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Assessment and Map Analysis of the Terrain and Landscape for the Siting of Banks Locations in Abaji Area of Abuja Federal Capital Territory, Nigeria

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Abstract

Land is the centre point in human existence and development. Development is achieved through modernization, improvement of infrastructure, financial systems and agriculture. In any economy, the financial system plays active role in production. Banks are seen as agents of development. This work is aimed at assessing and identifying optimal locations to site new banks in Abaji L.G.A of Abuja Federal Capital Territory, Nigeria. It seeks to examine the distribution patterns of existing banks and the factors necessary for the location of banks. GIS analysis was done in ArcGIS software to analyze maps extracted from satellite imageries. Nearest neighbour analysis was used to explain the pattern of distribution of banks within the study area while proximity analysis was also carried out to assess the distance of major population areas to the banks. Descriptive analysis was used to analyse demographic characteristics of the respondents. Results from analysis shows that banks in Abaji L.G.A. are in a regular pattern and they only exist within Abaji town leaving out other areas in the study area leading to increase in the number of the financially excluded populace. Overlay technique was used for all the variables that were analyzed, this makes for proper identification of suitable locations for sitting of banks in the study area.

Keywords: *Map Analysis, Abaji, Banks, Landscape, Financial systems, Assessment*

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Background of the Study

One of the prime pre-requisites for better use of land is information on existing land use pattern and changes through time. Land is the centre point in human existence and development (Briassoulis, 2000). Since human existence on earth, man has used land and the resources within and above it to meet all his needs. Man has used land for the provision of food, via cultivation, clothing, shelter and heat; for producing large variety of goods and service, for his own use or market exchange; for moving around and transporting goods, for recreation and leisure, for pleasure, for attaining social status and prestige, for spiritual satisfaction and for clamouring territorial sovereignty (Briassoulis, 2000). Land is defined as a specified geographical tract of the earth's surface including all its attributes, comprising its geology, superficial deposits, topography, hydrology, soils, flora and fauna, together with the result of past and present human activity, to the extent that these attributes exert a significant influence on the present and future land utilization (Whittow, 1984; Ndulue, 2018). "Land" "Landscape" and "Terrain" are used interchangeably (Stewart, 1968; High, 1972; Townshend, 1981) even though users of lands are obvious of the differences from what each practitioner conceives the terms to mean (Ayadiuno, Ndulue and Mozie, 2021)

Since land is the stage on which all human activities are being conducted and the source of the material needed for this conduct is being provided, human use of land resource give rise to land use which varies with the purpose it serves overtime and space. Land use is shaped under the influence of two broad set of forces: human needs and environmental feature and processes. Neither one of these forces stays still; they are in a constant state of flux as change is the quintessence of life (Olaleye, Abiodun and Igbokwe, 2009).

In the global landscape, location is very vital and key in competitive advantage (Nyandwi, 2013) especially for banks. Banks occupy centre stage with the effect of accelerating both local and foreign resources for investment purpose. In any economy, the financial system plays active role in production through financial intermediation. It is the provider of payment services and fulcrum of monetary policy implementation. Banks provide employment opportunities and services to the people and government. Banks play a crucial role in a nation's quest for economic development. They serve as major institutional mechanism for mobilizing resources from surplus unit of the economy and channelling these to deficit unit through credit expansion (Heffernan, 1996).

Similarly, banks are seen as agents of economic development because they invest directly in the economy and also grant loans to others for investment. Through the method of taking deposits, making loans, and responding to rate of interest signals, the banks help to channel funds from savers to borrowers in an efficient manner (Ubom, 2009).

Financial access facilitates daily living, and helps families and businesses plan for socio-economic activities and unexpected emergencies. Financial inclusion means individuals and businesses have access to useful and affordable financial products and services that meet their needs such as transactions, payments, savings, credit and insurance delivered in a responsible and sustainable way. Being able to possess access to a transaction account is an initiative toward broader financial inclusion since a transaction account allows people to store money,

and send and receive payments (World Bank, 2018). The increasing importance of monetary inclusion as a catalyst for economic process and development cannot be overemphasized. Financial exclusion signifies lack of access by certain segments of the society to appropriate low cost, fair and safe financial products and services from mainstream providers (Mohan, 2006; Kama and Adigun, 2013). A transaction account also can function as a gateway to other financial services, which is why ensuring that people can have access to a transaction account is the focus of Bank Group's Universal Financial Access 2020 initiative (UFA 2020), (World Bank, 2018). The role of banks in the financial inclusion process is pivotal and cannot be overemphasized.

In fact, there is the understanding that financial inclusion process is not possible without the banks. There are views also that only an inclusive economic system will promote financial inclusion while the banks remain the critical agent of achieving this through the supply of efficient and key financial services. Many researchers argue that a sound and efficient banking system is critical in achieving economic development. Thus, well-functioning banks accelerate economic progress, while poorly functioning banks are an obstacle to economic progress and aggravate poverty (Richard, 2011).

In Abaji L.G.A, there is insufficiency in the number of banks needed to support the population leading to low interest in investments, bank transactions and savings. According to field observations and discussions, about 98% of the respondents want more banks in the area. The global financial inclusion average defined the number of adults with access to financial services as less than 50.0 per cent. The problem is more acute in the developing countries in particular, such that achieving a higher financial inclusion level has become a challenge. The global target has been to eliminate all the barriers, including education, gender, age, irregular income, regulation and geographical locations that have altogether contributed to the dearth of access to financial services by billions of adults worldwide (Ardic et al, 2011).

Greater access to banking facilities enhance the power of monetary intermediaries to mobilize savings, while better access to finance facilitate economic process by increasing the power of households to undertake productive investments (Andrianaivo and Kpodar, 2011). Access to a functioning economic system, by creating equal opportunities, enable socially and economically excluded people to integrate into the economy and actively contribute to economic development (Chong and Chan, 2010 cited in Kama and Adigun, 2013). This ensures that the financial system plays its role of inclusive growth which is one among the main challenges of emerging and developing economies. The establishment of an account relationship can pave way for the customer to be availed the benefits of a variety of financial products, which are not only standardized, but are provided also by institutions that are regulated and supervised by credible regulators that ensure safety of investment (Mohan, 2006; Kama and Adigun, 2013). The CBN initiated a rural banking programme directing banks to open branches in the rural areas, encouraging Nigerians to use financial institutions and products more (Driga, 2013).

