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Determination of the Typical Patterns of Medium-Sized Towns in Eastern Algeria

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Abstarct

This study aims to determine and classify so-called medium-sized cities of colonial creation in the Eastern Algeria region. We examined the impact of several factors and their interactional effects on the history and future of these cities. The objective is to select case studies in which the state of their former centres is subsequently the subject of a comparative study. We chose criteria that represent the overall conditions in which these cities live. For this purpose, a research method based on the statistical analysis of demographic and economic criteria was adopted. It is accompanied by an examination of the effect of the geography and history of creation and the administrative promotion of these cities.

INTRODUCTION

The study of a district or a part of a city cannot be carried out without understanding the elements that have contributed to the city's emergence as a whole. Similarly, a city cannot be studied without considering its interrelations with the coexisting areas. This study aims to identify and classify the so-called medium-sized cities of colonial creation in the region of eastern Algeria by examining the impact of a series of factors and their interactional effects on the history and future of these cities to subsequently select case studies whose former centres constitute the subject of another study. To this end, a research method based on the statistical analysis of SPSS data relating to demographic and economic criteria and a geo-administrative presentation should be considered.

The demographic criterion is used to develop the first field of investigation relating to the cities introduced into the demographic scope of the average city in Algeria. The economic criterion aims to understand the behaviour of the cities determined by the first criterion regarding the availability and scarcity of activities, which is done by determining the agglomeration index of the located activities using the Davies method (Davies 1967). The combination of these two criteria mentioned above (demographic and economic) is used to examine the effect of the centrality of activities on the degree of importance of cities using the Bennison method (Bennison 1978). The intervention of the parameters related to the geographical location and administrative promotion of the cities allows us to have a final form of classification. The classification is achieved by the principle of dimension reduction using principal component analysis (PCA).

DEMOGRAPHIC STUDY

Based on the official definition of the medium-sized city in Algeria, we first selected the range of cities with a population threshold of between 50,000 and 100,000 inhabitants. This range was chosen by referring to the medium-sized city's definition according to the *Journal Officiel d'Algérie* (Official Algerian Journal) (Officiel 2001, Officiel 2006). However, most of the so-called medium-sized Algerian cities of colonial origin have long since exceeded this demographic threshold and undergone various development forms. Despite their rapid demographic growth, they still have the characteristics of medium-sized cities.

Most of these cities are overpopulated due to multiple factors, especially during the years known as the "black decade". The urban population during the decade 1998-2008 has always grown at rates higher than the natural increase due to the rural exodus and the reclassification phenomenon (ONS 2011). This phenomenon has been accompanied or not by a certain economic development. The unfavourable economic and security conditions experienced by Algeria during the decade 1987-1998 encouraged the population to confine itself to the urban centres closest to the countryside.

The urban network has been strengthened by an additional 172 settlements, including 6 large cities with more than 100,000 inhabitants, 13 medium-sized cities (50,000 to 100,000 inhabitants) and 28 small cities (20,000 to 50,000

inhabitants) (ONS 2011). After a decade since the last population census (RGPH2008) was carried out, it is intuitive to think of broadening the field of prospection of these cities from a demographic point of view. To this end, we increased the range for this type of city to between 50,000 and 150,000 inhabitants. This operation enabled us to identify twenty-three (23) medium-sized cities in eastern Algeria that met this criterion.

Circumstances of Demographic Growth in the Medium-Sized Towns of Eastern Algeria

To monitor the growth of the twenty-three medium-sized towns in eastern Algeria, it is necessary to look at the various demographic censuses carried out since independence up to the present day. The censuses in question were carried out successively in 1966, 1977, 1987, 1998 and 2008. To update the demographic data in the study, we projected the data from the 2008 RGPH for the following ten years, using the average annual population growth rate indicator for each locality. This indicator was used with caution, as it was felt that a high growth rate in an agglomeration was not necessarily a good indicator (ONS 2011).

The results obtained from this projection show that there are cities that have sometimes barely exceeded the maximum population threshold previously set at 150,000 inhabitants in the 2008 census, reaching 190,000 inhabitants (the example of El Eulma and El Khroub). To enrich our field of study with a broadly representative number of cities, we considered it useful to keep these cities for the following parts of the analysis, particularly in the economic analysis of city classification. Table 1 shows the connection of these results with the data on the evolution of the population of urban agglomerations for the years 1966-1977-1987 (ONS 1988) with the addition of statistical data from the 2008 census (ONS 2011).

The graphical representation of the growth of these cities shows that considerable development has taken place from independence to the present day (Figures 1 and 2). These cities have shown significant disparities in the population they house and the circumstances of their demographic growth. To have the first classification for these cities, we used a method of analysis based on the exploitation of statistical tests carried out by applying the SPSS software.

Table 1. Demographic data of the population of current medium-sized cities in Eastern Algeria

	City	1966	1977	1987	1998	2008	2018
1	Skikda	62102	94719	128747	-	147594	154220
2	Guelma	36308	56106	77821	108680	120004	132434
3	Ain Beida	30412	42578	61997	88290	115286	152896
4	Khenchela	28606	44223	69743	86620	108580	139438
5	Djijel	25737	35065	62793	106310	131513	156603
6	El Eulma	25617	41564	67933	104760	145380	192808
7	Boussaâda	24322	46760	66688	99770	111787	137501
8	M'Sila	19657	29512	65805	102150	132975	174475
9	Ouenza	18069	30281	36096	45881	47312	55130
10	Chelghoum Laid	14634	21376	29896	41960	54495	69234
11	Barika	13872	26315	56488	79510	98141	122026
12	Ain M'lila	12638	19452	33345	50670	65371	84856
13	Mila	12484	17267	33456	54720	63251	73703
14	El Khroub	9561	14962	36924	65240	89251	193736
15	Oum el Bouaghi	9282	15123	34257	47840	67201	93022
16	SidiAissa	9217	16898	31455	53120	66856	86784
17	Ain Fakroun	6889	11829	25432	47237	48804	58115
18	Ain Touta	6133	14693	28915	44900	55736	64946
19	Cheria	5844	10434	32953	53650	66160	78782
20	Ain Oulmane	5496	9077	21676	39030	51207	65056
21	Bir El Ater	5187	13812	33364	53160	70749	95862
22	Taher	1944	8311	22990	51310	59250	69793
23	El Bouni	-	-	-	30148	69295	79011

Source: ONS, updated by (2020).

