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Accessibility of Market to Agricultural Products in Ido Local Government Area Oyo State.

Adebayo, Afeez A.[1]; Ehisienmhen, Nicholas O.[*1]; Ashiru, Saheed K.[1]; Sedenu, Hafeez A.[1]; Haruna, Rabiu S.[1]; Isa, A[1]; Odediran, Omotayo O.[1]; Adewale, Eunice T.[1]; Amos, Ibrahim.S.[1]; Aribilola, Toba R.[1]; Omisore, Omotoye O.[1]; Afiz, Razak A.[1]

[1]Advanced Space Technology Application Laboratory (ASTAL); National Space Research and Development Agency, Obafemi Awolowo University Ile-Ife, Nigeria.

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Corresponding Author
Ehisienmhen, Nicholas O
E-mail: *unclenick2020@yahoo.com, abiodunafeez200@gmail.com*

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ABSTRACT

This research investigates the distribution of markets and the accessibility of farms to agricultural markets in the Ido Local Government Area of Oyo State, Nigeria. It combines primary and secondary data sources, utilizing GPS coordinates, administrative maps, satellite imagery, and road data to analyze spatial relationships.

The study reveals a clustered distribution of markets, predominantly along major roads, while farmland is concentrated around rural settlements. Proximity to roads plays a vital role in farm accessibility, with closer proximity benefiting transportation efficiency.

The study highlights the importance of road infrastructure in promoting agricultural productivity and recommends road improvements, storage facilities, and the upgrading of minor roads to facilitate efficient farm-to-market transportation. These findings have significant implications for agricultural development and economic growth in the region.

INTRODUCTION

Accessibility of markets to agricultural products is a critical aspect of achieving SDG Goal 2, which is "Zero Hunger." Agriculture plays a significant role in driving Nigeria's socio-economic development, particularly in rural areas where a substantial portion of the population relies on farming for their livelihoods (TE Olagunju, 2015). Ido Local Government Area, situated in Oyo State, South-western Nigeria, stands out for its agricultural potential and serves as a prominent agricultural hub in the region. With its fertile lands, diverse agro-ecological zones, and cultivation of various crops by local farmers, the area holds great promise for agricultural productivity and economic growth (K Adebayo, 2018).

Despite this agricultural potential, farmers in Ido Local Government Area encounter numerous challenges in accessing suitable markets to sell their agricultural products (B Wahab and O Abiodun, 2018). Market accessibility is a critical factor directly influencing agricultural productivity, economic growth, food security, and poverty reduction (B Shiferaw, J Hellin and G Muricho 2011). The lack of well-developed transportation infrastructure, particularly roads, hampers the efficient movement of agricultural goods from production areas to markets, resulting in post-harvest losses, limited market opportunities, and reduced income for farmers (V Kiaya, 2014).

Furthermore, the role of markets in facilitating the exchange of goods and services significantly affects market accessibility (Y Bakos, 1998). As economic mechanisms that determine prices and connect buyers and sellers, markets play a crucial role in the overall functioning of an economy (O Regev, N Nisan, 1998). Over time, the evolution of market demands has transformed certain regions surrounding market centers into central places within their respective areas (B Cohen, 2004). The activities in markets attract people from neighboring regions, making market centers integral to the settlement system (R Burgess, 2002).

In Ido Local Government Area, markets can be classified as rural or urban, with the urban center primarily relying on the rural area to supply its agricultural needs (Ç Keyder, Z Yenal,2011). However, marketing systems are dynamic and continuously evolving, impacting rural development, income generation, and gender issues. To improve market access and address challenges faced by farmers, effective planning of market design and site selection is essential.

Agricultural marketing encompasses various interconnected activities involved in transferring agricultural produce from farms to end consumers (G Mendoza, 1995). It involves production, cultivation, harvesting, grading, packaging, transportation, storage, food processing, and the final sale of agricultural products. Rural assembly markets play a crucial role in connecting farmers with traders, providing a platform for agricultural transactions.

Market centrality, influenced by distance, plays a significant role in consumer behavior, as consumers tend to choose the shortest routes to access goods from the market. The location and accessibility of markets have a direct impact on farmers' ability to reach potential buyers and participate in economic activities (MT Makhura,2002).

Understanding the interlinkages between local markets and farming in Africa and Nigeria is essential, as markets play a pivotal role in the growth and sustainability of the agricultural sector. Despite the dominance of oil in the Nigerian economy, agriculture remains the main source of livelihood for most Nigerians (OO Izuchukwu, 2011). However, smallholder farmers often face challenges accessing inputs, selling their produce, and adding value to their products, hindering their potential for increased yields and incomes.

Improving market access for farmers requires favorable policies, farmer-to-market linkages, and access to timely market information. Organizing farmers and enhancing their knowledge of market engagement are crucial steps towards enhancing food security and economic growth at both family and national levels (S Odini, 2014). This research seeks to address the issues of market accessibility for agricultural products in Ido Local Government Area, providing valuable insights for policymakers and stakeholders to foster sustainable agricultural development and economic prosperity in the region, in line with the United Nations' Sustainable Development Goal 2 - "Zero Hunger". By enhancing market access for agricultural products, this study aims to contribute to eradicating hunger, promoting food security, and improving the livelihoods of farmers in Ido Local Government Area and beyond.

Statement of the problem

SDG number 2, one of the Sustainable Development Goals, focuses on eradicating hunger, ensuring food security, improving nutrition, and promoting sustainable agriculture. In Oyo State, one of the prominent agricultural hubs in southwest Nigeria, farmers encounter significant challenges related to accessing suitable markets to sell their products. The lack of well-developed transportation infrastructure, particularly roads, poses numerous detrimental effects on both food security and the local farmers' economic prospects. Insufficient road access hampers the farmers' ability to transport their goods, resulting in increased vulnerability to theft and other security concerns (V Kelly, AA Adesina, A Gordon - Food Policy, 2003). Additionally, inadequate marketing sites, limited distribution channels, and a lack of proper storage facilities contribute to spoilage of farm products, diminishing farmers' profits and exacerbating food shortages in local communities and urban areas.

Aim

The aim of this study is to enhance the accessibility of agricultural products to markets in Ido Local Government Area, Oyo State.

Objectives

- To identify the distribution of existing market in the study area.
- To access the accessibility of farmers farm lands to the agricultural markets.
- To analyze the market linkage to the farm.

Study Area

Ido Local Government Area is located in Oyo State, Nigeria. It is situated in the southwestern part of the country. The geographic coordinates of Ido Local Government Area are approximately latitude 7.536°N and longitude 3.242°E.

Ido Local Government Area is positioned within the Ibadan metropolis, which is the capital city of Oyo State. It is bordered by other local government areas, including Akinyele to the north, Ibadan North to the west, Ibadan Northeast to the east, and Oluyole to the south.

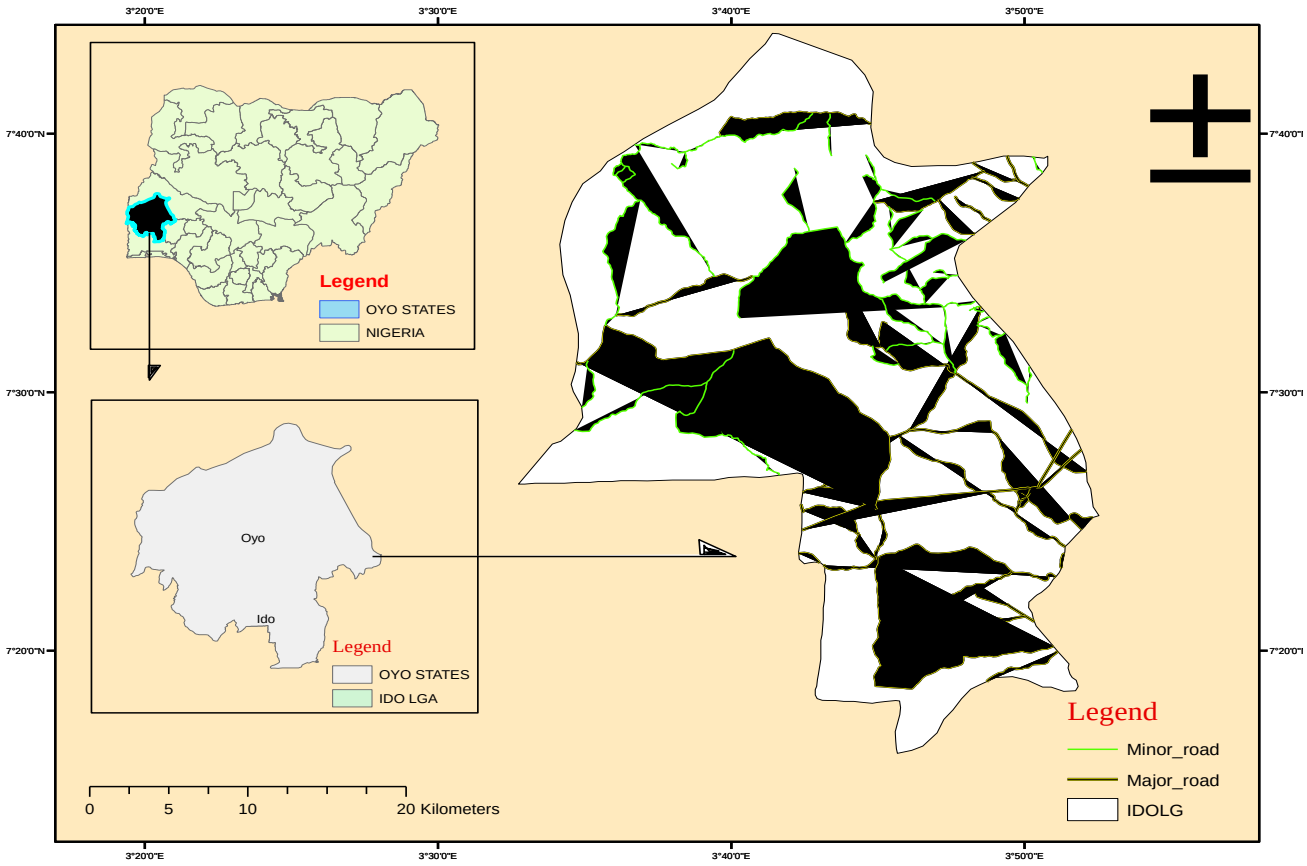

Fig 1a: showing location of the study area.

