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The Modern Techniques in Spatial Analysis to Isolate, Quarantine the Affected Areas and Prevent the Spread of COVID-19 Epidemic

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Abstract

COVID-19 is a disease caused by a coronavirus spread globally, including in Iraq; infections have appeared on all Iraq lands in varying proportions. Iraq is among the higher infected world countries. Forty-six infections were simulated on 23 March 2020. Injuries on the eastern side of Baghdad city and to the right side of the Tigris River, which divides the city into two parts, are a natural barrier in quarantine and easily control the movement of people from both sides.

In this study, a model was considered a scientific and practical method by following the steps of identifying infected people using the best scientific approach for the spatial process to prevent the virus from spreading. Remote sensing techniques were used as simulations of actual reality by depending on databases from the Iraqi government (Crisis Cell Dept.), tabulating data, and projecting them on virtual maps. Theories and statistical methods were applied in geospatial data analysis by managing these tools and capabilities of geographic information systems.

The locations of the infected people were identified to control the spread of the Coronavirus. Two primary groups were identified and analyzed according to real spatial analysis techniques to facilitate control of the region in case of increasing numbers of infected people and control of the region's residents; later, the epidemic broke out.

The first group included the regions (New Baghdad, Al-Ghadeer, Al-Zafaraniya, Al-Amin, Al-Amin, and Karrada), and the second group included the regions (the Tariq neighborhood, Sadr City, Al-Kabir, and Al-Ghozlan). Baghdad city was isolated into two parts by a natural barrier: the Tigris River, Baghdad Rusafa in Baghdad, and Al-Karkh. There is another natural barrier if the epidemic is spread more than the normal state: a water channel (Al-Jayesh Channel) and an international highway (Muhammad Al Qasim).

These natural measures and barriers are an ideal model for controlling epidemic spreading, optimizing health capabilities and protection teams, and limiting population movement to prevent the spread of the Coronavirus Covid-19.

Keywords: Epidemic spread and quarantine, geographic information systems, remote sensing techniques, spatial analysis, and spatial data.

التقنيات الحديثة في التحليل المكاني للعزل، الحجر الصحي في المناطق المتأثرة ومنع انتشار جائحة COVID-19

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الخلاصه

جائحة كورونا (COVID-19) هو مرض يسببه فيروس تاجي. انتشر COVID-19 في جميع أنحاء العالم بما في ذلك جمهورية العراق، ظهرت الاصابات على كامل الاراضي العراقية وبنسب متفاوتة، وتعتبر هي من ضمن الاعلى اصابات من بين دول العالم، تركزت دراستنا في مدينة بغداد لظهور اعلى نسبة من الاصابات بهذا الفيروس، تم محاكاة 46 من العدوى في 23 مارس 2020، وانحصرت معظم الاصابات في الجانب الشرقي من مدينة بغداد، وعلى يمين نهر دجلة الذي يقسم المدينة الى جزئيين لتكون حاجز طبيعي في عملية الحجر والسيطرة بسهولة على تنقل الأشخاص من الجانبين .

قدمنا في هذه الدراسة نموذج يعتبر منهاج علمي وعملي باتباع خطوات تحديد المصابين بفيروس كورونا وافضل نهج علمي لعملية الحجر المكاني لمنع انتشار هذا الفيروس.

تم استخدام نظم المعلومات الجغرافية في ادارة وتحليل بيانات تقنيات التحسس النائي كمحاكاة للواقع الحقيقي بالاعتماد على بيانات الصادرة من خلية الازمة وتبويبها واسقاطها على الخرائط الافتراضية، وتم تطبيق واستخدام نظريات والطرق الاحصائية في التحليل المكاني الجغرافي للبيانات، ذلك بإدارة هذه التقنيات بتطبيق أدوات وامكانيات نظم المعلومات الجغرافية.

وللسيطرة على منع انتشار الفيروس تم تحديد مواقع المصابين، فتبين ان توزيع الفايروس على شكل عنقودي (تجمعات)، تم تحديد مجموعتين اساسية والعمل على تحليلها وفق تقنيات التحليل المكاني الحقيقي، لتسهل السيطرة على المنطقة في حالة تزايد اعداد المصابين واعلان حجر سكان المنطقة فيما بعد اذا تفشى الوباء.

كانت المجموعة الاولى تضم مناطق (بغداد الجديدة، الغدير، والزعفرانية، الامين، ضباط الامين والكرادة)، اما المجموعة الثانية فتضم مناطق (حي طارق، مدينة الصدر والكبر والغزلان)، وتم عزل مدينة بغداد الى قسمين بواسطة حاجز طبيعي هو نهر دجلة وهي بغداد الرصافة وبغداد الكرخ، وتوجد عوازل طبيعية اخرى اذا تم انتشار الوباء اكثر من الحالة الطبيعية وهي قناة مائية (قناة الجيش) وطريق سريع دولي (محمد القاسم).

هذه الاجراءات والحواجز الطبيعية تمثل نموذج مثالي للسيطرة على انتشار الوباء وتوزيع الامكانيات الصحية وفرق الحماية بشكل امثل والحد من حركة السكان لمنع انتشار الفيروس.

Introduction

COVID-19 is a new strain of coronavirus that has appeared in infected people and has not been recorded in humans. The Chinese authorities knew the strain of the World Health Organization (WHO) as an outbreak of pneumonia in Wuhan on December 31, 2019, which was registered and categorized as a new disease. The term COVID 19 is derived from CO, and it is an abbreviation of the word (Corona), the VI abbreviation of the word (Virus), and D abbreviation of the word (Disease), while the number 19 refers to the year 2019, the year that the virus first appeared [1].

The strain that began to spread in Wuhan, the capital city of China's Hubei Province, is associated with two other coronaviruses that have caused the outbreak in recent years, Sever Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS). On January 30, 2020, the World Health Organization (WHO) declared an outbreak of COVID-19 International Anxiety Emergencies Public Health Emergency of International Concern (PHEIC), creating a widespread and rapid disease outbreak. Although there is no vaccine against COVID-19 or a specific, registered, licensed, and anti-viral drug, most treatment is towards symptomatic management and support for patients. Moreover, working to control virus spreading using all possibilities, including screening returnees people from infected areas and inducing self-isolation to prevent the spreading of the virus.

Controlling the broad areas of COVID-19 disease spreading requires outstanding efforts and participation of all relevant institutions with voluntary organizations and linking this effort with a unified leadership or Crisis Cell Dept. with full powers. Capabilities must be harnessed with modern technological techniques such as remote sensing and global positioning stations (GPS) or Differential Global Positioning Systems (DGPS) to monitor people's movement and locate injuries on-site by providing illustrative maps with procedures. Simulation of actual reality and managing programs and geographic information systems (GIS), which have the full ability to store, manage, and manipulate data, are examples of these procedures. Programs and systems are tabulating, analyzing, and devising data to serve and control the spreading COVID-19 epidemic and identify foci that contain the most injuries. Moreover, the best limit for limiting the residents' injuries is quarantine to prevent spreading of deadly diseases.

