favours junction	600572.49864	819988.919877
13	Point	0	HERITAGE BANK	Secretariat	600638.13307	819378.30442
14	Point	0	STANBIC IBTC	Mokola	598169.16876	818847.637387
15	Point	0	POLARIS BANK	Agodi Gate	602056.43487	818386.838132
16	Point	0	STANBIC IBTC	UI Second gate	600078.25175	822738.981454
17	Point	0	GTBANK	Ajibade	598642.99454	819492.978434
18	Point	0	UNION BANK	UCH	599425.96985	818122.54427
19	Point	0	FIRST BANK	UCH	599404.80314	818476.425186
20	Point	0	ACCESS BANK	UCH	599295.00084	818458.565775
21	Point	0	STANBIC BANK	AGODI	600408.89890	818000.306525
22	Point	0	FCMB	UCH	599806.17686	818475.234558
23	Point	0	UBA BANK	UCH	599344.47802	818254.571617
24	Point	0	UNION BANK	Secretariat	600408.98709	818883.399263
25	Point	0	FIRST BANK	Secretariat	600549.21654	819056.701693
26	Point	0	POLARIS BANK	Secretariat	600620.65418	819174.441512
27	Point	0	ACCESS BANK	Aare	600423.01004	820409.254399
28	Point	0	FCMB	Aare	600487.30392	820445.502388
29	Point	0	ECOBANK	Favours juction	600519.31856	820200.762315
30	Point	0	ACCESS BANK	Preboye,UI	600266.39844	822394.647605
31	Point	0	STANBIC IBTC	Bodija	600481.10825	821940.555551
32	Point	0	POLARIS BANK	Bodija	600530.85001	821877.584592
33	Point	0	UNITY BANK	Osuntokun	600341.90406	820905.311658
34	Point	0	WEMA BANK	Secretariat	600511.29525	818909.925508
35	Point	0	ZENITH BANK	Secretariat	600476.89934	819207.582354
36	Point	0	STERLING BANK	Secretariat	600196.44045	819253.88453
37	Point	0	ZENITH BANK	Osuntokun	600352.54493	820755.397949
38	Point	0	DIAMOND BANK	Bodija	600431.92009	820982.940071

Source: Author's work

Table 2 present the names, address and coordinates (X, Y) of banks in the Ibadan North local government of Oyo State. The table shows there are 42 active commercial banks in the study area.
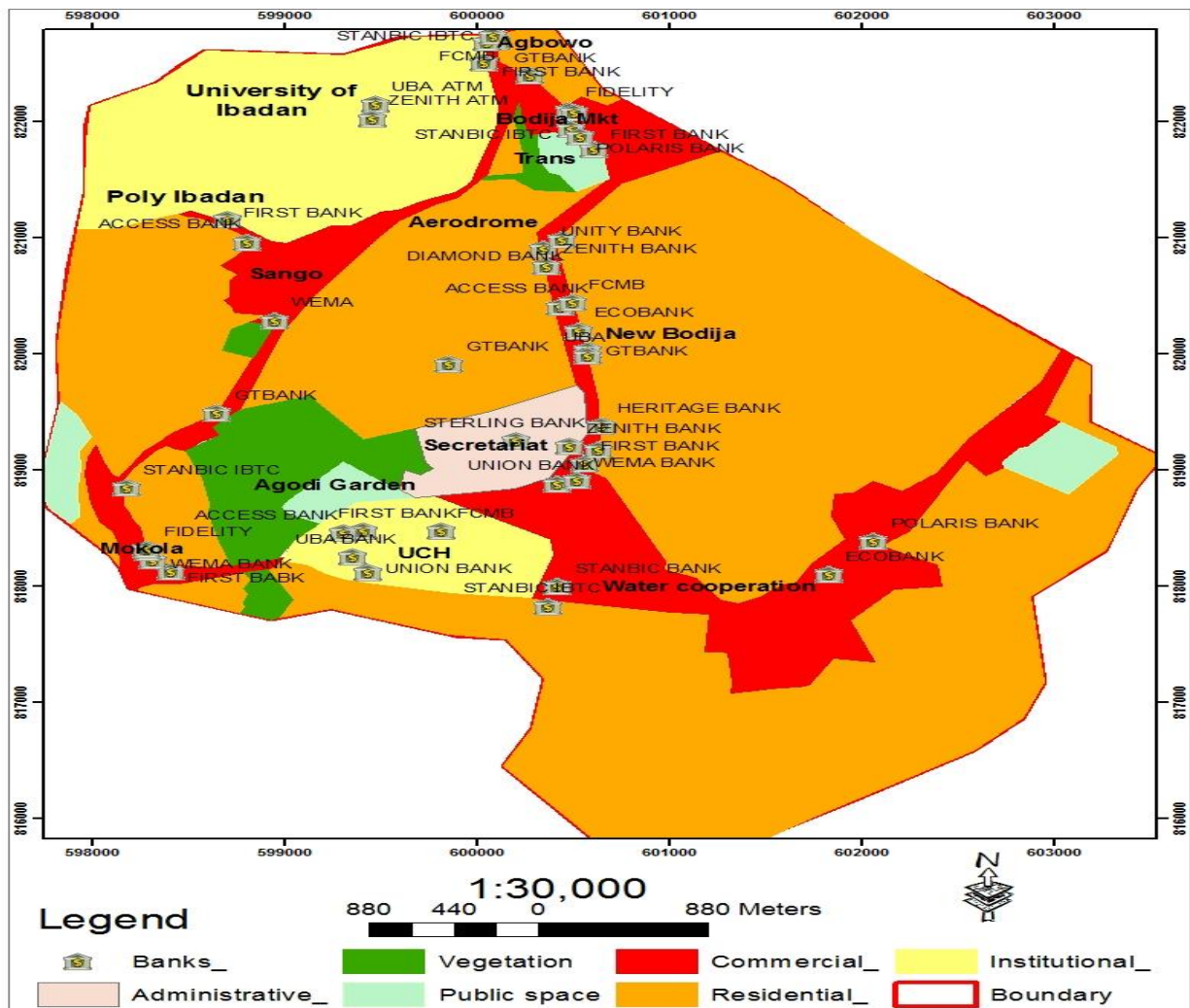
Source: Author's work