METHODOLOGY

The section outlines the research design, population of the study, sample size, and the sampling procedure utilized. It also discusses the instrumentation used, including the validity and reliability of the instruments. The process of data collection is described, along with the acquisition of spatial data. Furthermore, the data processing and analysis methods are explained. The flow diagram depicting the sequential steps of the research process is presented below.

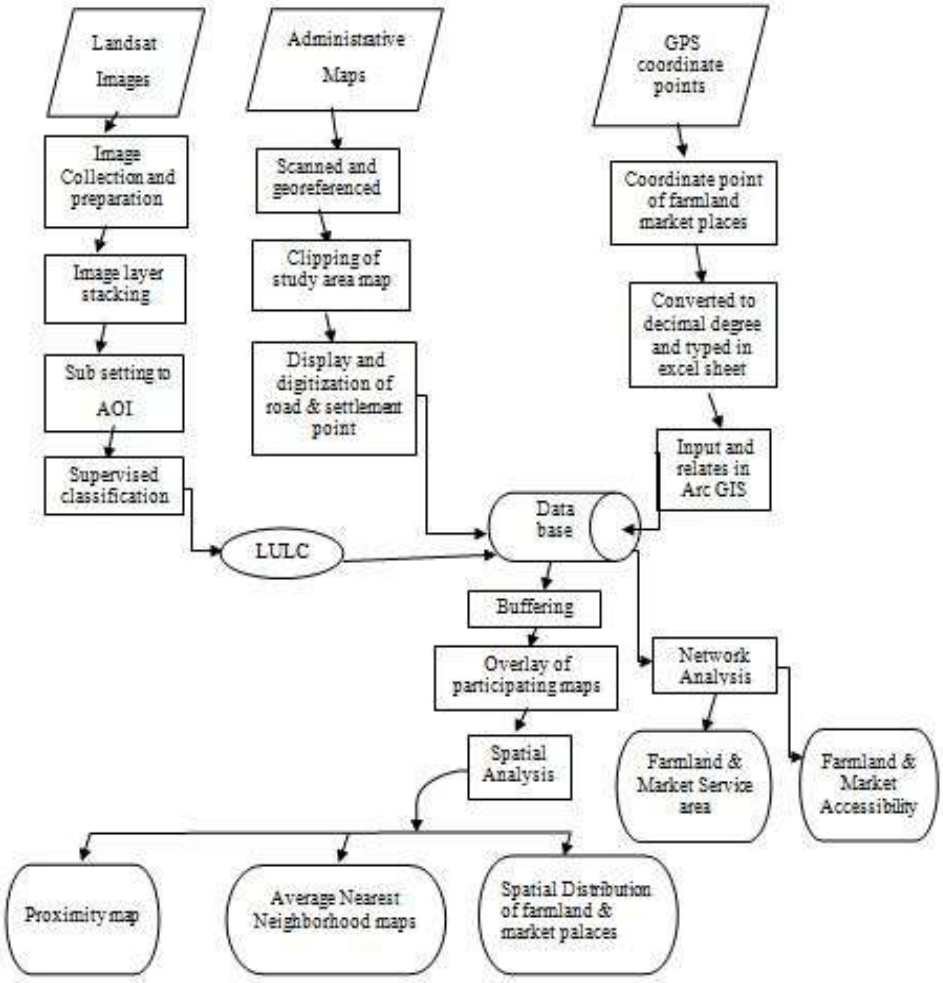

Figure 2: Methodology Flow Diagram

Data Sources and Acquisition

This study employed a combination of primary and secondary data sources. The primary data consisted of GPS coordinate points specifically collected for the markets in the study area. These points were utilized to accurately map and illustrate the locations of the markets. To further enhance the clarity of the area's boundaries, topographic and administrative maps were utilized. These maps, obtained from the Ido Local Government Area Geographic Information Service (NAGIS), were at a scale of 1:250,000. Additionally, Landsat 8 OLI imagery from 2018 was utilized to assess the land use and land cover within the study area.

Table 1: summary of data type & sources

S/N	DATA TYPE	DATA	SOURCE	SCALE/ RESOLUTION	RELEVANCE
1.	GPS Points(market & farm location)	N/A	Field survey	Garmin eTrex 10	Map out and show the distribution of Markets & farmland
2.	Administrative Map	N/A	ADVANCED SPACE TECHNOLOGY APPLICATION LABORATORY (SOUTH-WEST)COPINE	1:250.000	Delineate the boundaries of the study area
3.	Google Earth Imagery	N/A	www.googleearth.com	15m	Extracting road in the study area
4.	Sentinel Satellite Data	15/8/2021	https://scihub.copernicus.eu/dhus	10m	Land use land cover 2021 (to identify farmland & differentiate from vegetation)

The integration of these primary and secondary data sources enabled a comprehensive analysis of the accessibility of agricultural products to markets in the Ido Local Government Area, Oyo State.

a) Primary data

The data collected for this study primarily consist of:

- The locations of markets and farmland were determined by capturing coordinate points using handheld GPS devices.

b) Secondary data

- The study made use of secondary data sources, which included...
- The study obtained road layers by downloading them from Bing Satellite Map.
- The study obtained the boundary shapefile of the study area from ADVANCED SPACE TECHNOLOGY APPLICATION LABORATORY (SOUTH-WEST) COPINE.
- Landsat satellite image was accessed from (http://www.carthexplorer.usgs.gove)

Method of data preparation

During the field survey using the Garmin eTrex 10 device, GPS coordinate points of the market were collected and converted into decimal degrees. These points were then recorded in a Microsoft Excel sheet and integrated within the ArcGIS environment through joining and relating procedures. The Topographic and administrative maps were scanned and georeferenced to the Universal Transverse Mercator (UTM) coordinate system, specifically the WGS-84 ZONE 32N, using on-screen digitization techniques to extract road information. The road layer encompassed attributes such as street name, street type, street length, speed limit, direction, and minute details.

To establish the spatial relationship between the market and the surrounding area, the boundary shapefile of the Local Government Area (LGA) was superimposed onto the coordinate points and road layers. Proximity analysis, utilizing the Proximity analyst tool, was performed to determine the distances between the farmland and the roads leading to the market. Distances of 1km, 5km, and 10km from the roads were measured to assess accessibility. Proximity analysis is a valuable technique for assessing spatial relationships, often employed in business marketing and site selection to analyze demographics and infrastructure for identifying trade areas.

For image classification and interpretation purposes, a false-color composite image was generated by stacking and combining Landsat bands 4, 3, and 2. The study area was clipped using the IDO Local Government Area shapefile to enhance the spectral characteristics and features present in the Landsat 8 OLI imagery. Image interpretation was conducted to identify various land use/land cover categories, including built-up areas, bare surfaces, croplands, grasslands, tree cover areas, and water bodies.

To achieve accurate classification, a training site was established, and an accuracy assessment was performed using ERDAS software. Ground truth data, obtained through field surveys with a GPS receiver, assisted in validating the interpretation of satellite imagery and verifying significant areas and features. The resulting classified image was converted into a vector format and exported to ArcGIS for layout creation. The road layer and market location were overlaid on the land use/land cover map, facilitating spatial and network analysis within the ArcGIS environment for this research.

Method of data analysis

I. Geo-referencing

The process of geo-referencing involves determining the precise spatial location of a phenomenon in physical space by defining its position using map projections or coordinate systems. This term is utilized when establishing the relationship between raster and vector images, as well as coordinates, and when determining the spatial location of other geographical features.

II. Network Analysis

This study utilized the Network Analysis tool, specifically the new service area (drive time analysis) and closest facility tools. The service area is defined as the geographic region that includes all the streets accessible within a specified travel time. In this research, the service area analysis was conducted to assess the extent of market coverage within a predetermined time frame. By employing this analysis, the study aimed to identify areas within the study area that had limited market accessibility within the designated time and geographical boundary. This information was valuable in identifying gaps in market coverage and determining areas that require interventions to enhance accessibility.