Economist and other social scientists need effective decision-making tools that could help them conduct analysis, display and disseminate results and make informed decisions about where to locate new businesses or grow existing ones. GIS technology is proven to be powerful and effective in delivering these functionalities that assist economic developers sustain economic recovery and growth. GIS tools can provide the required platform for visualization, modelling, analysis, and collaboration. The following articles outline these trends and best practices and illustrate how GIS is being utilized as a platform in assisting economic developers achieve their goals (Esri.com 2010). Geo-spatial information answers the question, "*where on earth is it*"? It defines the locations of things that can be described in terms of space - buildings, roads, highways, railways, land use, administrative boundaries amongst others (Yeh, 2001).

The Study Area

Location, Population and Economic Activities

The study area is Abaji Local Government Area of the Federal Capital Territory. It lies between latitude $8^{\circ}28'0''$N and $9^{\circ}1'0''$N and longitude $6^{\circ}45'0''$E and $6^{\circ}57'0''$E. It covers a total landmass of 992 km^2 out of the 8,000 km^2 of the total FCT landmass. It is bounded by Kwali on the East, Gwagwalada on the North-East, Kogi on the South, and Niger on the West stretched to the North. Abaji L.G.A is located in the heart of the country which is where development is currently springing up from (Agbakwuru, 2018). See figure 1- 4.

As at the 2006 census, Abaji L.G.A had a population of 58,444. The current population is estimated at 117,637 using the 5.83% population growth rate for 2018 by world population review and urbanization prospects. The population density of Abaji is therefore 119 persons per area (NPC, 2006). The area is made up of mostly Nupe, Gbagyi and Egbira people and their common language is Hausa. Primary, secondary and tertiary economic activities are found in Abaji L.G.A. The presence of schools, hospitals, banks, Local Government Secretariat amongst others gives evidence of tertiary economic activities. Civil servants live and work in Abaji L.G.A. Education and administrations are significant economic activities in the area, while manufacturing industries (secondary activities) is presently low. Primary activities in the area include agriculture which involves both crop production such as maize, cassava, groundnut, cocoyam, vegetables cowpeas amongst others and livestock management such as fishery, poultry, goat and sheep herding etc. The informal sector, mainly wholesale and retail trading, roadside mechanics, furniture making, timber selling and others are very dominant and visible in the town's landscape (Agbakwuru, 2018).

Geology and Topography

Sandstones and clay occur in significant proportion in parts of Abaji L.G.A and underlain majorly by sedimentary rocks which are remnants of erosion processes of the quaternary period. The soils are brown in colour indicating the presence of humus. They are well-drained and support building of housing structures. The elevation is about 350 meters above sea level. The slopes are generally long and gentle with an average angle of 1.5^{0}. Constraints to development caused by relief and soil factors are minimal in the area **(**Edicha and Mgbanyi, 2013**)**.

Climate and Vegetation

Abaji L.G.A falls under the Aw climatic group according to Koppen's climatic classification which features a tropical wet and dry climate. It includes the warm, humid rainy season with a blistering dry season. Sunshine duration in the area ranges from eight to ten hours a day during the dry season. Abaji L.G.A records its highest temperature and greatest diurnal ranges during the dry season months, with maximum temperature ranges between 29°C and 33°C. During the rainy season, the maximum temperature ranges between 25°C and 27°C. The wet season is about 5 to 6 months of year. It has a moderate rainfall of 1300 – 1500mm, starts in April and ends in October (Idoko and Bisong, 2010).

It is located within the Guinea savannah mosaic region of the West Africa sub region and the two major types of vegetation found in the country (forest and savannah) are also recognizable within it (Idoko and Bisong, 2010). Examples of common species are *Afzelia Africana, Shea butter trees* and *Daniella olivera.* In Abaji there is absence of natural disasters, severe storms and rising seas which means that the area suitable for any form of development – in this case siting of banks locations. Also since the climate is favourable, there is a high probability of influx of migrants into Abaji L.G.A providing more thresholds to support the banks.

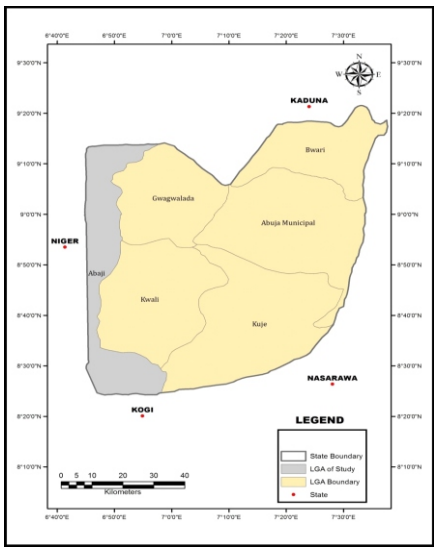

Fig 1: Abuja showing the Study Area
Source: Authors Analysis, (2020)

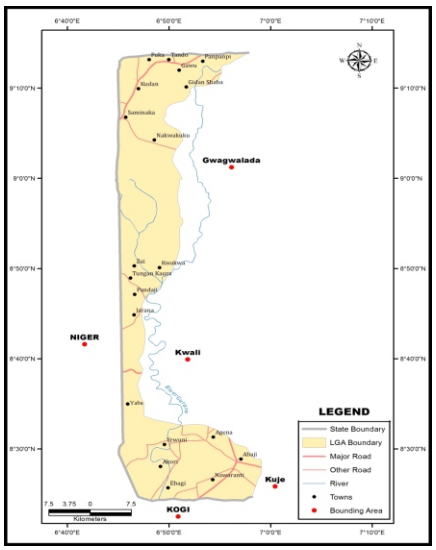

Fig 2: Study Area
Source: Authors Analysis, (2020)