Most procedures are necessary to help Crisis Cell Dept. make the right decisions and distribute emergency groups according to these technologies' data to allow quick access and treatment of critical cases. In addition, to make decisions on the geographical boundaries of insulation and quarantine according to the country's Geodata (spatial data). The research aims to follow modern techniques in spatial analysis to prevent the spreading of COVID-19 and use the best way to isolate and quarantine the affected areas.

1- Study Area

Baghdad city was chosen as a study region due to the most significant number of infected people by a coronavirus, and a population density of 7.457772 million can increase the number.

Baghdad city is located between the latitudes of (33°73 and 32°80 N) and longitudes of (43°82 and 44°95 E). the top left corner of the landscape is at 33°73’15’’ N, left at 32°81’15’’E, right at 43°83’10’’W, and at 44°94’10’’E; below the right corner of the landscape, with the area of 521.7 km^2.

Iraq is located between the latitude 29^o and 38^o N and the longitude 39^o and 49^o E (the top-bottom landscape geo-coordinates are 37^{o}22’17’’ N, 38^{o}48’33’’E, and right at 29^{o}06’10’’N, 48^{o}36’15’’E). with the area of 4383,18 km^2, it is the 58th largest country in the world [2], as shown in Figure 1.

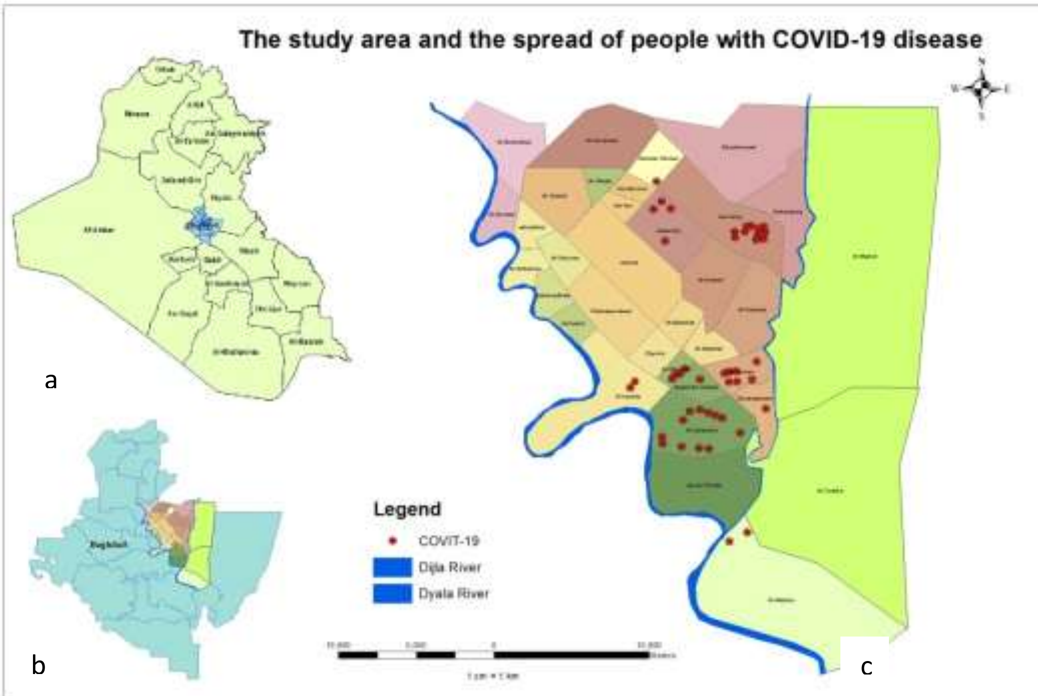


Figure 1- Illustrates, (a) The administrative borders of the provinces of Iraq, (b) The Baghdad city represent the capital and the highest population density province, and (c) The study area, the main side of Baghdad city and represents the highest population density.

1.1 Study Area Descriptions

Baghdad's administrative map consists of ten districts and thirty-four subdistricts; Baghdad, Salahuddin, and Diyala cities are to the north, Kut is to the east, Anbar is to the west, and the ancient city (Babylon) is to the south. The population density is concentrated on the eastern side of Baghdad, with about five million people, most of which are popular and ancient areas with coherent social conditions. The research focuses on the Rusafa side of Baghdad, located between 44o23’52.664 ”E 33o25’20.659N and 44o52’15.179” E 33o22’28.72 ”N, where Iraq follows the UTM_Zone_38N projector and the WGS_1984 Datum stereotype between two points at the top left of the landscape (434401.552 3704091.354 m), (465646.141 3666307.199 m) [3], as shown Figure 2.

1.2 The climate of Iraq and the study area

Iraq generally has a hot and dry climate for nine months and three months as a cold winter, including December and January, with temperatures near zero or below and sometimes reaching 4-8 C below zero as a maximum. Iraq is affected by the climate of arid semi-tropical

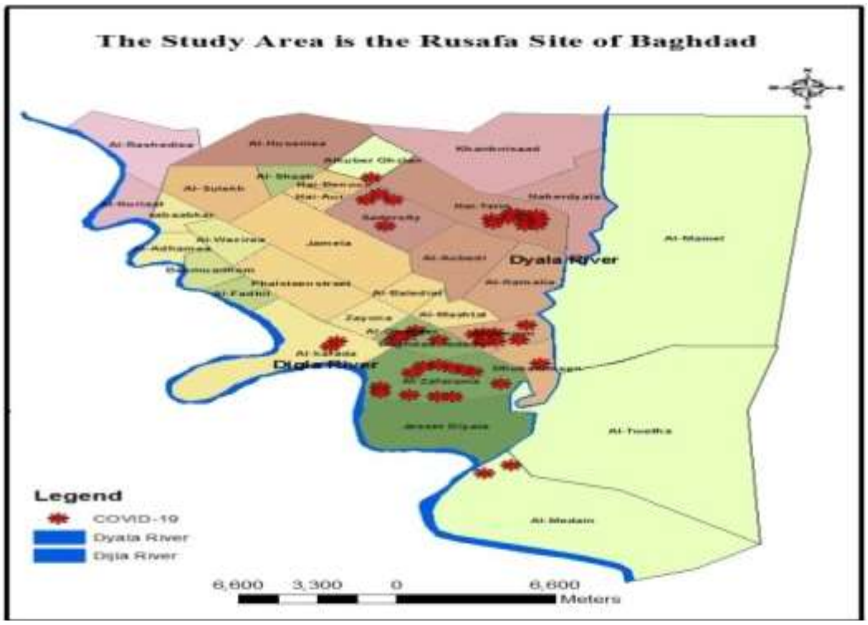


Figure 2-Al-Rusafa, the eastern part of the densely populated city of Baghdad, in which most of the cases of people with up to 43 cases were infected with the Covid-19 until March 23, 2020.

regions such as the Arabian Desert or the Arabian Peninsula, the Indian continent, and southeast tropical Iran, and the subtropical humidity in the Arabian Sea and the Persian Gulf connected to the Pacific Ocean and the Anatolia region and the Mediterranean Sea from the north and northwest of Iraq. The hottest months are June and July; temperatures reach 40 to 50 C. Wind and Atmospheric pressure are changed a lot according to global climate change. Iraq witnessed unprecedented rain and dust storms between March and September [4].