III. Analysis of the distribution pattern of the market and farmland

The market and the farmland locations obtained from field surveys were plotted on the district layers to examine their spatial distribution. To analyze the distribution pattern, the nearest neighbor analysis was conducted using the ArcGIS 10.3 Spatial Statistics Tools, specifically the "Analyzing pattern" function.

Using the Average Nearest Neighbor tool, the distances between each market's centroid and the centroids of its nearest neighbors were calculated and averaged to determine the average nearest neighbor distance. By comparing this average distance to what would be expected in a random distribution, the

analysis determined whether the market locations showed clustering or dispersion. The average nearest neighbor ratio was computed by dividing the observed average distance by the expected average distance, which was based on a hypothetical random distribution with the same number of features and total area.

The nearest neighbor analysis is a versatile technique applicable to various types of features, both human and physical, to assess their proximity. The nearest neighbor index, ranging from 0 to 2.58, was used to quantify the spatial dispersion. This index helped identify whether the market and farmland locations exhibited clustering, randomness, or a regular pattern.

Table 2: nearest neighbor analysis, rating scale (0 to 2.58)

S/N	Rating value	Interpretation from the chart symbol	Interpretation
1	± 0	±0<1	Clustered feature
2	1.0	=1	Random feature
3	2.58	1>2.58	Regular feature

The formula for nearest neighbor can be expressed as follows:

- For each market and farmland, calculate the straight-line distance to its nearest neighbor.
- Sum up all the distances calculated in step 1.
- Divide the sum by the total number of market and farmland to find the mean distance of features

Rn-2dVn/a Where:

Rn is the nearest neighbor value.
d is the mean distance of nearest neighbor in kilometers.
n is the total number of features to be studied.
a is area of study in kilometer square

The z-score typically falls within the range of -2.58 to 2.58. A negative z-score below -2.58 suggests a significant clustering with a 0.01 probability level. Conversely, a positive z-score above 2.58 indicates significant regularity or dispersal with a 0.01 probability level, as described by (Getis and Ord in 1998).

Table 3: nearest neighbor analysis, rating scale (0 to 2.58) and Z-score

S/N	Rating value	Interpretation from the chart symbol	interpretation
1	-0	A negative Z-score	clustering
2	0	A positive Z-score	Disperse or Evenness
3	-2.58	A negative Z-score less than -2.58	Significant clustering
4	2.58	A positive Z-score less than -2.58	Significant regularity or Disperse

IV. Proximity analysis

Proximity analysis is a method used to assess the spatial relationships between features by measuring the distances between them and other neighboring features. One commonly employed technique in proximity analysis is buffer analysis, which helps identify areas surrounding geographic features. This involves creating a buffer zone around existing features and determining which features fall within or outside the buffer boundary. By utilizing such tools, one can identify the nearest neighboring features, calculate distances within and between them, monitor events in specific areas, determine the service area of a facility, or identify features impacted by a particular activity.

RESULT AND DISCUSSION

This section presents and discusses the findings of the study in relation to its main objective, which was to analyze the distribution of market locations and assess the accessibility of farms and farmers to agricultural markets based on land use and road infrastructure. To achieve this, a supervised classification method was employed to identify and classify four land use land cover classes in the study area. These classes include farmland, water body, settlement, and vegetation. The analysis and discussion in this chapter revolve around these aspects, shedding light on the spatial patterns of market distribution and the impact of land use and road infrastructure on agricultural market accessibility for farms and farmers.

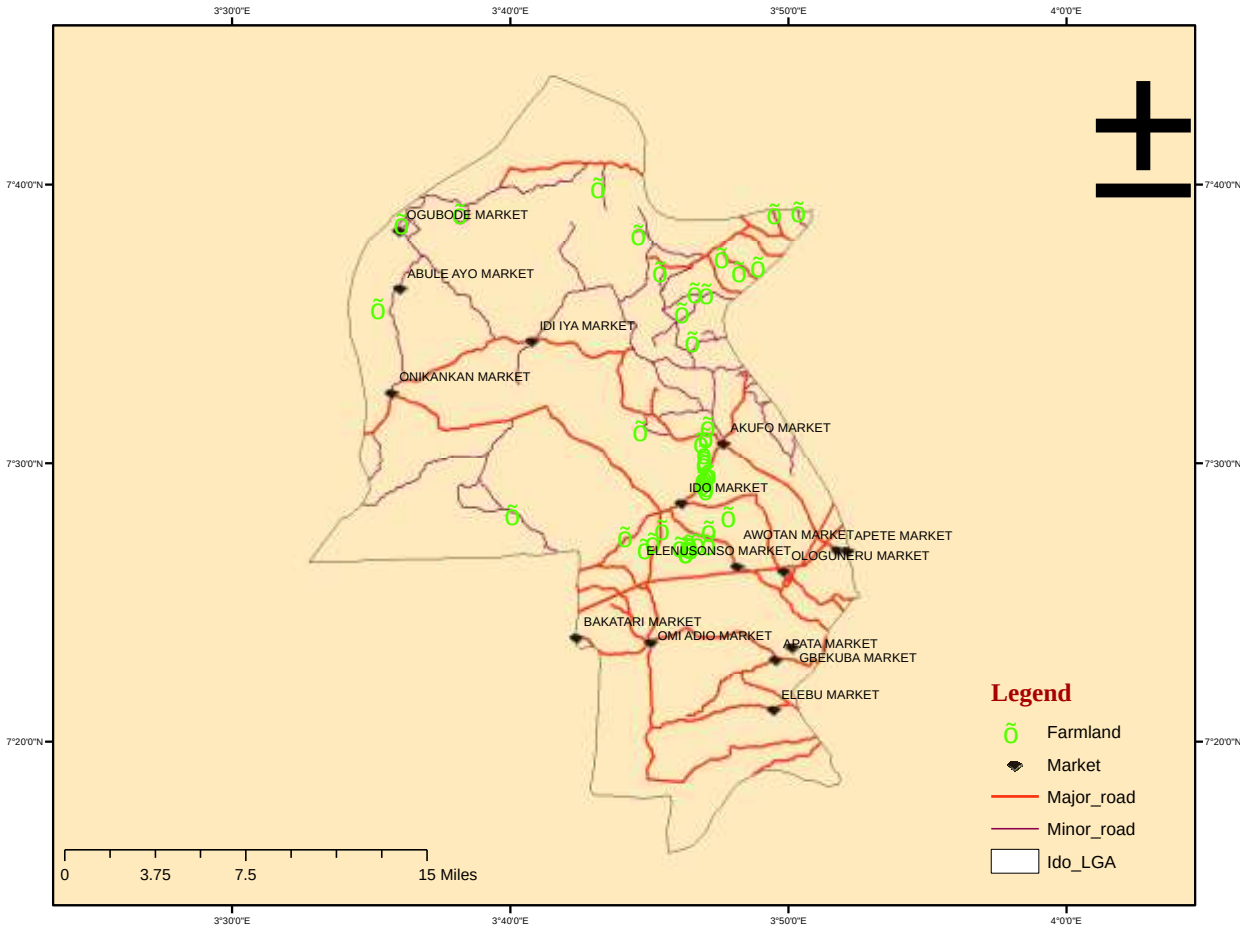

Figure 3: showing farmland, market, major & minor road.