Figure 3: Spatial distribution of banks on various land uses in Ibadan north local government area.

Figure 3 represents spatial distribution of bank on different landuses so as to have a better view on how banks are located in Ibadan north local government area. Table 3 represent the percentage of banks located in different land uses. This shows that virtually all the banks in the study are area are located in commercial areas and institution. Customers coming from residential areas would have to travel far distance to access bank for any physical distribution.

Table 3: spatial distribution of banks on various landuses in the study area

LAND USE	NUMBER OF BANK	PERCENTAGE
Commercial	36	78
Institutional	7	15
Residential	1	2
Administrative	2	5
Public space	0	0
Vegetation	0	0
TOTAL	46	100.0

Source: Author's work

Table 3 shows that 78% of banks in Ibadan North are situated in commercial areas, 7% are established in institutional areas which comprises of mainly Automated Teller Machine (ATM). 2% of the banks in the study area are situated in residential area while 5% of the banks area are situated in administrative premises. No banks in sited in both the public space and vegetated areas.

Spatial distributional pattern of banks
Identifying spatial patterns is important for understanding how spatial phenomena behave. In other to achieve this objective to high standard, ArcGIS spatial statistics tool was queried. This makes it easier to access Average Nearest Neigbhour Analysis (ANNA) to determine the specific patterns of distributions banks in Ibadan North as shown in Figure 4.
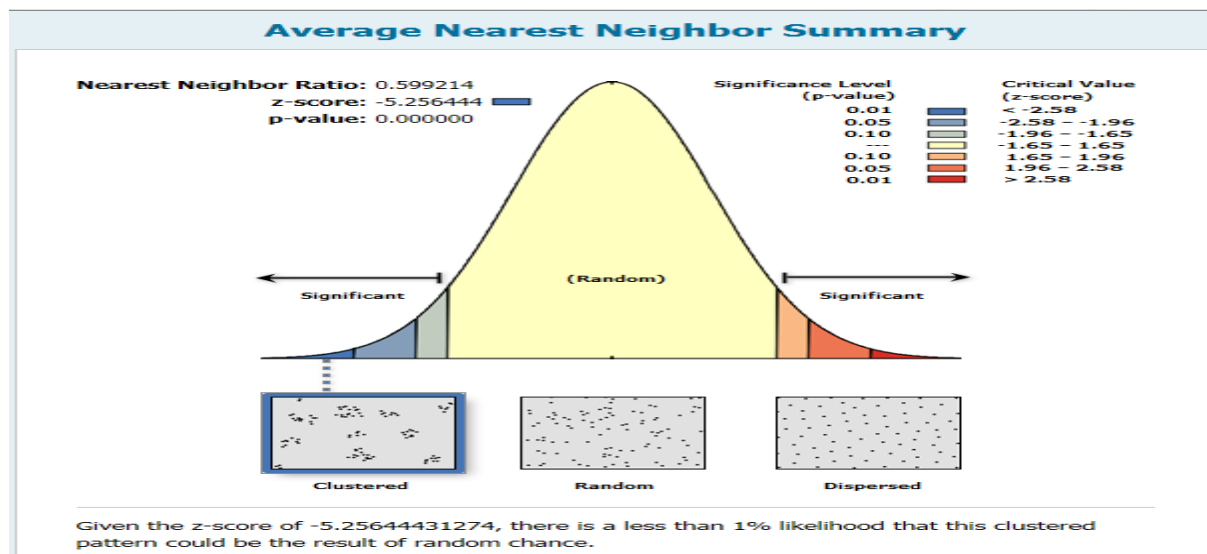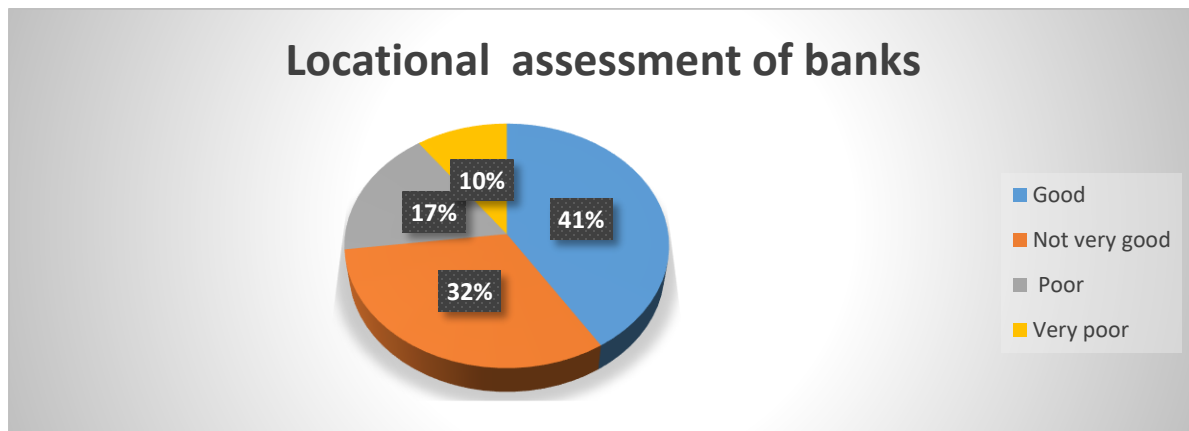

