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"Spatio-Temporal" Reading: The Great Constantine (Algeria)Through Time

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Abstract		

Urban sprawl has profoundly changed the relationship of cities to space and has led to the emergence of new urban forms. In the Greater Constantine in Algeria, the number and size of urban units have multiplied considerably, generating a set of socio-spatial transformations translated by the emergence of new and more complex urban forms. The objective of this paper is to study the growth of the urban task, to quantify and characterize the urban sprawl, taking into account the scale to appreciate the morphogenesis of the scalar level in order to lead to a prospecting of future urbanization. This work has both academic and professional relevance (regional planners and local authorities).

Will the diachronic study allow a better prospection for future urbanization?

The evolution of the urban task of Greater Constantine has allowed us to clearly distinguish between the diffuse urbanism of the mother city and the compactness of the new cities, which are reflected in very different density values. This urban diffusion is marked not only by the topography of the exceptional site, but also by the liberation of several land plots by transferring the population outside the limits of the commune of Constantine. Considerable and unprecedented urban changes give the new city Ali Mendjeli the role of a new urban pole with assets that must be preserved.

Key words: Urban sprawl, GIS, urban growth, geo governance.

Glossary

Ha: Hectare

NUHZ: New Urban Housing Zone

NSO: National Statistics Office

INTRODUCTION

This work was carried out in one of the North African metropolises, ranked third in Algeria. Our research reports on the results obtained through the spatio-temporal approach and the interpretation from statistical data of the new land use pattern through time. The compatibility of spatial simulation with the prospective dimension and the ability to anticipate the future of the territory, from the theme of the dynamics of land use.

Prospecting implies the identification of the factors responsible for this urban sprawl, the desired and unwanted transformations of land use. It also requires the evaluation of the speed and directions of such transformations affecting urban areas. To this end, precision in measurement is mandatory to draw realistic conclusions. This measurement can be carried out thanks to the progress of remote sensing and the exploitation of geographic information systems (GIS) considered as a reliable tool to measure the land use transformations of cities.

The spatio-temporal approach is used to be able to make predictions from a set of data representing a phenomenon, according to Peuquet (2002), the main reasons for which we build models. Peuquet (2002) developed a triangle (TRIAD) that describes three simultaneous views of spatio-temporal modeling, namely the position-based view (where), the time-based view (when), and the object-based view (what). These are the fundamental concepts that a spatio-temporal data model should be able to represent in the best way.

This work has an impact for the scientific communities, urban planners, regional planners and local authorities (academic and professional relevance). However, how can we quantitatively and qualitatively evaluate the urban sprawl of the Greater Constantinois? Even if this is not the only angle of approach, the question of the evaluation of this phenomenon appears crucial. Is it a question of measuring the sprawl of a city and analyzing the effects of this sprawl? In other words, how to characterize, locate and quantify the urban sprawl of the Greater Constantine? Will the diachronic study allow for a better prospecting of future urbanization? Thus, the objective of this article is to assess the spatial dynamics of Greater Constantine on satellite images through the analysis of urban sprawl.

Constantine, Cirta in antiquity, is one of the oldest cities in the world. It has this very rare characteristic of having lived nearly 3000 years of uninterrupted history on the same site, the Rock. Capital of Eastern Algeria, the geographical position of Constantine is revealing on a regional scale. Having a very strategic location, Constantine irrigates a set of cities that depend on it economically and administratively. Composed of 12 communes and 06 Dairates, it is limited to the South by the Wilaya of Oum El Bouaghi to the East by the Wilaya of Guelma to the West by the Wilaya of Mila and to the North by the Wilaya of Skikda.

The Constantinois inter-municipal grouping is composed of five communes namely: Constantine, El Khroub, HammaBouziane, DidoucheMourad and Ain Smara, geographically located in the North-East of the country and in the center of the wilaya of Constantine.

Constantine in the center framed by these four municipalities within a radius of 18 km and all communication routes converge towards it making it very attractive and radiating. This privileged position of the agglomeration naturally gives it a crossroads function and a place of privileged exchanges. By the concentration of administrative and commercial functions, Constantine has a primordial role to play in the whole Eastern region of Algeria.

Its territory covers an area of 2297.20 km² (Constantine 183 km2, El Khroub 255 km2, HammaBouziane 71.18 km2, DidoucheMourad 115.70 km2, Ain Smara 123.81 km2) "PATW Constantine 2011" and its population has reached 1,300,000 inhabitants in 2019 (according to an estimate by the ONS).

