Journal of Geoscience and Environment Protection, 2025, 13(1), 475-494
https://www.scirp.org/journal/gep
ISSN Online: 2327-4344
ISSN Print: 2327-4336

Simulation of Urban Mobility between Azove and Aplahoue Using a Geographic Information System

Apollinaire Cyriaque Agbon[1,2]

[1]Department of Geography and Regional Planning, CU-Adjarra, FASHS, University of Abomey-Calavi, Abomey-Calavi, Benin
[2]Geomatics Applications and Environmental Management Laboratory (LA2GE), CU-Adjarra, FASHS, University of Abomey-Calavi, Abomey-Calavi, Benin
Email: cyrtou_74@yahoo.fr

How to cite this paper: Agbon, A. C. (2025). Simulation of Urban Mobility between Azove and Aplahoue Using a Geographic Information System. *Journal of Geoscience and Environment Protection, 13,* 475-494.
https://doi.org/10.4236/gep.2025.131024

Received: December 6, 2024
Accepted: January 28, 2025
Published: January 31, 2025

Abstract

People, goods and services' mobility is increasing in the cities of Azovè and Aplahoué. This research aims at simulating urban mobility between these two cities using the Geographic Information System. The data was collected through individual interviews with 115 people using a questionnaire. GPS was then used to collect the geographical coordinates of existing infrastructure in the two cities. The roads were identified, categorized and mapped using the data available on the IGN's 1:50,000 Aplahoué topographic sheet. By calculating the frequencies of the responses, we were able to identify the most frequently used roads, factors and purposes of mobility. These frequencies and the coordinates collected were used to categorize the roads and map them using the *Graduted symbols* tool in *Quantities* under ArcGis 10.7 software. Population growth, the extension of urban areas, the increase in commercial and service infrastructures, the rehabilitation of certain roads and the transport of farming products, goods and people associated with the Tohoun border between Benin and Togo are the factors driving urban mobility. This research has shown the infrastructures responsible for this mobility and the spatial structuring of these cities. It has also shown the main current and future routes for urban mobility as well as the traffic development hubs.

Keywords

Forecast, Mapping, Mobility, Trunk Road, Aplahoué-Azovè

1. Introduction

The highly polarizing nature of demographic growth and spatial flows has led to

significant mobility within the world's major cities. This mobility is multidimensional, affecting many sectors, with direct and indirect impacts on space, city dwellers themselves, urban and economic activities (Bennouna et al., 2020: p. 5). The issue of urban mobility is increasingly becoming a major concern and is determined by the degree of accessibility of city populations to transport, commercial and socio-community infrastructures (United Nations, 2015: p. 2). In West Africa, the processes of accelerated urbanization, which began in the early 1960s, have continued to grow over time, leading to a vast restructuring of both rural and urban areas (El Amraoui et al., 2017: p. 3). This phenomenon of urbanization is developing throughout the sub-region and is generating new problems in terms of land management and the equal distribution of socio-community infrastructure and services. Many people, not only will be living and working in cities, but more and more people and goods will be moving from urban areas over longer distances (Coundoul et al., 2022: p. 37). More and more of this mobility will be from production areas to processing areas, i.e. from rural areas to city centers. Urban mobility enables city dwellers to access the vast range of agricultural products, equipment, services and jobs throughout the urban agglomeration; this is increasingly generating profound upheavals in terms of urban responsiveness, requiring new approaches to urban planning and management. This planning must be based on rigorous methods such as cartography and Geographic Information Systems (GIS), which present the results in the form of dynamic databases that can be modified at any time and legible maps that are much easier for everyone to understand so that concrete and reliable decisions can be taken in time and space.

Benin, like most countries in the sub-region, is faced with galloping population growth without demographic and spatial planning. For example, the country's urbanization rate rose from 35.7% in 1992 to 38.9% in 2002, before reaching 44.6% in 2013. Benin's main cities are expanding rapidly in spatial terms, with rapid growth in the number of people moving around and expanding their usual living environment. Road infrastructure has also contributed to this growth and expansion. These cities, which have experienced great mobility due to population growth, agricultural production and the renovation of road infrastructure, are above all the crossroads cities, namely Djougou, Parakou, Bohicon, Aplahoué and Azovè, from north to south. The last two cities open onto another country, Togo, in the south-west of Benin, and link several of the country's communes, such as Abomey, Bohicon, Lokossa and Cotonou. These two very dynamic cities, like other cities in Benin, are experiencing strong demographic growth, leading to very dynamic urban mobility and a very advanced urbanization process (NISEA, 2005: p. 16) linked to the installation of socio-community, road and commercial infrastructures. Because of their geographical position, Aplahoué and Azovè represent a crossroads for migratory flows from the Republic of Togo in the west, the Department of Zou in the north and the Department of Mono in the south, and for agricultural produce from the rural areas of the commune of Aplahoué in

the east (Foly et al., 2021: p. 575). This enables them to be a real economic and social space for supplying the other communes. As a result of the socio-economic issues in the area and since the renovation of the road infrastructure, the farming populations and traders who frequent these two cities have become very dynamic in marketing agricultural produce to other urban centers. These observations raise the question of whether the infrastructure currently available will continue to meet the needs of this growing mobility. To answer this question, we need to use GIS and cartography to simulate urban mobility between these two cities between 2024 and 2034. The aim is to simulate urban mobility between Aplahoué and Azovè using GIS.

2. Data and Methods

The methodology involved the research environment, data collection techniques and data processing before arriving at the various results.

2.1. Study Environment

Located to the south-east in the commune of Aplahoué in the Department of Couffo, the Azovè-Aplahoué urban doublet is situated between 6˚55'34" and 7˚00'36" north latitude and between 1˚37'30" and 1˚45'00" east longitude (Figure 1).

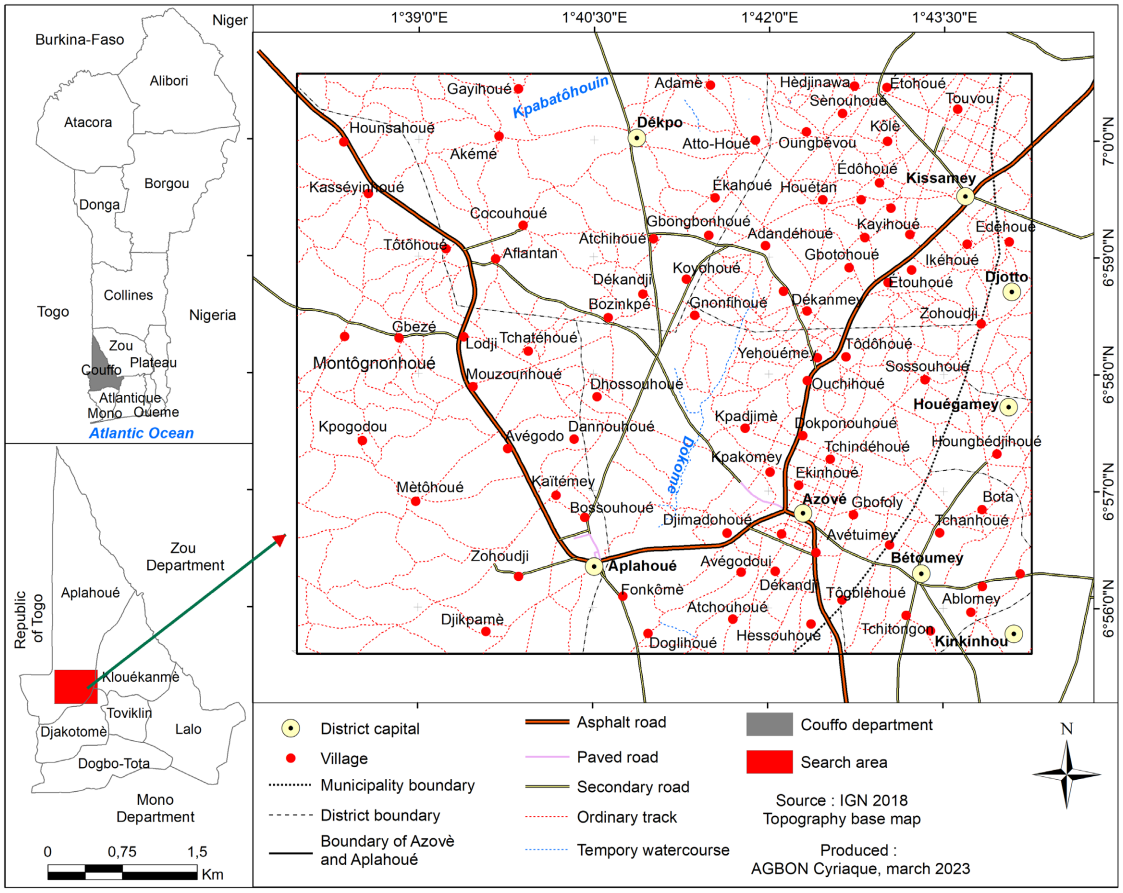

Figure 1. Geographical and administrative location of Aplahoué and Azovè.

