

Characteristics' Analysis of Urban System in Northern Upper Egypt Region (NUE) Size Distribution Analysis of Urban Settlements; 1976~2016

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Abstract

Characteristics of urban system of regional structure are: size of settlements, their spatial distribution, and their functions. Despite rapid development in Egypt, sufficient studies of the development patterns of its territories have not been sufficiently achieved or covered. Like other regions of the Nile valley in Egypt, Northern Upper Egypt region (NUE) was characterized by its natural, social, and economic homogeneity for long periods of time. But the accelerated development that has given rise to new axes of movement has revealed imbalances in a pattern that has not been analytically studied to help guide current and future development processes. Thus, this research focuses on analyzing size distribution (as the most important element of the structure). The aim of this paper, therefore, is to analyse the size distribution of urban system in the northern oblasts in terms of: the change in the size, proportions and growth rates of urban agglomerations over the past 40 years, the change in their grade and size distribution, followed by a change in their urban dominance. To achieve this, the paper reviews a theoretical review of methods for analysing urban styles/systems size distribution. The paper then examines an analysis of the size distribution of northern regions using some theoretical and applied measures (Primate City law, Size-Rank Distribution, Urban Primacy Index). The research concludes a set of findings and recommendations that may help to understand the size distribution of the northern region as one of its most important characteristics. Search also used GIS programme ((Arc GIS Desktop) to analyse spatial relationships between groups of different size strips to ensure accuracy of results.

1. Introduction

There are many literary readings on the concept of urban system" [2], [3], [4], [5], [6], [7], [8], from which we deduce the concept of urban system as a group of urban and rural settlement dispersed by size within a hierarchy of small and large urban settlement. It has a dominant urban primacy - the city of the province - and is spread spatially within a specific system that varies from environment to environment depending on natural, social and economic conditions. They are connected by a series of regional links of roads, railways, land areas, and these communities interact with each other - urban and rural - as well as with surrounding areas within the region, These interactions are the key determinants of the network of urban system [9].

Northern Upper Egypt region is a testament to the development of human civilization from prehistoric times through Pharaonic, Greek, and Roman civilizations to Coptic and Islamic times. Because of its unique location, the province has many traces of natural and environmental suitability for human settlement in different historical times [10]. Human settlements in the Nile valley have grown over time under very similar social, economic and technological conditions, with the Nile river as the most important natural feature and agriculture

as the main economic activity. However, the Nile valley has undergone dramatic and accelerated economic, social and demographic changes over the past 200 years, very different from the Nile valley's stability and tranquillity over the previous 5,000 years. With the real impact of the industrial revolution in Egypt in the mid-nineteenth century, and nearly a hundred years after it in Europe, economic and social conditions in the region began to change. This has been achieved through a series of major projects in the areas of roads, transport, agriculture, irrigation, industry and urbanization [11]. The main developments in the Northern upper region (the study area) in the past 30 years have been the emergence of the eastern desert road, the western route, and the Karimat road, These roads have contributed to the emergence of large development landscapes and land reclamation areas, new industrial zones, infrastructure projects and many new settlement developments (new towns and villages of agrarian reclamation). All these dramatic and accelerating changes in the region are expected to have a significant impact on its urban system characteristics. However, the current effects and characteristics of this system have not yet been precisely identified, This makes it necessary to identify the characteristics of the existing urban system of the territory, so

that future development projects can be planned in accordance with or integrated with the existing urban system.

The research used GIS software (ArcCatalog) & (ArcMap) to analyse spatial relationships between groups of different sizes to ensure accuracy of results.

2. Aim of the research

The aim of this paper is to analyse the size distribution of urban system in the Northern Upper Egypt region in an attempt to identify one of the main features of the urban system in its region. By studying the change in population ratios and growth rates in different sizes of these populations, rank and size analysis, urban primacy, and has changed over a long period of time (1976 to 2016), its contours and implications.

3. Research methodology

The research begins with a theoretical review of methods for analysing the size distribution of urban settlements in general, followed by applied study in Northern Upper Egypt region by statistical analysis of the size distribution characteristics of urban settlements. The research covers a geographical area in the northern region of upper Egypt including the governorates of Minya and Beni Suef; excluding the governorate of Fayoum for the following reasons:

- Natural, social, and economic characteristics of Fayoum governorate differ from the rest of the region and are characterized by oasis characteristics.
- The pattern and form of distribution of urban settlement in Fayoum governorate differ from that of the northern part of the country. The distribution of settlements depends on the diffuse pattern (similar to that of the Nile delta as it relates to the expansion of the delta's agricultural area), unlike the axis pattern in the provinces of Minya and Beni Suef, which stretches along the valley on the Nile banks.
- The 2006 regional difference coefficient ^[*1] for the region as a whole (Minya, Beni Suef and Fayoum provinces) was 10.56%. If limited to Beni Suef and Minya only, this coefficient is only 1.76%, indicating that the territory would be more homogeneous with Fayoum governorate [12].

Thus, Fayoum governorate was excluded, because if it is incorporated into the study of the region with these differences in place, this would lead to unrealistic and potentially misleading results.

With regard to the size classification of urban settlement in the Nile valley; the research has adopted the classifications presented in two studies. First: the general authority for urban planning prepared "study on urban development strategy for the north upper Egypt region" In 2004 [13]. Urban settlement -cities only- in the north of upper level were classified into five size categories: less than 20,000, 50,000, 100,000, 250,000, and more than 250,000 of populations.

The second study was dissertation by researcher Mahmoud Fouad El Buwab, "spatial distribution patterns of urban settlement -

an analytical study of the Egyptian urban system", in 2004, [14] which classified Egypt's settlements into four size categories of cities and four other categories of villages. The categories of cities included: less than 40,000, 40-100,000, 100-500,000, and more than a million of populations. The village categories included small villages (less than 10,000), medium villages (10,000-20,000), large villages (20,000-50,000), and giant villages (more than 50,000 of populations).

With the exclusion of Fayoum governorate, the study of urban planning authority could also be taken into account in the classification of rural settlement by Dr. Mahmoud Fouad El-Buwab. This is in seven categories as follows: First, five categories of urban settlement including groups of less than 20,000; 20,000-50,000; 50,000-100,000; 100,000-250,000; 250,000-million of populations. Second, two categories of rural settlement, including groups of 20,000-50,000; and larger than 50,000 of populations. The research is considering only the main big villages; because they are the most populous, functional, and therefore the most influential in terms of the existing urban system of the region compared to other villages. It is difficult to cover all the villages because of the size of the area and the dispersion of the villages.

