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The Demographic and Functional Situation of the Primate City, Gafsa within the Network of Urban Centers of the Tunisian State Gafsa

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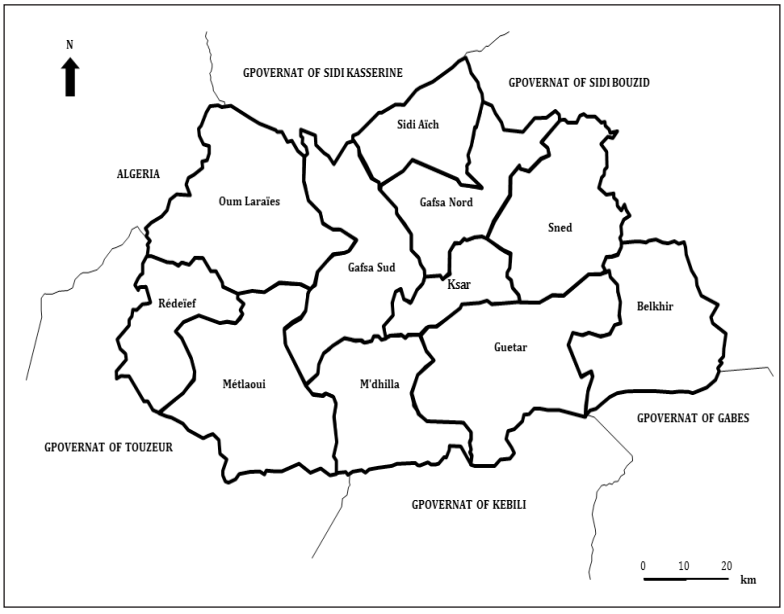
Abstract

This research paper aims to study the demographic and functional situation of the primate city of Gafsa within the network of urban centers and urban systems of the Tunisian state, Gafsa. The paper studies and analyzes the demographic hierarchy based on several models, the most important of which are Ziph, Beckmann and the macrocephaly index, as well as hierarchy. The centers under study are functionally based on 48 indices related to the most important equipment belonging to the social and economic development sectors represented in the sector of education, health, culture, sports, small and medium enterprises, childhood, justice, commercial and service institutions, post, and industry. This study resulted in a clear demographic and functional concentration the primate city of Gafsa more than the rest of the urban centers of the state. This hierarchical organization of urban centers lead to a clear gap between the primate city of Gafsa and the rest of the other urban centers, which confirms the macrocephaly of the hierarchical structure of the urban centers of the wilaya of Gafsa.

Key words: Hierarchical structure, demographic analysis, functional analysis, macrocephaly, Gafsa city.

INTRODUCTION

The spatial structure of the centers results from the simultaneous effect of a frame and the links between the elements of this frame (1). This frame is made up of spatial units of different functions and of various sizes that fit into spatial systems. The exchanges of people, goods and information are carried out within these systems according to a hierarchy generally linked to size because the more the latter increases, the more there is diversity in the different function and activities (2). The imbalance of the spatial structure in terms of concentration of population, functions and activities accompanied by the predominance of a spatial unity inevitably leads the centers into urban chaos.



Map 1. The urban centers of Gafsa city, 2022 (Source: The researchers' achievement, based on the general census of housing and population for the year 2014.)

The latter translates into a multitude of facets; poverty, social heterogeneity, lack of solidarity, unemployment, delinquency, etc., this led various sections of society to take care of themselves informally, which is explained by the presence of slums, housing spontaneous, illegal connection to the drinking water, sanitation, electricity supply networks, etc. the degradation of the roads due to the swelling of the car park, the absence of parking, the dilapidated state of the public places, the relative inexistence of green spaces and many other scourges become major characteristics of the cities victims of their unbalanced development by relation to the urban system to which they belong'' (3). Accordingly, the thirteen urban centers of the city of Gafsa, located between the upper steppes and the Tunisian desert, extending over the southern part of the Saharan Atlas and in the southwest of Tunisia [5], have been highlighted. Their population, according to January 2022 estimates, reached 354,604 people. This is done through studying the hierarchical structure of demographic and functional distribution of the urban centers of the city of Gafsa.

The previous discussion leads us to ask the following question: What does the demographic and functional situation of the city of Gafsa look like within the hierarchical structure of the urban centers of the state of Gafsa?