According to Figure 1, the two cities border the Republic of Togo to the west and link several communes in the Couffo and Zou departments. This geographical position is the main factor in the mobility of people, goods and services.

2.2. Data Collection Techniques

Two data collection techniques were used: the acquisition of planimetric, demographic and geographical data and the collection of data in the field using a questionnaire.

2.2.1. Acquisition of Planimetric Data

Two (02) satellite images were used for cartographic production in order to analyze the spatial dynamics of the two cities. These were Landsat TM images (15 m resolution) from 2005 and Oli-Tirs images (10 m spatial resolution) from 2023, downloaded from the earthexplorer.usgs.gov website in Geo Tiff format. These images were used to produce land-use maps and to analyze the spatial dynamics of the cities of Azovè and Aplahoué. Vector data (shapefile) of the road network, hydrographic network, localities and administrative boundaries of the city were extracted from the 2018 National Geographic Institute database and superimposed on the land use data of the cities over the two periods (2005 and 2023).

2.2.2. Field Surveys

The field surveys were carried out in two steps: mapping and interviews with the population on the basis of the questionnaire.

- Collecting map coordinates

The map coordinates of the socio-community infrastructures and associated information such as the date of installation and the type of infrastructure were taken using the Locus Map application. The Locus map application is accurate to within 1 meter. It is therefore suitable for collecting information for this study and for mapping the Aplahoué-Azovè geographical area. The coordinates were collected over a period of three (03) days (09 to 11 February 2024) and consisted of moving from district to district in order to record all the infrastructure likely to contribute to urban mobility in the area. In addition to the coordinates of the infrastructures, those of the nodal points of the migratory flows (origins and destinations) as well as the circuits of displacement were taken. The quantities of products were also estimated by site and by trunk road.

- Questionnaire interviews

Once the map coordinates of the infrastructures had been taken, individual interviews were conducted with people from several resident socio-professional categories (traders, transporters, farmers and road infrastructure managers). Survey sheets were used to guide the interviews. The sample size was determined using the formula, which is expressed as follows: n = N x 400/N + 400; where n = Size of the sample. where n = sample size; N = total number of households in the city of Azovè. n = 9920 × 400/9920 + 400

n = 384.49; a rate of 30% was applied, so n = 384.49 × 0.3 = 115.34 i.e. 115

people.

In total, 115 people were interviewed. These 115 people were selected using the reasoned choice survey technique. This technique makes it possible to identify people who are likely to answer the questions correctly. The data collected at this level concerned urban mobility factors, migratory and commercial flows, mobility problems and the perception of the stakeholders interviewed about urban mobility.

2.2.3. Processing Cartographic Data and Simulating Urban Mobility

The data from the survey forms on the determining factors of urban mobility and its effects on urban dynamics were analyzed and coded to form a database. Using Excel 2019, this database was used to calculate the frequencies of respondents' answers and produce graphs with their comments.

The data from the Geographic Information System (GIS) was processed in several stages: the production of maps of land use and its changes between 2005 and 2023, the dynamics of socio-community infrastructure in the two cities (Aplahoué and Azovè), migration and trade flows, and population dynamics. For the production of land use maps to analyze urban dynamics, the cartographic processing method used is on-screen digitization. A digital interpretation of the 2005 and 2023 images was carried out, which enabled the attribute table for each year and the transition matrix to be brought out. The cartographic coordinates of the socio-community infrastructures were downloaded onto the computer and used to create a database containing the names, installation dates and categories of the infrastructures over the two periods (2005 and 2022). This data was used to produce a map showing the distribution and dynamics of these infrastructures. Data on the population of the city's 41 neighborhoods between 2005 and 2021 obtained from the INStaD was inserted into the attribute table for city locations to produce the population density. Categorization was carried out using the *Graduted symbols* tool in *Quantities* under ArcGis 10.7 software. Data on incoming and outgoing products, their destination and the various migrations observed, together with their level of importance, were inserted into the attribute table and were also used to produce maps of migratory and commercial flows. A cross-reference was made between the spatial dynamics of the city and its infrastructures and demographics. The dynamics were also simulated by cross-referencing the map of the dynamics of flows along current routes and the mapping of the road network currently available by 2040. Roads were categorized as follows: asphalted main road, asphalted secondary road, unpaved secondary road, paved and unpaved tracks, etc. These various technical operations were carried out using GIS on ArcGIS 10.7 software.

3. Results

The factors of urban mobility as well as its manifestations and simulation have been developed in this section.

3.1. Urban Mobility Factors

The factors of urban mobility concerned the dynamics of land use units, infra-

structures and demographic growth.

3.1.1. Dynamics of Land-Use Units in the Cities of Aplahoué and Azovè

The results of the interpretation made it possible to distinguish 08 land-use classes, namely: tree and shrub savannah, forest and swamp savannah, forest and fruit plantation, crop and fallow, crop and fallow under oil palm and agglomeration (Figure 2).

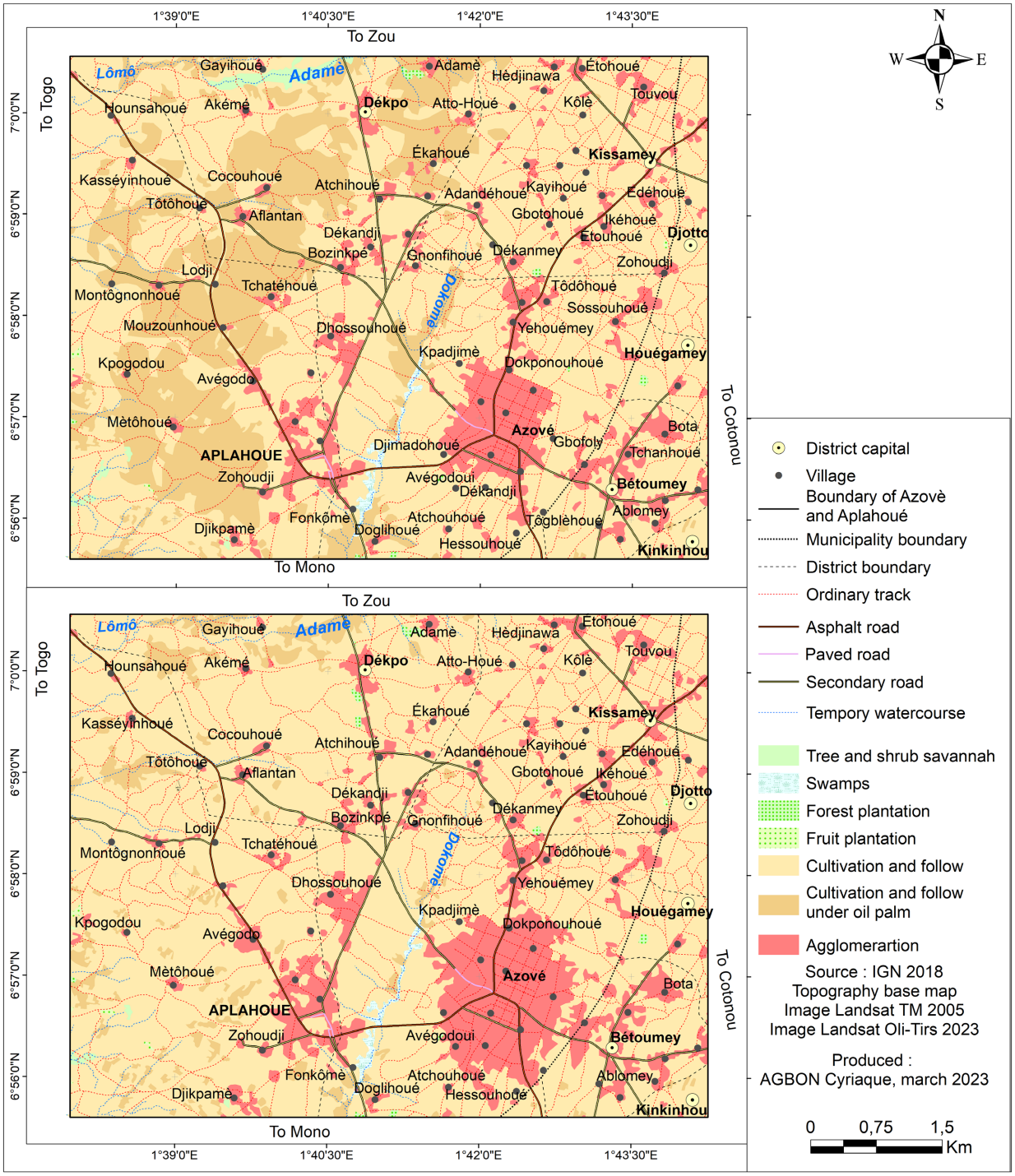

Figure 2. Dynamics of land use units between 2005 and 2022.

The dynamics of the land-use units showed a shift towards housing and crop and fallow land, to the detriment of the other units. The areas of crop and fallow land under oil palm observed in the west in 2005 have almost disappeared during this period, with a few islets in the north-west in 2023. The same is true of the wooded and shrubby savannahs. The increase in the surface area of dwellings during this period has greatly influenced urban mobility between the two cities. Table 1 shows the transition matrix for the land-use units.

