# Analyzing Patterns of Spatial Distribution of Secondary Education Services in Babylon Governorate of Iraq by Using Geographical Information Systems (GIS)

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## Abstract

Secondary Education services are among the necessary services that contribute to the development of personal skills and capabilities of individuals, as they have an effective role in the cultural, social and cultural development of societies. Geographical (GIS), and the study revealed through statistical analysis that the average center, the average center of secondary schools appears in the center of Hilla district, as the study showed through the analysis of the standard distance to the sites of middle schools in the study area that the proportion of (60,69%) of the schools The middle school is spread around its actual center, and (56.25%) of the middle schools are spread around their actual center, and (57.76%) of the secondary schools are spread around their actual center. As for the distribution direction for secondary schools, it took an oval shape from the northwest to in the southeast of the study area, it was also found through the analysis of the nearest neighbor of secondary schools that it adopted the clustered pattern that tends towards randomness.

## 1. Introduction

Educational services are one of the most important services that are required to be provided to all members of society, as they are one of the main pillars in developing the personal skills and abilities of individuals, as well as contributing to the development of the spiritual, moral and intellectual aspects of society, spreading the spirit of education, eliminating manifestations of ignorance and backwardness, and creating a conscious and educated generation capable of On the events of community development, therefore, secondary education services are one of the educational services that will be limited to the research, which is represented by government secondary schools (intermediate, middle , secondary) in the province of Babylon, as we try to know the average center of secondary education schools and the standard distance to the locations of those schools, as well as knowing The direction of its distribution and its spatial spread pattern.

### The First Subject: Concepts of the Study

**First: Educational services**: They are all services that aim to spread education in society and eliminate manifestations of ignorance and backwardness. These services are represented by educational institutions (R. Al-Qaisi, 2009) as they are known as services provided to individuals through governmental and non-governmental educational institutions, as educational institutions are among the pillars of life It is a basic and a strong pillar of the cultureal progress of societies (D. Al-Qaisi, 2018). It is not just a consumption of services, but rather a human development and a preparation for the workforce required by economic and social development plans (Ab-Amir, 2011). It can be said that educational services are an effective tool that contributes to the development and development of general culture and defining the features of society.

**Second: Secondary Education**: Secondary education is considered one of the important academic stages as it contributes to preparing students scientifically, intellectually and practically for the subsequent university study, from which the student learns various pure sciences and humanities, and this stage provides its services to students whose ages range from (12-17) years (Al Hitti, 2003).

Secondary education is defined as a planned, organized and programmed system and is based on scientific bases from which it derives its objectives and its outputs are classified according to the philosophy of the state. 3) years (15-17). This stage is also important and decisive for learners in general education, as it is a link between primary education and university education, in which young people are brought up and prepared for life and productive work in addition to study (Al-Jourani, 2013). Education at this stage is divided into:

**Third: Geographical Information Systems (GIS):** It is a method or method for organizing geographical and non-geographical information by means of a computer and linking it to their locations based on specific coordinates, that is, linking phenomena on the surface of the Earth to a coordinate system. It also aims to collect, analyze, interpret and produce information based on a stored database. In the memory of the computer (Al-Dulaimi, 2010).

**The Second Subject: Analyzing Patterns of Spatial Distribution of Secondary Education Services in The Province of Babylon Using Geographic Information Systems (GIS).**

The main objective of analyzing the patterns of the spatial distribution of secondary education services in the province of Babylon in order to identify the structure of this distribution to reach the sites of imbalance in the distribution, through the use of Geographical Information Systems (GIS) that helps in revealing the nature of the spatial distribution and the efficiency of that distribution In order to identify the degree of spread and concentration of the phenomenon studied, therefore, statistical methods will be relied on to analyze the spatial distribution patterns of secondary education services in the study area. As follows: -

**First: The Average Center (Spatial Average)**

The mean center is one of the most prominent measures of point spatial distributions that enables the researcher to identify the geographical location of the phenomenon (Dawood, 2009). The nature of the distribution of the phenomenon or the comparison between two or more elements in a specific place, and this depends largely on the weight of the spatial distribution (Abdullah, 2012). secondary school in the study area, as follows:

**A- Intermediate Schools:** It is evident through the results of the statistical analysis and determining the coordinate points (x,y) for the locations of the middle schools in the study area by means of the program (10.3Arc map) that the average center point is the average center of these schools appears in the center of the district of Hilla near the Al-Waeli medium for girls And between the rest of the schools is less than the distance that separates the phenomenon (schools) from the rest of the other sites, and this indicates that the distribution of middle schools is affected by the population density in the center of Hilla district due to the spread of government institutions and commercial and industrial activities, as well as the availability of various services, including educational, all of which helped to Attracting large numbers of residents from neighboring areas, as shown in map (1).

