ISSN: 0067-2904

Detecting The Best Relationship Optimizing between Drug Dealers and End Users Following Networking Techniques in Geographic Information Systems (GIS)

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Received: 11/3/2023 Accepted: 4/6/2023 Published: 30/6/2024

Abstract

The research aims to find the highest spatial distribution and the best relationship between drug dealers and drug users using networking technology, as all roads connect between population, industrial, commercial, agricultural, and tourist centers and between transportation points for other types of transportation. Baghdad province was chosen as a study area due to increased drug prevalence in recent years. Remote sensing techniques, including Geographic Information System tools, were used to implement the study. Statistical methods were applied in the geographical analysis of samples based on the moon. European industrialist Copernicus and Sensor 2b to locate these samples. The nearest neighborhood was calculated to determine spatial distribution; the distribution was clustered into two groups stationed in the middle of the study area. The network technique, which depends on the transport network of the study area, was used to find a relationship between 12 drug dealers and 65 drug users to find the shortest and fastest distances. To find out the shortest time to promote drugs. The study method can help decision-makers to take precautions to reduce this phenomenon.

Keywords: Drug dealers, Drug users, Networking technique, Spatial distribution, Statistical methods.

كشف افضل علاقة بين مجاميع مروجي المخدرات والمتعاطين بتطبيق تقنية الشبكات باستخدام نظم المعلومات الجغرافية (GIS)

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الخلاصه

الهدف من البحث هو إيجاد أعلى توزيع مكاني وأفضل علاقة بين تجار المخدرات ومتعاطي المخدرات باستخدام تقنية الربط الشبكي ، حيث تصل جميع الطرق بين المراكز السكانية والصناعية والتجارية والزراعية والسياحية وبين نقاط النقل لأنواع النقل الأخرى. تم اختيار مدينة بغداد كمنطقة دراسة ، وذلك بسبب تزايد حالات انتشار المخدرات في السنوات القليلة الماضية ، تم استخدام تقنيات الاستشعار عن بعد ، بما في ذلك أدوات نظام المعلومات الجغرافية (GIS) في تنفيذ الدراسة، تم تطبيق الأساليب الإحصائية في التحليل الجغرافي للعينات بالاعتماد على القمر الصناعي كوبرنيكوس الأوروبي وجهاز الاستشعار 2b لتحديد هذه

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العينات. تم حساب اقرب جوار لتحديد التوزيع المكاني، فكان التوزيع عنقودي في مجموعتين متمركزة في منتصف منطقة الدراسة، استُخدمت تقنية الشبكة والتي تعتمد على شبكة النقل لمنطقة الدراسة، لإيجاد علاقة بين تجار المخدرات وعددهم 12 موقعًا، وعدد متعاطي المخدرات وعددهم 65 من متعاطي المخدرات، للعثور على أقصر المسافات وأسرعها. لمعرفة اقصر وقت للترويج للمخدرات.
يمكن أن تكون طريقة دراستنا مفيدة لصناع القرار لاتخاذ الاحتياطات اللازمة للحد من هذه الظاهرة.

1- Introduction

Both network analysis and geographic information systems (GIS) are developing topics that have recently witnessed rapid methodological and scientific advancement. A GIS is made for collecting, archiving, handling, analyzing, and presenting geographic data. The feature that sets geographic information apart from all other data types is its geographic location. Data without a location are called non-spatial and limited use in a GIS. Hence, the location serves as the foundation for several advantages of GIS, including the ability to map, measure distances, and connect various types of information because they pertain to the exact location [1]. Following the application of hot spot analysis methodologies, law enforcement, community crime analysts, and researchers were able to identify and discover high-crime regions. Data on crime and demographic heterogeneity were analyzed primarily using hotspot detection. These analysts aim to identify areas with higher than average criminal activity or disorderly conduct rates. There is no fixed measure for these operations, but rather different from case to case, such as terrorist attacks. Many factors influence hotspot analysis; several components of these parameters, such as analysis focus, spatial dependency, crime type, time intervals, barriers, and output display, are required in studying hot spots [2].

Hotspot maps are generally used to assist in assigning locations for criminal investigations. A deeper connection between theory and practice will also aid in avoiding arbitrary hot spot analysis methods and provide an analyst with a solid scientific platform to build and use spatial analysis of drug dealers and drug users [3]. One of the most significant areas of GIS technology today is GIS-T or geographic information systems for transportation issues. GIS-T needs new data structures to represent the complexity of transportation networks and to carry out various network algorithms to realize its potential in logistics and distribution logistics. Traditional GIS formulation's strengths are in mapping display and geo data processing; it is pure if a network's topology and connectivity are the only factors considered. A network is referred to as a flow network if its topology and flow characteristics (such as capacity limits, path choice, and link cost functions) match one of the most significant areas of GIS technology used today is GIS-T, or the use of geographic information systems to transportation issues [4]. GIS-T needs new data structures to represent the transportation network's complexity and to carry out various network algorithms to realize its potential in logistics and distribution logistics. Traditional GIS formulation's strengths are in mapping display and geo data processing. Using signals transmitted from satellites in real-time to determine the locations needed and their exact coordinates using the Global Positioning Systems (GPS), which multiple organizations utilize for mapping and GIS, among other uses [5]. GPS is also used for navigation on land, air, and sea [6]. Before the computer's invention, it was impossible to gather and analyze field data in the ways that have become possible today [6]. This research aims to identify the communication network between drug users and dealers of all narcotic substances spread in the Baghdad governorate, particularly narcotic crystal in the Rusafa district. The research also investigates analysis to find the shortest way and the least possible time to reach the security forces by finding the nearest police stations that can arrest the accused dealers using GIS and GPS systems.