MATERIALS AND METHODS

In order to deal with the subject of the study, a special methodology was followed, which adopts the method of analyzing spatial statistical data produced by the National Institute of Statistics, the Office for the Promotion of the South and the Delegation of Gafsa, such as general housing and population statistics, the atlas of the city of Gafsa, estimates of the population of the province of Gafsa for the year 2022 and other statistics, are all sorted and classified. Consequently, they are presented in the form of tables and graphs that help explain the phenomena that the research seeks to analyze and discuss (6). Accordingly, the data were processed according to the following methodology:

Study of the City of Gafsa within the Hierarchy of the Demographic Structure of the Urban Centers of Gafsa State

To do so, in order to carry out an accurate study of the hierarchical structure of the urban centers of the city of Gafsa and to study the city of Gafsa within this structure, the following analysis models were taken into account:

Ziph 's Law

The Rank-Size law, which makes it possible to partly characterize the hierarchy of centers in an urban system often known by the Ziph's law. This latter was preceded by other works, like the pioneering work of AUERBACH (1913), GOODRICH (1926) and SINGER (1936) who highlighted, for the first time, the existence of a link between two forces of spatial organization: the size and rank of cities. These works were followed by those of LOTKA (1941) and ZIPH (1949) (7). Consequently, to handle our study, the rang-size distribution of cities is used for the study of cities or population centers in a geographical area according to a Cartesian diagram with ranks on the x-axis and sizes on the y-axis (8)

This latter allows finding the relationship between the numbers of centers and their sizes in a specific field according to the rank-size rule (9), through the following equation (10):

$$Pr=P1/r$$

Where: = Population of a town of the rank in question,

P1 = Population of the largest city

r = rank of town in question

In order to calculate the ideal population size, the following mathematical relationship should be applied (11):

$$\text{Log } y = -m\,x + c.$$

Where :

y: is the actual size of the population taken in logarithms

X: is the rank of the center taken by logarithm

m, c: are the two indices of this relationship

Beckmann's Law

Unlike Ziph's law, which is concerned with the hierarchical distribution within the urban system, Beckman's law considers the main city as a reference unit for the entire urban system, (Belhadi, 1992). (12):

yn = x/ zn.u

Where :

Yn: the population of center n

X: the population of the home city

Zn: the order of the center n

The Law of Macrocephaly

Numerous indices can be used to measure primacy, ranging from the ratio to the second city (13)

This index of macrocephaly which requires an ordering of the sizes of the establishments of the settlement system. It provides information on the hierarchical organization of a system of cities, in particular on the weight of the largest cities in the hierarchy. The macrocephaly index is the highest population ratio between two successive cities in the order of population. However, It is necessary to know not only the value of this report but also the ranks of the two successive cities producing this report (14).

- When a high ratio is measured between the two largest cities in the distribution, the system is primate.
- When this high ratio is measured between the 2nd and 3rd cities, the system is two-headed. When a high ratio is measured further down the distribution,
- The system is multipolar or polycentric.
- When the ratio is relatively low and the cities that have been used for its measurement are far apart in the scheduling, the system is homogeneous or hierarchical.

Study of the Actuality of the City of Gafsa within the Hierarchy of the Functional Structure of the Urban Centers of Gafsa State

In order to study the functional reality of the city of Gafsa within the hierarchical structure of the urban centers of the city, 48 indices were used within 10 variables represented in the equipment of the most important sectors of social and economic development represented in the sectors of education, health, culture, sports, small and medium enterprises, childhood, justice, institutions, commercial, service, postal, and industry, by converting the mean of the number of different equipment for each sector from absolute values to relative values, and then carrying out the hierarchical arrangement of urban centers across the city's territory and identifying the actuality of the city of Gafsa is included in this ranking.

RESULTS AND DISCUSSION

Demographic Study

The status of GAFSA, the Primate City within the Urban Centers Network of the Urban Centers of Gafsa State Based on Ziph's Law

In order to understand and reveal the position of Gafsa city within the hierarchical structure of population sizes across the urban centers of Gafsa, Ziph's law, known as the rank-size law, was applied. Ziph's law allows for a synthesis of the distribution of cities according to their demographic sizes (15-17). The analysis was based on 13 urban centers (municipalities) through the completion of the following figure, which allowed comparison of the real distribution with the ideal distribution of the network of urban centers, which resulted in the following groups:

The First Group

Includes one center represented in Gafsa city , which is located above the ideal line (theorical vaccum) and is far away from the rest of the centers. Its real population size is estimated at 120,379 inhabitants, and its ideal population is 100,577, i.e. with a large population surplus of plethora estimated at 19,802 inhabitants. This is what is called the phenomenon of urban inflation of the primate city in relation to the hierarchical structure of the urban centers of Gafsa state.

