International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	THE CITY AND ITS SPATIAL TRANSFORMATIONS: A DIACHRONIC AND QUANTITATIVE ANALYSIS OF THE URBAN SPRAWL PROCESS. CASE STUDY OF TÉBESSA (ALGERIA)
ARTICLE INFO	Radhia Decha, Mohammed Cherif Adad. (2024) The City and Its Spatial Transformations: A Diachronic and Quantitative Analysis of The Urban Sprawl Process. Case Study of Tébessa (Algeria). *International Journal of Innovative Technologies in Social Science*. 4(44). doi: 10.31435/ijitss.4(44).2024.3091
DOI	https://doi.org/10.31435/ijitss.4(44).2024.3091
RECEIVED	02 November 2024
ACCEPTED	24 December 2024
PUBLISHED	30 December 2024
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

THE CITY AND ITS SPATIAL TRANSFORMATIONS: A DIACHRONIC AND QUANTITATIVE ANALYSIS OF THE URBAN SPRAWL PROCESS. CASE STUDY OF TÉBESSA (ALGERIA)

Radhia Decha *(Corresponding Author)*
Ph.D. Student, Institute Of Management of Urban Techniques. Laboratory of Natural Resources and Management of Sensitive Environments (RNAMS) . University Larbi Ben M'hidi, Oum El Bouaghi, Algeria
ORCID ID: 0009-0005-2430-8960

Mohammed Cherif Adad
Professor, Faculty of Earth Sciences and Architecture. University Larbi Ben M'hidi, Oum El Bouaghi Algeria
ORCID ID: 0000-0001-7647-194X

ABSTRACT

Urban sprawl is a significant phenomenon affecting many cities, including the city of Tebessa in Algeria. This spatial dynamic, characterized by often uncontrolled expansion of the urban fabric towards the peripheries, generates profound transformations in the morphology and functioning of cities. This article proposes an in-depth analysis of this process through a methodology combining diachronic analysis and spatial quantitative analysis. The objective is to model the percentage of built-up area as a function of distance from the historic core, using a logistic function. This approach highlights the transition between the compact urban fabric of the center and the dispersed periphery, thus offering a measure of urban dilution. The study reveals that Tebessa has undergone significant spatial transformation since independence, transitioning from a compact urban morphology to a more extensive urban sprawl. The results demonstrate a gradual decrease in building density radiating outward from the center, illustrating the phenomenon of spatial dilution. Although urban expansion continues, its pace tends to stabilize. This research underscores the utility of the logistic model for understanding and forecasting urban growth dynamics, offering a new perspective on the spatial evolution of cities.

KEYWORDS

Building Density, Urban Dilution, Urban Sprawl, Logistic Model, Tebessa

CITATION

Radhia Decha, Mohammed Cherif Adad. (2024) The City and Its Spatial Transformations: A Diachronic and Quantitative Analysis of The Urban Sprawl Process. Case Study of Tébessa (Algeria). *International Journal of Innovative Technologies in Social Science*. 4(44). doi: 10.31435/ijitss.4(44).2024.3091

1. INTRODUCTION

The city, a complex and dynamic entity, presents itself as a living organism in perpetual evolution. Over time, its morphology transforms, transitioning from a compact form to a more sprawling and diluted one. Cities grow, expand, and sprawl on a global scale (VÉRON, 2008). Kevin Lynch, in his book "The Image of the City" offers an illuminating vision of this urban reality: *"A city is a changing organization with multiple uses, a space with many functions, built by many hands in relative coherence"* (LYNCH, 1960). This definition highlights the multidimensional and collaborative nature of urban space, emphasizing the diversity of actors and functions that contribute to its formation and evolution.

The city is the form and symbol of an integrated social relationship (MUMFORD, 1961). This relationship evolves and becomes more complex with urban growth, leading to profound urban mutations.

These mutations are defined as changes that affect the structure and functioning of cities. They manifest in various forms and have significant impacts on the urban fabric, society, and environment. These transformations include spatial, social, economic, and environmental modifications that continuously reshape the urban landscape.

Urban growth, the main driver of these mutations, manifests itself today primarily through spatial dilation or urban sprawl. This recent process of urban growth creates "Urban footprint" that spread in a low-density and discontinuous manner over surrounding rural areas (RITCHOT, 1994). This peripheral growth induces significant urban mutations: decreasing densities, the extension of agglomerations towards peripheral communes forming conurbations, and in parallel, new polarities emerge (GALSTER, et al. 2001); (EWING, 2002) posing many challenges in terms of infrastructure management, preservation of agricultural lands, and access to services and facilities.

Algeria, like many countries experiencing profound mutations in the urban domain, has been confronted with the phenomenon of urban sprawl. Since its independence in 1962, the country has experienced exponential growth in its urban population accompanied by rapid and often unplanned urbanization. As SEMMOUD points out, *"Algerian cities have experienced significant spatial sprawl in recent decades due to several factors: rural exodus, demographic explosion, speculative logic"* (SEMMOUD, 2003).

Côte adds that Algerian urbanization is characterized by considerable sprawl and diffuse urbanization that is difficult for public authorities to control just after independence (CÔTE, 1994). Like Algerian cities, the city of Tebessa has not escaped this movement. Since its promotion to the rank of wilaya capital in 1974, it has experienced strong demographic growth accompanied by rapid spatial expansion, profoundly transforming its landscape and urban morphology.

In this context, the present study aims to analyze and quantify the phenomenon of urban sprawl in the city of Tebessa. It will allow for a better understanding of the specificities of urbanization in this city. To explore this dynamic in depth and guide our analysis, we will rely on the following research questions:

- What are the main forms and directions of urban sprawl in the city of Tébessa?
- What indicators and methods are most appropriate for quantifying and characterizing the process of urban sprawl in the city of Tébessa?

2. METHODOLOGICAL APPROACH OF THE STUDY:

This study adopts a dual methodological approach to analyze and quantify the process of urban sprawl in Tebessa, combining diachronic and spatial quantitative analyses:

a) Diachronic Analysis: This approach aims to trace the historical evolution of urban sprawl in Tebessa. It allows for:

- Identification of different phases of urban development.
- Understanding growth trends over time.
- Offering a longitudinal perspective on the city's expansion.

b) Spatial Quantitative Analysis: This approach measures he extent of urban sprawl by:

- Calculating the percentage of built-up area in relation to the distance from the city center.
- Quantifying the progression of urbanization from the historic core to the periphery.

c) Morphological Analysis through Dilution: At the heart of our methodology is the morphological analysis through dilution, a technique rooted in geographical tradition. This method consists of:

- Examining the evolution of the percentage of built-up area as a function of distance from the historic center.
- Quantifying and visualizing the spatial structure of the city.
- Providing valuable insights into the dispersion of the urban fabric and dynamics of urban sprawl.

Our study will follow a rigorous methodological structure. We will begin by precisely defining the notion of dilution, then present the model used and its relevance. This model will then be applied to our study area, allowing us to gain an in-depth understanding of the spatial and temporal dynamics of its urban sprawl.

2.1. Definition of Urban Dilution:

The notion of urban dilution, although commonly used in geography, does not have a universally accepted definition. However, several authors have contributed to its conceptualization:

The concept of urban sprawl is often envisioned as a gradual transition between urban and rural areas. DAVID (1984) describes it as a continuum, BERGER (1989) evokes the expression **"buffer zone",** which Anglo-Saxons qualify as **"rural-urban continuum"** or **"rurban belt".** However, the relevance of classical demographic approaches to analyze this essentially morphological phenomenon is questioned. BURGEL (1991) associates dilution with low-density suburban extensions. BRUNET (1992) does not directly define dilution but evokes related concepts such as dissolution and dispersion. SENECAL and al (1994) link dilution to dispersion, low densities, and discontinuity of urban space. "*BORDREUIL and al (1995) contrasts the diluted city with the compact city, defining dilution as a space with a* ***"lower content"*** *of built-up area."* Cited by (ENAULT, 2003, p.233).

JEANNIC (1997) uses the term to describe the mutation of urban spaces moving away from the structure of the dense center. FRANKHAUSER (1998) questions the distinction between density and compactness. FRANKHAUSER (1994) identifies four types of spaces in the urban structure, ranging from a compact center to a diffused periphery.