**B- Middle Schools**

It is evident through the results of the statistical analysis and determining the coordinate points (x,y) for the locations of the middle schools in the study area by means of the program (10.3Arc map) that the average center point, the average center of these schools, appears in the center of the Hilla district near the Shatt Al Arab high school for girls and among the rest of the schools is less From the distance that separates the phenomenon (schools) from the rest of the other sites, and this indicates that the distribution of middle schools is affected by the population density in the center of Hilla district due to the spread of government

institutions and commercial and industrial activities, as well as the availability of various services, including educational, all of which helped to attract large numbers of Population from neighboring areas, as shown in map (2)
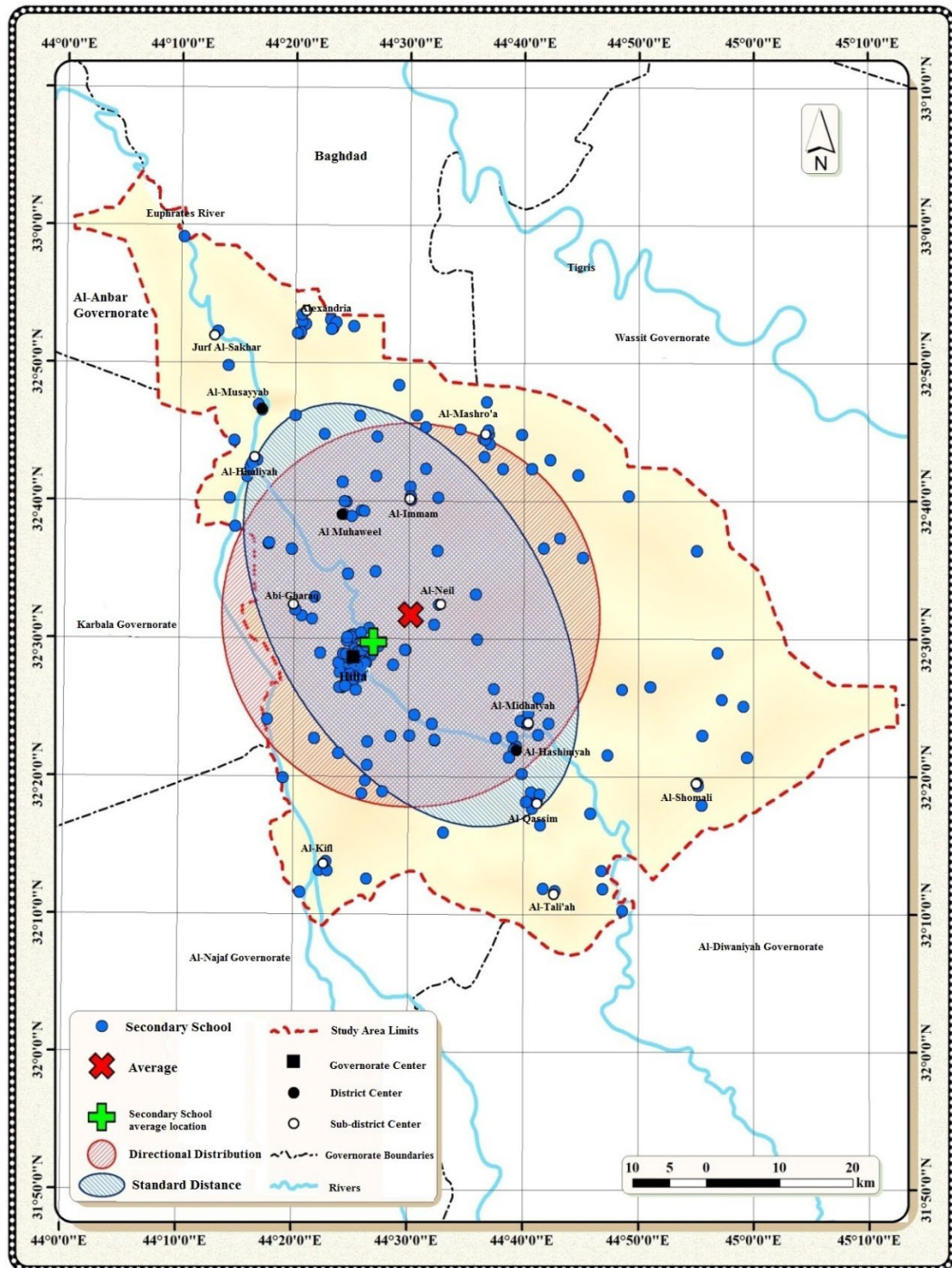


Map 1. Average Position, Standard Distance and Distribution Direction of Middle Schools in The Study Area 2021