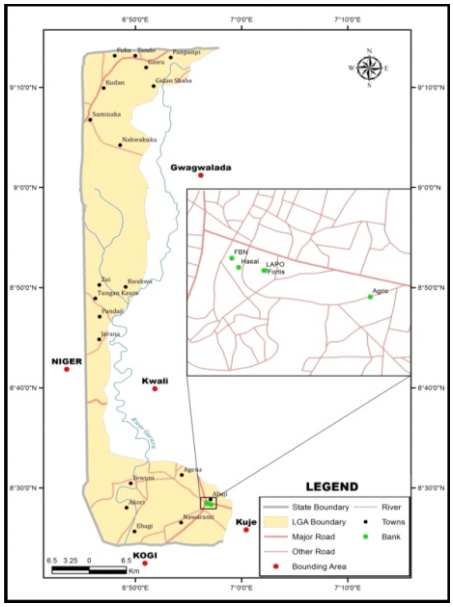

Fig 3: Abaji Local Government, showing Locations of Banks
Source: Authors Analysis, (2020)

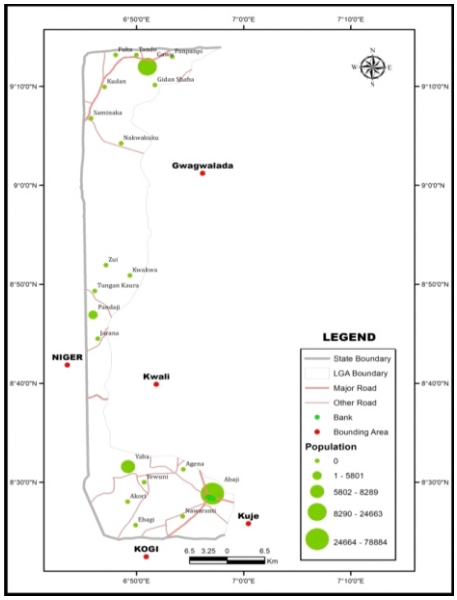

Fig 4: Population distribution in Abaji
Source: Authors Analysis, (2020)

Land Use Characteristics and Settlement Pattern

The study area as in most areas in rural Nigeria has agriculture as the most dominant occupation and constitutes majorly the land use in the area. Gawu, a town in the north of Abaji L.G.A is majorly an agricultural settlement due to availability of cultivable land. There are also other land uses such as commercial, educational, residential and administrative land use. Abaji L.G.A comprises three distinct areas; the well planned and built up areas, the overcrowded, unplanned areas with poor road system (Slums) and the sparsely developed areas with open land surrounding the houses. The well-planned areas include Senior Staff Quarters, Junior Staff Quarters and Low-Cost Housing Estate. The unplanned areas are the Abattoir and Gbakya areas while the open area is north of Abaji town (Gawu), which has been primarily, used for agriculture. Abaji town is nodal in nature as its development springs around the major road junction linking Lokoja, Abuja and Nasarawa State (Agbakwuru, 2018).

The relationship between the banking sector and economic development points out clearly the importance of banks and its expansion in a nation's quest for economic development and financial inclusion. Also, the application of GIS shows its potentials to a degree of accuracy in land assessment for suitability in siting of banks locations in Nigeria. Optimal locations for siting new banks were determined using GIS for the purpose of attracting and establishing even distribution and development of banks in the study area.

Materials and Methods

The research method applied in carrying out this research is based on two (2) data types which are:

Primary Data: This is based on field observation, use of GPS and camera to get coordinates and photographs in the study area respectively. Oral interviews were used to collect needed information from knowledgeable individuals. Three Hundred and Fifty (350) structured questionnaires containing questions intended to elicit information from respondents were used. The questionnaires were randomly distributed to encompass all the areas within Abaji L.G.A such as Pandagi, Naharati, Agyana, Staff quarters etc. Information from the questionnaires were computed and presented in tables and graphs.

Secondary Data: These include data from other research works, journals, textbooks, reports, articles from the internet, published and unpublished research projects and papers from international and local seminars.

Nearest neighbour analysis was used to determine the areas with sufficient number of banks and areas in deficit. Mathematically, it is expressed thus;

$$Rn = 2\bar{d}\sqrt{\frac{n}{a}} \quad \text{.......} \quad (1)$$

Where Rn = nearest neighbour index
$\bar{d}$ = mean distance of nearest points
n = number of points
a = areal extent within which the points are found

Result Analysis and Discussion

Location and Physical Identification of Existing Banks in Abaji L.G.A

A field work was carried out to establish the absolute locations of banks within the study area using global positioning system (GPS) which produced points referenced in Universal Transverse Mercator (UTM). The points were also converted to World Geographic System (WGS) as seen in the table below. The GPS location of existing banks in Abaji town was used to identify the exact location of these facilities on the map of Abaji L.G.A and for further geo-referencing in the GIS environment. The coordinate points were captured in projected format using Universal Transverse Mercator (UTM) to enable flexibility and accuracy in calculating distance and other proximity related analysis as it gives best result when in projected coordinate. The coordinate points generated with the use of GPS were fixed on exact position on the digitized map of the study area. See the table below.

Table 1: GPS Locations and names of existing Banks in Abaji

S/N	Banks	Location in Universal Transverse Mercator (UTM)		Altitude (m)	Location in WGS (degrees)	
1.	Fortis Microfinance	0937252N	0273940E	163	8.4735930400N	6.9466072390E
2.	LAPO Microfinance	0937252N	0273931E	163	8.4735926100N	6.9465255250E
3.	FirstBank of Nigeria	0937333N	0273737E	161	8.4743155390N	6.9447602330E
4.	Hasal Microfinance	0937273N	0273779E	175	8.4737751780N	6.9451444490E
5.	Bank of Agriculture	0937078N	0274576E	152	8.4720504930N	6.9523900700E

Source: Authors Analysis and Computation, (2020)

In Abaji town, there is a hierarchy of services, with microfinance banks providing Lower Order Service (LOS) amounting to 3/5 of the total banks within the study area, a bank of agriculture provides a Lower Order Service and a commercial bank providing a Higher Order Service (HOS) to the town. Banks in Abaji town can be grouped into three, namely: commercial banks, microfinance banks and agricultural banks. There is more microfinance banks in Abaji town because of the type of economic activities carried out in the area and level development.

