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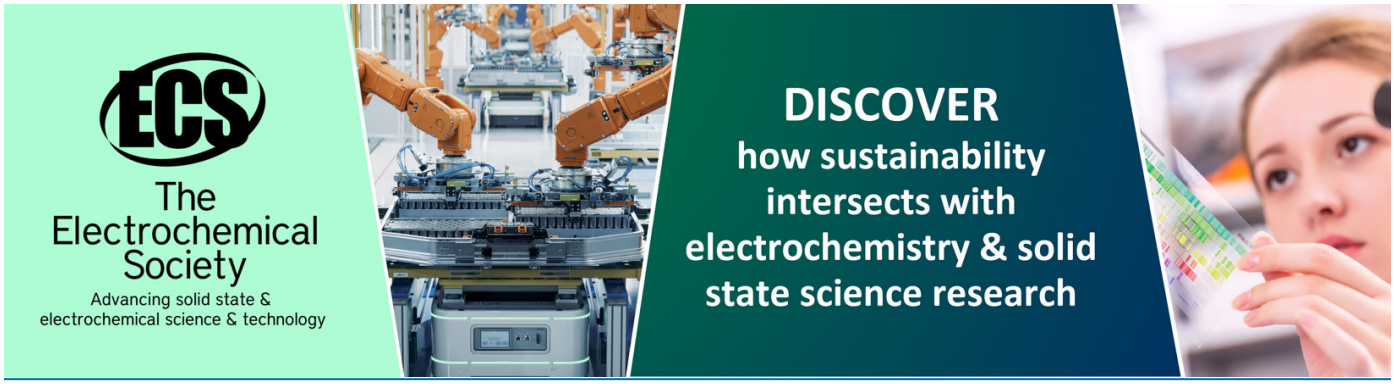

Color coding for Disaster Risk level in urban environments

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Abstract. Reducing risks and coping with disasters in contemporary cities has become a necessity when dealing with urban systems at different levels. The problem of the research focuses on the weakness of information and indicators available in urban maps related to preparedness for disasters and their potential risks. The paper aims at establishing risk levels and coding them in color codes and assuming that they can be marked on the basic maps, introduced and represented within the GIS program, and used in providing the necessary information for preparedness and response to disasters. The question is (how to denote the level of seriousness and threat of disasters in contemporary cities and what are the indicators included in this coding?). Hence, the hypothesis refers to "prediction of disaster occurrence depends on many factors interact with each other to form one colored structure" while the methodology was based on the creation of an evaluation matrix that includes influential indicators in the prediction or occurrence of the disaster and its consequences. The study of the city was taken Baghdad as a case study, The results showed the disparity of risk ratios in urban environments within the city of Baghdad, and opens the door to represent those risks on maps to be a reference for each urban intervention or disaster management policy or any study or procedures that require that information.

Key words: Color coding; Vulnerability; disaster risk.

1.Introduction

The aim of this research is to review the existing knowledge about the methods used in risk analysis and measurement of threats to urban systems, including indicators in the field of disaster management and preparedness, and to represent these standards in the form of color-coded data in cooperation between the different specialties using digital programs, including GIS.

The use of digital techniques to shape our understanding of cities multiplies the evolution of urban theories and how they affect design and urban planning and linking them using computer modeling and planning, such as GIS that are less expensive to implement, less difficult to learn, more intuitive and above all more customizable (1). Modern technologies with data that are sensed in the GIS environment are opening up the space to help manage crises. The most important component is the Crisis Preparedness Plan, Spatial data science contributes significantly, Preparedness protects the population

from disasters through a dynamic Contributes to the analysis of the qualitative characteristics of data and access to data from crisis management personnel to facilitate communication between the sending and rescue team. This is facilitated by placing keys in maps where colors and shapes are the main features used (2).

Perceived risk as the possibility of a risk during a given period of time while weakness is exposure to injury or damage caused by the risk, while the disaster is the occurrence of risk leads to injury or significant damage, as can be seen at risk elements as layers of spatial information (Eg population, characteristics, infrastructure) and these layers can be integrated through spatial modeling procedures to arrive at an effective risk assessment (3). Risk appraisal is the way toward contrasting the consequences of risk investigation and risk criteria to decide if the dangers and/or their size are satisfactory or not. Risk criteria are the terms of reference under which hazard is evaluated. Risk criteria may incorporate costs, lawful necessities, social, monetary and ecological elements, And so on. Risk appraisal is utilized to settle on choices about the significance of dangers, regardless of whether to acknowledge or treat every particular risk (4)

2.Psychology of colors

Colors affect people's perception, this is influenced by different cultures and ages, some of them are relaxing, some of them help to activate and stimulate the brain and other connotations that may vary by different people and the collective memory of the society as a whole.

