

Urban Expansion and Planning Dysfunctions in the City of Pobe (Benin)

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Abstract

The city of Pobe is experiencing strong population growth and stands out in the Plateau department due to its rapid urbanisation. This rapid spatial dynamic of the city generates urban management and planning problems, which this research aims to study. The methodological approach adopted is based firstly on data collection through desk research and fieldwork, which involved observation, questionnaire surveys of 154 households and interviews with 18 key informants; secondly, the processing of the data collected; and finally, the analysis of the results using the SWOT model. Also, Landsat 7 ETM satellite images from 2005 and Landsat 8 OLI/TIRS images from 2025, along with DEM images (SRTM, 2014) of the city, were used to produce the various land-use maps as well as the slope map. The results show that the city's population has more than doubled, rising from 33,552 inhabitants in 2002 to 69,872 in 2025. This increase has been accompanied by an expansion of urbanised areas, resulting in the decline of natural formations in favour of agglomerations and the transformation of the city's infrastructural landscape. In fact, from 23.3% of the city's area in 2005, or 719 hectares, urban areas have grown to 45.22% of the city's area in 2024, or 1.395 hectares. The city's expansion can be explained by several factors, including migration to Pobe as the capital of the Plateau department, relatively affordable housing and land costs, and the proximity of Nigeria with its booming economic activity. However, this urban expansion is causing development problems, including uncontrolled land use,

sanitation issues, cyclical flooding and erosion. These problems are exacerbated by the absence and insufficient implementation of spatial planning and urban management tools. Therefore, the population and the authorities must work to establish and implement a genuine urban development policy for the city of Pobè.

Keywords

Pobè, Urban Expansion, Planning Problems, Planning Tools

1. Introduction

By 2040 or 2050, the world population is expected to reach at least 9 billions, with most of the new inhabitants living in developing countries, whose population will increase from 5.6 billion in 2010 to 7.9 billion in 2050 [1]. By 2030, Africa as a whole will have an average population of 1.5 billion, compared to 921 million in 2005. In other words, between now and 2030, Africa's population is expected to grow by between 57% and 74% in 25 years, which is considerable, and this growth will be significantly stronger in sub-Saharan Africa than in North Africa [2].

This demographic dynamic is leading to spectacular urban expansion on the African continent. The African urban population has grown rapidly, from 14% in 1950 to 40% in 2008. Projections indicate that by 2035, half of Africans (50%) will live in cities [3]. This situation has led to increased demand for housing in rural areas by middle-income individuals who cannot afford the cost of living in urban areas, resulting in the emergence of peri-urban areas on the outskirts of former urban centres [4].

In Benin, the population growth rate rose from an average of 3.25% over the decade 1992-2002 to 3.5% between 2002 and 2013 [5]. These population growth rates have placed Benin among the countries with the highest population growth rates in the world. However, urban growth raises the issue of the infrastructure and facilities needed for new neighbourhoods [6]. These population growth problems in Benin can be observed in both rural and urban areas. These multiple problems include poor household waste management, unsanitary conditions, uncontrolled population growth, lack of maintenance of social and community infrastructure, etc. This situation is exacerbated by uncontrolled and unregulated urbanisation, with excessive and disorderly growth in the suburbs, where there is now strong pressure on land, leading to chaotic land management and a lack of good urban planning [7]. Urbanisation is therefore causing environmental degradation. This degradation mainly concerns flooding, erosion, soil degradation, high rainfall variability, etc. [8].

This situation can be observed in several secondary cities in Benin, including the city of Pobè. The latter has experienced rapid urban expansion in recent years. This expansion is reflected in socio-spatial changes, but it is also linked to many planning difficulties. This research is being conducted to gain a better understand-

ing of the situation. This raises a key question: what are the planning constraints associated with urban growth in the city of Pobè? To address this concern, an overall objective has been set, which is as follows: “to study the planning problems associated with urban growth in the city of Pobè.”

2. Materials and Methods

This section presents the data used for the study and the methods used to collect and process it.

2.1. Study Area

The city of Pobè consists of the Central District, which is one of the five districts that make up the Municipality of Pobè. It is located between 6° 58' and 7° 01' North latitude and between 2° 38' and 2° 41' East longitude. The town of Pobè, which has 17 neighbourhoods, is located on the Pobè-Sakété plateau and is bordered to the north and east by the borough of Ayoyéyé and to the south and west by the commune of Adja-Ouèrè (**Figure 1**).

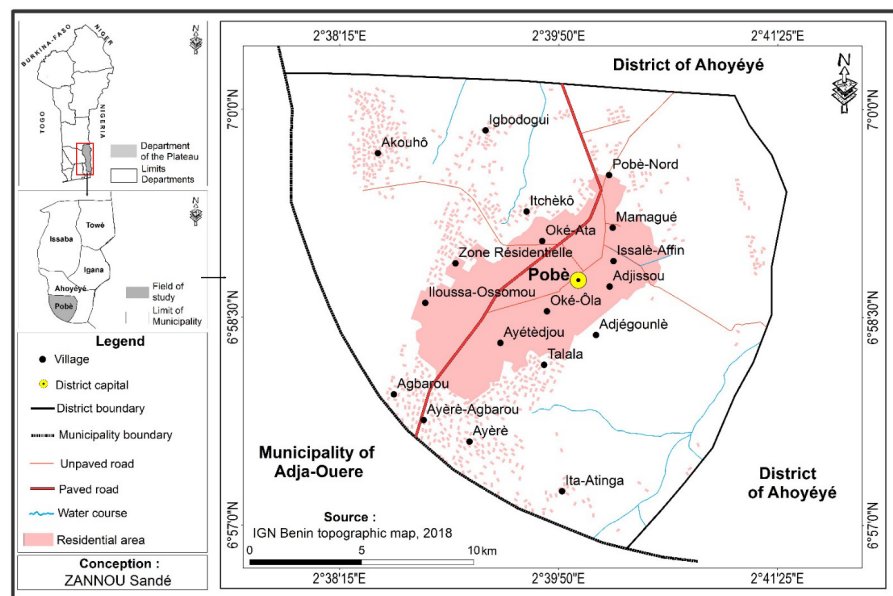


Figure 1. Geographical and administrative location of the town of Pobè.

