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Study of the Spatial Growth Factors by the use of the Fractal Analysis Case Study City of Biskra

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Abstarct

The rapid spatial growth that the city of Biskra has experienced in recent years has made up a significant transformation of its urban form, which has been radically transformed from a compact to an amorphous form. This study analyses the spatio-temporal growth of the city of Biskra from 1958 to 2015 as well as the explanatory factors of this spatial growth. (Huang, 2017) (Huang, 2017) The methodological approach is based on the processing of different urban plans of the city on different dates (1958, 1998, and 2015) and fractal analysis. The results show a spatial growth of the city of 2137 ha between (1977 – 2008) has taken place mainly on vacant land and agricultural land (palm groves) with an irregularity in size and shape (Dsurf1958= 1.567, Dsurf 1998= 1.727and Dsurf 2015 = 1,77), from a compact to a fragmented form (a1958 = 3.444 a 2015=2,565) and revealed that the factors of this spatial growth are socio-economic, economic and political. Furthermore, the results obtained will allow us to redefinition of boundaries and rationalize the use of urban space efficiently and develop new measures in urban management. The data were processed using QGIS and Fractalyse software (Ver.2.3.1).

Keywords: Biskra. fractal analysis, morphological analysis, Spatial growth, urban management.

INTRODUCTION

The increasing urbanisation of cities has accelerated a demographic and spatial growth, which has led to spatial growth in urban areas. Urbanization is a dynamic evolutionary process that includes multiple dimensions of population, land, and economy in which population agglomeration is the external manifestation of the flow of resource factors to cities, and economic growth is one of the core goals of urbanization and land is the basic carrier to support population agglomeration and economic growth (Liu, et al., 2022)

The process of urbanization is characterised by an increasing concentration of the population in cities and the loss of the "compact" form is accentuated by the sprawl of the industrial and post-industrial city" (De Keersmaecker, Frankhauser, & Thomas, 2003). Between 2011 and 2050 the world's urban population will grow from 3.6 to 6.3 billion (DIALLO, DIARRA, TOURE, & CISSE, 2020) Authors such as Françoise Choay have seen in these transformations, in particular the dilution of the city in the rural space, the death of the city and its replacement by 'postmodern' urban spaces symbolising these transformations. The questions linked to the understanding of urban hierarchy and organisation are therefore more topical than ever and must be considered at all scales, global, national and local.

In Algeria, despite the various policies applied in terms of urban management, cities have remained subject to galloping and uncontrolled urbanization. The report on the development of the territory and the environment in Algeria indicates: "Uncontrolled urbanization, absent or marginal urbanism, unsuitable housing, abusive and speculative use of communal land reserves, overloading of equipment and collective utilities, speculation and real estate rents, inappropriate industrial locations, competition for utilities (water), pollution, negative impacts on the living environment, abusive use of materials and lands. (CNES, 1995). Following the example of other Algerian Saharan cities, the city of Biskra has for several years been undergoing major and rapid changes which are reflected in major spatial transformations towards Ouest and the East, due to a demographic growth which is accompanied by an anarchic spatial growth and a fragmented urban fabric compared to a compact configuration.

This spatial growth has not followed a rational urban management approach and has been the subject of several urban planning and development studies, the main reference tools for the management and control of urban space. These famous urban planning documents that the city of Biskra has known, have all been judged inoperative because of the

delays in their elaboration and approbation. For the sake of understanding these problems, we tried to explain this shape of implicit spatial growth which developed anarchically "It is the fragmented aspect in which this articulation is presented in today's agglomerations that leads them to be perceived as «amorphous», i.e. «without form», which ultimately means that we have neither a vocabulary nor appropriate geometric references to describe them» (Frankhauser P. , 2002). In this context we need to explain the spatial growth process, «The process of urbanization is characterised by an increasing concentration of the population in cities and the loss of the «compact» form is accentuated by the sprawl of the industrial and post-industrial city» . Previous studies on the growth of cities have mainly been focused only on solving temporal problems, but it must be analysed over a period of time to better understand its process, The analysis provides a rough comparison of spatial and temporal growth (Cheng, 2003). In this process, the spatial growth of the city of Biskra must be examined from the physical, spatial and also from the historical and socio-economic aspects (Meziani & Kaneda, 2005). Spatial patterns, with their associated processes, have long been a focus of urban geography. The spatial pattern is often analyzed and explained in the context of the urban social fabric, economic structures, and functions. (Huang, 2017).

We also tried to include the reasons which chaired it and the urban morphology which it generated, "However, fractal geometry and morphic indicators allow us to describe and measure the structure of urban fabrics, the reality of the spatial organisation, as well as the functioning of these fabrics and their character of self-similarity and interlocking scales are courted" (Badariotti, 2005). For example, Chen et al. (2001) computed a fractal dimension for various land use classes and used it to analyse land use change between two areal pictures taken 20 years apart over a 4 km2 mountainous catchment. (Gires, et al., 2017).