Researchers like HIRSCH (2000) have already explored in 2000 the relationships between the percentage of built-up areas and the distance from the historic center. Following these research lines, GUEROIS and ENAULT proposed in 2003 a study of urban form also based on building density. The percentage of built-up area decreases as one moves away from the historic center. This gradual decrease in the density of constructions is referred to as urban dilution.

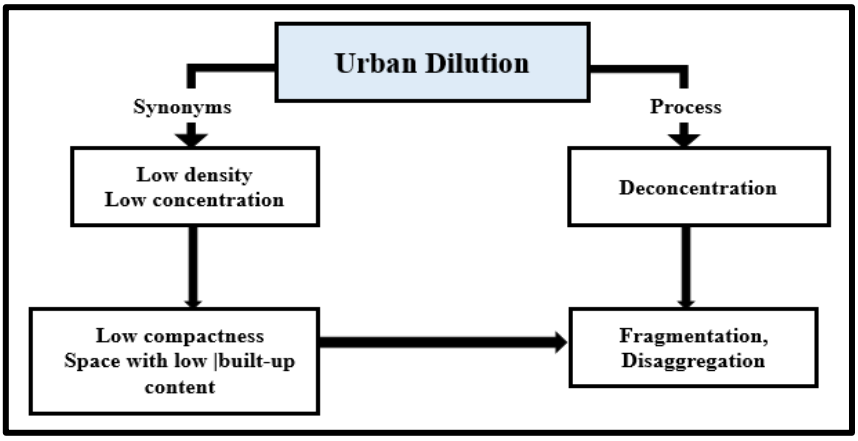


Fig. 01. Definition of urban dilution according to ENAULT
Source: ENAULT (2004) + Established by the author (2022)

2.2. The Dynamics of Urban Dilution: Towards a Center-Periphery Continuum

2.2.1. A change in the rupture between the center and the periphery: Over the long term, we observe an evolution of the transition between the center and the periphery, shifting from a spatial rupture to a continuum. That is, the distinction between the center and the periphery was quite clear, with a sharp break between the two. However, this rupture evolves over time, becoming less marked and transforming into a continuum where the boundaries between the center and the periphery become more blurred and less defined. This mutation can be considered a concrete manifestation of urban dilution.

2.2.2. A complexification of city limits: Urban boundaries, once simple and linear, become more complex and adopt a form resembling a fractal structure. This evolution is characterized by urban contours becoming more irregular and less predictable, resembling more of a surface than a simple line.

2.2.3. Widening of the transition zone: Consequently, the zone separating the center from the periphery widens considerably. This transition zone is characterized by:

- An increasing combination of built spaces (buildings) and unbuilt spaces (green spaces, agricultural areas, etc.).
- A more gradual gradation of urban densities.
- A less defined boundary between urban and rural areas**. (See Figure 02)**

This dynamic of urban dilution thus redefines the spatial structure of cities, replacing the traditional model of center-periphery rupture with a more complex and nuanced urban-rural continuum.

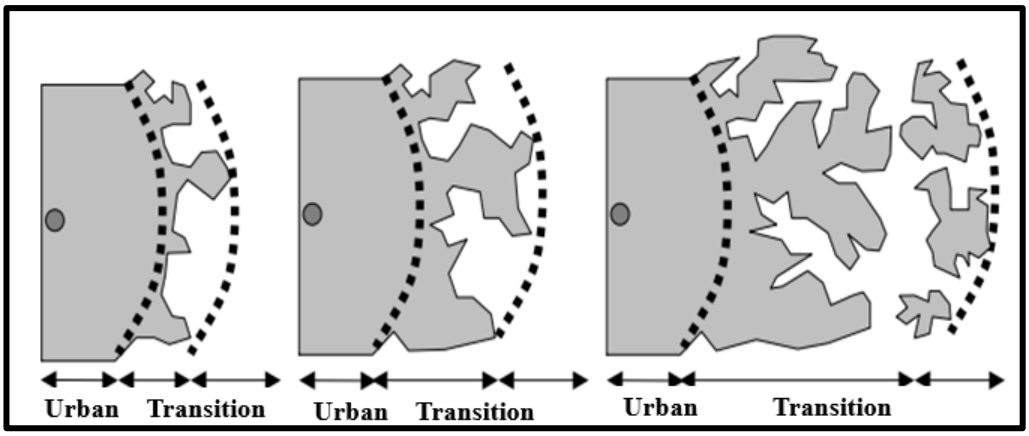


Fig. 02. The dynamics of urban dilution
Source: ENAULT (2003)

2.3. A Logistic Function to Analyze the Process of Urban Dilution: To analyze this process, we propose modeling the percentage of built-up area as a function of distance from the city's historic center, using a logistic function. This approach allows highlighting a smooth transition between the compact center and the diluted periphery, thus offering a measure of urban dilution based on the percentage of built-up area. This method is inspired by FANKHAUSER'S work on fractals and based on studies by GUEROIS and ENAULT on urban form and density using a logistic function.

The logistic model, as presented by PUMAIN (2001), illustrates the evolution of populations between a minimum and maximum threshold, following exponential growth. According to their description, **"the absolute variation will be between a level X0 reached at time t0 and a level N that cannot be exceeded"**, expressed by a differential relation where the variation of a function x, dx depends on a limit N.

The expression of the logistic model is based on the following equation:

$$D(x) = (Ne^{(-\omega x+p)}) / (1+e^{(-\omega x+p)}) \quad (1)$$

Where:
x: Denoting the distance t from the historic center in kilometers
N: Denoting the level of saturation that cannot be exceeded (here =100% of the urbanized area)
ω: Denoting the gradient of the logistic model
P: Denoting the parameter of distance from the historic center
e: Denoting Napier's constant (≈ 2.71828)
The linearization of the previous equation results in:

