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Spatial Analysis of Suicides in the Governorates of Iraq for 2022 Using ArcGIS Pro

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Abstract:

Suicide attempts are a severe global public health concern; suicide patterns might vary based on individual features, techniques, causes, geographical area, and socio-cultural milieu. Suicide rates in Iraq and throughout the world differ significantly by geography. ArcGIS Pro software was used for spatial analysis of the number of suicide cases. Data was collected from the Iraqi Supreme Judicial Council. This study intended to explore spatial patterning and governorate variations in suicide mortality by gender across 15 governorates of Iraq, except for the Kurdistan provinces, between 2017 and 2021, increasing the number of cases by an estimated percentage of 187%. The Suicide Index to 1.409 suicides per hundred thousand people, and the percentage of men who committed suicide was higher than women's suicide rate increased from 96 men and 82 women in 2017 to 286 men and 225 women in 2022; that was based on suicide sites distributed in the governorates of Iraq from the statistics of the Iraqi Ministry of Health. It was found that the Maysan governorate for the year 2022 had the most suicides at 4.6, while the lowest governorate was Anbar at 0.15. The benefit of the study maps designed in the results is to develop planning policies that are appropriate to the location, aimed at mitigating suicide attempts in the governorates of Iraq.

Keywords: Suicide, Kernel Density, ArcGIS Pro, Iraq map, Population.

التباين المكاني لحالات الانتحار في محافظات العراق لعام 2022 باستخدام ArcGIS Pro

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الخلاصة:

تُعد محاولات الانتحار مصدر قلق عالمي خطير للصحة العامة؛ وقد تختلف أنماط الانتحار بناءً على السمات الفردية والتقنيات والأسباب والمنطقة الجغرافية والبيئة الاجتماعية والثقافية. تختلف معدلات الانتحار في العراق وفي جميع أنحاء العالم اختلافاً كبيراً حسب الموقع الجغرافي. تم استخدام برنامج ArcGIS Pro لتحليل المكاني لعدد حالات الانتحار تم جمع البيانات من مجلس القضاء الأعلى العراقي. هدفت هذه الدراسة إلى استكشاف الأنماط المكانية والاختلافات بين المحافظات في معدل وفيات الانتحار حسب الجنس في 15 محافظة

عراقية، باستثناء محافظات كردستان، بين عامي 2017 و2021، مما أدى إلى زيادة عدد الحالات بنسبة تقدر بنحو 187%. ارتفع مؤشر الانتحار إلى 1.409 حالة انتحار لكل مائة ألف شخص، وكانت نسبة الرجال الذين انتحروا أعلى من معدل انتحار النساء من 96 رجلاً و82 امرأة في عام 2017 إلى 286 رجلاً و225 امرأة في عام 2022؛ وكان ذلك بناءً على مواقع الانتحار الموزعة في محافظات العراق من إحصاءات وزارة الصحة العراقية. تبين أن محافظة ميسان سجلت أعلى معدل انتحار لعام 2022، بمعدل 4.6، بينما كانت محافظة الأنبار الأقل، بمعدل 0.15. وتتمثل فائدة خرائط الدراسة المرسومة في النتائج في وضع سياسات تخطيطية مناسبة للموقع، تهدف إلى الحد من محاولات الانتحار في محافظات العراق.

1. Introduction

Suicide is a global phenomenon, causing the death of 700,000 people annually, an average of one person every 40 seconds, and represents the fourth cause of death globally for the age group between 15-29 years; male suicide rates are more than twice as high as female suicide rates worldwide. Suicide happens everywhere in the world, but in 2019, more than three quarters (77%) of all suicides worldwide took place in low- and middle-income nations [1].