Psychological, emotional responses are often people attribute to one color picking it consciously, but in practice no effective response is triggered by a single color, but by color groups, individual colors psychological characteristics are universal, but when combined they produce in response Emotional and that can be a positive or negative reflection on the fundamental characteristics of color, either in private there is no classification of any color that is bad or good (5). For example, the blue color in the maps refers to water, sky or cold. Either symbolically indicates consultation and recommendations. Green in the maps indicates plants. Symbolically indicates the starting, security, the right thing and the good thing. Vegetation or drought and others symbolically refers to caution, preparedness, warning, either brown in the maps refers to the ground mountains warmth, red in the maps important elements or roads or cities or hot thing, symbolically denotes stop, danger, warning, something unsafe, white In maps shows high altitudes, symbolically j Indicates data or neutral thing (6). Therefore, the expression of color is not uniform in the psychological impact on people, and that according to international conventions, it is possible to determine the symbolism of colors according to different disciplines stemming from indicators leading to this, there are global agreements in different disciplines, for example, planning and architectural design in the use of certain colors with a certain symbolism.

3.Color and spatial dimension

Maps of land use is one of the ways that use color coding in the expression of the place and nature of its activities and statements, infrastructure and roads and other facilities.

Maps generally a different color for each category of the main land use is common, for example, provide residential uses: yellow (like family), Brown for multiple homes and towering housing families, commercial uses red, magenta for industrial uses, Blue, green for recreational uses, leaden of industrial facilities (Sanjay Jeer ،1993). Common methods in color-coding to show the data in the form of several programs, including maps by GIS, which helps to visualize that data faster, as the graph (below).

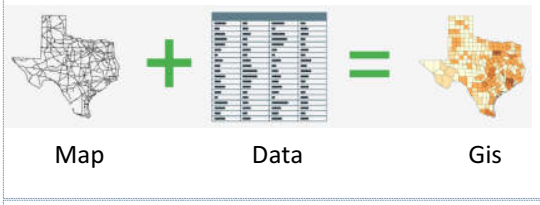

Figure 1: The function of Gis

source :(https://mangomap.com/what-is-gis)

Therefore, possible to invest such applications in the area of risk reduction and disaster response in many ways, the paper is a measure of risk depending on the levels of vulnerability in urban areas and then suggest chromatic encoding of data representable in the form of maps.

Color classification and its relationship with risk

There are degrees of color classification of risk and safety in several areas, universally agreed, where green is less risk and red top those grades.

- Color risk divided as follows (Indiana University):
- Red level-extremist (emergency)
- orange-(emergency)
- yellow-moderate (active emergency)
- Green level-normal (daily operations)

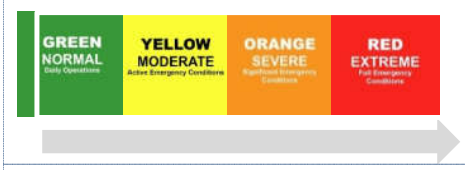

Figure 2: Direction of risk escalation

Source: (Indiana University)

There is agreement that green expresses situations better in terms of security, while the term (Red Zone) is used to refer to several settings (spatial and temporal) that may qualify as a hostile or dangerous or lately, including anything that results from natural disasters such as hurricanes and earthquakes, as well as those associated with the terrorist attacks and war (7). Therefore, can combine colors used in basic maps for land use and expression among those intended to express the scale of danger.

4. Disaster risk

The term "disaster risk (risk Disaster Research (usually the size of expected damages and losses caused by a natural event in the area is calculated as the product of factors of risk and vulnerability (8). Affected by the destructive power of the disaster occurred many physical characteristics (for instance, the size and extent of impact, just as the level of presentation to impacts), yet the intensity of physical fiasco (physical) are inadequate to clarify the (Risk), territories confronting equivalent degrees of power to certain calamitous occasion may Presented to various degrees of risk (chance), shortcoming ((vulnerability is an idea that clarifies why, synchronized with the great quality of the catastrophe,

individuals and property which thus cause various degrees of risk (9). Risks of disasters (region or family or anyone) consists of two elements: danger ((hazard)) and ((vulnerability)) (10). And there's an equation to calculate the risks of natural disasters on the basis of these two elements (10):
Disaster risk= hazard* vulnerability
That there is a direct correlation between the increase in vulnerabilities (vulnerability) and increase the potential risks, so must review public vulnerability factors in selected areas of study.

