Assessing the resilience of a city in relation to its healthy urban systems: a case study of Baghdad city

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Abstract. This research investigates the relationship between city resilience and its urban systems. The study determines the efficiency of a healthy urban system as one of a main characteristic in achieving a compatible resilient city. Most of the current studies are theoretical and suggest pathways and procedures that are beyond virtual practices. Healthy urban systems are suggested to link human well-being with the effectiveness of the city infra-structure and municipal services. These services are associated with the drinking water supply, sewage disposal, garbage system, and adequacy of the transport system. Many recent approaches have agreed on the importance of these elements related to resilience. However, any involvement in operation of these elements may lead to all types of pollution. This may eventually affect the nature of the urban system and reduce the city’s resilience to pressure and disasters. The study intends to explore this relationship in the city of Baghdad. This city has faced accelerated disasters for many years. The research attempts to determine the resilience pathway of Baghdad and investigate its ability based on its urban system. The research concludes that sound healthy urban systems are one of the most effective pathways to achieve resilience in the city of Baghdad. Introduction.

Keywords: Baghdad; resilience; urban system; healthy city; pollution

1. Introduction

The principles of urban sustainability have been developed and practiced widely in many of the most progressive cities and municipalities in the world. However, these places are increasingly suffering the risk and threats associated with various types of natural and environmental disasters. More specifically, these include issues related to energy resources, increases in demand outpacing the supply of certain goods, climatic pollution, old urban structures that are gradually deteriorating, and non-biodegradable garbage that continues to accumulate in environmentally sensitive areas. These threats have resulted in a variety of serious consequences for the affected cities, communities, and their residents. Therefore, urban and municipal structures and infrastructure must be made more resilient and carefully constructed to manage any threats in the future. Urban resilience is the capability of urban systems, communities, individuals, unions and companies to recover maintain their function and prosper in the reverberation of a tremor or a stress, regardless its impact, frequency or magnitude. [1] Resilience in community systems has the added human ability to anticipate for the future [2] In the similar approach, is the definition of resilience as “the aptitude of systems and components, to react in such a way to internal or external disturbances that – after a period of recovery – the crucial characteristics (abiotic and biotic characteristics, as well as functional relationships) are retained. [3] It is only current, that...
resilience has been developed with cultural identifications. Cultural resilience “has appeared to refer to this continuity of a co-established set of long-term relationships between the cultural character of a people and the set of social-ecological relationships within which this identity was founded. [4]

2. Materials and Methods

2.1. City Resilience Framework

This framework was developed by (Arup*) and supported by the Rockefeller Foundation. This framework which is adopted by this paper is designed to integrate theoretical and empirical knowledge of the factors that contributing to resilience with processes for translating those concepts into practice [1]. The framework consists of variables that provide a robust basis for measuring resilience at the city scale. Moreover, this index contributes to increased flexibility and provides an inter-city language to share experience in enhancing and improving urban resilience [5]. The framework includes four basic dimensions for resilience and each category has three drivers and qualities which represent the actions that can be taken to improve the flexibility and resilience of cities, fig. 1 summarizes the framework, the basic dimension, drivers, and qualities that are important to the entire system.

Figure 1: City Resilience Framework [5]

2.1.1. Basic Indicators and Drivers for the Resilience Cities

The city resilience framework comprises 12 indicators that refer to the fundamental qualities of a resilient city, as shown in the (Table 1).