The research used GIS software (ArcCatalog) & (ArcMap) to analyze spatial relationships between groups of different sizes, to ensure accuracy of results. Questions based on population characteristics by size have been used (Select by attribute) in (ArcMap). Also, data computation tools based on other data were used (Field Calculator), to automatically calculate the ratios of urban and rural settlement in the study area, the ratios of its population by size categories, the actual proportions of settlement size, the theoretical proportions according to the law of the first city, according to the law of rank-size, and the index of urban primacy. The formulas used for the calculations were introduced a one-time requirement for all communities, to ensure accuracy and speed in obtaining the required results. The functionality of a spatial information display has also been used in an encoded way to display size categories of urban settlement after the entry of these data, using quantitative population division coding and based on the classification adopted by the research.

4. Size distribution analysis

4.1. A theoretical review of the methods for analysing size distribution

In general terms can be suggested that analysis of urban system is the study of the system of towns and villages in a city or region in terms of spatial interaction, size and rank, spatial distribution of settlement on a regional map, distance and functional and size composition [15]. The research here focuses on one of the most important elements of urban system analysis it is the size analysis of this system, which concerns with understanding the characteristics and features of different sizes of the region's urban settlement. The importance of addressing this element stems from the fact that size can measure the value

of a physical/urban centre based on the general premise that large human settlement centres are multifunctional, with extended impact. The larger the size, the more jobs there are; thus, the city degree of centrality and its impact in its rural and urban surroundings have increased. There are variety of literature on methods for analysing the size distribution of urban settlement, from which we can generally divide them into two basic trends: qualitative analysis methods and quantitative analysis methods. Some different trends were involved. In particular: geography (central place theory, hierarchical diffusion theory); and urban (first city law, rank and size rule). While the study of statistical analytical methods were in two parts: statistical metrics, for determining urban primacy, other metrics for determining urban settlement, and computation of urban concentration, (Figure 1).

For theoretical trends, geographically determining the relationship between urban settlement and their hierarchy emerged, with “the central place theory” of Christaller of 1933 studying the relationship between size, rank and function of the assembly (16), (17), (18) , (19) and the "hierarchical diffusion theory", which appeared in the writings of Hagertranal (1953), Rerry (1972) and Redon (1975); were based on the study of interrelationships, size hierarchical, and functional hierarchical of urban settlement [14]. **Studies on urban orientation** In 1939, Mark Jefferson introduced "the law of the primate city", which deals with the importance of the primat city, its dominance over the urban system and the rank of the next two cities through population size [20]. In the same vein, Zipf introduced in 1949 “Size-Rank Distribution” which aims at establishing a correlation between population sizes of cities and their general rank according to these sizes [17],[21].

The methods of quantitative statistical analysis were twofold: the first of these are the measures of **urban primacy**, presented also by Mark Jefferson in 1939, [20] which relate to the measurement of the degree of the urban primacy, among the cities of the region, and the concomitant inequality in function and

urban field. A number of the "index to measure urban primacy" have been developed, the most significant being the ratio of any city to the first city, the urban size convergence index, the urban primacy or concentration ratio, and the urban primacy index for the four cities [21], [22]. The second is the measurement of **distribution the hierarchical of urban settlement and computation of function centrality**, including: the Gutman scale method and Scalogram, [15], [22] Pearson correlation coefficient link and Spearman correlation coefficient [23].

By restricting the analysis of urban system in Egypt, reference literature on understanding the characteristics of the urban system in Northern Upper Egypt is still scarce. A study entitled "an urban approach to determining the role of urban system in promoting balanced development" [18], analysed the experiences of earlier developed and developing countries, with a view to deriving measurement methods that can be used to monitor the characteristics of the current urban system in the region Southern Upper Egypt region. Another study, entitled "urban sprawl of median cities and the influence of regional and social factors on its characteristics from 1976-1989" [19], An assessment of the areas of the urban sprawl of the intermediate cities - the areas most affected by urban growth - in order to determine their current population absorption potential and to determine factors affecting their rapid population growth, their correlation with the urban system and its size and functional content of urban areas and rural settlement in three governorates of the delta region, namely, Sharqiya, Daqahliyah and Kafr El-Sheikh. According to a recent study entitled "patterns of spatial distribution of urban settlements - an analytical study of the Egyptian urban system" [14]; analysis of the patterns of spatial distribution of urban settlement in Egypt in terms of rank, size, spacing and function, and a proposed concept for dividing this system through local factors and variables, was carried out. The research concluded that the Egyptian system could be divided into two main types of spatial distribution of urban system, namely "aix" and "diffuse" types.

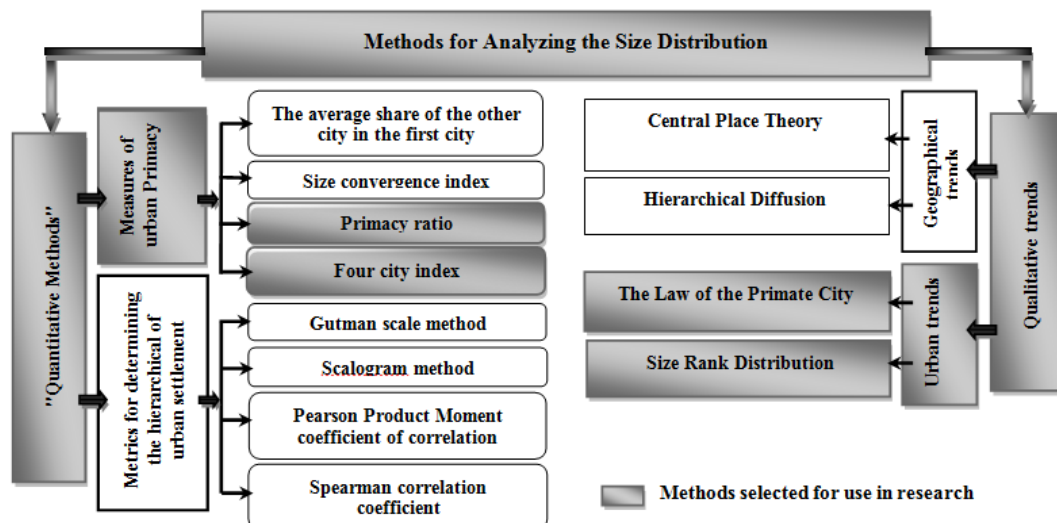


Figure 1: Theoretical Trends and Statistical/ Quantitative Methods used to Study the Size Distribution of Urban Settlements [12]

Thus, the existence of a systematic study to analyse "urban system" in the Northern Upper Egypt Region represents a scientific addition in this area. This research considers, as part of the first research series that follows, one of the components of its analysis, namely the size distribution of the urban settlement. In order to understand the size distribution characteristics of the study area settlement, the research will begin by providing an analysis of the size and proportion of the population in the different study area size groups, followed by area size analysis using two analytical methods from each direction (from theoretical trends, urbanization will be used in "The Law of the Primate City", "Size Rank Distribution", and from analytical methods the four city index and Primacy ratio will be used.