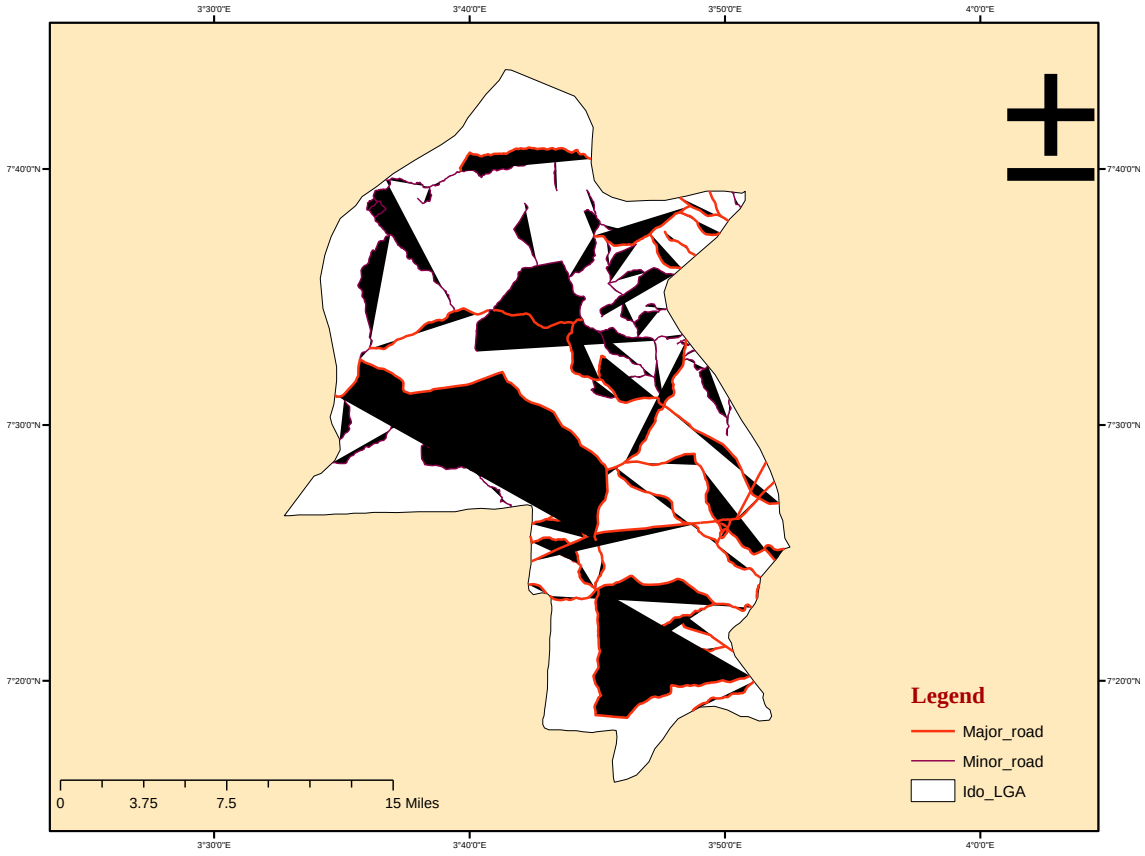

Figure 4: showing major & minor road

The process of extracting the road network is being described

The findings from the on-screen digitization of roads in the study area revealed a total of 821 road segments with a combined length of 278.69 km. This is due to the digitization process stopping and continuing at each junction. The extracted road segments consisted of 191 paved segments and 630 unpaved segments. These road segments were categorized into three major classes: major road segments (15 segments) with a total length of 75.58 km, minor road segments (258 segments) totalling 92.31 km, and unpaved road segments (372 segments) covering a total distance of 110.8 km (as shown in Figure 4).

The results obtained from the network dataset analysis indicated the presence of 902 junctions and 1804 edges. The connectivity of the road network, as calculated by the network analysis, was determined to be 1. A value of 1 for connectivity implies that the entire study area is well connected in terms of road infrastructure.

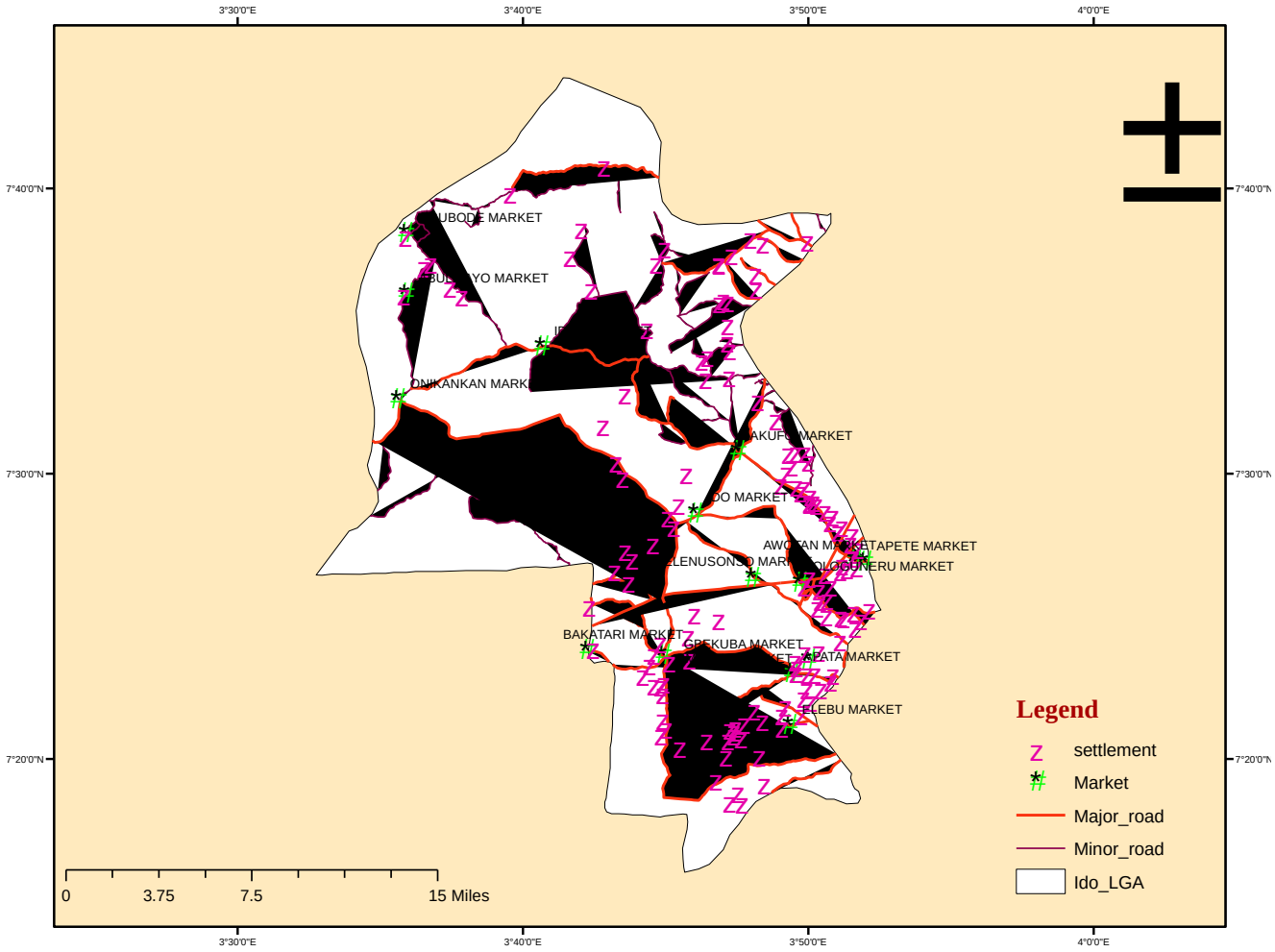

Figure 5: showing settlement, market & road network.

The location of markets is influenced by the size and distribution of the population

The location of markets in Ido Local Government, Nigeria, is influenced by several factors including population, urbanization, proximity to roads, and levels of industrialization and agricultural productivity. Figure 5 depicts the market locations, highlighting a distinct pattern wherein the majority of the markets are situated in the southern part of the study area. Additionally, a few markets can be found in the central region, particularly in areas that exhibit relatively higher levels of urbanization. Notably, there is a noticeable scarcity of markets in the northern part of the study area.

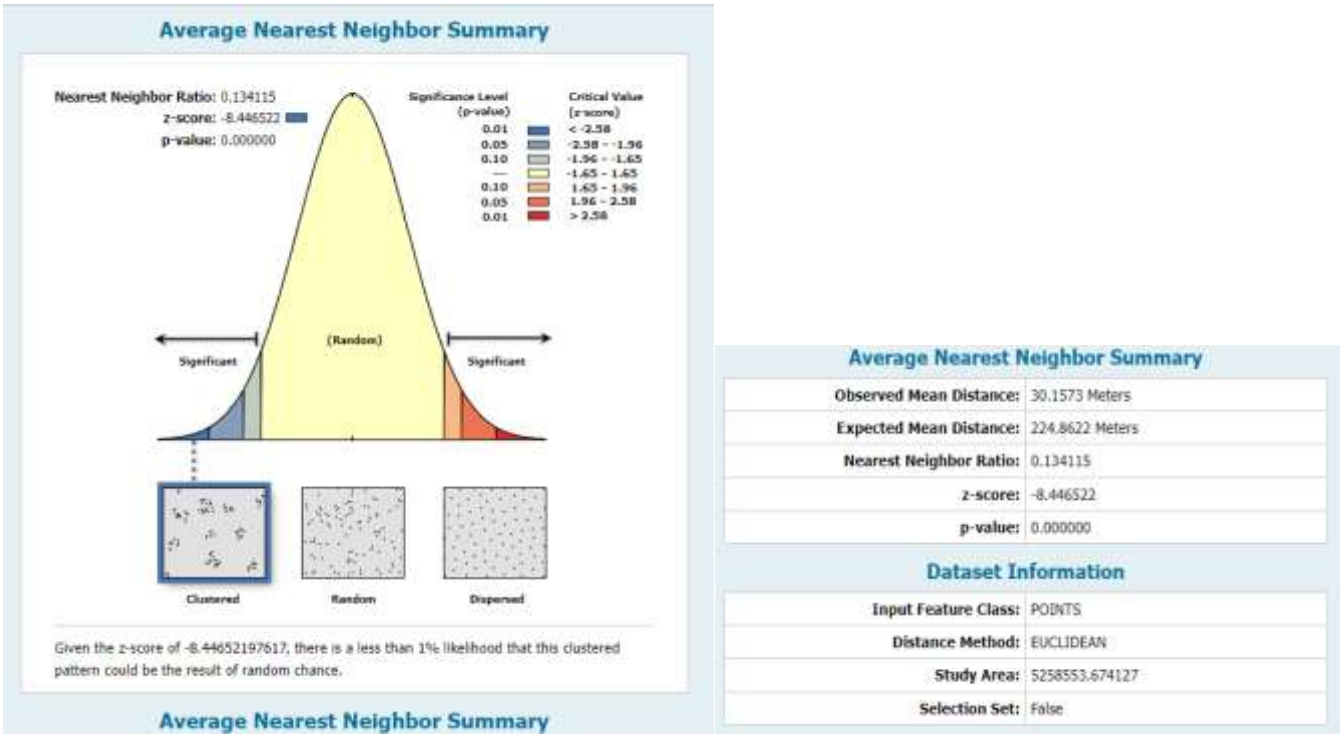

Figure 6: showing the spatial distribution of market analysis.