5.Vulnerabilities

Various factors weak element basis effect of the disaster on society and urban environment (whether at the level of physical and non-physical environment), so this element linked to flexibility and responsiveness to the cities through finding and trying to downgrade.

Since all natural hazards pose a threat to humans, natural disasters occur only when potential threats with human life, there is a wide range of risks involving all the risks derived from technical and human activity, and many categories The risks that interact with each other (11).

Factors which exacerbate the impact of disasters on urban systems (12):

- Population growth is considered.
- Indiscriminate land use.
- The poverty that forces people to resettle dangerous areas.
- Factories that work on dangerous substances which give rise to harmful substances or radiation for example.
- Technical solutions such as the towering blocks or large dams.
- Poor population because of poor health and inadequate infrastructure

Any vulnerability that can be divided into political, economic and social factors and design and planning. Disaster risk reduction can be considered as the development and implementation of policies and strategies and methodological practices to minimize vulnerabilities and disaster risks throughout society to prevent the negative effects of the notification, within the broader context of sustainable development, for example, in South Africa, reducing Disaster risk is an integral part of disaster management (13).

a set of policies designed to analyze weaknesses in the system, and that in the event of a disaster, coupled as impact factors, thus reducing those dots and reverse its effects.

From previous studies in the field of global vulnerability indicators as in the table below:
The focus areas of the Ministry of Planning are: education, health, safety, economy, social security and housing, As in the following table:

Table 1: Risk Indicators Based on the Iraqi Ministry of Planning indicators at the disposal of researchers

Field	Components
Education	Number of people who are illiterate or have not attended school
	Number of people who have completed university education

Safety and Security	Assessment of the level of safety and protection by residents in the area
Health	Distance to the nearest health center / doctor
	Malnutrition
	Negative working conditions
Economic situation	Dependency rate
	Average household income
	Loans and advances
	Investment
Infrastructure	The main water source
	Electricity source Sewage
	Waste lifting
	The quality of the road leading to the dwelling
Housing	Roof material
	Material of walls
	Total rate of quota for individual rooms
	Water heating

The criteria adopted in the assessment (based on the deprivation and living map of the Iraqi Ministry of Planning) (14) at the disposal of researchers:

1. Education: based on the calculation of the proportion of people who did not attend school.

2. Health:

- Distance to the nearest health center / doctor: The family is considered deprived if the distance is more than 5 km.

- Malnutrition: A child aged 6 months to the age of less than 5 years, the weight to be the result of half the weight.

- Negative working conditions (a composite index based on the number of negative influences of nine working conditions are dust and gases, chemicals and radiation, heat, humidity, noise, lighting, insects, stress and others): where a person is considered deprived if he suffers from 5 conditions Or more.

3. Security and Safety: we set a scale for household assessment of the security level, As shown in the table below:

Table 4: Safety measure in the field of security and protection (prepared by researchers)

Scale	Risk Assessment
Very good	0%
Good	25%
medium	50%
Weak	75%
Very weak	100%

4. Economic situation:

- Dependency rate: the result of dividing the size of the family by the number of individuals working in it, if the rate is 5 or more or if there is no individual working, the family is deprived, we take the total dependency rate by dividing the total number of individuals by the total number of individuals working.

- Average household income: We set a measure to estimate the level of income, deprivation is (100%) If the answer is weak or very weak.

- Loans and advances: The family is considered deprived if there are loans or advances.

5. Infrastructure:

- The main water source: The family is considered deprived if the water source is not the public network.

- Source of electricity: The family is considered deprived if the source of electricity is not the public network.

- Sanitation: The family is considered deprived if the housing is not connected to a septic basin, or the public sewer network.

- Waste removal: If the means of waste collection is not put in a special container or collected by the garbage worker, the family is considered deprived.

The quality of the road leading to the dwelling: If the road is not completely paved, the family is considered deprived.