The study of urban forms through the fractal dimension is not a new technique, it has been used to describe the structure of cities on their global and local scales. (Guillemet, Hausser, & Glaus, 2014).

This has led us to ask ourselves this question: What are the factors that have favoured the spatial growth of the city of Biskra? And how is it proceeding? Let us postulate that: Spatial growth of the city can be manifested by peripheral dynamics despite the city centre due to deficient urban management and socio-economic changes. Two hypotheses can be applied:

The spatial growth directly intervenes on the morphology of this urban fabric marked in particular by the differentiation of spaces and the cohabitation of heterogeneous urban fabrics, which result from a historical evolution fuelled by major ruptures in the mechanisms of space formation, and land planning policies.

METHOD AND MATERIALS

The monitoring and controlling of spatial growth is an important issue for most of the local and territorial authorities, especially in the context of prospective programmes aiming to envisage the future evolution of the city. Investing in spatial growth, which is diachronic in nature, requires to our knowledge a consideration of the evolution of the landholdings and the distribution of the populations in the Biskri space.

In this perspective, our study is focused on this human settlement of oasis origin, on both diachronic and synchronic plans, taking into account the two determining physical and geographical contexts of its genesis. Empirical estimation models use statistical techniques to model the relationships between land use changes and the drivers based on historic data (Hu & LO, 2007). Statistical approaches can readily identify the influence of independent variables and also provide a degree of confidence regarding their contribution. In many cases, these models fit spatial processes and land use change outcome reasonably well (Irwin & Geoghegan, 2001)

"It is therefore imperative to use quantitative tools to evaluate the way the territory is organised and thus to carry out qualitative studies" (Badariotti, 2005). Fractal analysis relies on scale invariance and the concept of fractal dimension enables one to characterize and quantify the space filled by a geometrical set exhibiting complex and tortuous patterns (Gires, et al., 2017).

To arrive there, we opted for a comparative analysis of the urban tissue of Biskra city on three different dates. The work knew two phases which are:

The research technique on linear documents (general census of population and housing, bibliographical search and as well as statistical data collected from the technical service of town planning of the MPA (Municipality Popular Assembly).

The analysis of the data aims was to determine the characteristics which continued overtime. It was necessary thus to redraw the history of the spatial growth and to determine the factors which favoured it as well as to study the urban morphology of this establishment on various dates (in1958, 1998 and 2015).

For the fractal analysis, the town planning schemes of 1958 and 1998 as well as the satellite picture of 2015 (professional Google earth) used were treated and rasterized with QGIS 2.18.2 (software open-source SIG. The town planning schemes of (1958,1998,2015). Where provided by the Public Office for Urban Planning studies of the Wilaya of Batna (URBA) unit of Biskra. The maps, which were previously drawn up from satellite images and cadastral surveys on a scale of 1:25,000, were taken, processed and rasterized into binary images in uncompressed format (*.TIFF). The images were then analysed by the Fractalyse 2.3.1 software on a scale of 1:5000. The software was developed by the team « Ville, Mobilité, Territoire « of the laboratory Thé MA (theorising and modelling for planning), directed by Professor Pierre Frankhauser. This software has a wide range of analysis methods, as well as various options that make it interesting for our research. (see figure 01).