Source: Author's work
Figure 4: Spatial distribution of banks in Ibadan North

The z score of -5. 25644431274 which is less than -1.96 table value and Nearest Neighbour Ratio of 0.599214 which is less than 1, hence the pattern of spatial distribution of banks in the study area is not distinct from clustered.

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**Perception of banks' customers towards location of banks**

Perception of bank customers in Ibadan North were sought and obtained through questionnaire, the context of the questionnaire includes the assessment of location of bank, distance to get to their respective banks, transportation cost, choice of choosing the bank and safety.
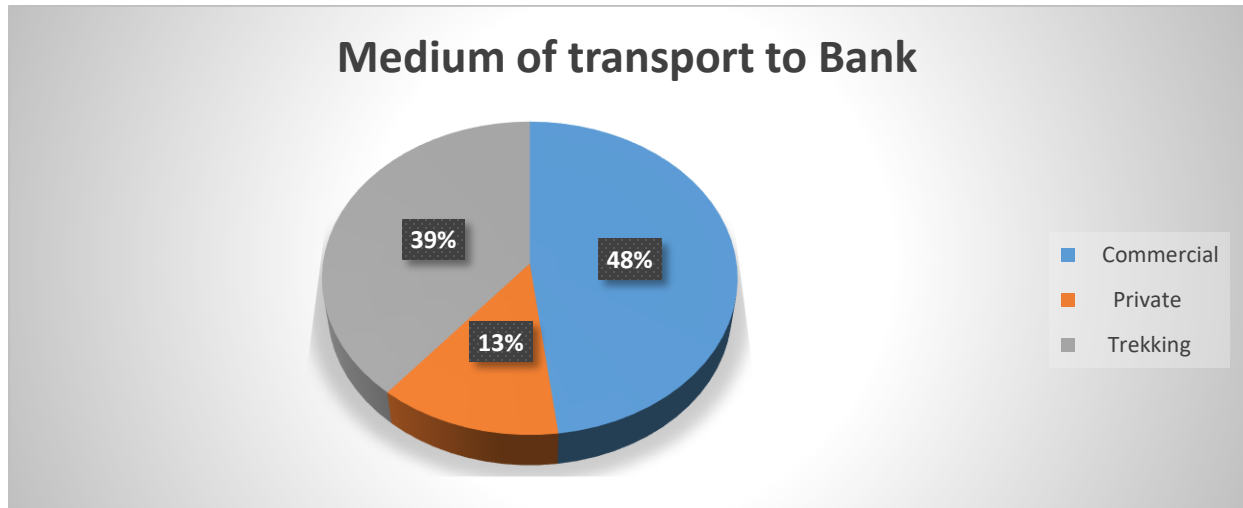

