

## Spatial Analysis Of Indicators Of Sustainable Environmental Development In The City Of Shatrah Using GIS

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### Abstract

*Spatial analysis (spatial analysis) in GIS is one of the most prominent characteristics that distinguish it. Because of their effective role in analyzing and treating spatial distributions as they were applied in studying sustainable environmental development indicators (poverty, energy and education) in the city of Shatrah, and the problem of the study included, is it possible to achieve balance and balance. The rational signature of the indicators of sustainable environmental development in the city of Shatrah using GIS software due to its speed and local accuracy in the representation and processing of spatial data? While the hypothesis of the study was that geographic information systems can deal with, organize and re-represent the spatial signature of indicators of sustainable environmental development in the city of Shatrah in light of the proposed treatments for its significant role and the speed of data processing.*

### Introduction

GIS software solutions (Geographical Information System) and making the best decisions, especially with regard to processing and analyzing spatial information to assess indicators of sustainable environmental development in the city of Shatrah and employing GIS to sign indicators at the level of study areas and digital access the maps that represent an important database to review this distribution.

### The Theoretical Framework

#### Research problem

Is it possible to create a balanced and rational signature of the indicators of sustainable environmental development in the city of Shatrah using GIS software for the speed and accuracy of the site in the representation and processing of spatial data?

#### Research Hypothesis

Geographical information systems can process, organize and re-represent the spatial signature of indicators of sustainable environmental development in the city of Shatrah in light of the proposed treatments because of their important role and rapid data processing.

#### Research objective

1. Determining the spatial reality of indicators of sustainable environmental development in the city.
2. Working on applying planning standards to identify indicators through the use of the capabilities of geographic information systems.

#### Research importance

1. A statement of the importance of geographic information systems in studying and analyzing the spatial footprint of the indicators of poverty, energy and education, which is represented in the coordinates of the locations of those indicators.
2. Determining the possibilities of sustainable environmental development in the study area for the poverty, energy and education index.

**Research Methodology:** The researcher relied on the inductive approach, starting from the part to the whole in collecting data through processing it using geographic information systems and preparing objective maps for indicators of sustainable environmental development (poverty, energy and education).

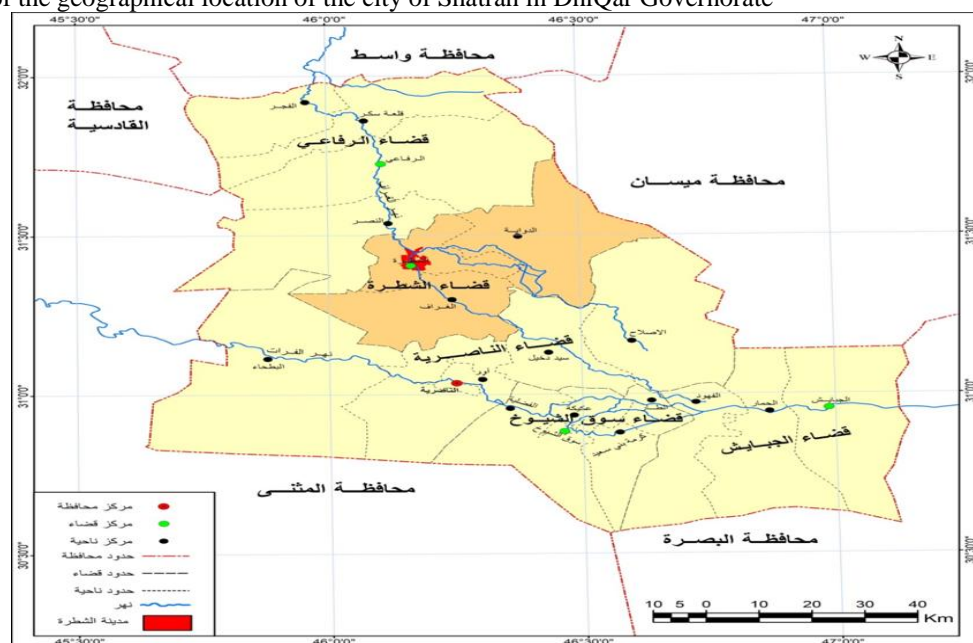
**Research Structure:** The reseArch consists of an introduction and two sections. The first topic consists of a theoretical and conceptual framework. The second topic deals with spatial analysis of indicators of sustainable environmental development in Shatrah using GIS. The reseArch also included a set of conclusions and a list of sources.

**The limits of the reseArch:** The spatial boundaries are represented in the city of Shatra, which is the center of the Shatra district of DhiQar governorate, which is limited between latitudes 31.28-31.24) in the north, and between longitudes (46.12-46.8) in the east, on the highway linking the cities of Kut and Nasiriyah, so it is It is located at a distance of 150 km from the city of Kut and (50) km from the city of Nasiriyah. It is bordered on the north by Al-Nasr district and from the south by Al-Gharraf and Nasiriyah city, while Al-Dawaya district is located on its eastern borders, as shown by Map (1).

The area of the city is 396 km<sup>2</sup> and constitutes (3%) of the total area of the governorate of (13830 km<sup>2</sup>), and it is made up of (50) residential neighborhoods, distributed on both sides of Shatt al-Shatrah, on the right side (31) residential neighborhoods with an area of (15) km<sup>2</sup>, while on the left side (19) neighborhoods covering an area of (12) km<sup>2</sup> map (2).

As for the time limits of the study, it included the year 2020.