The environment of Iraq is not suitable for the growth of microbes and viruses, including coronavirus, which has a short lifespan in temperatures of 27 C° and above, as shown in Figure 3.

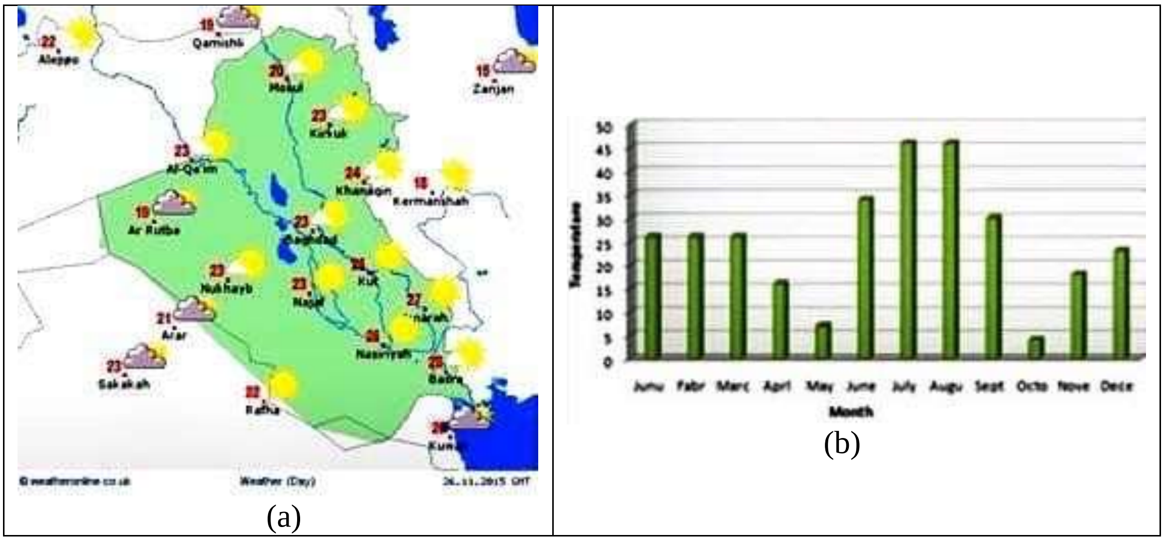


Figure 3. (a) illustrates Sun-shine of Iraq map, (2) Temperature level over 25 years, Obviously, there are eight months with average temperature above 20 C, Iraq is sunny annually and its temperature is above normal [4].

Methodology

Remote sensing (RS) techniques, satellite image data, and global positioning system (GPS) data were used to locate cases of Covid-19 in Baghdad city (Russafa Site) to manage the epidemic spreading and address it using geographic technologies information systems (GIS) applications. Using spatial geodata analysis provides a model to simulate the ground that the epidemic has spread. Applications provide the ability to control the epidemic by determining location, spreading, and the ideal limits for encircling spread and isolation. The GIS applications display results electronically through screen screens or paper maps of all sizes quickly and report to the Crisis Cell Dept (CCD) in a way that protects people from affected areas.

2. Coronavirus (COVID-19) disease

Coronaviruses are a family of viruses common worldwide in animals and humans; certain types cause diseases. For example, some coronaviruses cause common cold symptoms, while others cause many more severe diseases such as (MERS) a severe acute respiratory syndrome (SARS), both of which often lead to pneumonia [1].

Since there is currently no vaccine for COVID-19, most treatment is symptomatic management with advice and instructions at home, work, public squares, contact with others, and patient support with primary symptoms or complications. The majority of people with COVID-19 recovered without any specific treatment, as is the case with colds or seasonal influenza, expecting that in case of an outbreak and a declaration as a pandemic, the majority of cases will be managed at home as is the case with colds and flu because there is no possibility to accommodate large numbers.

Since it is a new and unknown virus, information about it is unavailable, and the world is surprised by the infection speed in a person’s immunodeficiency; the absence of an effective vaccine yet means that COVID-19 has the potential to spread. If people get by COVID-19, symptoms will develop and complications severe enough to require hospital care, such as pneumonia. Furthermore, when some people lack immunity or have other health problems, the disease may lead to death.

WHO data so far has shown that the risk of severe disease and death is more significant among older adults and people with chronic health risks; that means it is similar to seasonal flu [1], as shown in Figure 4.

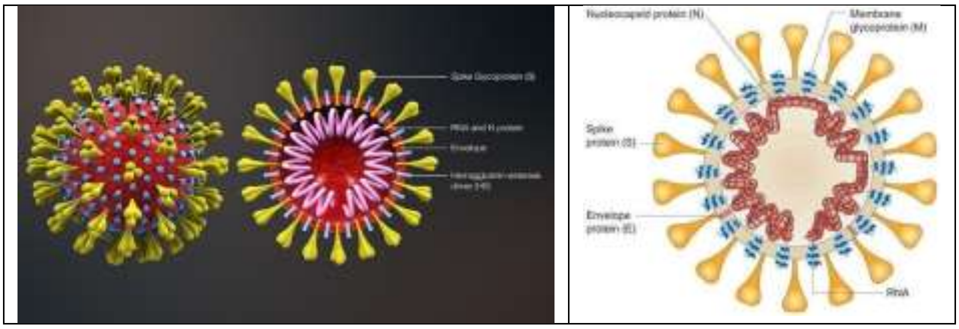


Figure 4-Explains the chemical composition of the spherical shape of corona virus particle, which are fine organic particles with a diameter of 200-400 nm, also, non-cellular organisms that do not contain the nucleus and cytoplasm, It has a RNA and E protein chain, [1].

3. Hotspot and Coldspot of infections Techniques

One of the most popular and creative uses of epidemic mapping is to compile many of them into hotspot maps reflecting a different kind of clustered style. In hotspot mode, events tend to point distance under correlation (Dependency is any statistical relationship between two random variables or bivariate data) compared to another style.

Objects are always more common in the hotspot area than in other densities. A hotspot is used to evaluate spatial data regions where a point is present or where more artifacts appear in contrast to other areas. Two types of Hotspots, one of which represents location, are called individual, and the second represents the region called global Hotspots. The stated Hotspot maps allow biologists to investigate the individualization of situating resource epidemic. Applying sensibility and hotspot analysis found that these facilities' effect on the product's distribution depends on the product's stage [5].

How to understand Hotspot Analysis by applying Getis- Gi*. The Hotspot Analysis tool measures the Getis-Ord Gi * statistic from each element as the type of infection. The resulting Z score (weight field in the file) indicates where elements with high or low values are spatially clustered. This technique looks at each element in the sense of the neighboring features, and the equation Getis-Ord local statistic is [6].

$$G_i^* = \frac{\sum_{j=1}^{n} \omega_{ij} x_j - \bar{X} \sum_{j=1}^{n} \omega_{ij}}{S\sqrt{\frac{n\sum_{j=1}^{n} \omega_{i,j}^2 - \left(\sum_{j=1}^{n} \omega_{i,j}\right)^2}{n-1}}} \quad \ldots\ldots 1$$

Where: x_j is the infection value for location j,
$w_{i,j}$ is the distance inverse which is the spatial weight between location value i and j,
n is equal to the total number of infections value, the mean center and standard deviation are;

$$\bar{X} = \frac{\sum_{i}^{n} x_i}{} \quad \ldots\ldots 2$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2} \quad \ldots\ldots 3$$

$\sum_{i}^{n} x_i$ Is a total of infections value in the region,

$\bar{X}$ is the mean center of infections value locations,

S is the standard deviation represented by a z-score in a test of the distribution types.

