

Using CRF Tool for Analyzing the Resilience of Cities

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Abstract

The new sustainable development goals set by the UN include a goal of making cities inclusive, safe, sustainable, and resilient. Cities are growing at huge rates, and conditions of deteriorating QOLs are increasing in the form of poor access to services, and slums are remarkable, especially in the cities of the Middle East; hence, the research problem can arise from a lack of knowledge regarding the in determination of a way to assess the resilience of cities to develop mechanisms that will improve the quality of urban life. In this study, a tool called CRF has been applied for the assessment of the city's resilience principles of health and quality of life, economics and social, infrastructure and environmental systems, and the principles of governance and strategic leadership. The research aims to determine the efficiency of Kufa City in achieving the principles of resilience according to the CRF. The research is based on the descriptive analytical method. The research concluded that the city of Kufa achieves low levels of some indicators of resilience, especially on the imposition of security and the rule of law, transportation, and communications, and achieves reasonable rates of resilience regarding opportunities for creating a sustainable economy and achieving basic needs.

Keywords: Resilience of Cities; Resilience Framework; CRF; Urban Containment; Goals; Indicators; Al-Kufa; Al-Najaf.

1. Introduction

For proper planning, we have to think of the city not only as a place where people live and a built environment that includes streets, shopping centers, and service facilities [1], but as a complex network of human-produced systems that overlap and interact with each other [2, 3]. Planning determines the extent to which societies can sustain growth and revitalize themselves. Planning for a sustainable future aims to restore environmental equilibrium, economics, as well as social values [4]. Cities around the world are facing the challenges of an increasing frequency of disasters, climate risks, and other risks like the COVID-19 outbreak. For these new places to meet the work and life needs and interests of the local population, they must embrace an ongoing, dynamic process of analysis and encourage individual participation. It is no longer ideal to take just one risk reduction approach without the other. Local planners must be involved with the representation of multiple sectors or stakeholders [5, 6], as well as the debate and renewal processes of plans. Given the numerous risks that cities face, one of the most significant modern developments in sustainable planning is the flexible city strategy [5, 7], which is depicted in Figure 1 [8-10].

Scholars have focused much on environmental resilience and have provided frameworks for the evaluation of resilient cities. For instance, the study by Osman (2021) [11] examined the ideas of resilient cities and environmental resilience by employing a framework for evaluating resilient cities and developing test indicators to gauge local governments' environmental resilience. As a result, a city that is resilient will be able to respond to a variety of risks. The author used a framework that includes different resilient measures (precautionary, adaptive, and conversion

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measures) that local governments are preparing (administrative indicators), the kinds of external forces and vulnerabilities that local governments face, and anticipated scenarios to be avoided (end-points); the quantitative (urban indicators) and qualitative (citizen indicators) assessment of the kinds of resilient measures were also conducted. At the end of the study, more than 130 indicators were produced. Most local governments in Japan were aware of potential dangers like earthquakes, population loss, and increases in greenhouse gas emissions. As a result, they are putting into place and getting ready resilience measures, including support for renewable energy as a preventive measure, and developing techniques for gathering and disseminating information about disasters as an administrative indicator.