Spatial distribution of market

The markets in the study area demonstrate a discernible spatial distribution pattern, indicating that their locations are influenced by various factors. The Average Nearest Neighbor (ANN) technique was employed to analyze this distribution pattern. The results reveal that the distribution of markets in the study area follows a clustered pattern, meaning that they are not randomly dispersed. Figure 6 supports this finding, as it illustrates a concentration of markets along the roads. Specifically, there are 13 markets situated along major roads and 2 markets along minor roads. These markets along major roads serve not only the local residents but also offer accessibility to travelers from other areas, including interstate or inter-LGA travelers. Consequently, markets located along roads are easily reachable by individuals from different locations, in contrast to those located in the interior regions that face challenges in terms of limited access due to poor road conditions.

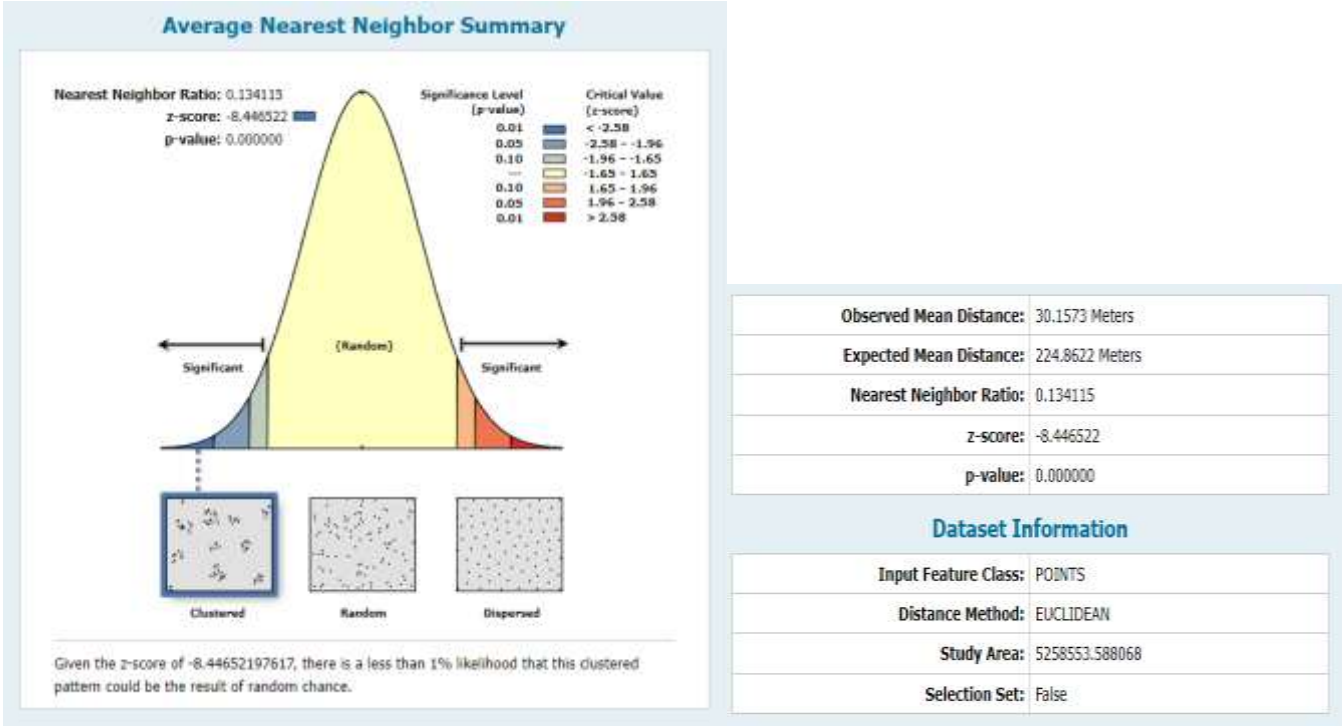

Figure 7 showing the spatial distribution of farmland analysis.

Spatial distribution of farmland

The distribution of farmland in the study area exhibits a distinct spatial pattern, indicating that various factors influence its location. The Average Nearest Neighbor (ANN) technique was employed to analyze this distribution. The results demonstrate that farmland in the study area tends to cluster rather than being randomly dispersed. This observation is supported by Figure 7, which depicts a concentration of farmland surrounding rural settlements. More specifically, a significant portion of farmland is situated in the rural region, maintaining a moderate distance from major roads. In contrast, there are relatively fewer farmland areas located at a considerable distance from both major and minor roads, albeit the condition of these roads might pose challenges to motorists, particularly during the rainy season. The farmland areas along major and minor roads not only serve the local population but also provide accessibility to travelers from other regions, including those traveling between different regions or local government areas (LGA). Consequently, farmland located in the rural area is less readily accessible to individuals from diverse locations compared to those in interior regions. However, the farmland in interior regions faces limitations in terms of access due to poor road conditions, particularly during unfavorable weather conditions such as heavy rainfall. Figure 4.6 showing the land use land cover (LULC) classes of the study area.

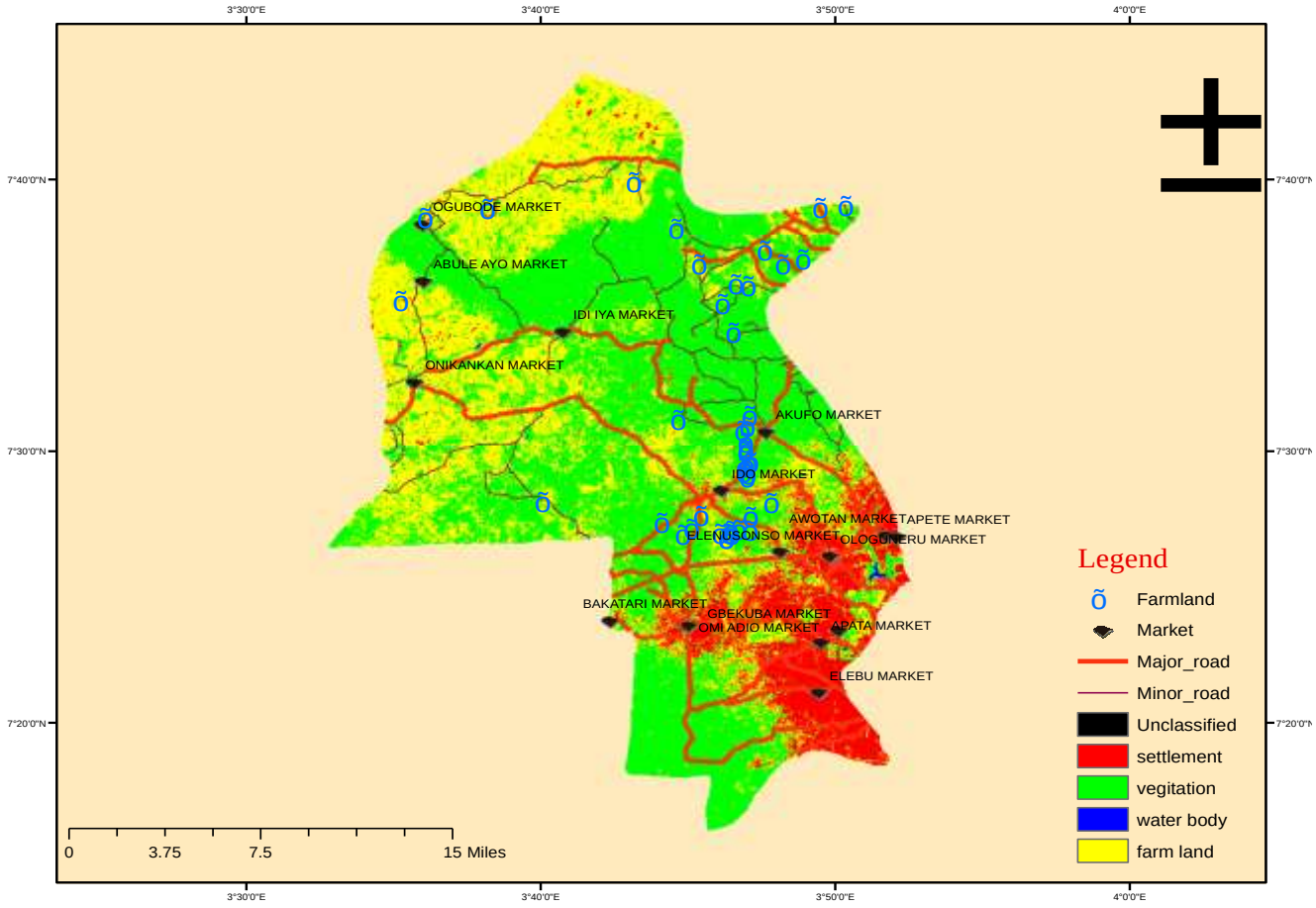

Figure 8 showing LULC with roads, market & farmland classes in the study area

Analysis of LULC of Ido Local Government Area.