$$\text{Ln}\,(D(x) / (N-D(x))) = \omega * x + P \quad (2)$$

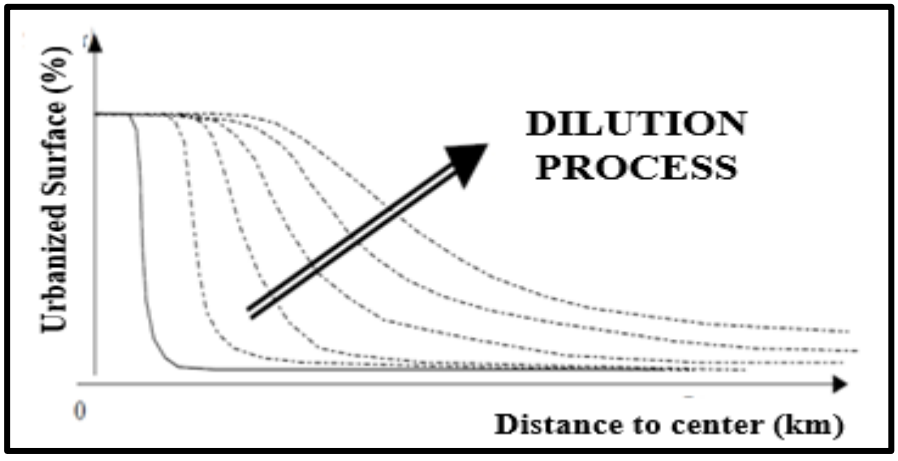


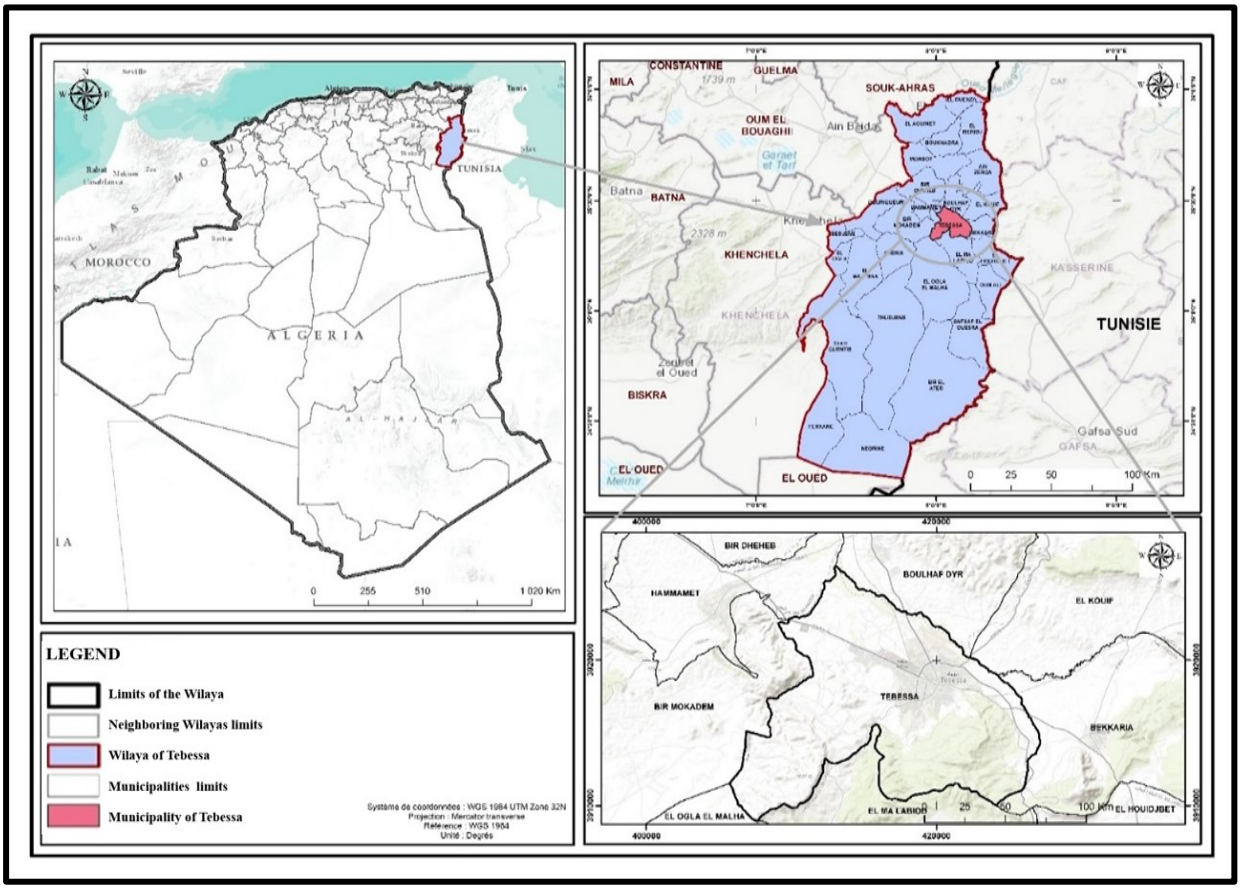
Fig. 03. Urban dilution process. Source: ENAULT (2003)

This decreasing logistic model used in this analysis tends to widen the transition zone between the two extremes of the urban profile. Mathematically, this translates into a reduction of the dispersion factor ω and an increase in the sprawl coefficient p. In a dynamic perspective, the parameter **ω** decreases with time, while **p** increases as a function of time **t**.

2.4. Presentation of case study Tébessa (Algeria):

The study area is defined as the city of Tébessa, represents the chief town of wilaya (province). It occupies a remarkable geographic position from all perspectives: its central location, its proximity to the Algerian-Tunisian border (30 km), and its situation at an important node of communication routes (National Roads 10, 83, 16, and the railway line). It extends over an area of 184 km², which is 1.33% of the total area of the wilaya.

As of December 31, 2023, its population reached 253,826 inhabitants, resulting in an average population density of 1,379 inhabitants/km² (23 times higher than the wilaya average of 60 inhabitants/km²), distributed across 11 sectors. Housing 30% of the total population of the wilaya, it represents the most populated commune in its wilaya **(see map 01)**.



Map 01. Location of the study area
Source: Established by the author (2020)

3. RESULT AND DISCUSSION

3.1. Diachronic analysis of urban growth in the city of Tebessa: "From ancient Theveste to the contemporary city"

The study of a city's urban growth process over time is a crucial element in understanding its current structure, challenges, and future potential. In this context, the diachronic analysis of Tebessa's urban growth emerges as a relevant methodological approach to comprehend the spatio-temporal dynamics that have shaped its current urban landscape. Tebessa presents a rich historical heritage reflected in its urban fabric. From the

ancient Roman Theveste to the contemporary city, through the Byzantine, Arab, and colonial periods, the city has experienced phases of growth, stagnation, and transformation that deserve particular attention.

This diachronic analysis aims to trace the major stages of Tebessa's urban expansion, which are: the pre-colonial period, the colonial period, and the post-independence period to present day. This temporal structuring will allow us to analyze in detail the urban transformations and forms of urban growth specific to each period:

3.1.1. The pre-colonial period: before 1842

Table 01. Table presenting an overview of Tebessa's urban evolution during the pre-colonial period

The Roman period		
Events	**Urban Characteristics**	**Form of Growth**
-Strategic occupation of the site -Establishment of an important road network	-Orthogonal plan with CARDO Maximus (North-South) and DECUMANUS Maximus (East-West) -City center: Caracalla's Triumphal Arch -Proximity to water resources and agricultural lands -Junction point of eight distinct roads, connecting Theveste to several cities -Development of agriculture and hydraulic system. -Construction of prestigious monuments (triumphal arch, temple, BOUZEGUANE oil mill, museum, Temple of Minerva, Christian Cemetery)	-The CARDO and DECUMANUS represent the two main streets of the old city, the urban structure preserving the layout and direction of the Roman roads CARDO (national road n°10) and DECUMANUS (national road n°41) **(see map 02)**
The Byzantine period		
Defensive reconstruction	-Citadel on Roman remains Fortified enclosure: 320m x 280m -Walls of 9 to 10m, towers of 14.50 to 17m -Two doors : Caracalla and Salomon -Respect for Roman organizational axes **(see map 03 and 04)**	-Intra-muros concentration -Morphology: Rectangular block enclosed by a fortification wall -Creation of the current historic center of Tebessa
The Islamic period		
-Conquest in the 7th century -Brief Berber domination -Hilal invasion (1056) -Hilalian domination (4 centuries) -Turkish sovereignty (1573-1842)	-Transition from Thevest to Tebessa -Adaptation of existing structures Construction of the El Atik mosque (Turkish period)	-Limited growth City surface reaching 8.9 hectares

Source: (ROCCA and BEJAOUI, 2021, P 223-239) +Established by the author (2022)

3.1.2. The colonial period: from 1842 to 1962

Table 02. Table presenting an overview of urban transformations and forms of growth in Tebessa during the colonial period

From 1842 to 1851		
Events	**Urban transformations**	**Form of growth**
French occupation attempts from 1842, definitive occupation in 1851	-Beginning of city reorganization **(see map 05)**	-Preparation for extension
From 1851 to 1932		
-Establishment of colonial power -Spatial segregation	-Creation of two distinct urban fabrics: 1. **Colonial fabric in checkerboard pattern** with wide roads, orthogonal grid, residential blocks 2. **Indigenous fabric in the North,** spontaneous and traditional in character Construction of military barracks within the Byzantine enclosure Creation of the military quarter, church, hospital Installation of the railway network Implantation of colonial and Arab-Muslim houses in the old center Construction of public facilities (hospital, barracks, public gardens, town hall, school, cinema) Extension of the urban area to 53.35 hectares **(see map 06)**	- City expansion -Planned growth for the colonial fabric -Spontaneous development of the indigenous fabric -Expansion within Byzantine walls -Extensions in colonial suburbs along Roman road axes (Roman CARDO) and (Roman DECUMANUS).
From 1932 to 1962		
-Implementation of the development plan of 1931 -- Intensification of colonization	-Urban development along two axes: East-West (towards El-kouif) and North-South (towards Constantine) -Densification of buildings to fill empty spaces -Expansion beyond previous limits	- Growth organized according to the 1931 development plan - Significant spatial extension -Increase in urban area to about 126.05 hectares (136% increase in 30 years)

Source: (GSELL, 1901, P. 204) and (MOLL, 1886, P. 33-34) +Established by the author (2022)