The estimated suicide rates in the WHO Middle East region are generally lower than in other areas, and this may be due to the prevalence of religious beliefs, social and cultural norms, and traditions related to suicidal behaviors. However, there is evidence of an increase in suicides in the Middle East region, especially among young people between 15-29 years and the age group of 60 years [2][3]. Namely, grave societal issues have worsened in Iraq's governorates [4]. A geographic information system (GIS) can be a valuable tool in this context for identifying high-risk and critical locations and informing the development of effective public health management decisions and policies. Suicide centers can apply GIS tools to monitor early detection and intervention processes. A precise comprehension of the spatial distribution of suicide methods may facilitate the planning and assessment of suicide prevention initiatives [5]. Studies have varied in determining the spatial variability in monitoring and recording suicides, including. In East and South East England, including London, Congdon, P. A study of hospitalizations for self-harm and suicides among males and females in 3242 local districts (referred to as wards) [6]. Eunah Kim & Seulgi Kim Suicide mortality rates were calculated by gender, age group, and district using South Korea's Causes of Mortality Statistics for 2021. Suicide deaths were substantially higher among men (40.64 per 100,000) and those over the age of 65 (43.18 per 100,000). Male suicide rates vary significantly by area (high global Moran's I, $p < 0.001$), highlighting the necessity for spatial study [7]. Chien-Yu Lin estimated the smoothed standardized mortality rates for overall suicide, as well as suicide stratified by sex and age group, across 432 neighborhoods in Taipei City (mean population size: 5500) between 2004 and 2010 using Bayesian hierarchical models [8]. Andrew B. Trgovac's research investigates the spatial diversity of characteristics related to male suicide in the United States, using county-level data from 2000 to 2006. The results indicate that the global model obscures regional disparities, and the impact of social isolation markers on suicide may differ according to geographic location [9]. According to Eiji Yoshioka's study, which examined the spatial patterning of rural-urban differences in suicide mortality by age group and gender across 1,887 Japanese municipalities between 2009 and 2017, notable differences were observed in the geographical distribution of these differences by age and gender in Japan [10]. The Iraqi National Suicide Study (INSS) is a government effort overseen by the Mental Health Office (MHO) of the Iraqi Ministry of Health. It has been established as part of the Iraqi nationwide Strategy of Suicide Prevention, and it is the first stage in building a nationwide registry of suicide cases to enhance data quality and monitoring suicide cases [11].

The number of suicides (511) in 2022, reported to the Iraqi Ministry of Health, and the official population statistics issued by the Supreme Judicial Council regarding suicides in Iraq, except for the Kurdistan governorates [12]. The number of suicides in the provinces of the Kurdistan region is taken from police stations and population counts from the federal government statistics [13] [14]. The research objective is to combine remote sensing and Geographic Information System technologies to ascertain the incidence of suicide in the governorates of Iraq.

1.1. Study Area

One of the nations that comprises the West Asia and North Africa region, known as the MENA region, is Iraq. It is located in the northeastern section of this region. The longitudes of Iraq are 38° 45' to 48° 45' East, Latitudes: from 29° 5' to 37° 22' N. 438,320 km² make up its area. The number of Iraqi governorates is 18 [15].