(a) an independent firm of designers, planners, engineers, consultants and technical specialists offering a broad range of professional services. Through our work we make a positive difference in the world.
| Drivers                      | Indicators                        | Indicators dimensions                                                                 |
|------------------------------|-----------------------------------|----------------------------------------------------------------------------------------|
| Health and Wellbeing         | Human Vulnerability               | In times of crisis, it is essential to ensure that individuals have access to their basic needs for survival such as food, water, sanitation and energy. |
| Living and Employment        |                                   | Facilitate individuals to access various livelihoods and employment opportunities, including access to investment in business and social welfare. This includes skills training, fair business policy, and innovation. |
| life Protection and Services |                                   | Offer access to active emergency conditions and public health services to protect mental and physical health. |
| Economy and Society          | cohesive and integrated communities | Create a sense of collective identity and mutual support. This includes building a sense of local identity, social networks, |
| Social Stability, Security and Justice |                                   | Ensure a holistic approach to law enforcement and justice that promotes a stable, secure and just society. |
| Economic Prosperity          |                                   | Ensuring sustainable economic system which creates contingency funds for private and public sectors. Thus, cities will be able to respond to any economic crises and change and pursue long-term affluence. |
| Urban Systems and Services   | Conversation of Environmental and Artificial Assets | Preserve natural and artificial resources to reduce the exposure and vulnerability of the city systems. |
|                              | Continuity of Critical Services    | The effective management of resources creates enhanced knowledge city systems which accommodate unusual pressure and demand and maintain function continuity. |
|                              | Communication and Mobility         | Provide cohesive flow and reliable communication between people, places and services. |
| Leadership and Strategy      | Leadership and Management         | Promote effective and purposeful leadership during crises. This involves enhancing inter-sectoral communication and supporting effective decision making. |
Healthy Cities Concept

The city's health concept is referred to community sharing and contribution between municipal firms, citizens, planning firms, and individuals to recover human wellbeing, environment quality, and the quality of living in the cities. This type of sustainable urban system was developed to improve a city’s characteristics in physical, social, economic, environment, and even spiritual terms. Eventually, the improvement of both urban health and the urban environment leads to revitalization. Moreover, the urban health system emphasizes issues related to improving the healthy environment, refining water supply and sanitation, reducing all kinds of pollution, and improving urban housing [6].

Healthy development in urban parts engages, health facilities, the nature, the economy, population development, social issues, education and consciousness, etc. To reach enhanced health, the healthy cities concept provides a good chance to address all the bases of health in united and holistic manner. It has its establishments in community participation and aims to put health at the centre of social and political agenda of the city. The concept also offers public health and environmental control, inspires innovation and depend on mobilization of skills and the community involvement, capitals and ideas [7]. A healthy city has an expressive level of promise, assisted by dependable structures and supported by procedures to attend all the factors of health in accomplishing healthy cities. There must be efforts by the city and local government, nongovernmental organizations and community groups to work together to address all of the urgency issues [8]. Political promise augmented by intersectoral support and association by stakeholders is an vital factor in the healthy cities model. fig2. There is no one single formula for developing a healthy city. Therefore, the tool kits and techniques used to initiate an alternate, healthy urban planning process will indeed vary from city to city, neighbourhood to neighbourhood. The overall process, must take into account the various cultures, religions and lifestyles in the community. [9]

2.2.1 City Health Profile

city health profile is a public health report that arranges key information on a city’s health station ,presents and determinants the information in a useful arrangement. According to WHO, the city health profile is a report which classifies health problems ,suggesting potential solutions in a city. The profile describes the current health grade and other related information on the city. Analyzing of the information will identifies according to priority possible areas for action. The city health profile includes both health-related measures and indicators with an in-depth appraisal of the information. Data related to the selected core indicators are collected from all sources and analyzed ,to provide an summary of its health status. A good city health profile identifies health problems and their possible solutions and provides direction to policy-makers as to where to employ resources to enhance the city’s health status [10]
2.3. Healthy Urban Planning and the City Resilience

The definition of urban resilience has been debated over the past few decades across scientific disciplines such as urban planning. Many of the current descriptions are related to the capacity of an urban system to maintain its function during and after a crisis, pressure, and/or urban disturbances. Issues associated with food shortages, urban services, health, outbreaks of diseases, violence, and terrorist attacks have all been seriously discussed on a global scale. Hence, focusing on the idea of urban health planning and how it provides support for the health of the urban individual, promotes a healthy lifestyle, and supports economic activities. Comparing these aspects with the basic indicators of a city’s resilience framework in Table1, the urban health system enhances most of the basic dimensions of healthy urban planning to achieve the resilience of cities as proposed by the CRF framework. Therefore, the implementation of the healthy urban system of any city can contribute to its resilience and increase its ability to adapt to anticipate shocks associated with urban crises.