The city of Constantine has experienced a significant urban expansion through the different periods of its history. Conditioned by the complexity of its site.

METHODOLOGY FOR READING NEW URBAN FORMS

Case Study of a North African Metropolis

Presentation of the City of Constantine

Before colonization, the city of Constantine was limited to the Rock with an area of no more than 30 hectares. The city was isolated by the deep gorges of the ouedRhumel. Then, over time, its growth developed from the rock in the form of a rather complex urban sprawl, which took several directions and different forms.

Geographic Location

Situation on a National Scale

Occupying a privileged geographical position and strengthened by its particular history, the city of Constantine plays an essential role in the organization of the space of Eastern Algeria. Real crossroads of exchanges between the different parts east-west, north and south, it is the central node coveted by traffic in transit from all over eastern Algeria at the intersection of the major axes North-South (Skikda-Biskra) and West-East (Setif-Annaba). Straddling two structural sets, the southern spillover of the north Constantine tell and the northern fringe of the highlands.

The wilaya extends over an area 6°40" E to 6°80"E and 36°14" N to 36°50" N .(Map n° 01).

Situation at the Regional Scale

Composed of 12 communes and 06 Dairates. Bordered to the South by the Wilaya of Oum El Bouaghi to the East by the Wilaya of Guelma to the West by the Wilaya of Mila and to the North the Wilaya of Skikda. Its territory covers an area of 2297.20 km² (Constantine 183 km2, El Khroub 255 km2, HammaBouziane 71.18 km2, DidoucheMourad 115.70 km2, Ain Smara 123.81 km2) "PATW Constantine 2011" and its population reached 1,300,000 inhabitants in 2019 (according to an estimate by the ONS).



Map 1. Geographical situation of the great Constantine (Situation of the intercommunal grouping of the great Constantine.)

Situation on a Local Scale: The Greater Constantine

The metropolis of Constantine is organized as a tripod, the triangle of Greater Constantine. According to the categories defined by the Algerian state in 2001 and 2006, Constantine is one of the country's four metropolises along with Algiers, Oran and Annaba.

The metropolitan area of Constantine extends over a radius of 15 to 20 km which includes, in addition to the mother city, two new cities and four satellite cities:

-The satellite city of El Khroub, located near an important crossroads. It has a market and two industrial zones.

-The satellite city of AïnSmara, old village, it has a market and an industrial zone.

- The satellite city of DidoucheMourad, with a cement factory and several brick factories.

-The satellite city of HammaBouziane, former colonial village. The old garden of the city.

-The new city of Ali Mendjeli, has a central position between the agglomerations of Constantine, El Khroub and AïnSmara

-The new city of Massinissa, in urban continuity with the city of El Khroub.

It is a formalized organization grouping five municipalities with the aim of rethinking the city in the context of its metropolitan area. The city of Constantine has undergone significant urban expansion throughout the different periods of its history. Conditioned by the complexity of its site, the spatio-temporal reading of Greater Constantine can be carried out in several stages. This reading will allow us to grasp and understand the urban phenomenon and its evolution over time, its genesis, its demographic, spatial, functional and formal mutations.

Before colonization, the city of Constantine was limited to the Rock with an area of no more than 30 hectares. The city was isolated by the deep gorges of the ouedRhumel.

Then, over time, its growth developed from the rock in the form of a rather complex urban sprawl, which took several directions and different forms. A diachronic analysis would explain the process of growth and spatial dynamics of the city through its urban history in order to understand its spatial spread and the different factors that have generated its current composition and formation in order to understand its growth patterns, its dysfunctions, and its current urban problems.

Data Acquisition

This example is analyzed from simple and easily reproducible treatments carried out on satellite images and processed with GIS tools, following a multi-scale approach that distinguishes two scalar levels: the greater Constantine represented by the intercommunality (the scale of the metropolis) and the scale of the city.

RESULTS

The assessments provided an understanding of the dynamics and consequent impacts of urbanization on the land cover classes selected for global assessments. Growth in the Urban (Table 1). The share of this class increased from 4.28% in 1985 to 9.10% in 2020.

	Areas 1988	Areas 1995	Areas 2000	Areas 2008	Areas 2020
Urbanized area (Ha)	3293	3800	5 138	6052	6543
Urban area's share of the total intermunicipal area	4.28%	4.94%	5.96%	8.28%	9.10%
Growth in Ha		507	787	1783	173
Growth in %		15.40	20.71	38.87	2.71
Annualgrowth in %		1.54	4.14	3.88	0.27



Map 2. Evolution of the grouping of Constantine through time

DISCUSSION

Three major stages will durably mark the Constantinian urban space.