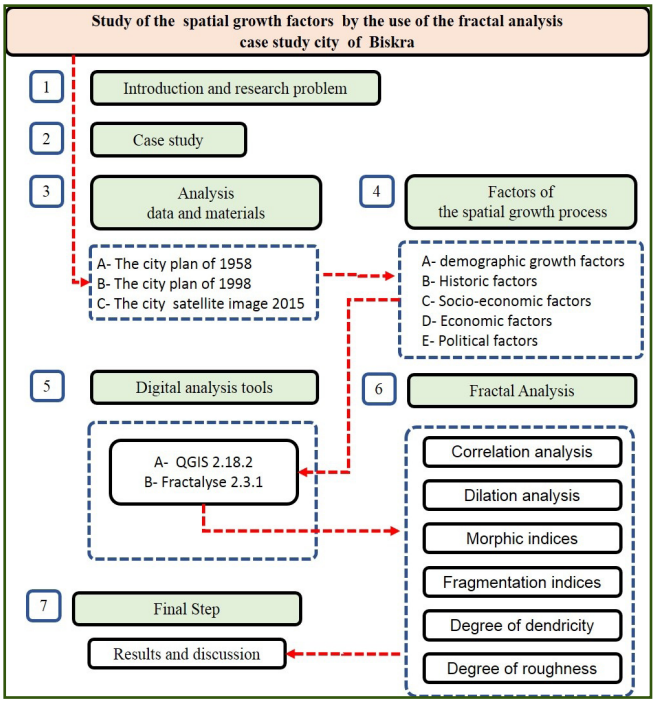


Figure 1. Framework of the research

THE FRACTAL DIMENSION

The fractal approach to urban fabrics: One of the main characteristics of any fractal object is its fractal dimension, denoted D, and we can calculate the fractals descriptors which are: correlation analysis, radial analysis and the scaling behaviour, dilation analysis, Morphic indices (Mandelbort, 1975), It measures its degree of irregularity and fracture. It varies between 0 and 2 **(**De Keersmaecker, Frankhauser, & Thomas, 2003).

Correlation Analysis

spatial organisation at the agglomeration scale: allowed us to determine the homogeneity of the surface, its hierarchy and complexity (Frankhause, 2003).

Dilation Analysis

spatial organisation at the agglomeration scale: allowed us to determine the homogeneity of the surface, its hierarchy and complexity (De Keersmaecker, Frankhauser, & Thomas, 2003)

Morphic Indices

The fractal dimensions resulting from these analyses allow us to understand the Morphic logic of the studied edge and to calculate its Morphic indices; fragmentation (φ), dendricity (δ), and the synthetic index (Is), whose value varies between zero and one. A value of zero indicates that the structure consists of a single aggregate, while a value close to

one characterises a fragmented tissue consisting of a large number of islands that cover the surface almost uniformly (Frankhauser *et al.*, 2003).

$$\varphi = \frac{D_{bord/tot}}{D_{bord/agr|}} - 1$$

The degree of dendricity (δ)

It provides information on the dendricity of the urban border and the tortuosity of the fabric. It represents the relationship between the built mass and the border as well as the mode of occupation of the border (De Keersmaecker, Frankhauser, & Thomas, 2003)

$$\delta = 2 - \frac{D_{surf}}{D_{bor/agr}}$$

The degree of roughness (Is)

This index increases with the roughness and complexity of the tissue. For a Euclidean shape, homogeneous in surface and border, it is equal to zero (Is =0). For a rougher and more complex shape, it is between one and two (1 < Is <2 (Badariotti, 2005).

The formula is as follows:

$$Is = \left(2 - D_{surf}\right) - \left(1 - D_{bor/tot}\right) = 1 - D_{surf} + D_{bor/tot}$$

PRESENTATION OF THE CASE OF STUDY

The region of Biskra is located in the South-East of Algeria between the Aures region and the Zibans region which covers an area of 2,167.20 km2. Biskra is the capital of the Wilaya and covers a communal surface area of 33.48 km2. It is bounded: to the north by the communes of Branis and El Outaya. To the East by the municipality of Chetma. To the South by the communes of Oumache and Sidi Okba, and the West by the municipality of El Hadjeb. Biskra city is a Saharian city (BOUZAHER - LALOUANI & ALKAMA, 2012). It is located at latitude 34.89° North and longitude between 5.65° and 05.77° East and its altitude is estimated at 120 metres above sea level. Its location in the southern foothills of the Zibans (Djebl Boughezel), belonging to the Saharan Atlas chain, is at the crossroads of the passes that link the North and the South. The city of Biskra is the southern gateway to the Aurès, like Batna, the northern gateway, and commands the entire eastern Algerian Sahara» (COTE, 2006), Biskra city has a fan-shaped morphology from north to south. The north is the aridity of its climate, with cold and dry winters and hot and dry summers. An average annual temperature of 22°C, with rainfall rarely reaching 200mm per year. Biskra has been the seat of many ancient civilisations (Gétule, Phoenician, Greek, Numidian, Roman, Arab, Hafside, Ottoman, French...). The Saharan urbanization rate is higher than the national average. It exceeds 63%, whereas it is only 58% for the north of Algeria (Fontaine, 1996). With its population of 654, Biskra remains one of the main demographic engines of the Algerian Sahara. Biskra, with the singularity of its fabrics, in accordance with its history, is undergoing mutations under the effect of successive in accordance with its history, is undergoing mutations under the effect of successive re-appropriations, reconstructions, new architectures that transform the urban spaces and territories. (as shown in Figure 2)

THE FACTORS OF THE SPATIAL GROWTH PROCESS OF THE CITY OF BISKRA

Demographic Growth and Anarchic Spatial Growth of Biskra City

Biskra began its demographic growth in the early 19th century and has not been stopped. The demographic growth of Biskra is clearly shown in Figure 03.