2- Study area

Baghdad Governorate was selected as the case study, considered the smallest of Iraq's governorates in terms of land. It is situated between latitude and longitude, starting at the top left. From the bottom right, (44 57.23° 32 48.59°) min and (43 50.06° 33 45.68°) min, with an area of 927.61 km^2; the Universal Transverse Mercator (UTM) planar metric projection is from the top left (391695.26) to the bottom right (495676.664) m [7]. The highest point in Baghdad is 48 m above sea level in the north and 23 m above sea level in the south. [8], with an estimated population of 8.4 million people living there. In 2016, Baghdad had the most population of any Iraqi governorate [9]. The Baghdad region has a semi-arid subtropical and continental climate that is dry, hot, and chilly in the winter and spring, with brief spring and fall seasons [10]. The Tigris River's passage through the Baghdad region separates it into two geographical sides, AL- Karkh and AL-Rusafa regions, making it a unique city. Al-Rusafais situated on the eastern bank of the Tigris River. It was founded in 159 AH under Abu Abdullah al-caliphate Mahdi [11], and there are several essential neighborhoods and streets there, including Adhamiya, Zayouna, Sadr City, Palestine Street, Abi Nawas Street, Al-Saadoun Street, Karrada, New Baghdad, and many others. Districts and sub-districts have been established at the Rusafa site [12]. Rusafa's population is growing, where the majority of Baghdad's citizens reside, due to the availability of the majority of social and economic activities centralized in Al-Rusafe. The study area for Baghdad is depicted in Figure (1), which uses sentinel 2B to represent the network and high spatial resolution to display features. The features include buildings, streets, rivers, and all the details of a feature on the ground in Baghdad [13].

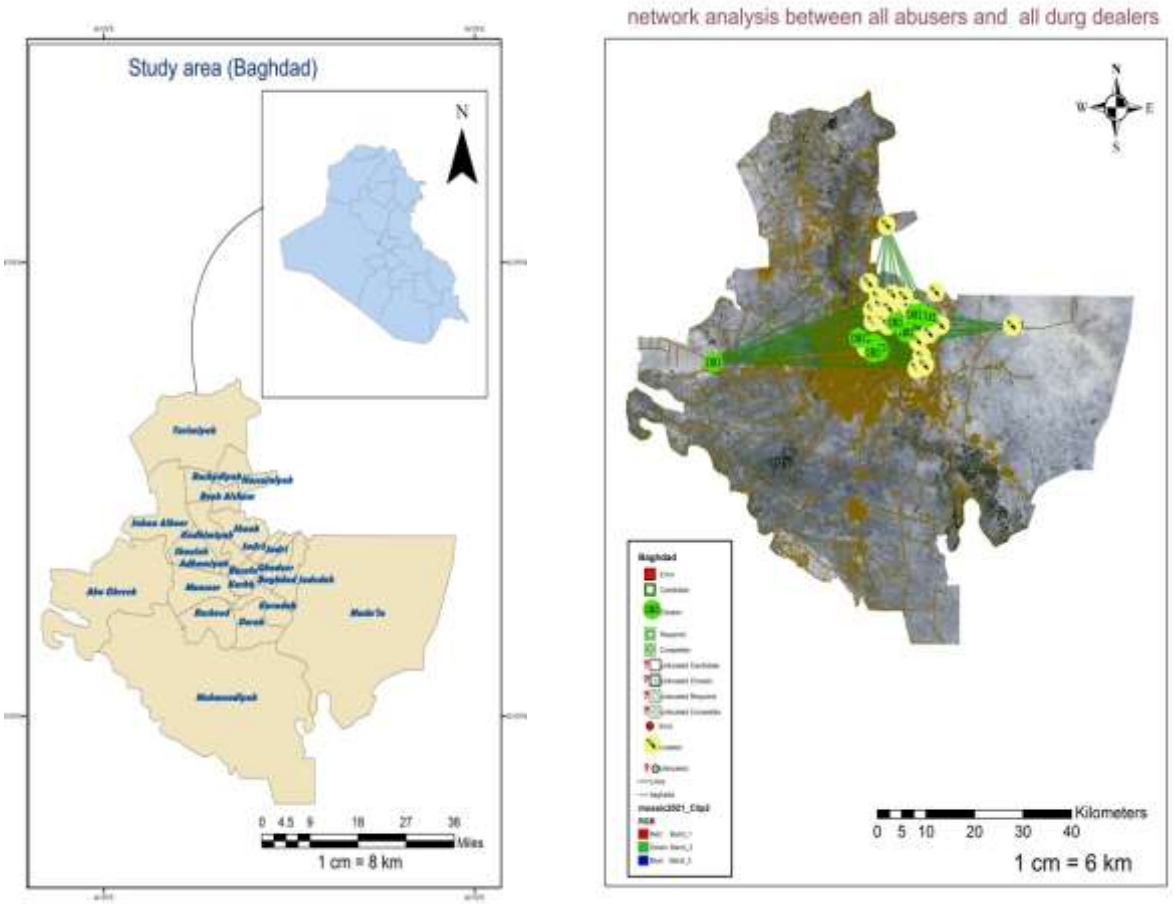

Figure 1: The study area illustrates administrative Iraq, the Baghdad region, and the center of Baghdad.

3- Methodology and Material

By using data on the numbers of drug users and dealers obtained by the Ministry of Interior, Narcotics Department, and Statistics Department, which includes their residence locations, analyzing and managing them using geographic information systems, and converting them into information in the form of maps that help the user to understand the behavior of the consumers. GPS and Google systems were used to locate police stations near the suspects to help arrest and follow them up. Also used is the communication network to find the shortest distance and the least possible time and the best way to be used by police and drug control operations. Figure (2) show elucidate the model builder the essential steps in the network analysis of Baghdad governorate, identifying the roads, the relationship of dealers and users, determining the practicable road the most likely ways for the drug user or the dealer to communicate in the shortest time and distance, and how to determine the nearest police station to arrest them.