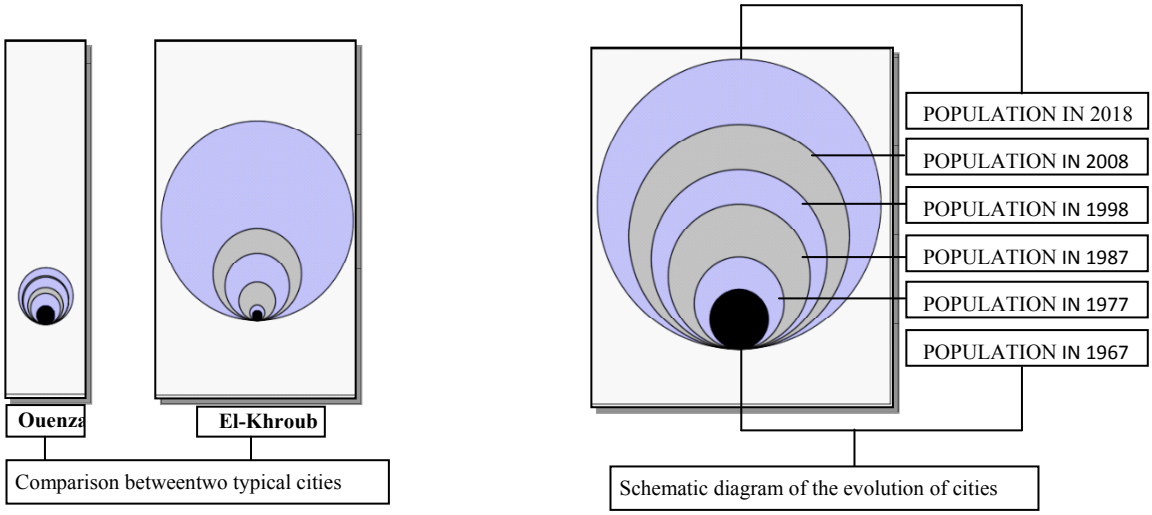


Figure 1. Diagram of the cities. Source : Authors (2020).

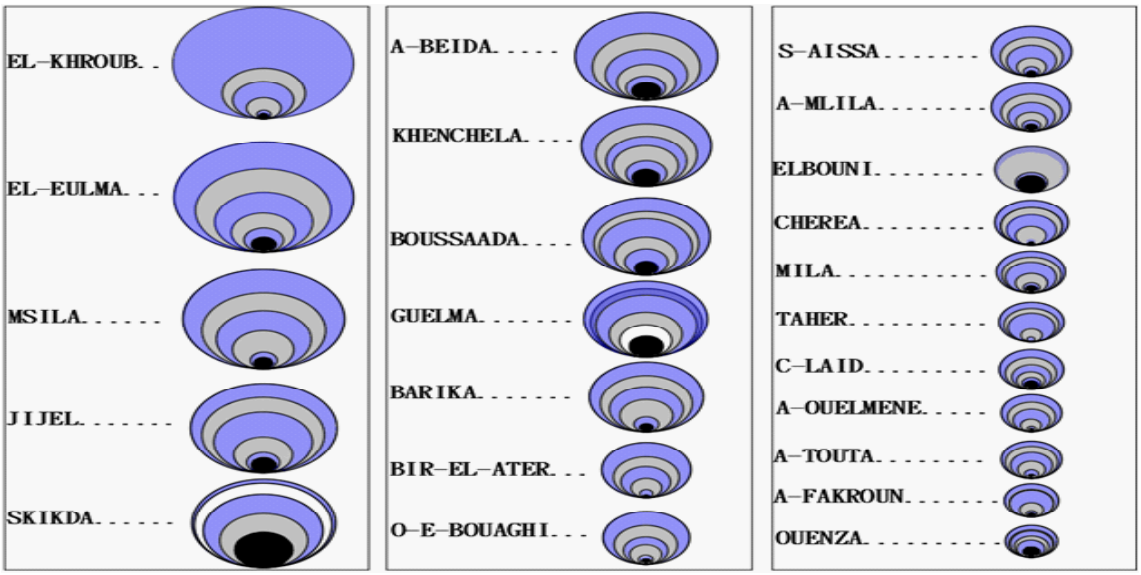


Figure 2. Development of the demographic growth of the medium-sized cities of eastern Algeria. Source : Authors (2020).

STATISTICAL ANALYSIS OF DEMOGRAPHIC DATA

Classification Using the Hierarchical Bottom-Up Classification Test

We opted for the hierarchical bottom-up classification (HBC) test to form clusters of homogeneous cities with similar growth profiles. HAC proceeds by iteratively classifying the data from the minimum of clustering criteria to the maximum of clustering criteria until all objects are clustered into classes. The successive clusters produce a classification tree called a dendrogram (a kind of tree diagram that starts from the largest number of clusters to the smallest and shows us the different choices that can influence the choice of the number of clusters). This ultimately gives an idea of the classes and how they are clustered (Mazouz 2020b).

To carry out this test, we selected a set of continuous quantitative variables that correspond to the population of the twenty-three cities from 1966 to 2018. We must also insert the nominal qualitative variable (the names of the cities) as an observation indicator to have more appreciable readings. In terms of graphic representation, dendrograms should be adopted. The results obtained after the application of this analysis technique are presented in several ways. The transformation of the selected tabular results into a graph allows us to have the result shown in Figure 3.

The transformation of this information into a graph allows us to understand these results (Figure 3) better. We notice at the beginning that the results lead to very low losses, and therefore the clusters are natural. The first signs of information gain were only made after the 13th and up to the 16th observation, so the real differentiations are recorded after these

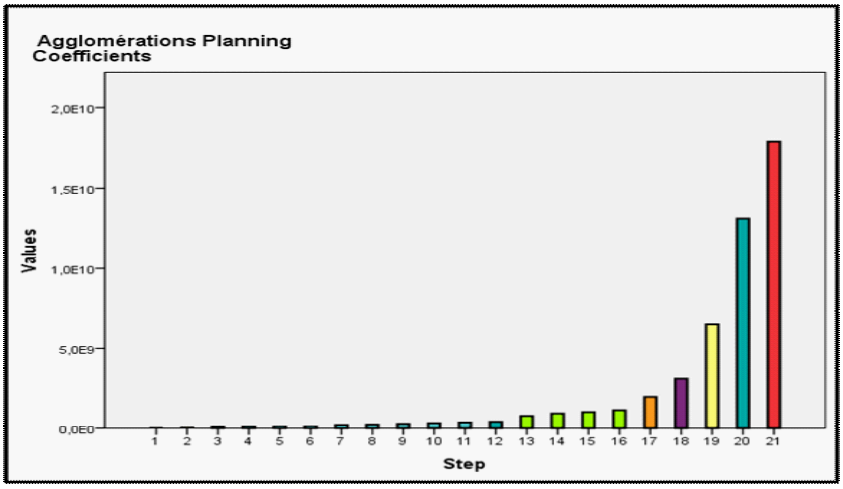


Figure 3. Agglomeration planning. Source: Authors (2020).

values. On the other hand, the differentiations recorded on observations 17 to 21 allow us to have a very clear reading of the formation of the clusters.

Francois (2014) pointed out that the choice of the number of classes is important, as building a partition with too few classes may lead to classes that are not homogeneous, and on the contrary, building a partition with too many classes may lead to classes that are not sufficiently differentiated. The tree diagram clearly shows that the division into 2 or even 3 clusters gives too generalised readings and presents a large quantitative phase shift between the clusters; on the contrary, the division into four up to five clusters gives quite important results, with homogeneous results and balanced clusters. This split is considered the most convincing in terms of cluster formation (Figure 4).