The Second Group

Includes three centers located below the ideal line from the lower side, far away from the only center located in the first group, despite its ranking among the top four within the network of urban centers in the state in terms of population

size. These cities are Metlaoui, El Ksar, And Redeyef whose real population sizes are estimated, respectively, at 39,142, 27,817, and 26,906, where the population deficit is estimated at 13,475, 8,202, and 621, respectively. It is noted that the last city within this group represented by the city of REDEYEF is the closest in terms of the difference between the real and ideal population size, which makes it the most demographically balanced within the network of urban centers of the state.

The Third Group

Contains the majority of urban centers, estimated at 08 centers located on the side above the ideal line. The highest population surplus is estimated in GATAR city with 4780 people and the lowest population surplus with 2059 people in SNED city. Comparing these values with the population surplus value of the primate city represented in the city GAFSA We find that the latter is nearly four and a half times greater than the surplus population in this group, and this confirms the phenomenon of population inflation in Gafsa city within the network of urban centers of the state of GAFSA.

The Fourth Group

Includes a single center located below the ideal line, represented by the Sidi BOUBAKEUR center, with an estimated real population size of 4255 inhabitants and a population deficit of 4892 inhabitants, which is a large value when compared to the real population size.

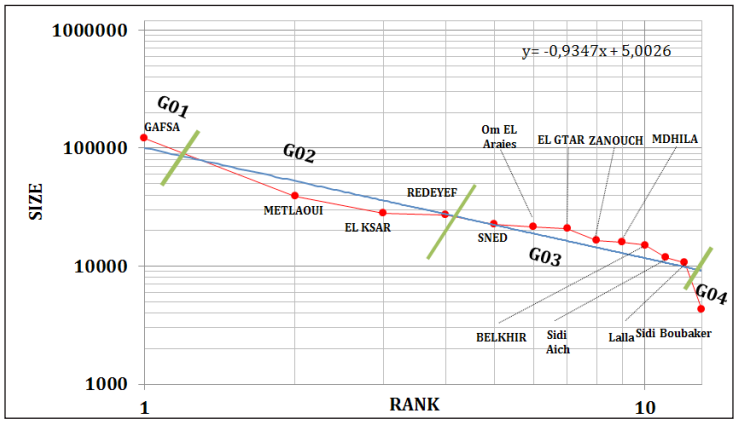


Figure 1. The demographic distribution of the population according to the Ziph's model (Source: The researchers' achievement based on the data of the Tunisian Statistical Office, 2022.)

In order to check the position of Gafsa city within the urban network of the city, much focus was placed on the space between the first center (Gafsa) and the second center (Metlaoui) as shown in the following graph, where a sharp decline was observed between the real population size in the first and only center in the group located above the ideal line represented by Gafsa city and the first center in the second group located below the ideal line, and this indicates the clear lack of urban centers with a population ranging between 120,000 and 40,000 people, which results in an inappropriate demographic distribution in the upper part of the urban system. All these results confirm the clear demographic inflation of the primate city compared to the rest of the cities of the urban system of Gafsa state , which is characterized by a polarity that attracts housing and related activities, jobs and services.

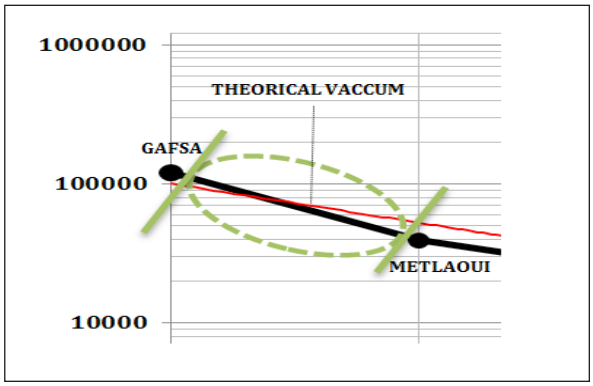


Figure 2. The Demographic Gap between the Centers of Gafsa and Metlaoui, According to the Ziph's Model (Source: The researchers' achievement based on the data of the Tunisian Statistical Office, 2022.)