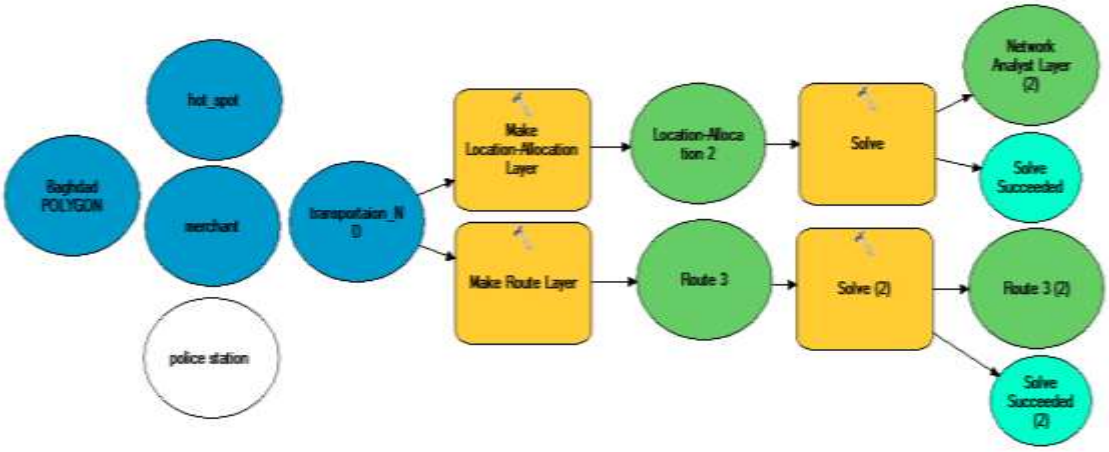

Figure 2: Reflects GIS study's model Builder**.**

Figure 2 shows a flowchart of the proposed improved road network analysis methodology using GIS software. Six stages of the process were applied, starting from collecting and preparing data used in the analysis (study area base map, road network data, health care provider data, and historical traffic data), then georeferencing the base map. Then after a geodatabase is created to store the prepared data and build the network structure and network data set then created. Finally, the network analysis process was applied to the road network in the AL-Rusafa district of Baghdad. Figure (3) shows how to obtain crime data, represent it in the study area, and analyze the road network to find the roads between drug users and traffickers, Figure (4).

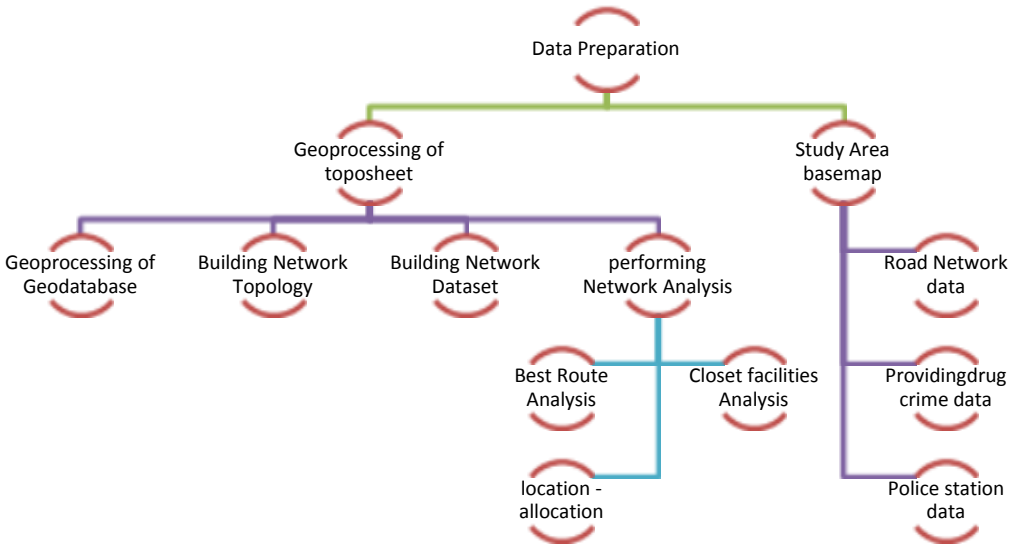

Figure 3: Enhanced Network Analysis Process Flow Diagram.

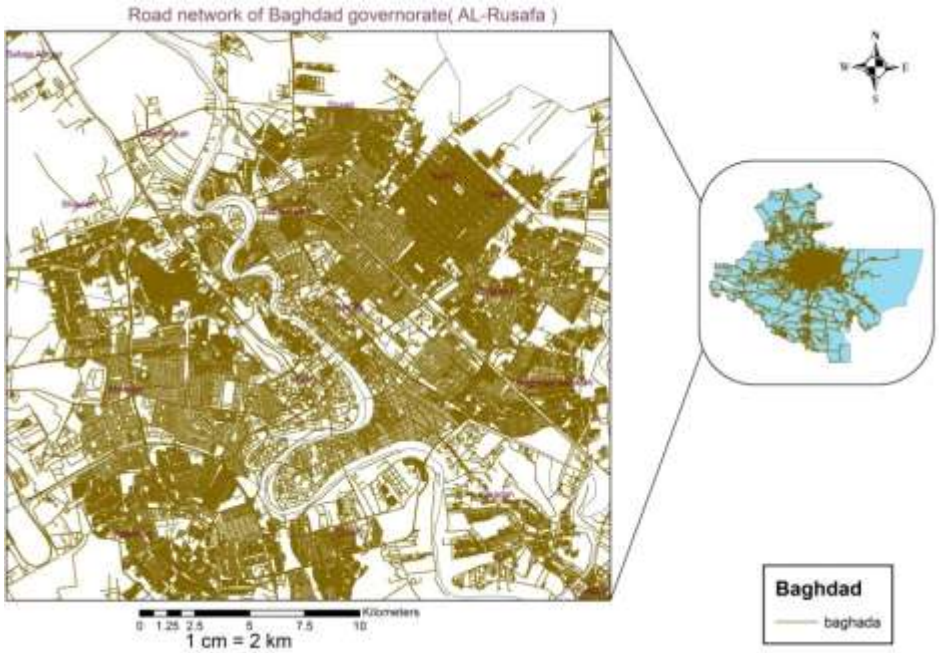

Figure 4: Illustrates Baghdad's road networks and the Al-Rusafa and Al-Karkh regions appear on both sides of the Tigris River.