Table 2: Banks in Abaji Town, Services Rendered and Category

S/N	Names of Banks in Abaji Town	Services Rendered	Category
1	Fortis Microfinance Bank	Similar to commercial banks, also assist small businesses with low interest loans	Microfinance
2	LAPO Microfinance Bank	Similar to commercial banks, also assist small businesses with low interest loans	Microfinance
3	FirstBank of Nigeria	Accepting deposits, providing loans to large businesses, offering basic investment products	Commercial
4	Hasal Microfinance Bank	Similar to commercial banks, also assist small businesses with low interest loans	Microfinance
5	Bank of Agriculture	Financing agricultural sector	Land mortgage

Source: Authors Analysis, (2020)

There is therefore a growing mismatch in banking supply and demand. These banks are not also evenly distributed across Abaji town, which cause dwellers, especially from Pandagi, Yaba and Gawu, to travel a long distance before accessing banks. Most times too, people have to wait for a very long time to access the ATM as only one bank has ATM galleries which are insufficient. Also due to pressure on the machines by customers, some of the ATM outlets have broken down further reducing efficiency and satisfactory service.

Nearest Neighbour Analysis of Banks in Abaji Town

Nearest neighbour analysis was used to determine the pattern of distribution of these banks within the study area. Any calculated value of nearest neighbour index will fall between 0 and 2.1491(Clark and Evans, 1954). The lower the value of nearest neighbour index, the more clustered is the pattern. When nearest neighbour index is zero, all the points are at the same place. A value of *Rn* between 0.10-0.49 indicates a clustered pattern. And if *Rn* is between 0.5-1.57, the pattern is said to be random. On the other hand, if *Rn* is 1.58 and above, it is regular. The higher the value of *Rn* the more regular the pattern will be and vice versa.

Test of Hypothesis

Let H_o be: "There is no statistically significant difference in the distribution (pattern) of banks in Abaji Local Government Area".

Let H_1 be: "There is statistical significance difference in the distribution (pattern) of banks in Abaji Local Government Area".

Here z-Score is positive (because expected distance is less than observed distance). As the result, (3.25) is greater than +/-1.96, H_o is rejected. Thus, there is a statistical significant difference between in the distribution pattern, and since the nearness neighbour index is 1.75, the earlier conclusion that the pattern of banks in Abaji town is regular, and therefore is upheld. The p-value (0.001163) is less than 0.05 and shows that the distribution pattern is statistically significant. Since Nearest neighbour index of 1.75 is closer to 2.15 than it is to 1, objectively the pattern of distribution of the phenomenon in question may be described as regular. This clearly indicates that the distribution of banks where they are located in Abaji town is evenly distributed. However, as seen in figure 3, there is an obvious concentration of banks in the northern part of Abaji town leaving out other areas in the local government area. This may be attributed to a number of factors ranging from high population density in the town, road accessibility, political factors, level of economic activities in the town etc.

Proximity Analysis of Banks (Distance Matrix)

This algorithm creates a table containing a distance matrix, with distances between all the points in a point layer. It involves the examination of different settlements and their distances to the banks, that is, to assess the closeness of population areas to the banks. It is used to measure areal coverage. The result of the analysis is presented as a table with the mean distances from one settlement to the five banks in the study area.

Table 3: Average distances of settlements from banks

S/N	Settlement	Mean distance (m)
1	Abaji town	959.8940744
2	Agyana	6973.306596
3	Akori	14091.55264
4	Ebagi	13684.92095
5	Naharati	5784.284807
6	Yewuni	11626.05645
7	Pandagi	39234.41421
8	Jarana	18088.77500
9	Tungan Kaura	42550.20073
10	Kwakwa	42422.28723
11	Zui	44465.72769
12	Nakwakuku	67800.9637
13	Kudan	78682.68734
14	Gidan Shaba	77514.11532
15	Gawu	81038.41319
16	Fuka	84100.76762
17	Tando	83491.60304
18	Panpanpi	82463.10802
19	Saminka	73617.35669
20	Yaba	15149.93363

Source: Authors Analysis and Computation, (2020)

From the data above, it can be deduced that only Abaji town has a minimum distance of below 1000m (1km) from the existing banks. This analysis also shows that places with distances of 18,000m and above are not served by the banks as they are not within the range of the banks' areal coverage. See table 3 above.

Factors Determining the Location of Banks

There are different explanations as to why a phenomenon or event exists and where. These explanations could be major or minor according to its contribution or influence on the phenomenon or event in question. The factors determining the location of banks in an area includes the following but not limited to these;

Population

As a factor for site selection of banks, population is multifaceted. The number of people to be served by opening a new bank branch, are they underserved or over served by the banks? These are questions that need answers in decision making concerning banks' locations.

Population of Abaji L.G.A

Abaji L.G.A is a fast developing area whose current population has outgrown most of the social amenities present in the area. Research shows that a large percentage of the working population are civil servants and workers (some of who reside in the area and work in other places), while others are involved in other businesses. The population of Abaji L.G.A according to ward's is displayed on the table below. The figures were extracted from the 2006 National Population Commission (NPC) data and updated using the 5.83% population growth rate of Abuja for 2018 by world population review and urbanization prospects (NPC, 2006).

Table 4: Population distribution in Abaji L.G.A According to Wards

Wards	Males	Females	Population of 2006	Projected Population (2018)
Abaji Town	17,495	21,696	39,191	78,884
Gawu	5,826	6,427	12,253	24,663
Pandagi	1,142	1,740	2,882	5,801
Yaba	2,457	1,661	4,118	8,289
Total	26,920	31524	58,444	117,637

Source: National Population Commission, 2006

Target Market Profile/Demographics

The number of people that are home owners, business owners, salaried people, and age group amongst other things also aid in deciding the branch viability. Data from questionnaire distributed in Abaji L.G.A reveals the information below:

Table 5: Age and Sex Distribution of Sampled Population

S/N	Age group	Percentage	No of Respondents
1	Under 30	46	161
2	30 – 39	25.14	88
3	40 – 49	16.86	59
4	50 and above	12	42
	Total	**100**	**350**
	Sex		
1	Male	67.14	235
2	Female	32.86	115
	Total	**100**	**350**

Source: Authors Analysis and Computation, (2020)

The implication of the age-sex distribution is that the population which is fairly young and active is at best situation for financial inclusion. It the course of financial inclusion, the male population constitutes a higher percentage of those who are formally banked.