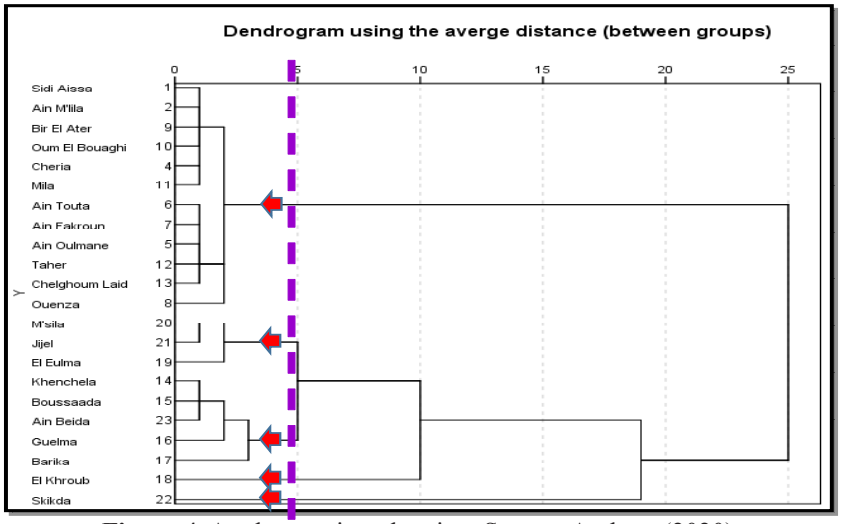


Figure 4. Agglomeration planning. Source: Authors (2020).

There have been remarkable changes in how these cities have developed over the last 50 years, with the emergence of some cities and the decline of others. This is due to several factors that need to be verified later on. At the end of the clustering process, the cities of Skikda and El-Khroub form the first and second clusters, the cities of Khenchela, Boussaâda, Ain Beida, Guelma, and Barika form the second cluster. The third cluster is formed by the cities of Jijel, M'Sila and El-Eulma, and the fourth cluster is composed of the cities of Sidi-Aissa, Ain M'Lila, Bir El Ater, Oum el Bouaghi, Cherea, Mila, Ain Touta, Ain Fakroun, Ain Ouelmene, Taher, Chelghoum Laid and Ouenza.

ECONOMIC STUDY

Economic parameters are of great importance in studying the growth and dynamics of cities. So the classification of cities is not only done through the population they house but also their economic potential. Size is certainly an essential dimension in assessing the importance of the city. Still, it remains insufficient if it is not combined with a more detailed analysis of the structure of the active population and the urban product because cities are increasingly differentiated by

their economic weight rather than by their demographic weight (Rahmani 1982).

The economic parameters are not limited to their quantitative components but also the qualitative presence of this economy. Many quantitative descriptors, such as the number of jobs, establishments or dwellings, and qualitative descriptors, such as the diversity or scarcity of activities and the variety of the population present, are correlated with the size of the cities (SNAT2030 2010). Indeed, many studies have addressed the subject of city classification. Some have approached it from the point of view of the specialisation of cities (Cheurfi 2011). Others have studied the classification of cities via the scarcity of activities established by the Davies index and the centrality of activities established by the Bennison index (Lekehal 1982).

So we opted for an economic study of the classification of cities; based on the calculation of the indices of scarcity and centrality of economic activities (Davies index and Bennison index) remodelled by a descriptive analysis carried out by SPSS. The choice of this analytical model was developed concerning part of the study by Lekehal (1982). The number of establishments that a locality possesses does not clearly express its territorial importance. However, based on the qualitative analysis of economic activities in all the cities, we can examine the importance of a locality through the scarcity and the centrality of its economic activities. This analysis was carried out in three distinct stages:

- The first determines the scarcity of activities according to the agglomeration index of localised activities (Davies index).
- The second addresses the determination of the activity centrality index (Bennison index).
- The third deals with the relationship between the two indices.

According to the data provided by the National Statistics Office (ONS) on the economic entities in the capitals of twenty-three cities, we obtained 13277 establishments with 374 types of activities unevenly distributed. Commercial activities are unevenly distributed; some appear frequently, others are sporadic or specific to particular geographical regions, and others are closely linked to the size of the agglomerations. To highlight this reality, Davies (1967) developed a very simple method to overcome these assessments (Lekehal 1982).

ANALYSIS ACCORDING TO THE DAVIES INDEX

The Davies index evaluates the weight of a locality not through the total number of establishments of the activities it possesses but according to the weight of each localised activity in relation to its regional importance (Lekehal 1982). The procedure for highlighting this index must initially involve calculating the total number (T) of establishments for each activity (the activity (i) present in the region (r) signified by "*Tir*), then calculating the scarcity of establishments of activity (i) in region (r) *Rir* (location coefficient) of each activity.

Location Coefficient

The location coefficient (Lekehal 1982) is formulated as follows

$$Rir = 1/Tir \quad (1)$$

Eq. (1) application to all activities (the 374 activities identified) gives their location coefficients. Annexe 1 lists the results obtained.

Partial Agglomeration Index of Localised Activities

Multiplying the number of establishments of each activity in each city by the location coefficient of the same activity gives the partial agglomeration index of located activities according to Annex 2.

Agglomeration Index of Localised Activities

The agglomeration index of the localised activities in each city is the sum of the indices of all activities in each city (Table 2). A ranking of the cities follows the ranking of the selected agglomeration indices in ascending order according to this index (Davies index).

The intersection of the selected quantitative variable "agglomeration index of localised activities" with the qualitative variable "cities" produces the graphical representation (Figure 5). A simple reading of this configuration allowed us to categorise the cities in 5 different levels according to the Davies index:

Table 2. Agglomeration indices of localised activities for the 23 cities. Source: Authors (2020).

N°	CITIES	Agglomeration indices of localised activities	Total number of establishments
1	El Khroub	52.5192	1505
2	El Eulma	39.0587	2164
3	Skikda	36.2147	868
4	M'Sila	27.0653	954
5	Jijel	24.8185	559
6	Khenchela	23.7869	663
7	Ain Mlila	18.0071	749
8	Chalghoum Laid	17.2951	428
9	Elbouni	16.2393	432
10	Guelma	15.3895	466
11	Oum el Bouaghi	14.2961	440
12	Ain Beida	13.4297	367
13	Ain Fakroun	10.0410	1074
14	Mila	9.2990	315
15	Boussaada	9.0070	268
16	Bir El Ater	8.9123	730
17	Taher	8.7689	219
18	Ain Ouelmene	8.7497	377
19	Barika	6.6318	275
20	Sidi Aissa	4.1456	102
21	Cherea	4.0444	136
22	Ain Touta	3.0272	117
23	Ouenza	2.6303	69

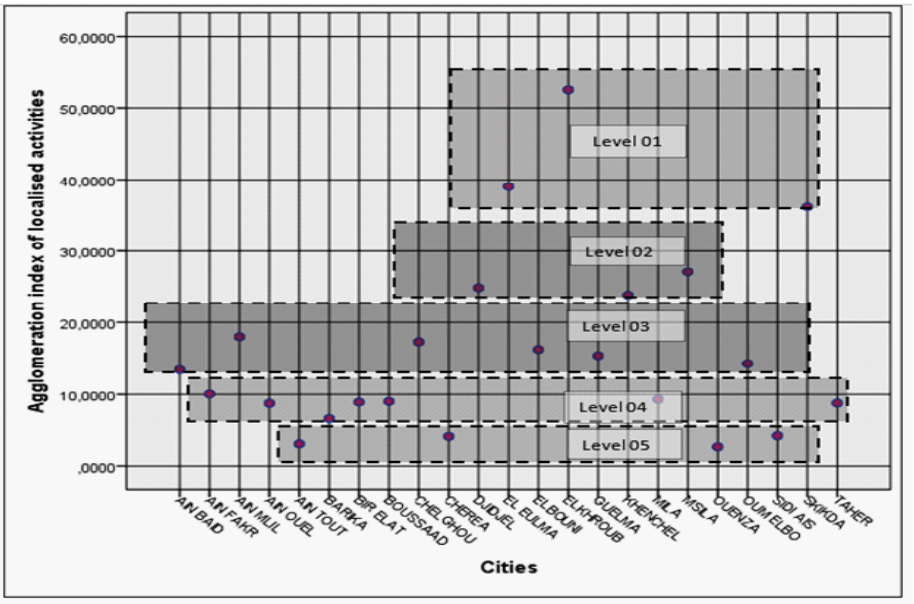


Figure 5. Distribution of medium-sized Algerian cities according to the Davies index Source: Authors (2020).

