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Evaluating the Impact of Major Road Axes on Urban Sprawl: The Case of Road Axes 03 and 28 (AïnYagout – Batna – Barika), Algeria

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Abstract

The twentieth century witnessed a great development in road networks, mainly the major regional traffic axes, the fact of which was reflected in the increase in the surface of the urban blocks, or the event known as the phenomenon of linear urban sprawl. Besides, this phenomenon has comprised all cities of all sizes in a short period of time, whereat there was an interrelationship between urban sprawl and transportation axes, as this latter became directed towards urban growth.

In view of that, this research dealt with the confirmation of the strength or weakness of the relationship all the way through studying this mutual influence, which is represented in the phenomenon of the urban sprawl for urban, semi-urban and sometimes rural agglomerations according to the classification of the National Office for Statistics (NOS 2008) situated in one of the important axes of the Province of Batna, and consisted of two sections (the National Road N°03 and the National Road N°28) with a length assessed to 170 km. Moreover, this axis was chosen for its diversity in terms of geography, movement and dynamism. More to the point, this includes the main-town of the Province along with the most important major population and functional agglomerations (Barika and AïnTouta). More and more, it is alike considered one of the most concentrated road axes for the population, as it includes about 34.33% of the total population of the Province of Batna and 42% of the total urban population; likewise, it is considered a strong link between several provinces and a strong attraction for investors, in addition to the attractiveness of the axis with its centres and the elements it possesses for the local population and investors for both private and public sectors.

Key words: Road axe; Urban Growth Corridor; Urban sprawl; Axis efficiency; Built-up area.

INTRODUCTION

In 2008, more than 50% of the world's population lived in urban areas, but this figure is expected to rise to 70% by 2050 (United Nations 2020). Besides, this increase will roughly occur in the countries of the third world, the fact of which is confirmed by the rapid urbanization in one of such countries, mainly Algeria, as it is witnessing a very important and complex stage of urbanization, which is reflected in the growth of large and medium-sized cities, in addition to the spread and doubling of the number of small urban centres on the outskirts of big cities, which have significantly contributed to changing the composition of the urban network (BEN DJELLID, 1986). More to the point, it recorded a duplication in the size and number of residential agglomerations, whereat the urban population doubled from 11,420,000 in 1987 to 22,471,000 in 2008, which has become representing 2/3 of the population of Algeria (NOS 2011). In virtue of which, the number of cities increased from 439 to 751 between 1987 and 2008, with an increase of 312 agglomerations. As consequence, urban areas will constantly witness rapid urban growth that will pose more challenges for urban planners, similarly to what was inherited by Algeria after the independence from various forms of organization of the territorial coverage. Subsequently, we will analyze the circumstances that led to the transformation of villages and rural centres into small cities in line with the road axes and the emergence of the so-called urbanisation corridor (Jérômel, Olivier N, 2013) symbolized by the important road axes in Batna: Batna – AïnTouta, Batna – AïnYagout, Batna – Chemora, Batna – Doufana, Batna – Barika, together with the evaluation of mechanisms and contexts that led to such transformations and urban sprawls in these axes belonging to the territory of the Province of Batna.

Above and beyond, for examination and evaluation purposes of the expansion process at the road axial level in the Province of Batna, we will adopt a set of simple indicators of the phenomenon of urban sprawl, in respect such as the number of cities, their distribution in the field, the size of their inhabitants and their demographic growth (REDJEM Ali and Tachrifat Abdel Malik, 2011). Subsequently, we will be in a position to reveal many field dynamics that contributed to the formulation of the so-called urban corridors, so as to attain a comprehensive approach to urbanisation directed at the roads axis.

Goal and Problem of the Research

The research problem can be summarized by a major question, as follows: What is the spatial relationship between the land transport roads network and the growth of urban agglomerations across the major roads. Moreover the scientific hypothesis has several possible answers to the research problem that is summarized in the fact that the transport roads networks, mainly the major roads, have a clear role in the distribution of population and the distribution of urban agglomeration. Besides, they represent two complementary processes for each other, and that the relationship between them has shown to be a positive and spatially varying relationship.

Goal of the Research

It aims to uncover the relationship between the road axe and the expansion of agglomerations in the studied area. Thus, it has been revealed that the relationship, between the transport roads network and the importance of the road axe and the expansion of the urban centres situated in the Province of Batna, has shown to be a positive and spatially varying relationship. More to the point, our study reached the necessity of taking care to these road axes through improving the urbanization and the city entrances, along with controlling the growth thereof, in order to avoid future repercussions. Furthermore, this research aims alike to track whether or not the urban sprawl in both parts of the road axe was carried out at the same rates and proportions, or is there any difference therein, together with the influence of the population growth on the urban change and development of cities based on this axis.