Source: Author's compilation

Figure 5: Locational assessment of banks in Ibadan North

Figure 5 presents the perception of bank customers towards the location of banks in the Ibadan north local government. Majority (41%) of the customers affirmed the location of bank is good, 32% of the customers said the location is not really good, 17% responded that the location of bank is poor while 10% said the location is very poor. Also, concerning the customers' safety as presented in figure 6, 26% agreed the location of bank is very safe, 42% said the location is safe, 24% responded it is not safe while 8% are undecided.
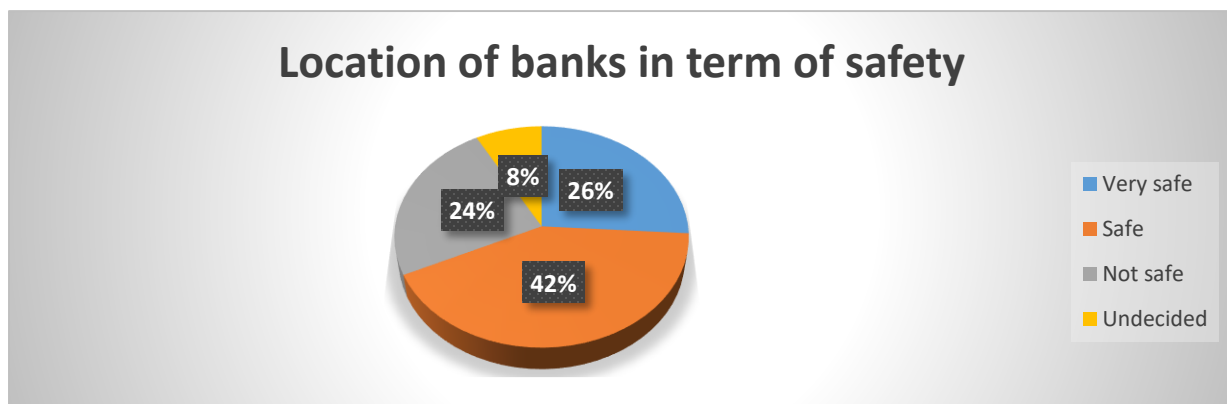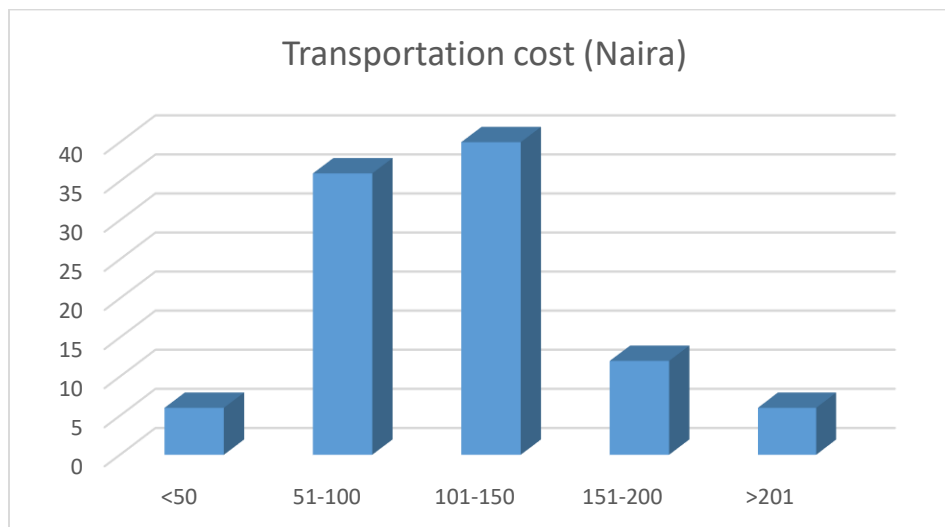

Source: Author's compilation

Figure 6: safety of banks in the study area

Source: Author's compilation
Figure 7: Medium of transportation to banks

Figure 7 presents the response of the bank customers concerning medium bank customers get to their respective banks for physical transactions. Majority (48%) of the customers take commercial transport to access their banks, 13% go with their private means of transportation while 39% trek to access their banks for physical transactions.

Source: Author's compilation
Figure 8: Transportation cost to bank

Also, figure 8 presents transportation cost in naira covered by the customers to get to their banks. 6% spends less than 50 naira on transportation to get to their bank. 36% spends between 51 – 100 naira, 40% spends between 101 – 150 naira on transportation to get to their banks, 12% spends

between 151 – 200 naira while 6% of the bank customers spends above 200 naira to get to their banks for physical transaction.