Source: Researchers based on schools' websites and the statistical equation

### C- Secondary Schools

It is clear from the results of the statistical analysis and determining the coordinate points (x,y) for the locations of secondary schools in the study area using the program (10.3Arc map) that the average center point, the average center of these schools, appears in the center of the Hilla district near Babel High School for boys and among the rest of the schools is less than The distance that separates the phenomenon (schools) from the rest of the other sites, and this indicates that the distribution of secondary schools is affected by the population density in the center of the district of Hilla due to the spread of government institutions and commercial and industrial activities, as well as the availability of various services, including educational, all of which helped to attract large numbers of residents From the neighboring areas, as shown in map (3)
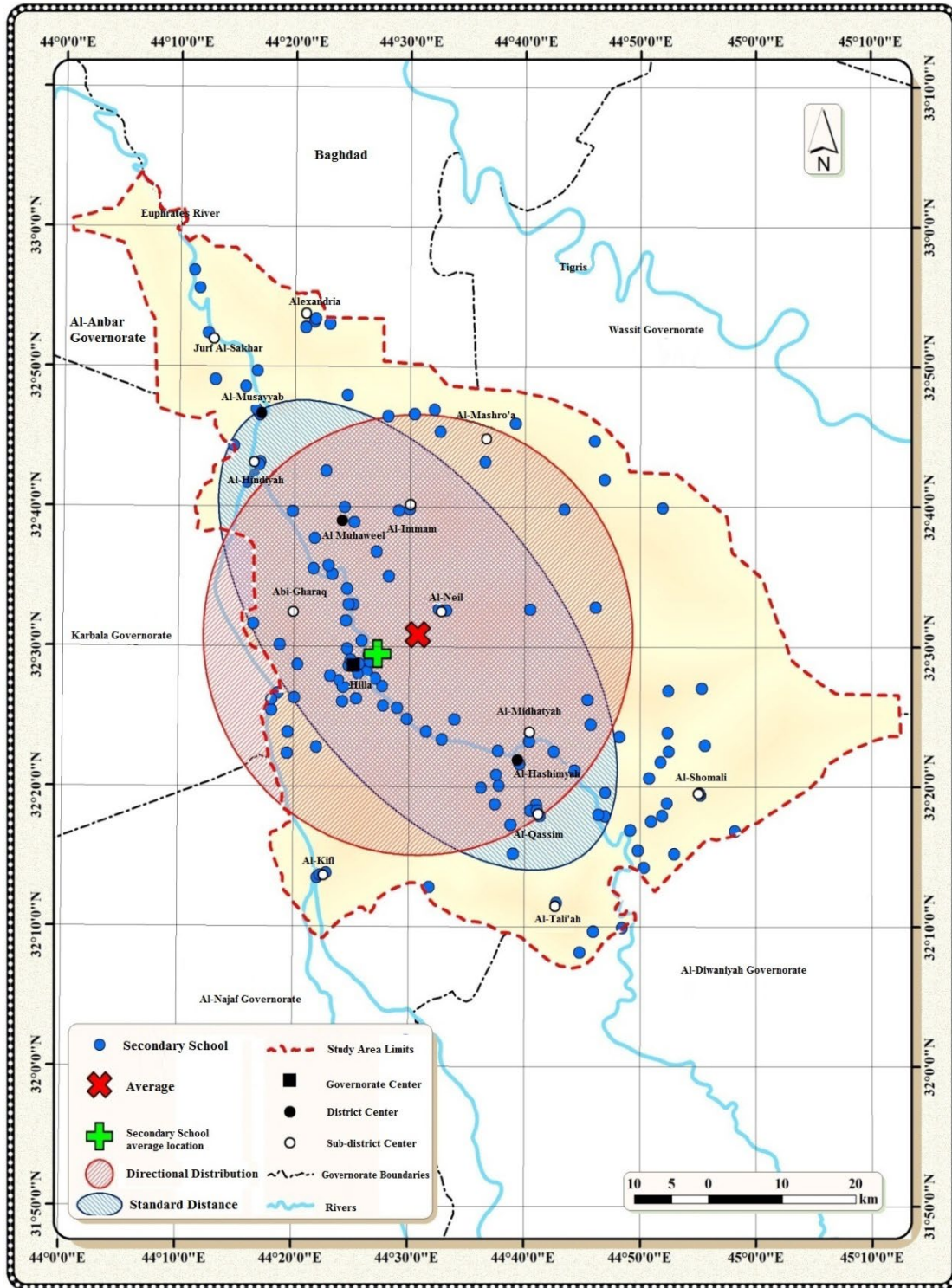
### Second: Standard Distance

The standard distance is one of the most important statistical methods adopted in the process of spatial analysis of geographical phenomena, because it is used to measure the degree of dispersion of the studied points around their spatial mean, and it is similar to the standard deviation (Khair: 282). Its location is the average center of the distribution of the phenomenon, where one third of the location is inside the circumference of the circle and one third is outside its circumference (Al-Omar, 2004). The larger the circle, the more this leads to the dispersal and spread of the phenomenon, while the smaller its size indicates the concentration of the phenomenon and its proximity to the median center (ALomer, 1989) and many geographers have used it to know the pattern of the spread of geographical phenomena on the map of spatial distributions by describing the spread of points around the spatial average (Saleem, 2012) The dispersion of phenomena (secondary education schools) in the study area will be measured, as follows:

**A- Intermediate Schools:** We note from Map (1) the results of the standard distance analysis of middle schools in the study area, that the number of middle schools within the circle's perimeter has reached 122, while the number of schools outside the circle's perimeter has reached (79) schools, and this indicates The percentage of (60.69%) of the middle schools is spread around their actual center, while the percentage of (39.3%) of the middle schools lies outside the standard distance range.