The population of Biskra has quadrupled due to the arrival of Europeans from 4000 inhabitants in 1844 to 19000 in 1893. It's doubling, from 58 561 in 1966 inhabitants to 90471 inhabitants in 1977, is explained by a migratory flow due to work and a higher birth rate than mortality. The second doubling took merely 30 years from 128924 inhabitants in 1987 to 235166 inhabitants in 2018. Biskra is the most populated and attractive area of the Ziban region, with over 10,000 entries, of which more than 55% are recorded as coming from the Algerian North and slightly over 28% as local movements, from the Algerian North and a little more than 28% from local movements. (Kouzmine 2007).

This demographic growth had an impact on spatial growth over time (figure 4): The most important periods of this growth are the periods between 1680 and 1844, with a spatial growth of 129.66 H, between 1932 to 1962, with 203.24 H of space acquired, due to the demographic growth, and between 1977 to 2008 with a 2137 H. An area of 1426.7 H was acquired between 2008 and 2018.Other periods 1844 - 1865, 1865 - 1932 have not grown at the same rate as other periods due to the colonization. The periods 1844 - 1865 and 1932 - 1962 mark the first spatial growth.

The formation of the city, from the first nucleus to the current city, has not been identical. The city of Biskra counted 24519 houses in 1998and 31396 houses 2008, while in 2013 and 2018, we listed 43020, 46116 houses consecutively (Figure 05).

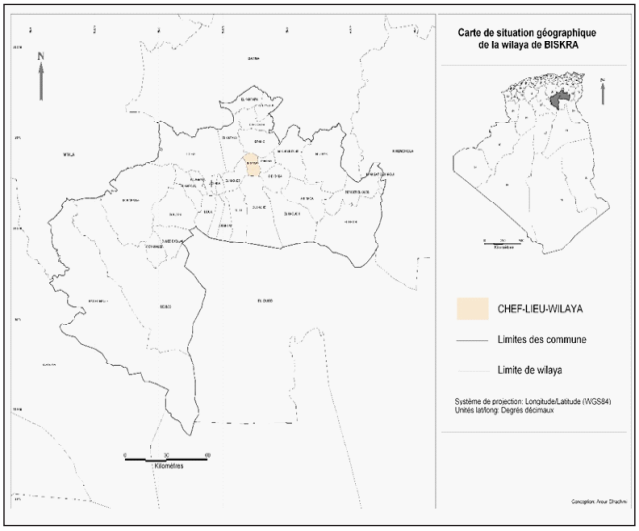


Figure 2. Situation of the city of Biskra. (Source: AROUR, A)

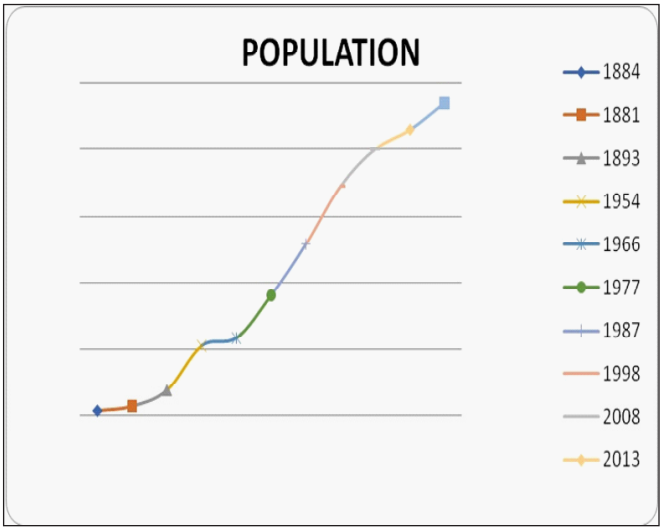


Figure 3. Evolution of the population of Biskra

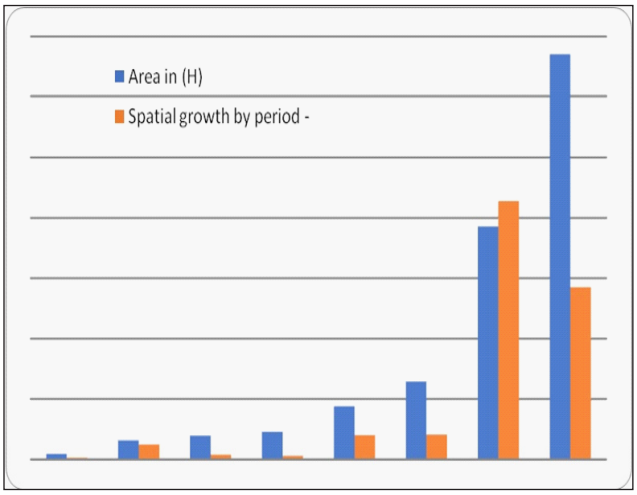


Figure 4. Evolution of the surface area of the city of Biskra (1541-2008)