6. Housing:

- Roof material: The family is considered deprived if the roof material is not iron ribs or concrete.

- The material of the walls: We considered the danger scale if the material of the walls was not brick or concrete block.. Etc. iron sheets, clay..etc.

- The total rate of individual quota of rooms: the result of dividing the total number of individuals by the total number of rooms, if the result is less than 0.5 there is deprivation, we put a measure of deprivation in this category as shown in the table5 below:

Table 5: Measure of the total rate of output of individual rooms

The average	Risk Assessment
0.41-0.49	25%
0.31-0.4	50%
0.21-0.3	75%
0.1-0.2	100%

- Water heating: The family is deprived if the source of energy to heat water for bathing is white oil (kerosene) or wood or coal or other types of energy sources.

Table 2: The chromatography risk scale

Scale	%0_%25	26%_50%	51%_75%	76%_100%
Color	Green	Yellow	Orange	Red
Color gamut				
	Normal	low risk	High Risk	Very high Risk

6. Case study

The study area is Karada, (In particular, the eastern Karada), and Sadr City (the sectors (4) and (0)) in Baghdad Their location as shown in Figure(4). The reason for choosing the two regions is the disparity in services between the two regions, The sample of 20 intentional house of each sample, which were randomly selected within the selected areas, As the residential area consists of 400 families according to the standard, so 20 families means that the sample represents 5% and this is consistent with the scientific method of statistics.

The questionnaire for the points that have been mentioned as aforesaid weakness in the urban environment points, Education, Health, Safety and Protection, Economy, Infrastructure and Housing.

After questionnaire for the six fields mentioned above, by calculating the percentages of each field, through evaluate sub-indicators for each field, and extract percentages for each, as in the table(7) below:

Table 3: Indicates the status quo data identified in each of the six fields

Education						
Region / Categories	Number of samplesand dwellings	Total number of persons	Number of people who are illiterate or have not attended school	Number of people who have completed university education	Percentage of people who are illiterate or have not attended school	Percentage of people who have completed university education
Karada (Eastern Karada) (locality 909 and locality 911 and family from locality 907)	20	123	8	26	6%	21.1%
Sector 4 - in Sadr City	20	180	31	18	17.2%	10%
Sector-0- bypass area in Sadr City	20	113	23	7	20.4%	6.2%

Percentage of deprivation					
Karada (Eastern Karada)	6.5%	Sector 4 - in Sadr City	17.2%	Sector-0- bypass area in Sadr City	20.4%

Safety and Security						
Region Categories	Karada (Eastern Karada)	percentage For deprivation	Sector 4 - in Sadr City	percentage For deprivation	Sector-0- bypass area in Sadr City	percentage For deprivation
Security level	20 samples (very good)	0%	20 samples (medium)	50%	15 samples (medium) 5 samples (weak)	56.25%

Health field						
Region	Karada (Eastern Karada)	percentage For deprivation	Sector 4 - in Sadr City	percentage For deprivation	Sector-0- bypass area in Sadr City	percentage For deprivation

Categories						
Distance to the nearest health center / doctor	4 samples (from 300 Up to 500 meters) 16 families (out of 100 Meters or less)	0%	20 families (the health center or doctor is 100 m or less and the presence of a center to serve the rest of the nearby residential shops)	0%	20 samples (health center or doctor is more than 1.5 kilo)	0%
Malnutrition	There is no malnutrition	0%	10 families (16 least children)	50%	17 families (26 less weight children)	85%
Negative working conditions	There are negative working conditions but less than Five conditions	0%	20 families with 7 adverse working conditions)	100%	20 families suffer from 6 of the negative working conditions mentioned in the questionnaire in addition to 2 of the non-mentioned conditions (rats, loose dogs)	100%
Economic situation						
Region / Categories	Karada (Eastern Karada)	percentage For deprivation	Sector 4 - in Sadr City	percentage For deprivation	Sector-0- bypass area in Sadr City	percentage For deprivation
Dependency rate	The aftereffect of isolating the all out number of people by the all out number of representatives (4.6), under five	0%	The aftereffect of separating the all out number of people by the all out number of workers (1.7), under five	0%	The aftereffect of separating the all out number of people by the complete number of workers (2.45), under five	0%
Average household income	-5 samples (weak) -15 samples (average)	25%	-8 samples (weak) -12 samples (average)	40%	-14 families (weak) -6 samples (average)	70%
Loans and advances	One family (emergency)	5%	-13 families (land purchase) -7 families (consumer goods, buy a motorcycle to work)	100%	-4 samples (land purchase) -16 samples (consumer goods)	100%
Infrastructure						
Region / Categories	Karada (Eastern Karada)	percentage For deprivation	Sector 4 - in Sadr City	percentage For deprivation	Sector-0- bypass area in Sadr City	percentage For deprivation
The main water source	20 samples(connected to public water network with little interruption)	0%	-6 samples (public network frequent outages) -14 (family network public outage few) -6	0%	-8 samples (car Pelvic) -12 samples(bypassing a public network)	100%