**B- Middle  Schools:** We note from Map (2) the results of the standard distance analysis of middle  schools in the study area, that the number of middle schools within the circumference of the circle has reached (45) schools, while the number of schools located outside the circumference of the circle is (35) schools, and this indicates The percentage of (56.25%) of the middle schools are spread around their actual center, while (43.75%) of the middle schools are outside the standard distance range.
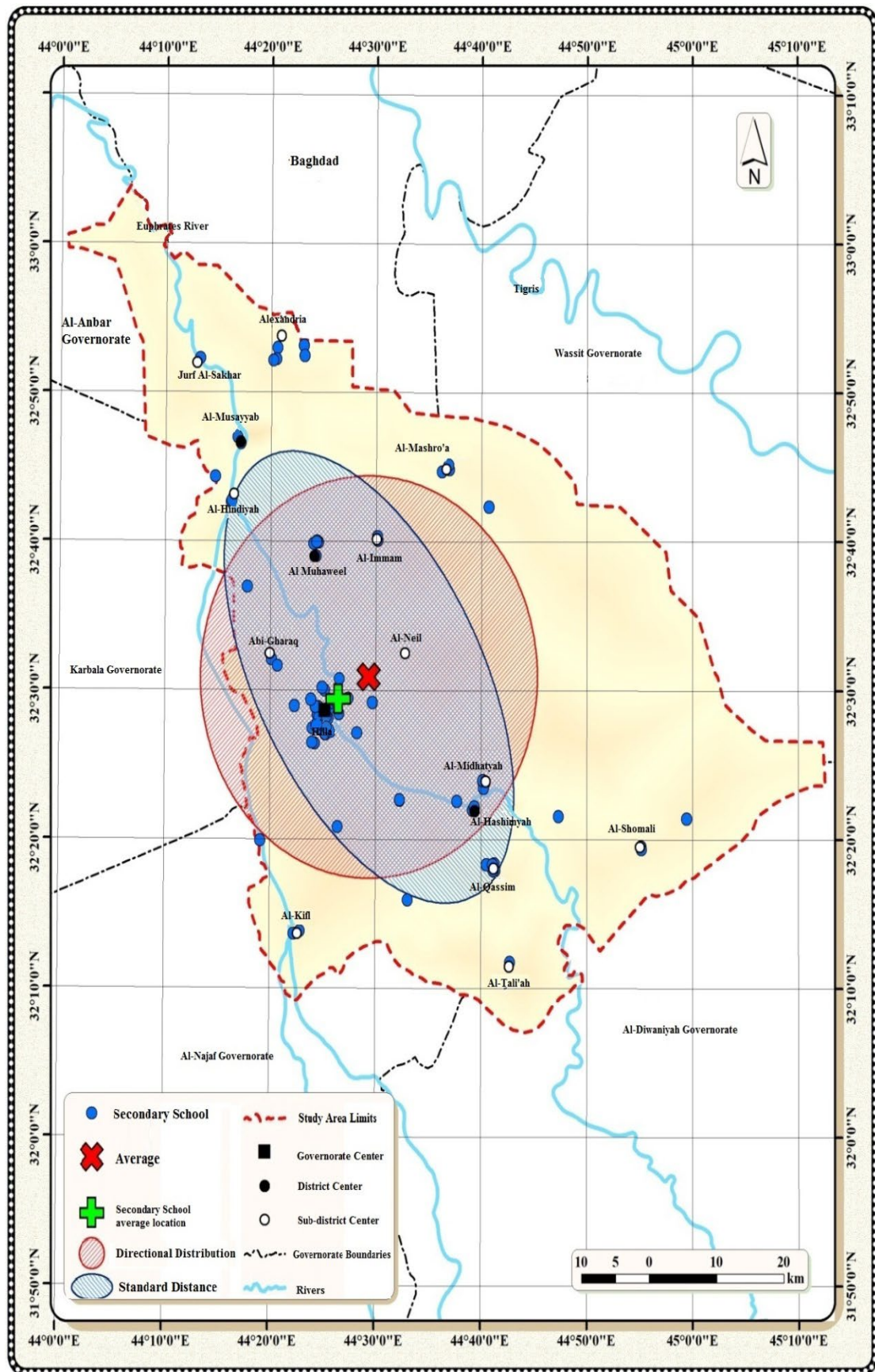
Map 2. Average position, standard distance and distribution direction of middle
schools in the study area 2021
Source: Researchers based on schools' websites and the statistical equation