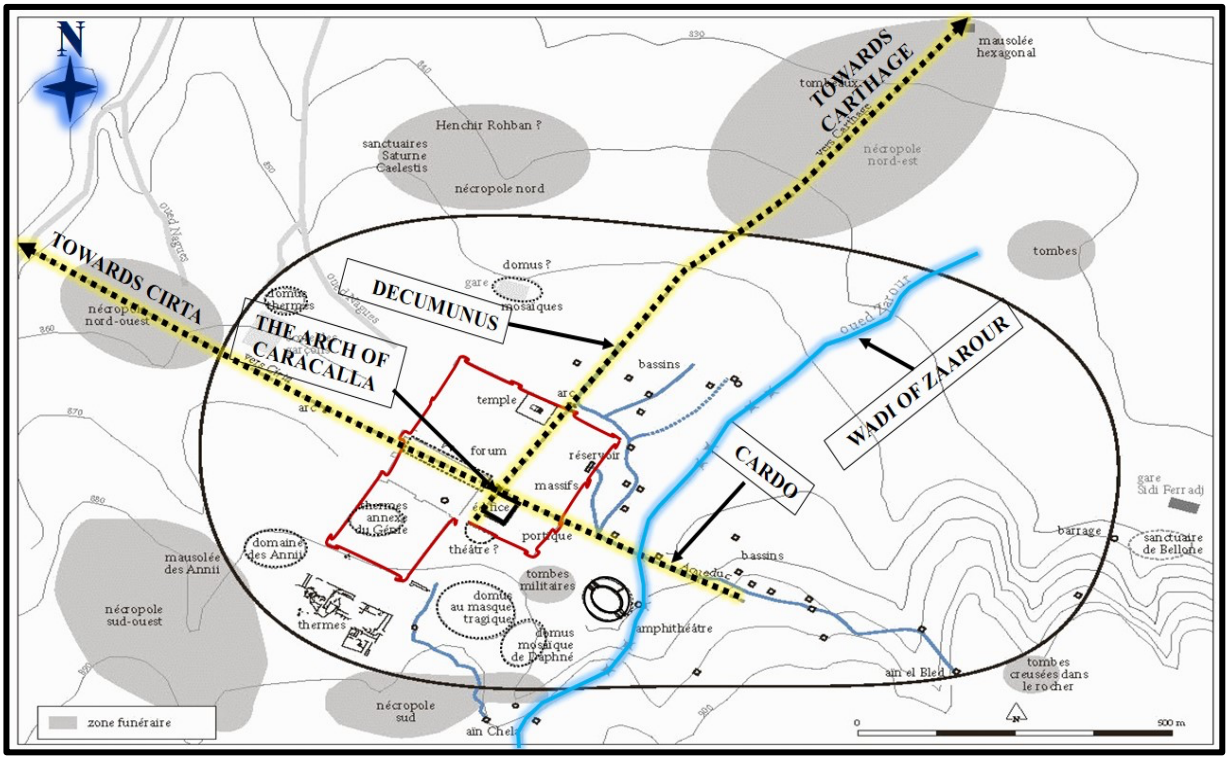
3.1.3. The post- independence period to present day: from 1962 to today

Table 03. Table summarizing urban transformations and forms of growth in Tebessa during the post-colonial

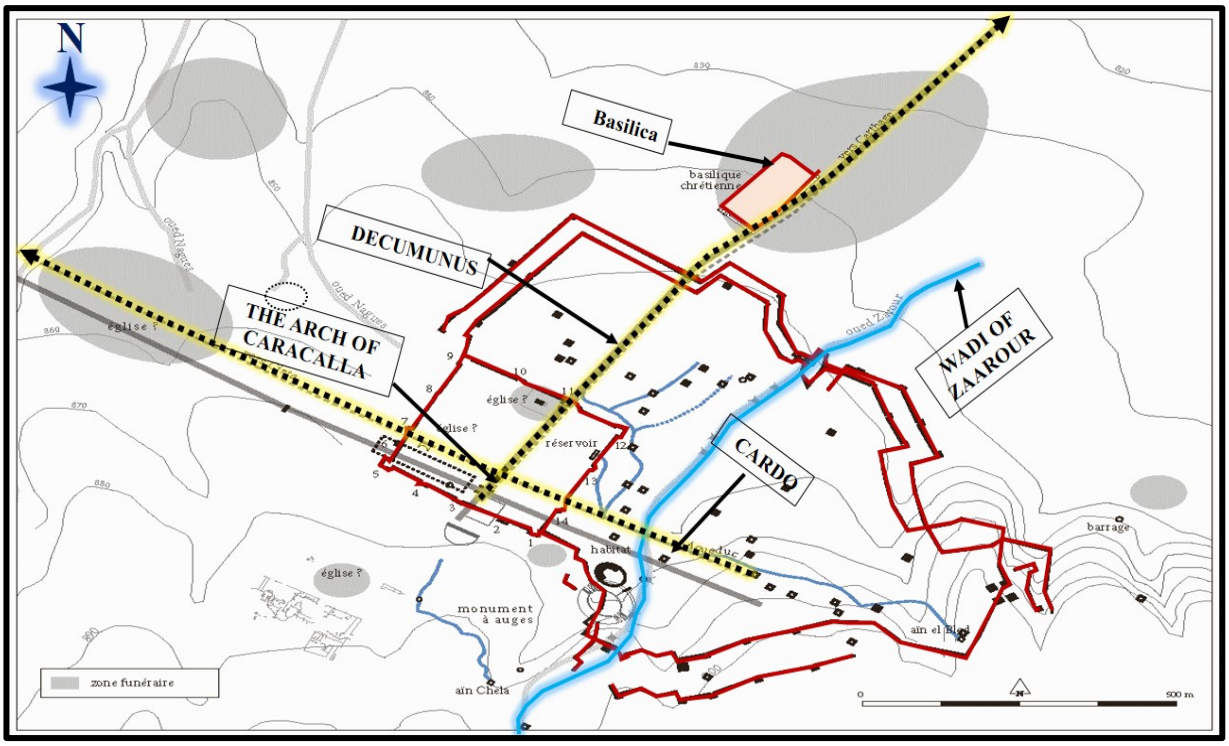
From 1962 to 1988		
Events	**Urban Transformations**	**Form of Growth**
-Independence in 1962, Tébessa gained value at local and regional levels due to its agro-pastoral and mining assets. These led to its classification as a wilaya capital in 1974. This classification caused significant rural exodus, consequently increasing the population.	-During this period, Tébessa underwent flagrant spatial growth accentuated by highland consumption, seeing many urban changes, namely: housing construction, proliferation of commerce and services, establishment of new facilities, and creation of the airport and industrial zone. -Construction of a considerable number of ZHUN, housing estates, facilities, collective housing, and self-construction	Two types of urban development: the first is regulated, while the second is anarchic. This urban development was organized around the old center, We note that the city's extension during this period was towards the northeast and west near national roads n°10 and n°16. This extension translated spatially into a densification of empty fabrics

From 1988 to present		
-Housing and equipment programs -Expansion beyond the old center (from 1990) -Urban sprawl along RN10 towards Constantine	-Extension on agricultural lands and industrial zone -Creation of ZHUN3 and new collective housing neighborhoods -Development of spontaneous neighborhoods in the South and Southeast -Development of new planned neighborhoods according to urban planning instruments (PDAU, POS) -Transformation of agricultural lands into urban zones -Creation of tentacular extensions -Massive construction of participatory and social housing -Realization of new public facilities	-Linear urban sprawl towards the Northwest (along the RN10 axis) -Extension constrained to the south by natural obstacles -Emergence of a conurbation with neighboring communes like Boulhaf Dyr -Development of the city along major road axes -City surface reaching 2998 hectares **(see map 07)**