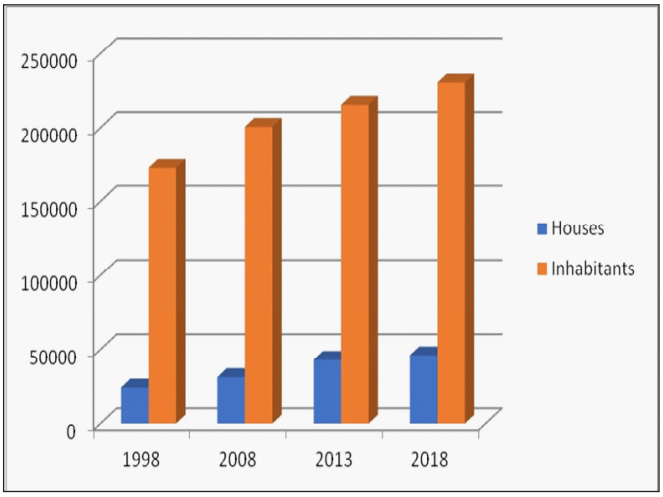


Figure 5. Evolution of houses of Biskra city between 1998 and 2018

From a Literature Survey

A. The Ottoman Period (1541-1844)

Water is, consequently, the fundamental support for the existence and survival of Biskra. like all desert cities, evolved from a fertile oasis. It functioned in a real "oasis" model. Before the Ottomans period, agriculture was the major activity in Biskra. The current city was originally founded according to an oasis system. It is the site currently known as "Beskra Légdima" or old Biskra, with the arrival of Turks, according to the major Seroka cited by (Agli, 1988) before its dissolution, the city saw a new urban aspect, it became a fortress surrounded by a wide pit without drainage. In 1670, according to the major Seroka cited by (Agli, 1988). following a vast epidemic of plague, which killed 7,000 people in Biskra, the

Turkish authorities ordered the population to leave the city to settle in scattered groups, and to build the seven villages, using the materials of the old houses making up the ksar (plural: ksour or ksars: It is the urban form of the cities of the Sahara and has the evocative meaning of a palace). The first spatial growth.

B. The Colonization Period (1844-1962)

From a city that functioned in an urbanization mode according to vernacular techniques inside the oasis, to a city with a checkerboard pattern dating back to the French occupation in 1847, with the military intervention. The oasis city break begins at the same time as the colonial habitat break - native habitat» (Agli, 1988), a new urban fabric was created which resulted in the appearance of a city opposite the Old Biskra and based on a checkerboard plot layout, which reflects the second spatial growth during the period 1680 - 1844 with a 129.66H. This period saw the establishment of Fort Saint Germain, the first nucleus of the colonial city, and the appearance of the straight, driveable street, the covered gallery street. The city was also endowed with important green spaces. 1932 - 1962 was the period when Biskra adopted its first development plan (Plan Dervaux 1932) to link the colonial town to the oasis (Alkama, 1995), to reorganize mechanical traffic, and to make the town a real tourist attraction (large public garden, spa, large boulevards).In the period 1950-1960, the city of Biskra experienced a spatial growth characterized by the appearance of districts, which extended the colonial checkerboard to the South and the North, which were characterized by a different and very varied morphology, such as: Z'mala, Star Mlouk (Zeguegue Ben Remdhane), Chatonnier and, Dhalâa. In 1958, Biskra applied a new plan (Plan de Constantine) which consisted of the realization of social housing programs (HLM type).

C. The Independence Period (since 1962)

After independence was the phase of rejection of the colonial graft (Côte, 1988). the city grows at this period under the effect of the rural exodus and the natural demographic growth anarchically way with no orientation with an urban extension towards the railway on the Western side, and the palm grove on the Southern side. The various spatial growth of the city has been carried out with no reference urban planning schemes or tools, and a flagrant absence of urban planning control, passing from ethnic segregation in the colonial period to functional segregation after independence (La Bruyère, 1988).

In 1974, a date coinciding with the promotion of the city of Biskra to the rank of the chief town of the Wilaya, the city was marked by quick urbanization which resulted from a quantitative approach based on development tools, which largely opened the perimeter, at that time, one noted a spontaneous development of the city, at the expense of the palm grove, as in the peripheral grounds, such as El Alia, and Sidi Ghezel, as well as in the sites unsuitable for urbanization. The period (1977 - 2008) spatial growth is the most important of the urban fabric with 2137 H particularly in the East and West, in this period, Biskra knew the beginning of another phase of urbanization by the establishment of law 90-29 relating to development and town planning by two documents which are The Planning and Land Use Directorate, the Urban Planning and Construction Directorate).