4.2. Size and proportion of the population of urban settlements of different size groups in Northern Upper Egypt Region

The Northern Upper Egypt Region stands out among the regions of Egypt, being the closest to greater Cairo to the Upper Egypt region, which is highly urbanized and concentrated in services and economic activities, and is the link between the Nile delta and ribbon valley. The Northern Upper Egypt Region is characterized by its unique composition and the cultural heritage of the Nile valley in the governorates of Beni Suef and Minya. The oasis in the desert is represented by the Fayoum oasis, which

is similar to the lower western desert.

The territory administratively comprises three provinces, Minya, Beni Suef and Fayoum, with a total area of up to 70,000 km². Two governorates are located in the Nile valley (Bani Suef 7169 km², Minya 56587 km²) with a total area of about 64 000 km², while Fayoum governorate includes the low fayoum and Wadi El-Rayan governorates with an area of 6,000 km²(12). In this study, the cities of Fayoum governorate were excluded from the northern region of upper Egypt for the above-mentioned reasons in the methodology.

Of the total population of the study area as a whole in 2016 (8.36 million) [*2], approximately 46.62% [*3] were selected for study (major towns and villages of Minya and Beni Souif provinces). It is distributed among the seven size categories already approved in the methodology as follows: First, five categories for urban settlements (categories of less than 20, 20-50, 50-100, 100-250, 250-500 thousands of populations). Second, two categories for rural settlements (the main ones located only within the urban periphery) (from 20-50, and greater than 50 thousands of populations). The study focused only on the main pre-urban villages being the most influential (demographic and functional) type of urban system in the region compared to other villages, because of the large size of the area and the dispersion of the villages, it is difficult to cover all the villages (Tables 1 and 2).

Table 1: Distribution of urban settlements (towns and villages) in the study area according to the population size of the regional administrative centres for 2016

status	Urban settlements (1000)					Rural settlements (1000)		Total cities	Total villages
	250- million	250 -100	100-50	50-20	اقل من 20	Villages are over .50,000	Villages 20-50,000		
Beni Suef	1	-	-	-	-	-	5	1	5
New Beni Suef	-	-	-	-	1	-	-	1	-
Al Fashn	-	-	1	-	-	-	2	1	2
Al Wasta	-	-	-	1	-	-	5	1	5
Ehnasia	-	-	-	1	-	-	3	1	3
Biba	-	-	1	-	-	-	2	1	2
Samasta	-	-	-	1	-	-	2	1	1
Nasir	-	1	-	-	-	-	2	1	2
Total of Beni Suef Governorate	1	1	2	3	-	-	21	8	21
Minya	1	-	-	-	-	1	9	1	10
New Minya	-	-	-	-	1	-	-	1	-
Abu qurqas	-	--	1	-	-	-	5	1	5
El Edwah	-	-	-	-	-	-	1	1	1
Bani Mazar	-	1	-	-	-	-	7	1	7
Dayr Mawas	-	-	1	1	-	1	2	1	3
Samalut	--	1	-	-	-	-	9	1	9
Matay	-	-	1	1	-	-	2	1	2
Maghaghah	-	-	1	-	-	-	8	1	8
Mallawi	-	1	-	-	-	-	13	1	13
Total of Minya Governorate	1	3	4	2	1	2	56	10	58
Total of Beni Suef & Minya Governorate	2	4	6	5	1	2	77	18	79

Source: CAPMAS, 2016 Census [24] at the disposal of researchers).

Table 2: Ratios of urban settlement (cities& rural) in the study area and their population by size groups in the 2016 census

Settlement Size	Size Categories (Thousand People)	Number	%Number	Population	%Population	Average population (People)
Urban Settlements (Cities)	million-250	2	2.06	553333	14.19	276.666
	250-100	4	4.12	515102	13.21	128.775
	100-50	6	6.19	447118	11.47	74.519
	50-20	5	5.15	191206	4.90	38.241
	less than 20	1	1.03	6032	0.15	6.032
Urban Settlements (Rural)	More than 50	2	2.06	144096	3.70	72.048
	50 -20	77	79.38	2042549	52.38	26.526
Total		79	100	3899436	100	34.890

Source: CAPMAS, 2016 Census [24] (at the disposal of researchers).

Analysis of the urban Settlement during these different sizes shows the following:

- **The first group to the (City population 250-million of populations):** This group includes the largest cities (the largest population group), which constitute a high concentration of population in the study area. In 2016, approximately 14.19% of the study area's population was inhabited by 553,333 inhabitants. With an average population of 276,666 population /settlement, this group represents the cities of Beni Suef and Minya.
- **The second group to the (City population 100-250 thousand people):** consists of the four largest cities, with 515,102 residents, representing 13.21% of the study area's population in 2016, with a population average of 128,775 population /settlement, this group represents the city of Malawi, Samalut, Nasir and Bani Mazar.
- **The third group (City population 50-100 thousand people):** includes the intermediate 6 cities, with 447,118 residents and 11.47% of the study area's population in 2016, with an average population of 74,519 population /settlement, this group represents the city of El-Fashn, Biba, Maghagha, Abu Qurqas, Matay and Dayr Mawas.
- **The fourth group, (City population 20-50 thousand people):** includes the 5 smaller cities settled by 191,206, representing 4.90% of the study area's population in 2016, with an average population of 38,241 Population /settlement, This group represents the new city of Samasta, Al Wasta, Ehnasia, Al Edwah, Beni Suef.
- **In the fifth group of (cities less than 20 000 thousand people):** we represent one city, the city of New Minya, with 60,320 Population, and representing 0.15% of the study area's total population in 2016. A population average of 6,032 population /settlement.
- **The sixth group of (village more than 50 thousand people):** represents two mega-villages, the village of Dalija, in Dayr Mawas city, and Telah village in Minya city, with a population of 144,096%, representing 3.70% of the total population of the study area in 2016, with an average population of 72,048 population /settlement.

- **The seventh group of (village 20-50 thousand people):** They constitute the most numerous rural settlements in the study area, accounting for 79.38% of the total number of settlements in the area, and settling in 52.38% of the total population in the area in 2016, with an average population of 26,526 Population /settlement. And so has been distributed to all the centres in the study region but is increasingly concentrated in the Minya provincial cities (Malawi city, Minya, Samalut, Abu Qurqas accounted for 35.54, 32.89, 31.07 and 25.92% respectively of the total number of rural settlement in study governorates) [^{*4}].