Table 4: closeness of banks to residential and office

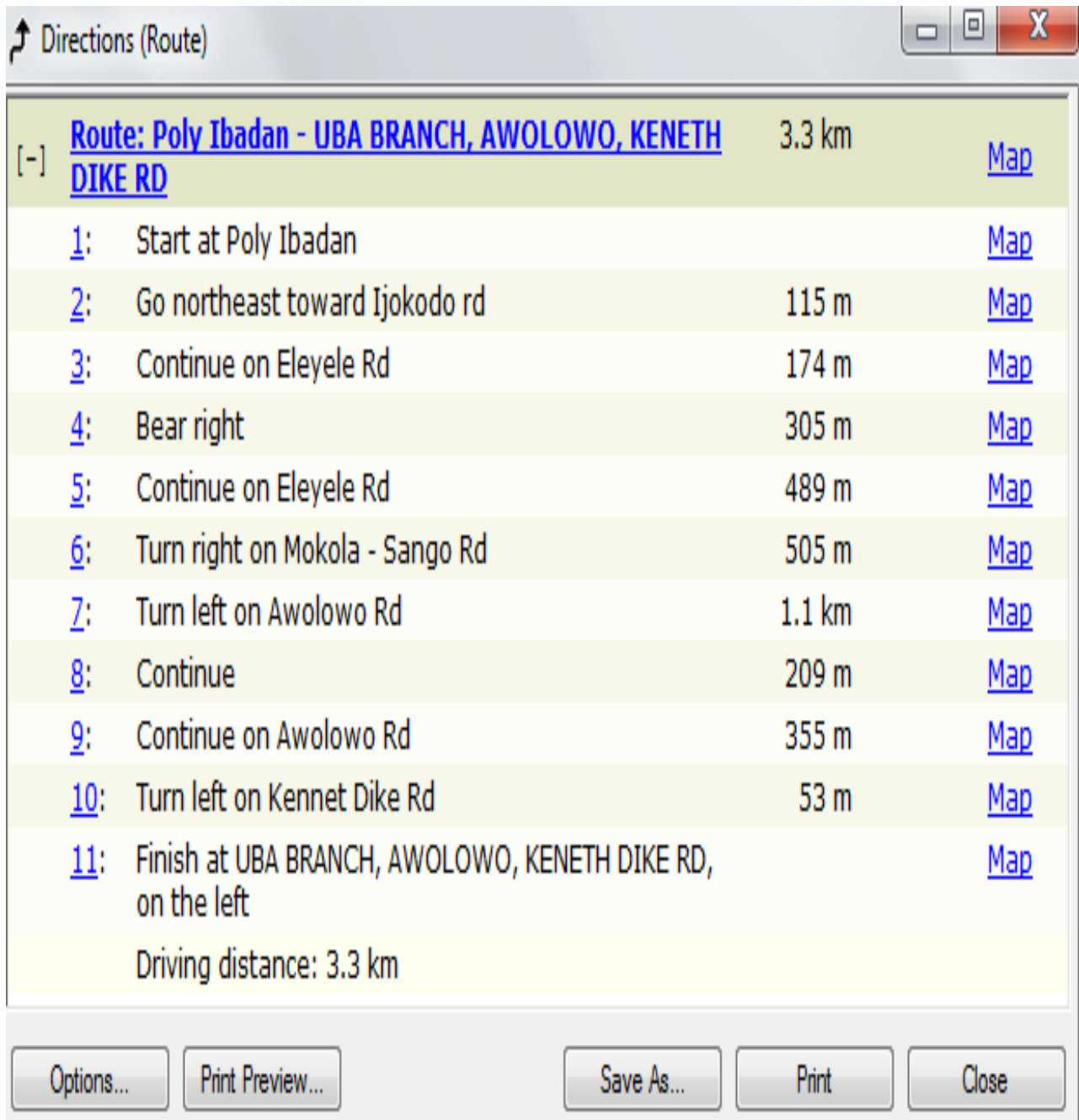| Closeness of bank to residences	Variable	Frequency	Percentage
	Yes	121	33
	No	247	67
Total		368	100.0
Closeness of banks to offices	Variable	frequency	Percentage
	Yes	215	58
	No	153	42
Total		368	100.0