The Status of Gafsa, the Primate City Within the Urban Centers Network of the Urban Centers of Gafsa State Based on Beckman's Law

To find out the extent of the balance of the demographic distribution of the components of the urban system of Gafsa city , it is important to relate it to the city that occupies the first place in terms of demographic size of GAFSA and consider it as a reference. However, its demographic constant (u) should be equal to the correct one. Thus, after checking the demographic constants (u) for the rest components of the network of urban centers of Gafsa state , which appear in the following figure, through which the following categories can be obtained:

The First Group: The Demographic Constant(U) is Equal to The Correct One

This category includes Gafsa city , which is the primate city, that is, the city center of the state, which is considered by the Bekhman's law as the reference city for the urban system.

The Second Group: The Demographic Constant(U), is Greater than the Correct One

This category includes five urban centers represented in the cities of Sidi Boubaker, Metlaoui, Al-Qasr, Al-Radef, and Al-Sanad, with demographic constants estimated respectively at 2.17624514, 1.53772163, 1.44251117, 1.11851446, and 1.05944114, which are values that indicate the existence of a reservation in the size of the population in the centers whose population size exceeds 20,000 thousand inhabitants, and centers with a population of less than 5,000 inhabitants.

The Third Group: The Demographic Constant(U) is Less Than One

This category includes eight urban centers represented in the cities of Lalla, Oum Al-Araes, Sidi Aish, Zanoush, Madila, El-Kettar, and Belkhair, with demographic constants estimated respectively at 0.94370492, 0.93251995, 0.92577155, 0.91590328, 0.83858586, 0.82598463, and 0.8008182 in surplus. The size of the population in the centers that increase the size of the population ranges between 5,000 and 20,000 inhabitants.

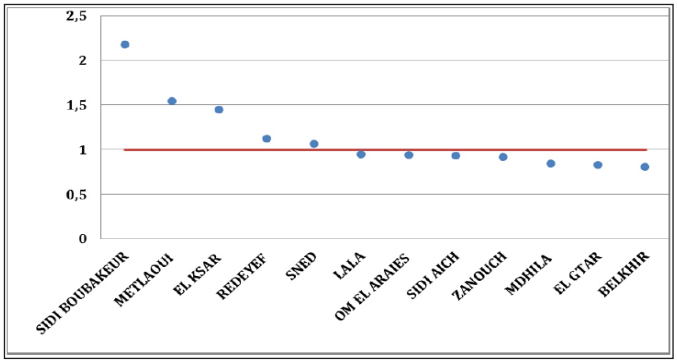


Figure 3. The Demographic Distribution of the Population According to the Beckman's Model. (Source: The researchers' achievement based on the data of the Tunisian Statistical Office, 2022.)

The Position of the Main City Gafsa within the Network of Urban Centers of Gafsa City Based on the Law of Macrocephaly

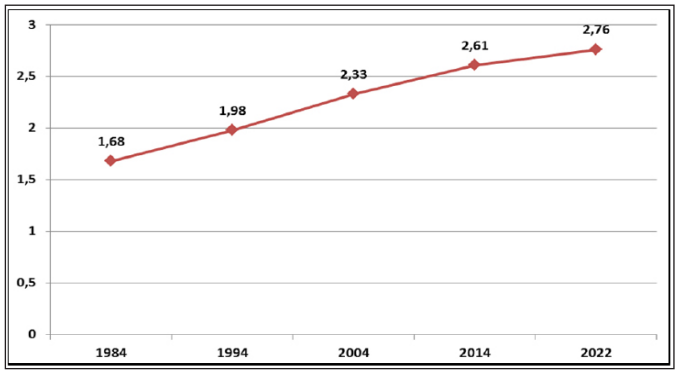


Figure 4. The Macrocephaly Index for Gafsa City.(Source: The researchers' achievement based on the data of the Tunisian Statistical Office, 2022.)