2.2. Data Collection Method

The data collected is diverse and provides a better understanding of urban growth in the city of Pobè and the associated development issues. This includes: socio-anthropological data obtained during field surveys, which enabled the collection and analysis of difficulties related to development and demographic change; geographical coordinates of socio-community infrastructure in order to map spatial distribution; data on development issues in the city of Pobè, which were identified during field surveys; data linked to satellite images relating to land use patterns, based on Landsat 7 ETM and Landsat 8 OLI-TIRS images for the years 2005 and 2025 cover-

ing the city of Pobè. Several tools and materials were used to collect the data. These included: a questionnaire sent to households in the city of Pobè; an interview guide for resource persons; an observation grid used to record phenomena related to urban sprawl and development issues in the city; a camera for taking photographs.

The data used for this research was collected from a primary target group consisting of households and a secondary target group consisting of resource persons. Sampling was determined within the main target group, *i.e.* households. Within the primary target group of households, the choice of respondents was based on the following cumulative criteria: being a head of household or their representative; having lived regularly in the city of Pobè for the last ten (10) years. To this end, the sample size was determined using the formula [9]. Thus, if n denotes the sample size, we have:

$$n = \frac{Z\alpha^2 \times pq}{i^2} \quad \text{with:}$$

N = the sample size;

$Z\alpha = 1.96$, the reduced standard deviation corresponding to a 5% α -level risk;

p = the proportion of households in the various target villages relative to the total number of households in the study district (number of households in the surveyed villages and urban neighbourhoods = 8711; total number of households = 9358) according to (RGPH4), *i.e.* $p = 93.08\%$ or 0.9308 ;

i = desired precision equal to 4%;

$q = 1 - p$ (here, $q = 0.6161$); $n = (1.96)^2 \times 0.9308 (1 - 0.9308) / (0.04)^2 = 154.42$ households.

A total of 154 households were surveyed.

Thus, for the distribution of surveyed households by village or urban district, a reduction coefficient is applied to the sample. This coefficient is expressed as $k = N/P$; where N = sample size obtained using D. Schwartz's method, and P = total number of households in the surveyed villages according to the INSAE's RGPH4. In fact, $k = N/P$ results in

$k = 154/8711$, hence $k = 0.017678$, or $k = 1.76\%$ allocated to each household population per surveyed locality. **Table 1** presents the distribution of the surveyed sample by selected localities.

Table 1. Distribution of the sample by selected localities.

Districts	Villages/City neighbourhoods	Total number of households	Number of households surveyed	Percentage (%)
Pobè	Adjissou	410	7	4.54
	Akouho	571	10	6.49
	Idogan	208	4	2.6
	Oké Ola	1266	22	14.29
	Oké Ata	726	13	8.44
	Issalè Afin II	572	10	6.49

Continued

	Mamangué	158	3	1.95
	Adjégounlè	1302	23	14.94
	Illoussa	2233	40	25.97
	Pobè Nord	1265	22	14.29
Total	10	8711	154	100

Table 1 shows that 10 villages and urban neighbourhoods were visited in the Pobè district. A total of 154 households were surveyed within the main target population. In addition to the respondents, interviews were conducted with key informants. These included the Mayor of the municipality, the Executive Secretary, the District Chief, ten (10) neighbourhood chiefs, the Head of the Planning and Local Development Department, three (03) members of housing estate committees, and a manager of a household waste collection facility. In total, 18 key informants were interviewed as part of this research.

2.3. Data Processing Methods

The data collected was processed statistically and cartographically. Word 2016 software was used to process the text, Excel 2016 software was used to create tables and graphs, and ArcGIS 10.8 software was used to create maps.

2.3.1. Method for Calculating the Urbanisation Rate Index

Statistical data from image processing was used to calculate the urbanisation rate index for the city of Pobè. This index is based on the cumulative built-up area in a given spatial unit over the course of a year. The index makes it possible to identify the rate of urbanisation over a given period. The formula used to calculate this index is that used by Rousseaux, 2009, cited by [10]:

$$IVU = \frac{Sb}{NS}$$

where: *IVU* = Urbanisation Velocity Index; *Sb* = Built-up area; *S* = Total area; and *N* = Number of years over which built-up areas have been accumulated.

2.3.2. Processing and Interpretation of Satellite Images

Landsat 7 ETM satellite images from 2005 and Landsat 8 OLI/TIRS images from 2015, along with the IGN topographic base map from 2018, were used. DEM images (SRTM, 2014) of the study area were also utilised. This enabled an assessment of the various changes undergone by land-use categories linked to urban dynamics in the town of Pobè. The Landsat satellite images were downloaded from the Earth Explorer platform, and the SRTM DEM images were obtained from the website <https://dwtkns.com/srtm30m>. These were used to produce the land cover map. The satellite images were processed in accordance with the following steps:

- 1) *Band stacking (Stacking)*

Stacking is an essential operation as it allows all imported bands to be combined into a single image file to facilitate subsequent operations. It is performed using all bands from the same scene with identical spatial resolution. Consequently, the information contained in all these bands is utilised to maximise the quality of the result. This is carried out using the Stacking function in the Basic Tools window. To this end, it is advisable to select only the bands that are important and to reorder them; this makes it easier to proceed with the subsequent operations.

2) Extraction of the study area and colour composition

The process of extracting the study area involves loading the stacked Landsat satellite images into ENVI 5.0 and exporting them to ArcMap using the Chip View tool. The study area shapefile is overlaid onto the Landsat images, and the study area is then extracted using the “Extract by Mark” tool. A colour composite using bands 4, 3 and 2 was also created, enabling better differentiation of land cover types.