Table 6: Educational Qualification of Sampled Population

S/N	Educational qualification	Percentage	No of Respondents
1	FSLC	7.14	25
2	SSCE	14.86	52
3	NCE	23.71	83
4	BSc	52	182
5	MSc	2.29	8
	Total	**100**	**350**

Source: Authors Analysis and Computation, (2020)

Table 6 above shows that the study area has more of educated people most of whom reacted positively toward having knowledge of banking facilities and also understand their roles in economic development.

Data from questionnaire shows that some customers have more than one bank account preferably with different banks for reasons such as having separate current and savings account, more satisfaction, convenience, diversification, precautionary motive against disappointment by one bank, network failure etc. See figure below for statistics.

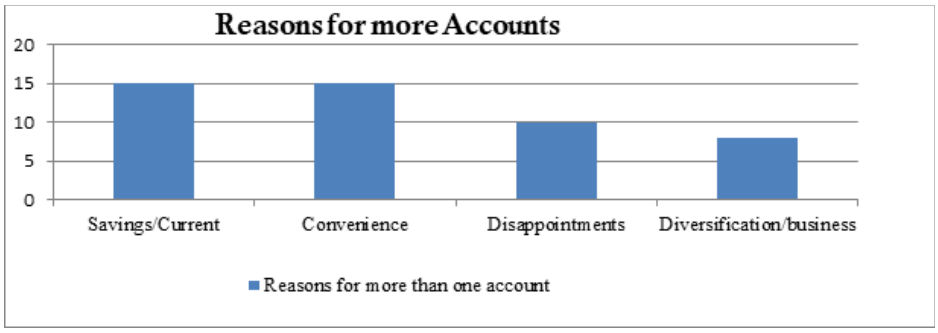

Fig 5: Reasons Customers have more Bank Accounts
Source: Authors Analysis, (2020)

Population and Number of Banks in Abaji L.G.A

The relationship between the population and number of banks in Abaji L.G.A is somewhat linear. This relationship is predictable since there are banks only within Abaji town which means that there is a positive correlation between population in Abaji LGA and the number of banks. Therefore, it is established that Abaji town with high population attracted more banks than others, that is, the locations of banks in Abaji follows population distribution as presented in the graph below.

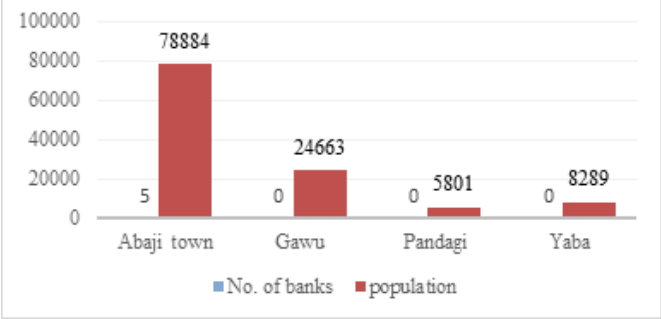

Fig 6: Population Distribution in Abaji Vis-a-vis Number of Banks
Source: Authors Analysis, (2020)

Security and Safety

Security is an indispensable factor that affects the location of banks or business venture. Security simply means safety from harm, a term that has different dimensions but highly needed for the proper wellbeing of any community or society (Spearin, 2017). The security of life and property is vital for siting banks because without security people will not have trust and confidence in putting their money and other valuables for fear of loss. Safety is the first consideration in the selection of banks' sites.

Land Use

The spatial distribution human activities across an area are important for economic development and distributing resources. Knowledge and understanding of population distribution is very important for bank viability and service delivery, as it allows for planning

and targeted service. Land use refers to the various ways in which man uses land (Ayadiuno, Mozie and Ndulue, 2020).

Land use is a reflection of the functions of that settlement. In siting of the new banks, land use land cover map of the study area was produced to enable the researchers identify the following: built up areas (residential, commercial and institutional areas), bare land (open space), vegetation or crop land (open space), and water bodies which are among the criteria for choosing a site. This land use gives an insight as to where population exist and other wise. Banks are sited where commercial land use is dominant. See figure 13 below

Accessibility and Road Network

Population distribution is one major parameter for measuring accessibility. "People are distributed unevenly in earth space and they must obtain many kinds of goods and services from facilities located at widely separated places. They have an obvious interest in the location of these facilities being 'most accessible' to them" (Rushton, 1979, p. 31). Accessibility was defined by Moseley (1979) as the ease with which people in an area obtain necessary services. The concept of accessibility has physical, financial, social and time dimensions. The physical dimension of accessibility pertains to the ease with which the friction of distance can be overcome to reach necessary banks while the financial dimension concerns the issue of affordability of such services or the ease with which they can be paid for by the people. The social dimension of accessibility concerns the ease with which the clientele can relate to those providing them, while the time dimension concerns the level of satisfaction with the amount of time spent to obtain such essential services. In this study, the physical dimension of accessibility is measured. The financial component is not measured because it varies with the type and it falls out of the scope of this research.

To avoid siting banks in areas that are not accessible, road map of Abaji L.G.A is considered as one of the criteria in siting these facilities. Abaji L.G.A has one major road which only cuts through the town towards Gwagwalada, and other minor and local roads linking districts and neighbourhoods. When trying to study and project development within an area, circulation (accessibility) is very important. The degree of connectivity in Abaji L.G.A was calculated using the descriptive measures of connectivity according to Kansky (1963)

Gamma index *Y;*

$$Y = \frac{e}{3(v-2)} * 100\% \quad \ldots\ldots (2)$$

Where Y = degree of connectivity

e = edges or links = 19

v = nodes or vertices = 22

Y = [22 / (3(19 - 2))]

Y = [22/51] 100

Y = 0.43 * 100

Y = 43%

A complete network is 100%. The lower the connectivity index, the less efficient the network system will be and vice versa. A connectivity index of 43% shows that the network system of Abaji L.G.A is poor. The degree of connectivity within the area is not complete, hence low efficiency because of the road network system and connectivity since all the nodes in Abaji L.G.A are not connected by road links. This can be seen in the map of the study area. This poor connectivity index can also be attributed to the form and elongated shape of the study area which is also bounded on the right by water bodies which is an obstruction to road constructions through neighbouring settlements. Abaji L.G.A is disadvantaged because of the shape of the area which makes it difficult for development to spread across the area faster and simultaneously. Information revealed that 52% of the population reside within 0-4m radius from their banks while 48% reside 4m and above from their banks and incur cost (transportation fare) and time (an average of 30 minutes) to commute to the banks and access services. Due to the way Abaji L.G.A is planned and organized, physical restrictions abound between homes and work places, creating inconveniences in terms of cost and stress for people to transport themselves around, to places of work, study, or leisure.