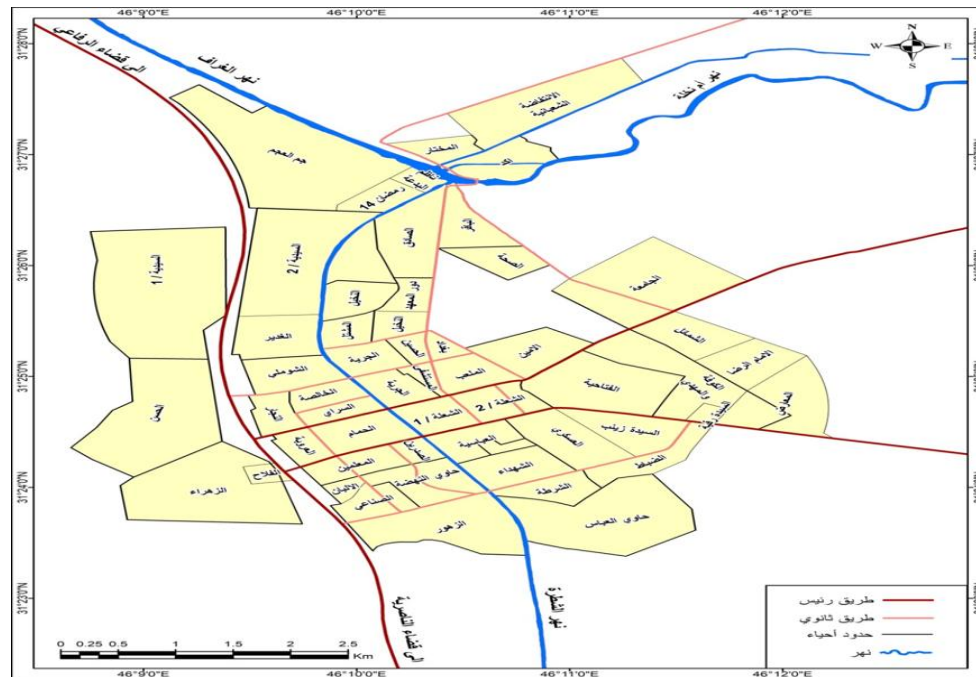
Map (1) of the geographical location of the city of Shatrah in DhiQar Governorate



Source: reseArcher using ArcGIS.10.8 according to:

Republic of Iraq, Ministry of Water Resources, General Authority for Survey, Department of Map Production, Administrative Map in DhiQar, Scale 1: 500000, Baghdad, 2018

Map (2) residential neighborhoods in the city of Shatrah



Source: The researcher used ArcGIS.10.8 program, based on: American Moon Quick Bird 2 visible Study area, 0.60 cm resolution, 2010.

### Concepts and Terminology

1. Spatial analysis: is how to understand our world and the possibility of identifying things and how they relate to the actions that must be taken to reach the desired place and achieve the desired goals and requirements (1)
2. Geographical information systems portal is an application pattern of computer technologies with its basic parts represented in computer components and software, which allows inventory, storage and processing of various information and data and its output in multiple forms such as maps, forms and tables and texts. (2)
3. Development: It means improving and developing economic, social, health and environmental patterns of life, with the aim of obtaining the various human needs in a more qualitatively efficient manner while seeking to improve and upgrade them, or it is a comprehensive continuous process. Or development and it takes various forms aimed at improving the human condition to the prosperity, stability and development part, in line with his economic, social and intellectual needs (3)
4. Sustainable environmental development: It is the development that meets the needs of the present without compromising the ability of future generations to satisfy their needs, or it is a set of policies and procedures that are taken to move society to a better situation using appropriate means. Technology for the environment to achieve a balance between the construction of natural resources and their human demolition, and it has been a local and global policy to maintain this balance. (4)

**The second topic:** Spatial analysis of indicators of sustainable environmental development in the city of Shatra using geographic information systems

Spatial statistical analysis tools Spatial statistics tools in geographic information systems (GIS) The best way in spatial analysis of geographical phenomena, and linking them with laws to reveal relationships and interrelationships in order to build a spatial model of geographical phenomena, using spatial statistical means for their ability to deal with patterns of spatial distribution of spatial phenomena Including indicators of sustainable environmental development, these analyzes include the following-:

1-Actual distribution of sustainable development indicators: The method of actual distribution of sustainable development indicators in the study area is used to show the nature of their spatial distribution and perform spatial statistical analyzes on them. The quantitative significance was chosen for the researchers, the subject of the technical meaning, the truth of the quantitative point depends on the number of points on the map, the greater importance or the increase of the points less and vice versa as shown in equation (5)

(The magnitude of phenomena) / (the meaning or value of a point) = the number of points

When choosing the importance of a point for their number, it is taken into account that the numbers do not become too many, so the number of points increases and combines with each other and becomes a black mass or becomes devoid of points. From the observation of Table (1) and Map No. (1) that the quantitative significance of the poverty index reached the highest value of (21) points in Al-Hamam neighborhood and the lowest in the hospital area and Hawi Al-Abbas with (9). The energy index reached the highest value in Al-Hammam