3) Contrast enhancement and visual interpretation

Contrast enhancement produces a clear image that facilitates visual interpretation. This involves the identification and recognition of details within the satellite image, with the naked eye, using an interpretation key that indicates the correspondence between each object and a spectral colour. The results of this visual interpretation were used for image classification. Furthermore, to achieve greater accuracy, it was necessary to carry out a recognition of the land-use units present in the study area.

4) Supervised classification

Supervised classification was used, taking into account knowledge of the terrain. This involved first visually identifying a number of natural or man-made features or objects—which may be point, linear or areal features—on the images. This classification, carried out using the ENVI 5.0 image processing software, took place in five phases: the definition of the legend or specification of the ROI (Regions of Interest), the selection of training plot samples (or Regions), the description and specification of the different classes, and the choice of classification algorithm. The definition of the legend or ROI in ENVI 5.0 was carried out using the ROI tool within the Region of Interest tool. Furthermore, the Maximum Likelihood algorithm of the supervised classification tool was selected for the classification.

5) Post-classification operations

The post-classification stage consisted of three operations, namely: filtering of the classified images, validation using the confusion matrix, and vectorisation. The filtering operations are: Sieve classes (to remove isolated pixels); Clump classes (to homogenise the classes). The evaluation of the classification is based on the confusion matrix and the calculation of the Kappa coefficient. Thus, the procedure consisted of Classification/Post-Classification Confusion Matrix Using Ground Truth ROIs. Vectorisation is performed using the “Classification to Vector” procedure, followed by “Export to Shapefile”.

2.3.3. Determining the Average Annual Rate of Spatial Expansion

The average annual rate of spatial expansion expresses the proportion of each land cover unit that changes annually. This rate, Ta , is calculated using the following formula ([11]):

$$Ta = \frac{S2 - S1}{S1(t2 - t1)} * 100$$

where $S1$ = area of a landscape unit at time $t1$, $S2$ = area of a landscape unit at time $t2$, and t = number of years between $t1$ and $t2$.

2.3.4. SWOT Analysis Method

The SWOT model is a strategic analysis tool designed to identify a project's strengths and weaknesses, as well as the opportunities and threats in its environment, with a view to making strategic decisions ([12]).

The SWOT analysis takes the form of a 2×2 matrix, comprising two axes:

- The internal axis, which identifies the project's strengths and weaknesses. The aim here is to objectively identify and analyse the project's strengths and weaknesses. This involves identifying and analysing the project's internal resources and skills that would enable the project to be implemented, or those that are lacking in relation to the project;
- The external axis allows the project to be positioned within its broader context, in a wider external environment that extends beyond the project's internal boundaries. This involves identifying and analysing major trends that could present opportunities to support or justify the project, as well as threats in terms of competition and broader trends that could hinder it.

3. Results

3.1. Overview of Urban Expansion in the City of Pobè

The overview of urban expansion in the city of Pobè is analysed from the perspective of the city's urban expansion factors, the spatial manifestations of urban expansion and the evolution of housing typology in the city of Pobè.

3.1.1. Factors Contributing to Urban Expansion in the City of Pobè

The dynamics of expansion in the city of Pobè have evolved at a pace that is the direct result of several factors that accentuate movements in the area.

1) Population growth

The town of Pobè has seen rapid population growth in recent years. From 33,552 inhabitants in 2002, the population of Pobè rose to 49,232 in 2013; this represents a growth rate of 46.74% over 11 years (INSTaD 2025 and formerly INSAE, 2013). Estimates for 2025 put the population at around 69,872 (Figure 2).

The population of the city of Pobè has grown dramatically, leading to an increase in demand for building plots and housing. As a result, the city is expanding to accommodate the surplus population.

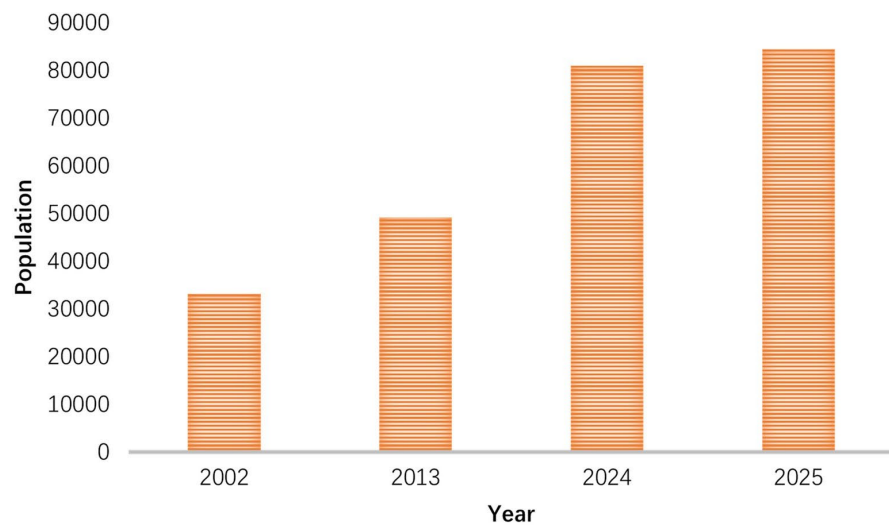


Figure 2. Population growth in the city of Pobè from 2002 to 2025.

2) Boom in economic activity

Commercial activities occupy a large part of the working population in Pobè. Due to its geographical proximity to Nigeria (approximately 18 km from the border), many retailers source their supplies from this neighbouring country before redistributing their goods to local and Beninese markets. This situation promotes the availability of Nigerian products, such as hydrocarbons and manufactured goods. Thanks to this commercial vitality, the population has access to a variety of products, particularly food, that meet their daily needs. This commercial dynamic generates significant income within the community. Thus, economic activity directly stimulates the urban growth of the city of Pobè, improving living conditions, enhancing local attractiveness and contributing to the gradual transformation of the urban landscape.