- Level 1: El-Khroub, El-Eulma and Skikda.
- Level 2: M'Sila Jijel and Khenchela.
- Level 3: Ain M'Lila, Chelghoum-Laid, El-Bouni, Guelma, Oum el Bouaghi, Ain Beida.
- Level 4: Ain Fakroun, Mila, Boussaada, Bir El Ater, Ain Ouelmene, Barika and Taher
- Level 5: Cheria, Sidi Aissa, Ain Touta, Ouenza.

The bi-ranking of the cities according to the total number of establishments and the scarcity of the activities they retain expresses the importance of the research on the parameters of the scarcity of activities in the economic values of the cities. The example of the cities of Elkroub, El-Eulma, Ain Fakroun, and Chelghoum Laid is clear.

Bennison Index (Index of Centrality)

The Bennison index (1978) aims to determine the relative centrality index. This index considers the total number of establishments in a locality and the regional total of establishments in the same activity, as well as the localised population corresponding to the size of the centre and the total population. To do this, we must begin with the calculation of the activity concentration index (CI), followed by the calculation of absolute centrality (AC) and finally, the determination of relative centrality (RC). It should be noted that the data relating to the population of each city and the total population and the economic activities included in the study are presented in Appendix 3.

Activity Concentration Index (ACI)

The activity concentration index (CI) (Lekehal 1982) is expressed as the result of calculating two successive division ratios, the localised supply and the overall supply, divided by the ratio of the population of the locality to the population of all cities according to the following formula(2)

$$C = \frac{\text{number ofestablishments in a locality}}{\dfrac{\text{regional total of establ ishments in the same activity}}{\dfrac{\text{the population of the locality}}{\text{total population of localities}}}} \quad (2)$$

The final results are summarised in Annex 3.

Absolute Centrality (AC)

This is the centrality of each activity for each city and is obtained by multiplying the Davies index (agglomeration index of localised activities IAAL) detailed in appendix No. 2) by the concentration index (CI) of activities (detailed in appendix No.3) city by city and variable by a variable:. The results obtained are detailed according to a regular crossing between the activities in columns and the cities in rows in appendix N° 4.

Relative Centrality Index (RCI)

This is an index for each city. It is derived from the global addition of the results of the absolute centralities of each city's activities according to the following formula:

$$RCI=\sum AC \quad (3)$$

Table 3 summarises the results of this operation. After completing all the calculation operations, we retained three continuous variables: the population of the cities, the Davies index and the Bennison index. The linking of these three variables allowed us to have more clustering types of cities. To do this, we opted for Bivariate correlation using the SPSS software.

Table 3. Index of relative centrality (Bennison index)

City	Index of Relative Centrality
El Eulma	37.2477
Elkhroub	57.2121
Ain Fakroun	14.5672
M'Sila	21.7358
Skikda	34.5551

Ain Mlia	20.7705
Bir El Ater	9.0923
Khenchela	22.7991
Djijel	20.4052
Guelma	12.3598
Oum el Bouaghi	14.4289
Elbouni	19.6886
Chelghoum Laid	21.6095
Ain Oulmene	11.1378
Ain Elbaida	10.0961
Mila	10.8235
Barika	4.6503
Bousaada	7.2003
Taher	8.7543
Cherea	3.7770
Ain Touta	4.0356
Sidi Aissa	4.2255
Ouenza	2.8281

CORRELATION BETWEEN THE POPULATION AND THE BENNISON INDEX

Table 4 summarises the correlation results between the number of the population and the Bennison index.

Since correlation is a symmetrical measure, it can be seen that the coefficient is the same for the association between population and relative centrality on both sides. The result recorded a correlation (R=0.663), with a two-sided significance of 0.01. Figure 6 shows the graphical representation in the form of cloud points of these results.

Table 4. Correlation between population size and Bennison index

Correlations			
		Number of population in 2018	Relative centrality
Number of population in 2018	Pearson correlation	1	0.663**
	Sig. (bilateral)		0.001
	N	23	23
Relative centrality	Pearson correlation	0.663**	1
	Sig. (bilateral)	0.001	
	N	23	23
**Correlation is significant at the 0.01 level (two-tailed).			

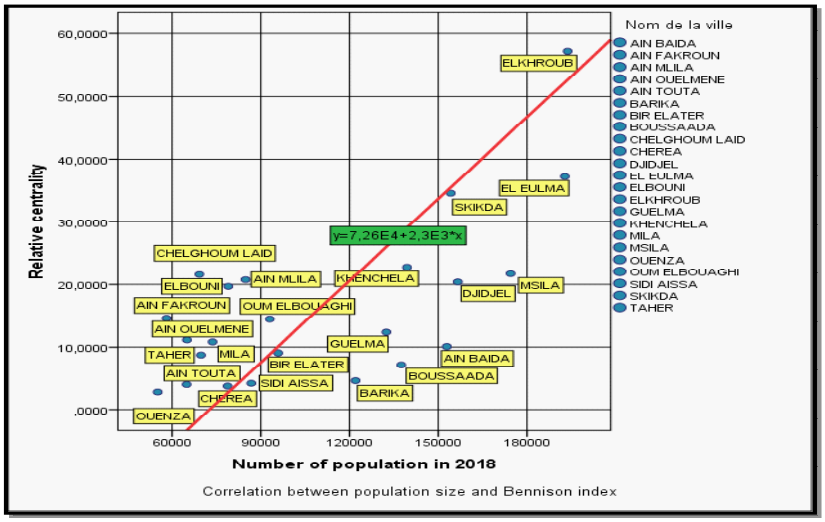


Figure 6. Correlation of the population with the Bennison index of the 23 cities. Source: Authors (2020).

The coefficient of determination of the linear fit, which indicates the intensity of the relationship between the two axes, is less than 0.50 (linear R^2 =0.432), which means that the correlation shows a medium linear fit between the variables. This value measures the percentage of scatterplot variance taken into account by the regression: 43.20%. The 1-R^2 measures the significance of the residuals (100%-43.20%= 56.80%), a rather large value, which implies the existence of other explanatory factors (Dumolard Pierre 2008). For the equation of the line y= 7.26E4+2.3E3*x, this means the existence of a transitive relationship between the two clusters of variables.