Road Condition

When inquired about the condition of roads in the study area, 51% of the respondents affirmed that the road is fully tarred, 24% affirmed partially tarred, 23% affirmed not tarred while 2% described the roads as footpaths. Higher percentage of respondents affirmed that the roads are tarred because most of the respondents reside within Abaji town where these banks are located. The road condition of Abaji town is fairly good.

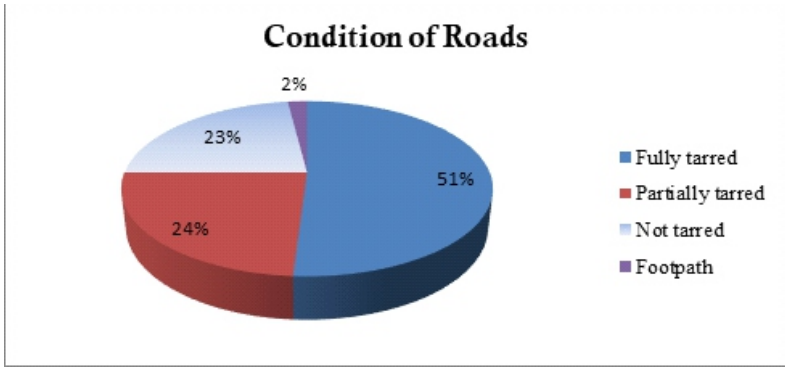

Fig 7: Condition of Roads in Abaji
Source: Authors Analysis, (2020)

Economic Implication of Inaccessibility to Banking Facilities

In the study area, the economic implication of inaccessibility to banking facilities includes:

Increase in Number of the Financially Excluded

The financially excluded are those people who are not formally banked with a registered banking institution. Some people give up the quest of actually going for what they want if the process of getting that particular thing is too tedious. The inability to access banks makes people lazy towards banking which has caused them to prefer local thrifts and contributions, or some to actually resort to hiding money in holes and mattresses.

Low investments and Savings
Banks occupy centre stage in the effect of accelerating both local and foreign resources for investment purpose. In essence, without accessibility to banks, there will be little or no investments.

Decrease in Circulation of Money
Since the financial system plays active role in production through financial intermediation which without, there will be limitations in money supplies, hence the circulation of "old money".

Decrease in International and Internal Trade
Without bank accessibility it would be difficult to involve in international trade as it would require conversion of currency and transfer of money from one country to another. Internally, within states, it would be cumbersome to purchase something from another state by travelling there or carrying money in hand while doing so.

Less Loan Facilities
Banks alter the nation's money supply, and by extension affect the size of production, what is produced and where it is produced. Inability to access banking facilities will result in low scale of production due to paucity of funds.

Economic Activities or Potential
Most banks look for substantial economic activity (or potential) in the area they are prospecting for a new location. This includes the high daily business turnover and more business prospects in an environment. The features of the primary, secondary and tertiary economic activities abound in Abaji L.G.A. The presence of schools, hospitals, banks, Local Government Secretariat amongst others gives evidence of tertiary economic activities. Civil servants both State and Federal live and work in Abaji L.G.A. Education and administration are significant economic activities in the area. As at the time of this research, a project is on-going to establish a university of technology within Abaji L.G.A. In the nearest future when this is feasible, a large economic base would exist in the area which would pull in development. Data from the questionnaire shows the occupation of the sampled population thus:

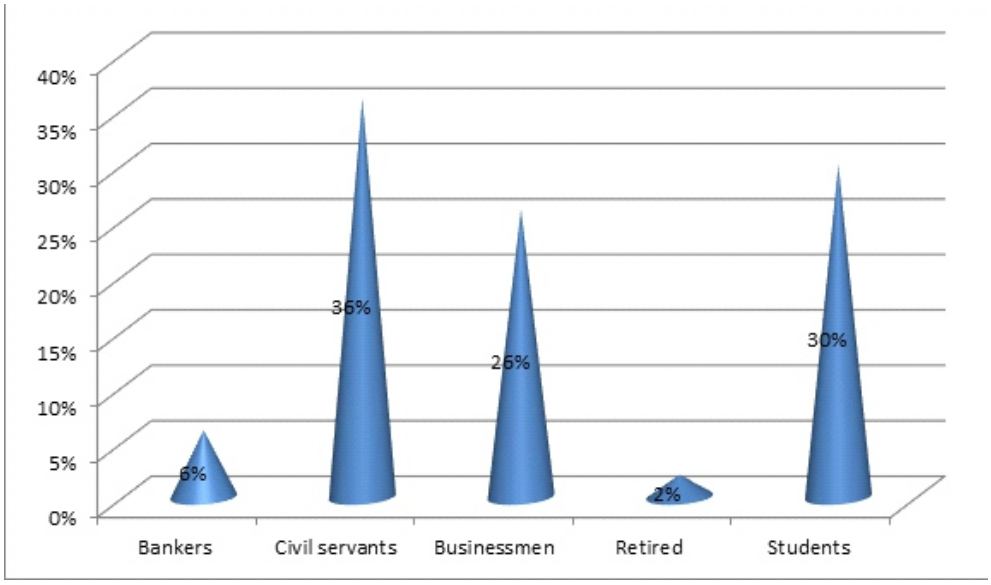

Figure 8: Occupation Status of Sampled Population
Source: Authors Analysis, (2020)

Application of GIS for Optimal Locations for Siting Banks
The geographic information system (GIS) tool was used to determine optimal locations for siting banks to ensure easy accessibility; minimize travel time and increase coverage. To effectively site banks locations, the following assumptions were made:

In general, the closest bank will be chosen (*ceteris paribus*) when there is a choice of which to patronize. Another assumption here is that banks do not have a limited capacity or number of customers they can serve. Consumers would have identical needs and tastes (that is the same demand) and would aim to minimize the distances they travel to access bank services. This means siting the facilities so close to minimized travel time and or distance. This is applicable since there is regular travel between the banks and all demand locations and will help to minimize the distance that people will have to travel to the banks to ensure equal or almost equal access from all parts of the community. The bankers would aim to maximize the profits by providing adequate banking services and facilities to their customers.