3) Urban development

The urban development of central Pobè relies heavily on the road and urban development efforts made in recent years. Improvements to the road network, with the rehabilitation of the main roads (Pobè-Onigbolo and Pobè-Adja-Ouèrè) and the paving of several secondary roads, have greatly facilitated the movement of people and goods. By ensuring better connectivity between neighbourhoods, markets and administrative infrastructure, these roads have boosted trade and the attractiveness of the town centre. The development and opening of roads has also helped to open up several areas that were previously difficult to access (Ayèrè, for example). These changes have attracted new private investment, promoted the construction of modern housing and encouraged the establishment of businesses.

4) Choice of Pobè as the capital of the Plateau department

The official designation of Pobè as the capital of the Plateau department, ratified by the Council of Ministers on 22 June 2016, marked a turning point in the administrative and territorial history of the municipality and particularly of the town. This strategic choice, motivated by its central geographical position and

proximity to Nigeria, gave Pobè a role as an administrative, economic and logistical hub within the department. Since then, numerous socio-community and administrative infrastructures have been built in Pobè. These include the Pobè Court of First Instance, the Plateau Prefecture, the Departmental Treasury, the Departmental Directorates of Health, the Republican Police, Culture and Tourism, Nursery and Primary Education, Secondary Education, Technical and Vocational Training, Agriculture, Livestock and Fisheries. **Figure 3** shows a map of infrastructure development in the city of Pobè from 2005 to 2025.

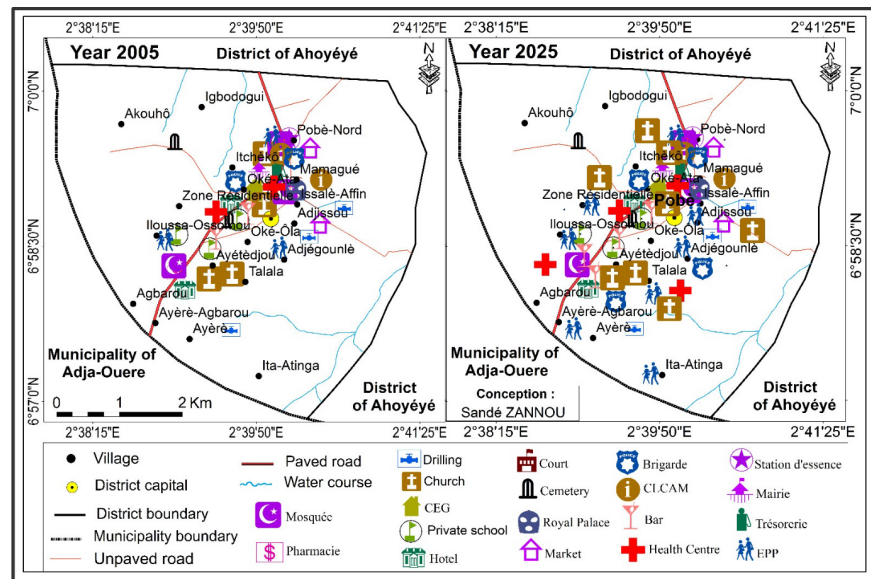


Figure 3. Spatial distribution of infrastructure dynamics in the city of Pobè.

Analysis of **Figure 3** shows that social and community infrastructure increased between 2005 and 2025 in the city of Pobè. Today, the city of Pobè has 23 public primary schools, six nursery schools, 20 private primary schools, seven private nursery schools, three general secondary schools and one technical secondary school. In addition, there is a public health centre, a regional hospital, numerous private health centres, a multi-purpose stadium and other facilities. Since becoming the departmental capital in December 2016, the city of Pobè has attracted a steady stream of civil servants, visitors and institutional partners, stimulating demand for housing, services and infrastructure, which is accelerating urban expansion.

3.1.2. Spatial Manifestations of Urban Expansion in the City of Pobè

Urban expansion is mainly reflected in the considerable reduction of natural spaces in favour of buildings, but also in changes in housing types.

1) Dynamics of urban growth in the city of Pobè

Urban growth in the district of Pobè is assessed on the basis of the dynamics of the units that occupy the land area of the city of Pobè. Human action on the space has contributed to the dynamics of all these units. The dynamics have affected

both natural and artificial elements (Figure 4).

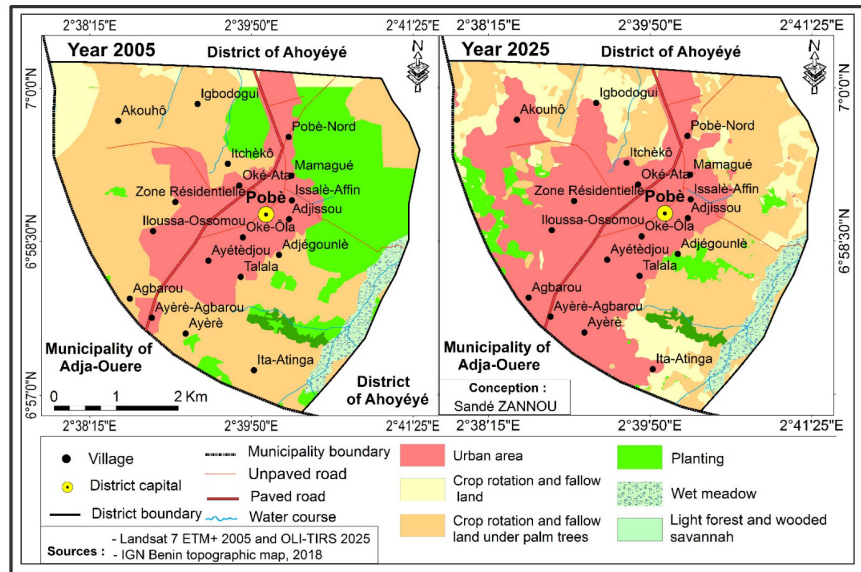


Figure 4. Land use in the town of Pobè from 2005 to 2025.

Analysis of Figure 4 shows that all land use units underwent changes between the two periods. The changes that occurred between these two dates are analysed using Table I of the transition matrix.