Figure 8 illustrates the extent of Land Use Land Cover (LULC) in Ido Local Government Area. The predominant LULC category is farmland, covering an area of 348.143 km², which represents 35.46% of the total area. Settlement areas account for 115.894 km², equivalent to 11.81% of the area. Water bodies make up a small portion of 0.9846 km², representing 0.10%. Vegetation covers the largest area of 516.775 km², making up 52.64% of the total area. Table 4 presents the overall accuracy assessment of the classified images for the study area, indicating that the results achieved an accuracy of over 88%. This suggests that the image analysis conducted was successful, as stated by Herold, Clarke, and Scepan (2005).

Table 4: showing the summary of LULC classes.

Classes	Area (H)	Area (sqkm)	Area (%)	Classes
Farmland	34814.3	348.143	35.45979	Farmland
settlement	11589.4	115.894	11.80428	settlement
Vegetation	51677.5	516.775	52.63565	Vegetation
Water body	98.46	0.9846	0.100286	Water body
Total	98179.66	981.7966	100	Total

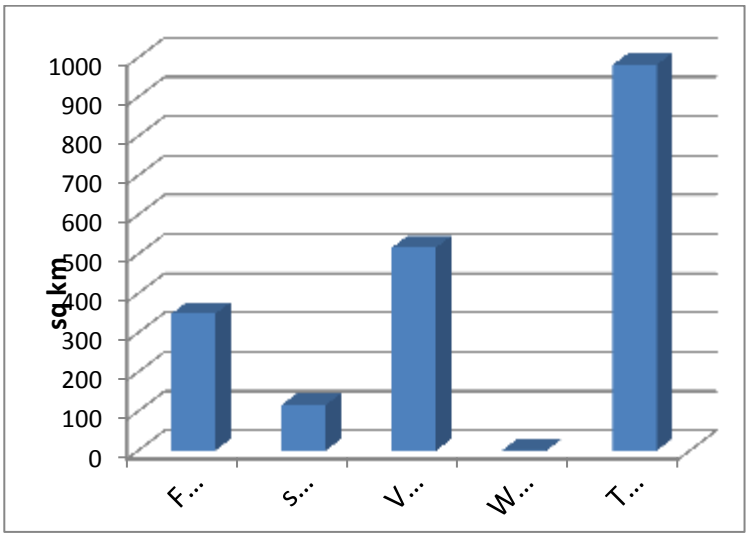

Figure 9: showing bar chart representation of LULC classification.

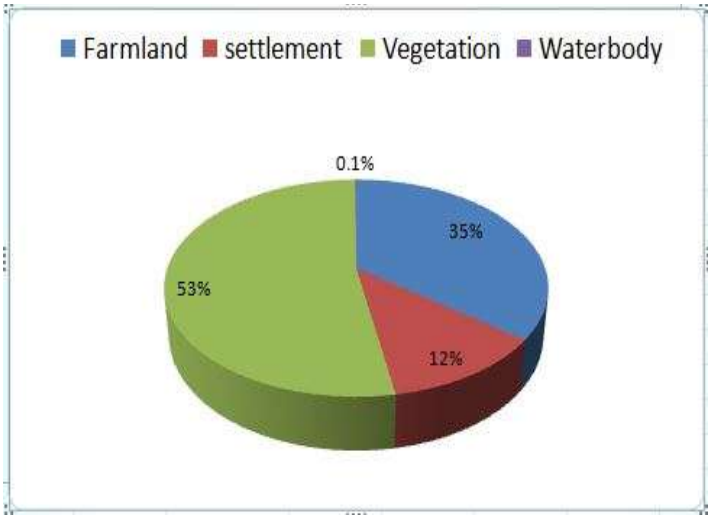

Figure 10: chart showing LULC classification.

Table 4: showing the Classification accuracy assessment report.

S/N	Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
1	Unclassified	27	28	27	----	---
2	settlement	1	1	1	100.00%	100.00%
3	vegetation	14	14	13	92.86%	92.86%
4	water body	0	0	0	----	----
5	farm land	8	7	6	75.00%	87.71%
Overall Classification Accuracy = 94.00%						
Overall Kappa Statistics = 0.8994						

Farmland / Market Service area

The service area of a facility refers to the accessible area for people within the facility's perimeter. It determines the efficiency of the facility and its ability to serve the local community without causing inconvenience. The proximity of farms to markets plays a crucial role in supporting the local economy and the income of farmers. By analyzing the distances and travel times, it was found that certain farms are located within 0-2 square kilometers of the market and can reach it within a 6-minute drive, assuming no obstacles such as bad roads. Additionally, there are farms situated within 2-4 square kilometers, requiring approximately 12 minutes of driving time to reach the market. Moreover, some farms fall within 4-6 square kilometers from the market, with an estimated travel time of 18 minutes, while others are within 6-8 square kilometers and require a 24-minute drive.