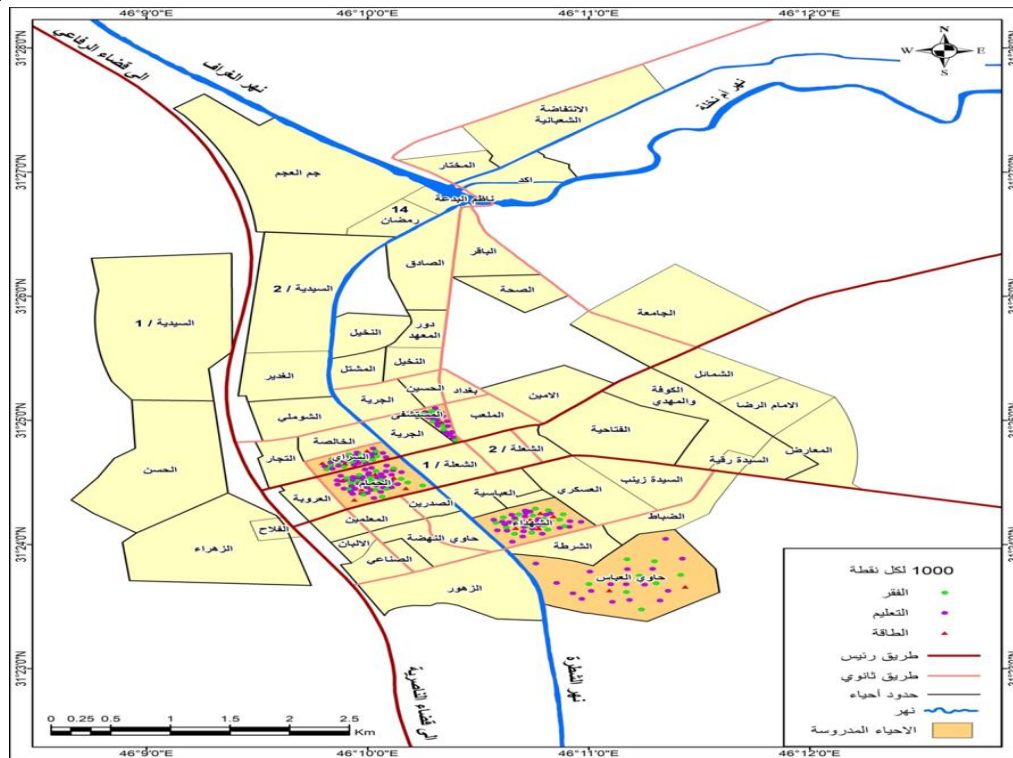
neighborhood (6) and the lowest in the hospital area and Hawi Al-Abbas with (2) points, and the education index reached the highest value in Al-Hammam area (41). And below are Hayy Hospital (18) and Hawi Al-Abbas (17) points.

Table No. (1) Indicators of sustainable development and its quantitative indicator in the city of Shatra

Quantitative significance	Education	Quantitative significance	Energy	Quantitative significance	Poverty	Neighborhoods
41	41396	6	5510	21	20947	The bathroom
34	34023	5	4529	17	17215	Martyrs
25	25364	3	3376	13	12834	The serail
18	17,970	2	2392	9	9092	The hospital
17	17048	2	2269	9	8626	Hawi al abbas
135	135801	18	18076	69	68714	Total

Source: the reseArcher based on the field study.

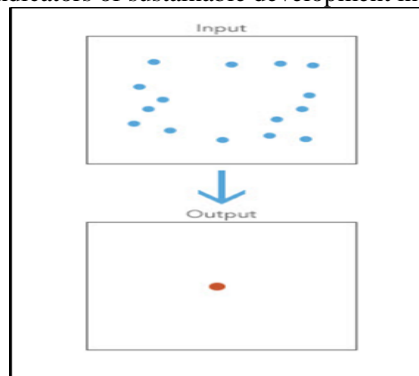
Map (1) the actual distribution of indicators of sustainable environmental development in the city of shatrah



Source: The reseArcher used the ArcGIS 10.8 program based on the field study

2- Spatial median center: It is the actual center or location that mediates the geographical locations (coordinates) and is used in determining the average of (x) and (y) coordinates (for all phenomena in the study area) (6) It is an ideal virtual center for spatial features, which represents the center of the phenomenon, which creates a balance between the distribution of development indicators under study as shown in Figure (1)

Figure (1) the spatial center of the indicators of sustainable development in the city of Shatra

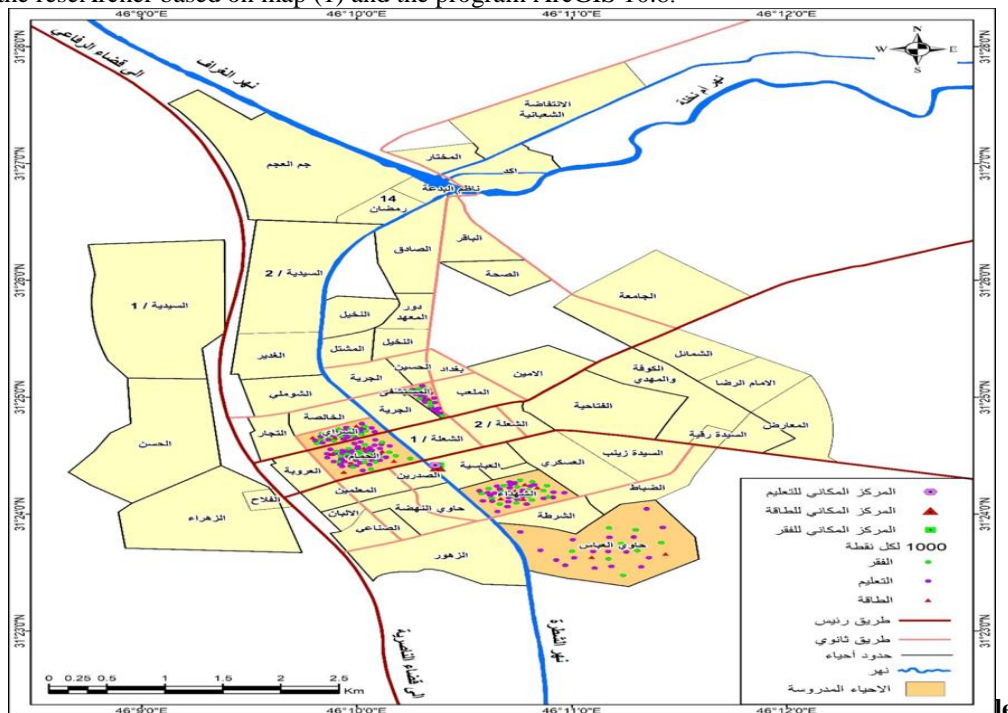


Source: the reseArcher, based on the program ArcGIS 10.8.