Table 2. Change in land use area between 2005 and 2025.

Land use units	Surface condition in 2005		Surface condition in 2025		Surface condition assessment 2005-2025	
	Area (ha)	Prop (%)	Area (ha)	Prop (%)	Area (ha)	Prop (%)
Crop rotation and fallow land	161	5.22	420	13.61	259	8.39
Crop rotation and fallow land under palm trees	1365	44.25	1030	33.39	−335	−10.86
Wet meadow	124	4.02	124	4.02	0	0
Urban area	719	23.3	1395	45.22	676	21.92
Light forest and wooded savannah	31	1.01	29	0.94	−2	−0.07
Planting	685	22.2	87	2.82	−598	−19.38
Total	3085	100	3085	100		

Analysis of Table 2 shows that between 2005 and 2025, there was a decline in crops and fallow land under palm trees, light forest and wooded savannah, and plantations in favour of urban areas. Indeed, from 23.3% of the city's area in 2005, or 719 ha, urban areas increased to 45.22% of the city's area in 2025, or 1.395 ha. Thus, the urbanisation rate of the district is $IVU = 0.66$. The dynamics of the city's urban environment and these factors have led to changes in the architecture of housing.

2) Changes in housing types in the city of Pobè

Until the mid-1960s, housing consisted mainly of mud-brick houses and colonial-style houses. Since then, housing has evolved and modern buildings have sprung up in the city. Population growth has led to the expansion of housing in all directions from the old neighbourhoods in the city centre. As a result, the urban landscape of Pobè can be divided into three types of housing: traditional, semi-modern and modern. **Figure 5** shows the evolution of the different types of housing in Pobè.

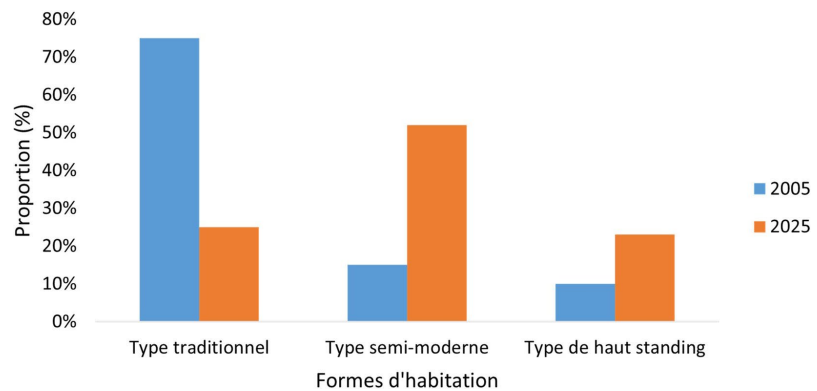


Figure 5. Evolution of housing types in the city of Pobè between 2005 and 2025.

Analysis of **Figure 5** shows that between 2005 and 2025, housing types underwent a transformation in the city of Pobè, with traditional housing gradually giving way to modern housing (**Plate 1**).



Plate 1. Types of housing in the city of Pobè.

Plate 1(a) shows a traditional dwelling in the Issalè-Affin 2 neighbourhood of the town of Pobè. This is the first type of dwelling known in the area after those with thatched roofs. This type is characterised by very dense community and working-class housing. The dwellings are built of plastered earth, without amenities, often in a state of disrepair and with corrugated iron roofs. Some are very old dwellings, consisting of huts and houses, arranged side by side with or without fences. They are built of precarious materials. **Plate 1(c)** presents a high-end residence, characterized by modern architecture, meticulous finishes, and quality materials, reflecting a significant level of investment. The presence of a second floor, furnished balconies, and a secure fence illustrates a desire for comfort and prestige, generally associated with rapidly expanding urban areas. This building thus reflects the current dynamics of the city of Pobè, marked by a progressive

transformation of its urban landscape. It illustrates the shift from traditional to modern housing, driven by rising living standards, the influence of urban models, and land pressure, contributing to urban sprawl and the reshaping of space.

3.2. Development Issues in the City of Pobè

3.2.1. Uncontrolled Urbanisation in Pobè: A Land Use Planning Challenge

For several years, the city of Pobè has experienced sustained demographic and spatial growth, driven by its status as the capital of the Plateau department, its proximity to Nigeria and the boom in its economic activities. However, this urban expansion has often been disorderly, without rigorous supervision, leading to major problems in land use planning. Many neighbourhoods have developed without prior planning, leading to uncontrolled densification and a lack of structured road networks. This is the case in the Itchèko and Talala neighbourhoods, where access is virtually impossible due to impassable roads.

The city of Pobè lacks the essential tools for urban management, and the few that are available are not always implemented effectively. Among the tools available are the Economic and Social Development Plan (PDES), the Municipal Health and Sanitation Plan (PHAC) and the Municipal Development Master Plan (SDAC). These are strategic documents intended to guide the spatial development of the municipality, but their implementation remains partial. They are often developed without up-to-date data or rigorous monitoring.

It should be noted that an Urban Development Master Plan (PDU) is currently being developed to regulate urban expansion and anticipate infrastructure needs. Overall, the urban management policy of the city of Pobè suffers from the absence of a functional land registry; however, the lack of reliable land data prevents effective land management. In addition, there is a low level of digitisation of urban data, which means that information on inhabitants, plots of land and infrastructure is rarely centralised or updated. Added to this is the unavailability of precise zoning plans, which makes it difficult to distinguish between buildable, administrative and protected areas.

Another significant problem associated with uncontrolled urbanisation is that of post-occupation subdivisions. In several areas of the city, people settled before any subdivision operations took place, making it difficult to regularise land ownership and set up basic infrastructure. The resumption of subdivision work in Pobè in August 2023 in the areas of Ayèrè, Ita-Atinga and Agbarou is a good illustration of this phenomenon. People have been living there for a long time, often without title deeds, which complicates demarcation, servicing and regularisation operations. This gap between occupation and planning creates social tensions, land conflicts and unsustainable urbanisation.