Following independence and during the decade that lasted from 1966 to 1977, the city of Biskra experienced a real demographic expansion, particularly after its administrative promotion to the rank of Wilaya chief town. But the main mechanism of the urban dynamic was certainly the critical situation of the rural world which provoked the rush of the population of the hinterland towards the city. Despite the agricultural vocation in the region of the Zibans, the primary sector occupies only 5.86% of the total sector in Biskra. The tertiary sector, therefore, predominates with over 63% of those employed in 2008. This dominance is explained by the role attributed to the city, which is considered being a commercial and administrative center. After 1974, the rapid urbanization - under the effect of the rural exodus and the natural demographic growth - gave rise to new extensions characterized by planned urbanism. All this rapid and uncontrolled dynamic of the city was guided by instruments of intervention and planning based on a quantitative approach, neglecting any dimension of sustainable development.

Socio-Economic Factors

the following independence and during the decade that followed, the city of Biskra experienced a real demographic explosion, particularly after its administrative promotion to the rank of the chief town of the Wilaya. During the 1990s, Biskra was considered the most populated region of the Zibans. This demographic explosion transformed the landscape, the use of space, and the sociological composition of Biskra.

Economic factors

Although the city of Biskra is by nature an oasis and agriculture were dominant and plays a role in the economic life of the inhabitants, it is no longer a dominant activity because the tertiary sector (trade and services) is dominant in this city, occupying 63.31% of the active population. It is the trade, public services, companies, transport, industry, and public services which provide jobs.

Political Factors

The failure of urban management instruments: The authorities play a direct or an indirect part in spatial growth, from which we can distinguish two forms of spatial growth: regulated and anarchic.

Spatial Growth Regulated Through Urban Planning Instruments

the city of Biskra has known several urban plans, including three during colonization: DERVAUX plan (1932), Constantine plan (1958. And since independence: (PUD, ZHUN, and the P.D.A.U1998 and the revision of the P.D.A.U in 2008 until today). These vast operations of urbanization and land development took place practically outside the urbanized area. They are characterized by the irrational use of municipal land reserves and have constituted an immense appropriation of land. All this has led the city into an upset in the planning, occupation, and practices of the urban space of Biskra, and total anarchy in its development, producing an extensive uncontrollable urban structure and provoking another break with the ancient fabrics, which are more adapted to climatic conditions.

Informal spatial growth

The "laissez-faire" policy on communal and agricultural land, or inside the urbanization perimeters subjected to the urbanization plan, has resulted in a proliferation of spontaneous housing, which had already begun in the palm grove since the colonial period, by populations excluded from the administrative circuit for the acquisition of property. The multiplication of spontaneous constructions with no logic of urbanization, on peripheral lands with ambiguous or private legal status, has generated an inconvenient living environment. This type of housing has taken the form of informal settlement, creating fragmented urban forms (Figure 06).

FRACTAL ANALYSIS

Looking at the maps (Figure 07), we notice the presence of a large urbanized core in the center of the city of Biskra, and a strong dilution in its surroundings through the decades. This is due to the phenomenon of spatial growth which has generated a conurbation that has allowed the fusion of Biskra with the urban centers that surround it (Chetma and El Hadjeb), and to the presence of voids in the south that represent the palm groves, and in fact, the spatial growth of the city has taken place along the three main axes (Batna, Bousaada, and Aris) due to its collision with natural limits (the valley, the agricultural land) and artificial limits (the military zone, the industrial zone).