4- Analyzing networks and identifying crimes

The study of detection is a multifaceted and constantly developing topic of this study. For public safety, governmental organizations use data mining extensively to investigate criminal pattern identification, crime detection, and crime prevention [14]. This study describes how to recognize criminal patterns and foresee crime hotspots in Baghdad. Based on the search for commonalities, approaches were employed to identify criminal trends and predict crimes. The precision of the network clustering was taken into consideration. Compared to other methods, network clustering produces exact and efficient findings. Hence, this technology helps government agencies enhance and properly assess crimes [15]. The effectiveness of the network clustering techniques was precisely evaluated using silhouette measurements. It offers mapping that includes consistent, practical high-density crime areas. It has been established that using GIS and clustering techniques in the spatial-temporal analysis is an effective way to comprehend the underlying relationships between occurrences. The dataset

cannot be converted into information GIS may use to find criminal patterns based on the crime's attribute; network clustering is shown in Figure (7). This will make it easier to use GIS to extract the dataset records with the highest criminal density [16]. The clustering aims to identify any probable criminal activity within the probability in a given area during a specific period. The research seeks to provide the highest level of accuracy in identifying criminal trends.

5- The quickest route

The shortest distance between two points is a method of network analysis frequently used to find the shortest distance and the least time to reach between the drug user and the dealers, or between two drug users or two dealers, as an example to illustrate the way of working. The term "shortest" route in a network of streets can relate to a variety of elements, including distance, time, and cost (such as the price of a plane ticket) [17]. For example, an ambulance driver trying to find the quickest route to their destination will take the path that will get them there in the fewest period [18]. This equation was used to find the time from one point to another.

Time in minute = length *(60/50000)

- Length represents the distance between two points (unit meter).
- 60 represents the time one hour in a minute.
- 5000 represents the speed of the meter.

6- Results and Discussions

Data on drug users and dealers were used in the Baghdad governorate, which contains drug users, dealers, their locations, ages, and genders. Using remote sensing technology, GIS, the Sentinel 2B satellite image, and the global positioning system (GPS), the gathering places were identified and classified into dense aggregation centers and fewer aggregation areas. The angle of their spread was determined using GIS and hotspot tools in ArcGIS. A dedicated communication network was used to determine the direction of the accused and find the shortest path and the least time to reach them. Figure (5) shows the distribution of drug users and dealers in the Baghdad governorate and classifies them into hot and cold areas points according to the standard distance between points. Figure (6) depicts the hot areas gathered in the Al-Rusafa district. Identified within the AL-Rusafa district, the mean center, distribution direction, and computed standard deviation were identified.

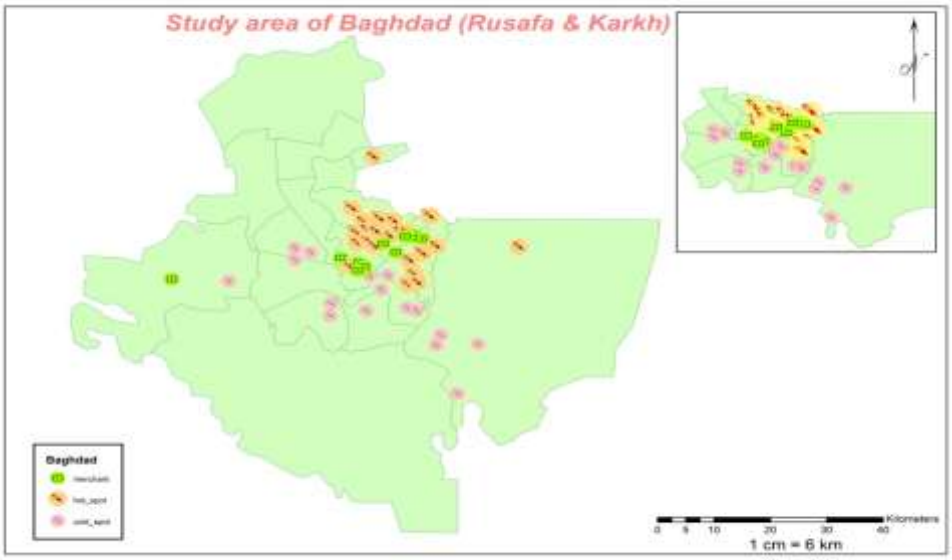

Figure 5: Represents the distribution of drug users and dealers in the Baghdad governorate.

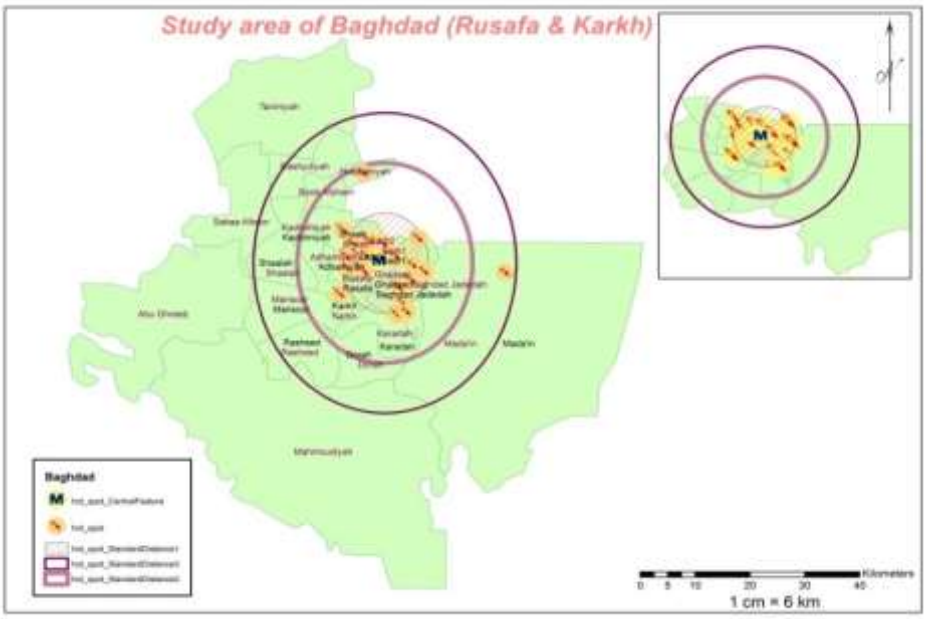

Figure 6: Hot spots were identified within the Al-Rusafa district, and the mean center, distribution direction, and standard deviation were identified.