DETERMINATION OF THE STUDY AREA

The Geographical Location of the Field of Study

The study area is located in the Algerian East region, and forms an important part of the eastern high plateaus area between the two lines of 04 and 07° East and 35 and 36° North, and sits on an total surface of 1,203,876 km^2, which forms a territory belonging to a natural group consisting of the meeting of the Atlas and Saharan Atlas, whilst the centres of studied cities belong to the important road axes that pass through the province in the north and east, and correspond to the development axes that distinguish the province.

In the seventies, the site in the vicinity of the transportation axes was a major factor in the emergence of a new generation of urban centres. For that reason, we find that construction corridors are formed along the important road axes, which include many urban centres and acquired a simple commercial feature, some of which has a refuge for the neighbouring countryside residents. However, in the following period, mainly after the nineties, a series of small cities and urban centres began to emerge and some jointed agglomerations have then been developed.

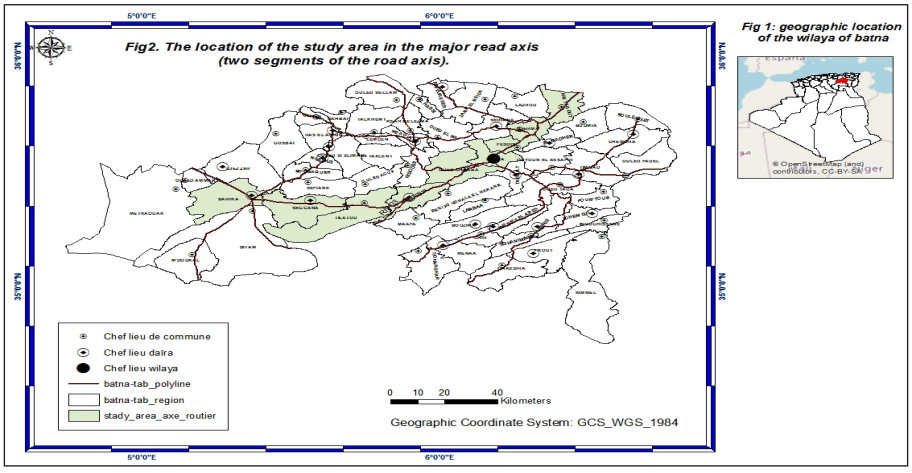


Figure 1. The road axe location with its two sections (03 and 28) (cities and important roads)

Definition of the Road Axe

The research area represents the road axe consisting of two sections (N°03 between AïnYagout and AïnTouta right the way through Batna, and N°28 connecting AïnTouta and Barika), which expands from the northeast to the southwest, and has been witnessing in the recent period a mixed urban sprawl in use and planning policy (organized and random), whereat many urban and semi-urban agglomerations, and sometimes rural, are situated according to the classification of the National Office of Statistics (NOS 2008), 03 of which are crowded with populations and having important administrative ranks; likewise, it witnesses very often random expansions along the road, as it extends from the north to the south of the province, and from its south towards its western the city of Barika; subsequently, the study area includes 08 agglomerations, in addition to some of the expansions of the important centres. Nonetheless, such agglomerations differ significantly in terms of size, population and urbanisation.

In reality, the distribution of urbanization on this axis or the study area did not start as it was influenced by the passage of the National Road N°03 and N°28, since most of the urban centres are older than the paved road, but the effect of the two roads appears, mainly after the project of their duplication of the track in creating and forming modern urban forms in the study area (field investigation 2018). More to the point, the settlement of some industrial services and institutions on its outskirts has alike helped to confirm the extensive form that was clearly done on one side of the road or both sides, in addition to the factor of the flat position along the axis, whereat the most important stage in the dynamics of the axis has shown to be the creation of new road links to transfer the frequent traffic sizes in the centre of big cities (Batna, Barika and AïnTouta), and from the two National Roads N°03 and N°28 with ease, speed and safety, away from the traffic jam and congestion of traffic in the centres of the cities.

METHODOLOGY AND TOOLS OF THE RESEARCH

This study sought to elucidate the urban sprawl during specific periods, mainly 1998, 2008 and 2018, and what happened to the cities located on the major road axes symbolizing the two Roads N°03 and N°28, whose importance originates from being the most important axes, which represents the most important cities and urban centres in terms of population and surface. Additionally, it aimed to clarify the amount and percentage of this urban change, together with the urban growth trends in various cities according to the size categories thereof (urban centres, small cities and big cities) during these periods throughout the use of software with a spatial dimension, whereat the techniques of the geographic information systems were use, in respect such as ArcGIS Software, by means of the Geological Survey Authority's website (USGS), visualizations (LANDSAT) were downloaded for the study periods. Above and beyond, analysis and processing operations have been carried out, in respect such as classification, cropping and the like, along with using the statistical analysis processes and together with supporting the same with indicators to measure the phenomenon of expansion as a false model and the built-in surface density in order to confirm the strength of the mutual relationship between the road axe and the expansion of the agglomerations situated thereon, seeing that we will rely on the statistics of the general censuses of housing and population 1998 – 2008 – 2018.