*Constantine the City on the Rock

The site of Constantine has evolved over time since the first occupants built their houses on it. It was the capital of Numidia from 300 B.C. to 46 B.C. It was known as "KIRTA" which means "CITY" in the Punic language of the time. In the 3rd century B.C. Massinissa made it his capital, and organized from there a centralized state.

In 112 it was occupied by the Romans. Cirta came back on the scene of history under the hand of the Emperor Constantine the Great who rebuilt it and that is how it took its name in the year 311 "Constantine", it knew its golden age under the Romans.

During the Arab period, it vibrated with all the great events that moved the Maghreb. It was occupied by the Fatimids, in the 11th century by the Hammadids and in the 12th century by the Hafsids until the 14th century when it is described as a flourishing economic and cultural metropolis, the third of the kingdom after Tunis and Bejaia.

The 16th century marks a new stage for the city: within the framework of the Ottoman regime, it was chosen as capital of the Beylik of the East. We can note the revival of the influence of the city in the 18th century, with several Beys of great value, including Salah Bey, responsible for important contributions to urban planning (roads, schools, water supply).

"From the earliest times, until the Ottoman period and even during the first years of French colonization from 1837, Constantine remained within its walls and its natural ramparts.

At the time of the colonial conquest, the city occupied only 30 hectares of the Rock.

*Constantine's Spatial Expansion Outside the Rock

A century of Urbanization (1837 - 1930)

The occupation of the city by the colonizer in 1837, until the country's independence in 1962, upset the established order and shaped the space in the image of the French urban model.

The first step was the crossing of the physical break of the gorges, the extension was done in stages, throughout the colonial century, of a radius of 3 km, extensions characterized by a modern and regulated urbanization.

Oriented to the East and South-West, these extensions were built on easily urbanizable land and in continuity with the rock. On the East side, the construction of the railway station, the reconstruction of the Bab El Kantarabridge in 1864, and the subsequent construction of the El Kantara suburb. On the South-West side, the construction of the Saint Jean and Saint Antoine suburbs and the occupation of the Coudiat hill by administrative buildings.

The city already covered 234 ha at that time.

Bridges and Footbridge for Spatial Continuity

The realization of the SidiRachedbridge in 1912, of the SidiM'cid bridge the same year, of the falls bridge which connects the city to HammaBouziane in 1928, of the Perrégaux bridge (current MellahSlimane bridge)

Urban Expansion as a Consequence of Demographic Growth

Nearly a century after colonization, the Algerian and European populations were almost equivalent and evolved quite rapidly, with relatively small differences in favor of the Algerian population. From 1948 onwards, these gaps widened more and more between the two communities. At the time of the 1954 census, the Algerian population was 2.5 times larger than the European population.

This population lived in very different conditions. The European population occupied European-type housing: collective buildings and individual villas (28,300 housing units) of which only 800 housing units were in the evolving cities, the Algerian population lived in shanty towns or in hardened housing (17,600 housing units), 5,500 "housing units" in the old city of which more than 50% were one-room housing units and 500 housing units for resettlement.

The urban expansion induced by the demographic growth was translated on the ground by a spatial continuity with that which had preceded it in spite of the difficulties of the ground, on the two hills: East (SidiMabrouk) in continuity with the military site of El Mansourah (the barracks and the wood of honor), West (Belle Vue) in continuity with the suburb Saint Jean. SidiMabrouk and Bellevue, two residential neighborhoods, were to offer their inhabitants individual and collective social housing and the necessary facilities.

This urbanization is part of an amazing spatial continuity with the one that preceded it: despite the difficulties of the land, it continues on the path, by successive budding, in the form of suburbs.

In 1958, the city gave its name to the "Constantine Plan" launched by de Gaulle to renovate the country.

The Constantine plan proceeded to the extension and densification of residential areas (SidiMabrouk, Mansourah, Bellevue and the southern extension on Boufrika).

At that time, two types of social housing had appeared in the urban landscape: collective

Housing and Resettlement Housing

-Collective housing was built for both communities.