The network analysis was used to find the relationship between all abusers and all drug dealers and that each dealer contacts a specific number of users, depending on the shortest time, distance, or the spatial connection of the suspects, Figure (7).

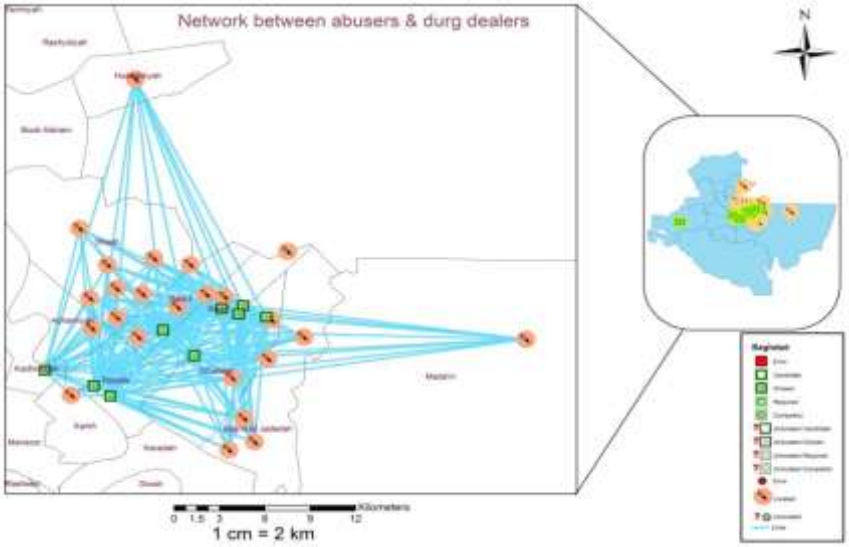

Figure 7: The network analysis between the abusers and all drug dealers.

According to the network analysis between the abusers and drug dealers, four dealers were identified based on their locations of presence with all drug users. It was discovered that each dealer contacts several drug users, as the least dealer contacts three drug users as a minimum for the shortest distance and the shortest time for communication, and according to the region's direction, Figure (8).

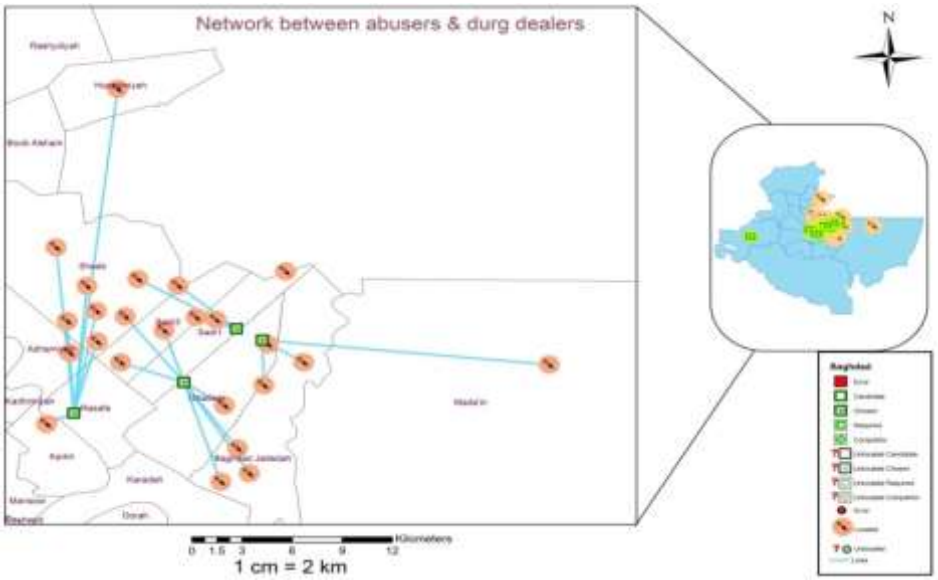

Figure 8: The network analysis between the abusers and four drug dealers.

The network analysis of sampling between the abusers and drug dealers is shown in Figure (9). The rest of the dealers were identified according to their whereabouts with all the drug users, as it was found that each dealer contacts several drug users depending on the least distance and last time, as the least dealer contacts three drug users as a minimum; about the least distance and the last time for communication, according to the direction of the region. The merchants in Al-Sadr City were determined to have the most contact with drug users.

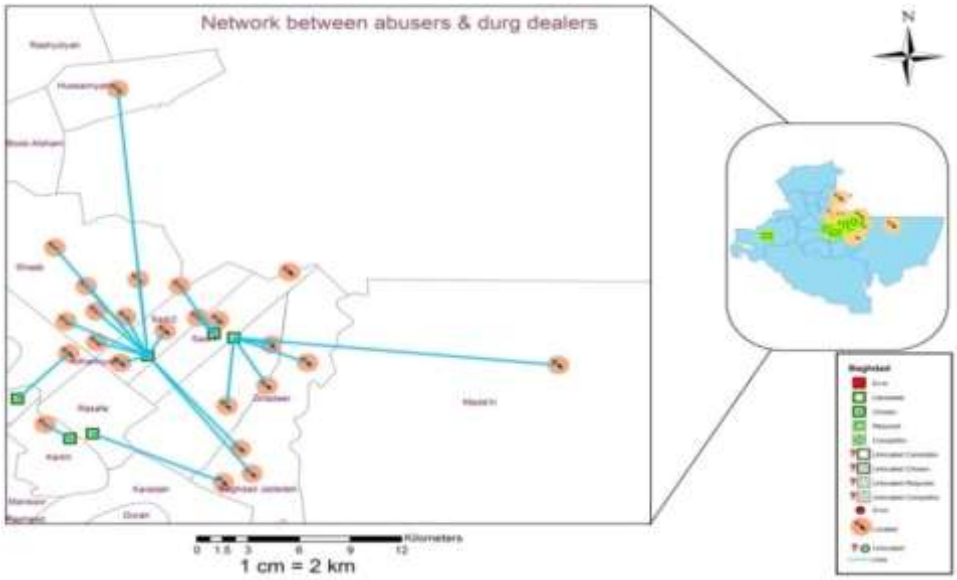

Figure 9: The network analysis between the abusers and drug dealers.