4. Intensity Value Analysis

Utilization Intensity Value Analysis (IVA) estimates the intensive area of the COVID-19 outbreak, such as districts, regions, etc. The IVA also uses Inverse Distance Weighting (IDW) efficiency to evaluate the epidemic affecting the position (i.e., IDW and kriging interpolation techniques); The IDW determines the relationship between all infections and the amount of infection around which interest and attempts to create a new location of events predict [7]. The IVA is similar to a buffer tool (which zones of specified radius or width) analysis. It allows an analyst to create a buffer zone that extends a defined distance previously from the position under investigation using the distance referred to as cutoff (bandwidth) distance and then counts the number of point incidents (COVID-19 infection) within that cutoff distance. For each parameter, different conceptual maps (layers) can be created using the IDW (algorithms applied to region-wide surface maps of point events (prediction, expectation, and barrier determining)) interpolation technique in the ArcGIS [8]. The IDW interpreting method is reliable on spatial autocorrelation (*also known as serial correlation*); the surface generated with IDW does not exceed the known range of values or move through any sample points. The IDW is a strong interpolator for environmental phenomena, the distribution of which is correlated with distance power. One possible benefit of the IDW method, which helps to monitor the effect of distance directly. Each parameter may be reclassified and translated to a raster format by layer maps [9]. Weights are proportionally inverse to distances; i.e., when a point is far away, its effect is diminished, and the following equation describes it [10].

$$z(x, y) = \sum_{i=1}^{n} \lambda_i * z_i \xrightarrow{where} \sum_i \lambda_i = 1 \qquad \text{........ 4}$$

Where: d_i is the metric distance weight of infection between the reference point and another point, i.e.

$$d_i = \sqrt{(x_i - x)^2 + (y_i - y)^2} \qquad \text{....... 5}$$

n: is the number of infection points within the nearest neighborhood defined for x, y.
Z_i: is the observed value at location i.
λ_i, represent the distance-dependent weight associated with each sample point.
d_i: is the distance between infection points location x, y.
p: is the power of the rate of weight reduction when the distance increases.

5. Standard Deviation Distance (SDD)

The standard deviation distance (SDD), used for distance correlation analysis of multivariate data, is studied as a measure of spread. The standard deviation (SD) is the function of the mean distribution of the mean-variance of dispersion values; in other words, it is approximately the mean of the data deviation from the mean, which is the same as the mean deviation. It is possible to create a model for standard deviations in any crisis and be considered a parameter on which information can be built due to the possibility of distribution of dispersed values. It can include 95% of the expected values if used in the (ordinary most minor squares process) option. The remaining dispersed values follow the user's estimate or the crisis cell Dept; although they are considered lost or neglected, the occupied area is extensive, causing a lack of control over the region. Otherwise, the maximum likelihood process can be used to ensure control of all dispersion values.

Standard deviation distance formulae for the single variable for one dimension given by [11];

$$SDD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{N}} \qquad \text{....... 7}$$

For two dimensions equivalent given by;

$$SDD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - X_C)^2 + \sum_{i=1}^{n}(Y_i - Y_C)^2}{N}} \quad \ldots\ldots 8$$

The weighting technique is designed to simulate the relation of dispersion values. This technique was applied to large open areas, where surface maps are extracted to identify expected infection values or predict new infections. It is essential for Crisis Cell Dept in case it wants to deal with the epidemic strictly or to reduce measures or lift restrictions taken previously. The choice of algorithm is not crucial, and analyses with different algorithms showed promising results [12].

Weights are proportionally inverse to distances; i.e., whenever the point is far away, its effect is reduced, as the following equation

$$SDD = \sqrt{\frac{\sum_{i=1}^{n} w_i(X_i - X_C)^2 + \sum_{i=1}^{n} w_i(X_i - X_C)^2}{\sum_{i=1}^{n} w_i}} \quad \ldots\ldots 9$$

Where;

i and *c* are the two-dimensional equivalent standard deviation for a single variable, and w is inverse distance weight. To calculate the inverse distance from Pythagoras, a reduced equation.

$$SDD = \sqrt{\frac{\sum_{i-1}^{n} {d_{iC}}^2}{N}} \quad \ldots \quad \ldots. 10.$$

The average number of points from the center provides a valuable unit measure of distribution dispersion values (Randomly or in Clusters).

6. Standard Deviational Ellipse (SDE)

Standard Deviational Ellipse (SDE) is the degree of measurement and analysis of autocorrelation of COVID-19 in any area.

These statistics require the measurement of the weighted matrix, which is the inverse of the density value of the study area.

It is a geographical relationship between the measured values of infection, provided that they are within the values of the nearest neighborhood within the eigenvalues region of autocorrelation [12].

This technology is distinguished from the standard deviation distance with the following features:

Searching for an axis along the most significant values of sporadic infections generates the angle of dispersion values with the main axes. Based on this axis, it is possible to calculate the SDE for covid-19 infection values, where three-volume values are applied, so that any user can control the area of values. The standard deviation of the values can be calculated based on the distance inverse weight technique, which is the second half of the ellipse's small diameter, perpendicular to the second axis, the radius of the large axis [13].

In conclusion, as an advantage of the technique, the rotation angle indicates that Covid-19 values are dispersed in a specific direction. The large axis of the ellipse includes all the dispersed values, which are the infections of people with Covid-19, and the minor axis of the ellipse includes all values [4], shown in Figure 5.

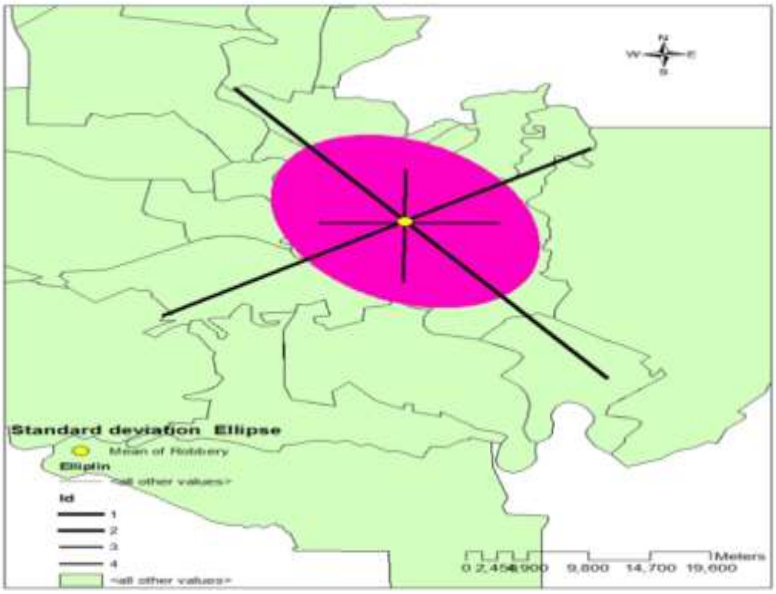


Figure 5- The axes of the basic cartesian coordinates, the ellipse axes, notice the large axis and the small axis perpendicular to the large axis, can easily observe and determine angle of rotation around the mean center [4].