In fact, it has been illustrated through the concluded results that a clear effect of the major road axes exists on the size of the urban sprawl of the cities located along the same during the study periods, as the annual urban sprawl rate was (13.47%) between the years (1998 –2008) and (3.71%) between the years 1987 – 2018, seeing that the urban growth trends have alike varied during the same period. Further, it confirmed that the proportion of expansions along the national roads reached to 70% of the total expansions and changes in the built-up framework.

RESULTS AND DISCUSSION

Indeed, many indicators were adopted in order to measure and analyze the urban sprawl of the agglomerations located along the axis of the study, the most important of which are the urban sprawl index, the population load and weight of the urban agglomerations, the change in use through traffic avoidance methods which are considered as a motive force for urban sprawl at the major agglomerations.

Urban sprawl index

The urban sprawl results from the growth of built-up areas on the outskirts of cities faster than urban population growth (Pouyanne. G, 2004), and it symbolizes a housing choice in general that some families make. Besides, this corresponds to the spread of population and activities outside the centres of the cities.

Moreover, urban sprawl was defined by (Bessy. P, 2000) as the spatial physical sprawl of the city in a less density form than it is within the city, at the expense of the agricultural lands around the city adjacent thereto, which alike means the horizontal expansion of the built-up area.(Julien. P, 2000, p3-33)

Nevertheless, according to other researchers, the phenomenon of sprawl leads – through the increase of physical and environmental impacts in urban areas – to the destruction of the constituents and diversity of nature and to the dispersion of the natural areas, as well. Subsequent to which, choosing the right direction for the future of urban sprawl has shown to be of great importance to limit its damage and improve the quality of the population life. (Oueslatietal, 2015; Hossainietal, 2015)

Additionally, the growth index of the urban built-up area, together with its relationship to the population growth for the periods (1998 – 2007 – 2018), were used to uncover the role of the road axe in its two sections in bringing about changes in the built-up area. Further, it became clear through calculating this indicator that almost all agglomerations, by around 85%, witnessed amazing spatial expansion, as the largest values were witnessed by each of AïnYagout, Djerma and Fesdis due to the development projects that were settled along the National Road N°03, the fact of which has increased the longitudinal expansion thereof (Figure 02).

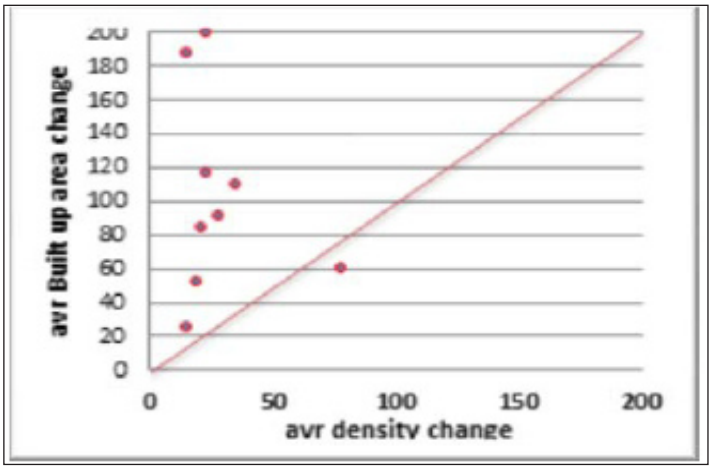


Figure 2. Relationship between urban population vs. built-up area of theurban agglomerations located along the studied road axis (1998 to 2018)

The Demographic Weight Of The Road Axes – A Dynamic And Spatial Approach

The population analysis is based on the demographic development of the municipalities through which the road axes pass. However, this development affects the residents of the agglomerations along with their neighbouring areas, and the relationship of this development to the administrative rank.

More to the point, through analyzing the numbers illustrated in Figure 01, the demographic weight of the axes and their agglomerations becomes obvious, as we record population agglomerations with a high demographic weight represented in the metropolitan area of Batna and a large city which is Barika (according to Law 20/01 pertaining to the territorial planning and its sustainable development). Furthermore, the population of the first city increased more than 1.5 times during the period extending from 1998 to 2008, which accommodates 1/4 of the population of the province, from 247,520 to 340,659 people, whilst the second city witnessed a population increase by a multiplication of 1.4 times during the same period, from 85,670 to 121,195 people. In light of which, this weight is explained by the fact that the first city stands for the main-town of the Province and has a large population concentration as a result of its acquisition of a large percentage of investment projects, the fact of which gave it an attractive force from outside the province; whilst the second city is the nerve centre of an old district and has forward-looking dimensions within the scope of the decision related to the administrative reorganization of the high plateaus regions on2015. Likewise, we can add to these two cities the city of AïnTouta, which has known exceptionally rapid growth.