Types of failure can range from delaying the provision of municipal services, the spreading of pollution (water, antenna, dust, noise and visual), and the lack of efficient urban transportation systems to the traumatic effects of violence and terrorism. In the case of Baghdad, the city has repetitively faced different types of challenges, including terror attacks and other crises. Undoubtedly, the implementation of a healthy urban system can generate new frameworks to connect different urban aspirations and concepts about livability, sustainability, cohesion, development, and robustness. In this case, a city that adopts a holistic perspective of urban resilience and permits an integrative approach of urban planning may combine the physical, environmental, economic, and social infrastructural aspirations that will co-shape a city’s future.

2.4. Baghdad City

Situated in the Tigris grainy plain in central of Iraq, Baghdad city is the smallest governorate of the country. In spite of being the smallest governorate, The city of Baghdad has the largest population of all Iraqi governorates and is also the location of Iraq’s capital, Baghdad, the most crowded city of the country. The governorate is divided in 14 districts. The districts of Adhamiyah, Karkh, Karadah, Kadhimyah, Mansour, Sadr City, Al Rashid, Rusafa and 9 Nissan are part of Baghdad city, while the districts of Al-Mada’in, Taji, Tarmiya, Mahmudiya and Abu Ghraib cover the rest of the governorate.
The governorate’s population is mainly urban. [11]. Baghdad has been through various historical periods, succeeding stages of success. Yet, the whole region has faced a series of economic and political crises that have led to important socio-demographic and environmental changes. These alterations have led to diversity in the urban fabric and its demographic composition and this has been spatially reflected on the great diversity of land uses. Table 2.

Table 2: Iraq Statistics [12]

| Category                                      | Value   |
|-----------------------------------------------|---------|
| Total population                              | 37,203,000 |
| National gross income /per capita              | 15,220  |
| Life expectancy at birth m/f                   | 68/72   |
| Probability of dying below five (per 1,000 live births) | 30      |
| Probability of dying between 15 -60 years m/f (per 1,000 population) | 213/133 |
| Total expenditure on health per capita (Intl $) | 667     |
| Total expenditure on health as % of GDP       | 5.5     |

2.4.1. Iraq Health Profile

According to the recent statistics by WHO regarding the current health condition in Iraq (see figures below), many conclusions have been drawn, which can be summarized as follows:

- The lack of immunization rates between 2000 and 2015 (Figure 3).
- The lack of health expenses compared with the general government expenditure rate (Figure 4).
- High death rates due to Infectious diseases (Figure 5).
- High rates of disability and incidence of suicide (Figs. 6 and 7).
- High rates of death due to traffic accidents, which are accelerating (Figure 8).
- High rates of carbon dioxide emissions (Figure 9).
- Significant decline in the levels of municipal services over the last 10 years (Figure 10).

Figure 3  Immunization, DPT (% of children ages 12-23 months) [13]
Figure 4. Current health expenditure (% of GDP) [14]

Figure 5. Cause of death, by communicable diseases and maternal [15]
Figure 7: Suicide mortality rate (per 100,000 population) [17]

Figure 8: Mortality caused by road traffic injury (per 100,000 people) [18]

Figure 9: CO2 emissions (metric tons per capita) [19]
3. Results and Discussion

3.1. Analysis of The Healthy Urban System Report for Baghdad’s Critical Areas

This study has adopted the city of Baghdad to test the indicators of the healthy city as an approach to resilience city. Baghdad has been chosen among the other cities for the following reasons:

- Baghdad, as noted, represents an economic and institutional service center and is considered to be the most significant city in the region which composes of diverse urban communities.
- The lack of statistical data regarding the healthy city profile of the other Iraqi cities.
- The necessity of this research that imposes defining an ideal region as an approach to achieve the resilience for other cities (authors).

According to the World Health Organization (WHO), mechanisms for selecting the appropriate urban area for the implementation of the healthy urban system and the analysis of Baghdad will be performed through a deductive spatial analysis based on the actual data of this city Fig. 11.