7. Results and Discussion

7.1 Preventive Procedures to Stop the Spread of COVID-19 Disease

There are two methods to help residents and the CCD emergencies and stem the spread of Covid-19 infection: natural and practical.

7.1.1 Natural Procedures

Remote sensing techniques provide a clear view of the landscape or area infected from the emergency management center, where it can make sound and effective decisions to avoid the epidemic disaster and preserve the population's lives. Control the effect of spreading the deadly COVID-19 and restricting infections for treatment in a sound and optimal manner so that the support and medical teams can perform well.

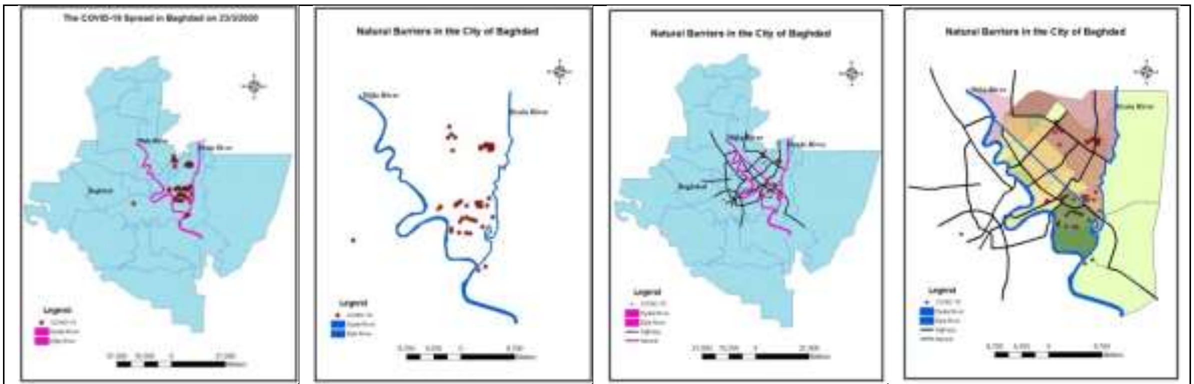
Through the data provided by remote sensing techniques, it can be managed with GIS applications and tools regarding searching for places and natural borders such as significant features like rivers, mountains, valleys, plains, coasts of seas, and bays, and massive human activities (Land Use) such as highways, waterways, dirt dams, farms, and strategic fields.

After the epidemic spread, the thinking was serious about isolating and quarantining the affected areas. Baghdad city, through GPS data, showed that most injuries were on the city's eastern side.

Tigris river separates the two sides of the Rusafa region on the right side and the Karkh region on the left side the Tigris. It is natural and logical to isolate and then quarantine the right side from the left and control without stopping the interests and actions of the residents on the left side of Baghdad city, or the occurrence of friction and then infection and the spread of the epidemic, as in table 1 and shown in Figure 6.

Table 1-Location coordinates of infected areas with COVID-19 in Baghdad, a total of 46 people on March 23, 2020.

NO	Sex	Age	Latitude ϕ (Degree)	Longitude λ (Degree)	X-Coordinate (Metric)	Y-Coordinate (Metric)
1	Baby girl	2	44 31.379	33 23.836	455641.224847	3695427.30607
2	Baby girl	2	44 31.2	33 23.833	455364.133812	3695427.30607
3	Baby girl	4	44 31.11	33 23.627	455222.420626	3695046.03624
4	Baby girl	7	44 30.678	33 23.627	454550.178898	3695046.3059
5	Baby girl	16	44 31.662	33 23.745	456079.125028	3695257.36635
6	Man	27	44 31.643	33 23.518	456044.640549	3694838.92202
7	Man	28	44 31.583	33 23.341	455952.952261	3694509.44202
8	Man	29	44 31.894	33 23.378	456437.861572	3694578.71478
9	Woman	30	44 31.95	33 23.612	456527.897208	3695009.75577
10	Woman	40	44 31.897	33 23.808	456437.584117	3695375.30534
	……..	…….	………….	……………	…………..	…………….2
36	Man	42	44 27.651	33 24.676	449864.635045	3697011.44239
37	Man	49	44 27.305	33 24.4	449335.46732	3696503.44138
38	Woman	50	44 27.804	33 23.292	450097.468844	3694450.2706
39	Man	43	44 26.568	33 18.382	448128.964907	3685390.91915
40	Man	55	44 26.391	33 18.166	447853.79769	3684988.75168
41	Man	23	44 31.27	33 13.142	455377.229211	3675673.20478
42	Woman	48	44 30.536	33 12.805	454234.226925	3675054.07854
43	Woman	56	44 28.233	33 18.622	450709.969876	3685817.35006
44	Man	65	44 28.104	33 18.47	450511.531979	3685539.53701
45	Woman	50	44 27.419	33 25.369	449518.308651	3698293.49633
46	Woman	71	44 17.546	33 15.378	434096.885288	3679919.17065



(a) (b) (c) (d)

Figure 6-Illustrates (a) The study area shows the distribution of the infected persons' sites, which it concentrated on the eastern side of the Tigris River, and (b) the actual natural barriers that can be used as sites for quarantining the region and blocking the epidemic, (c) the study area with the natural and land use barriers and the distribution of the infected people, (d) the natural barriers and land use, which can be used as a population quarantine and prevent the spread of the COVID-19.

7.2 practical procedures

Remote sensing techniques, geospatial data, and GPS devices provide strategic and tactical solutions to manage disasters such as COVID-19. The techniques are installed in the study area, which could be treated and managed to simulate the actual reality. Then treating the Point Pattern Analysis (PPA), people with COVID-19, by statistical methods and theories to extract the best information that helps control the epidemic spreading. The decision-makers and the crisis cell can make appropriate decisions by accreditation on maps prepared according to this new information to stop the repercussions of this disease COVID-19.

A point pattern of injuries would be used in areas with a continuous surface that differs from the statistical calculations for the discrete surface.

The spatial analysis depends on the type of points pattern distribution (random, uniform, and cluster); it is clear from the prevalence and concentration of infections with COVID-19 that it is a cluster distribution concentrated in two regions of the eastern side of the city or the Tigris river, which formed a natural barrier to reserving the epidemic. The first group of injuries is named "cluster 1," north of the study area, and the second group is "cluster 2," southeast of the study area [4].

The process guides to determine the shape of the distribution, which the tools of statistical analysis of random distribution differ from the regular and cluster, and that the discrete surface plays a crucial role in statistical calculations, which are dependent on expectations and frequent operations, as in Table 2 and show Figure 7.