It is clear from map (2) that the spatial center of all indicators of sustainable development in the study area is located between the abbasid neighborhood from the east and sadrin from the west, being the location in the middle of the study neighborhoods with coordinates (611508.03) and (3475301.5) for the poverty index, and with coordinates (611503.17) and (3475266.16) for the energy indicator, (611482.45) and (3475302.00) for the education indicator, as shown in table (2) and figure (2)

Map (2) the spatial center of the indicators of sustainable development in the city of shatrah

Source: the reseArcher based on map (1) and the program ArcGIS 10.8.

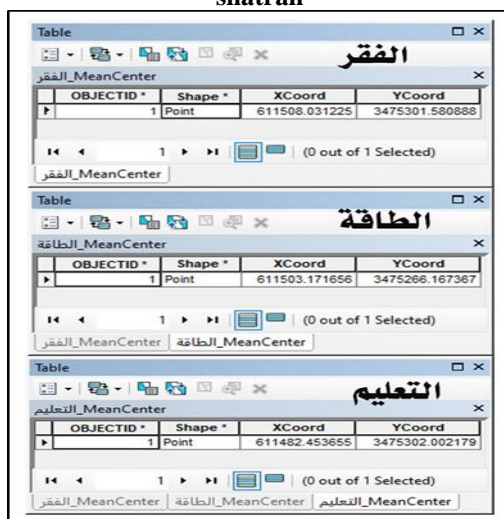


**Table (2) The coordinates of the central phenomenon of indicators of sustainable development in the city of Shatrah**

Y	X	Development index
3475301.5	611508.03	Poverty
3475266.16	611503.17	Energy
3475302.00	611482.45	Education

Source: the reseArcher based on map (1) and figure (2) and the program ArcGIS 10.8.

**Figure (2) the coordinates of the spatial center of the indicators of sustainable development in the city of shatrah**

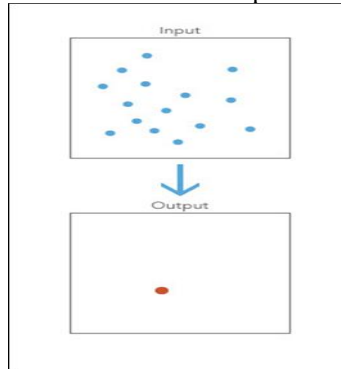


The reseArcher based on the map (2) and the program ArcGIS 10.8.

**3. Central feature:** It is the location of the focus of the vocabulary of the phenomenon under study. The phenomenon that mediates the distribution of phenomena, as illustrated by Figure (3), shows that the

distribution and intensity of geographical phenomena are in the southwestern part, so their spatial center is concentrated in the southwestern part.

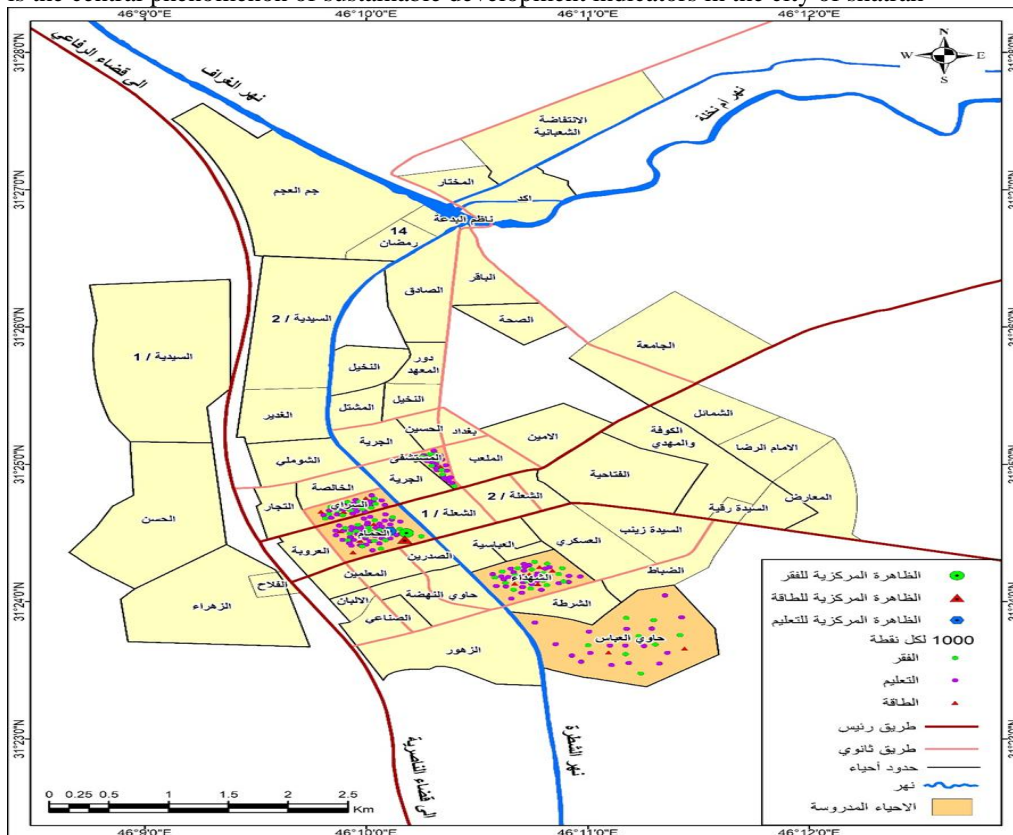
Figure (3) shows the central phenomenon of sustainable development indicators



Source: the reseArcher, based on the program ArcGIS10.8.

It is clear from map (3) that the central phenomenon of the poverty index is concentrated within the coordinates (611508.03) and (3475301.5) in al-hamam neighborhood for its geographical location, which is in the middle of the city, in addition to being the most densely populated neighborhood in the study .As for the energy index, it focused to the south of the spatial center, poverty, with coordinates (611503.17) and (3475266.16), while the education index deviated to the west of the spatial centers with coordinates (611482.45) and (3475302.00) .(We conclude from this that the spatial centers of development indicators are all located within the hamam neighborhood, meaning that it is the site that mediates the distribution of sustainable indicators in the city of shatrah.