As for the agglomerations with a medium or stable demographic weight: in respect such as those close to the major poles like Tazoult and Fesdis, together with the demographically unstable agglomerations, as is the case for both of Tilatou, Seggana, and the two agglomerations of Lambiridi and El Ghedjati, which witnessed a kind of imbalance among its population during the period extending from 1987 to 2008.

In reality, the analysis of the table pertaining to the population distribution on the study field across the various censuses shows relatively strong spatial differences from one census to another. In this respect, the population distribution witnessed a profound demographic transition as the population increased from 1998 to 2018 by 140%, which is matched by an annual urban population growth rate of 2.53%. Further, the build-up area is almost 05 times doubled. Hence, such development indicates the continuous transition of urbanization and the presence of continuous internal migration.

Certainly, most of the cities included in the road axe have witnessed an unprecedented demographic explosion (DPSBof Batna, 2019), thus exceeding the cities of Batna, Barika and AïnTouta, whilst the 2018 census process has revealed a similar demographic pattern to the one recorded during 2008 for both Batna and Barika, which stands for a continued decline in their growth rates (Figure N°03), with exceptional cases recorded for both of Lambiridi 5.49% and Tilatou (Legridet) 5.16%, together with a decline for each of the rest of the localities (Fesdis, the secondary agglomeration of Araar, Seggana). In virtue of which, this situation can be explained by the waves of migration towards such agglomerations which have recorded significant growth rates since 1990.

Table 1. Relationship of the population growth rates with the expansion areas for major road axe

Urban development axes	Urban centres	98	Surface	2008	Surface	2018	Surface
National Road N°03	AïnYagout	6172	5.6	7588	87,93	9 290	269,29
	Djerma	867	3.69	1442	24,57	1 658	71,02
	Fesdis	1977	13.25	3616	80,73	4 879	169,64
	Araar	538	7.15	930	23,48	1 185	45,14
	Batna	247520	906.12	297814	2615,4	340 659	3307,94
	Lambiridi	915	2.3	1631	32,58	2 890	52,50
	El Ghedjati	420	1.97	650	7,29	800	15,79
	AïnTouta	48495	132.03	54505	411,7	64 645	629,72
National Road N°28	AïnTouta	48495	132.03	54505	411,7	64 645	629,72
	Tilatou (Legridet)	868	13.23	1442	5,4	1 247	17,57
	Seggana	1735	1.71	2544	7,65	3 210	59,03
	Barika	85670	224.19	100597	791,28	121 195	1467,49

Source. Authors, based on the data of the Monograph of the Province of 2018, and the main roads network

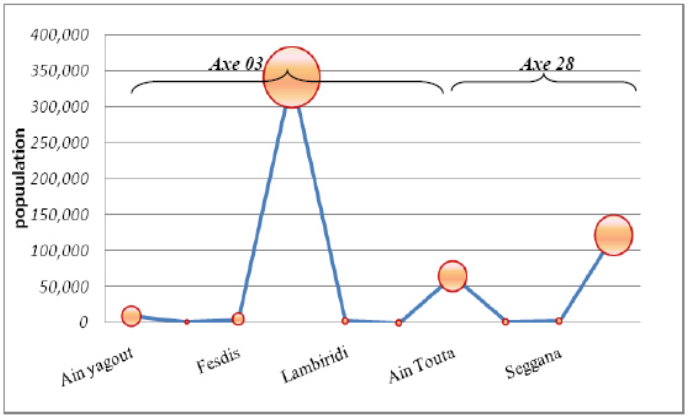


Figure 3. The urban network on the major road axe in its two sections (National Road N°03 and National Road N°28)

In the light of analyzing the urban structure on the road axe of National Road N°03 and the National Road N°28, and by moving from one axis to another, the hierarchical sequence of cities changes based on: the seniority of the establishment of agglomerations as administrative centres, the presence of important colonial centres before the intervention made by the State, in addition to other elements that have a direct relationship with the geographical location and the terrain nature of the municipality, which includes the agglomerations that highlights a clear dominance of the major cities on the rest of the agglomerations; in other words, heterogeneous hierarchy (Table 02).