Figure (10) represent the network analysis between the police and drug user, ten police stations in the Al-Rusafa district were identified, which are essential in following up and arresting those accused of drug abuse crimes.

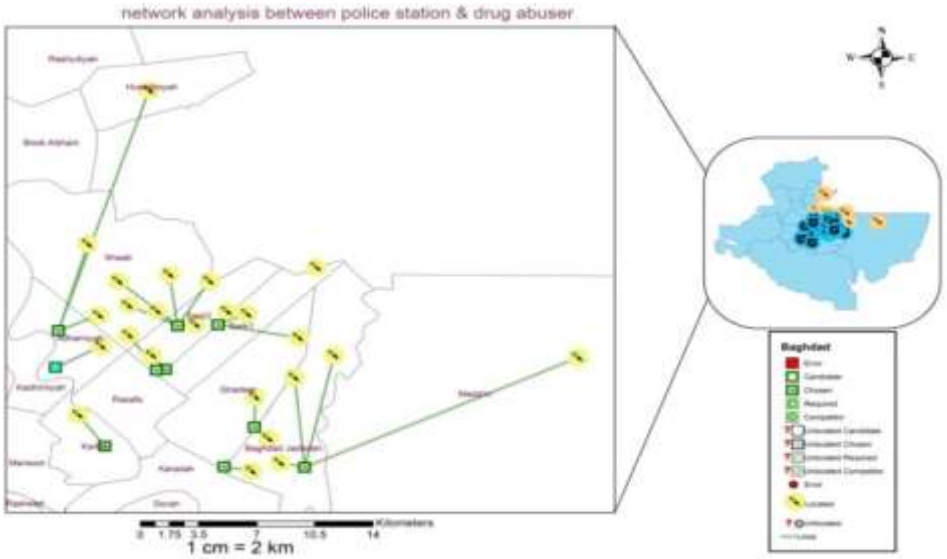

Figure 10: Represent the network analysis between the police and drug user.

Five basic police stations were allocated to track merchants, where each center is limited to several merchants according to the least distance and the shortest time, as well as depending on the area in which the police station department is located, as well as the merchant, Figure (11).

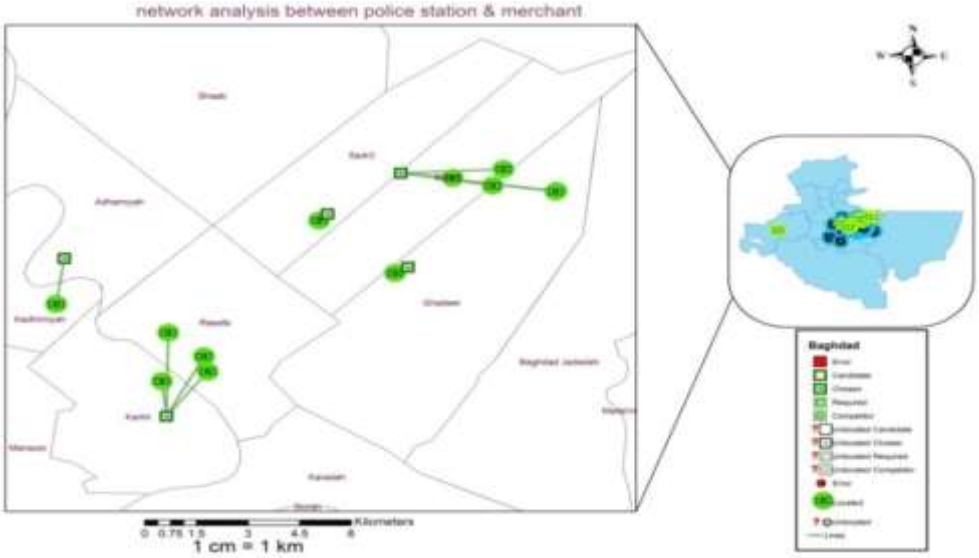

Figure 11: Represent the network analysis between the police and the merchant.

For example, use two merchants were chosen to determine the shortest path between them and the best way to connect them and to calculate the time taken in minutes and the distance between them in kilometers, Figure (12).

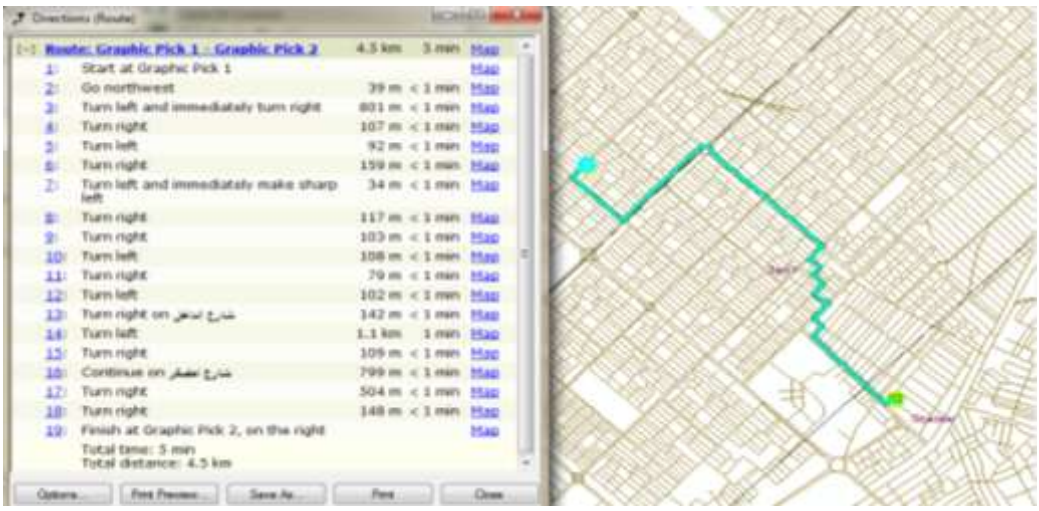

Figure 12: The short road between two points.