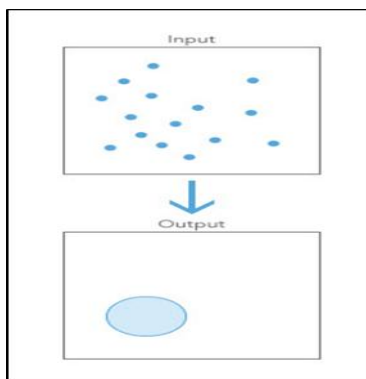
Map (3) is the central phenomenon of sustainable development indicators in the city of shatrah



Source: the reseArcher based on map (1) and the ArcGIS 10.8 program.

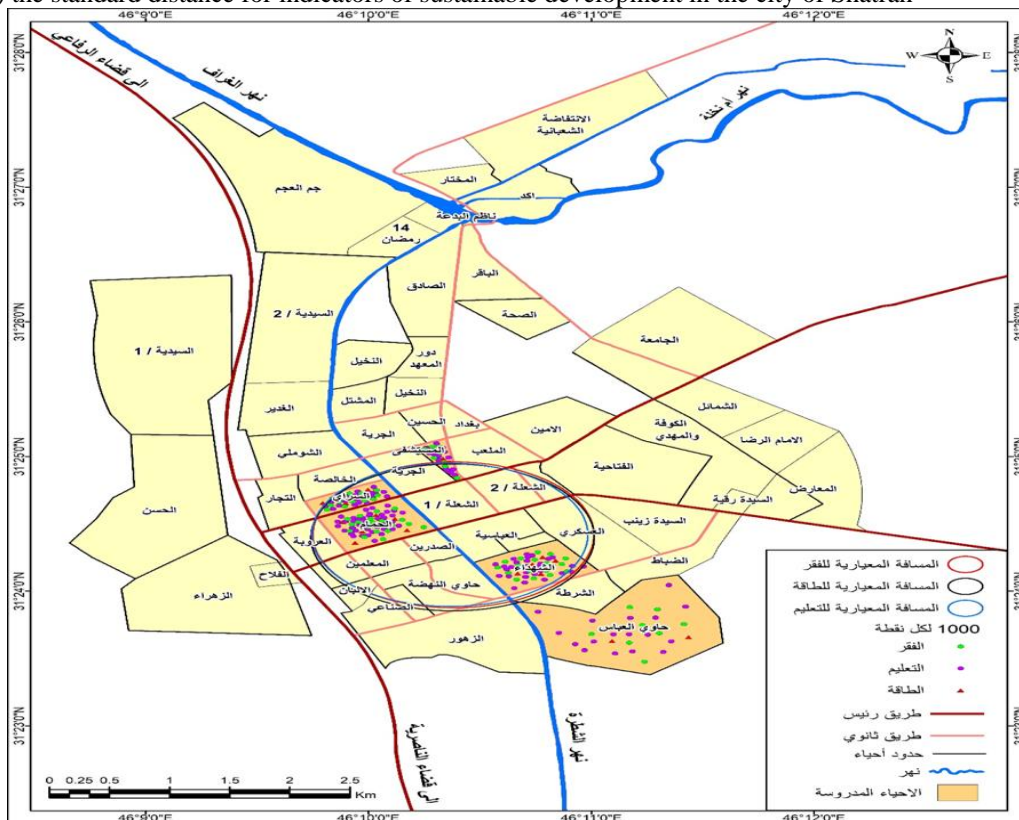
4- Standard distance: it is an indicator for analyzing non-spatial data, and it is an indicator for measuring the extent of spatial dispersion or concentration of the vocabulary of the phenomenon (7) This is done by drawing a standard circle (a standard circle) through which it is possible to know the extent of the concentration or spread of sustainable development indicators and their spatial spread within the study neighborhoods, and the location of this circle is the coordinates of the average. In the center, the larger the diameter of the circle, the greater the value of the standard distance and the larger the circle. It is clear from Figure (4).

Figure 4 The standard distance for indicators of sustainable development in Shatra city



Source: the reseArcher, based on the program ArcGIS10.8.

Map (4) the standard distance for indicators of sustainable development in the city of Shatrah



Source: the reseArcher based on map (1) and the program ArcGIS10.8.

It is clear from Table (3) and Figure (5) that the education indicator is characterized by concentration, as the average diameter of the standard distance to it was (981.7), while the energy indicator reached (1007.4), and this puts it in the criterion of dispersion and irregularity, while poverty was within the level of concentration also in the average of Qatar Standard distance amounted to (999.68).

Table (3) the average standard distance for indicators of sustainable development in the city of Shatrah

Standard average distance	Development index
999.68	Poverty
1007.4	Energy
981.7	Education

The reseArcher based on map (4) and figure (5) and the ArcGIS 10.8 program.

Figure (5) the average standard distance for indicators of sustainable development in the city of Shatrah

OBJECTID	Shape	CenterX	CenterY	StdDist	Shape_Length	Shape_Area
1	Polygon	611508.031225	3475301.580888	999.683615	6281.117643	3139445.633343

OBJECTID	Shape	CenterX	CenterY	StdDist	Shape_Length	Shape_Area
1	Polygon	611503.171656	3475266.167367	1007.403448	6329.622229	3188120.243056

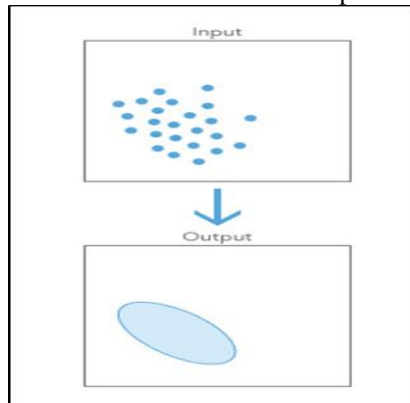
  

OBJECTID	Shape	CenterX	CenterY	StdDist	Shape_Length	Shape_Area
1	Polygon	611482.453655	3475302.002179	981.735584	6168.348314	3027728.23013

Source: reseArcher based on ArcGIS 10.8.