Map 3. Average position, standard distance and distribution direction of secondary schools in the study area 2021
Source: Researchers based on schools' websites and the statistical equation

**C- Secondary Schools**: We note from map (3) the results of the standard distance analysis of secondary schools in the study area, that the number of secondary schools within the circumference of the circle has reached (93) schools, while the number of schools located outside the circumference of the circle is (68) schools, and this indicates The percentage of (57.76%) of secondary schools is

spread around their actual center, while (42.24%) of secondary schools lie outside the standard distance range.

### Third: The Direction of Distribution

It is one of the most prominent statistical techniques that are used to determine the direction and extension of the distribution of geographical phenomena by determining the angle of deviation by the mean center and in two separate directions on the (x) axis and the second on the (y) axis. It results in the oval shape that encircles the features of the phenomenon and allows to show the features (Hamad, 2013) as it is one of the important methods used in the geography of services as it contributes to knowing the direction of the spatial distribution of the phenomenon in the study area and benefiting from it in the future planning of the phenomenon (Abbas, 2011) and we will address the direction of the spatial distribution of schools of education secondary school in the study area, as follows:

**A- Intermediate Schools:** The distribution direction of middle schools in the study area takes an oval shape extending from the northwest to the southeast, and as shown in Map (1). Which links the administrative units in the northwest of the study area and the southeast, which helped the spread of middle schools with this type of distribution to serve the population.

**B- Middle Schools:** The direction of the distribution of the middle schools in the study area takes an oval shape extending from the northwest to the southeast, and as shown in map (2). Which links the administrative units in the northwest and southeast of the study area, which helped the spread of middle schools with this type of distribution to serve the population.

**C- Secondary Schools:** The direction of the distribution of secondary schools in the study area takes an oval shape extending from northwest to southeast, and as shown in map (3). Which links the administrative units in the northwest and southeast of the study area, which helped the spread of secondary schools with this type of distribution to serve the population.

**Fourth: The nearest neighbor**: GIS possesses a set of spatial statistics methods that many researchers use to reveal the spatial distribution of phenomena and their pattern. Phenomena, therefore, occupies great importance in the geographical analysis of the place and determining the spatial distribution of points (Saleh & Al-Seryani, 2021) because they are used to measure the scattering of points around each other and to determine the general pattern of the spread of points because the distribution can be (random, regular, aggregated), which helps to develop future plans (Shehadeh, 2002) The spatial distribution patterns of secondary education schools in the study area will be analyzed according to this technique, as follows:

**A- Intermediate Schools**: From the application of the nearest neighbor to the locations of middle schools in the study area, the following results appear:

1- The Z-score value for middle schools is (-8.66) and falls outside the critical value range (-2.58) (+2.58) and therefore it falls within the rejection region. Therefore, we reject the initial hypothesis (the null hypothesis) which says that the expected pattern of distribution is a random pattern resulting from chance and luck, and we accept the alternative hypothesis which says that the distribution pattern of middle schools is organized according to a special pattern due to certain factors.

2- The level of confidence (Signifcance Level) indicates that there is no possibility (zero%) of an error in rejecting the initial hypothesis and accepting the alternative hypothesis, that is, there is a possibility of (100%) that the distribution pattern of middle schools is caused by certain factors.

3 - The value of the analysis of the nearest neighbor in middle schools has reached (0.68), so it takes the cumulative pattern that tends towards randomness. As shown in Figure (1) and Table (1).

This is due to the lack of planning by the concerned authorities in distributing these middle schools and achieving justice in providing services to students with the least effort and cost, in addition to the lack of school buildings and the occupancy of one building by more than one school, which led to a decrease in the efficiency of middle schools.

Table 1. Results of the application of the nearest neighbor to secondary schools in the study area 2021

| Educational level | Analysis value | (Z Score) Value | (p Value) | Accepted Assumption |
|---|---|---|---|---|
| Intermediate | 0.68 | 8.66- | 0.00 | Alternative |
| Middle | 0.44 | 9.55- | 0.00 | Alternative |
| Secondary | 0.65 | 8.05- | 0.00 | Alternative |

Source: The application of the nearest neighbor technique to the data of secondary schools within the program (10.3 Arc GIS)

### B- Middle Schools

The application of the nearest neighbor to the middle school sites in the study area shows the following results:

1- The Z-score value for middle schools is (-9.55) outside the critical value range (-2.58) (+2.58) and therefore it falls within the rejection region. Therefore, we reject the initial hypothesis (the null hypothesis), and accept the alternative hypothesis that the distribution pattern of middle schools is organized according to a special pattern due to certain factors.