Source: Author's compilation

Table 4 present the view of the customers concerning closeness to residential and offices. Majority (67%) of the respondents affirmed that the location of bank is far away from their residence while 33% responded bank is nearby to their residential areas. Also, 58% of the bank customers said that the location of bank is closer to their offices while 42 responded that banks are far from their offices.
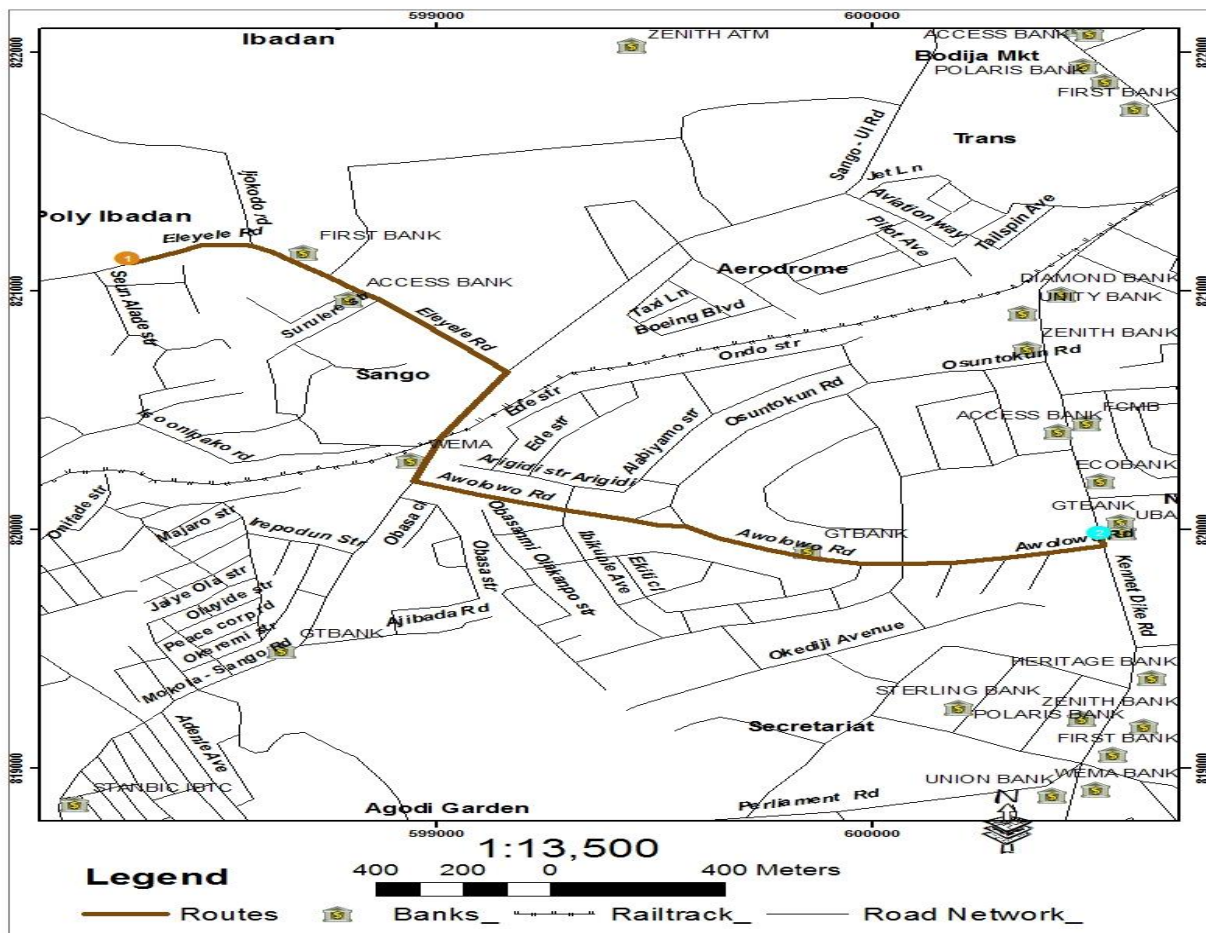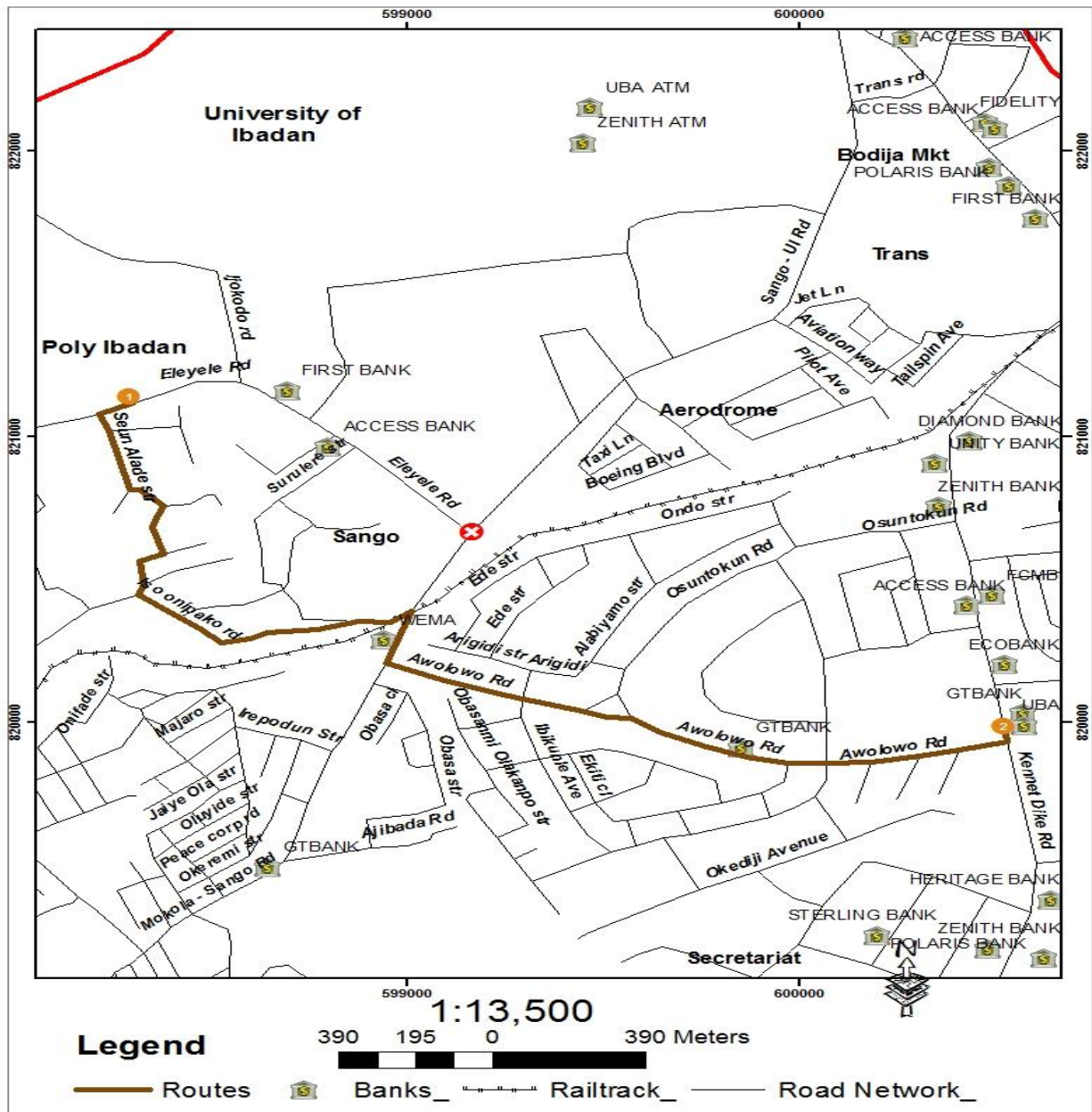
Source: Author's work