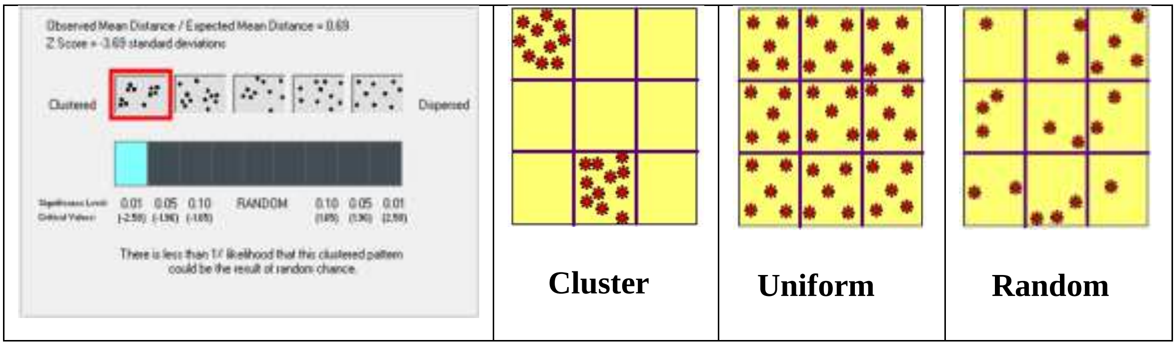
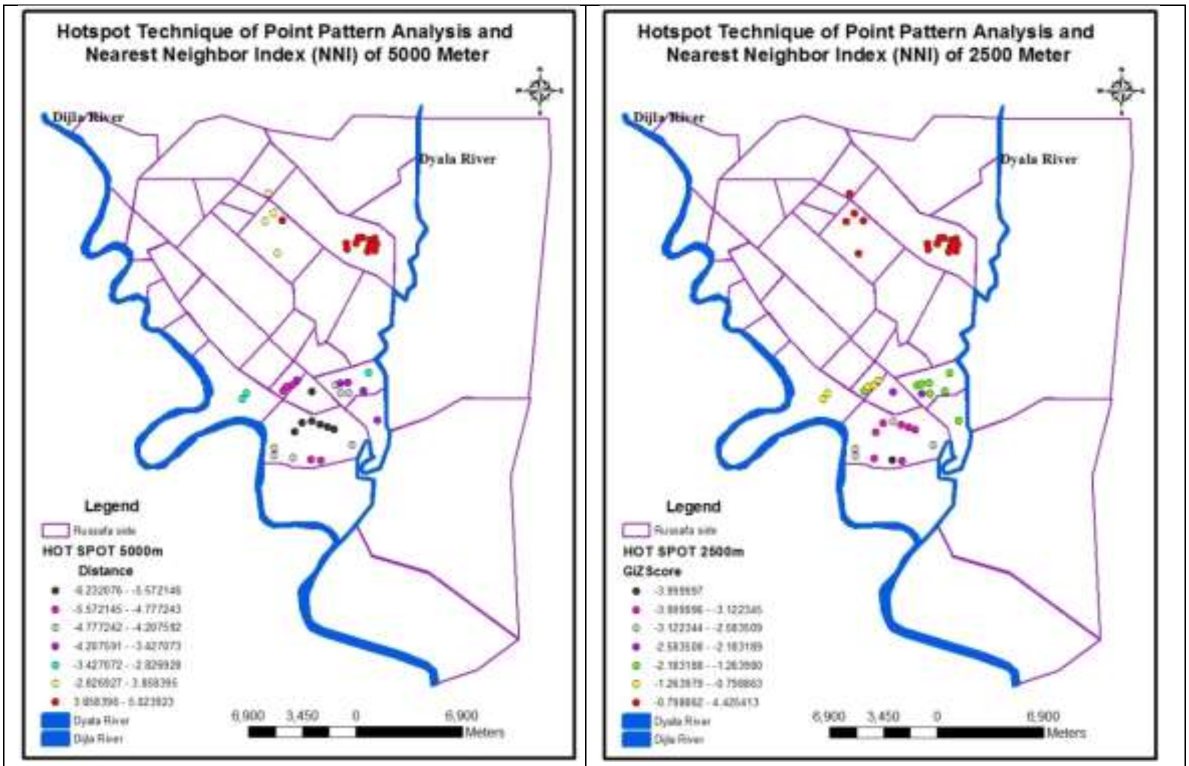


Figure 7-Test knowledge of the COVID-19 disease distribution in the study area to choose the appropriate techniques to control spreading, where the type of cluster distribution appeared [4].

7.2.1 Identifying Foci of Injuries

7.2.1.1 Hotspot Mapping Techniques

The technology allows decision makers or the emergency department cell for foci-searching using data and information about those infected with the knowledge of the oldest infected or the carriers of the infection. This information allows controlling the spread of the epidemic by taking steps to isolate and monitor the injured and take appropriate measures, as shown in Figure 8.



(a) (b)

Figure 8- Explains, the hot spots technique for infected people areas with the COVID-19 for identifying foci of infections, and the cutoff distance was calculated in two cases according to the estimation of the epidemic contingency, (a) The cutoff distance is 5000 m to the farthest distance inverse of the infection site, and the infections outside this distance are neglected, (b) The cutoff distance is 2500 m to the farthest distance inverse and also neglect infections outside this distance.

7.2.2 Determine the Spreading Epidemic and Recession of the Epidemic (Tightening and Loosening of Restrictions)

The cutoff distance is the basis of which deals with the distance for all injuries equally and deals with injuries outside distance by negligence; it is not possible in the case of fatal epidemics such as a virus, so consideration must be taken to stop epidemic spreading and take precaution even if the case is suspicious. So an area must be controlled injury to the lowest possibility and the work of barriers and quarantine to prevent epidemic transmission to other regions. Therefore, standard deviation distance or deviational ellipse technologies best suited for open areas should be used.

7.2.2.1 Standard Deviation Distance (SDD) Result

Analysts can choose the region that includes infection values as a model using the observed data flow, standard deviation distance technology, maximum likelihood, or ordinary least squares, as shown in Figures 9, 10, and 11.

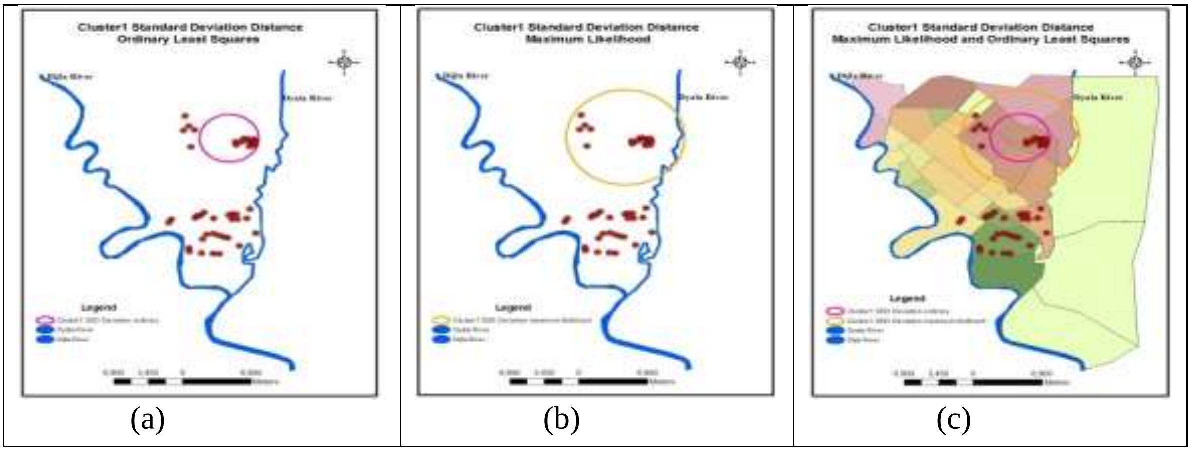


Figure 9- Illustrates the standard deviation distance technique, (a) cluster 1 using ordinary least squares process, it represents part of the values and neglects the other, (b) cluster 1 using maximum likelihood process, it represents all values, (c) cluster 1 using both processes for all values.