3.2.2. Problems Relating to Household Waste Management and Environmental Sanitation

The Pobè Town Council is the main institutional body responsible for household

waste management. In theory, it is responsible for: organising waste collection in neighbourhoods; setting up and maintaining collection points or intermediate dumps; coordinating transfer to treatment or landfill sites ; raising public awareness of hygiene and urban cleanliness. However, these tasks are very difficult to carry out due to a severe lack of financial, technical and human resources. The town does not have a fleet of vehicles suitable for regular collection. There are not enough rubbish bins and those that do exist are often in poor condition, which has led the City Council to call on NGOs specialising in waste management in Pobè, notably APESaB ONG. This NGO goes from house to house to collect household waste, which it transports to a landfill site that it has paid for itself and which is located on the northern outskirts of the city. It sorts through the waste to separate what it needs. However, the waste is not actually treated or recycled. To benefit from the services of this NGO, households pay a monthly fee of 1500 CFA francs, which is considered too expensive by the population, who refuse to subscribe. As a result, in the city of Pobè, less than 20% of the population subscribes to the waste collection service. This encourages people to dump their waste in public spaces, gutters or vacant lots. The rubbish tip shown in **Plate 2** clearly illustrates this situation.



Plate 2. Rubbish dump in Pobè-Nord.

Plate 2 shows how an empty plot of land has been turned into a household waste dump by local residents. These illegal dumps can be found all over the town of Pobè (**Figure 6**).

Figure 6 shows that the city of Pobè has 25 illegal dumps and five collection points, two of which are not operational. Faced with the limitations of waste management and urban sanitation strategies, in July 2025 the City Council asked SGDS S.A. to collaborate on a structured waste management plan through the BRIC (Building Resilient and Inclusive Cities) project.

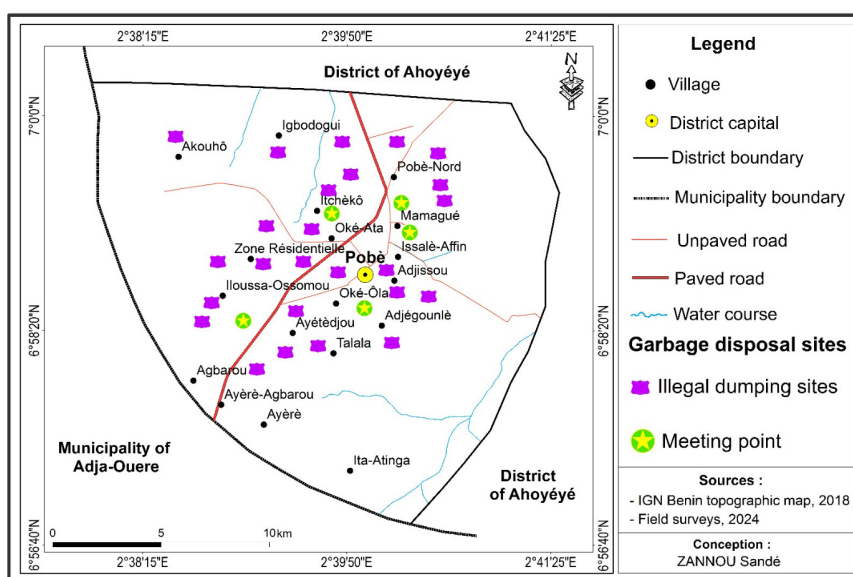


Figure 6. Spatial distribution of illegal dumps and household waste collection points in the city of Pobè.

3.2.3. Rain Erosion and Flooding in the City of Pobè

In the city of Pobè, erosion is one of the fundamental causes of soil degradation. The impacts of rain erosion are multiple and multifaceted, given the intensity of runoff and the slope. These include the formation of gullies and the stripping away of building foundations. Under the intensity of falling and runoff rain, gullies are becoming deeper and deeper. In certain neighbourhoods such as Ossomou, Talala, Illoussa, Adjissou and Adjégounlè, gullies can be seen on almost all unpaved streets, which are already in poor condition due to inadequate drainage and rain-water and wastewater disposal infrastructure. **Plate 3** illustrates the condition of some degraded roads in the town of Pobè.



Plate 3. Condition of some damaged roads in the town of Pobè.

Plate 3(a) shows a damaged road in the Oké-Ola neighbourhood and **Plate 3(b)** shows a damaged road in the Mamagué neighbourhood. This photo plate provides an overview of the effects of rain erosion on the soil in the city. Rainwater digs and carves furrows into the soil, making it difficult for people and goods to move around. This phenomenon also has a negative impact on homes by eroding the foundations of buildings. This situation can be explained by the fact that the city is located in a region with a gentle slope (**Figure 7**).

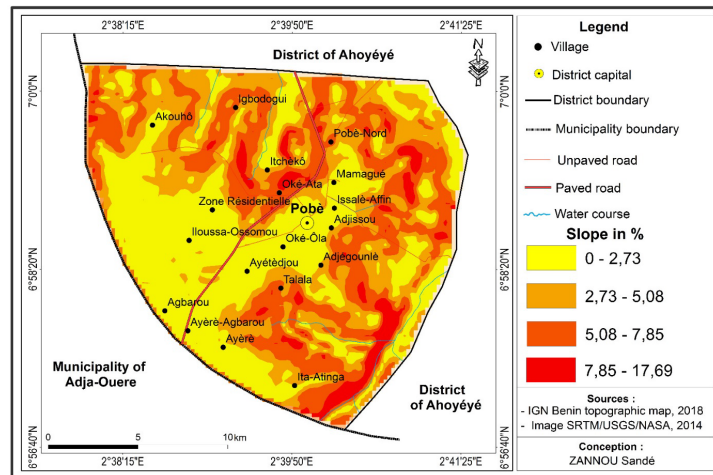


Figure 7. Slope of the town of Pobè.