Figure 6 shows three distinct clouds, the first of which concerns the summit cities. The change in the clustering of these cities with respect to the Davies index can be seen. Consequently, the cities of El-Eulma, El-Khroub and Skikda, on the one hand, and the cities of Khenchela, M'Sila and Jijel, on the other hand, have formed a separate cloud in the upper part of the graph. A second cloud includes the cities of Guelma, Ain Beida, Boussaâda and Barika. This cluster of cities confirms the results observed with the Davies index. At the bottom of the graph in Figure 6, it can be seen that this cloud has not undergone any change with regard to the results retained by the Davies method. The cities of Ain M'Lila form it: Chelghoum Laid, Oum el Bouaghi, Elbouni, Ain Ouelmene, Ain Fakroun, Taher, Bir El Ater, Mila, Sidi-Aissa, Ain Touta, Cherea and Ouenza.

CORRELATION BETWEEN DAVIES AND BENNISON INDICES

The results retained by the correlation of the Davies index with the Bennison index are fairly adjusted with a correlation coefficient of 0.976.

The graphical representation of these results is illustrated as follows (Figure 7):

The linear coefficient of determination is R^2 =0.953. Thus, it is very close to the ideal value of the adjustment between the variables in parallel to the equation of the line y= 0.62 + 0.96*x, which is perhaps due to the remoteness of the individual El-Khroub. Still, the correlation between the two variables is always rather positive. While the large, medium-sized cities still retain their coherence (El-Eulma, Skikda), they have more to do with the agglomeration index of activities than with the centrality of activities, the opposite for the city of El-Khroub. Below the regression line are two clouds of seven separated cities with a positive correlation. The first is formed by the cities of M'Sila, Jijel and Khenchela, and the second includes the cities of Guelma, Ain Beida, Boussaâda and Barika together. The relationship of these cities with the scarcity of activities is clearer than their relationship with the centrality of activities, but the thirteen cities are above the regression line. They presented a vocation of centrality much more than the scarcity of activities.

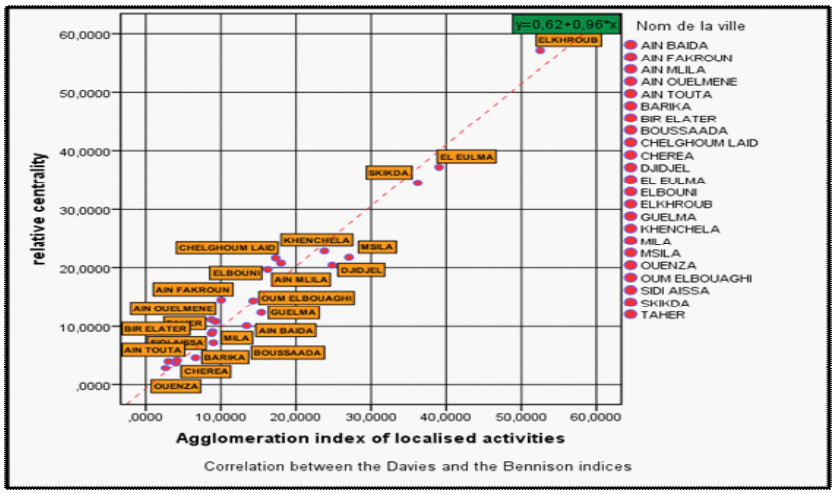


Figure 7. Correlation between the Davies and the Bennison indices. Source: Authors (2020).

Table 5. Correlation of the Davies Index with the Bennison Index.

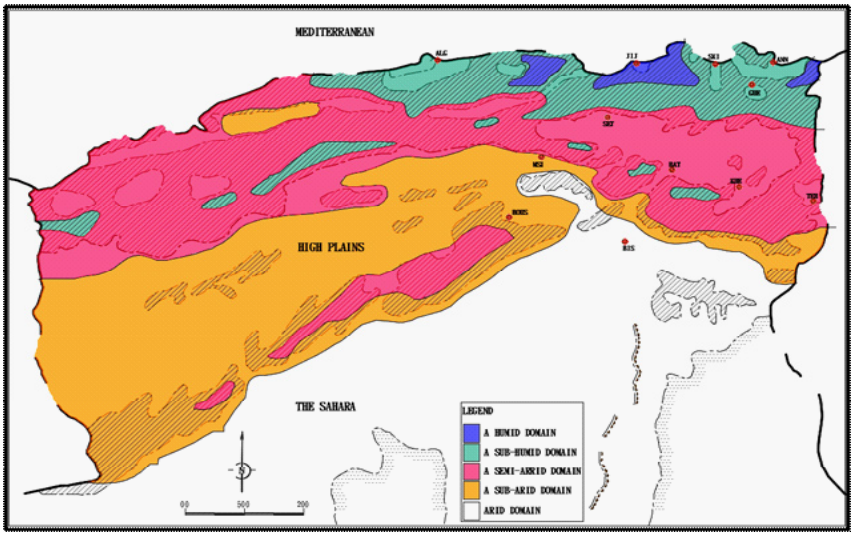
		relative centrality	Agglomeration index of localised activities
relative centrality	Pearson correlation	1	0.976**
	Sig. (bilateral)		0.000
	N	23	23
Agglomeration index of localised activities	Pearson correlation	0.976**	1
	Sig. (bilateral)	0.000	
	N	23	23
**. The correlation is significant at the 0.01 level (two-tailed).			

GEOGRAPHICAL-HISTORICAL AND ADMINISTRATIVE PRESENTATION OF THE TERRITORY AND THE CITIES

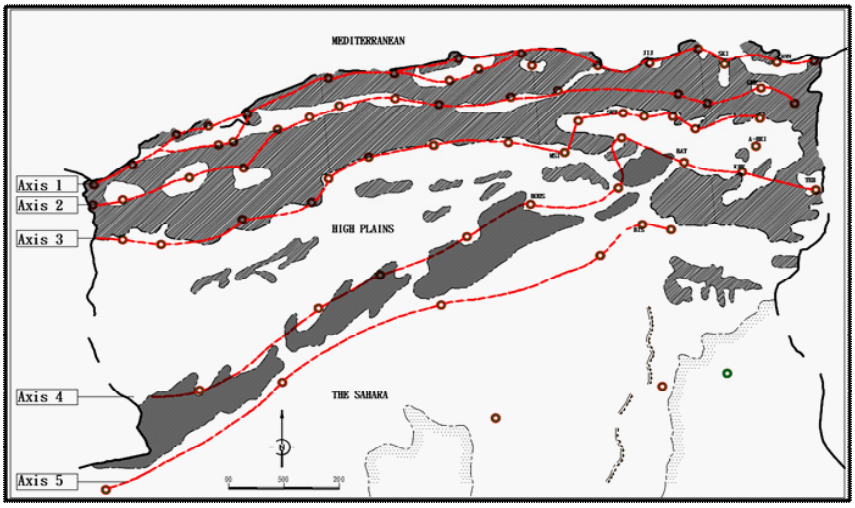
Geographical Presentation

The Algerian territory offers a diversified relief from North to South and West to East. It extends over 1,622 km from the Mediterranean coast and over 2,000 km into the African continent (SNAT2030 2010). The northern part of the country is characterised by the extension of a series of three parallel mountain ranges encased from the western to the eastern borders between the Mediterranean in the north and the Sahara in the south. The first chain, called the "Tellian chain", is formed by two other chains and closes the country to the sea. The second chain is called the Atlas chain and includes the regular alignments of the Ksour, Djebel amour and Ouled Nail mountains and the large block of the Aurès. The whole constitutes the Saharan Atlas. Between the two lies the wide platform of the high plains, whose average altitude is 800 m in the East and rises from 400 m in the Hodna to 1100 m at the Moroccan border (Cote 1983). This space is decorated from north to south by palm oases with high agricultural yields, large sandy and gravel surfaces, and vast plains formed by salt marshes. Further south lies the great desert (Berard 1867).