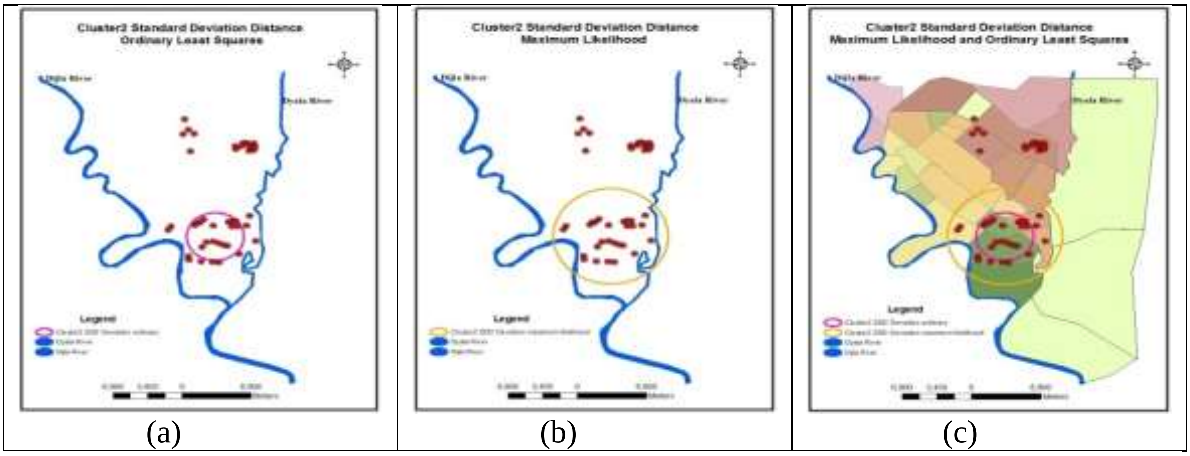


Figure 10- Illustrates the standard deviation distance technique, (a) cluster 2 using ordinary least squares process, it represents part of values and neglects the other, (b) cluster 2 using maximum likelihood process, it represents all the values, (c) cluster 2 using both processes for all values.

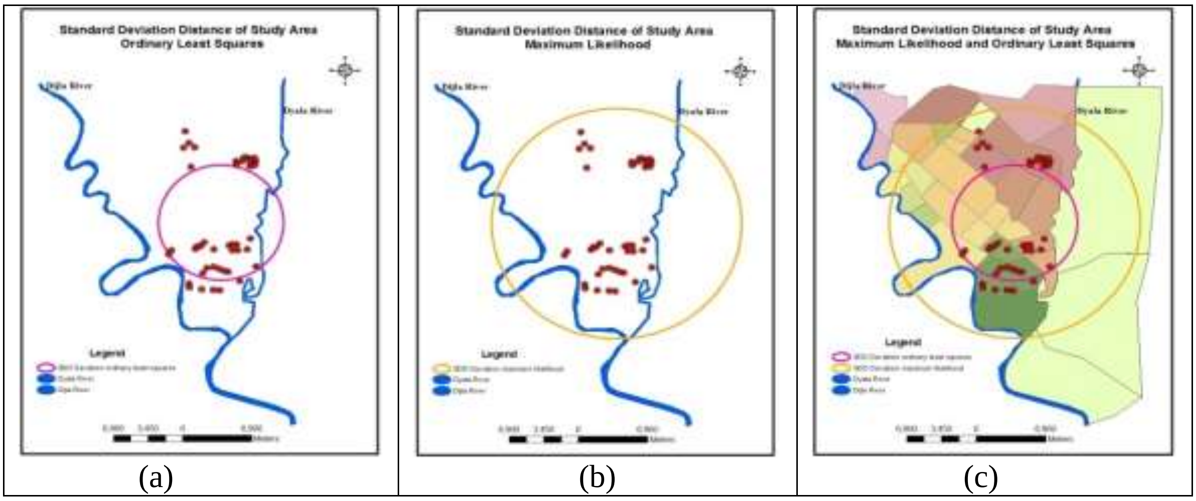
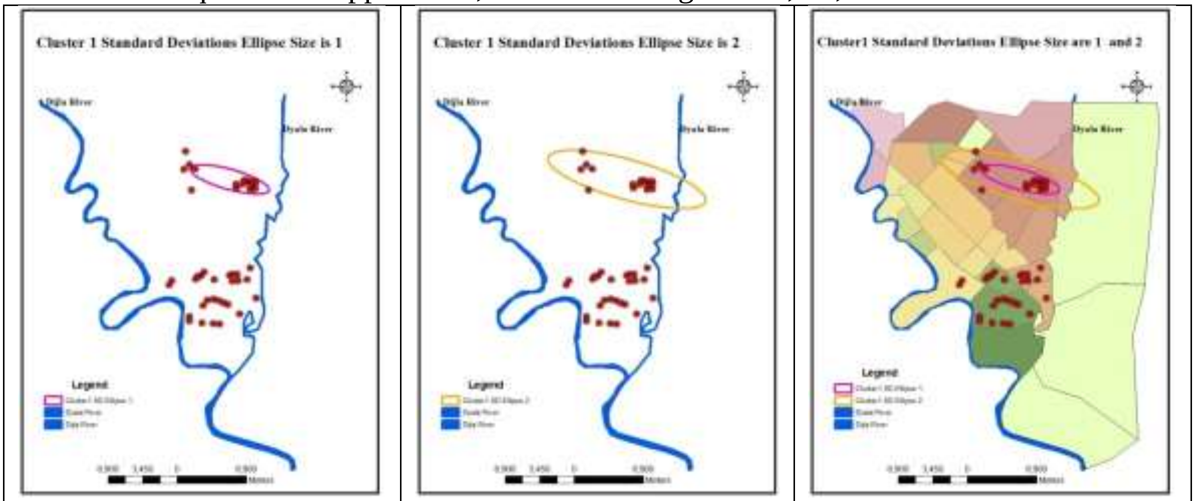


Figure 11-Illustrates the standard deviation distance technique, (a) cluster1 and 2 using ordinary least squares process, it represents part of the values and neglects the other, (b) cluster1 and 2 using maximum likelihood process, it represents all values, (c) cluster 1and 2 using both processes for all values.