Figure 10. Services, value added (annual % growth) [20]
Moreover, the analysis adopts the previous indicators obtained from the analysis of the health status of Iraq in general and specifically Baghdad since it is considered to be a significant institutional and economic service center in the region. These indicators were subjected to a questionnaire of experts with specialists transferred between architects and city planners on the correlation of health profile indicators with the municipal service system and according to the municipalities of the city of Baghdad as in the (table3).

Table 3: the questionnaire form for Community health and resilience in relation with the urban System design and planning.

| Fig.no | Healthy/resilience indicator | Cause attached with urban System design and planning. | The most affected Municipalities. |
|--------|-------------------------------|----------------------------------------------------|----------------------------------|
| 4.     | immunization rates            | imbalance in urban administration.                | ¹1,2,3,4,5,6,7,8…15              |
|        |                               | infrastructure services.                          |                                  |
|        |                               | Lifestyle.                                         |                                  |
|        |                               | lack of spatial distribution of green spaces.      |                                  |
|        |                               | transportation system.                             |                                  |
|        |                               | slum settlements.                                  |                                  |
| 5.     | health expenditure            | imbalance in urban administration.                | 1,2,3,4,5,6,7,8,…15              |
|        |                               | infrastructure services.                          |                                  |
|        |                               | etc….                                             |                                  |

¹the numbers refers to munisepeties of Baghdad city were: ¹ refer to :New Baghdad municipality, ²:Al-Mansour, ³ Al- Karkh, ⁴: Al-Karrada, ⁵: Al-Kadhimiya, ⁶: Al-Ghadeer, ⁷:Al -Sadr 1st, ⁸: Al -Sadr 2nd sec, ……ect.
The results showed that:

- **Figure 3** shows a spatial imbalance in urban administration, which is considered to be the responsibility of the local authority. Consequently, all the municipalities of Baghdad city can be nominated since they collectively indicate the same resilience issues.

- **Figure 4** indicates the failure of spatial planning for infrastructure services. This can be noticed in areas that have high population densities, low economic incomes, and those areas that have expended the capacity of their development, such as, Al -Sadr 1st municipality and Al- Sadr 2nd municipality which are suffering the same complications. New Baghdad municipality have witnessed problems of high population densities and extra pressure on its infrastructure system and may encounter resilience risks and challenges.

- **Figures 5 and 6** refer to the lifestyle, which is an indicator that can be generalized over all municipality in Baghdad City.

- **Figure 7** exposes the lack of spatial distribution of green spaces caused by illegal changes of land use. Accordingly, the Rasafa Municipality will be a probable candidate, the periphery of the AL-Sadr 1stand 2nd municipality has witnessing high population densities resulting in land use change towards residential use. Moreover, the borders of Al- Ghadir municipality have encountered land use changing like those in Al-sadr municipality.

- **Figure 8** reveals the defect in the spatial planning of the transportation system. The central commercial center of Al- Rusafa municipality is characterized by high traffic density. The boundaries of the municipality of Al-kadhimiya may also be considered since it includes the shrine of Imam Al-Kadhim.

- **Figure 9 and 10** reveals the emergence of slum settlements due to the failure of spatial planning and urban management by the local authorities, which results in high population densities associated with internal migration. In addition, the city of Baghdad has witnessed a major demographic redistribution due to civil war, which has led to this urban issue. Hence, many districts, such as Al- Tarik district in Al-Sadr 1st municipality, AL- Jekok district in Al-kadhimiya municipality, and Al- Talbiya and Jiftlik districts in Al-sha’ab municipality can be identified as risk and pressure locations.

### 3.2. Finding Indicators

Depending on the previous analyses, a set of indicators can be formulated to choose certain areas in Baghdad City to develop healthy urban programs. It should be noted that the previous analysis tried to examine different municipal regions, which represent the areas most related to the indicators of the city’s health profile. However, there are certainly other districts that include similar issues but to lesser degrees. The research has chosen the listed-mentioned municipalities, which have the most critical urban system to achieve urban resilience.