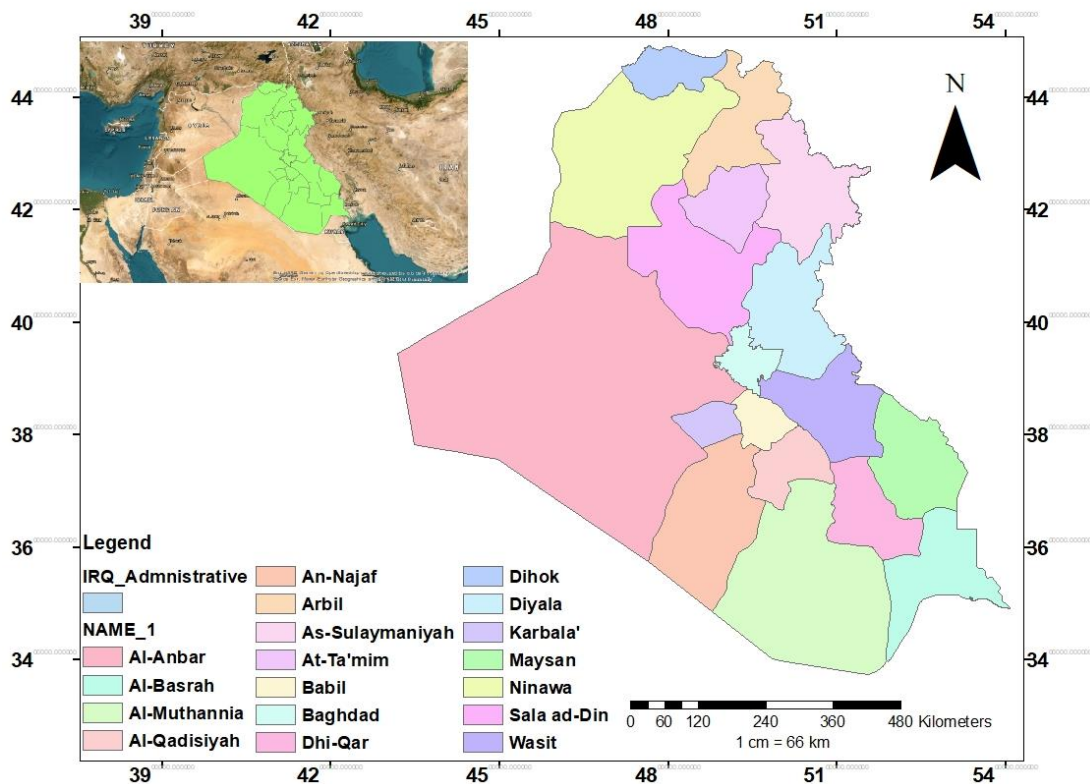


Figure 1: Geographical location of the study area within the WANA region.

2. Methodology

Suicide is defined as a deliberate act in which a person kills themselves. Suicide is typically performed out of despair, which is frequently linked to a psychiatric disease such as depression, manic-depressive disorder, schizophrenia, alcoholism, or drug misuse. Financial issues, the death of a loved one, or difficulty in personal relationships are all common stressors [16] [17]. The study used an analytical data analysis method to meet its goals and produce its findings, and a descriptive technique to illustrate the temporal and regional distribution of suicide occurrences [4]. The required tools for data analysis and high-quality result display were employed using ArcGIS Pro. This program offers numerous impressive features and serves as a professional geographic information system. Descriptive spatial information is used, and ArcGIS Pro (Esri) was employed [12]. Pro ArcGIS has several sub-windows under its umbrella, such as Catalog, Map, Scene Global, and Local Scene [18]. ArcGIS Pro is the most recent version of the desktop GIS. It was designed to utilize the full capabilities of multicore 64-bit

CPUs while making it easy to access GIS services. It has a new interface design and a new work management system. Early versions lacked certain capabilities from ArcMap and ArcCatalog, but additional features have been added with each subsequent edition [19]. Population data analysis and contrast illness incidence, prevalence, and death information. From these statistics, the case rate can be computed by dividing the number of occurrences, such as hospitalizations, fatalities, or suicide cases, in a population by the total population in a given year; these results are usually expressed per 1,000 or 100,000 people. Evaluating the morbidity or mortality of a population, it is essential to examine this rate, as it represents the experience of those individuals [20].

The Standardized Rate (per 100000) is the sum of all suicides divided by the total standard population $= \frac{\sum S}{\sum P} * 100,000$ 1

S = Number of suicides

P = Population

Estimating Kernel Density (KDE): A kernel density estimator in a 2-D space, known as KDE for the remainder of this study, has the following general form [21]:

$$\lambda(s) = \sum_{i=1}^n \frac{1}{\pi r^2} k\left(\frac{d_{is}}{r}\right) \dots\dots\dots 2$$

Where:

$\lambda(s)$ denotes the density at position,

s, r is the search radius (bandwidth) of the KDE,

n is the number of sampling points,

and k is the weight of a point i at a distance d_{is} to the location,

s. k is usually modeled as a kernel function of the ratio between d_{is} and r. In this study[21].

3. Results and Discussions

Through reviewing the official statistics issued by the Iraqi Supreme Judicial Council for the year 2017-2022 as the responsible and authorized body to issue data, figures, and statistics in Iraq, except for the Kurdistan region, on the numbers of deaths caused by suicide, as well as the responsibility of the Ministry of Health for statistics on suicide attempts, 178 suicide cases were recorded in 2017, 206 cases in 2018, 316 in 2019 and 233 cases in 2020, official statistics indicated an increase in 2021, as a result of the emergence of the corona pandemic, 364 suicides and 511 cases were recorded in 2022, From Equation 1 the annual rate of suicide per 100,000 inhabitants was calculated, Table (1).