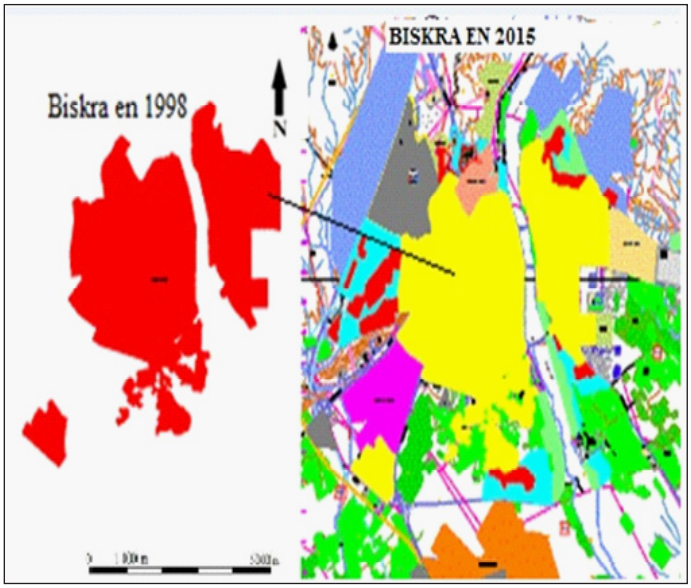


Figure 6. The spatial growth of Biskra in 1998 and 2015

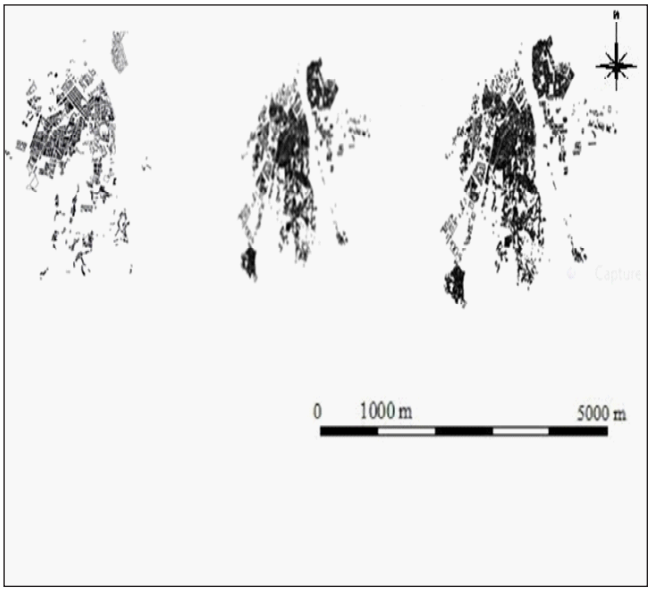


Figure 7. The city of Biskra in 1958,1998 and 2015

Homogeneity and Hierarchical Organization of the Urban

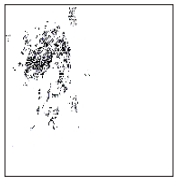
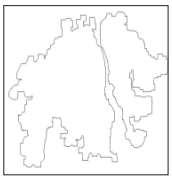
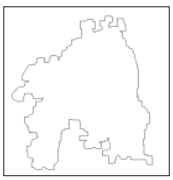
Correlation Analysis: Spatial Organisation at the Agglomeration Scale

In our study case, the values of the dimensions of surface correlation "Dsurf" vary between 1.567and 1.77. The higher value is the one of 2015 and the smallest is the one of 1958, while the value of "Dsurf" of 1998 is 1.727. All these values tend towards 2 and indicate that the morphology of the urban fabric of the city of Biskra for the three dates tends to be homogeneous (Table 1).

Table 1. Correlation analysis

Date	1958	1998	2015
Raster image			
D_{surf}	1.567	1.727	1.77
A	3.444	2,382	2,565

Table 2. Dilation analysis

Date	1958	1998	2015
Border before dilatation			
D_{surf}	1.567	1.727	1.77
Border after dilatation			
$D_{bor/tot}$	1.696	1.45	1.371
Main aggregate border			
$D_{bor/ magr}$	1,328	1,226	1.258
Dilatation steps	30	22	7

The Complexity of the Urban Fabric

The factor "a" shows us the degree of complexity of an urban fabric. The more its value is big, the more the urban fabric is complex. From (Table 1) the degree of complexity of the urban fabric of the tissues that concern us, the value of 'a' for 1958, 1998and 2015 is 3.444, 2.382, and 2.565 respectively.

The Dilation Analysis

The Compactness of the Urban Fabric

The rasterized images, the information on urban fabric before the dilation (surface and number of objects), and their numbers of dilatation steps issued from the dilatation analysis (Table 2) allow us to pronounce their degrees of compactness. In 1958, the urban fabric has a surface of 621480 points and the obtaining of a unique cluster required 34 iterations. The urban fabric of 1998 has a surface of 96149 points and requires 22 iterations to train only one cluster. As for the urban fabric of 2015, its surface is 112382 points; and requires 7 iterations to train the only one cluster. The loosest fabrics are those from 1998 and 2015, characterized by the presence of cemeteries, industrial and commercial fabrics, or mixed fabrics; whose simple mesh is very distended because of their required adaptation to modern means of transport and movement (wide roads with multiple lanes). In both cases, we can say that in 1958, the urban fabric was cowardly while in 1998and 2015 the tissue is compact (table 2).

The Dendricity of the Border and the Fragmentation of the Built Space

If we measure the fractal behaviour of the built-up area and the edge separately in an urban fabric, it is, therefore, possible to compare its spatial organization with a Sierpinski carpet, or even a Fournier dust, or a teragon.

We then proceed to determine the fractal dimensions of the built-up area (Dsurf) in order to be able to evaluate the urban edge, of which we must measure:

The fractal dimension of the total edge (Dbord/tot) of all the aggregates that form the agglomeration, including the edges of the unbuilt-up areas within the urbanized areas.

The fractal dimension of the outer edge of the main aggregate (Dbord/agr), i.e., the central city. From which it will then be possible to calculate the indicators δ and φ.