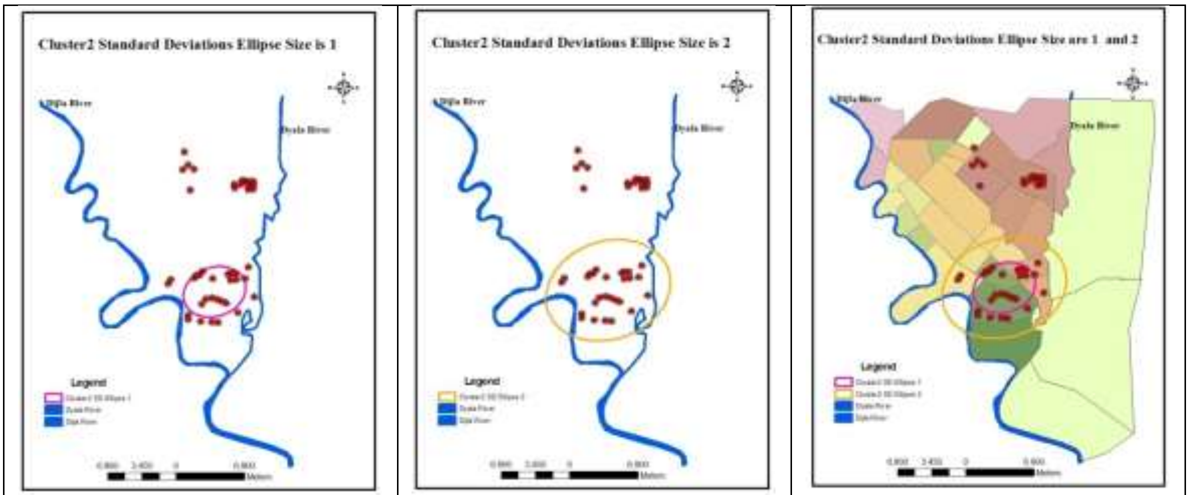
7.2.2.2 Standard Deviational Ellipse Result

Unlike Standard Deviation Distance, analysts can use the standard deviational ellipse (SDE) technology as a valuable model to identify the direction of the epidemic, especially the densely populated areas while controlling all dispersed values using data flow monitor injuries. The importance of the situation is that the procedures at the beginning of the process differ in their end with knowledge of behavior and life cycle of the Covid-19 virus. For example, the virus's incubation period and the number of infections decreased during the isolation and quarantine application, as shown in Figures 12, 13, and 14.



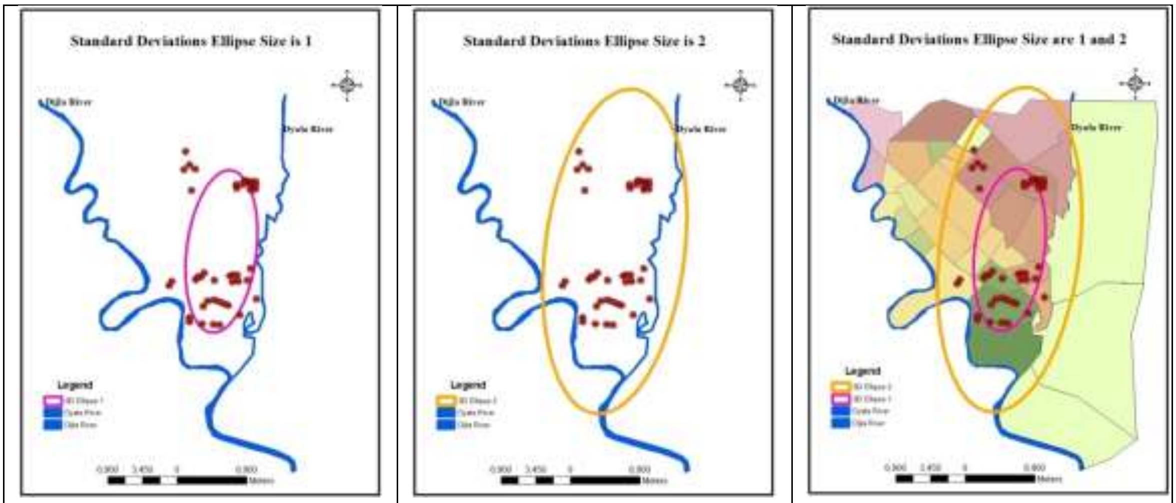
(a) (b) (c)

Figure 12-Illustrates the standard deviational ellipse technique, (a) cluster 1 using the default ellipse size is 1 process, it represents part of the values and neglects the other, (b) cluster 1 using the default ellipse size is 2 process, it represents all values, (c) cluster 1 using both processes for all values.



(a) (b) (c)

Figure 13-Illustrates the standard deviational ellipse technique, (a) cluster 2 using the default ellipse size is 1 process, it represents part of the values and neglects the other, (b) cluster 2 using the default ellipse size is 2 process, it represents all values, (c) cluster 1 using both processes for all values.



(a) (b) (c)

Figure 14-Illustrates the standard deviational ellipse technique, (a) cluster1 and 2 using the default ellipse size is 1 process, it represents part of values and neglects the other, (b) cluster 1 and 2 using the default ellipse size is 2 process, it represents all values, (c) cluster 1 and 2 using both processes for all values.

8. Conclusion

Crisis or disaster management, including the spread of viral epidemics and diseases, especially the deadly Covid-19 epidemic, has made it possible to use modern technologies to control the epidemic spreading in an ideal and rapid manner, such as remote sensing techniques, spatial analysis, management and control of files by applying GIS tools.

Techniques were used to manage the deadly Covid-19 epidemic in Baghdad, relying on information provided by the media; the infections began spreading until March 23, 2020.

Most of the infections were on the eastern side of Baghdad.

Using spatial data analysis techniques, a model simulates the infected regions, to prevent the spreading of the epidemic to other regions. Hence, we conclude the following:

1. Based on identified natural barriers, the study area can be used in reserving and quarantining the epidemic regions: natural rivers, water channels, highways, main streets, railways, and power transmission lines.
2. The eastern side of Baghdad city was isolated by the Tigris river from the western side, while the Diyala River isolated the eastern side. The region's north is isolated by the main street adjacent to the soil dam.
3. Facilitating of identification of foci infection regions using the hotspot and coldspot technique, which the necessary precautions are taken to know the movement of the infection, to take appropriate measures to isolation or quarantine.
4. The boundaries of the injured regions were determined using the SDD technique. The SDE controls the dispersion of the values (infections) and provides appropriate options for assessing the situation by the CCD. Observing the spread of the epidemic in the world depends on the nature of the population's commitment and living conditions and government attention to the assistance provided to allow the citizen to commit.
5. The technology allows restrictions lifting and population movement scheduling through isolation and site quarantine. It is necessary to be under the supervision of specialists and monitor cases according to prepared and studied instructions, among which this technique can be relied upon because it is flexible, accessible, and responds to temporary conditions.

6. The facility provides the CCD with maps of detailed infected regions, the epidemic spreading, and information about injured persons from the main city database.

Author's declaration:-

Conflicts of Interest: None.

I hereby confirm that all the Figures and Tables in the manuscript are mine.

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