Criteria for Siting Banks Locations
Land use Land Cover: Land use Land Cover gives an insight as to where population is dense. Banks are best suited in areas where commercial land use is dominant. See figure 9.

Topography: Banks need to be sited in areas not too high to pose constraint to accessibility or too low to experience flooding. Naturally, highlands pose barriers to transportation as they prevent road constructions and are expensive to develop. Highlands are associated with soil erosion due to the speed of running water down the steep slopes while plains favour population settlement and road constructions. The geomorphological surface at the end is actually an economic surface. Whatever bank developers want to do, the first input is the physical attributes of the area. See figure 10.

Slope: The simple idea of slopes is one of the main bases of the modern world in terms of both technology and the built environment (Ayadiuno, 2014; Ayadiuno, Ndulue and Mozie, 2021). Slopes of $1^0 – 5^0$ are best for constructions and habitations, and they are depositional while areas with slopes higher than 5^0 are considered to be erosive (Ayadiuno, 2014). In essence, areas with steep slopes ranging from 35^0 and above are out of consideration for siting banks. See figure 11.

Terrain Accessibility: This is very important in fostering development within an area. Banks must be sited in areas with good roads and efficient connectivity. 10m setback from roads, 2km away from existing banks and 500m away from water bodies is necessary. A safe distance from the road especially major routes is advisable so as to avoid unnecessary congestion or disruption of activities, far from rivers to avoid any incidence of flooding, erosion, subsidence or reduction in the strength of soil along the river bank.

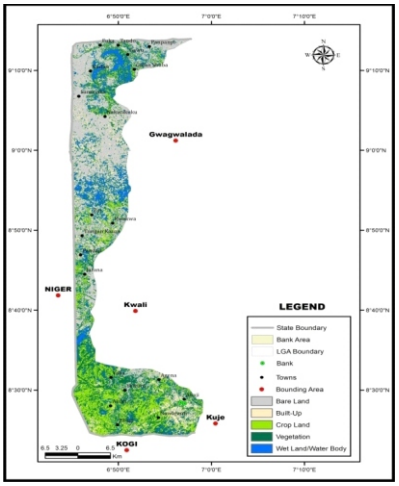

Fig 9: Abaji Land Use Land Cover
Source: Authors Analysis, (2020)

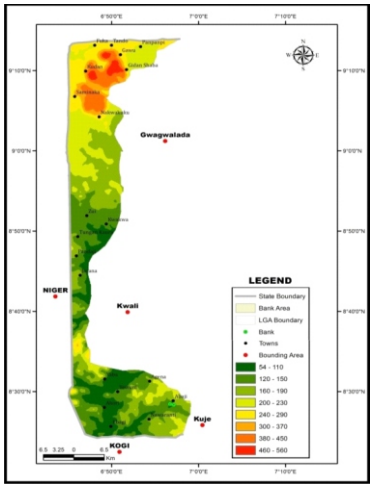

Fig 10: Digital Elevation Model of Abaji
Source: Authors Analysis, (2020)

The Digital Elevation Model (DEM) of Abaji L.G.A shows the relief of the area. Yellow colour represents area of gentle slope (medium) which is the best site to locate a bank to avoid flooding (low areas) and areas of high altitude. From the DEM, areas around 160 – 230 high are suitable for siting banks. See figure 10.

As it is within the scope of this research work, concerned with increasing the zone of influence of each bank by siting them in central places where it can serve the population, points with 2km of buffering were created in the study area to show possible locations of banks in the area. See figure 11 – 14.

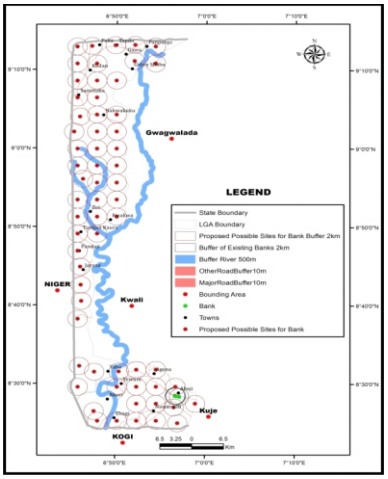

Fig 11: Existing and other Possible Banks Locations
Source: Authors Analysis, (2020)

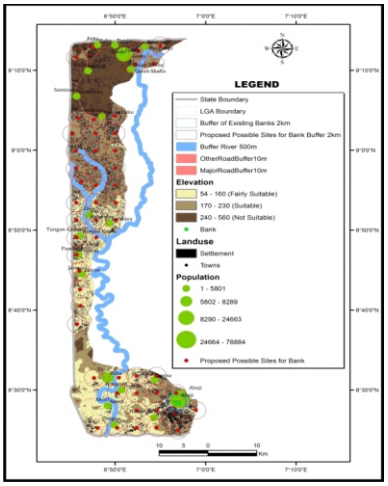

Fig 12: Overlay of Variables for Siting Banks
Source: Authors Analysis, (2020)

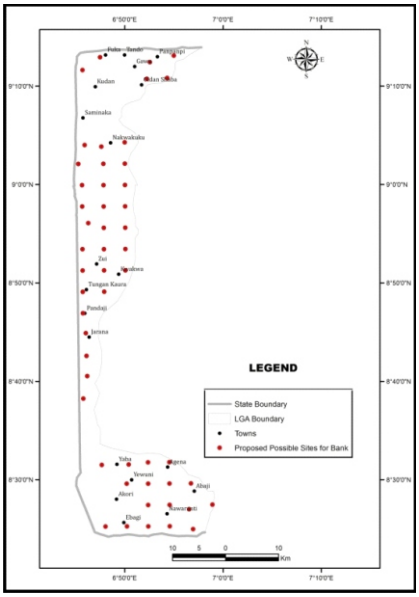

Fig 13: Proposed possible locations for siting banks
Source: Authors Analysis, (2020)