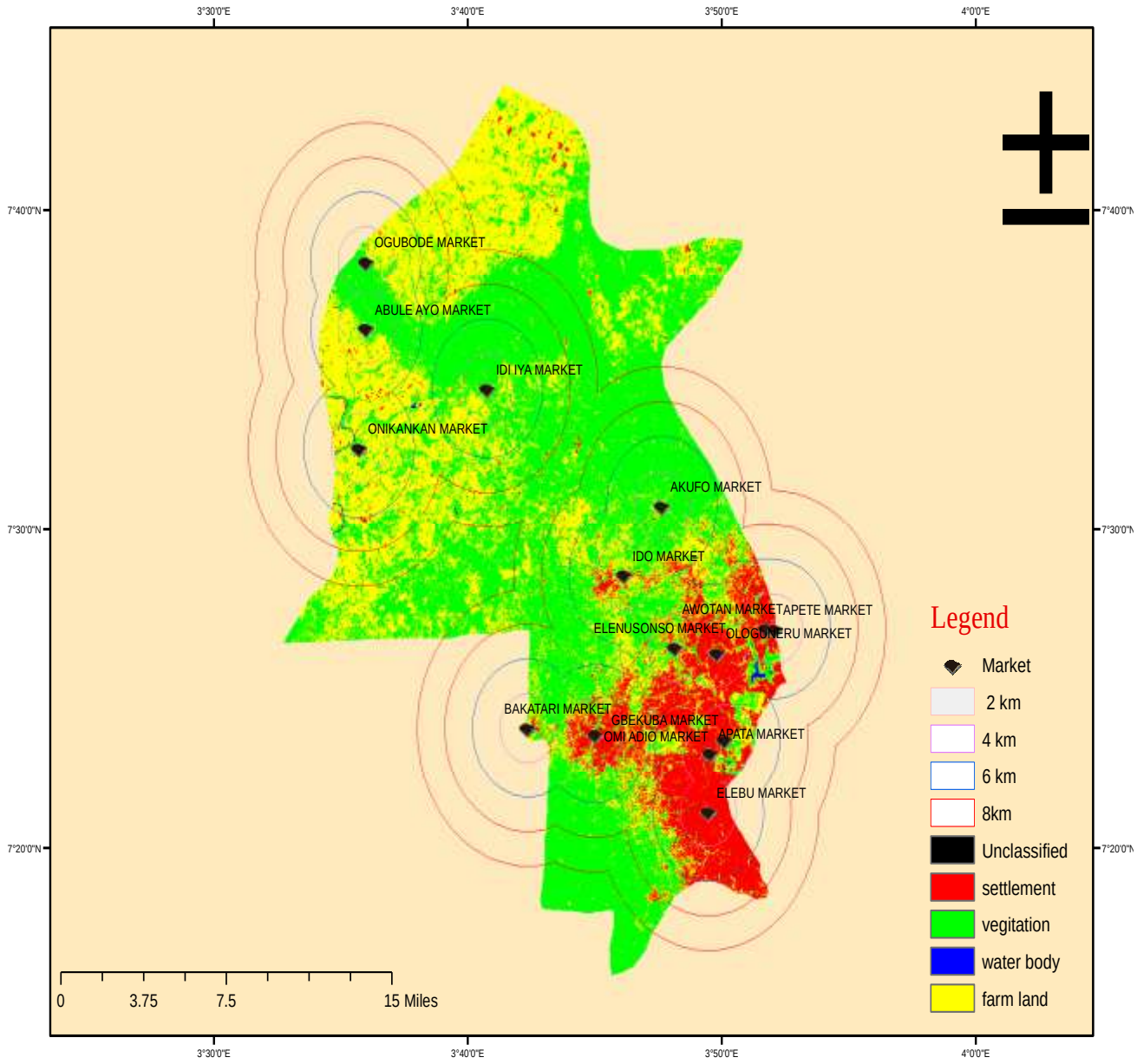

Figure 11: showing service areas of the market

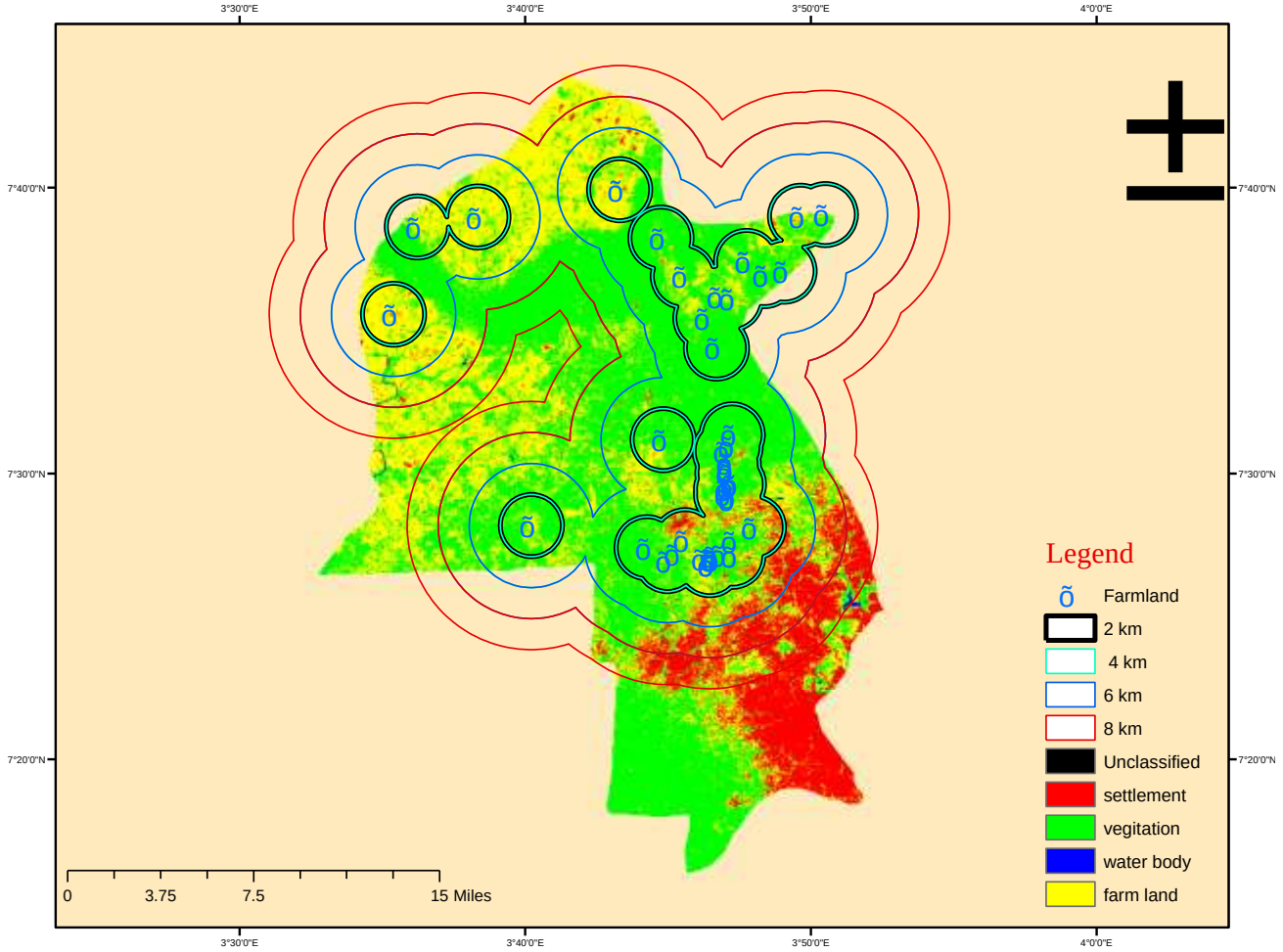

Figure 12: showing service areas of the farmland.

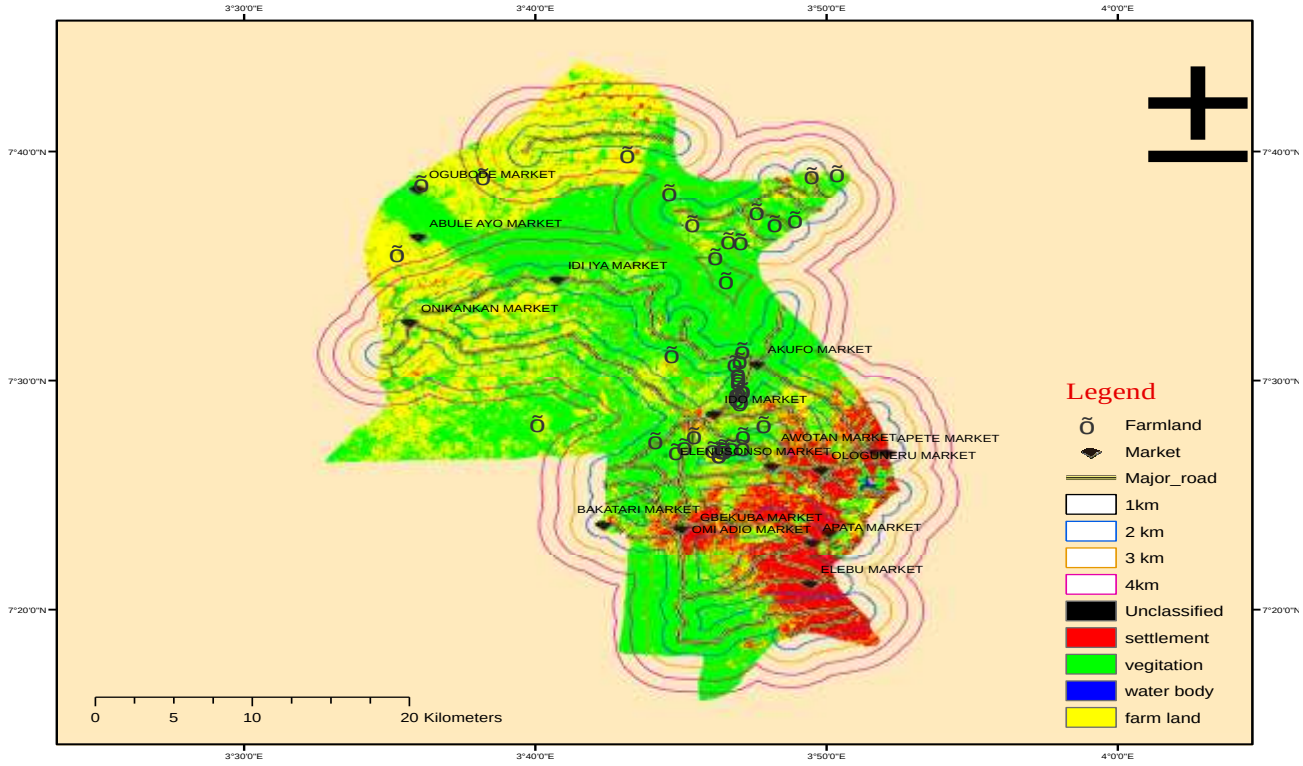

Figure 13: showing the proximity of the farmland & market to major road in kilometers.

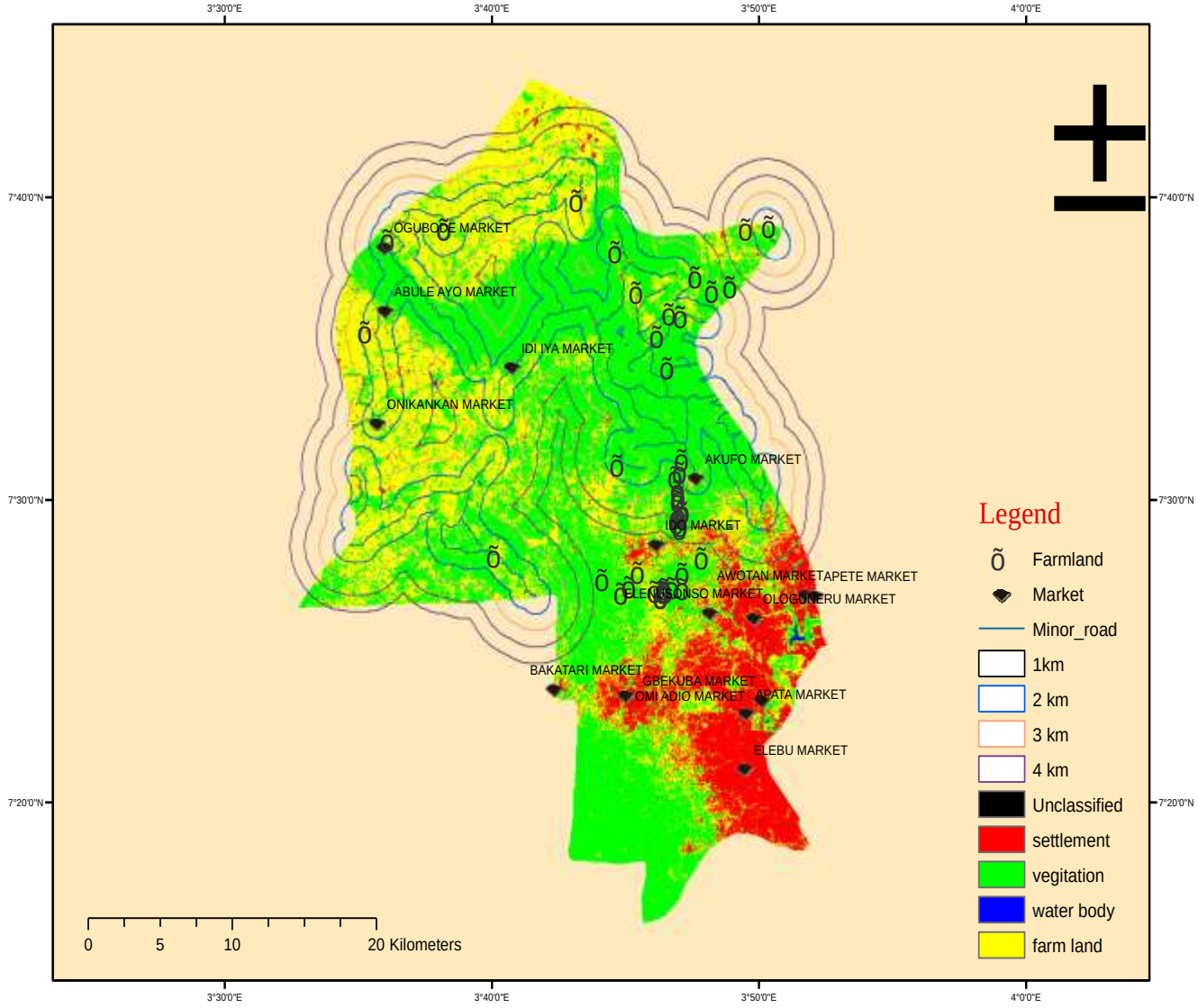

Figure 14: showing the proximity of the farmland & market to minor road in kilometers.