With this geographical composition, the climate of the Algerian territory is divided into five different domains (Map 1): a humid domain, a sub-humid domain, a semi-arid domain, a sub-arid domain and finally, an arid domain (Cote 1983). Geographical disparities, climatic variation, product diversity and the requirements of economic exchange with other factors have determined the logics of social and economic movements and population stability from one area to another. Map 2 of urban settlements shows five simple axes of urbanisation:



Map 1. Climatic map of the Algerian territory.



Map 2. The five historical axes of urbanisation in the Algerian territory. Source: Cote (1983)

- **Axis 1:** Coastline.
- **Axis 2:** Inland basins.
- **Axis 3:** Northern foothills of the high plains
- **Axis 4:** Southern foothills of the high plains.
- **Axis 5:** Saharan piedmonts.

The medium-sized cities of eastern Algeria are located between the basin of the eastern high plains region and the coast. They are all distributed between three climatic domains:

- The cities of Jijel and Taher are in wet areas.
- The cities of Skikda, Guelma, El Bouni and Mila are in sub-humid areas.
- The towns of El-Eulma, El-Khroub, Ain M'Lila, Ain Fakroun, Oum-El-Boughi, Ain Beida, Khenchela, Cheréa, Ouenza, Cheghoum-Laid and Ain Touta are in semi-arid environments.
- The towns of M'Sila, Boussaâda, Sidi-Aissa and Barika are in sub-arid environments.

The geographical location of these cities is materialised by the Cartesian coordinates of which we grasp the situation between the longitude 4° in the West (Boussaâda) and the longitude 8° in the East (Ouenza) and between the North latitude 36 (Skikda, Jijel) and the South latitude 35 (Barika), on altitudes varying between 1159 m in Khenchela and 27-32 respectively for the cities of the Skikda and Jijel coast. Table 6 summarises all the geographical coordinates of these cities, including information on latitude, longitude and altitude.

Table 6. Geographical location coordinates of the twenty-three medium-sized towns in eastern Algeria.

Cardnumber	City	Latitude	Longitude	Altitude
82	Oum el Bouaghi	35.523887	7.064864	943
83	Ain Beida	35.475594	7.233095	1006
81	Ain Fakroun	35.582316	6.521734	943
62	Ain M'Lila	36. 20063	6.345982	770
119	Barika	35.23945	5.215639	480
120	Ain Touta	35.230017	5.535905	920
190	Bir El Ater	34.445918	8.032939	904
124	Cheria	35.160009	7.450012	1090
84	Ouenza	35.564756	8.082123	590
11	Jijel	36.490026	5.455659	32
-	Taher	36.461304	5.535316	55
60	El Eulma	36.090339	5.4140057	958
78	Ain Oulmene	35.555004	5.175278	932
13	Skikda	36.525784	6.550094	27
15	El Bouni	36.511343	7.442983	40
46	Guelma	36.275861	7.255950	275
45	El-Khroub	36.155084	6.415716	623
97	M'Sila	35.425036	4.325989	484
75	Sidi Aissa	35.530310	3.462897	663
139	Boussaâda	35.122957	4.104481	563
123	Khenchela	35.245877	7.080034	1159
44	Mila	36.270895	6.155504	474
61	Chelghoum Laid	36.095340	6.105648	765

Source: National Institute of Cartography and Remote Sensing (INCT 2016)

ADMINISTRATIVE PRESENTATION OF THE CITIES

The Algerian territory's administrative organisation considers the functional organisation to represent the space. The new territorial organisation of the country comprises fifty-eight (58) wilayas and one thousand five hundred and forty-one (1541) communes (Officiel 2019). The Wilaya is a territorial collectivity of the State. It is also a deconcentrated administrative district of the State and constitutes the space for the joint implementation of public policies and consultation between the territorial collectivities and the State. The wilaya has a name, a territory and a capital (Officiel 2012). The Daïra (prefecture office), represented by the head of the Daïra, assists the Wali in his function as representative of the State. In this capacity, he leads the activity of a commune and/or leads and coordinates the activity of two or more communes (Officiel 1991).

The twenty-three (23) cities that are the subject of our research are regularly distributed according to their administrative status as chief towns of Wilaya and chief towns of Daïras as follows:

Wilaya capitals: Oum El Bouaghi, Jijel, Skikda, Guelma, M'Sila Khenchela and Mila.

Chief towns of Daïra : Ain Beida, Ain Fakroun, Ain M'Lila, Barika Ain Touta, Bir El Ater, Cheria, Ouenza, Taher, El Eulma, Ain Oulemene, El Bouni, El Khroub, Sidi Aissa, Boussaâda and Chelghoum Laid.

PROCESSING OF RESULTS BY PRINCIPAL COMPONENT ANALYSIS (PCA)

The final objective of this study is to examine the impact and interactional effects of all the factors predefined above and their effects on the history and future of medium-sized cities of colonial creation in Eastern Algeria, To define a few representative cities whose state of their old centres we intend to examine later. The Principal Component Analysis (PCA) is a descriptive technique that allows the study of the relationships between quantitative variables without considering a priori, any structure, neither of the variables nor the individuals (Palm 1998). This technique concentrates the information on the first two axes by changing the coordinate system. The best axis is the one that best represents the data on a factorial plane. So on until the first, three or more dimensional axes summarise the information contained in an unreadable n-dimensional system (Mazouz 2020a). The valuation results of the nominal qualitative variable of the 23 cities in relation to the 5 continuous quantitative variables (population, Davies index, Bennison index, latitude and longitude of the cities) are discussed in the following subsections.

THE CORRELATION MATRIX

The Correlation Index (CI) presents a correlation matrix in the form of two interesting readings derived from the horizontal and vertical crossing of variables. These are the correlation coefficients at the top and the one-sided significance at the bottom.

Table 7. Correlation matrix of variables.

CORRELATION MATRIX[a]

		Number of population in 2018	Bennison Index	Davies Index	Latitude	Longitude	Altitude	Administrative status
Corrélation	Number of population in 2018	1,000	0.663	0.793	0.130	-0.124	-0.125	-0.331
	Bennison Index	0.663	1.000	0.976	0.470	0.124	-0.119	-0.174
	Davies Index	0.793	0.976	1.000	0.449	0.084	-0.167	-0.283
	Latitude	0.130	0.470	0.449	1.000	0.376	-0.671	-0.262
	Longitude	-0.124	0.124	0.084	0.376	1.000	0.014	-0.160
	Altitude	-0.125	-0.119	-0.167	-0.671	0.014	1.000	0.291
	Administrative status	-0.331	-0.174	-0.283	-0.262	-0.160	0.291	1.000
significance (one-sided)	Number of population in 2018		0.000	0.000	0.278	0.287	0.285	0.061
	Bennison Index	,000		0.000	0.012	0.287	0.295	0.213
	Davies Index	,000	0.000		0.016	0.351	0.223	0.095
	Latitude	,278	0.012	0.016		0.038	0.000	0.114
	Longitude	,287	0.287	0.351	0.038		0.475	0.233
	Altitude	,285	0.295	0.223	0.000	0.475		0.089
	Administrative status	,061	0.213	0.095	0.114	0.233	0.089	