			samples (electricity)			
Electricity source Sewage	20 samples(electricit-y from public grid and other source only)	0%	20 samples(electri-city from public grid and other source only)	0%	20 samples(override on public network and other source)	100%
Sewage	20 samples(sanitation through public network)	0%	20 samples(sanitatio-n through public network)	0%	20 samples (septic tank + covered stream)	0%
Waste lifting	Each sample answered (uploaded by the municipality or municipal contractor)	0%	- 6 samples (special container) - 14 families (raised by the municipality or the contractor of the municipality)	30%	- 2 samples (thrown out) - 12 samples (special container) - 6 samples (waste collected and burned)	100%
The quality of the road leading to the dwelling	- 4 samples (paved road without pavement) - 16 samples (paved road with pavement pavement)	0%	- 16 samples (paved road without pavement) - 4 samples (paved road with pavement pavement)	0%	20 samples (unpaved road)	100%
Housing						
Region / Categories	Karada (Eastern Karada)	percentage For deprivation	Sector 4 - in Sadr City	percentage For deprivatio n	Sector-0- bypass area in Sadr City	percentage For deprivation
Roof material	-9 samples (Concrete reinforced) -Single samples (other (Iron sheets)) -10 families (Brick and iron (Section I))	55%	-4 samples (Concrete reinforced) -16 families (Brick and iron (Section I))	80%	-3 samples (Concrete reinforced) -6 samples (Brick and iron (Section I)) -11 samples (other(Iron sheets))	85%
Material of walls	20 families (Bricks)	0%	20 families (Bricks)	0%	- 17 families (Bricks)	0%
					-3 samples (concrete block)	
Total rate of quota for individual rooms	Dividing the total number of rooms output (68) on the total number of people (123) Equals (0.55)	0%	Dividing the total number of rooms output (61) on the total number of people (180) Equals (0.34)	50%	Dividing the total number of rooms output (35) on the total number of people (113) Equals (0.31)	50%
Water heating	20 samples (electricity)	0%	-4 samples (oil) -10 samples (gas)	70%	-3 samples (Gas) -17 samples (electricity)	85%

7.Results

Table (8) below shows the total risk ratios for each field and then the overall rate of ratios for those fields for each region, where the highest risk ratio was in Sadr City, Sector-0- and then followed by Sector-4, and karada comes in last place in this area, where the highest risk ratio was in the field of housing for The 13.8% of the eastern karada area (which is considered within the least dangerous area and symbolized in green), while the highest risk in the fields of security and protection, health and housing) was 50%, in Sadr City Sector-4 (which is considered within the area classified as medium-risk and symbolized by color In Sector 0, the highest risk field was the 80 percent infrastructure (which is considered to be in the area classified as very dangerous and symbolized in red), with high percentages also in other areas, which are also classified as dangerous (security, protection, health and housing). As shown in Figure(1).

Table 4: The deprivation rates in each field

Feilds / Region	Education -ED-	Security and protection -SP-	Health -HE-	Economic situation -HC-	Infrastructure -IS-	Housing -HO-	The rate of total ratios as a whole
Karada (Eastern Karada)	6.5%	0%	0%	7.5%	0%	13.8%	4.6%
Sector 4 - in Sadr City	17.2%	50%	50%	35%	6%	50%	34.7%
Sector-0- bypass area in Sadr City	20.4%	56.25%	61%	42.5%	80%	55%	52.5%