Analysis of the figures in the two previous (Tables 1, 2) and (Figure 2) shows the following:

- Most urban settlements are concentrated in the village group of (the 20,000 to 50,000 populations), probably because the vast majority of these villages have grown on a poorly productive rural economy based on land production around the colony produces. It should be noted that the study focused only on the main villages, which are located in the periphery of cities, have the greatest impact (in terms of population weight) on the existing urban system in the territory compared with the other villages, and also because of the large size of the area and the dispersed nature of the villages, it is difficult to cover all the villages.
- urban settlements, a group of 18 urban city, 18.55% [^{*5}] of the total number of study area, comprises two cities with a size of 250,000 and a population of 500,000, Minya (capital of the region) and Beni Suef (capital of the governorate), which, because of their job opportunities and cultural upgrading, have attracted people from within the region and helped to expand their population size, Four large cities with a population size of 100,000 to 250,000(the cities of Malawi, Nasser, Samalut and the Bani Mazar, all with a large population weight), six cities with a size of 50,000 to 100,000 were named (these cities spread over the district and are all the capital cities of study area administrative centres They are Al Fashn, Biba, Nasir, Abu Qurqas, Dayr Mawas,, Matay and Maghagha), five medium-sized cities of 20,000 to 50 000 people (all also the capital of study area

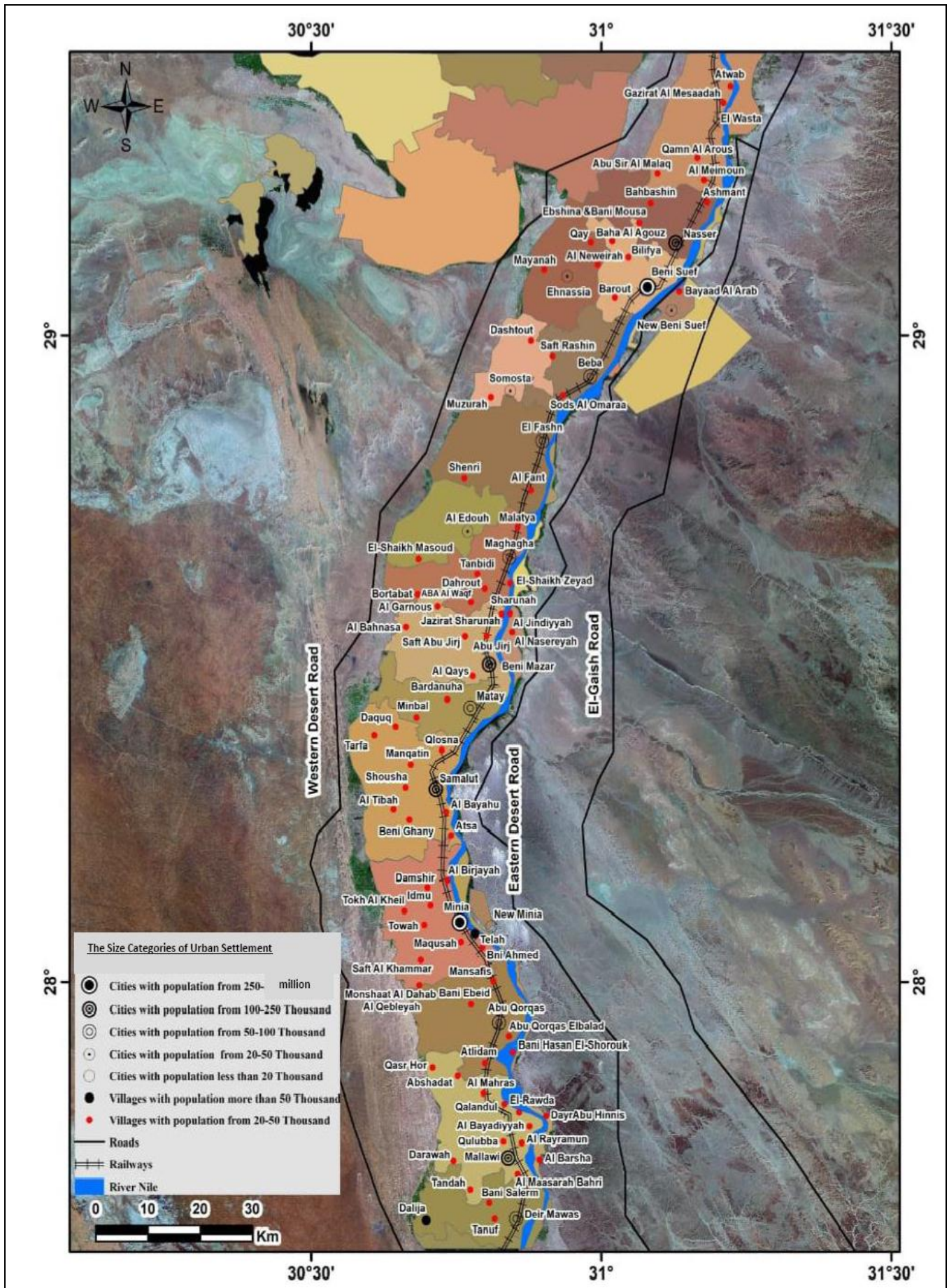


Figure 2: Analysis of the Size Distribution of Urban Settlements in Northern Upper Egypt Region (in the 2016 census).

administrative centres, namely, Al Wasta, Ehnasia, Samasta, Al Edwah, Beni Suef), and one small city - less than 20,000 of them - (this category is represented by the new city of Minya).

- The largest percentage of rural settlements in the study area, including the large villages^[6*] (20,000 to 50,000). They constitute 79.38 % of the number of settlement in the study area, followed by the mega-villages (2.06% of the number of settlement in the area). It is represented by the village of Dalija, Dayr Mawas city, and Telah village, Minya city, all of which are local units. The reduction in the population of these villages, despite the important administrative function they perform, can be justified by the fact that they fall into a cluster of villages that converge.
- In addition, we note the absence of the upper size group (above a group larger than 1 million), where the first city of the region is located (Minya), whereas in the third size group, (the group 250,000 to 500,000), preceded by two large groups, cities larger than the million, cities of 500,000 to 1 million - up to 301,823 inhabitants in the 2016 census.
- There is an inverse relationship between the number and size of the settlement, we note that the picture of population concentration in urban settlement is that a high percentage of the number of rural settlements, (such as huge, medium villages), constitute 81.44^[7*] of the number of urban settlement in study region, including a low percentage of the population of 65.62 %^[8*]. In other words, a low proportion of the number of urban settlements (large cities account for 6.19% of the number of urban settlements) has a high proportion of the population (27.4% of the total population^[9*] and concentration increases with the addition of small and medium-sized cities, amounting to 43.92% of the total population of the study region concentrated in 18.55% of the number of urban settlements.