For the second example, an obstacle was placed in the road, a security control for inspection on the road to Al-Dakhl Street. The path has changed with the increase of time and the distance traveled between them, and the researcher proved this through the use of GPS to compare the time and distance with the truth, and the time and distance were matched, Figure (13).

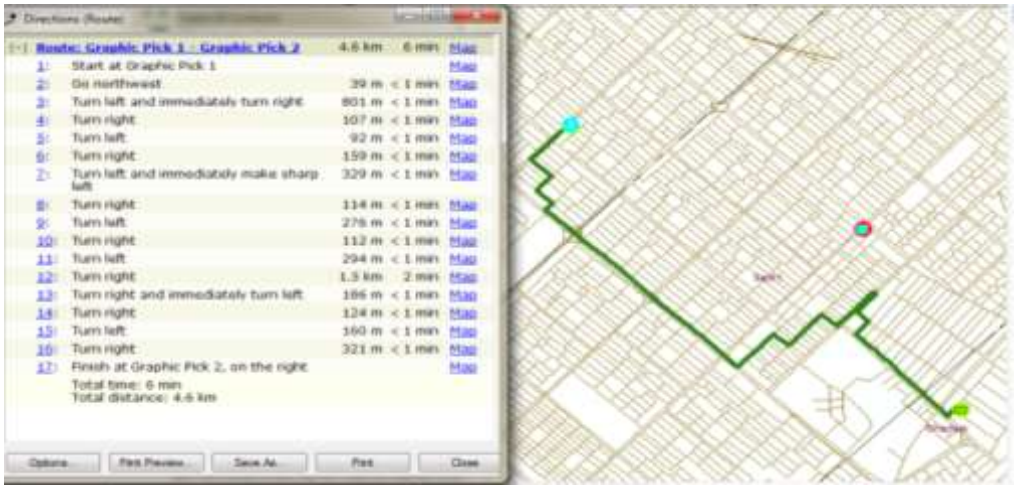

Figure 13: Place a barrier (security control) to change the access path.

The third example is when an obstacle is placed on the road crossing Al-Falah Street (Figure 14).

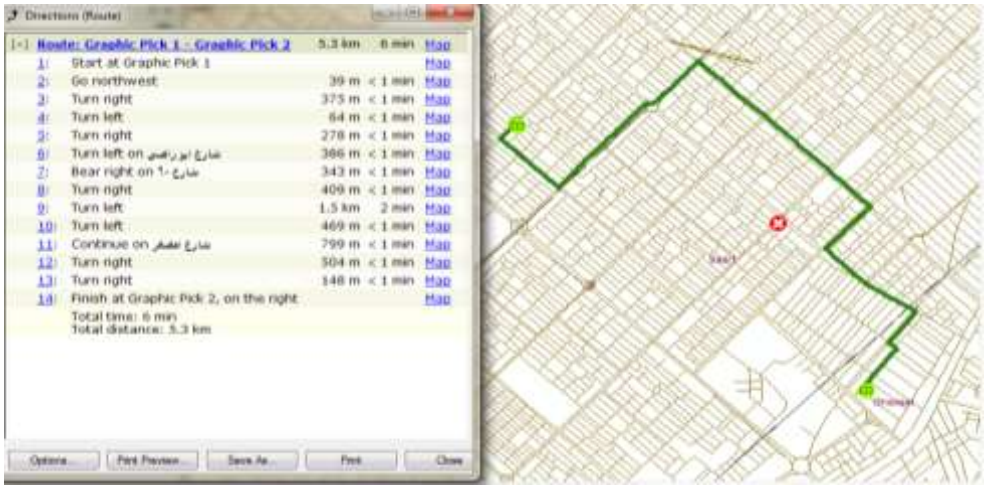

Figure 14: Place a barrier (cut road) to change the access path.

Discussions

After using the data obtained from Drug Control Department for 2022 and identifying the most common places for drug users and dealers, the methods most used by them and the most appropriate in terms of distance and least time were identified. It turned out that there are ten dealers spread in different areas of Baghdad Governorate, Al-Rusafa district; they have contact with drug users directly or indirectly, as for every four dealers, there are points of contact with more than one drug user, as each dealer has at least communication with 4 or 5 drug users within the region. This depends on the shortest possible distance and arrival time through different means of transportation, whether on foot or a motorcycle, which is faster and easier to move within the region. After determining the locations of dealers and drug users widely spread in the Al-Rusafa district, the communication network was used to find the nearest police station in each district in Baghdad. If more than 24 centers were identified and distributed in the Rusafa district, 12 centers were identified to have the ability to follow up and arrest the accused. These stations are Al-Rafidain, Al-Habibiya, Al-Salihiya, Al-Adhamiya, Al-Karama, Al-Jazaer, Al-Tahdheeb, Sulaikh, Al-Amin, Al-Rashad, and New Baghdad.

Conclusions

The significance of using GIS and satellite images in identifying road networks, analyzing and processing data, and displaying it in maps and layers that help the recipient understand and interpret the relationships in these maps. The relationship between information systems and communication networks was close and essential, as it was considered one of the essential relationships related to communication and distinguishing the most appropriate and important roads, as well as measuring the possible distance between any two locations on maps. Google Maps and GPS technology played a major help in locating these critical areas for drug users and sellers. This road network was essential in developing security and intelligence services to facilitate tasks in special operations of Iraqi security forces and their use in police stations to facilitate tasks in terms of time, distance, the shortest path, and the best way to reach the unique destination for operations.