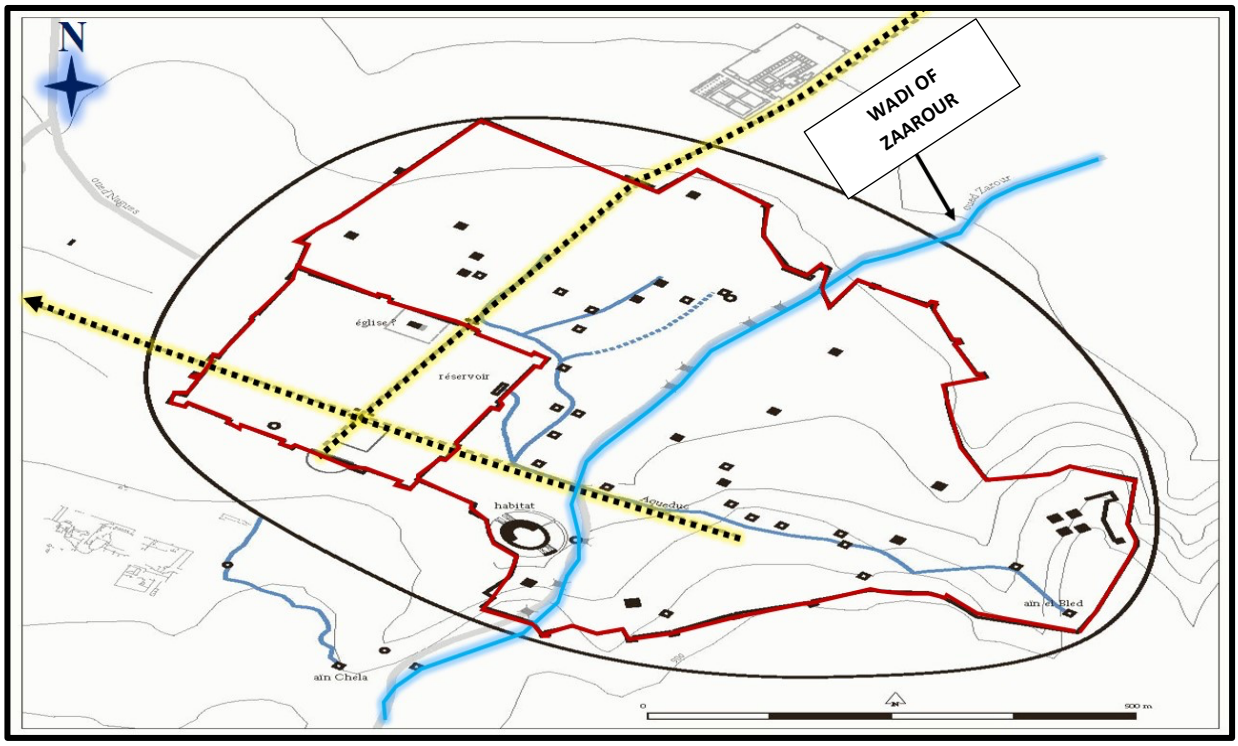
Source: (GSELL, 1901, P. 204) and (MOLL, 1886, P. 33-34) +Established by the author (2022)



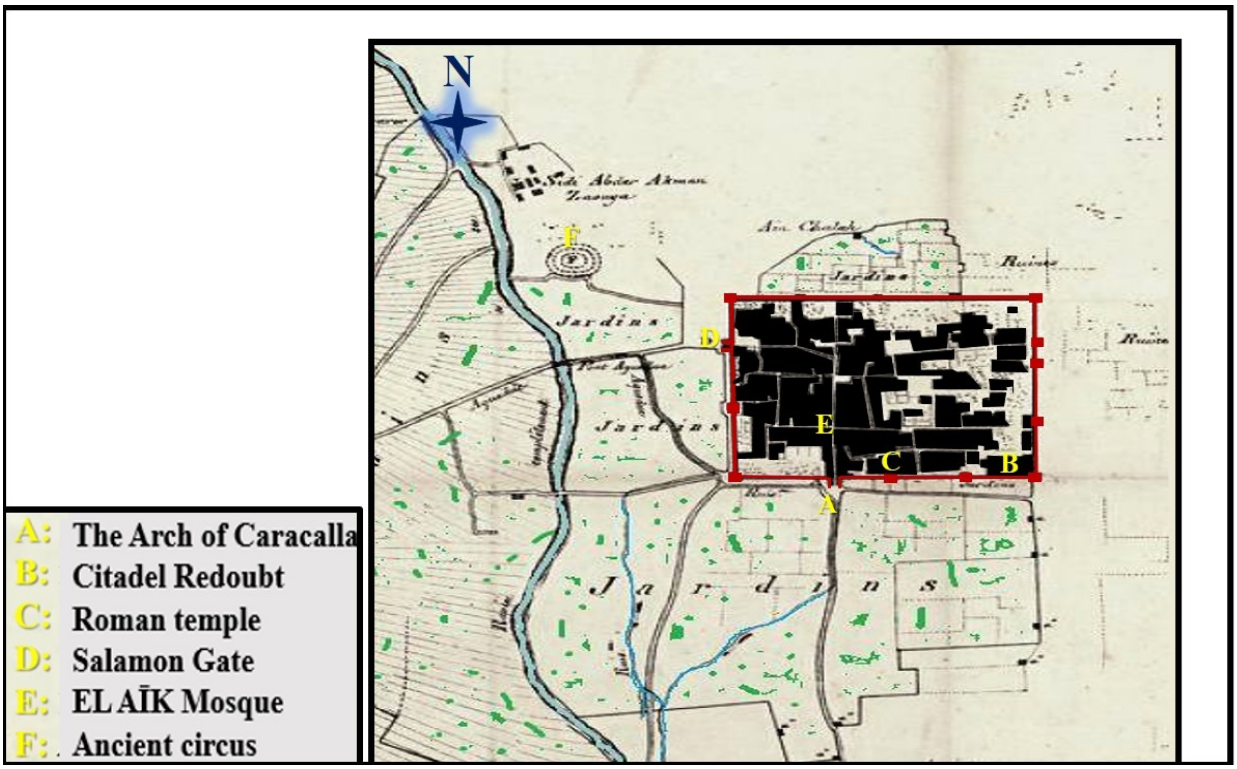
Map 02. The city of Tébessa during the Roman period
Source: Rocca & Bejaoui (2021) + Established by the author (2022)



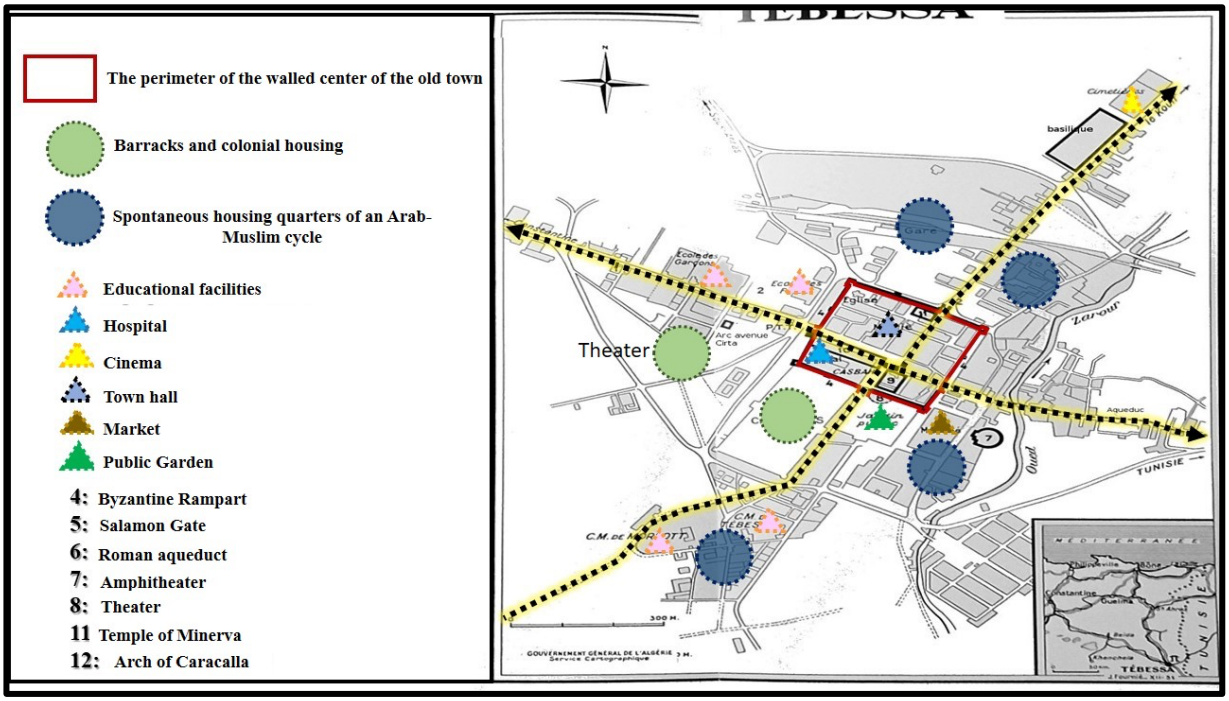
Map 03. Tébessa at the beginning of the Byzantine period
Source: Rocca & Bejaoui (2021) + Established by the author (2022)