- **Al- Rusafa** municipality has included most of the spatial indicators related to:
  - High building density as it represents the area of the central commercial district of the city of Baghdad, which is characterized by high density and different modes of transportation. This have decreased and exhausted the health of the urban system and weakened its current resilience.
  - Low quality of life due to the deterioration of the buildings, especially in the housing sector, which has significantly contributed to lowering the standard of living.

- **Al-Sadr First and Second** municipality have displayed indicators which are related to:
  - High population density due to the increasing growth rates of these two districts. However, low incomes and the lack of the local authorities’ ability to perform their duties have led to the deterioration of the infrastructure system. Consequently, the spread of polluted water and the declining health of individuals has emerged. Moreover, high densities have resulted in housing shortages, which led to the changing of many areas into residential land use. The green spaces have gradually disappeared and the quality of life has consequently declined.
Very low level of the quality of life due to the increasing slums and random buildings.

- Al-Kadhimiya municipality has comprised spatial indicators which are related to:
  - High population density due to the holy shrine of Imam Al-Kadhim. Population density is increasing in certain extraordinary situations, resulting in tremendous pressure on the urban system, infrastructure services and transportation, which exceeds the region’s capacity, and the decline of quality of life in the whole area on the other hand.

This study has concluded that New Baghdad Municipality, Al-Sha’ab Municipality and Al-Ghadir Municipality come in order (4), (5) and (6) according to their spatial significance of the involved indicators.

4-Conclusions

Based on the results, the following conclusions were developed for the four primary areas that were examined, including Rusafa Municipality, Al-Sadr First and Second Municipalities, and Al-Kadhimiya Municipality.

- **Al-Rusafa Municipality**
  - The system and planning of public parking in Rusafa should be significantly reconsidered and modified.
  - Encouraging public transportation and establishing other design alternatives for the primary traffic arteries should be employed to minimize the heavy load of the municipal transportation system.
  - Municipalities and local authorities should focus their attention on a policy of conservation and maintenance of historical and public utilities.
  - The study proposes adding a section dedication to the quality of life to all tasks and efforts associated with the health inspection teams during the routine evaluation of restaurants and mixed-use buildings.
  - Planters and landscaping on sidewalks and roof-greening should be promoted to minimize the pollution in the area and encourage a sustainable and livable environment.
  - Healthy urban program must be presented by special committees to improve understanding of how the different types of citizens can work together to turn central locations into sustainable and resilient places where the people can thrive and enjoy a higher quality of life.

- **Al-Sadr First and Second Municipality**
  - Effective control of population growth, and work to minimize its negative effects on poverty and social stability.
  - Low-cost or subsidized housing must be provided.
  - The resilience of infrastructure networks must be improved because they have been significantly degraded or partially destroyed, which has caused the contamination of local drinking water.
  - The local urban administration should increase their efforts associated with managing the high population density in relation to the public services provided.
  - Awareness of important ecological and environmental issues and the role of community should be a primary focus in managing environmental issues and preserving green spaces.

- **Al-Kadhimiya Municipality**
  - Management of the transportation system in this area must be examined and improved due to the heavy traffic caused by visitors to the holy religious shrine. However, the area must be continuously accessible to service and emergency vehicles.
  - The role of urban heritage management of the area with coordination between the physical planning department, as well as the land use and traffic administration must be established. The
residents can be involved in any future urban development or expansion in the area. However, participation depends on strong and comprehensive legislation set by the government.

- The emergence of slums and illegal structures must be identified early and controlled, and low-cost housing organizations must encourage citizens to improve social balance in the area.

The planning for the management of a healthy urban system in Baghdad’s municipalities has been initiated within the framework of achieving the flexibility and resilience of the city. This was the criteria for how the research has been diagnosed, to reach through results and discussions the nominated critical areas for a healthy urban system, these municipalities selected by our team of researchers can be the leadership forces that accelerate and activate the resilience and flexibility of Baghdad city if the healthy urban system is practiced and the level of municipal services is improved, so, sound healthy urban systems can be considered one of the most effective pathways to achieve resilience in the city of Baghdad.

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