Table 1: The official statistics of suicides in Iraq, according to the statistics of the Supreme Judicial Council, except for include the Kurdistan region.

The year	Number of cases (S)	Male ratio	Female ratio	Population (P)	The rate per 100000 of the population
2017	178	54%	46%	31967075	0,557
2018	306	57%	43%	32814590	0,932
2019	316	42%	58%	33678525	0,938
2020	233	50%	50%	34558451	0,674
2021	364	56%	44%	35454024	1,027
2022	511	56%	44%	36264860	1,409

Using the ArcGIS Pro program, the political map of Iraq was retrieved using the UTM WGS 1984 system for the Iraq region, specifically 38. The Polygon governorates were drawn to calculate suicides using an equation for each thousand inhabitants, after entering the data in the table above as metadata on the political map of Iraq. Then, it calculated the annual rate for each hundred thousand of the population from the attributes table field calculation.

The percentage of male suicide is higher than women in 2017, 2018, 2021, and 2022 and equal in 2020, and only in 2019 did the percentage of women increase by 17% of men, and the suicide rate increased from 2017 was 96 men and 82 for women and in 2022 the number of suicides is 286 men and 225 women, Figure 2 (A).

An increase in the number of cases observed between 2017 and 2022 by an estimated percentage of 187% and an increase in the Suicide Index to 1.409 suicides per 100,000 people compared to 2017, which was recorded at 0.557 suicides per 100,000 people, Figure 2 (B).

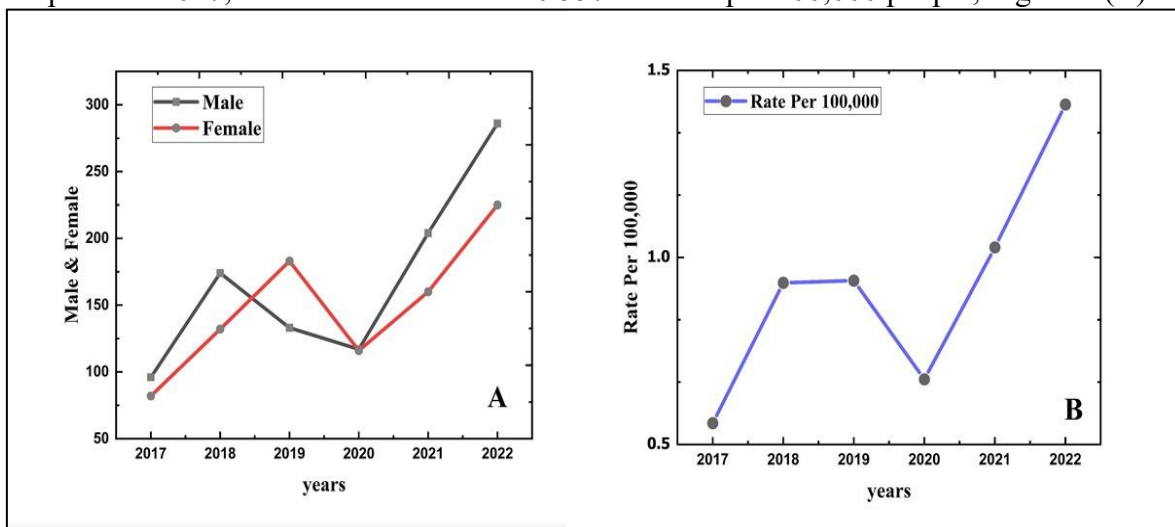


Figure 2: (A) Suicide rate for females and males from 2017 to 2022. (B) Suicide rate from 2017 to 2022.

According to the statistics of the Supreme Judicial Council and police directorates in the Kurdistan region, suicide data, and population censuses were collected for all governorates of Iraq and entered as metadata in the ArcGIS pro Program and a link with the political map of Iraq and the calculation of the annual rate per hundred thousand of the population in the calculation field as in Table 2.

Figure 3 shows the population distribution in Iraq's governorates, with Baghdad being the most populous and Al-Muthanna being the least populous. The population distribution chart shows 11 governorates with a population between 902,480 and 1,915,420, four governorates with a population between 1,915,420 and 2,928,360, one governorate with a population between 2,928,360 and 3,914,300, one governorate with a population between 3,914,300 and 4,954,241, and one governorate, Baghdad, with a population of 9,006,001.