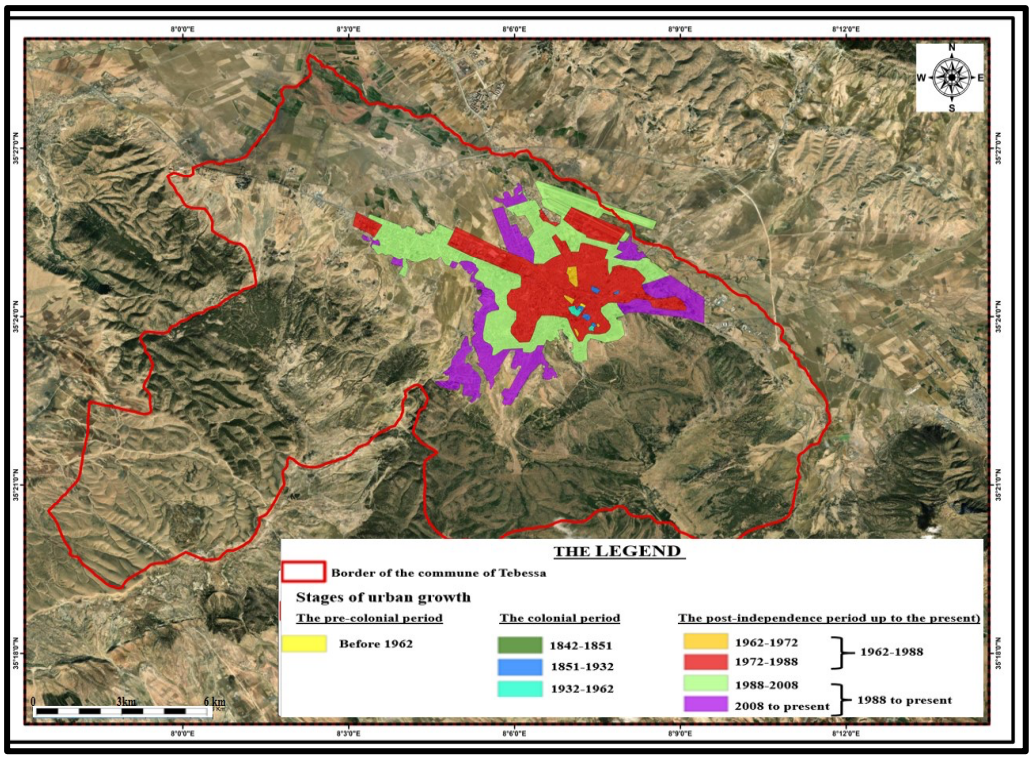
Map 04. Tébessa at the end of the Byzantine period and the beginning of the Islamic period
Source: Rocca & Bejaoui (2021) + Established by the author (2022)



Map 05. Layout plan of the city of Tébessa in 1842
Source: https://gallica.bnf.fr/ark:/12148/btv1b530614987



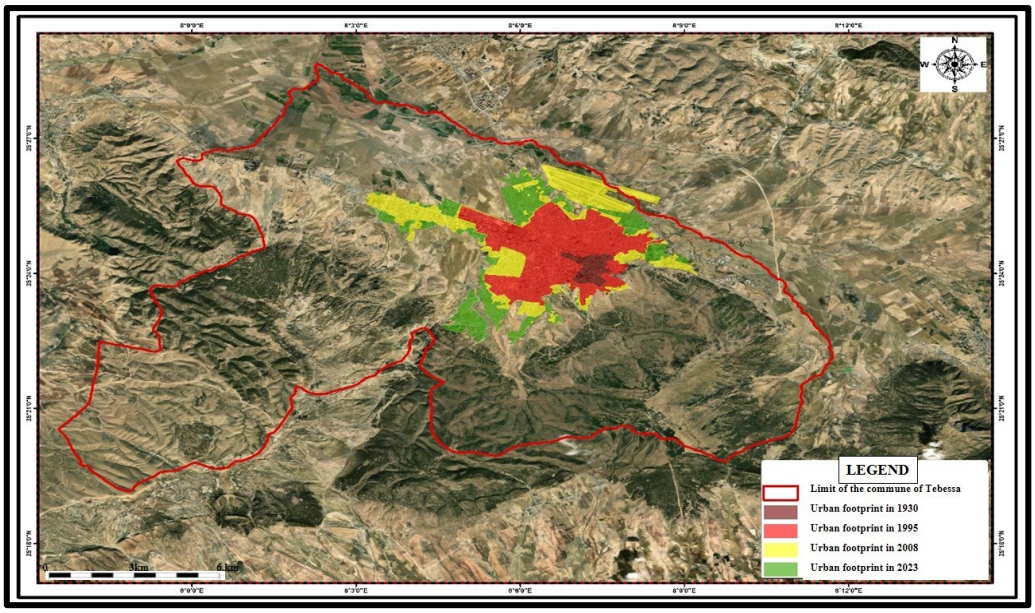
Map 06. Layout plan of the city of Tébessa in 1956
Source: https://gallica.bnf.fr/ark:/12148/btv1b530614987



Map 07. Stages of urban growth of the city of Tébessa
Source : Established by the author (2023)

3.2. Quantitative analysis of the urban sprawl process in the city of Tébessa through the application of the logistic model of urban dilution:

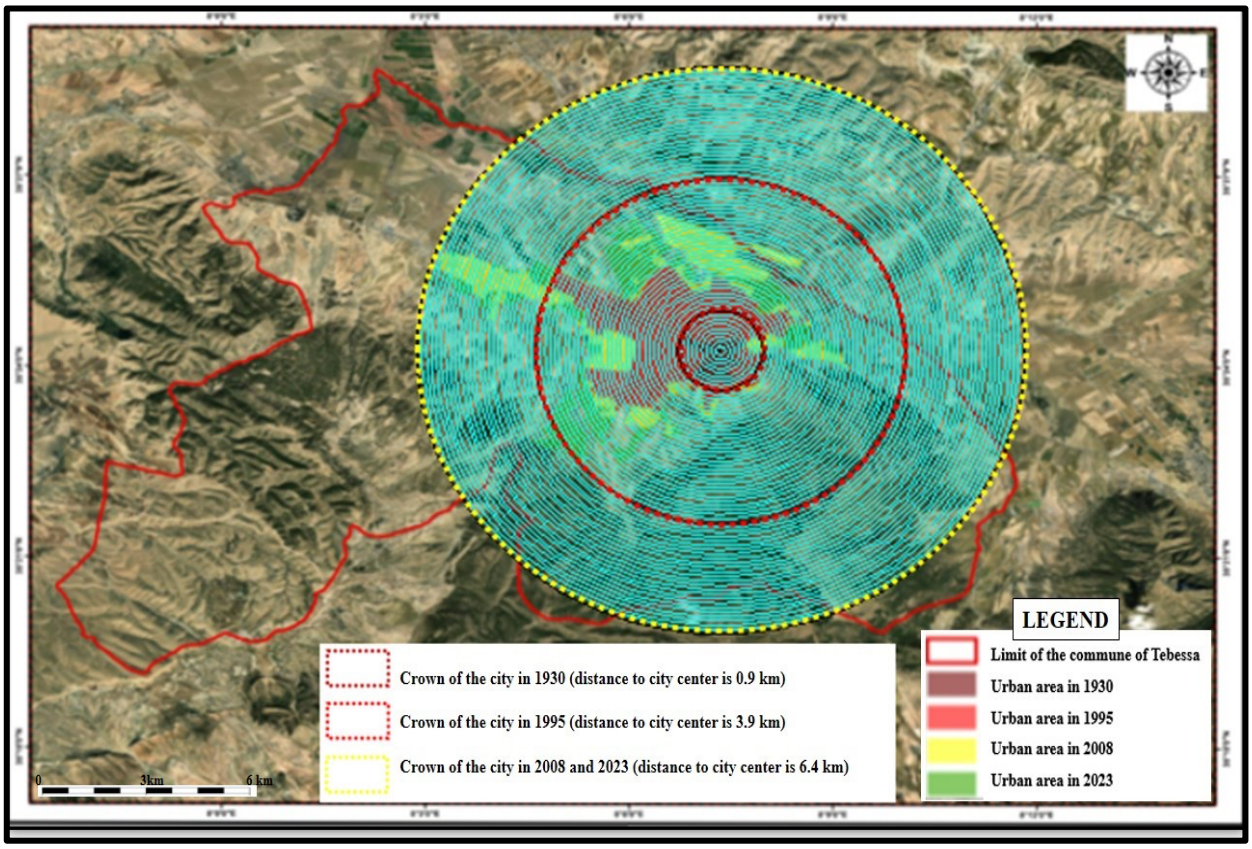
Our primary objective is to verify the hypothesis that there exists a gradient in the percentage of built-up area within the city limits, demonstrating that distance from the city center plays a determining role in the dilution of built-up areas. We focused our analysis on demonstrating a relationship between the distance from the city center and the percentage of built-up area for different periods: **1930, 1995, 2008**, and **2023**, based on a map of the evolution of the urban footprint of Tebessa during these periods. **(See map 08)**