a. Determinant = 0.000

The variables' cross-tabulation has an optimal correlation =1.00, located on the diagonal of the Table 7. Interesting correlations are displayed between the Benisson index and the Davies index on both sides, with a value of 0.976. Quite significant correlations were recorded between the Davies index and the population with a coefficient of 0.793 and between the Benisson index and the population with an index of 0.663. We also found average correlations between the latitude variable and the Benisson index with a value of 0.470 and with the Davies index with a value of 0.449, which means the importance of the geographical location of cities according to their economic opportunities. However, to verify the validity of these coefficients, it is necessary to check the one-sided significance level at the bottom. For these cases, it is of the order of 0.00. This value is ideal concerning the confidence interval, which must not exceed 0.05. Therefore, we can confidently retain these fairly high results between these four variables. Table 7 lists the average correlation presented between the latitude variable with the Bennison index (0.470) signified by 0.012 and the Davies index (0.449) signified by 0.016 (i.e. more than 98% confidence interval of correlation).

On the other hand, the correlation between longitude and the two indices shows low correlation results with all variables. This can be explained more by a strong relationship between these two indices (population and economic activities) in the horizontal direction (east-west) than by the distribution of cities in the vertical direction (north-south). What is also remarkable is the weak and sometimes negative correlation of longitude with the other variables, which indicates that the population and economic activities in these cities are more concentrated in the middle than in the extremities.

THE KMO INDEX AND BARTLETT'S SPHERICITY TEST

The Kaiser-Mayer-Olkin measure for the sampling quality measure has a lower value but is not too far from normal, indicating that the PCA performed is more or less acceptable. The zero significance value reinforces this. The partial values of the KMO index for each variable can be found in Table8. The diagonal numbers are with the superscript "a. sampling quality measure". All values are below the normal 0.60.

Table 8. KMO Index and Bartlett Test

Kaiser-Meyer-Olkin index for measuring sampling quality.		0.435
Bartlett Sphericity Test	Chi-square approx.	147.539
	ddl	21
	Meaning	0.000

Table 9. Anti-image matrices.

Table Anti-image matrice

		Number of population in 2018	Bennison Index	Davies Index	Latitude	Longitude	Altitude	Administrative status
Anti-image covariance	Number of population in 2018	,060	,017	-,015	,036	,007	,003	-,075
	Bennison Index	,017	,007	-,005	,003	2,303E-5	-,007	-,035
	Davies Index	-,015	-,005	,004	-,006	,001	,003	,027
	Latitude	,036	,003	-,006	,233	-,180	,215	-,020
	Longitude	,007	2,303E-5	,001	-,180	,669	-,196	,096
	Altitude	,003	-,007	,003	,215	-,196	,356	-,022
	Administrative status	-,075	-,035	,027	-,020	,096	-,022	,499
Anti-image correlation	Number of population in 2018	,394[a]	,869	-,921	,305	,033	,018	-,435
	Bennison Index	,869	,440[a]	-,989	,086	,000	-,153	-,602
	Davies Index	-,921	-,989	,462[a]	-,178	,011	,090	,590
	Latitude	,305	,086	-,178	,550[a]	-,455	,745	-,058
	Longitude	,033	,000	,011	-,455	,340[a]	-,402	,167
	Altitude	,018	-,153	,090	,745	-,402	,441[a]	-,052
	Administrative status	-,435	-,602	,590	-,058	,167	-,052	,299[a]

a. Sampling Quality Measure

THE QUALITY OF REPRESENTATION

The representation qualities give an idea of the percentage of information extracted for each variable relative to the percentage of the variance for the initial values =1,000. All extraction values are interesting, especially those related to the population and the Davies and Bennison indices.

Table 10. Quality of representation.

Representational qualities

	Initials	Extraction
Population number in 2018	1.000	0.805
Bennison Index	1.000	0.868
Davies Index	1.000	0.971
Latitude	1.000	0.850
Longitude	1.000	0.287
Altitude	1.000	0.601
Administrative status	1.000	0.281

Extraction method: Principal component analysis.

THE TOTAL VARIANCE EXPLAINED

Table 11 indicates the total variance, which is considered the key piece of this analysis. The PCA eliminated the values of the factors below 1.00, leaving only two factors that express a significant cumulative value of 66.599%. The first factor summarises 39.013%, and the second summarises 27.587% of the variance. This plot expresses well the decantation of the data by the seven components. The first and the second are quite important. The other three present values are presented in Table 11.

Table 11. Total variance explained.

THE TOTAL VARIANCE EXPLAINED

Component	Initial eigenvalues			Sums extracted from the load square			Rotation sums of load square		
	Total	% of variance	% Cumulative	Total	% of variance	% Cumulative	Total	% of variance	% Cumulative
1	3.128	44.682	44.682	3.128	44.682	44.682	2.731	39.013	39.013
2	1.534	21.918	66.599	1.534	21.918	66.599	1.931	27.587	66.599
3	1.051	15.019	81.619						
4	0.866	12.376	93.995						
5	0.297	4.245	98.239						
6	0.121	1.725	99.964						
7	0.003	0.036	100.000						

Extraction method : Principal component analysis.

ROTATION OF THE COMPONENT MATRIX

In terms of the rotation of the component matrix, we can see that the first component is represented by three variables with a significant correlation greater than 0.50. The second component is composed of three other variables, with the elimination of the fourth. The second component is composed of three other variables, with the elimination of the fourth. This indicates the existence of two clusters: the first attributed to demographic variables and the second to geographical variables. Thus, this operation reduced the 7 variables to two meta-variables (clusters).

Trace of the Components in Space After Rotation

Component 1, in the horizontal direction of the representation, shows the clustering of the Davies and Benisson index variables and the population of the cities. This representation reflects the strong positive correlation between these three variables. They are highly correlated and are opposed to the component of the administrative status variable on the vertical line. This shows that either this variable does not greatly influence the promotion of the cities or that the provision of infrastructures and services concerning these two statuses has not greatly influenced the promotion of these cities. This situation is concrete when we see that a city that is the capital of a daïra is more important in terms of

population and economic influence than the city which is the capital of the wilaya: the examples of the cities of Ain Beida and Boussaâda with Oum el Bouaghi and M'Sila, respectively.

Table 12. Rotation of the component matrix.

Rotation of the component matrix[a]

	Component	
	1	2
Davies Index	0.966	
Bennison Index	0.911	
Number of population in 2018	0.896	
Latitude		0.883
Altitude		-0.772
Longitude		0.530
Administrative status		

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser normalisation.

a. Convergence of the rotation in 3 iterations.

On component 2, operated on the vertical axis, the opposition of the variable Altitude is less important in relation to the variable longitude than to the variable latitude, which expresses the importance of the location of the cities on the historical urbanisation axes stretching from the East to the west of the country, and also expresses the negligible effect of climatic factors on the development and progression of these cities. This is probably explained because most cities belong to regions with similar climatic conditions.