As we have already pointed out, relying on "the size analysis theories of urban settlements", the research is dealing with size analysis as one of the most important element of the urban system and that's through:

- Rank and size analysis using "The Law of Primate City" and "The Size-Rank Distribution".
- To analyses "Urban Primacy" between the region's cities using the "Four City Index", and the "Primacy Ratio".

^[*1] Difference coefficient = (standard deviation of total provincial density / arithmetic mean)* 100.

^[*2] The total population of the study area in 2016= the total size of urban settlements (urban and rural) of the city of Minya + the total size of urban settlement (urban and rural) of the province of Beni Suef = 5.379.689+ 2.984.071= 8.363.670

^[*3] The total population of the cities and villages selected for study in 2016/total population of the study area*100=899436/8363670* 100=%46.62

^[*4] The size of rural settlements of the city of Malawi is 725.082, the size of rural agglomerations of the city of Minya is 671.846, the size of rural settlements of the city of Samalut is 634.719and the size of rural settlements of the city of Abu Qurqas is 529.436. By dividing it by the total size of the rural settlements 2.042.549, we obtain the proportions mentioned above.

^[*5] Pooled urban settlement in cities size group = 2.06%+4.12%+6.19%+ 5.15% +1.03%=18.66%

^[*6] They are: Dalija, Telah, Bilifiya, Ebshina &Bani Mousa, Barout, Baha Al Agoutz, Bayaad Al Arab, Al Fant, Shenri, Atwab, Al Meimoun, Qamm Al Arous, Abu Sir Al Malaq, Gazirat Al Mesaadah, An Neweirah, Qay, Mayanah, Saft Rashin, SoDs Al Omaraa, Muzarah, Dashtout, Ashmant, Bahbashin, Al Bijriyah, Bni Ahmed Gharbia, Saft Al Khammar, Tokh

Al Kheil, Idmu, Damshir, Towah, Maqusah, Monshaat Ad Dahab Al Qebleyah, Atildam, Bani Ebeid, Abu Qurqaz, Bani Hasan, El-Shorouk, Mansafis Abiouha, El- Shaikh Masoud, Abu Jirj, Al Gamous, Al Qays, Al Bahnasa, Al Gharbeyah WA Kafir Al Mansourah, Al Jindiyyah, An Nasereyah(Al Garabia Previous), Saft Abu Jirj, Bani Salem, Tanuf, Atsa, Shousha, Qlosna, Manqatin, At Tibah Al Bayahu, Bani Ghani, Daquq, Tarfa, Bardanuha, Minbal, ABA Al Waqf, Sharunah, Tanbidi, El- Shaikh Zeyad, Bartabat, Jazirat Sharunah, Dahrou, Malatya, Abshadat, Al Barsha, El-Rawda, Tandah, DayrAbu Hinnis, Qalandul, Al Bayadiyyah, AR Rayramun, Al Mahras, Al Maasarah Bahri, Darawah, Qasr Hor, Qulubba.

^[*7] Number of rural settlements = mega-villages + hamlets, %2.06+ %79.38=%81.44

^[*8] Population of rural settlements (mega-villages + hamlets) = %4.24+ %52.38= %65.62

^[*9] Population of urban settlements/ cities= 16.34+ 13.21= 27.4%

4.3. Rank and size analysis

Mark Jefferson in 1939 introduced the Law of Primate City as a starting point for city rank and size analysis, taking care of the importance of large cities in the urban system for any region and the rank of the next two cities in size. He noted (from his study of a group of cities in the 1930s) that the median value of the population of the second city was 30% of the population of the first (larger) city, The third city has 20% of the population of the first city [19]. The largest credit is due to "G. K. Zipf", in which he concluded in 1949 that there is a correlation between the city population size and the overall order of size. If cities in a region rank in descending order by population, the size of a city is 1/ n larger, according to series 1, 1/2, 1/3, 1/4,... 1/ n [17].

Applying these rules to the study region in order to determine whether there is a correlation between ranks, sizes and Numbers of cities in the study region, the following observations were made: (**Table 3 and Figure 3**):

- In 2016, Minya ranked first, with the largest urban population in the region, while Beni suef ranked second and accounted for 83.33% of the first city's population. It is therefore relatively far from the theoretical size assumed by Jefferson (30%) and zipf (50%).
- Mallawi was ranked third with 60.60% of the total population of the first city of the region and is also far from the theoretical size assumed by Jefferson and zipf.
- The rest of the cities of the region are quite distant from the assumed population sizes of Jefferson and Zipf such as the city of Nasir, Bani Mazar, Maghagha, Al Fashn, Abu QRqas and Matay, some more akin to the theoretical size of zipf such as the Al Edwah, and the new Beni Suef.

We can say that the size of the settlement in the study region does not correspond to the Size- Rank Distribution. There is even a gradient that is evident from a comparison of the size of the first city (Minya) with that of the last city (New Minya), which was 1/51 of the size of the city of Minya and ranked according to the rule of Size- Rank Distribution 1/18.

On the evolution of the ranks of the cities over the years 76, 86, 96, 2006, 2016 (Table 4) (Figure 4), we can conclude:

- Uneven population growth rates of the various population groups varied from 1976 to 2016, indicating that the population growth rate in the region generally rose during successive periods but varied from time to time depending on the influence of natural growth factors and migration.