Table 2: Suicide statistics in the provinces of Iraq in 2022, according to the statistics of the Supreme Judicial Council and the statistics of police directorates in the Kurdistan region.

S.	Conservatism	Number of cases (S)	Population (P)	The annual rate per 100000 of the population
1	Maysan	57	1233053	4.622
2	Erbil	77	1903609	4.045
3	Karbala	49	1350577	3.628
4	Duhok	45	1326558	3.392
5	Sulaymaniyah	69	2219193	3.109
6	Kirkuk	37	1770765	2.081
7	Thi-Qar	47	2321851	2.024
8	Babylon	34	2288456	1.486
9	Wasit	21	1527911	1.374
10	Salah-Aldeen	23	1767837	1.301
11	Baghdad	117	9006001	1.299
12	Diala	23	1814368	1.268
13	Al-Qadisiya	17	1430714	1.188
14	Al-Basra	34	3223158	1.055
15	Al-Najaf	16	1630807	0.981
16	Nineveh	29	4133536	0.702
17	Al-Muthanna	4	902480	0.443
18	Anbar	3	1963346	0.153

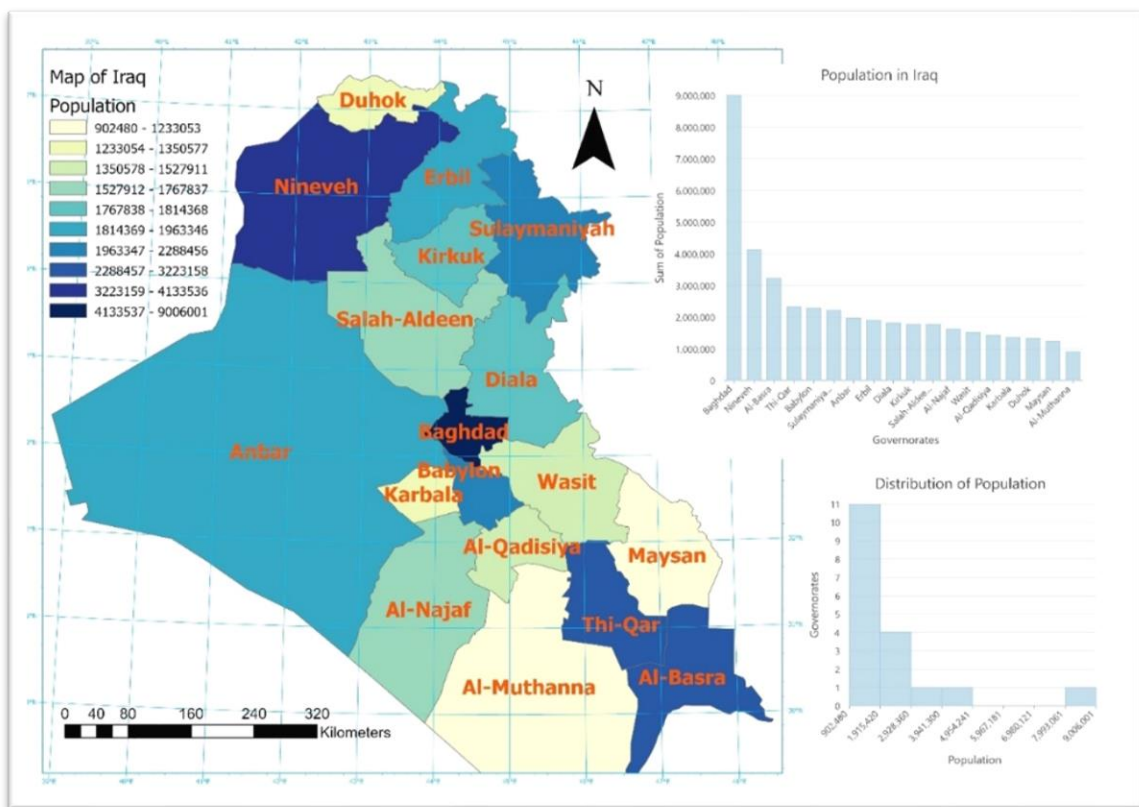


Figure 3: Population in the Iraqi governorates.