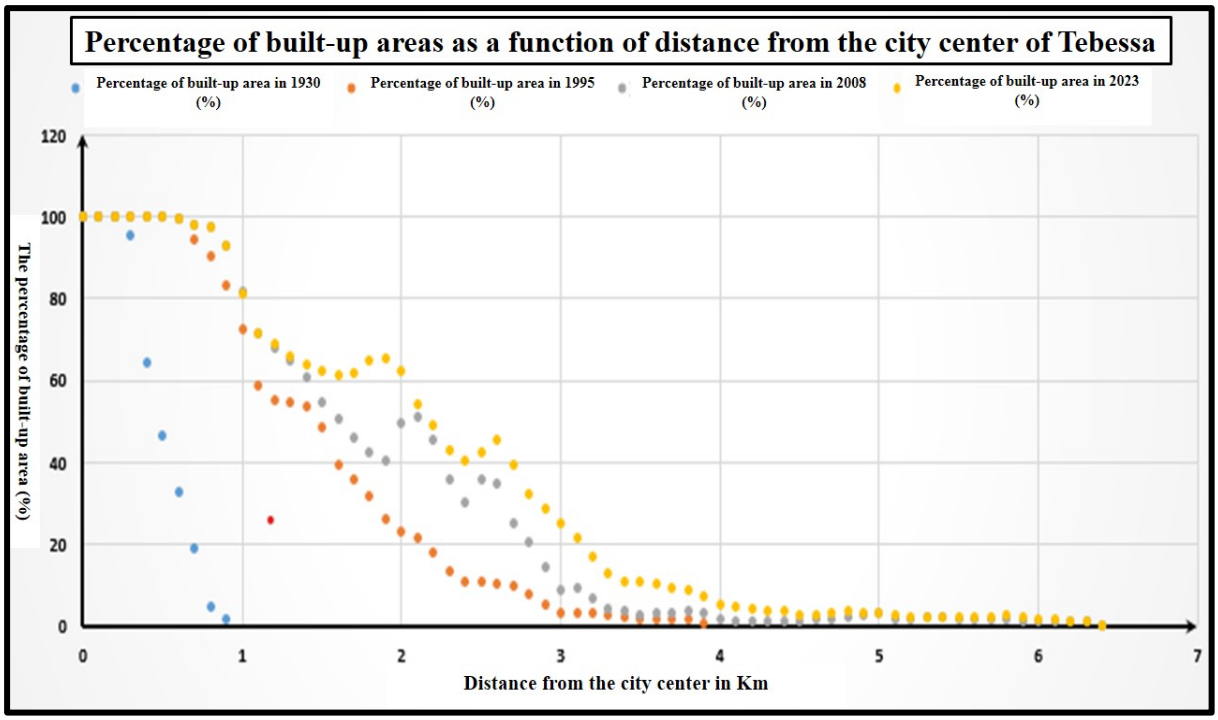
Map 08.The evolution of the urban footprint of Tebessa from 1930 to 2023
Source: Established by the author (2023) + topographic map (1930) + Google Earth

The methodology necessary to obtain surface data relies on the use of a Geographic Information System (GIS) and involves several steps:

- Starting from the fixed center, which is the Arch of Caracalla (reference point), we construct rings 100m wide, extending from the historical center of the city (considered as the zero point) to the current limits of Tébessa. **(See map 09)**
- Once the division is done, we calculate the built-up area in each ring; the built-up area per ring is inversely proportional to the area of each ring.
- The whole is exported to EXCEL where it is easy to calculate the percentage of built-up area.
- The data collected at different periods and for different locations will allow us to establish a graph where the x-axis represents the distance from the center, and the y-axis indicates the percentage of built-up area per ring.
- The set of point clouds obtained for each building layer will allow us to determine the different logistic functions specific to each period **(See Graph 01).**



Map 09. Division of Tébessa into rings of 0.1 km wide
Source: Established by the author (2023)



Graph 01. Percentage of built-up areas as a function of distance from the city center of Tébessa
Source: Established by author (2023)

Graph 01 illustrates the evolution of urbanization in Tébessa from 1930 to 2023, highlighting urban sprawl from its historic center. In 1930, the city was very compact, extending to about 0.9 km from the center. In 1995, significant sprawl occurred, bringing the expansion to about 3.9 km from the city center. In 2008 and 2023, the sprawl continued, reaching almost 6.4 km from the city center.

The city center maintained a high density (close to 100%) throughout this period. Density gradually decreases as one moves away from the center, but this decrease becomes less marked over time. The 1930 curve shows a rapid drop in density after 1 km. In contrast, the curves for 1995, 2008, and 2023 reveal "plateaus" or slowdowns in density decrease at certain distances, suggesting preferential development zones. The more recent curves (2008, 2023) show a more gradual dilution of density.

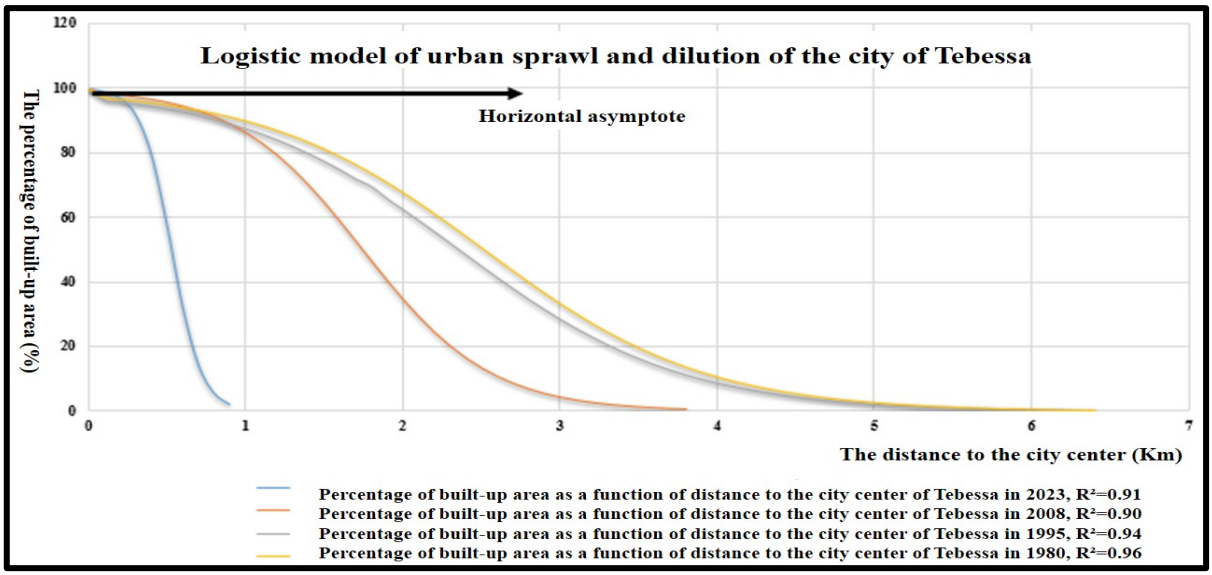
Curve adjustment by logistic function:

The previous **Graph 1** clearly illustrates a gradient between center and periphery, how can we define it precisely? To define it precisely, we move to this step which consists of grouping the point clouds using a curve adjustment by a logistic function, given that all the curves present profiles with a horizontal asymptote marked by the center. This mathematical process allows us to establish specific logistic functions for each date, using the parameters **ω** and **p** presented in the table below:

Table 04. Parameters ω (dilution parameter) and p (sprawl parameter) of logistic functions

Dates	Value of parameter ω	Value of parameter p
1930	-10,437	5,5214
1995	-2,4701	4,2972
2008	-1,4287	3,3613
2023	-1,4608	3,5964

Source: Established by author (2023)



Graph 02. Logistic model of urban sprawl and dilution of Tebessa
Source: Established by author (2023)

The analysis of the logistic model of urban sprawl and dilution of Tebessa indicates that the adjustments between 1930 and 2023 show a progressive decrease in urban density as one moves away from the historic center. Urban dilution becomes more pronounced over time, with a remarkable expansion of the urban area.