Table 1. Transition matrix of land-use units between 2005 and 2023.

Land use	FSM	SASa	PTFR	PTFT	CJ	CJP	HA	Total 2005	Loss
FSM	39	0	0	0	0	0	0	**39**	0
SASa	0	11	0	0	25	33	0	**69**	58
PTFR	0	0	15	0	0	0	0	**15**	0
PTFT	0	0	0	6	0	0	0	**6**	0
CJ	0	0	5	3	6556	68	401	**7034**	477
CJP	0	0	0	0	1875	367	11	**2253**	1886
HA	0	0	0	0	0	0	1186	**1186**	0
Total 2023	**39**	**11**	**20**	**9**	**8457**	**468**	**1598**	**10602**	
Gain	0	0	5	3	1901	101	412		

Legend: SASa: Tree and shrub savannah, FSM: Forest and swamp savannah, PTFR: Forest plantation, PTFT: Fruit plantation, CJ: Crops and fallow land, CJP: Crops and fallow land under oil palm, HA: Housing.

Table 1 shows that wooded and shrubby savannahs as well as crops and fallow land under oil palm are the units whose areas decreased between 2005 and 2023. Tree and shrub savannahs lost 25 ha and 33 ha respectively to crops and fallows and crops and fallows under oil palm. Crops and fallow land under oil palm declined by 1186 ha to the benefit of fields and fallow land. The other land-use units remained stable during this period. However, the agglomerations saw an increase of more than 412 ha to the detriment of crops and fallow land under oil palm. The development of crops, fallow land and of settlements is linked to the increase in population and agricultural productivity, which directly feeds the markets and the mobility of people and goods.

3.1.2. Population Growth from 1979 to 2023

The population of the two cities, estimated at 65,749 in 1979, rose to 188,518 in 2013, an increase of 122,769. In 2023, the population reached 299,300, reflecting rapid growth (Figure 3).

Analysis of Figure 3 shows that the Azovè and Bétoumey arrondissements have a high population density. Population density is medium in the arrondissements of Aplahoué, Dékpo, Kissamey, Houngamey and Kinkinhoué, and low in the arrondissement of Djoto. Since 1979, the population has increased in every arrondissement. This shows the impact that population growth can have on the living

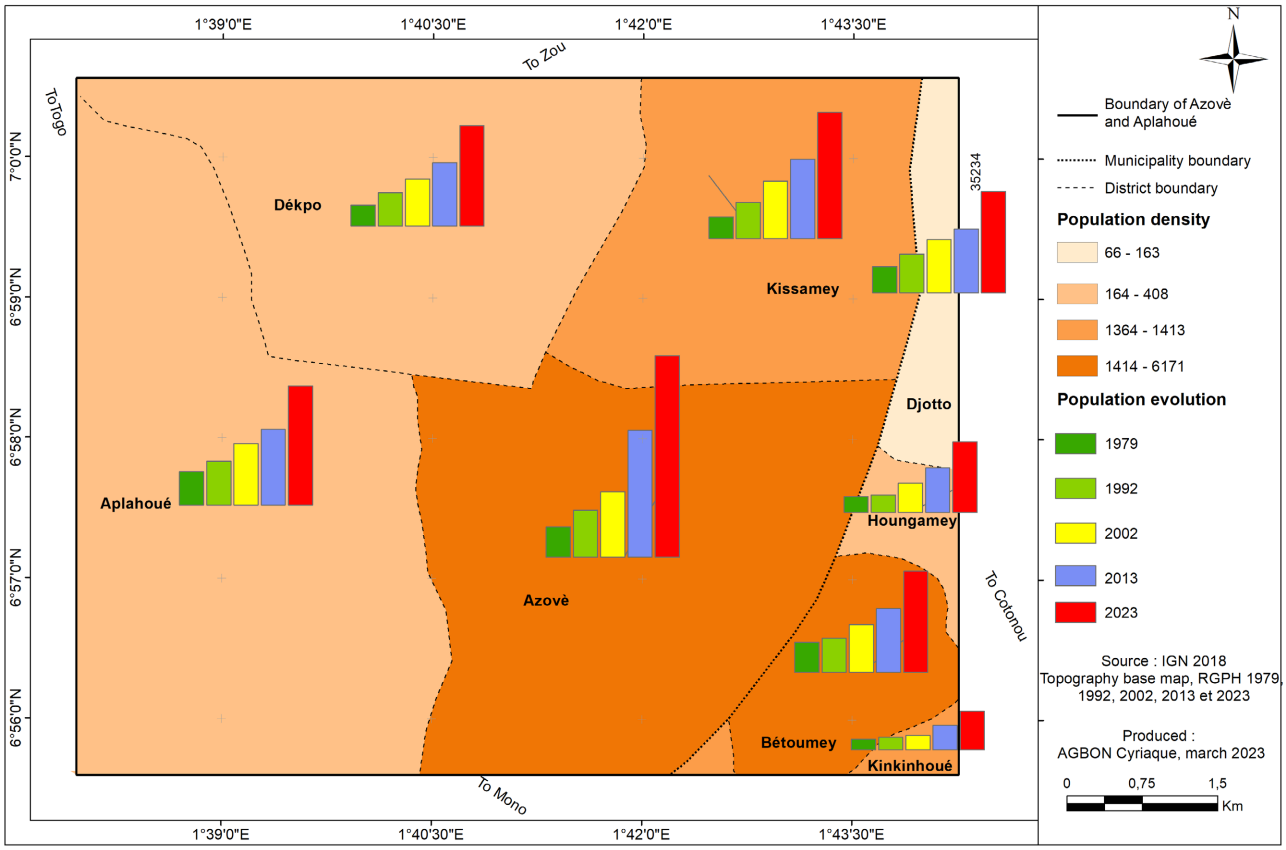

Figure 3. Population density and trends from 1979 to 2023.

environment. The impact of demographics is greater in Azovè and Bétoumey because of their high population levels and the influx of foreigners and goods, as well as the presence of most of the commercial and road infrastructure. The growing population in all the arrondissements, combined with the density, mean that urban mobility between Aplahoué and Azovè from Togo and the other regions of Benin is very rapid.

3.1.3 Road Infrastructure in the Two Cities

In the study area, only roads and waterways allow people to move from one place to another. **Figure 4** provides a summary of the local road network.

The category of roads available in the research area include asphalted main roads, paved secondary roads, unasphalted secondary roads and tracks. According to this figure, all these roads have a total length of 444.54 km, of which 379.8 km are tracks, 40.4 km are unasphalted secondary roads, 1.8 km are paved roads and 22.4 km are asphalted roads. This asphalted road links Togo to the two cities of Azovè and Aplahoué, and leads north via Abomey and Bohicon to Cotonou via Lokossa. It should be noted from this figure that the tracks are the most important roads in the research area, and these tracks link the main asphalted roads used for traffic and urban and rural mobility. It should also be noted that the rehabilitation of the road from Togo to Aplahoué has increased the flow of agricultural produce