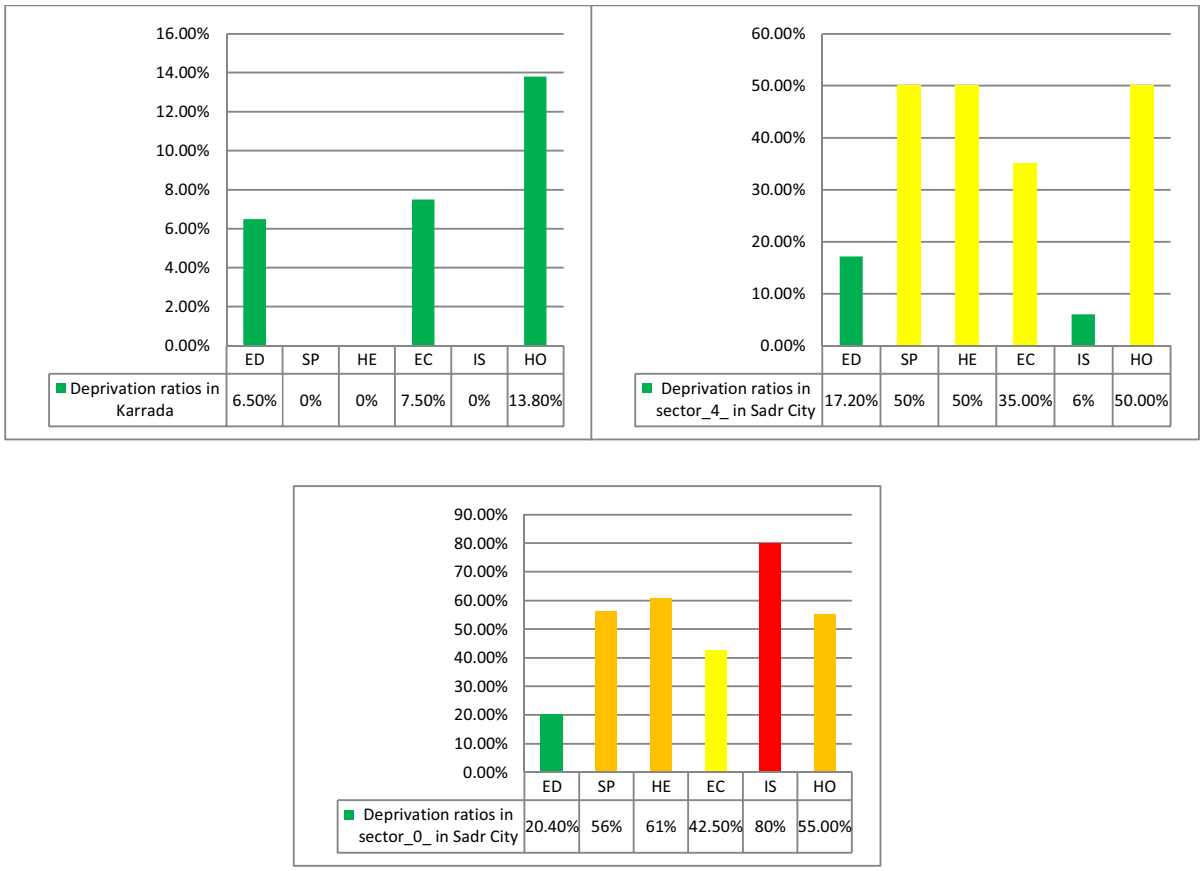

Figure 3: Chart showing risk ratios for each field for the three regions

The refore, if represented in the form of color circles for each region as described in figure (4)**:**