The value of the correlation dimension of the surface from table 02 "Dsur" for 1958, 1998and 2015 1.567, 1.727, and 1.77 respectively, corresponds to a non-homogeneous tissue in 1958 and a homogeneous in 1998 and 2015.

The Dendricity of the Border and the Fragmentation of the Built Space

The dendricity of the urban border is determined by the dendricity index "δ": it gives information on the dendricity of the urban boundary and the tortuosity of the tissue. It represents the relationship between the built mass and the edge as well as the mode of occupation of the edge (table 3).

Table 3: Values of the correlation dimensions and corresponding indices.

Date	*Dsurf*	*Dbor/tot*	*Dbor/agr*	***δ***	***φ***	Is
1958	1.567	1,696	1,328	0.821	0.025	0.761
1998	1,727	1,45	1,226	0.594	0,182	0,723
2015	1 ,77	1,371	1,258	0,406	0,089	0,488

In our case, we have the fragmentation index φ is equal to 0.118,0.182 and 0.089 in 1958,1998and 2015, which is a value approaching the minimal value 0. this means that dbor/agr is very close to dbor/tot, which shows that the agglomeration is dominated by the main aggregate. the dendricity index δ has a value of 0.821,0.594, and 0.406 in 1958,1998and 2015, which is close to the maximum value of 1, so we are dealing here with a fabric whose spatial organization is similar to a sierpinski carpet (frankhauser p., 2005). recall that (δ = 0) for a euclidean figure while it reaches its maximum value (δ = 1) with the sierpinski carpet. for, the synthetic index (is) of complexity or roughness (badariotti, 2005), it takes the value of 0.761,0.723,0.488 in 1958,1998and 2015, which is a value very close to the maximal value 1, indicating the morphological roughness, thus, (dbor/agr and dsurf) approach the value 1.5; we have therefore a heterogeneous perimeter and surface

RESULTS AND DISCUSSION

The results of this comparative analysis reveal that the spatial growth of Biskra city has been progressively practiced continuously over time with morphological upheavals and has taken several forms such as:

- The analysis of the continuous demographic growth in Biskra has resulted in an increase in density since 1998

from 91.68 inhabitants/hectare to 104.436 inhabitants/hectare in 2008.

- Spatially, the spatial growth has been in two directions: towards the south; to the west and south-west, along the main roads, in particular the RN 46, where the beginning of a conurbation is noted with the municipality of El-Hadjeb notably the RN 46, and towards the east, with the municipality of Chetma.
- The number of habitations showed a more accelerated increase during the first period (1998-2008) compared to the second period (2008-2018) with 6877 habitations against 3096 habitations.
- The current city is only the effect of a juxtaposition of different urbanistic models and that the colonial occupation was only the beginning of a rupture of spatial and social homogeneity.

As for the Fractal analysis: for three dates, the correlation analysis of the urban surfaces and borders is close to the Sierpinski carpet model.

- The results of the fractal analysis of the city of Biskra, show us that the urban fabric presents a weak homogeneity (Dsurf = 1.458,1.727,1.77 in 1958,1998and 2015), with a sinuous border (Dbor/agr = 1.328,1.226,1.258 in 1958,1998and 2015). It is a fragmented fabric with a clear dominance of the central city which corresponds to the main aggregate (fragmentation index at 0.118, 0.182, and 0.089 in 1958, 1998, and 2015). This confirms our hypothesis that this urban fabric is fragmented.

CONCLUSION

The study of the anarchic spatial growth of the city of Biskra, which is one of the many Algerian Saharan cities affected by this phenomenon, aims to analyze and explain the factors of this growth. It also seeks to determine the reasons for this growth and the urban morphology it has generated. It also seeks to determine the reasons behind it, the urban morphology it has generated.

The results obtained in this study test the hypotheses and confirm that spatial growth, was continuous in time and is resulted from socio-economic which is supported by demographic growth and deficient urban management, who generated a fragmentation of the urban tissue, with a spatial configuration characterized by fragmentation. Through our analysis, we have observed that several administrations share the decision in the management of the spatial growth of the city, which is characterized by a short-term vision instead of a global and prospective vision.

The results of the fractal analysis of the city of Biskra, show us that the urban fabric presents a weak homogeneity, with a sinuous border. It is a fragmented fabric with a clear dominance of the central city which corresponds to the main aggregate. This confirms our hypothesis that this urban fabric is fragmented. If we refer to the vernacular city that was Biskra, the current situation refers to the fragmented aspect and shows the anarchism in the urban intervention of the local representatives and the urban planning instruments that have contributed to the urban chaos. The ills of the city of Biskra are not only summed up by its urban management and anarchic spatial growth, but far from being an oasis city that preserves its sustainable development to a typical industrial city that endangers its ecosystem through a functionalistic urbanization approach.

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