Figure 7 allows us to classify the relief of this environment into four categories based on slope: areas with low relief and slopes between 0 and 2.73%, areas with moderate relief with slopes between 2.73 and 5.08%, areas with moderately steep relief with slopes between 5.08 and 7.85%, and areas with very steep relief with slopes between 7.85 and 17.69%. This terrain promotes the creation of ravines and gullies that are saturated with water throughout the rainy season, due to drainage and the stagnant movement of rainwater towards low-lying areas. In addition, the city of Pobè experiences cyclical flooding every year. Abundant rainfall, soil type and topography expose the city to the vagaries of nature. The variation in elevation within the city is illustrated by the digital terrain model (**Figure 8**).

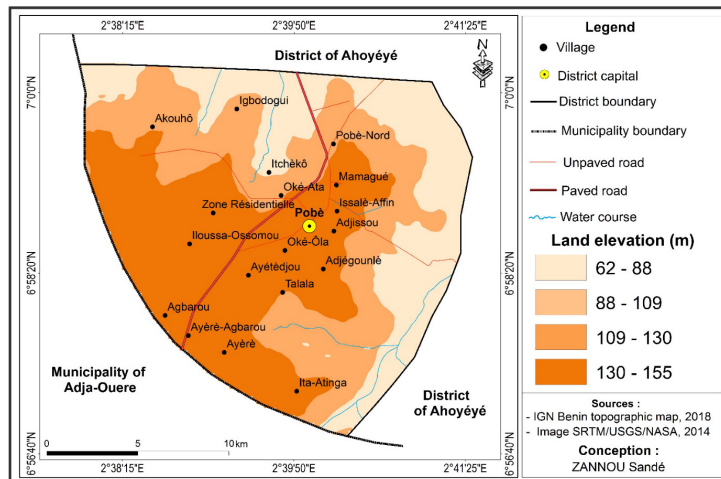


Figure 8. Altimetry of the town of Pobè.

Figure 8 shows that the territory of the city of Pobè has a very marked altimetry, varying between 62 and 155 m. There is therefore a difference in altitude of 93 m between the highest part located in the centre of the city and the northern part of the city. The hypsometry of this territory allows four different altitude classes to be dis-

tinguished. Low-altitude areas cover approximately 12% (3.71 km²) of the city's surface area. Located along streams and rivers, particularly in the far west and south-west of the city and part of the north, they define a landscape consisting mainly of valleys and wet depressions. Next, areas with altitudes ranging from 88 to 109 m border the first areas and cover 22% (6.78 km²) of the city's surface area, particularly in the Igbodogui region to the north of the city. The high-altitude areas (130 to 155 m) cover the very centre of the city and the extreme north of the study area, where they represent 48% of the total area, or 14.81 km². From north to south and west to east, the gradual increase in altitude influences the flow, accumulation and retention of rainwater on flat land in the form of lowlands and marshes. These areas are much more exposed to cyclical flooding due to the morphology of the environment and the lack of drainage infrastructure such as gutters, collectors, water retention basins, etc.

3.3. Summary of the SWOT Analysis Results

A summary of the SWOT analysis results is presented in **Table 3**.

Table 3. Summary of the SWOT analysis results.

STRENGTHS	WEAKNESSES
• Designated as the administrative centre of the Plateau Department since 2016, conferring a central administrative and logistical role. • Significant commercial dynamism due to its proximity to Nigeria (~18 km), which promotes the availability of goods and generates income. • Improved road network (Pobè-Onigbolo and Pobè-Adja-Ouèrè routes rehabilitated, secondary roads paved). • Significant community infrastructure: 23 state primary schools, district hospital, multi-sports stadium, court, prefecture. • Strategic planning tools available (PDES, PHAC, SDAC). • Resumption of land subdivision operations in 2023 (Ayèrè, Ita-Atinga, Agbarou), enabling gradual land regularisation.	• Lack of a functional land registry and poor digitisation of urban data (plots, residents, infrastructure). • Lack of a precise zoning plan and the inability to effectively implement existing planning tools. • Uncontrolled urbanisation: neighbourhoods developed without prior planning (Itchèko, Talala), impassable roads. • Very inadequate waste management: less than 20% of the population subscribed to waste collection, 25 illegal dumps identified. • Inadequate drainage and rainwater runoff infrastructure, contributing to erosion and gullies. • Low technical and financial capacity of municipal services in the area of urban planning.
OPPORTUNITIES	THREATS
• A decentralisation framework that encourages local authorities to take charge of development issues. • The existence of a Municipal Investment Fund (FIC) established at national level to help municipalities finance local development. • Project to draw up a Master Urban Plan (PDU) to regulate urban expansion. • Establishment of the Société de Gestion des Déchets Solides (SGDS) S.A. at central level for structured waste management and gradual extension to secondary towns. • Building Resilient and Inclusive Cities (BRIC) project for the construction of urban sanitation infrastructure in departmental capitals. • Project to establish a national land registry. • A steady influx of civil servants and institutional investors driving demand for housing and services	• The city's proximity to Nigeria exacerbates its vulnerability to security issues. • The predominance of the informal sector limits the city's ability to mobilise its own financial resources. • A proliferation of stakeholders, sometimes leading to conflicts over roles and responsibilities. • Rapid population growth exceeding urban planning capacities. • The city's topography and soil sealing leading to recurrent flooding. • Uncontrolled urbanisation with a sharp increase in built-up areas. • Rainwater erosion weakening roads and foundations in several neighbourhoods.

4. Discussion

The results of this research provide an overview of the factors influencing the dynamics of the environment in the city of Pobè. The data collected show that demographics are the most influential factor, followed by the growth of economic activities, particularly trade, road development and the designation of Pobè as the capital of the Plateau department. These various factors are causing profound spatial changes in the city with the construction of housing. These results are in line with the conclusions of [13], who emphasise that the construction of socio-community infrastructure (19%), population explosion (28%) and land subdivision (15%) are the main factors determining the spatial dynamics of the municipality of Adjara.