To find out how the phenomenon of macrocephaly has evolved at the level of Gafsa city , the evolution of the Jefferson index, or what has been termed by many researchers as the macrocephaly index, has been studied over nearly 40 years, as shown by the following chart that shows continuous and accelerating development in the macrocephaly of the main city, GAFSA, as this indicator jumped between the years 1984 and 2022 from 1.68 to 2.76, which is a large gap that illustrates the polarity that the primate city exercises over the rest of the urban centers of the Gafsa city.

Functional Studyrelated to the Facilities of Economic and Social Development

The assessment of the status of the Gafsa Center within the hierarchy of the centers of the state of Gafsa, based on the indices related to the equipment variable of the most important sectors of social and economic development represented in the sectors of education, health, culture, sports, small and medium enterprises, childhood, justice, commercial and service institutions, post and transportation, and industry, will depend on the average percentage of each center in terms of the number of equipment related to each indicator, which is illustrated by the following figure, through which it is clear that the center of Gafsa South is located far from the rest of the other centers in terms of the localization of the various equipment of these sectors. Compared to the rest of the centers in the state, percentage is 77.82%, while this percentage is estimated for the center of Al-Mitlawi, which is next in terms of ranking, at 8.4%. Therefore, the comparison of the two rates reveals a large gap between the two centers, and this is confirmed by examining the graphic figure that allows generalizing this result with the rest of the sectors, and thus confirming the phenomenon of macrocephaly of the main city of Gafsa at the level of the hierarchical organization of the state.

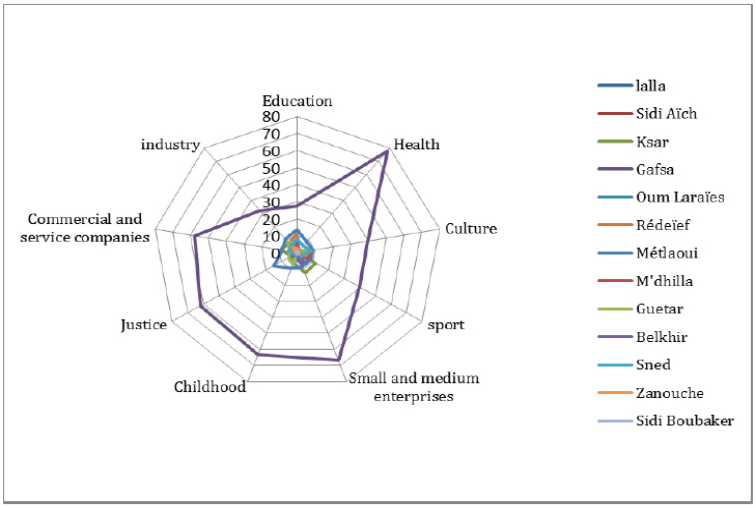


Figure 5. The functional Hierarchy of the Urban Centers of the State of Gafsa. (Source: achievement based on the data of the National Office for the Development of the South, 2022.)

CONCLUSION

In the sense that systems of urban settlements may be characterized in the long term by their hierarchical and spatial organization (18), a demographic and functional study of the hierarchical structure of the urban centers of the Tunisian state of Gafsa was carried out, by dissecting the pattern of population distribution across the network of urban centers of the state of Gafsa, showing heterogeneity in its demographic hierarchy. Their real distribution, which is the most important characteristic of the existence of a large gap between the city of Gafsa, the center of the state, which occupies the first place and located above the ideal line, and the rest of the other urban centers. This fact is confirmed by the demographic study of this urban system based on Beckman's law, which considers the main city as a reference for the rest of the urban system. This fact was enhanced by the main inflation index that took place for over 40 years, through which a continuous and accelerating development was shown in the macrocephaly of the main city. However, 48 indices fall within 10 variables, as they represent equipment related to the most important sectors of social and economic development represented in the sectors of education, health, culture, sports, small and medium enterprises, childhood, justice, commercial and service institutions, post , transportation, and industry, which shows that there exist a huge concentration of equipment of social and economic development in the city of Gafsa more than other urban centers, which is consistent with the demographic study. Nevertheless, in order to solve this urban chaos represented by the macrocephaly of the primate city at the expense of the rest of the urban centers of the urban system of the state, the

population and activities should be equally redistributed according to the theoretical demographic distribution. This can only be done by creating poles of urban balance and developing small urban centers by localizing activities and jobs that attract the population and generate wealth according to scientific methods and approaches. and this is what needs a study that may be one of the future research interests. This subject needs an in-depth study that may be one of the most important future research interests.

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