These collective housing estates were mainly attributed to the Algerian middle class, such as the family shelter in Constantine, the large buildings of the CILOC, Bel Air, Picasso and many others. Some of these cities or buildings were not completed until many years after independence, namely the city Filali, the city FadilaSaadane and Benboulaid, the building of the Ladies' Roads, the towers of Bosquet,

* The collective and individual resettlement housing and the evolving cities were allocated to buyers living in slums of a type closer to the rural than the urban.

Peripheral extensions in urban pockets unsuitable for urbanization located along the Rhumel and Boumerzougwadis in the south-eastern part, such as: Avenue de Roumanie, Les Mûriers, the 4th km, Oued El Had. The western zone of the city has seen the establishment of neighborhoods: Ameziane and El-Bir, Hattabia, resettlement cities for the resorption of precarious housing. On the eve of independence, the urban extensions in Constantine covered 1800 ha.

*Consumption of Space After Independence

Post-Independence Urban Sprawl

After independence, Constantine underwent major changes which had negative repercussions on its urban development. The urban fabric was characterized in the early 1970s by discontinuity due to natural breaks and other urban constraints, including the presence of some military zones within the urban fabric, which is an obstacle to the spatial expansion of the city.

After the war of liberation, the urbanization has experienced a slow evolution until 1966, it was characterized by the completion of projects already launched. After 1966, the urban evolution accelerated with the creation of new zones of habitat, equipment and activities:

- The industrial zone La Mauricière-Palma.- The industrial zone Boumerzoug.

- The university zone, located in the southern part of the city.- The sports complex of June 17, located in the southeastern part of the city.- The housing areas of 20 August 1955 and 5 July 1962.- The city Daksi.- The housing estates of Si di Mabrouk.- Saki and SidiYoucef and Ziadia cities.- The transit cities El Gammas and El Bir.

Until 1975, the consumption of space has increased, reflecting a massive industrialization that has led to the establishment of other urban facilities and which has prompted the rural population to leave the countryside for the city in the hope of finding employment.

The city occupied 2,558 ha in 1977.

Under the 1985 to 1989 five-year plan, the city was allocated new housing programs in the form of ZHUNs and housing estates:

- The zone of new urban habitat (ZHUN) of DjebelOuahch.
- The ZHUN of Boussouf.
- Sarkina allotment. 1.136 lots.

The period 1975-1988, completes the continuity of the fabric both in the North and in the South of the agglomeration (6 km radius). It gave rise to new spontaneous extensions implanted on the residual land availabilities not yet built, such as the very sloping grounds of Aouinet El Foul, not very stable grounds of Serkina and Boussouf, or sites difficult to connect to the city as it is the case of Békira, ElMenchar, Bencherghi, Sissaoui.

The urbanized area increased to 3,285 ha in 1987.

In the mid-1980s, the urbanization of Constantine took place practically outside the urban perimeter with the development of new housing areas such as Zouaghi in the south and Bekira in the north. The land was dedicated to rangelands and extensive cereal farming and was allocated for private housing programs, collective housing and some facilities.

The urbanization of the plateau Ain El Bey began with the establishment of a university campus and a university city (1981-1982). A first housing program was carried out including a collective housing (250 dwellings) and an individual housing (169 cottages) between 1983-1985. Program located near the small university campus.

The Ain El Bey district has undergone spatial development since 1984. Thus, nearly 75% of the current space has been realized after this date. It is a voluntary mode of urbanization, but nevertheless anarchic, given the gradual disengagement of the State which was until 1986, the producer and the exclusive promoter of space.

Between 1987 and 1988 Constantine experienced the most important waste of urbanizable land. From now on, a new era of more liberal urbanization. This was confirmed in subdivision and real estate development programs on the outskirts. Allotments scheduled throughout the wilaya on a total area estimated at 1,781 hectares for a total number of 23,176 lots studied and which 15,060 lots have been launched in servicing. In terms of scale, a waste of land that exceeds the scope of the new city Ali Mendjeli.

The plateau of Ain El Bey was included in this operation with nearly 2,000 lots, as well as a collective housing area of about 3,160 housing units covering 138 ha.

This first urbanization operation of the Ain El Bey plateau raised many hopes and desires for the people of Constantine. But it was an urbanization at the expense of agricultural land.

In 1989, five private promoters settled and began the construction of 578 villas, Ain El Bey 1 (471 lots covering 31.6 ha), Brothers Ferrad (670 lots covering 33 ha), the Plateau (449 lots occupying 18.4 ha), Ain El Bey 4 (235 lots on 13 ha), Ain El Bey 5 (210 lots on 10.2 ha), and that of Eucalyptus (393 lots on 18.3 ha). There will be 2428 lots covering nearly 125 ha.