However, the case of Pobè extends these analyses by highlighting the decisive role played by the town's administrative status, which has boosted its residential and economic appeal at the departmental level. This pattern confirms the 'combined factors' model commonly described in the literature on West African secondary towns, according to which population growth alone is not sufficient to explain urban sprawl: it is its interplay with political and administrative decisions and local economic dynamics that determines the pace and morphology of expansion [14]. A diachronic analysis of land use reveals a significant increase in built-up areas between 2005 and 2024, rising from 23.3% (719 ha) to 45.22% (1,395 ha) of the urban area. This development is part of the general trend observed in Beninese and West African cities, characterised by the increasing consumption of natural and agricultural land as a result of urbanisation. These findings corroborate those of [15], who demonstrated a significant expansion of residential areas at the expense of fields and fallow land in southern Benin. This dynamic is also observed by [16] south of the Sakété Plateau, where the acceleration of urbanisation is reflected in a proliferation of infrastructure and housing, leading to the gradual fragmentation of the landscape. According to this author, this expansion into the countryside is largely driven by economic factors that encourage an often unregulated occupation of the land, outside the bounds of urban planning regulations, a situation comparable to that observed in the town of Pobè. However, the situation in Pobè has certain specific characteristics.

Due to its location on the border with Nigeria and its role as a regional administrative centre, land pressure appears to be particularly acute there. This situation encourages sprawling and often poorly controlled urbanisation, a feature common to many of Benin's secondary towns, but one whose intensity appears to be exacerbated in Pobè by cross-border and administrative dynamics. The shortcomings observed in terms of urban planning, notably soil erosion, flooding, poor household waste management and limited control over land use, reflect the difficulties faced by local authorities in keeping pace with urban growth. These findings confirm the work of [17], who highlights that the municipalities of the Inter-municipal Eco-Development Zone face environmental and land-use constraints that limit their development. These observations also align with those of [18] in

the Agblangandan district, where the urbanisation of non-aedificandi zones is causing numerous planning difficulties and a deterioration in the living environment of the population. The authors highlight the frequency of flooding, water and soil pollution, the accumulation of waste, as well as health issues and problems with access to infrastructure, illustrating the environmental and social consequences of poorly regulated land use. Unlike [17], who focuses primarily on the territorial constraints on development, [18] provide a more in-depth analysis of the direct effects of uncontrolled urbanisation on residents' living conditions, reinforcing the argument that the problems observed in Pobè are not merely issues of urban planning, but also concerns regarding public health, quality of life and urban sustainability. However, the findings of this study suggest that these problems do not stem solely from natural factors, but also from institutional shortcomings in urban governance. Thus, the urban expansion of Pobè appears to be more a case of spontaneous urbanisation than the result of structured spatial planning.

This situation is exacerbated by the limited operational capacity of municipal technical services and by the absence or inadequate implementation of certain urban planning instruments. The lack of tools such as the land-use plan or the land registry, as well as the limited implementation of existing documents such as the Economic and Social Development Plan (PDES), the Municipal Health and Sanitation Plan (PHAC) and the Municipal Development Master Plan (SDAC), encourage the establishment of unauthorised buildings and complicate future development interventions. These observations are in line with those of [19], who emphasises that the rapid and uncontrolled urbanisation of Cotonou is closely linked to shortcomings in planning and local administration. This analysis is also corroborated by [20], who shows that the accelerated urbanisation of Cotonou has been accompanied by the unregulated occupation of wetlands and flood-prone areas, as well as inadequate management of environmental constraints. According to this author, poor compliance with town planning regulations and inadequate spatial management tools contribute to increased risks of flooding, erosion and unsanitary conditions, which reinforces the need for urban planning based on effective mapping and land management tools. The case of Pobè shows that this issue does not only affect major cities, but also secondary towns, where human, technical and financial resources are often more limited.

The results obtained nevertheless have certain methodological limitations that should be highlighted. On the one hand, the analysis of spatial dynamics relies on the classification of satellite imagery, the accuracy of which may be affected by the spatial resolution of the data and by spectral confusion between certain categories of land-use units. On the other hand, data from field surveys reflect the perceptions of households and local stakeholders at a given point in time; they may therefore contain biases related to the representativeness of the sample or to the respondents' statements. Despite these limitations, the cross-referencing of satellite, documentary and survey data has helped to strengthen the reliability of the results

obtained. From an operational perspective, the findings highlight the need to strengthen urban governance in Pobè. It appears essential to equip the municipality with up-to-date land-use planning and management tools, to build the capacity of the municipal technical services, and to improve the monitoring of land use. The implementation of integrated policies for stormwater management, erosion and flood control, as well as improvements to the household waste collection and treatment system, are also priorities. More broadly, the lessons learned from this study may be useful to other secondary towns in Benin facing rapid urban growth and similar planning challenges, thereby contributing to the development of more sustainable and resilient urban development strategies.

This study could be expanded if the quality of the Landsat images used were better, given that the work is being carried out at the sub-city level. It should be noted that studies in urban areas conducted using remote sensing typically employ lower resolution (less than 10 m, for example). However, the data used here have yielded satisfactory results.

5. Conclusion

At the end of this research, it should be noted that the city of Pobè is characterised by strong demographic and economic growth, with remarkable spatial expansion as a corollary. This spatial growth is taking place through the sprawl of the city towards its outskirts, engulfing formerly rural areas. Several factors are contributing to this dynamic, including population growth, the boom in economic activity, road development and the designation of Pobè as the capital of the Plateau department. The combination of these factors has led to unprecedented spatial expansion of the city of Pobè, with the construction of housing and socio-community and administrative infrastructure. As a result, natural formations and palm grove cultivation have declined significantly in favour of urban areas, which have grown from 23.3% in 2005 to 45.22% in 2024. This urban dynamic has implications for development. These include environmental problems (flooding, erosion, soil degradation), poor household waste management, unsanitary conditions, uncontrolled population growth and difficulties related to land subdivision. In the face of these land use planning problems, bold measures must be taken to improve the well-being of the population.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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