Table 3: Order of size of urban settlements (Cities) with more than 100,000 populations (2016), expected theoretical size of each according to the Jefferson “The Law of Primate City”, “Size- Rank Distribution” of Zipf

No	urban settlements (Cities)	Population and actual percentages, 2016		Population and theoretical ratio according to Jefferson's “The Law of Primate City”		Population and theoretical ratio by “Size- Rank Distribution” of Zipf	
		Population	%	Population	%		
1	Minya	301823	100.0	100.00	301823	301823	100.00
2	Beni Suef	251510	83.33	30.00	90546.9	150911.5	50.00
3	Mallawi	182921	60.60	20.00	60364.6	100597.6	33.33
4	Samalut	117231	38.84	14.20	42858.8	75455.7	25.00
5	Nasir	111602	36.97	11.10	33502.3	60364.6	20.00
6	Bani Mazar	103348	34.24	9.09	27435.7	50313.8	16.67
7	Maghaghah	98262	32.55	7.60	22938.5	43130.5	14.29
8	Al Fashn	85391	28.29	6.60	19920.3	37727.8	12.50
9	Biba	75177	24.90	5.20	15694.7	30182.3	10.00
10	Abu Qurqas	74794	24.78	5.80	17505.7	33532.5	11.11
11	Matay	60855	20.16	4.70	14185.6	27435.7	9.09
12	Dayr Mawas	52639	17.44	/	/	25141.8	8.33
13	Samasta	49494	16.39	/	/	23210.1	7.69
14	Al Wasta	49288	16.33	/	/	21550.1	7.14
15	Ehnasia	48344	16.01	/	/	20131.5	6.67
16	New Beni Suef	23405	7.75	/	/	18863.9	6.25
17	Al Edwah	20675	6.85	/	/	17747.1	5.88
18	New Minya	6032	1.99	/	/	16781.3	5.56

Source: CAPMAS, 2016 Census [25] (at the disposal of researchers).

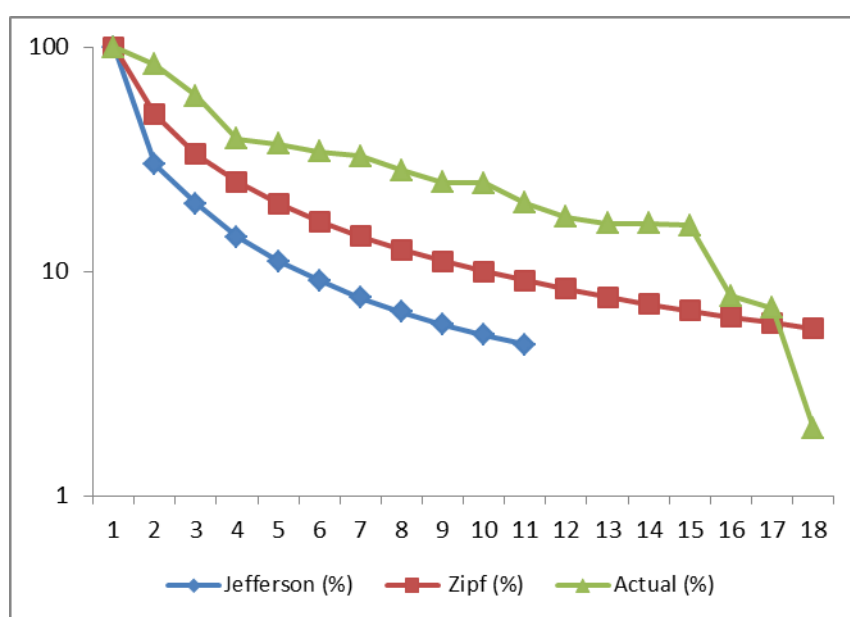
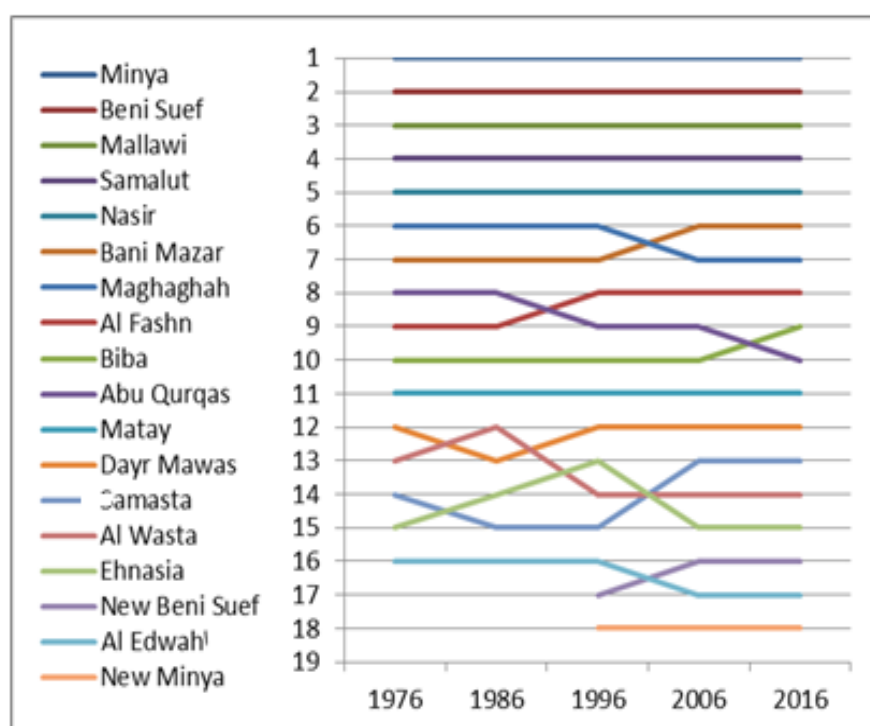


Figure 3: Variation in population sizes between theoretical and actual urban settlements in the study region, 2016
Source: prepared by researchers based on tabular data [3].

Table 4: Evolution of Rank of urban settlements in the study region from 1976 to 2016

Size Categories (Population)	City	1976		1986		1996		2006		2016	
		Population	Rank	Population	Rank	Population	Rank	Population	Rank	Population	Rank
From 250,000 to million	Minya	146,423	1	179,060	1	201,440	1	236,043	1	301.823	1
	Beni Suef	118,148	2	152,476	2	171,734	2	193,048	2	251.510	2
From 100 to 250,000	Mallawi	74,256	3	98,632	3	119,285	3	139,929	3	182.921	3
	Samalut	48,146	4	62,404	4	75,437	4	91,475	4	117.231	4
	Nasir	40,151	5	54,655	5	70,543	5	85,319	5	111.602	5
	Bani Mazar	39,373	7	47,982	7	52,690	7	79,553	6	103.348	6
	Maghaghah	40,102	6	50,916	6	60,405	6	75,657	7	98.262	7
From 50,000 to 100,000	Al Fashn	23,506	9	43,488	9	52,589	8	65,621	8	85.391	8
	Biba	33,047	10	40,668	10	49,516	10	57,716	10	75.177	9
	Abu Qurqas	33,498	8	43,765	8	50,031	9	57,892	9	74.794	10
	Matay	21,101	11	29,027	11	36,953	11	46,903	11	60.855	11
	Dayr Mawas	20,058	12	26,641	13	33,197	12	40,640	12	52.639	12
From 20,000 to 50,000	Samasta	17,202	14	23,958	15	30,714	15	37,965	13	49.494	13
	Al Wasta	17,659	13	27,269	12	30,879	14	37,916	14	49.288	14
	Ehnsasia	16,453	15	23,970	14	31,488	13	37,174	15	48.344	15
	New Beni Suef	-	-	-	-	8,106	17	17,921	16	23.405	16
	Al Edwah	7,146	16	10,349	16	13,553	16	15,875	17	20.675	17
Less than 20,000	New Minya	-	-	-	-	1,102	18	4,567	18	6.032	18

Source: CAPMAS, 76, 86, 96, 2006, 2016 Census [25], [26] (at the disposal of researchers).