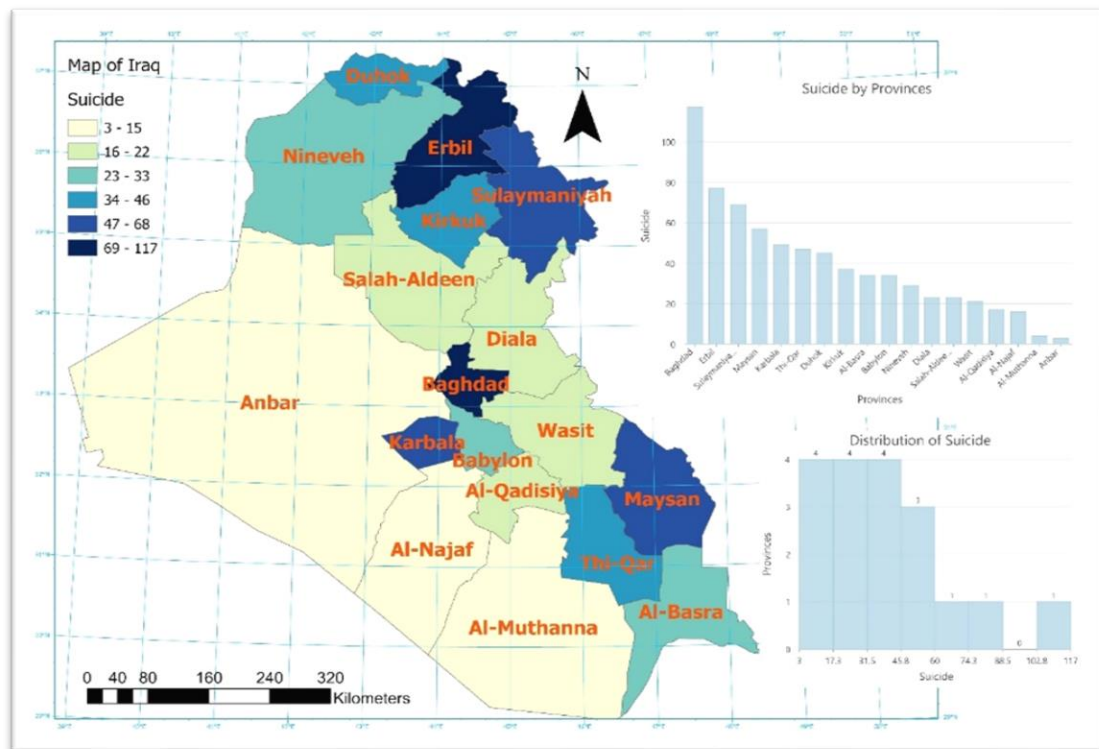


Figure 4: Number of suicides in the Iraqi governorates.

Figure 4 shows the number of suicides in the governorates of Iraq; the greatest number of election cases in the Baghdad governorate was 117, while the least province that had three suicide cases was the Anbar Governorate. As in the prevalence chart of suicides, there were four governorates from 3 to 17 suicides, four governorates from 17 to 31, four governorates from 31 to 45 cases, three governorates from 45 to 60 cases, a unit governorate from 60 to 74 cases, a unit governorate from 74 to 88 cases and a unit governorate from 102 to 117, namely Baghdad. Spatial analysis of the annual rate per 100,000 population, using the kernel density tool to estimate probability density, is a non-parametric method for determining the probability density function of the rate per 100,000 population variables based on kernels as weights.

The number of suicides in the governorates of Iraq relative to the population; as figure 5 from the ratio chart shows, the highest suicide rate for the population is Maysan at 4.6, and the lowest governorate is Anbar at 0.15. Moreover, the Suicide rates are higher in darker locations. They gradually decrease in brighter areas. The distribution diagram shows one governorate from 0.4 to 0.6 percent, one governorate from 0.6 to 0.8, three governorates from 0.8 to 1.1 percent, six governorates from 1.1 to 1.3, two governorates from 1.3 to 1.5, three governorates from 1.7 to 1.9 and two governorates from 1.9 to 2.2 percent of the number of suicides per thousand inhabitants.