2- The level of confidence (Significance Level) indicates that there is no possibility (zero%) of an error in rejecting the initial hypothesis and accepting the alternative hypothesis, that is, there is a possibility of (100%) that the distribution pattern of middle schools is caused by certain factors.

### Average Nearest Neighbor Summary

Nearest Neighbor Ratio: 0.682855
z-score: -8.665713
p-value: 0.000000

Significance Level (p-value) / Critical Value (z-score)

| Significance Level (p-value) | Critical Value (z-score) |
|---|---|
| 0.01 | < -2.58 |
| 0.05 | -2.58 – -1.96 |
| 0.10 | -1.96 – -1.65 |
| --- | -1.65 – 1.65 |
| 0.10 | 1.65 – 1.96 |
| 0.05 | 1.96 – 2.58 |
| 0.01 | > 2.58 |

(Random)

Significant    Significant

Clustered    Random    Dispersed

Given the z-score of -8.66571324348, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

### Average Nearest Neighbor Summary

| | |
|---|---|
| **Observed Mean Distance:** | 1727.9698 Meters |
| **Expected Mean Distance:** | 2530.5089 Meters |
| **Nearest Neighbor Ratio:** | 0.682855 |
| **z-score:** | -8.665713 |
| **p-value:** | 0.000000 |

### Dataset Information

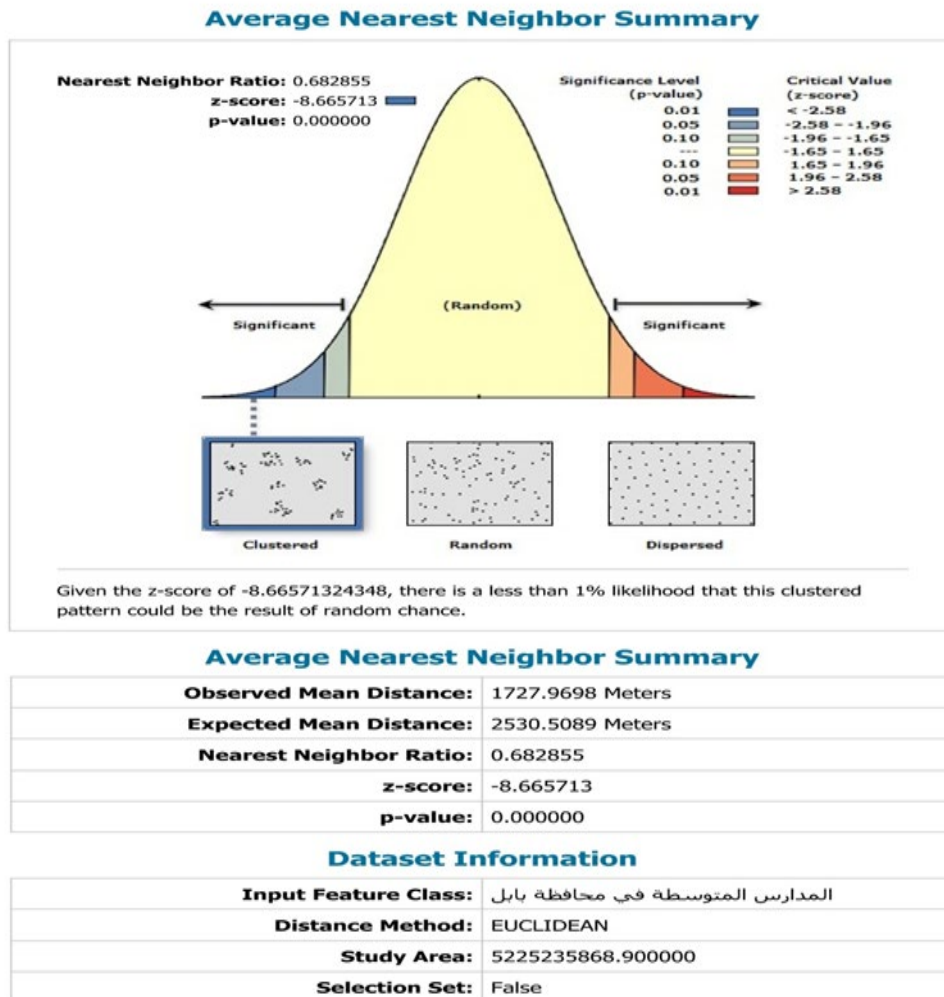| | |
|---|---|
| **Input Feature Class:** | المدارس المتوسطة في محافظة بابل |
| **Distance Method:** | EUCLIDEAN |
| **Study Area:** | 5225235868.900000 |
| **Selection Set:** | False |

Figure 1. The nearest neighbor analysis of middle schools in the study area 2021
Source: Researchers based on the results of the statistical equation in the GIS program

3 - The value of the analysis of the nearest neighbor in middle schools has reached (0.44), so it takes the cumulative pattern that tends towards randomness. As shown in Figure (2) and Table (1).