Table 2. Volumetric gradient (according to the population number) for cities at the axes level

	Axis of Urbanisation (A ïn Yagout – Batna-)	
Number of agglomerations according to sizes	Section 01, National Road N°03	Section 02, National Road N°28
agglomerations less than 5000	06	02
5000 – 20000	01	00
100,000 – 300000		01
Balanced network + 300000	01	Unbalanced network

Source. Authors, Based on the data of the Monograph of the Province of 2018

New Generation of Small Agglomerations

The dynamics of the distribution of the urban rank are illustrated in Figure N°04, whereat the value of the correlation coefficient ranged between 0.97 to 0.98 during the two periods of 1998 and 2008, which correspond to large values that indicate the importance of the city's rank in the urban centres' scale, meaning that there were a small number of cities with large size. Nonetheless, according to the time change of the Pareto Coefficient, three different stages were identified: 1998/2008/2018, despite some small fluctuations, bearing in mind that the Pareto Coefficient remained high, which indicates more irregularity during this stage extending from 1998 to 2018.

In reality, the regression curve recorded a value of 2.69 during the two years of 1998 and 2018, the fact of which indicates an irregular distribution of the built-up areas alongside the size of urban sprawl across the road axe formed by two sections National Road N°03 and National Road N°28, as this is due to the presence of large cities with a small number and many small urban centres that emerged between or at the vicinity of such cities, thus leading to such imbalance (the emergence of the so-called interstitial urbanisation).

More to the point, the ZIPF law is one of these theories that study the relationship between the hierarchy and sizes of cities (Arshad, S and 2018). Besides, this law is alike known as the size-rank rule, as one of the prominent methods that have been applied in the study of the urban geography and examining the distribution of city size and the growth of cities (Gabaix , X.). Hence, the ZIPF formula is as follows:-

$\log P_n = \log_i - \alpha \log n$ which can be written in a linear relationship according to the following equation: $Y = a_0 + \mathrm{a}\ x$

Whereat it represents $y = \log P_n \ldots\ldots a_0 = \log P_1 \ldots\ldots\ldots x = \log n$

As α stands for the inclination of the straight, this indicates the extent of difference of the cities' sizes, and explains the mechanism of hierarchy or urban sequence, as well. Besides, the more the inclination of the distributive straight towards one (1) is closer, the better the distribution.

Table 3. Rank-size Distribution of the built upof Cities in the Study Area (2008-2018)

Urban Development Axes	**Urban centres**	**Built-up 2008**	**Rank**	**Built-up 2018**
N R N°03	Batna	2615.4	1	3307.94
N R N°28	Barika	791.28	2	1467.49
N R N°03	AïnTouta	411.7	3	629.72
N R N°03	AïnYagout	87.93	4	269.29
N R N°03	Fesdis	80.73	5	169.64
N R N°03	Lambiridi	32.58	6	52.50
N R N°03	Djerma	24.57	7	71.02
N R N°03	Araar	23.48	8	45.14
N R N°28	Seggana	7.65	9	59.03
N R N°03	El Ghedjati	7.29	10	15.79
N R N°28	TilatouLegridet	5.4	11	17.57

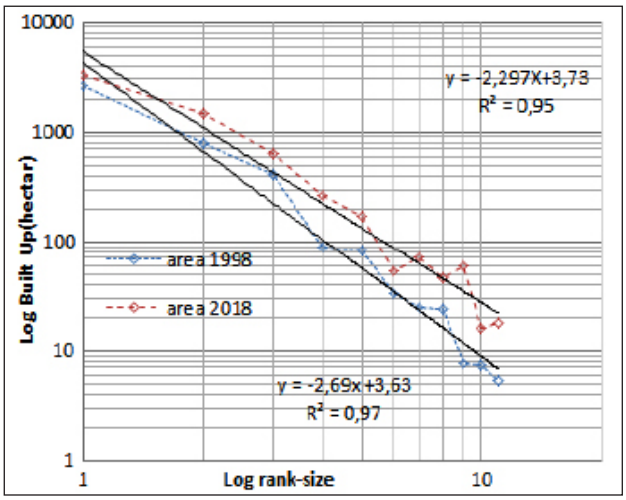


Figure 4. Change trend of the built-up rank-size (1998-2008) distribution

The application of the Pareto coefficient allowed us to confirm the positive impact of the city rank in terms of the built-up area on urban sprawl, whereat most of the cities of the axis witnessed a large urban sprawl, mainly AïnYagout (Impact of creation of an area of activities) and Djerma (Impact of the Batna University 2 construction project). Moreover, the differences can alike be noted in pace of demographic growth in the urban appearance according to the axes: there are centres that have gradually urbanized, in respect such as Tilatou, Seggana, Djerma and AïnYaqout. As for the others, urban centres witnessed maco-mutations due to the influx of immigrants, the fact of which contributed to giving them clear urban sprawls and very dense urban fabrics, in respect such as Barika, Batna and AïnTouta, whilst the remaining centres are still in their rural condition, such as Talatou, Seggana and Djerma, although they have already been included as urban centres in 1987, and administratively upgraded to main-towns of municipalities in 1984, such as: Seggana, Telatou, and Djerma. Besides, the size of the urban sprawls and the strong population changes reflect a strong political will on the part of the local authorities to intervene throughout various housing and equipment projects.