Proximity to road

Roads are the primary mode of transportation in Nigeria, and their quality is crucial for the efficient movement of goods, products, and people. For farmers, roads are vital in transporting their agricultural produce from rural areas to urban markets. Additionally, roads serve as the primary means of connecting individuals to different regions of the country. Figure 13 and 14 emphasize the significance of having farms located near roads for farmers. When farms are in close proximity to roads, farmers can easily and conveniently transport their products to the market, unlike those situated in remote areas with limited road access. In the study area, certain farmers have limited choices and must rely on minor roads that are close to their farms. Although these minor roads may not be major highways, they act as connectors between the farms and the main road network. Farms located at various distances, such as 1km, 2km, 3km, and beyond, can access these minor roads, enabling them to reach the main road (highway) and utilize it for transportation purposes.

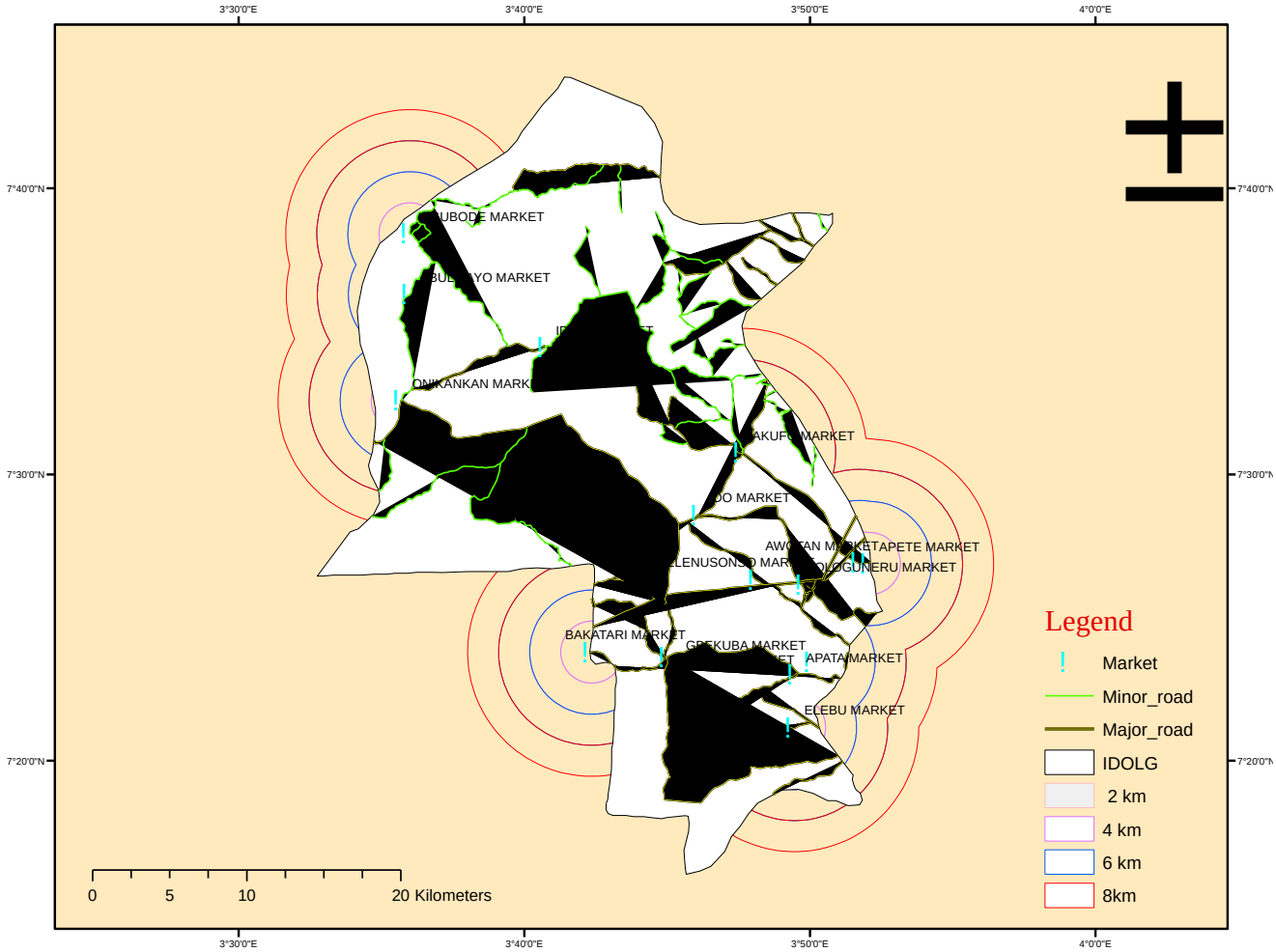

Figure 15: showing the market Accessibility index.

Market Accessibility index

Figure 15 provides a visual representation of the market access index in Ido Local Government. The index indicates the level of market influence in different areas, with the highest influence observed near large urban areas. As the population density decreases, the market influence diminishes until it reaches zero in areas with minimal or no human settlements. In particular, the market access index approaches 1.0 in significant villages and towns, especially in the urban parts of the local government where the population is larger. These areas enjoy easy accessibility to markets, allowing the residents to benefit from convenient access to goods and services.

Conversely, the market index is relatively low in certain areas, particularly in the northeastern part of the study area. This indicates that farmers residing in these areas would have to travel longer distances and incur higher costs to reach any of the markets within the study area.

CONCLUSION

The study conducted in Ido Local Government has revealed a clustered distribution of markets and farmland, with the market locations following the urban settlement pattern and the farmland aligning with rural settlements. On average, the markets are spaced approximately 2 to 8 kilometers apart, while the farmland is spaced approximately 2 to 6 kilometers apart. It is worth noting that over 65% of the markets are situated along major roads or highways, with roadside locations also being preferred. However, a larger portion of the farmland is located far away from major roads.

These findings emphasize the importance of accessibility as a crucial factor in determining market locations. They are in line with the perspective put forth by White and Gleave (1978), which suggests that markets can be established in various settings, including bush areas, pathway junctions, hamlets, villages, roadside areas, as well as towns and cities.

Furthermore, the study highlights the critical role of proximity to roads for farmers in efficiently transporting their agricultural produce from the farm to the market. Farms that are situated near roads benefit from easier access to transportation, enabling them to deliver their products to the market more effectively. Conversely, farms located far away or lacking proper road infrastructure face challenges in transporting their agricultural goods, which can lead to product

spoilage and discourage farmers from actively participating in agricultural activities.

Recommendation

The improvement of access roads in the study area would have significant positive effects on agricultural production, business opportunities, and the overall economic growth of the country. The study area is blessed with fertile lands that can be effectively utilized by farmers to increase food production and stimulate economic development. By linking roads in areas like Akufo, Kusela, and other regions within the Ido Local Government area to major highways, the abundant arable land in these localities could be fully utilized for cultivating crops such as maize, beans, yam, cassava, and pepper. These agricultural products can be preserved and transported to various parts of the country, expanding their market reach.

To support agricultural activities and prevent spoilage of perishable goods, it would be beneficial for the government to consider establishing cold room depots along major roads or strategically near farmland. These facilities would allow farmers and marketers to store perishable goods, reducing wastage and losses.

There is an urgent need to upgrade certain minor roads to major roads and construct unpaved roads that connect to the minor ones. This would facilitate the efficient movement of agricultural produce from farms to consumers by providing accessible transportation routes. Currently, many of the roads used by farmers are poorly developed, posing challenges to the transportation of agricultural goods. Enhancing the road network would also contribute to the establishment of a reliable farm transport system, catering to the requirements of long-distance agricultural production. Presently, farm products in the study area primarily rely on manual labor, motorbikes, or trucks for transportation.

In conclusion, the enhancement of road infrastructure in the study area would not only positively impact agricultural production and create business opportunities but also improve the overall efficiency of the farm-to-market transportation system.

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