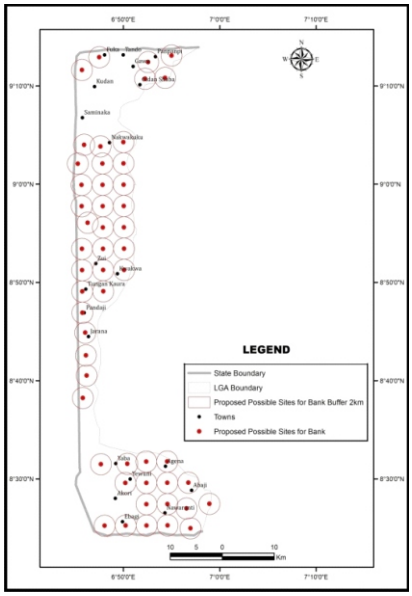

Fig 14: Possible locations for siting banks
Source: Authors Analysis, (2020)

Summary, Conclusion and Recommendations

Summary of Findings

There is a growing need for computer-based systems that are able to store, manipulate, retrieve, and, most importantly, analyse the large quantities of geo-referenced data that are available today. These data are a valuable resource for use in solving many problems that have not been easily addressed in the past because of lack of structure. This study has assessed the spatial distribution of banks, the factors of bank location and the criteria for siting banks within Abaji

L.G.A. It was observed that the banks were evenly distributed, and exist only within the town of Abaji while other settlements like Gawu and Pandagi are not served by the banks. Poor distribution of banks in the study area resulted in accessibility difficulties, which ultimately made it hard for customers to obtain desired services.

In the study area, the economic implication of inaccessibility to banking facilities include increase in number of the financially excluded, low investments, decrease in circulation of money, decrease in international trade and less savings. From the map of the study area it is seen that the area of influence of the banks is overly limited. The problem of distribution and inaccessibility has affected the rate of financial inclusion within the study area in several ways including discouraging people from banking as it is stressful and time consuming. A number of factors as explained earlier and more must come into play when deciding on locations to site banks.

Conclusion

Challenges faced by decision makers in providing services have a geographic or spatial dimension. Recently, the geographic information system (GIS) has been successfully employed to solve many societal problems ranging from creating political maps to locating best sites for service facilities amongst other things.

Today's banking institutions must meet their customers' needs at all touch points: on the phone, at the traditional teller window, at the ATM, at the point of sale, and at the new Internet storefront. Fast-paced technological change is responsible for new market segments and, consequently, new challenges for banking and financial institutions. Just knowing exactly where the customers are is important, as this unlocks the power of spatial analysis. Good locations facilitate the activities of new banks or business with broad prospect while bad locations can make the conduct of business activities unnecessarily difficult and costly.

GIS and spatial technology have a long history of adoption in the banking industry. Banks and financial institutions have diversified and now offer extended services and customer offerings. GIS is now recognized as the must-have tool for improving customer geo-demographic and market analysis to maximize asset return and improve the accuracy of investment forecasts of the customer segment or market area. GIS is now also considered to be invaluable to institutional operations and core financial services planning. Those that invest in greater use of geospatial technology and analysis have the potential to define core target segments and underexploited niches, lower exposure to risk; reduce operations costs; and increase profits per (which include opening new) branches, territories, or regions.

Recommendations

Based on the findings, the following are recommended:

1. Bank management and other decision makers should see and appreciate geographic information system (GIS) for their efficiency in location studies. The data management and cartographic display capabilities available in commercial GIS packages should encourage researchers and developers to implement heretofore untested algorithmic solution strategies. The strengths of this system include: flexible

data management capabilities; graphical display of analytical solutions; decision-maker participation; speed of alternative solution generation; and, iterative problem solving strategy.

2. The location of banks in the area must be done with adequate planning to increase areal coverage of the influence of the bank facilities. The fact that most settlements in Abaji L.G.A lack banks is an indication that adequate planning was not involved in the location of these facilities.
3. For the inclusion of the financially excluded, it is best to inform and educate people about banking facilities, services rendered and the benefits in economic developments. Knowledge of the benefits of loans, grants, shares and bonds provided by banks would encourage the rural population to get included.
4. The number of banks in Abaji L.G.A should increase as the population and its distribution are increasing. For financial inclusion and economic development, it is important to establish mediums to aid this development through establishment of banks and banking facilities. More growth poles should be established within the area which will help propagate development along Abaji L.G.A axis as it is evident that the shape of the area is a major constraint in itself which promotes only parallel growth of the area. Only one growth pole exists in the entire area, which is the Abaji town. From Abaji town however, development spread towards Kwali extending outwards from the local government leaving other areas in deficit. If this pattern of development continues, it may take incalculable years for development to get to all corners of Abaji L.G.A. The only way out is to create more growth poles by siting facilities like banks and other institutions within the area which will draw development into the area.
5. Owing to distribution of population densities in the area, it is recommended that areas like Yaba and Pandagi should have microfinance banks which would help fund their projects and help development, while Abaji town and Gawu should have commercial banks. This is based on information from respondents that it is difficult for local farmers to receive loans from banks which is the main focus of microfinance banks on the rural-active population as they are made to assist small businesses and farmers with loans at very low interest rates.
6. The transportation routes and degree of connectivity of Abaji L.G.A should be increased to enable accessibility to these bank facilities, not side-tracking the other benefits of transport and connectivity such as generation of revenue, employment, specialization, increased production, opening of new lands, enhancement of trade etc.
7. This study focuses on the use of GIS in decision making, however, other decision support systems exist which aids decision makers to make more informed decisions. Some of the criteria for siting banks are ill-structured or semi-structured, which cannot be analysed using the GIS. The spatial decision support systems can effectively support this class of problem.

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Conflict Of Interest
There is no conflict of interest known to the authors

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