According to ZHAOR2020, who endeavoured to apply the Pareto coefficient, he concluded through his research that the relationship between urban sprawl and population growth can record a negative value in case the city would adopt policies that regulate the peripheral sprawl of the cities and promote growth all the way through the compaction principle and avoidance of sprawl (ZHAOR2020. p1), the fact of which was underlined by the United Nations Conference on Human Settlements (UNO2020). Nonetheless, no negative value of this relationship was recorded at the level of the study area, as this was confirmed once again by the continuous expansion of the urban centres situated along the road axe.

Dynamic Analysis of the Built-Up Area of the Axis Agglomerations According to

The urban built-up area of the province of Batnain 2018 reached 10990,34 hectares, with an increase at an average annual urban sprawl rate of 17.8% since 2008. Besides, the urban scale was 7147.23 hectares, and an average annual urban sprawl rate of 3.98% during the period extending from 1998 to 2008, when the total built-up area thereof was 1637.1 hectares.

In fact, it has shown evident from the prepared maps hereunder the urban sprawl witnessed by the road axe between three periods 1998 – 2008 – 2018, whose spatial distribution is mainly concentrated in the expansion of agglomerations, as well as through the spread of housing along the main road axes, together with the creation of residential parcelling. Likewise, it turns out that the axis produced urban areas that know daily movement of urban sprawl and sprawl over interstitial agricultural and vacant areas.

In virtue of which, the road axe in its two sections (National Road N°03 and National Road N°28) has attracted rural agglomerations towards the same during the period of economic recovery along with attracting urban projects, as well. In consequence, this axis is considered the most important active factor that had a clear role in the rapid growth of human centres in both urban and functional aspects, as this growth was accompanied with the development that took place in the projects of duplication of the network of transportation roads, the axis and parts of the axis situated within the urban fabric; further, it has alike led to the emergence of new agglomerations, mainly at the intersection of roads, as per described by "Troin", who gave them the name of road agglomerations (Troin, J.F.2006).

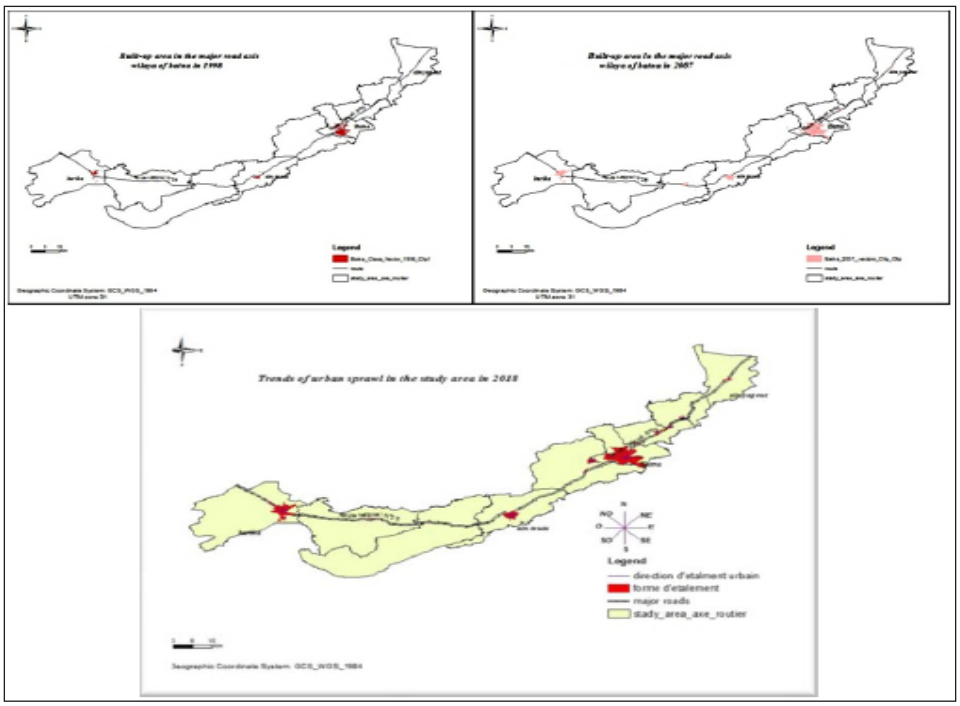
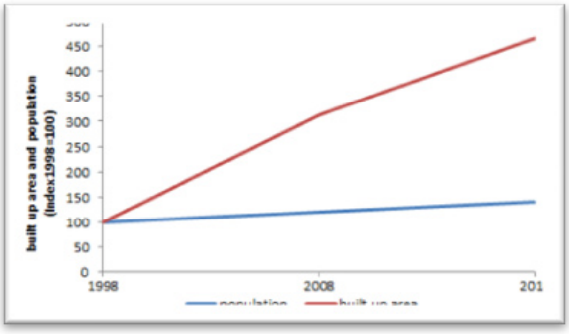