**Figure 4:** Evolution of Ranks of urban settlements in the study region from 1976 to 2016

Changes in the order of size of some of the regional urban centres and, consequently, the size order has taken different forms in terms of stability or variability, indicating that the size system was affected by many developmental and demographic changes from 1976 to 2016, owing to factors that contributed to the high population growth rates in cities at the expense of others, such as location, roads.

- The large size categories of cities maintained their rank; this reflected cities' ability to dominate urban areas under weak competition from other urban centres because of their functional characteristics and characteristics (functional diversity), their ability to attract populations and their enjoyment of development projects, which had led to the establishment of numerous activities and investments, as well as the availability of employment, the improvement of health and education services, facilities and better living standards.
- The smaller size categories of cities have fluctuated upward and downward rank, most being new cities (such as the new city of Beni suef, New minya) and other smaller developing cities (such as the cities of Ehnasia, Samasta and Al Wasta central) with a small population, so smaller cities were clearly and rapidly affected in rank, This is evident in both Ehnasia and central and Samasta, which have had fluctuations in rank and size and sometimes even decreased in rank, which can be explained by their high population growth resulting from increased internal migration from rural settlements to these urban centres and their natural rate of increase in time. The decline in those ranks has also in other periods been due to their low population growth rate, and this decline in population growth rates may be explained by the fact that these cities are no longer as attractive to the population as they were in earlier periods. In addition, residents search for investment areas in neighboring centers that have distinctive characteristics in terms of population attraction from other centers (such as the city of Bani suef, Biba, and Al Fashn) nearby with high population weight. This may also be due to their employment and investment problems.
- The cities of the first size categories (250,000 to million) were consistently ranked in 1976-2016, with Minya taking first place in terms of population size, followed by Beni Suef.
- The second size categories (100,000-250,000) also stood firm in its ranking from 1976 to 2016 in most of its cities, Mallawi, Samalut and Nasier, excluding Bani Mazar city, which rose from 7th in 1996 to 6th in 2016.
- The third size categories (50,000-100,000) had minor fluctuations in rank, including the cities of Maghaghe, Al fashn, BIba, Abu Qurqas, Matay and Dayr Mawas. Maghaghe rank decreased from rank 6 in 1996 to rank 7 in 2016 with the change in rank and size predominant. For example, Al Wasta
- city was ranked 13, 12, 14 and 14 according to the 1976, 1986, 1996, 2006 censuses, respectively.
- The fourth size category (20,000-50,000) predominates in rank and size. For example, the city of Ehnasia ranked 15,

14, 13, 15 and 15 according to the 1976, 1986, 1996, 2006, 2016 censuses, respectively.

- The fifth size category (cities less than 20,000) is represented by one city - New Minya - which is a developing city.

4. 4. Urban Primacy analysis

The analysis of "urban Primacy" measures the degree of variability in size among the region's cities and, consequently, the homogeneity of the urban system. The result of this analysis indicates the degree of concentration of services and economic activities in the cities of the territory, which is critical in guiding and propelling the development processes of the territory.

Using the urban Primacy index for the four metropolitan cities [22], [23] the predominance of the first city is determined only for the following four cities, which can be calculated using the following formula: $UP = c1 / (c2 + c3 + c4)$, UP = urban primacy index, c1 = population of the first (greater) city, c2 , c3, c4 = population of the (second + third + fourth) city. If the primacy index value of more than one is correct, this indicates that the population of the first city is higher than the population of the three cities combined, an indication of the dominance of the first (primate) city as compared with the other three cities. In general, index values fluctuate around one valid in developed countries, while in developing countries the value increases, and that shows the growing importance of the first (primate). The indicator is flawed by its focus on the relationship between the first four cities only, its focus on variables in population size, and the neglect of variables in function and distance.

Given the region of study, the size of the urban aggravation varies, but it is noticeable that not a single city primate the urban system, as there is some rivalry between the provincial capitals (Minya and Beni Suef). Despite the years that have passed, the new towns (New Minya and New Beni Suef) have not been able to function as they have been built, even they have been built since several years. Using the "Four City Index", a ratio of 0.55 to the next three cities was observed to be Minya, less than one true, indicating no urban Primacy in the region, (Table 5).

Using another measure, the "Primacy Ratio" (ratio of urban population to the first city/urban population of the second city) and its calculation in the North Upper region between 1976 and 2016, we also note that this ratio is low and does not reflect the extent of the control of the city of Minya (first city) over the city of Beni Suef (second city), although it increased slightly from 1.17 to 1.22 between 1986, 2006 and decreased slightly between 2006 and 2016, decreasing from 1.22 to 1.20 respectively, as shown in (Table 6).

Considering the size of the cities of Northern Upper Egypt in the various censuses from 1976 to 2016, the range between the size of the first and last cities of the region is constantly increasing, which means that the first "Minya" is increasing in size at the expense of smaller towns, (Table 7).

Table 5: Shows the relative importance of urban settlements (Towns) in the North Upper region in 2016

Towne	Rank	2016 population	Four City Index	% Of the total urban population ((171,2791 per cent)
Minya	1	301823	0.55	17.62
Beni Suef	2	251510	0.61	14.68
Mallawi	3	182921	0.55	10.68
Samalut	4	117231	0.37	6.84
Nasir	5	111602	-	6.52
Bani Mazar	6	103348	-	6.03
Maghaghah	7	98262	-	5.74

Source: CAPMAS, 2016 Census [24], [25] (at the disposal of researchers).

Table 6: Progress in the rate of urban concentration in the governorates of Minya and Beni Souif from 1976 to 2016

Towne	Rank	Population, 1976	Population, 1986	Population, 1996	Population, 2006	Population, 2016
Minya	First	146,366	179,060	201,440	236,043	301.823
Beni Suef	Second	117,910	152,476	171,734	193,048	251.510
"Primacy Ratio"		1.24	1.17	1.17	1.22	1.20

Source: CAPMAS, 2016 Census [24], [25] (at the disposal of researchers).