The urbanized area was spread over 4,547 ha in 1993.

In 1998 the area of Ain El bey to be considered according to the RGPH as a Secondary Agglomeration with an estimated population of 9299 inhabitants. A first assessment shows a minimum of 13000 dwellings, including 4835 individual dwellings.

Between 1999 and 2006, an extension of 400 Ha to the south of the already urbanized area of Ain El Bey was carried out in two POS (2A and 2B). POS 2A: urbanized area of an area of 332 hectares which consists of several housing operations and corresponds to the current extension area. POS 2b: extension zone on 62 hectares, to be urbanized in the short term. The headquarters of the regional directorate of Algerian Customs in Constantine, inaugurated in 2007.

A densification of the Zouaghi district between 2007-2009 by the construction of 66 EPLF promotional collective housing units and 64 villas on the land located near the GERIC city. An extent of the urbanized surface passed from 5 138 ha in 2000 to 6052 ha in 2008.

An irrational consumption of land (policy of the blow by blow) but obligatory (demographic push, demand for housing) led the metropolis of the Algerian East to a very important imbalance in the urban framework, artificialization of the grounds, fragmentation of the space, deterioration of the architectural image of the inherited heritage,)

In spite of all these constraints, the revision of the PDAU of the Intercommunal Grouping of Constantine foresees an occupation of the urbanized surface of up to 6760 ha in 2030.

CONCLUSION

The changes in land use of the metropolis, reveal upstream the significant increase of built-up land in the study area, over the last three decades, an urbanization that encroached mainly on the vegetation cover of agricultural land, downstream a translation (see a transfer) of urbanization of the metropolis to the south of the grouping occupying not only all the bare soil but also some agricultural land, thus materializing the new configuration of the urban triangle of Greater Constantine.

The spatial and temporal heterogeneity of these changes has allowed the identification of rapid and slow zones of "sprawling" expansion. The results of the analysis suggest that, at the metropolitan level, agricultural land has been most fragmented by urban development, while large wooded areas have not been affected. The parent city has undergone sprawling development that could lead to a conurbation with harmful consequences.

Like all Algerian metropolises, Constantine was faced since the 1980s-1990s with a massive rural exodus whose main consequence was a rapid and uncontrolled urban growth due to the political and security instability of the country but also to the search for employment. This has generated significant land pressure. The Algerian State had to think of solutions to counter this unplanned over-urbanization and take over the reins of urban development.

It is only after 1990 and the promulgation of the law 90-29, relating to the development and urbanism, and its executive decrees (This law sets the general rules aiming at organizing the production of urbanizable soil, the formation and the transformation of the built-up area within the framework of an economical management of soils), that the first urbanism instruments were born, but in spite of this law, the extension in the urban area was in the form of a conglomerate of planned and unplanned urban areas.

To control urban sprawl, the policies carried out so far have resulted in instruments that spatially limit the extension of the city by prohibiting the development of land beyond the "Urban Perimeter", but have never managed to correct the dysfunctions induced by the gap between their implementation and the urban evolution.

However, since the advent of satellite imagery, urban planning tends to use spatial remote sensing as an adequate tool in the hands of planners. Globally, the world scientific community has recognized urban remote sensing as an activity and technique in its own right, acceptable for studying the spatio-temporal dynamics and consequences of urbanization.

Urban planning, as a prerequisite for resilient urban growth, presents an adequate solution to quantitatively and qualitatively assess urban sprawl, thus measuring the sprawl of a city and analyzing its effects and prospecting the best trends for future urbanization.

Moreover, we will not omit to evoke the concept of governance of its usefulness and its relevance to think and elaborate territorial planning policies.

This will allow us to develop the concept of geo-governance which consists of an approach that should lead to a shared knowledge of the territory in order to plan the elaboration and the construction of tomorrow's territories. The approach to the concept of geo-governance can also be done within the framework of several thematic entries such as sustainable development or urban governance as key concepts.

The concept of geo-governance advocated by researchers is under construction and in permanent experimentation according to the vision of sustainable development. It emerges from the intelligence of the stakes of development, also taking into account the expectations of the strategy of the territorial actors and favors mainly the dialogue in order to build a living space in accordance with the will of the inhabitants and that "an optimalspatialized decision" is taken.

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