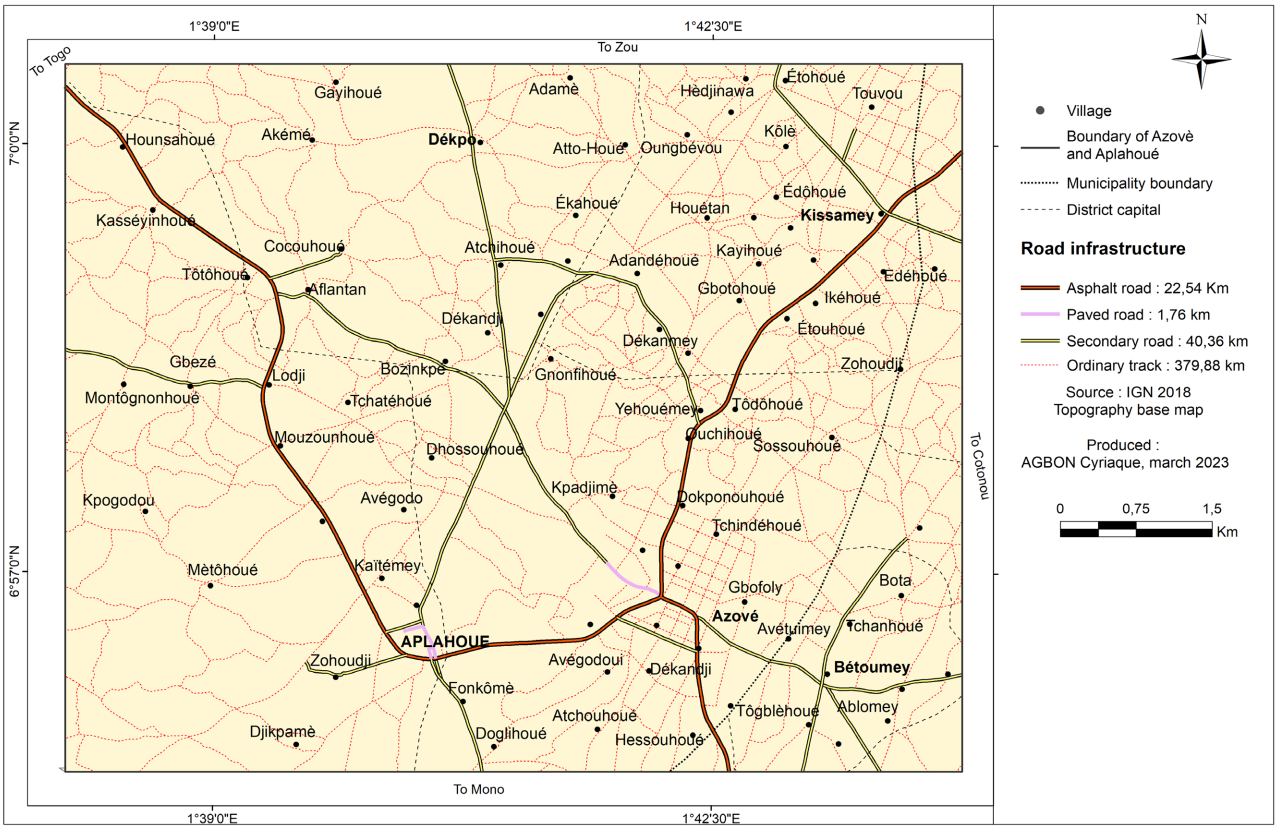

Figure 4. Road infrastructure the research area.

to urban centers. The area has a very loose and temporary hydrographic network. This means that the local population does not use the waterways for transport and mobility.

3.2. Infrastructure Dynamics and Urban Mobility between the Two Cities

These infrastructures can be grouped into two main categories: service infrastructures and commercial infrastructures.

3.2.1. Dynamics of Socio-Community Infrastructures in Relation to Urban Mobility

A total of 186 infrastructures have been identified in the two cities, including 87 in 2005 and 99 in 2023 (**Figure 5**). It is this infrastructure that underpins population mobility in the two cities.

Analysis of **Figure 5** shows that local infrastructure increased between 2005 and 2023. These dynamics of socio-community infrastructures have played a very important role in urban dynamics and the mobility of people, goods and services in the study area.

3.2.2. Commercial Infrastructure and the Population's Urban Mobility

Three main categories of commercial infrastructure have fueled the mobility of the urban and rural populations of the two cities. These include bus stations, su-

permarkets and public markets. This mobility takes place on the main roads between these two cities and the rural areas for transporting agricultural produce to markets and urban centers (Figure 6).

The commercial infrastructures promoting urban mobility in the two cities are markets (03), car park (01) and supermarket (01). They are linked by main roads to the city centres. The main road in question links Togo to the two cities (Azovè and Aplahoué) to reach the north via Abomey and Bohicon and Cotonou via Lokossa. Access to these infrastructures is more convenient for the population thanks to the development of the main road linking the city of Azovè to the city of Aplahoué

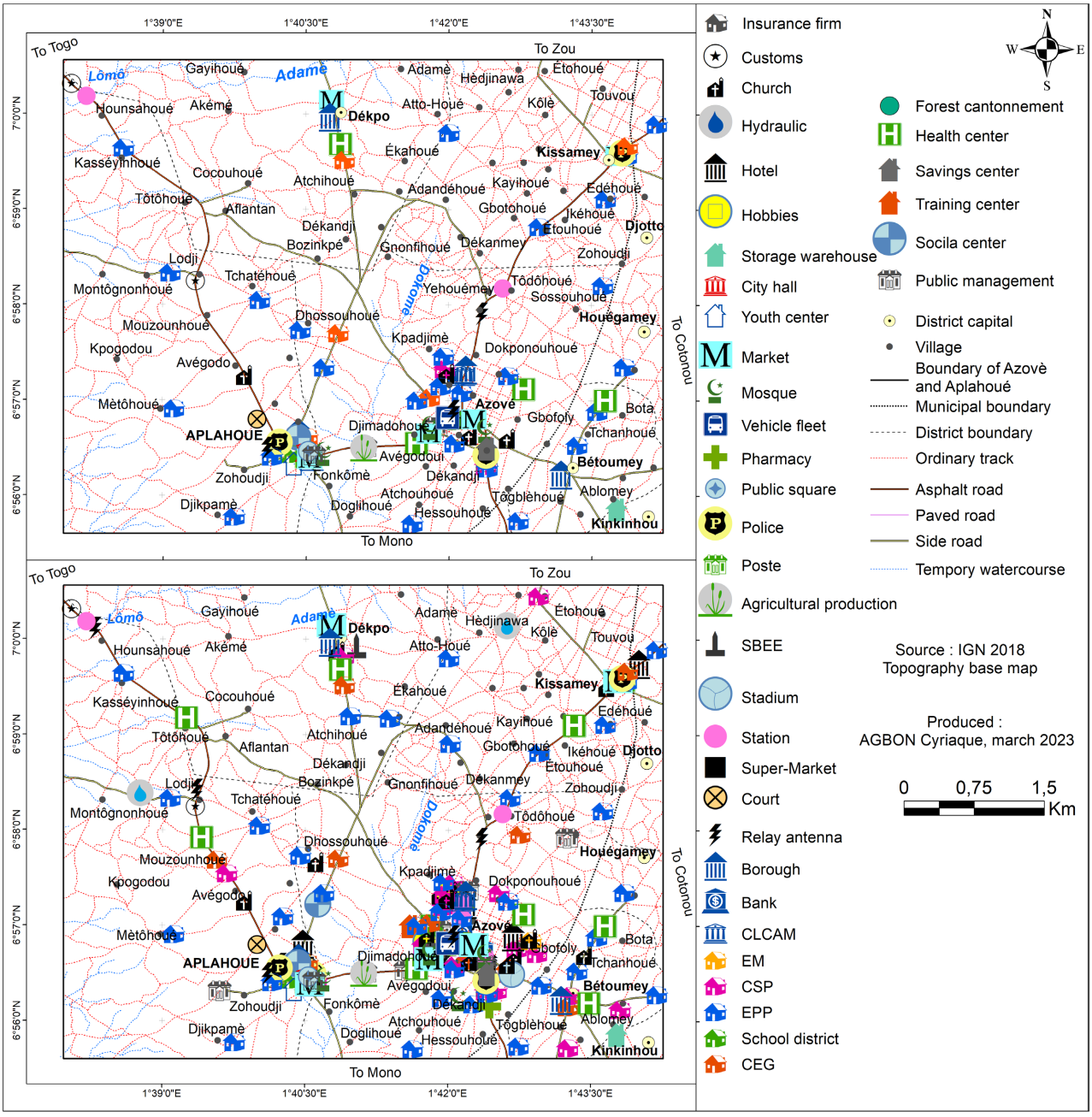

Figure 5. Dynamics of socio-community infrastructure in the two cities between 2005 and 2023.