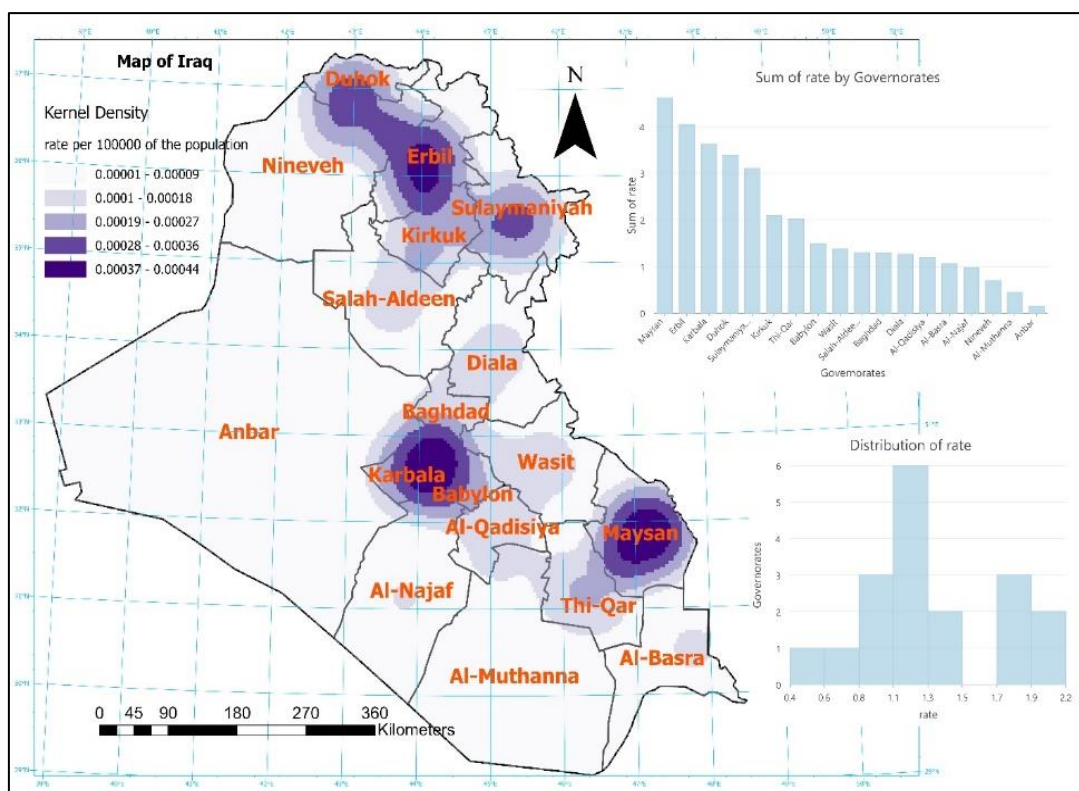


Figure 5: Kernel density is the annual rate per 100,000 of the population.

4. Conclusion

According to the results, the suicide rate among the residents of Maysan, Erbil, Karbala, Duhok, and Sulaymaniyah is higher than in other governorates in 2022. The number of suicide incidents was noted to be the most cases in the Baghdad governorate, 117, and the least number of suicide cases in a province, three, was in Anbar Governorate. An increase in the number of suicides was observed between 2017 and 2022 by an estimated percentage of 187%, and an increase in the suicide index up to 1.409 suicides per hundred thousand people compared to 2017, which was 0.557 suicides per 100,000 people; the percentage of male suicides was higher than that of women in 2017, 2018, 2021, and 2022 and equal in 2020. Only in 2019 did the percentage of women increase by 17%, and the suicide rate increased from 96 men and 82 women in 2017 to 286 men and 225 women in 2022. This distribution illustrates the diverse population of the governorates, with Baghdad being the most populous, at 9,006,001, and Al-Muthanna being the least populous, at 902,480. The research aims to conduct a spatial analysis to reduce suicide cases throughout Iraq, to identify the factors contributing to the high suicide rate in the aforementioned governorates, and to mobilize police stations, officials, and community organizations to curb this growing and perilous trend in Iraqi society.

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