5-Standard deviation: It expresses the standard deviation or the so-called standard cutoff of the scattering of the direction of the spatial distribution of the phenomenon (8). The oval shape expresses the characteristics of the distribution, and this shape applies to the spatial center point, and the axis and direction of this shape represent the highest value of the phenomenon distribution that takes most of the vocabulary of phenomena as shown in Figure (6)

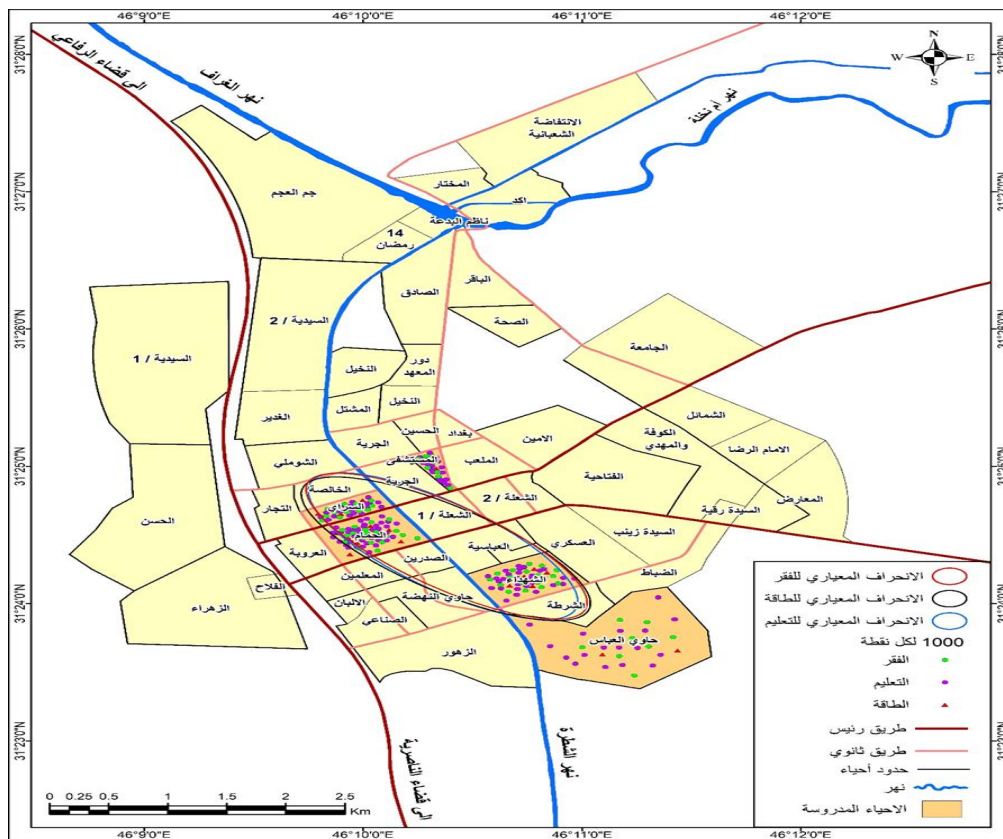
Figure (6)(Standard deviation of the indicators of sustainable development in Shatra city)



Source: the reseArcher, based on the program ArcGIS10.8.

we conclude from map (5), table (4) and figure (7) that the direction of the distribution of sustainable development indicators (poverty, energy and education) in the city of shatrah is north-west , south-east, and this corresponds to the location of the neighborhoods of al-saray, al-hammam, al-shuhada and hawi al-abbas, as for the hospital neighborhood it is located north of the neighborhoods .as for the standard deviation of the poverty index, it was at a deviation angle of (133.04) degrees in a north-west direction and included (48) points for the martyrs' neighborhoods (17) to include all its indicators and the bathroom (19) out of (21) points and the saray (12) out of (13) and this means that (31) points out of (48) points for the total development indicators included in the poverty deviation curve. As for the energy indicator, it included (13) points, including (3) in al-saray neighborhood and (5) in al-hamam from (6) and (5) out of (6) ) in the al-shuhada neighborhood, and as for the education indicator, it was the most prevalent of the points included in the education distribution curve with a number of (93) points, most of which are located in the al-hammam and al-saray neighborhoods. ) out of (41) points, as for the shuhada neighborhood, at (33) out of (34), meaning that (60) points in the northwestern part.It is clear from this that the direction of the distribution of the studied indicators applies with the direction of the locations of their spatial center and with the direction of the distribution of the population and their density within the neighborhoods. Compared with the neighborhoods of al-saray, al-hammam and al-shuhada, the distribution of the study neighborhoods is concentrated, and this is also true for the hospital neighborhood. Map (5) the standard deviation of the indicators of sustainable development in the city of shatrah





Source: the reseArcher based on map (1) and the program ArcGIS10.8.

Table (4) the coordinates of the spatial center and the angle standard deviation of the indicators of sustainable development in the city of shatrah

Standard deviation angle	Spatial center		Development index
	Y	X	
133.04	3475301.5	611508.03	Poverty
131.37	3475266.16	611503.17	Energy
134.82	3475302.00	611482.45	Education

Source: the reseArcher based on map (5) and figure (7) and the program ArcGIS10.8.

Figure (7) the spatial center and standard deviation angle of the indicators of sustainable development in the study area

Source: the reseArcher, based on the program ArcGIS10.8.