Figure 5. Trends of urban sprawl in major axis road (Section N°03 and N°28)

Table 4. Built-up area Vs population in the study area

Built-up area	Pop	% Buil-up	Built-up (Hectare)	% Pop	Pop	Year
100	100	192	1398.24	19.63	395177	1998
311.67	119.64		4088.01		472759	2007
465.6	139.91	49	6105.13	30.36	616303	2018



Source. National Office of Statistics and build-up areas calculated by Arc GIS 10.2

Since the urban sprawl is digitally defined as the growth of built-up areas at a rate exceeding the population growth rate, during a certain period of time, the fact of which is automatically reflected in the population density (Pouyanne. G, 2004), seeing that Table N°04 illustrates that the built-up areas are developing faster than the population increase, whereat it recorded a value of 192% (the period 1998 – 2008) and 49% (the period 2008 – 2018). Nevertheless, the population increase has recorded values of 19.63% and 30.36% during the two periods, whilst the coefficient of the population multiplication during 20 years has recorded a value of 1.4 times, whilst the built-up area multiplication recorded a multiplication coefficient assessed to about 05 times, the fact of which confirms the amazing urban sprawl across the axis as a result of the planning policies on the one hand, and the random intervention of individuals on the other hand, along with the settlement of some companies that need large areas and the proximity to the road, at the same time.

Change of the Urban Sprawls from the Nucleus to the Road: Spatial Expansion on the Edges of the Main Roads

The studied road axe in the two parts thereof (National Road N°03 and N°28) witnessed, considering its ancient history as the main-town of the Province, the expansions of some of its cities outside its first nucleus, whereat the limit reached the expansion outside its municipal administrative borders as a result of real estate saturation and the obstacles of the location, in respect such as the city of Batna that expanded towards the city of Tazoult towards the Road N°31 and the river of Châaba along the National Road N°77, and in two directions of Lambirid at the National Road N°03 and the new

urban pole Hamla, together with the urban agglomeration of Fesdis on the same axis, thus new spatial expansions are formed far from the mother town and close to the National Road N°03, and the same applies for Barika that was the main town of the township since 1974, which witnessed a significant expansion in the neighbouring municipality of Bitam.

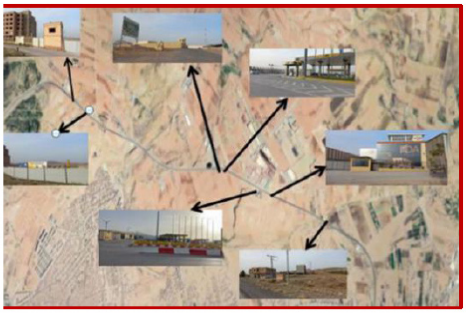
More to the point, it can be said that these emerging and newly born agglomerations tried to take the longitudinal form to attain two features (Al-Shariai, 2004, p.391): Benefiting as much as possible from the passage of the National Road in the two districts thereof, as well as elongation so as to reduce the distance between the same and the major agglomerations along the axis.

Impact of the Bypass Roads on the Expansion of Urban Centres

The most important stage in the dynamics of the axis has shown to be the creation of new road links to transfer the frequent traffic sizes in the centre of big cities (Batna, Barika and AïnTouta), and from the two National Roads N°03 and N°28 with ease, speed and safety, away from the traffic jam and congestion of traffic in the centres of the cities.

We will endeavour to shed light on the impact of traffic bypass roads as a complementary element of the major transport axes and a strong motivation for the urban sprawl of the agglomerations that pass beside the same, in order to know the factors and repercussions of the effect of such type of roads.

At the time of comparing the maps of uses of the lands surrounding the city of Batna, we find that the change was clearly made on the outskirts of the city, due to the realisation of the traffic bypass roads that urbanization is attracted to its sides at the expense of agricultural lands. However, this has led to a change in the function of such lands to other commercial jobs and light industries (Figure N°06 & 07).



Figures 6. The northern traffic bypass road. **Figures 7.** The eastern traffic bypass road

In reality, interchanges which are alike known as bypass roads in the city of Batna were created in the city of Batna have been realized in two phases (Figure N°08) whereat the urban agglomeration exceeded the limits of the two old exchangers that were realized in 1980 as they lost their basic function for which they were constructed, which is the transition of the movement that does not need traffic on the city; thus, they became integrated within the urban fabric, and have been supported by two new exchangers, one on the north and the other on the east, which have been constructed in 2015 and 2017, respectively, as they are witnessing the expansion of residential areas and the emergence of projects with the vicinity thereto, which may expose them in the future to the second loss of their function.