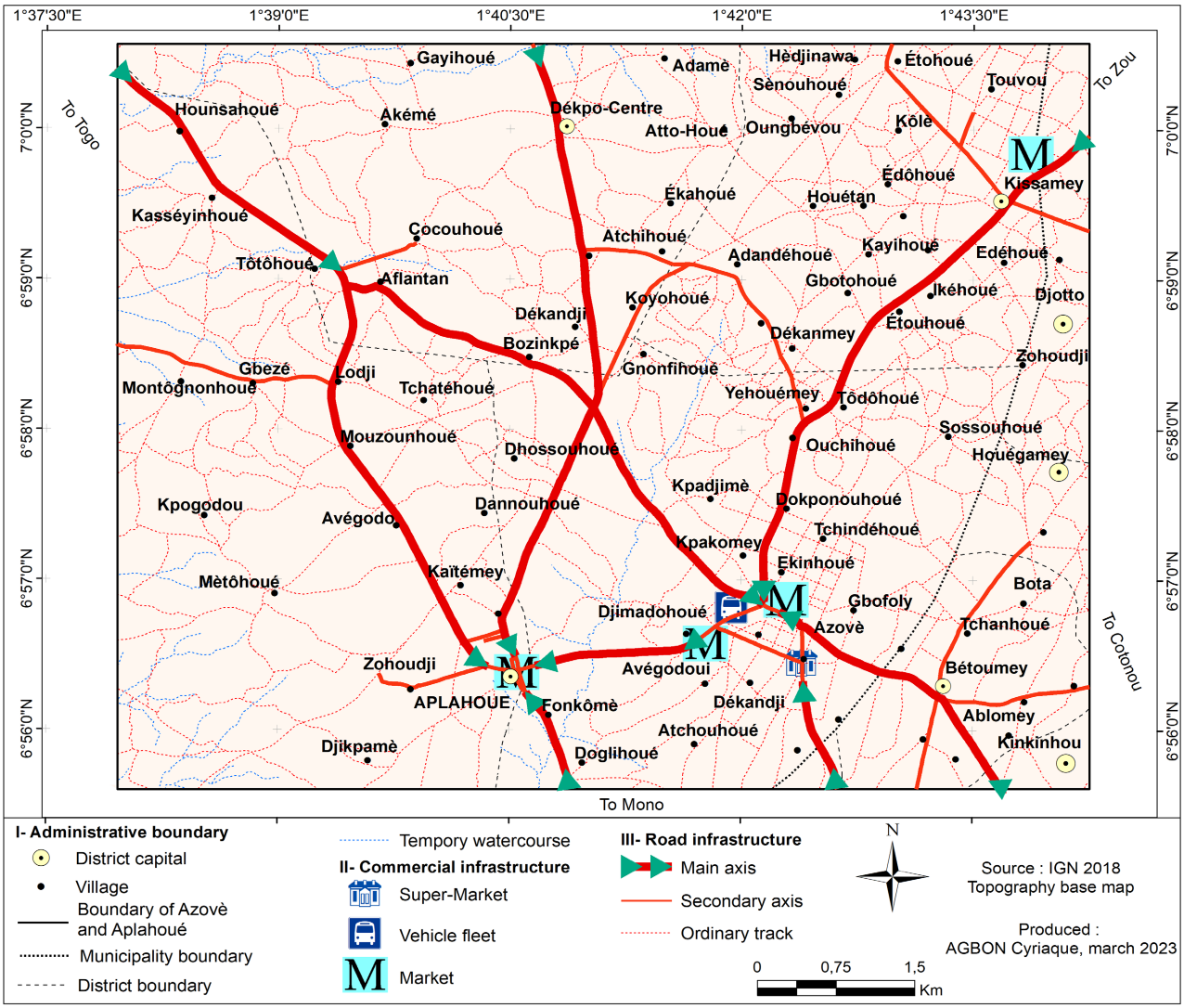

Figure 6. Mobility and commercial infrastructure between Aplahoué and Azovè.

and the Republic of Togo. The secondary routes are tracks and other roads that are being developed to facilitate the movement of agricultural and other products to market (Figure 7). They also provide access to administrative infrastructures.

Cassava (14.98%), beans (25.55%) and maize (52.86%) are the most important products transported between Aplahoué and Azovè. The least important products are peppers, millet, tomatoes, sorghum, fish and yams. This analysis shows that the dominance of agricultural products is due to the dominance of cultivation areas, market infrastructures and roads linking markets to agricultural areas. Less important products, on the other hand, are mostly imported from the surrounding communes. Figure 8 shows the origin of products entering the sector.

Most of the products entering Aplahoué and Azovè come from the departments of Zou (28.67%), Couffo (28.32%), Littoral (7.53%), Borgou (6.45%) and Plateau (5.38%). Products are also sourced from Togo (12.19%) and Nigeria (11.47%). The Zou and Couffo departments dominate along with Togo and Nigeria.

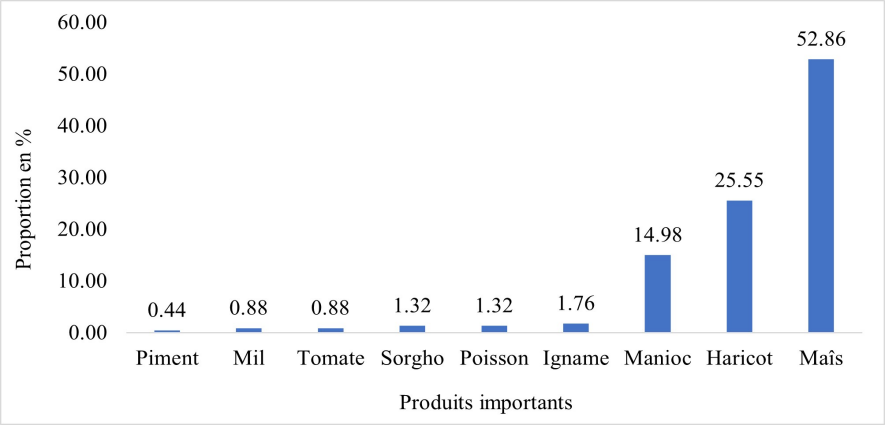

Figure 7. Major products transported between Aplahoué and Azovè.

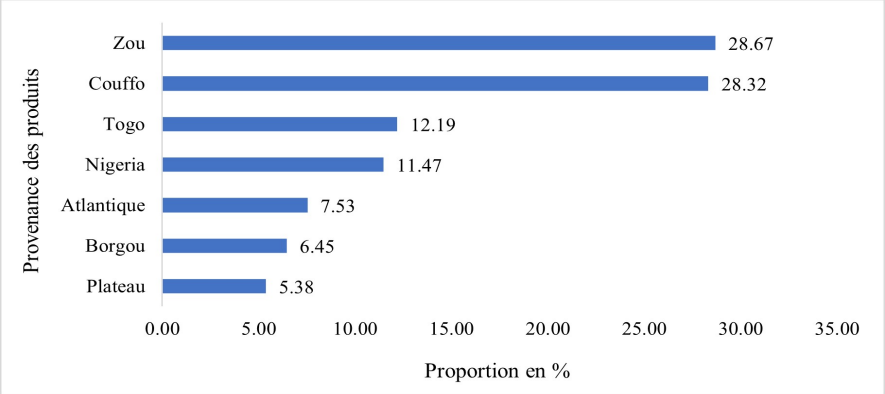

Figure 8. Origin of products in Aplahoué and Azovè.

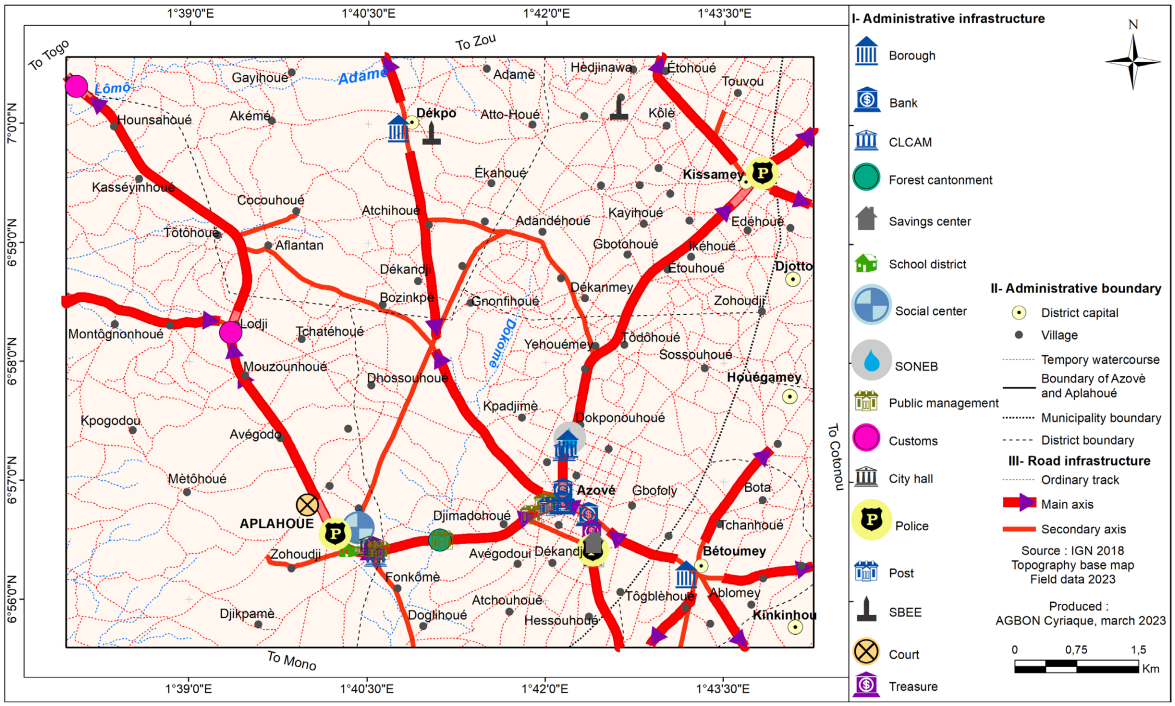

Figure 9. Mobility and administrative services infrastructure between Aplahoué and Azovè.

3.2.3. Administrative Services Infrastructure and Urban Mobility of the Population

Figure 9 shows the administrative infrastructures likely to drive population mobility in the area.

With 25 in total, the administrative infrastructures play a role in providing a certain quality of life, economic progress and ensuring the security of people and goods in the two cities. In terms of security, there are two (02) customs posts, three (03) police stations and one (01) court. To obtain certain administrative documents, people have to go to the relevant departments, which are easily accessible via the main and secondary roads.

3.2.4. Other Socio-Community Infrastructure and the Population's Urban Mobility

Figure 10 shows the other socio-community infrastructures in the two cities.