**6- Nearest Neighbor Analysis:** This analysis is used to study patterns of spatial distributions (pattern), especially the distribution of development indicators within cities. It is considered one of the most accurate measures that determine the pattern of service distribution, which is likely to be random due to chance or non-random, governed by a plan, controls and factors that were the reason for its distribution in the way it is, as well as being concentrated in one spot, close or divergent in a consistent or regular manner (Table 5) and Figure (8).

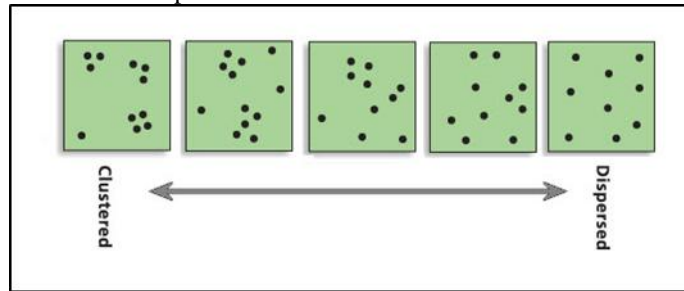
Table (5) nearest neighbor coefficient patterns and subtypes

The value of the nearest neighbor coefficient	Sub style	The value of the nearest neighbor coefficient	Patterns
Zero	Fully assembled	Less than 1.0	Convergent / convergent
0.5 – 0	Close but irregular		
1.0 – 0.5	Convergent oriented towards randomness		
1.0			Random
2.0 – 1.0	Spaced apart	Greater than 1.0	Divergent / regular

2.0	Regular (square)		
Greater than 2.0	Regular (hexagonal)		

Source: reseArcher, based on JumaDaoud, previous source, pg. 52.

Figure (8) nearest neighbor coefficient patterns



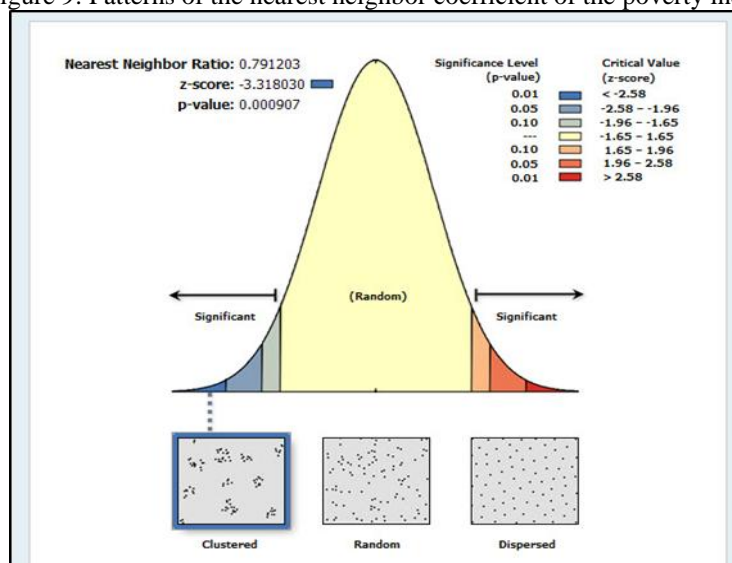
Source: the reseArcher, based on the program ArcGIS10.8.

Neighborhood analysis by indicators is the critical value (the critical value) (denoted by the symbol  $z$ ) and the significance level index (the level of significance is indicated by the symbol  $p$ ) the index (the ratio of the nearest neighbor) which expresses the neighborhood relationship.

From the analysis of numbers (9), (10) and (11) it becomes clear to us that:

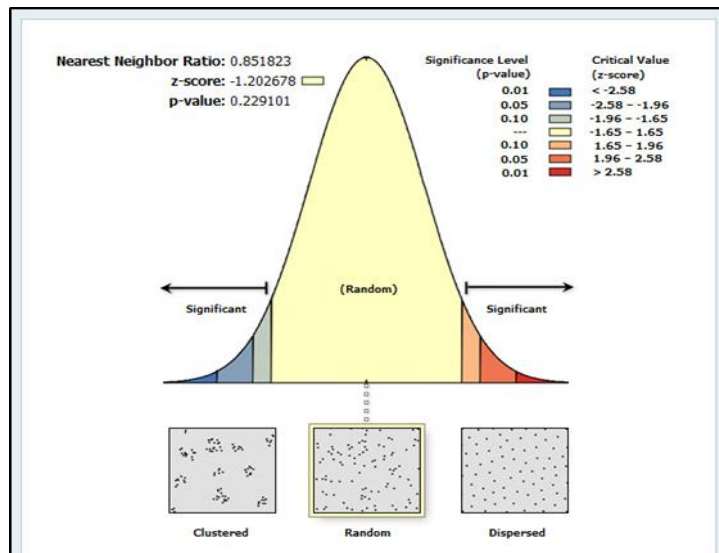
1. The nearest neighbor coefficient of the poverty index: It is evident from Figure (9) that the neighborhood correlation coefficient of the poverty index is (0.7), and this puts it within the convergent clustered distribution pattern that tends towards randomness, and this means that there is a large percentage of the population who are below the poverty line level in the study neighborhoods. The critical value of the poverty index was (-3.3) and its level of importance was (0.0). The reason for this is due to the small area of the neighborhoods compared to the rest of the neighborhoods in Shatrah city, and the distribution in it is linked to the dense clustered housing pattern.
2. The nearest neighbor coefficient of the energy index: the coefficient of the nearest neighbor of the energy index in Shatrah city tends to randomness with a coefficient (0.8) Figure (10) The coefficient of the neighborhood link index of the poverty index and this applies to the reality of the distribution of energy sources in Shatrah city if it is characterized by being distributed randomly and not A deliberate plan that is not commensurate with the needs of the population and their geographical distribution, which leads to the deprivation of other unserved neighborhoods

Figure 9: Patterns of the nearest neighbor coefficient of the poverty index



Source: the reseArcher, based on ArcGIS 10.8.