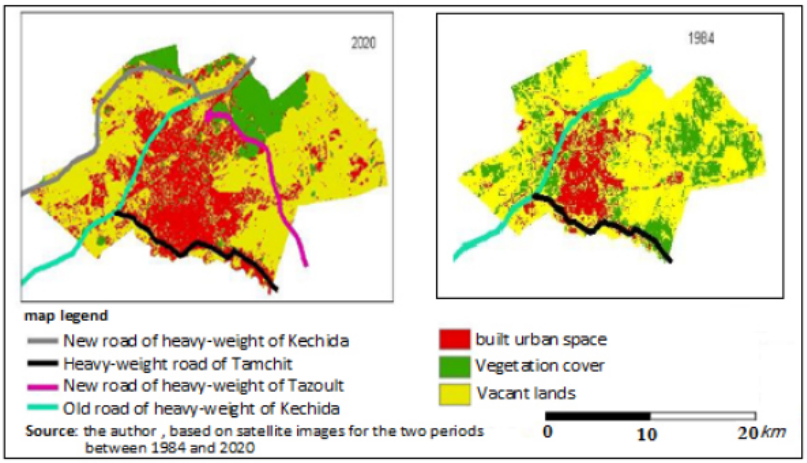


Figure 8. The urban sprawl of Batnaagglomerations before and after the construction of the traffic bypass road.

The phenomenon of sprawl, through increasing the material and environmental effects in urban areas, leads to the destruction of the constituents of nature, the loss of biological diversity, and the dispersion of natural areas, as well. In a consequence, choosing the right direction for the urban sprawl future is if great importance to put an end to the damages thereof, together with the qualitative improvement of the population life (Oueslati et al. 2015; Hossaini et al., 2015).

CONCLUSION

In the lightof the facts set out above, the central road connecting between the centre of the province (Batna) and the other neighbouring provinces facilitated the expansion of the cities located along the same, and created new economic activities. Above and beyond, the city of Batna, for instance, is witnessing a constant expansion with the three National Roads (National Roads N°03, N°28 and N°31). More to the point, the cities are in a linear form on the National Road N°03 that connects the same with the cities of Batna and Biskra,in addition to the National Road N°.28 that connects the city of AïnTouta to the city of Barika towards the Province of M'sila. Further, this is alike applicable to the cities of the centres of the townships and municipalities of the province, which take a linear form on the roads that connects the same with the state centres (Batna). On the other hand, this axis will allow the integration of cities build-up along the same in the local, regional and national economic development strategy, all the way through the possibility of future connection with the east-west road of the plateaus (Highway Rocade of High Plateaus) scheduled in the national policy pertaining to the adjustment of the national territory.

In virtue of which, we have attained the conclusion that the urban sprawl across the roads is more than what was imposed by the scheduled policies through various urban tools (Master Plan for Development and Urban Planning). In addition, the road network development, mainly the major roads, facilitated, through the projects of duplication of the tracks and realisation of the traffic bypass roads, the distribution of population and urban sprawl of agglomerations of various sizes, mainly those situated on the major transportation axes. More to the point, this has alike led to the emergence of new centres between major cities and the construction of interstitial fields.

Certainly, the urban structure at research area witnessed dynamic changes, mainly the growth of the urban agglomerations in terms of size, all the way through the continuous residential and functional expansions along the axis, together with the emergence and construction of new residential areas and their transition from rural to urban or urban semi-urban areas, which stands for a clear change in the patterns and urban structures, the fact of which has been reflected in a clear rise in the urban population percentage to the total population of the municipalities subject to the study area, alongside the disappearance of the rural – urban connection between the major agglomerations and the neighbouring affiliated agglomerations, the phenomenon of which was noticed through our research at the first part of the road axe N°03, while no agglomerations appeared on the expansion of the second part (National Road N°28) for several reasons, as the most important of which the absence of old colonial centres, the low productivity and the shortage of industrial projects. Nonetheless, as reflection thereto, the population density has shown to be lower and produces small population agglomerations whereat we have noticed that the appropriate conditions for urban sprawl at the two parts are not equal, whether in terms of population density or built-up areas.

In closing, it has been demonstrated that the relationship between the transportation road network, the importance of the road axe and the expansion of urban centres situated in the Province of Batna is a positive and spatial varying relationship. Moreover, this study reached the necessity of taking care of these road axes without leaving them to spontaneous interventions, all the way through improving urbanization and cities entrances, and also controlling growth in order to avoid future repercussions, taking into account that the needs received from the urban property of the big cities will be transferred, in the long run, to the neighbouring municipalities at the road axe.

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