Figure 9: shortest routes from Poly Ibadan to the nearest UBA bank within Ibadan North

Figure 9 shows the shortest routes for a UBA bank customer to access the nearest UBA banks for physical transaction within Ibadan North local government. This reveals that it will take the customer 3.3km to get to the nearest UBA bank from Polytechnic Ibadan. Figure 10 shows direction of the best shortest routes from poly Ibadan to the nearest UBA bank at Awolowo along Kennet Dike road. This also reveals the longest route to be taken is Awolowo road which is 1.1km while a short turning will be made at kennet Dike road to get to UBA bank.

Directions (Route)

[-]	**Route: Poly Ibadan - UBA BRANCH, AWOLOWO, KENETH DIKE RD**	3.3 km	Map
1:	Start at Poly Ibadan		Map
2:	Go northeast toward Ijokodo rd	115 m	Map
3:	Continue on Eleyele Rd	174 m	Map
4:	Bear right	305 m	Map
5:	Continue on Eleyele Rd	489 m	Map
6:	Turn right on Mokola - Sango Rd	505 m	Map
7:	Turn left on Awolowo Rd	1.1 km	Map
8:	Continue	209 m	Map
9:	Continue on Awolowo Rd	355 m	Map
10:	Turn left on Kennet Dike Rd	53 m	Map
11:	Finish at UBA BRANCH, AWOLOWO, KENETH DIKE RD, on the left		Map
	Driving distance: 3.3 km		

Options...   Print Preview...   Save As...   Print   Close

Source: Author's work

Figure 10: Description of shortest routes from Poly Ibadan to the nearest UBA bank

Source: Author's work

Figure 11: Alternative shortest routes from Poly Ibadan to the nearest UBA bank

Figure 11 shows the detailed alternative shortest routes from Polytechnic Ibadan to the nearest UBA bank at Awolowo along Kenneth Dike road. Suppose there is a road block at Sango junction, the above figure 7 shows the best shortest alternative routes to get to the nearest UBA bank along Kenneth Dike Road. The description of routes to be taken is shown in the figure 8.

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Source: Author's work

Figure 12: Description of best alternative shortest routes from Poly Ibadan to the nearest UBA bank

Figure12 shows detailed direction of routes to bypass road block at Sango junction. This reveals that it will take 3.5km to get to the nearest UBA branch at Awolowo compare to the best shortest routes which is 3.3km if there is no road block. This means difference of 200m between best shortest routes and alternative best shortest routes to get the nearest UBA branch from poly Ibadan.