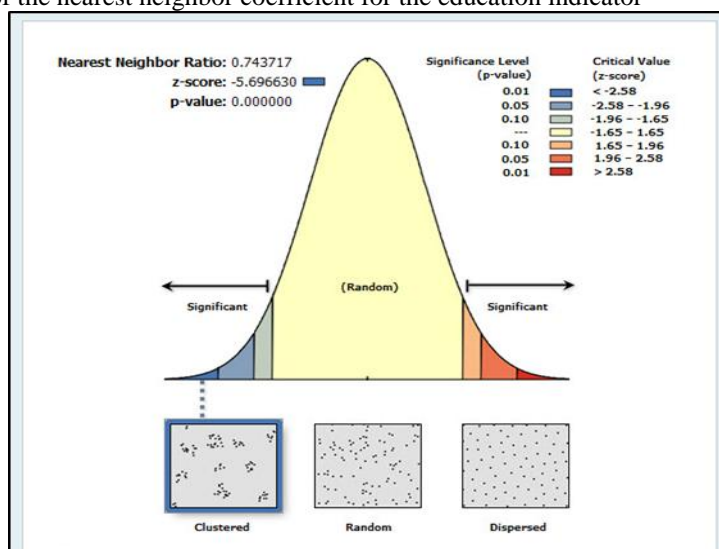
Figure (10) PNFC patterns for the power index



Source: the reseArcher based on the program ArcGIS10.8.

3. The nearest neighbor coefficient of the education indicator: The coefficient of the nearest neighbor indicator of the education indicator distribution pattern corresponds to the poverty distribution pattern and approaches the percentage of the indicator, as it reached (0.7) Figure (11), which places it within the convergent agglomerated distribution pattern heading towards randomness, and the reason for its random distribution is due to poor planning And management by those concerned with education in the process of school distribution.

Figure (11) Patterns of the nearest neighbor coefficient for the education indicator



Source: the rese Archer, based on the program ArcGIS 10.8

## Conclusions

1. The study proved that GIS software is not only a tool or technique for mapping, but rather a spatial analysis of geographical phenomena on the surface of the earth.
2. The direction of the distribution of sustainable development indicators (poverty, energy, and education) in the city of Shatrah is north-west, south-east, and this corresponds to the location of the neighborhoods of Al-Saray, Al-Hamam, Al-Shuhada and Hawi Al-Abbas. As for the hospital neighborhood, it is located in the north of the neighborhoods.
3. It is clear that the direction of the distribution of the studied indicators applies with the direction of the locations of their spatial center and with the direction of the distribution of the population and their density within the neighborhoods. Compared with the neighborhoods of Al-Saray, Al-Hammam and Al-Shuhada, the distribution of the study neighborhoods is concentrated, and this is also true for the hospital neighborhood.

## References

- Rasha Saber Nofal, Spatial Analysis in Geographic Information Systems, Faculty of Arts - Menoufia, 2020.
- Khalaf Hussein Ali Al-Dulaimi, Foundations and Applications of Geographic Information Systems GIS I 1, Dar Safaa for Publishing and Distribution, Amman, 2010.
- MajidMalak Al-Samarrai, Geography and the Prospects of Sustainable Development, first edition, 2015.
- Medhat Abu al-Nasr and YassinMedhat Muhammad, Sustainable Development, first edition, The Arab Group for Training and Publishing, Cairo, 2017.
- Hassan Sayed Hassan, Cartographic Representation Methods Used in Maps of Natural and Human Distributions, First Edition, Anglo-Egyptian Library, 2011.
- Hamza Abbas Hamad, The Efficiency of Spatial Distribution of Primary Schools in the Rumaithiya Region for the Year 2014-2015 Using Geographic Information Systems (GIS), Uruk Magazine, Volume 9, Issue 3, 2016.
- Juma'a Muhammad Dawood, Foundations of Spatial Analysis in the Framework of Geographical Information Systems, Kingdom of Saudi Arabia, First Edition, 2012.
- Mohamed Ibrahim Sharaf, The reference in geographic information systems, University Knowledge House for Printing, Publishing and Distribution, Alexandria, 2017.
- Rasha Saber Nofal, Spatial Analysis in Geographic Information Systems, Faculty of Arts - Menoufia, 2020, p. 4.
- Khalaf Hussein Ali Al-Dulaimi, Foundations and Applications of Geographical Information Systems, Part 1, Dar Safaa for Publishing and Distribution, Amman, 2010, p. 33.
- The glorious Samurai Kings: Geography and the Prospects of Sustainable Development, 1st Edition, 2015 p. 8
- Medhat Abu al-Nasr and YassinMedhat Muhammad, Sustainable Development, first edition, The Arab Training and Publishing Group, Cairo, 2017, pp. 66 and 81.
- Hassan Sayed Hassan, Methods of Representing Cars and Graphics Used in Maps of Natural and Human Distributions, First Edition, Anglo-Egyptian Library, 2011, p. 216.
- Hamza Abbas Hamad, The Efficiency of Spatial Distribution of Primary Schools in the Rumaithiya Region for the Year 2014-2015 Using Geographic Information Systems (GIS), Uruk Magazine, Volume 9, Issue 3, 2016, p. 254.
- Juma'a Muhammad Dawood, Foundations of Spatial Analysis in the Framework of Geographic Information Systems, Saudi Arabia, First Edition, 2012, p. 44.
- Friday from David, a previous source, pg. 46
- Muhammad Ibrahim Sharaf, The reference in geographic information systems, University Knowledge House for Printing, Publishing and Distribution, Alexandria, 2017, p. 223.

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