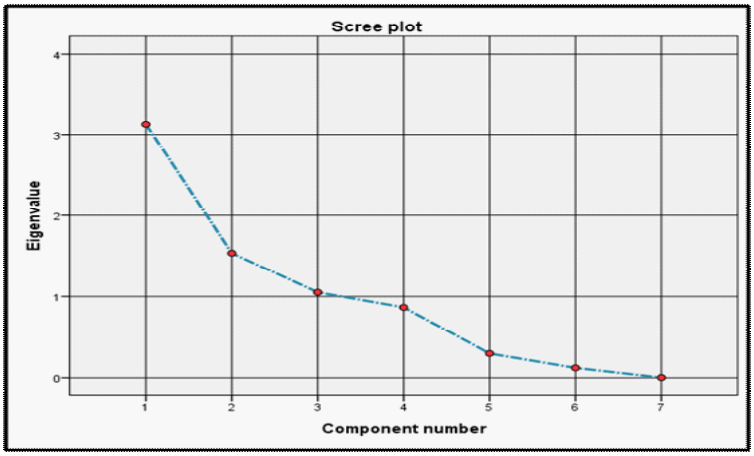


Figure 8. The Scree plot

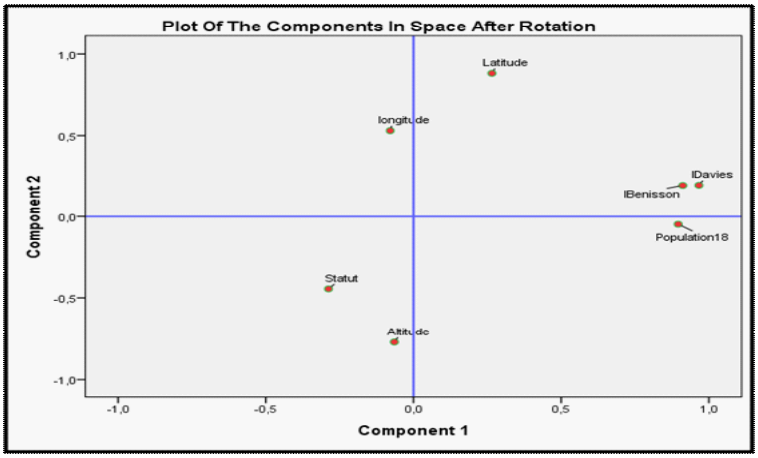
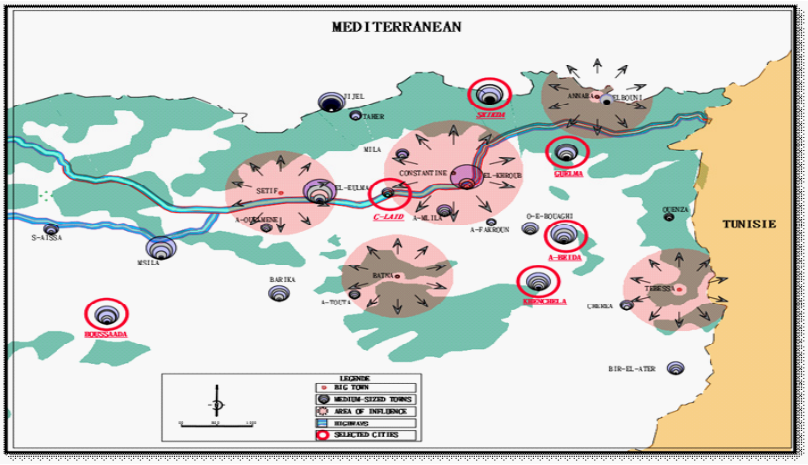


Figure 9. Plot of components in space after rotation.

The results obtained by this principal component analysis clearly show the effect of demographic and economic factors, in the first place, as major indicators which govern the effect of city promotion. This is linked to other factors, of which the impact of geography and history on the development of evolution plays an important role. There is an appreciable relationship between the development of a city and its proximity to the routes of the great historical axes of urbanisation and thus to the great sedentary settlements; this is signified by the effect of the tropism of the road and the importance of the existence of these cities in the areas of influence of the metropolises and large cities (Map 3).



Map 3. The illustrative map of selected typical medium-sized cities. Source: Authors (2020) based on the INCT map.

CONCLUSION

This study aimed to identify cities whose former colonial centres are the subject of our research and can constitute case studies in future work. This can be done through a logic of choice, based on criteria that represent the overall conditions in which these cities live. Demographic and economic factors have been of great importance in this study. Still, other factors have impacted the overall destiny of these cities, such as the effect of geography and the history of their creation and their administrative promotion.

The combination of demographic and economic parameters shows very high correlations, which means the importance of these two factors in the development of cities. The factors related to the geography and location of the cities are also important but with less interest, given that most of the cities examined belong to close territories with similar characteristics. The summary of the work of this first stage shows that three categories of medium-sized cities were selected. Medium-sized towns of the highest rank, called "large, medium-sized towns", are characterised by their high demographic weight, with a high range of exchanges, supported by a prominent presence of qualitative and quantitative economic offers. The cities of this rank are El-Khroub - El-Eulma - Skikda - M'Sila - Jijel.

Medium-sized cities of intermediate rank are characterised by moderate demographic inflation and slight disparities in their economic capacities. What is remarkable in this rank is its formation by cities that have maintained their positions in the different ranking periods. The example of Guelma and Ain Beida is very clear, among others. On two occasions, the city of Khenchela barely joined the cities of the higher rank, and the city of Boussaâda dropped to the lower rank. This has always occurred due to the scarcity of economic activities. In addition, the demographic effect compromises medium-sized cities of lower rank. This rank can even form more than one rank. There are cities with an apparent qualitative presence, such as Ain Fakroun, Chelghoum Laid, Ain M'Lila, Oum el Bouaghi and Bir El Ater, and cities that have maintained their position at the end of the ranking, such as Ouenza, Cherea, Sidi Aissa and Ain Touta.

So, after completing this work, we chose the following sample cities:

1- The city of Skikda: A medium-sized city of high rank, of colonial creation on ancestral Roman traces, the chief town of the Wilaya, situated on the maritime front of the country on the axis of coastal urbanisation with a subhumid climate.
2- The city of Guelma: A medium-sized city of intermediate rank, of colonial creation on ancestral Roman traces, the chief town of wilaya, located in the north of the country, on the axis of historical urbanisation of the interior basins, with a subhumid climate.
3- The town of Ain Beida: A medium-sized town of intermediate rank, of colonial creation, the chief town of the Daïra, situated in the region of the high plateaus between the axes of the northern foothills and the southern foothills of the

high plains with a semi-arid climate.

4- The city of Khenchela: A medium-sized city of intermediate rank, of colonial creation, the chief town of wilaya, located in the region of the high plateaus on the southern piedmont axis of the high plains with a semi-arid climate.

5- The city of Boussaâda: A medium-sized city of intermediate rank, of colonial creation on ancestral Arab traces, the chief town of Daïra, located in the region of the high plateaus towards the Saharan Atlas, on the axis of the southern piedmonts of the high plains with a sub-arid climate.

6- The town of Chelghoum Laid: A medium-sized town of lower rank, of colonial creation, the chief town of Daïra, located in the region of the high plateaus, on the axis of the northern foothills of the high plains with a semi-arid climate.

The following map illustrates the distribution of these cities in relation to the demographic masses they house, their economic potential, geographical locations, historical qualities, and administrative stratifications.

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