Service Area
Service area analysis is especially good for delineating 'travel sheds,' and defining accessible areas based on walking, cycling, driving, transit, etc
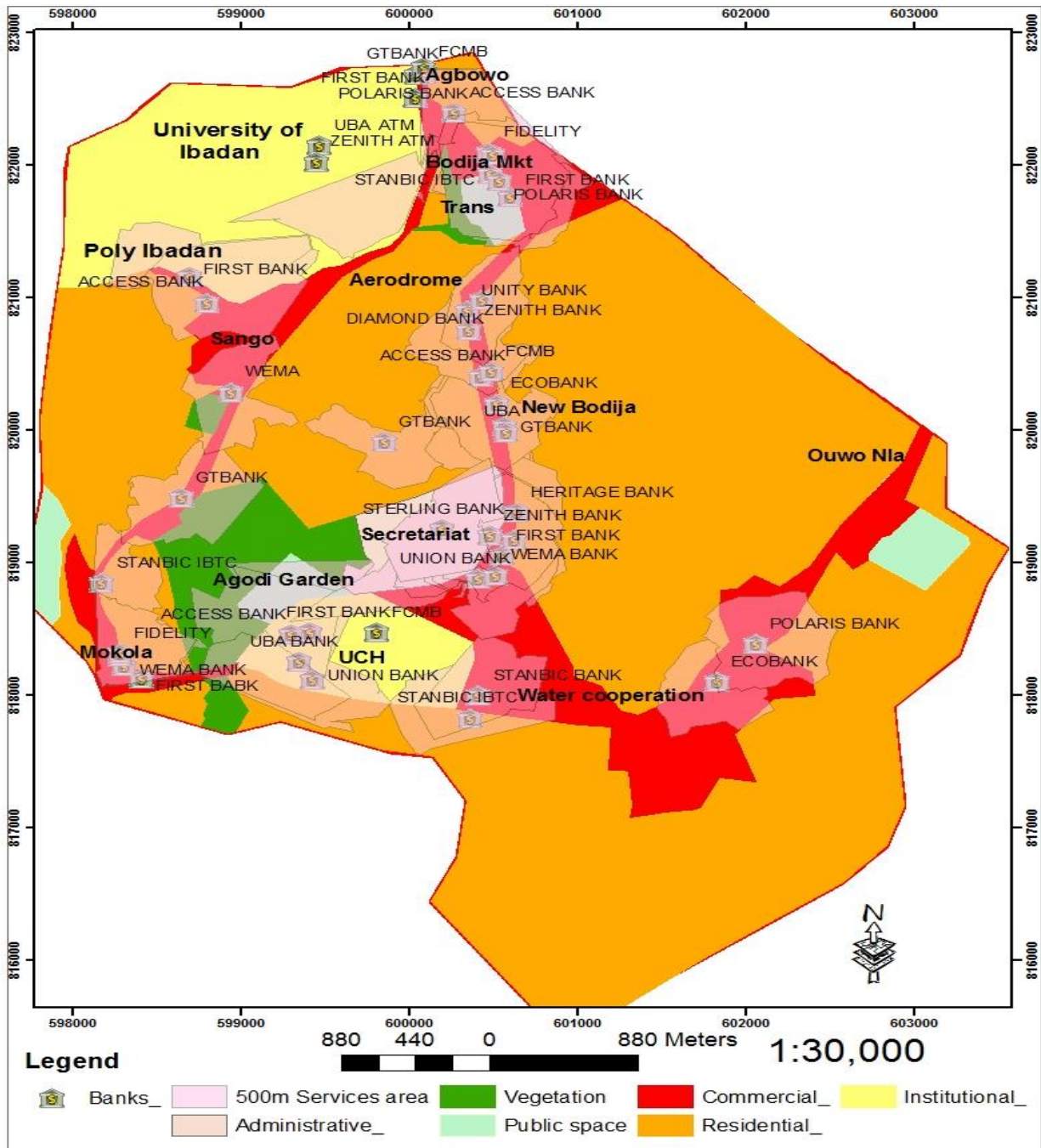
Source: Author's work

Figure 8: Map showing the service area network of 500m of each bank in the study area

Figure 8 shows the service area of each bank at a distance of 500m within the study area. It also, shows that the service area covers mostly commercial and institutional areas. And it can be deduced that there is clustered distribution of banks in commercial area than any other land uses

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in Ibadan north local government. Also, most residential areas are underserved because of bank wanting to locate at Central Business District (CBD).

CONCLUSION AND RECOMMENDATION

Geographic Information System is a system designed to enable users to collect, manage, analyze, and retrieve large volume of spatially referenced data and associated attributes collected from various sources. This study shows the capability of Geographic Information System in analysing spatial phenomenal relating to financial institutions and accessibilities. This research revealed that banks in Ibadan North are mostly located in commercial areas giving the residential areas less consideration. Majority of bank customers takes commercial transportation to make physical transaction in their respective banks due to distance. This study therefore suggest that residential areas should be considered in siting banks and there should be at least 100m intervals between banks to reduce the rate of bank clustering in a particular area. Also, more roads should be constructed to allow ease of movement.

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