In 2023, the growth of Tébessa maintains a pace comparable to that of previous years. We observe that the adjustments shift towards periurban and rural areas. This evolution is highlighted by the progressive decrease of the dilution parameter ω over time, while the urban sprawl parameter p increases.

The logistic model predicts a continuation of urban sprawl, albeit at a decreasing rate. This trend indicates a mutation towards a more diffuse mode of urbanization, characterized by a more gradual spatial extension and an attenuated densification of newly urbanized areas.

We can distinguish:

1- A change in the break between the center and the periphery: we clearly observe this transformation. In 1930, the city was very compact (up to 0.9 km), showing a clear break between the center and the periphery until 2008. After 2008 until 2023, this break has faded, creating a center-periphery continuum that extends up to 6.4 km from the center.

2- Urban dilution: the curves of 2008 and 2023 perfectly illustrate this concept. We observe a progressive dilution of the urban area, with percentages of built-up area that remain significant even several kilometers from the center. This dilution is visible by the gentler slope of recent curves compared to that of 1930.

3- Complexification of city limits: although the graph does not directly show the shape of the limits, the non-linear progression of the built-up percentage curves suggests a complexification of the urban structure. Variations in the slopes of the curves, particularly for 2008 and 2023, indicate preferential development zones, which could translate into a more fractal form of urban limits and leads us to assert that urban sprawl has shifted the city limits.

Tébessa has transitioned from a compact structure with clear limits to a more complex and extended model, characterized by a center-periphery continuum over a distance of 6.4 km.

Conclusions:

The analysis of the growth process of the city of Tébessa, from its creation to the present day, reveals complex dynamics of its urbanization. The examination of spatial dilution, a phenomenon characterized by the gradual decrease in building density as one moves away from the city center, allows us to understand the mechanisms of expansion and diffusion of urbanization.

At the beginning of the studied period, Tebessa presented a very compact urban structure with high density in the city center. Over the decades, the city experienced significant expansion that transformed its morphology. This process led to a transition from a concentrated urbanization model to a more extensive

sprawl, with a progressive dilution of density in the periphery. This phenomenon shows a continuum between the center and the periphery, characterized by a less marked decrease in density as one moves away from the historic core.

Tebessa has undergone continuous growth since independence, considerably modifying its urban boundaries. The analyzed logistic curves indicate that urban sprawl continues, although the pace of this process tends to stabilize, with a more gradual dilution of urban areas.

Finally, this research highlights the importance of the logistic model for understanding and predicting urban dynamics, offering a new perspective on the spatial mutations of cities.

REFERENCES

1. Berger, M. (1989). Towards news types of city-countryside relationships. The production of peri-urban spaces in France and developed economies. *Strates* 4, 1-16. https://doi.org/10.4000/strates.4552
2. Bordreuil, S. (1995). From inhabitant density to moving densities: hyper-urbanity. Peripheral development and mobility. *The Annals of Urban Research,* 67, 5-14. https://www.persee.fr/doc/aru_0180-930x_1995_num_67_1_1872
3. Brunet, R., Ferras, R., & Théry, H. (1992). The words of geography: critical dictionary. *French Documentation.* 470 p
4. Burgel, G. (1991). The urban periphery revisited. *Space Populations Societies*, 2, 359-366. https://www.persee.fr/doc/espos 0755-7809 1991 num 9 2 1475
5. Côte, M. (1994). Urbanization in Algeria: preconceptions and realities. In A, Marre (Ed). Algerian studies. *Works of the geographic institute of Reims.* 85-86: 59-72. https://www.persee.fr/doc/tigr 0048-7163 1994 num 85 1 1304
6. David, J. (1984).Urban peripheries: new space or discourse. Urban peripheries. Proceedings of the social geography conference; Angers, 259-262
7. Enault, C. (2003, 2004). Speed, accessibility and urban sprawl; analysis and application to the urban area of Dijon. *Doctoral thesis, university of Burgundy.* https://theses.hal.science/tel-00006172v1/document. Dilution: methodological note for the analysis of urban sprawl. *The Geographical Space.* 33(3), 241-255. https://shs.cairn.info/revue-espace-geographique-2004-3-page-241?lang=fr
8. Ewing, R., Pendall, R., & Chen, D. (2002). Measuring Sprawl and Its impact. *Smart Growth America,* 41 pages. https://raqc.org/wp-content/uploads/2018/07/MeasuringSprawl.pdf
9. Frankhauser, P. (1993). The fractality of urban structures. *Doctoral thesis*, *university of Paris 1 Panthéon-Sorbonne.*
10. Frankhauser, P., & Genre-Grandpierre, C. (1998). Fractal geometry: A new tool for evaluating the role of public transport network morphology in the spatial organization of urban areas. *The Scientific Journal of Transport*, 33, 41-78. https://hal.science/hal-04143753/document
11. Galster, G., et al. (2001). Wrestling Sprawl to the Ground: Defining and measuring an elusive concept. *Housing Policy Debate,* 12(4), 681-717. DOI: 10.1080/10511482.2001.9521426
12. Gsell, S. (1901). The ancient monuments of Algeria. *Paris: A. Fontemoing*. 1, 447 p
13. Guérois, M. (2003). The shapes of European cities seen from the sky. *A contribution of the CORINE Land cover image to the morphological comparison of the large cities of Western Europe. Geography. Panthéon-Sorbonne University Paris.* 303 p. https://theses.hal.science/tel-00004303
14. Le Jeannic, T. (1997). Thirty years of periurbanization: Extension and dilution of cities. *Economy and Statistics*. 307, 21-41. https://www.persee.fr/doc/estat_0336-1454_1997_num_307_1_2578
15. Lynch, K. (1960). The image of the city. *Paris, Dunod,* 222 p.
16. Moll, C. A. (1862). Historical and archaeological memoir on Tébessa (Théveste) and its surroundings. *Alessi and Arnolet, Booksellers publishers. Constantine, Paris; Challamel, Ainé, editor.* 148 p
17. Mumford, L. (1961). The city in history. Its origins, its transformations and its prospects *Science and Society*. 27 (1), 106-109
18. Pumain, D., & Saint-Julien, T. (2001). Spatial interactions. Armand Colin. 191 p
19. Ritchot, G., Mercier, G., & Mascolo, S. (1994). Urban sprawl as a geographical phenomenon: the example of Quebec. *Quebec Geography papers*.38 (105), 261-300. https://www.erudit.org/en/journals/cgq/1994-v38-n105-cgq2677/022451ar/
20. Rocca, E & Bejaoui, F. (2018). Urban occupation in the southwest of Proconsular Africa between late Antiquity and the middle Ages: The cases of Ammaedara (Haïdra, Tunisia) and Theveste (Tébessa, Algeria) Casa de Velázquez, 223-239. https://books.openedition.org/cvz/23752?lang=fr
21. Semmoud, N. (2003). The transformation of Algiers urban morphology. *Annals of Geography*. 633, 495-517. https://www.persee.fr/doc/geo_0003-4010_2003_num_112_633_965
22. Sénécal, G., Gaudreau, M., & Des Roches, S. (1994). The mechanisms of urban form production and the conservation of agricultural and natural spaces in the Montreal region: the case of Laval. *Quebec Geography Papers,* 38 (105), 301-326. https://www.erudit.org/fr/revues/cgq/1994-v38-n105-cgq2677/022452ar/
23. Véron, J. (2008). The urbanization of the world. *The discovery.* 122p
24. Weber, C., & Hirsch, J. (2000). Growth processes and urban boundaries. *Cybergeo: European Journal of Geography.* https://doi.org/10.4000/cybergeo.716