Table 7: Development of range between the largest and smallest city in the North upper region during the 1976-2016 period

year	The Frist Town		The Last Town		Range
	Towne	Population	Towne	Population	
1976	Minya	146,366	Al Edwah	7,146	139,22
1986	Minya	179,060	Al Edwah	10,349	168,71
1996	Minya	201,440	Al Edwah	13,553	187,88
2006	Minya	236,043	Al Edwah	15,875	220,16
2016	Minya	301.823	Al Edwah	20.675	281.14

Source: CAPMAS, 2016 Census [24], [25] (at the disposal of researchers). My New Mina city and New Beni Suef have been ruled out

5. Conclusions and Recommendations

The results of the analysis of the seven size categories in the study region in 2016 are as follows:

1. Regional importance and job creation are the main reasons why cities of a size (250,000-million of population) reach that size and represent the capitals of provinces such as Minya and Beni Suef, with large population burdens and more jobs than neighboring cities.
2. All cities that form capitals of administrative centers and have a similar managerial function fall into either the size group (100,000-250,000 of population), the size group (50,000-100,000 of population) or the size group (20,000-50,000 of population). Their occurrence in different categories may be due to some other factors, such as the different degree of urban primacy of each of these cities (over neighboring cities), or a degree that characterizing the geographical location of those cities, since these sizes are the final product of the interplay of a number of geographical, cultural and economic controls that influence a pattern distribution and size of centers of urban settlement.
3. New cities (New Beni Suef and New Minya) were located in the two smaller size categories: (20,000-50,000 of population) and (less than 20,000 of population), the first city fell into the fourth size category (20,000-50,000 of population) and the second into the fifth size category (less than 20,000 of population), owing to the desert nature of those cities.
4. Rural communities with a category (over 20,000 of population) in the study region are all local units; and this has resulted in larger sizes than other villages with fewer than 20,000 of population. These rural settlements constitute 81.44% of the total number of urban settlements in the study region in 2016, including the large villages (20,000-50,000 of population), which account for 79.38% of the population of the region, followed by mega-villages (over 50,000 of population) and 2.06% of the number of settlements in the region (namely, the villages of Dalija, Dayr Mawas neighboring rural areas). Although the number of such settlements is increasing, they make up the smaller proportion of the population of the region (56.08%) because these villages, while important in administrative function, are part of a group of smaller villages with which they are close and which prevent their inhabitants from migrating or even from smaller villages to be cities.
5. The inverse relationship between population and size in the region indicates that both service and economic activities are highly concentrated in large cities. About 56.08% of the study area's population resides in rural settlements (mega- and large villages), which make up 81.44% of the region's population, while 43.92% is concentrated in urban settlements (large, medium, and small cities), which account for only 18.55% of urban settlements.
6. According to rank and size analysis of urban settlements in the study region in the years 1976 to 2016; we found that the

size of urban settlements in the study region did not correspond to "Rank- Size Ruler". There is even a sharp decline and variation in size and rank of the cities of the region, where the variation appears large in the ranks taken by urban settlements, as can be seen from a comparison of the size of the first city (Minya) with that of the last city (New Minya), which is 1/51 times the size of Minya while having a rank at the base of rank 1/18. This confirms the concentration of economic and social development in the megacities and the delayed delivery of services to small and secondary-sized cities have been delayed, resulting in small and secondary cities losing their population to large cities, without being able to attract exodus from neighboring rural areas.

An analysis of the relationship between the ranks and sizes of the study region cities from 1976 to 2016 shows:

7. The size category of the large cities – 250,000-million in size - stood out in their order of rank, as in Minya, Beni Suef (which ranked first and second, respectively). On the other hand, the increased change in city orders was seen in the smaller segments - the fourth tier with a size group of 20-50,000. The cities of this segment fluctuated considerably, including the cities of Samasta, Al Wasta, Ehnasia, New Beni Suef, and Al Edwah. For example, the city of Ehnasia ranked 15, 14, 13, 15 and 15 according to the 1976, 1986, 1996, 2006, 2016 censuses, respectively. All of this demonstrates that small and secondary cities have lost their populations because of the concentration of economic and social development in the large cities, making them unattractive to the population. In addition to other problems, such as poor infrastructure, rising housing prices, the lack of employment opportunities that helped to make these cities extinct.

According to the analysis of the urban primacy of urban settlements in the study region from 1976 to 2016, we conclude that:

8. The lack of high urban primacy at the regional level, owing to some rivalry between the provincial capitals of the region (Minya- Beni Suef). The highest degree of primacy in the region was in Minya city in the province of Minya and did not reach the right one (0.55), with the Primacy index for all other cities approaching. This means that the region's cities lack dynamic economic and service interaction, making them more stable and stable.
9. Although no city primacy the territory, it examines the range between the size of the first and last city of the territory is constantly increasing reflects the fact that large and major cities continue to increase in size at the expense of smaller ones, which are more attractive to development and population than smaller ones.
10. The urban structure shows a clear overlap between rural and urban areas in terms of population size up to the size of the population groups (30,000 populations). This situation rises to 50,000, meaning that there are many urban settlements

that are in fact only large villages, thus weakening their role as urban centers, which, although dominated by the sector, are growing to the surrounding areas and which may be even larger in size. The only difference between these urban settlements and the other large villages is that there is a police station, even though it is dominated by the agriculture sector.

In the light of those findings, the research recommends that:

1. Ensure that the future development process corresponds to the characteristics of the existing form of development in terms of the size, number and rank of the urban settlements, in the Northern Upper Egypt region.
2. Accelerating the development of the new cities, given their great capacity to spread development, as they are a good tool for correcting the urban system imbalance in terms of size, function and location.
3. Raising the administrative rank of large villages such as Dalija village in the Dayr Mawas center, Tandah village in the Mallawi center, Muzurah village in the Samasta center, Telah in the Minya center to the small or secondary towns segment so that they could be provided with services for themselves and their rural surroundings, This makes it eligible to play effective roles in the balance of the urban system.
4. Development of the region's small and intermediate cities ^[1*], such as Al Edwah city, New Minya, New Beni suef, which act as a bridge between rural and urban development by being a center of services and marketing and a center of cultural and technological radiation.
5. Supporting economic and service activity in the cities of Minya and Beni Suef in order to meet the needs of the large urban and rural population of 14,89628,000 ^[2*] in 2016.

^[1*] Many researchers consider secondary cities of different sizes to be effective tools for achieving urban development goals generally aimed at balancing urban system, reducing population concentration in large cities and reducing regional disparities.

^[2*] Using the "Breaking Point Theory" in the following equation: $D / 1 + (PG/PS)$, where PG: population of the greater city, PS: population of the smaller city, D: distance

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