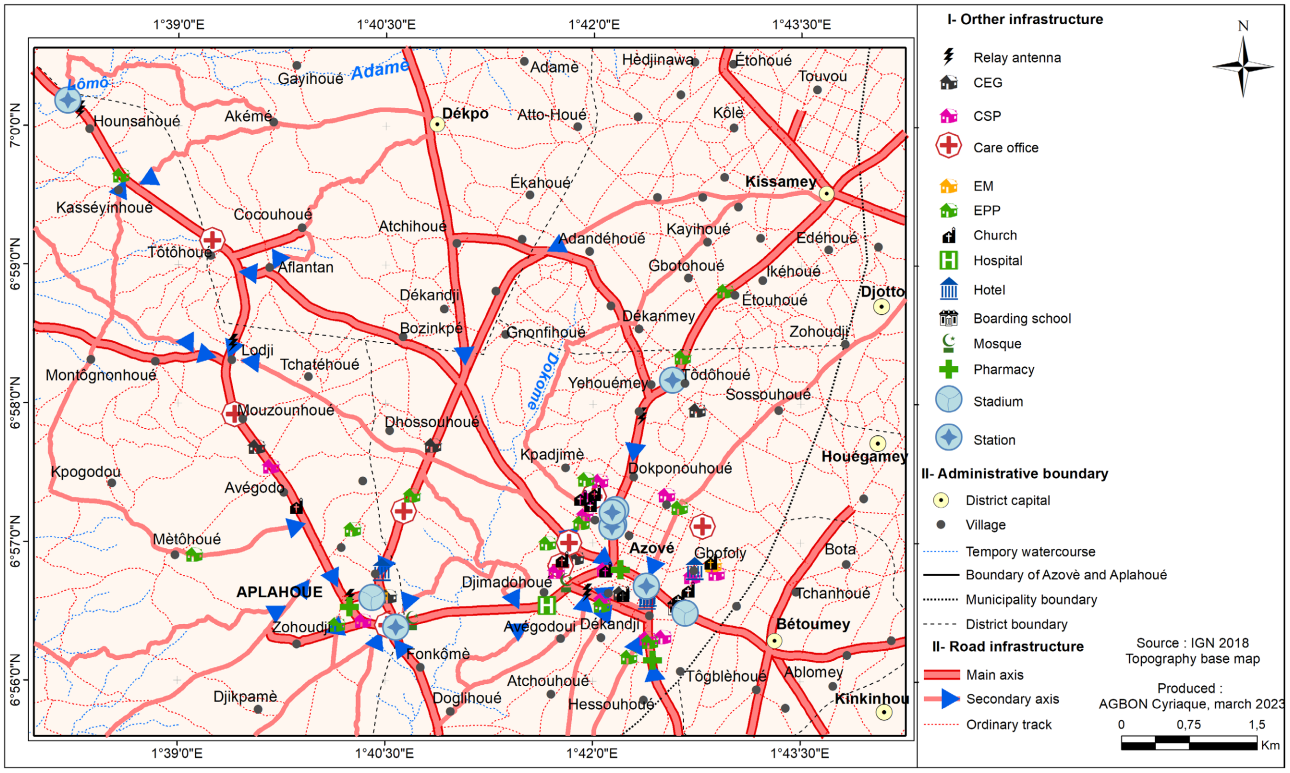

Figure 10. Mobility and other socio-community infrastructure.

There are 156 other socio-community infrastructures in the cities of Aplahoué and Azovè. They are linked by both main and secondary roads.

3.3. Development Pole between Aplahoué and Azovè

Most of the infrastructures are located along roads that have already been developed, making them easily accessible to the population. These roads are linked to the development centers and road traffic (Figure 11).

A polarized network is concentrated in the city of Azovè, due to the presence

of infrastructure that facilitates mobility in the city. Major networks can be seen in the districts of Aplahoué, Bétoumey, Dékpo, Kinkinhoué, Djoto, Houégamey and Kissamey. It should also be noted that mobility routes are more concentrated in Azovè than in Aplahoué.

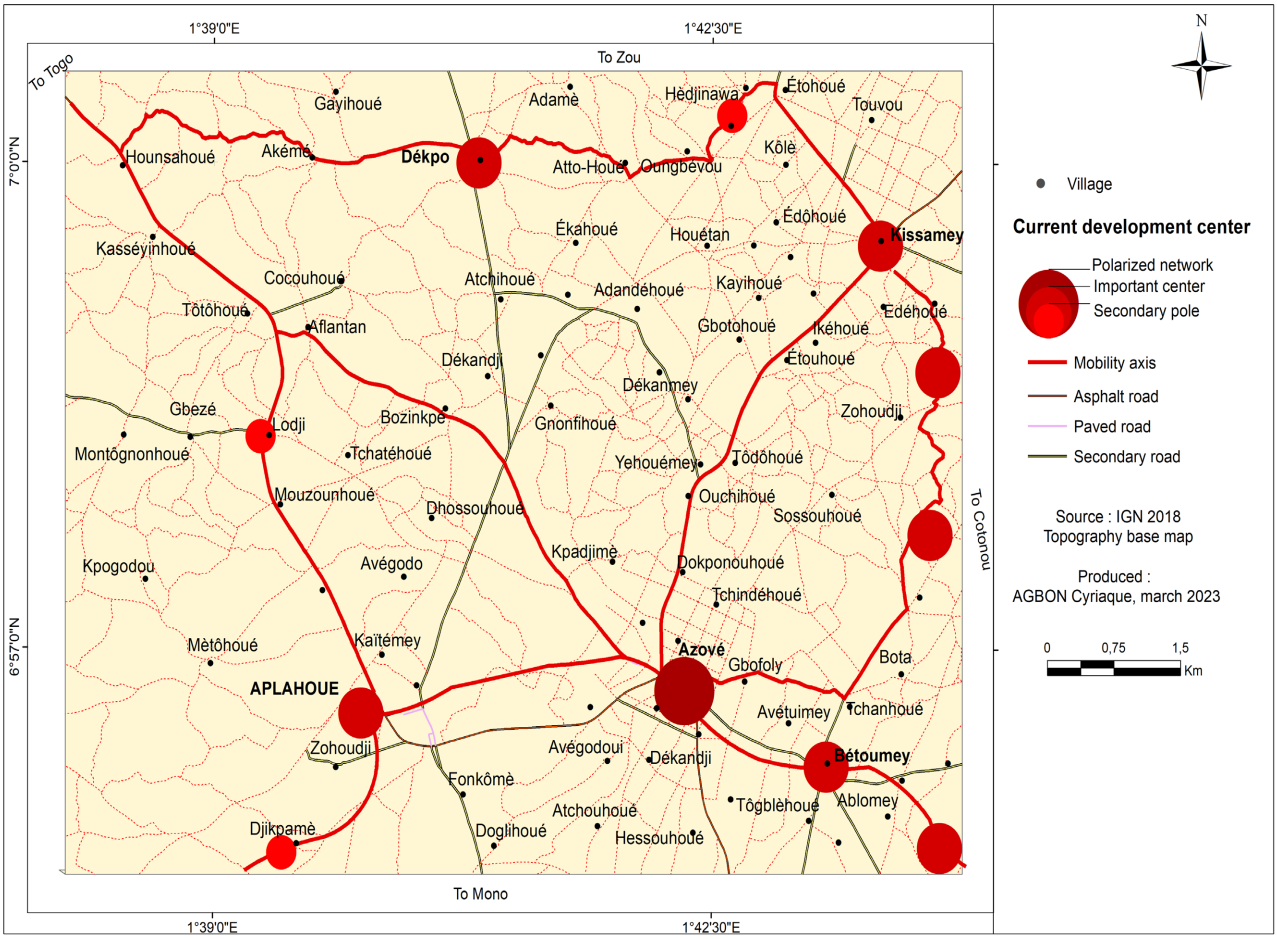

Figure 11. Development pole between Aplahoué and Azovè.

3.4. Development Pole between Aplahoué and Azovè

Main factors in urban mobility between Aplahoué and Azovè

The determining factors for urban mobility between Aplahoué and Azovè include population growth, trade, agricultural production, transport, urbanization, industrialization, the Benin-Togo border and asphalting. Figure 12 shows the main factors determining this urban mobility.

Population growth (26.7%), trade (21.92%) and urbanization (14.48%) are the most important factors in urban mobility between Aplahoué and Azovè. The importance of the Tohoun (Togo)-Aplahoué (Benin) border and the asphalting of roads in the sector should also be noted, most of which are in a state of disrepair (64.17%) according to field investigations, compared with 35.83% in normal condition.

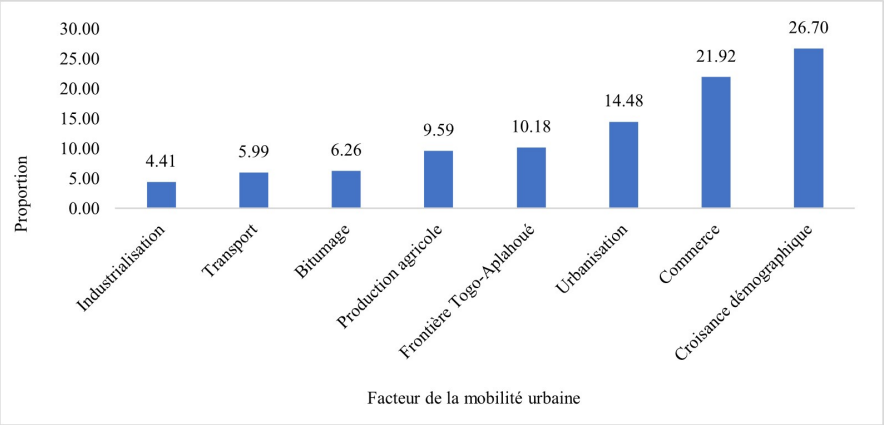

Figure 12. Factors in urban mobility between Aplahoué and Azovè.