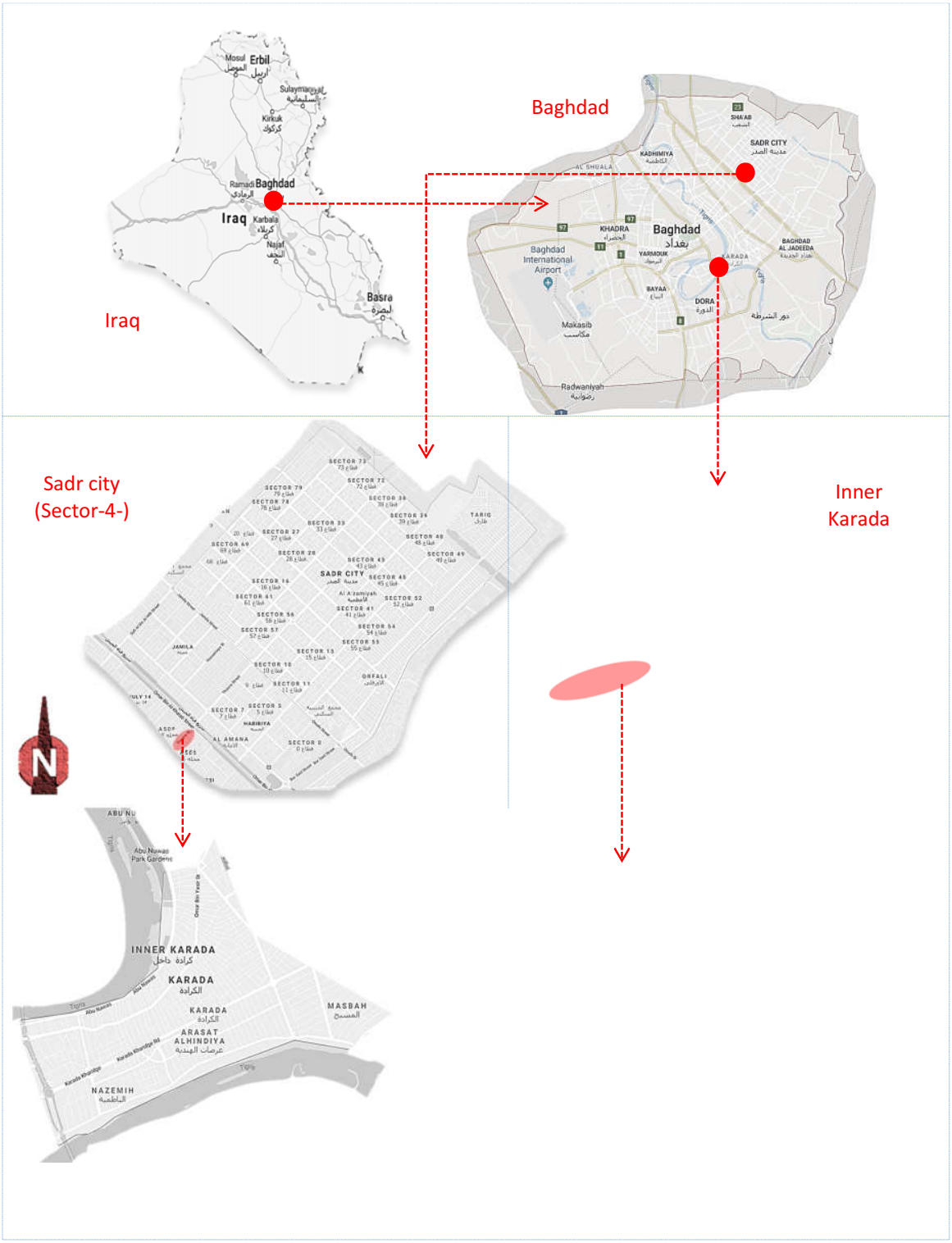
Iraq
Baghdad
Basra
Baghdad
Sadr city
(Sector-4-)
Inner
Karada
N
INNER KARADA
KARADA
KARADA
ARASAT
ALHINDIYA
MASBAH
NAZEMIH

Figure 4: The location of the regions, and the color circle of each area

8. Discussion

The methodology of the research summarized in extracting a color ruler of risks from previous studies and then developing a relative measure of those risks for those colors and then making a measure of the level of risk and from previous studies also by extracting risk indicators in the urban environment in the different fields of those environments and reaching To the sub-indicators and the measurement of these indicators so that it results in a relative measure and a color symbol of the risk where the risk levels can be represented in color for each region in a color circle that can be used to represent those ratios on spatial maps. This method can be used in several programs, including the storage of data for areas according to the levels of risk that can be utilized at the level of the various departments of institutions concerned with this field, which help to identify urban problems and thus try to solve them and reduce them in projects. The proposal for development, but at the level of research, we find in general the highest risk we find in the field of housing, which should focus on the field in particular to meet the needs of individuals and families in housing, in addition to the field of security, protection and health, which should be improved in these areas and given.

9.Recommendations

The research paper recommends the development in the field of spatial risk maps in urban environments in different fields and be updated continuously, through the representation of data by the GIS program, for example, and the introduction of these color codes to be part of the program, so as to be used in development projects and neighborhoods of different regions, And also benefit in the area of disaster response and risk, and can be used in determining the most appropriate and safest places, to overcome the period of disaster and beyond.

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