This is due to the lack of planning by the concerned authorities in distributing these middle schools and achieving justice in providing services to students with the least effort and cost, in addition to the lack of school buildings and the occupancy of one building by more than one school, which led to a decrease in the efficiency of middle schools.

### C- Secondary Schools

The application of the nearest neighbor to the middle school sites in the study area shows the following results:

1- The Z-score value for middle schools is (-8.05), which falls outside the critical value range (-2.58) (+2.58), and thus it falls within the rejection region. Therefore, we reject the initial hypothesis (the null hypothesis) which says that the

expected pattern of distribution is a random pattern resulting from chance and luck, and we accept the alternative hypothesis which says that the distribution pattern of middle schools is organized according to a special pattern due to certain factors.
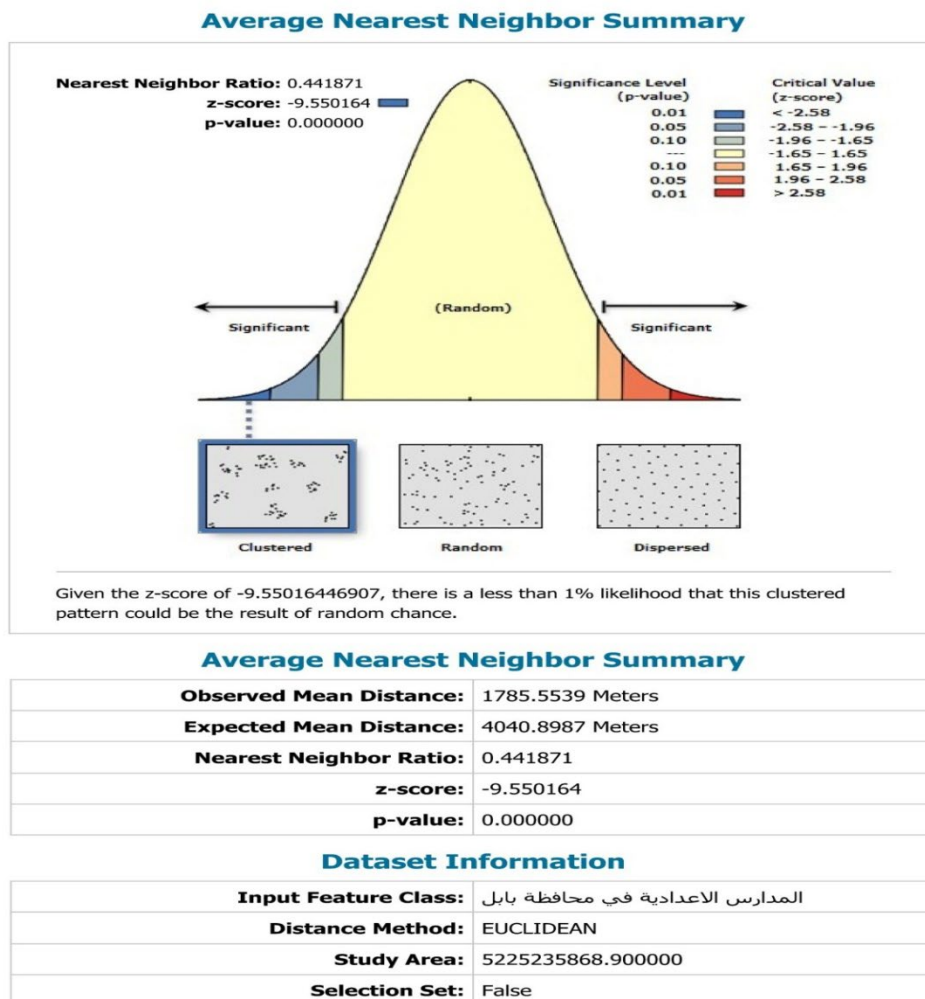


Figure 2. The nearest neighbor analysis of middle schools in the study area 2021
Source: Researchers based on the results of the statistical equation in the GIS program.

2- The level of confidence (Signifcance Level) indicates that there is no possibility (zero%) of an error in rejecting the initial hypothesis and accepting the alternative hypothesis, that is, there is a possibility of (100%) that the distribution pattern of middle schools is caused by certain factors.

3- The value of the analysis of the nearest neighbor's value for middle schools has reached (0.65), so it takes the cumulative pattern that tends towards randomness. As shown in Figure (3) and Table (1).

This is due to the lack of planning by the concerned authorities in distributing these secondary schools and achieving justice in providing services to students with the least effort and cost, in addition to the lack of school buildings and the occupancy of one building by more than one school, which led to a decrease in the efficiency of secondary schools.