3.5. Simulation of Urban Mobility between Azovè and Aplahoué

With the road, administrative and socio-community infrastructure favoring urban mobility and the development centers of the two cities, the current and future priority roads have been defined. The Togo, Aplahoué and Azovè axis is the most dynamic in terms of urban mobility between Aplahoué and Azovè. Figure 13 shows a simulation of urban mobility between Aplahoué and Azovè.

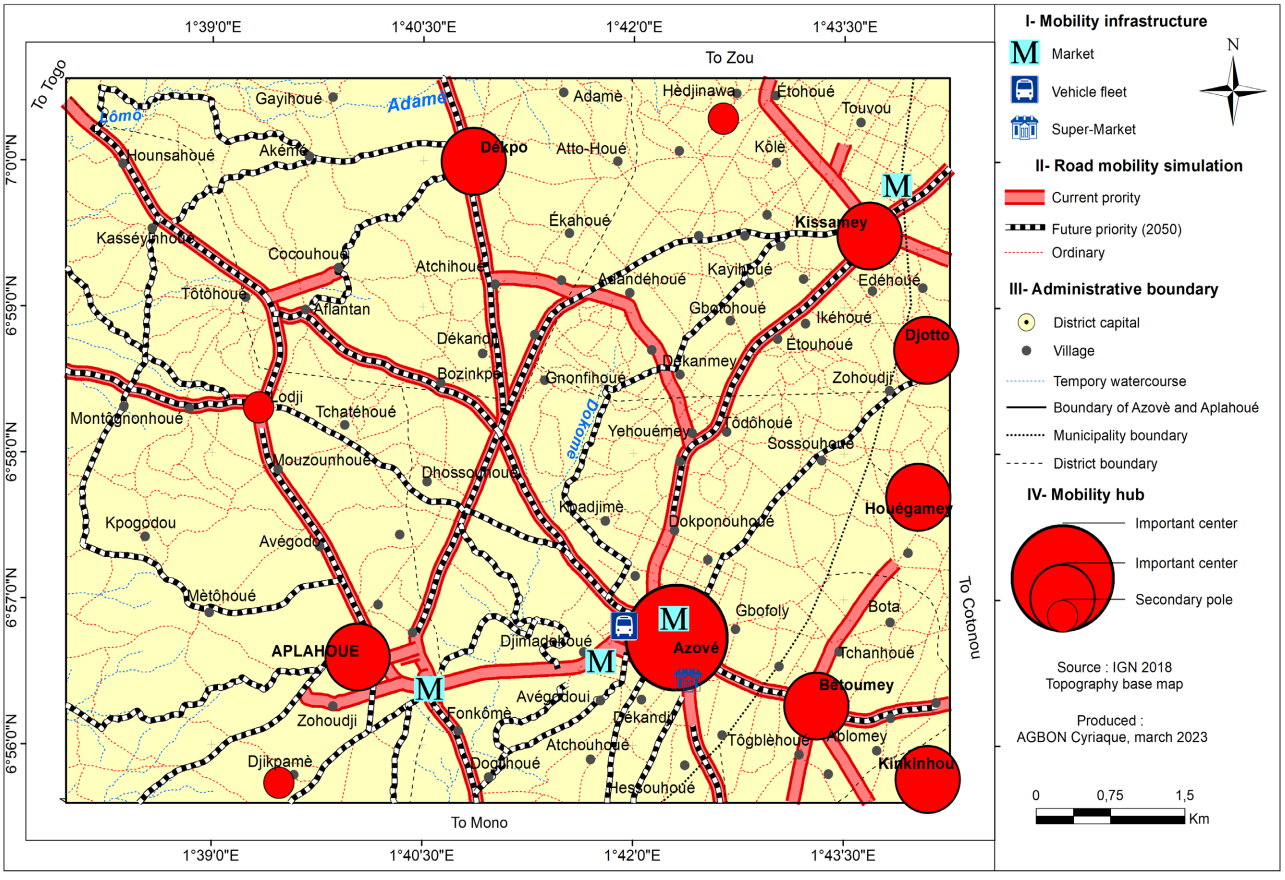

Figure 13. Simulation of urban mobility between Aplahoué and Azovè.

The road network and car park, administrative and socio-community infrastructures create mobility and accessibility links with the major, important and secondary poles. Most of the current priority roads link the major and important centers, while the secondary centers are linked by ordinary roads or roads under development. Future priority roads will take into account the major and important centers as well as the secondary ones. The development of these future priority roads will generate a high level of urban mobility in 2050 in both cities, but also on the importance of mobility hubs.

3.6. Spatial Organization between Aplahoué and Azovè

Considering this simulation of urban mobility, the structural and spatial organization of space can influence the urban mobility of people and goods between Aplahoué and Azovè. Figure 14 shows the spatial organization between Aplahoué and Azovè.

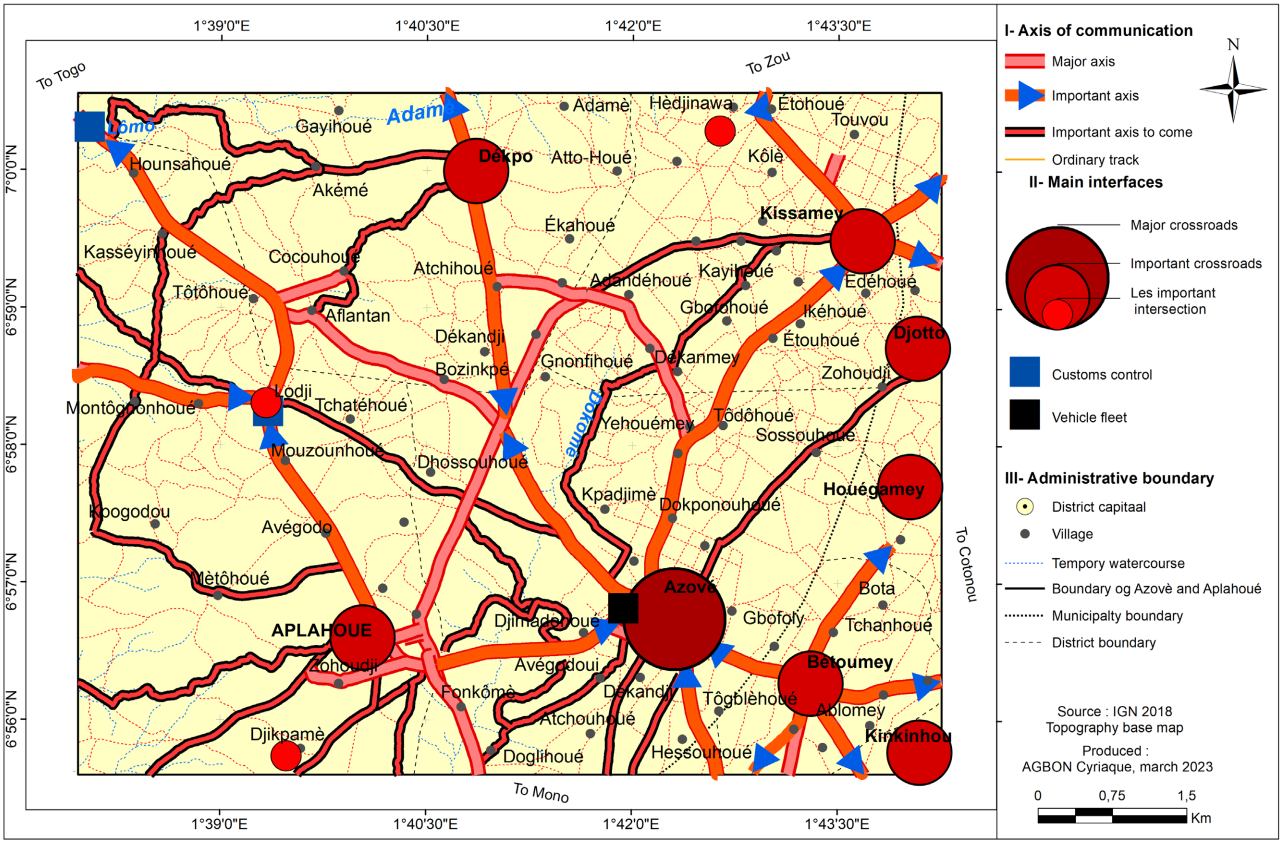

Figure 14. Spatial organization between Aplahoué and Azovè.