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Table 1: represent the time and length between the castles and four drug traffickers.

ID	Location	Total Length(m)	Total Time(min)
1	Location 1 & 6	9673.9	11.60
2	Location 1 &7	7509.0	9.01
3	Location 1 &8	9675.9	11.61
4	Location 1 &10	6588.7	7.90
5	Location 1&11	5156.3	6.19
6	Location 1&12	4503.9	5.40
7	Location 1 &17	7257.4	8.71
8	Location 4 &1	2524.6	3.03
9	Location 4 &2	12209.2	14.65
10	Location 4 &3	7240.8	8.69
11	Location 4 &4	5191.9	6.22
12	Location 4 &5	10922.8	13.10
13	Location 4 -&9	7120.6	8.54
14	Location 4 &16	9248.3	11.09
15	Location 4 &23	26124.6	31.34
16	Location 5 -&18	9564.1	11.47
17	Location 5 &19	6138.1	7.36
18	Location 5 &20	3208.7	3.85
19	Location 5 &21	1625.6	1.95
20	Location 6 &13	10515.9	12.61

21	Location 6 &14	941.9	1.13
22	Location 6 &15	8100.7	9.72
23	Location 6 &24	53263.9	63.89

Table 2: represent the time and length between the castles and six drug traffickers.

ID	Name	Total_Length	Total_Time
1	Location 3 - Location 6	10165.90965	12.194607
2	Location 8 - Location 12	6560.183915	7.86929
3	Location 8 - Location 13	12449.26322	14.933495
4	Location 8 - Location 14	3271.829127	3.924726
5	Location 8 - Location 15	10034.02411	12.036299
6	Location 8 - Location 24	55197.25519	66.211041
7	Location 9 - Location 19	4696.5685	5.633797
8	Location 9 - Location 20	1767.129181	2.119768
9	Location 9 - Location 21	1107.879318	1.328961
10	Location 10 - Location 2	11903.95728	14.279584
11	Location 10 - Location 3	6362.422907	7.632132
12	Location 10 - Location 5	8447.41424	10.133214
13	Location 10 - Location 7	9778.433261	11.729779
14	Location 10 - Location 8	11945.2886	14.329035
15	Location 10 - Location 9	4258.812098	5.108711
16	Location 10 - Location 10	4231.560747	5.076016
17	Location 10 - Location 11	2362.006405	2.833364
18	Location 10 - Location 16	5837.062574	7.001925
19	Location 10 - Location 17	4403.50679	5.282275
20	Location 10 - Location 18	7461.28491	8.950267
21	Location 10 - Location 23	25819.42884	30.972132
22	Location 11 - Location 1	3779.921569	4.534272
23	Location 12 - Location 4	6366.538755	7.637114

Table 3: represent the time and length between the police station and the merchant.

ID	police office	Name	Total_Length	Total_Time
1	Al -Rafidain Police Station	Location 4 - Location 5	4012.900114	4.813693
2	Al -Rafidain Police Station	Location 4 - Location 6	6095.890412	7.312345
3	Al -Rafidain Police Station	Location 4 - Location 7	6070.845336	7.282302
4	Al -Rafidain Police Station	Location 4 - Location 8	3680.07979	4.414457
5	Al -Rafidain Police Station	Location 4 - Location 9	2193.314976	2.631004
6	Salihiya Police Station	Location 11 - Location 3	2595.411207	3.113369
7	Salihiya Police Station	Location 11 - Location 4	4084.385205	4.899494
8	Salihiya Police Station	Location 11 - Location 11	3346.164055	4.013946
9	Salihiya Police Station	Location 11 - Location 13	1802.2571	2.161929
10	Adhamiya Police Station	Location 20 - Location 12	2469.75016	2.962646
11	Karama Police Station	Location 23 - Location 10	1391.070015	1.66867
12	Habibiya Police Station	Location 24 - Location 1	720.673308	0.864488

Table 4: represent the time and length between the police station and castles drug.

ID	police office	Name	Total_Length	Total_Time
1	Al -Amin Police Station	Location 1 - Location 8	1958.263145	2.349035
2	Al -Amin Police Station	Location 1 - Location 13	8890.142701	10.664163
3	Al -Amin Police Station	Location 1 - Location 15	10129.62664	12.150976
4	Al -Amin Police Station	Location 1 - Location 24	48794.66029	58.530859
5	Al -Rashad Police Station	Location 2 - Location 7	1843.484933	2.211358
6	Al -Rashad Police Station	Location 2 - Location 12	2916.250259	3.498199
7	Al -Rafidain Police Station	Location 4 - Location 14	6159.139438	7.388215
8	Al -Rafidain Police Station	Location 4 - Location 20	1397.33764	1.676185
9	Al -Rafidain Police Station	Location 4 - Location 21	2764.914535	3.316668
10	Tahdheeb Police Station	Location 5 - Location 5	7223.867093	8.665487
11	Tahdheeb Police Station	Location 5 - Location 11	1831.790441	2.19734
12	Tahdheeb Police Station	Location 5 - Location 16	5632.602857	6.756661
13	Tahdheeb Police Station	Location 5 - Location 17	2598.187242	3.116684
14	Tahdheeb Police Station	Location 5 - Location 18	5389.191253	6.464657
15	Tahdheeb Police Station	Location 5 - Location 19	4291.560749	5.147977
16	Baghdad Jadedah Police Center	Location 7 - Location 6	2094.83617	2.51287
17	Salihiya Police Station	Location 11 - Location 1	4140.179385	4.966427
18	Al Sulaikh Police Station	Location 17 - Location 2	10355.75752	12.422447
19	Al Sulaikh Police Station	Location 17 - Location 3	5387.375193	6.46253
20	Al Sulaikh Police Station	Location 17 - Location 23	24271.22908	29.114995
21	Adhamiya Police Station	Location 20 - Location 4	3987.10875	4.782814
22	Revolution Police Station	Location 21 - Location 10	1966.742976	2.359231
23	Algeria Police Station	Location 22 - Location 9	3721.074771	4.463666