**Average Nearest Neighbor Summary**

| | |
|---|---|
| **Observed Mean Distance:** | 1936.7369 Meters |
| **Expected Mean Distance:** | 2951.0551 Meters |
| **Nearest Neighbor Ratio:** | 0.656286 |
| **z-score:** | -8.053291 |
| **p-value:** | 0.000000 |

**Dataset Information**

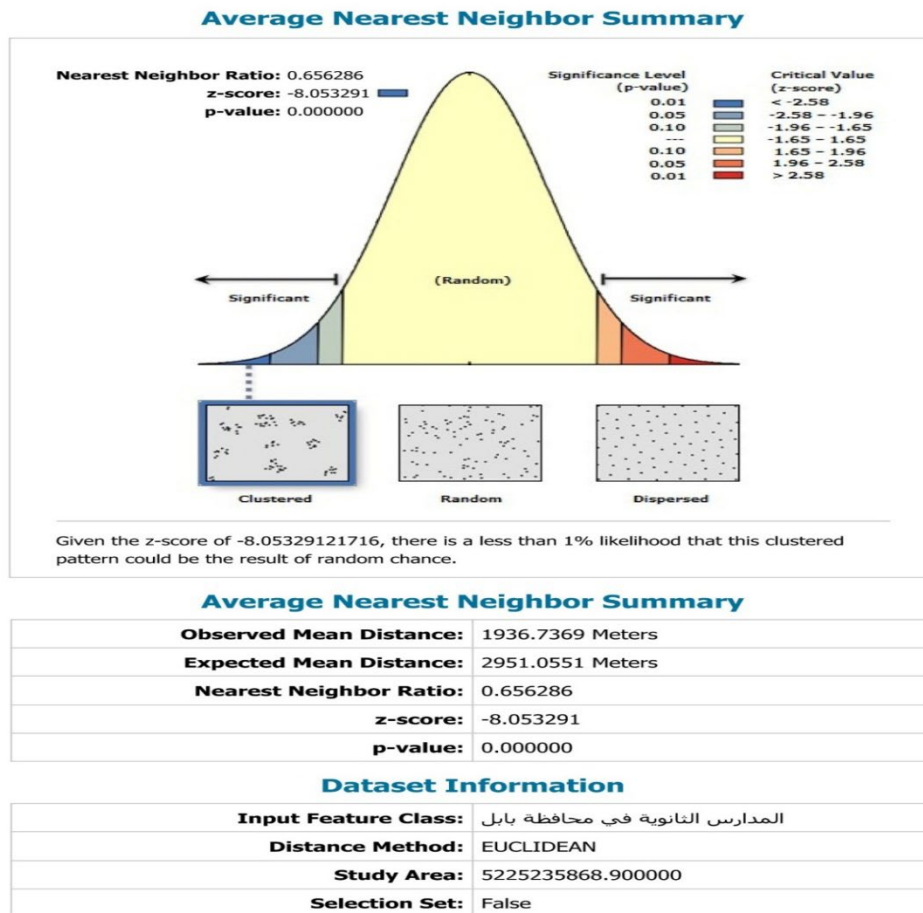| | |
|---|---|
| **Input Feature Class:** | المدارس الثانوية في محافظة بابل |
| **Distance Method:** | EUCLIDEAN |
| **Study Area:** | 5225235868.900000 |
| **Selection Set:** | False |

Figure 3. The nearest neighbor analysis of middle schools in the study area 2021
Source: For researchers based on the results of the statistical equation in the GIS program.

### 2. Conclusion

1- The study showed through statistical analysis that the average center (spatial average) for middle, middle and high schools in the study area appeared in the center of Hilla district.

2- The study showed, by analyzing the standard distance of middle school sites in the study area, that (60.69%) of middle schools are spread around their actual center, and (56.25%) of middle schools are spread around their actual center, and (57, 76%) of secondary schools are spread around their actual center.

3- The study revealed that the distribution trend of secondary schools (middle, middle, and high schools) in the study area has taken an oval shape extending from the northwest to the southeast.

4- The study showed through the analysis of the nearest neighbor of the schools (intermediate, middle, and secondary schools) that they have adopted the cumulative pattern that tends towards randomness.

### 3. Suggestions

1- Activating the technology of geographic information systems (GIS) in the planning and organizational government institutions, as it helps to find appropriate solutions to many planning problems in light of the spatial expansion and the increase in population size in the study area.

2- Relying on proper planning in distributing secondary education institutions according to spatial standards in order to achieve more efficiency for the largest number of the population and to ensure easy access to schools in a timely manner, taking into account safety and security standards.

3- Taking into account the balance in the distribution of secondary education schools in line with the number of students and within the urban and rural environments.

3- Relying on modern technologies in determining the ideal sites for establishing exemplary educational institutions in line with the development taking place in developed countries and providing them with the necessary equipment, laboratories, cooling and heating services, and modern means of illustration to achieve the greatest degree of efficiency for students.

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