An analysis of Figure 14 reveals three main lines of communication. The major routes are the roads that provide access to the infrastructure linking the crossroads, and the important future routes are the roads that need to be upgraded to facilitate fluid mobility between Aplahoué and Azovè. As for the ordinary routes, they represent the rural tracks that require major development work. The car park,

which is at the center of a major crossroads, and the customs controls to the north of the sector are the other spatial organization interfaces.

4. Discussions

This research has shown the mobility of people, goods and services between the cities of Aplahoué and Azovè, two border cities with the Republic of Togo in western Benin. Both cities are undergoing rapid urbanization and urban mobility is increasing. The cartographic approach has been favored in this research not only to identify the roads currently used and those that will be preferred by 2040, depending on current mobility and the position of service and commercial infrastructures. This approach has also made it possible to identify the main factors in urban mobility. For Benichou et al (2018: p. 46), this approach, based on the use of new information technologies, is now seen as a powerful tool for analysis and decision-making. For the authors, the volume of data to be analyzed in these types of research into urban infrastructure and mobility requires the use of these indispensable tools, which present the results in concrete terms and on maps that are easy for everyone to read.

Firstly, it showed that the urbanized area of these two cities increased by 412 ha between 2005 and 2023. Tossou et al. (2018: p. 378) also used the same approach to arrive at these results for the Bohicon-Abomey urban doublet, which lies to the north of the two cities studied in this research.

Research has shown that the cities of Azovè and Aplahoué have undergone changes as a result of the increase in the built-up area, the decrease in farmland, the presence of foreigners transiting from Togo to Nigeria via the two cities, and the increase in infrastructure, including the transport of agricultural produce. These are all factors in mobility between the two cities. Dansou (2019: p. 86) had shown that the geographical location of the two cities is also a factor in the mobility and dynamics observed. The attractiveness of an area depends on its ability to accommodate mobility, production and/or population factors. These factors have also been reported by Konan et al. (2019: p. 14) and Philippe (1997: p. 1). The two cities offer work opportunities and a number of economic, administrative and agricultural services, as well as normal and peaceful living conditions. Three categories of infrastructure have encouraged mobility in the cities. These are road infrastructure (roads and stations), commercial infrastructure (markets and supermarkets), socio-community infrastructure (schools, churches, hospitals, etc.) and administrative infrastructure. These infrastructures have facilitated the movement of agricultural products and goods from Benin's departments such as Zou, Couffo, Plateau, Atlantique and Littoral, as well as from neighboring countries such as Togo and Nigeria. The Azovè market is currently the main attraction, and the main transport route between the two cities is Notsé (in Togo) - Tohoun - Aplahoué - Azovè - and Tohoun - Aplahoué - Lokossa. It is in this sense that Alidjinou et al. (2023: p. 435) explain that road infrastructure plays an important role in the distribution of food and manufactured products.

Thanks to the road network and means of transport, goods can be moved from one place to another. The asphalting of the Notsé-Tohoun road has had an impact on transport on Route Nationale n°6 (RN6). According to the authors, asphalting the road has led to an increase in the number of vehicles. The average number of vehicles per day rose from 13 between 2000 and 2016 to 118 in 2022. It has also increased cross-border trade at customs. These localities have a high level of cereal production. Formal cross-border trade has intensified with the asphalting of the Tohoun Aplahoué road. This road has increased the volume of trade in agricultural produce and manufactured goods between the two cities and Azovè. The intensification of trade between Togo and Benin along this route has also been shown by Foly et al. (2021: pp. 135-199). Profound changes were observed in the environment after the asphalting of this road (Adjawouto, 2022: p. 110). The various changes observed in the area involved the construction of school infrastructure, roadside shops, new houses and housing estates. These changes have also led to the asphalting and use of roads that were previously less used.

Better access to urban centres boosts trade and strengthens socio-economic integration. However, it is crucial to continue efforts to maintain and develop road infrastructure to ensure that the benefits of this road network are sustainable. The integration of new GIS technologies and mobility management policies could also maximise the long-term impact of these developments by 2040. The limitation of this study lies in the fact that the analysis was based on descriptive statistics rather than more sophisticated statistical techniques to explore the relationships between the variables.

5. Conclusion

Urban mobility between Aplahoué and Azovè has undergone a rather specific dynamics linked to several environmental factors. In order to simulate this mobility with the help of GIS, we interpreted the occupation of the space, the evolution and density of the population, the road network, the mobility poles, the communication axes and the key crossroads. The results showed a spatial dynamic between 2005 and 2023, with an evolution of housing and areas of crops and fallow land to the detriment of other units. This dynamic is complemented by galloping growth in the population of the two cities, estimated at 65,749 in 1979 and 188,518 in 2013, an increase of 122,769. By 2023, the population will have reached 299,300. A total of 186 socio-community infrastructures have been registered, including 87 in 2005 and 99 in 2023. The commercial infrastructure contributing to urban mobility in the two cities includes markets (03), car parks (01) and supermarkets (01). The administrative infrastructure (25) provides a certain quality of life, economic progress and security for people and property, enabling people to obtain various administrative documents if necessary, the other remaining infrastructures number 156. All of this was used to produce a simulation of urban mobility, highlighting roads with current priority, roads with future priority and ordinary roads, as

well as the major junctions in the area. The focus is on the road network because some of the roads in the area are mostly in a state of disrepair (64.17%) according to the field investigations, compared with 35.83% in normal condition. In addition, demographic growth (26.7%), trade (21.92%) and urbanization (14.48%) are the main factors determining this mobility. It will therefore be vital to take all these factors into account in future planning.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Adjawouto, K. T. (2022). *The Development of National Road No. 6 in the Prefectures of Haho and Moyen-Mono in Togo and Its Socio-Economic Changes*. Master's Thesis, University of Lomé.

Alidjinou, K. T., Dandonougbo I., & Adjawouto K. T. (2023). Effects of the Development of the Notse-Tohoun Road on the Mobility of Goods and People in the Prefectures of Haho and Moyen-Mono in Togo. In *Proceedings of the International Symposium on Cross-Border Migration and Security Challenges in Africa* (pp. 435-449). Abomey-Calavi University Campus (Benin).

Benichou, C. E., Alaoui, M. D., & Faleh, A. (2018). Approche SIG Pour La Modélisation Du Réseau Routier et La Mesure De L'accessibilité Aux Équipements Publics. Cas De La Ville d'Agadir. *European Scientific Journal, 14,* 38-47. https://doi.org/10.19044/esj.2018.v14n2p38

Bennouna, M., Benmoussa, O., Gmira, M., & Slighoua, M. (2020). *Towards a Systemic Approach to Urban Mobility: Articulations and Governance Model. Territoriality of Public Action: Rethinking Governance from a Local Perspective*.

Coundoul, A. A., Dia, S., & Ba Amadou, T. (2022). The Challenges of Urban Mobility in Relation to Congestion and Pollution in Dakar. *Akofena, 2,* 37-48.

Dansou, C. S. S. (2019). *Spatial Structuring And dynamics of the Towns of Ouidah and Grand-Popo on the Benin Coast: Environmental Issues and Prospects*. University of Abomey-Calavi (Benin). https://shs.hal.science/tel-03321625v1

El Amraoui, S. M., Rouchdi, M., Bouziani, M., & El Idrissi, A. (2017). Integration of GIS and Hierarchical Multicriteria Analysis for Assistance in Urban Planning: A Case Study of the Province of Khemisset, Morocco. *Scientific Information System: A Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal, Papeles de Geografía, 63,* 21.

Foly, D. K., Vissoh, A. S., & Malomon, B. (2021). Tools and Mechanisms for Managing Trade in the Aplahoué/Moyen-Mono Cross-Border Area (Benin-Togo). *International Journals of Sciences and High Technologies, 30,* 574-586.

Konan, K. E., Mafou, K. C., Sylla, D., Diomande, G., & Lida, D. S. (2019). Prospective Modelling of Deforestation in the Mont Sangbé National Park (Côte d'Ivoire). *Conférence OSFACO: Des images satellites pour la gestion durable des territoires en Afrique*, 13-15 March 2019, Cotonou, 1-23.

National Institute of Statistics and Economic Analysis (NISEA) (2015). *RGPH4: What Can We Learn from the Population Figures for 2013. Database of the Directorate of Demographic Studies*.

Philippe, A. (1997). Urbanization in Africa and Its Prospects, Food in the Cities. *FAO Pro-*

gram.

Tossou, N. M., Vigninou, T., Saliou, A.. Guédénon, D. J., & Agossou, N. (2018). Manifestations and Factors of Urban Sprawl in the Abomey Bohicon Doublet (Benin). *International Journal of Innovation and Applied Studies, 25,* 370-387.

UN (2015). *Transport and Mobility. Habitat Working Paper 3*. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://habitat3.org/wp-content/uploads/19-Habitat-III-Issue-Paper-19_Transport-et-mobilite.pdf&ved=2ahUKEwj97ZThpayLAxUfAfsDHWK-wMwMQFnoECBMQAQ&usg=AOvVaw0Feo2CgTznX1ZmubfNy6d0