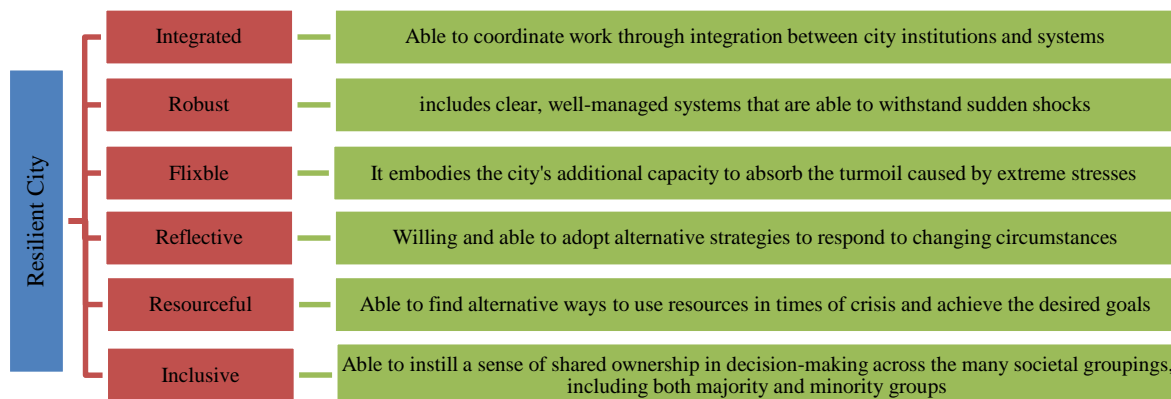


Figure 1. Characteristics of a resilient city

Adriana et al. (2020) [12] discussed many resilience assessment frameworks from various domains; specific needs, notably in evaluating strategic urban sectors and their relationships with one another and with the larger urban system, were also identified in light of the focus on climate change and urban services. To direct and facilitate an objectively driven resilience diagnosis of urban cities and services, a framework for resilience evaluation was created. This enables the choice of resilience measures, the creation of strategies to improve resilience, the process of jointly creating resilience action plans, and the monitoring of resilience development over time in the city or service. The concept and the key findings from its application to three cities with various settings are presented in this paper. It was shown that the framework identifies the most important areas for improvement, including anticipated future consequences, and illustrates where cities and urban services stand in terms of resilience to climate change.

The study by Gao & Wang (2021) [13] considered the traits of the structure and operation of the road system and metro system (two modes of urban transportation) to advance a trackable assessment methodology for their resilience. Based on their network models, distinct vertex-based and edge-based failure models were created for the two transportation systems. The suggested measuring approach was implemented to analyze the robustness of the inner-city road freight system and the metro system in Hangzhou, China, while taking into account various combinations of vertex-based and edge-based failures. When compared to an efficiency-based resilience measurement method, the suggested approach performed better in two areas: first, by employing a directed network model to represent disruptions occurring on a single directed vertex or edge, it has a wider scope than earlier related methods; second, the new approach considers more structural and functional aspects of urban transportation systems than earlier approaches, producing more trustworthy results.

Ribeiro & Gonçalves (2019) [14] evaluated the scientific and technological literature on urban resilience with a focus on its definitions, dimensions, application domains, traits, difficulties, and opportunities. In light of these issues, the study focused on the development of a methodical strategy and a distinct understanding of urban resilience for fortifying cities against new disturbances. The study observed that the four fundamental pillars of urban resilience are resisting, recovering, adapting, and transforming, while the five components of urban resilience are natural, economic, social, physical, and institutional. Eleven other characteristics—redundancy, robustness, connectedness, independence, efficiency, resources, variety, adaptation, innovation, inclusion, and integration—were also incorporated into urban resilience evaluation models. The absence of instruments and methodologies for evaluating resilience was finally found to be both a difficulty and an opportunity for future comprehensive studies about urban resilience, allowing the discovery of the most efficient ways to boost the resilience of various urban systems.

Narieswari et al. (2019) [15] described a quantitative study in Semarang City, which aimed to create an index using secondary data by taking into account 5 dimensions (social, economic, infrastructure, institutional, and hazard). The resilience level was displayed as a score between 0 and 1, with 0 denoting very low resilience and 1 denoting the highest resilience. Only three of the subdistricts (Semarang Selatan, Banyumanik, and Semarang Tengah) were at the level of high resilience, according to the data, and the infrastructure dimension was a major determining factor. The index enables fair spatial and temporal comparisons across a number of locations, which is crucial for further research on regional dynamics and setting priorities for where resilience should be strengthened to promote sustainable urban growth. The following gaps in the literature were noted following this review:

- Understanding the reality of cities’ indicators with regard to urban resilience is extremely important for preventive planning, especially for city planners and decision-makers to draw future plans and policies to confront the problems facing cities and focus on weaknesses to strengthen them to raise the cities’ immunity against internal and external crises.
- Most of the studies that were reviewed indicated poor identification of indicators to measure the resilience of cities, and they discussed some aspects related to cities, including the issue of climate change; other studies discussed the issue of the resilience of transportation networks. In this research, it goes far to more comprehensive topics related to aspects of social, economic and environmental sustainability, as well as institutional dimensions included in governance, which are topics that affect more broadly urban issues.
- There is no comparable study for Al-Kufa or other Iraqi cities utilizing the framework employed in this study.
- This study came up with proposals to increase the capacity of Kufa to face urban challenges, which showed a clear weakness during the analysis process.

2. City Resilience Framework (CRF)

This framework was released by the Rockefeller Foundation as part of its 100 Resilient Cities Campaign, is meant to serve as the framework for a tool that will allow all of us who are interested in city resilience to come together around a shared understanding of that concept and start to "baseline" what factors are most important for improving city resilience [16]. The framework and the index are meant to encourage a dialogue- and understanding-fostering process of involvement with and within cities. In the end, this will generate fresh perspectives and chances to involve new players in industry, government, and civil society about what makes a resilient city [11, 12].

The tool consists of four principles of resilience: health and quality of life; economy; society; infrastructure and environmental systems; and the principles of governance and strategic leadership. The principle of health and quality of life rests on three main goals, namely, achieving the minimum basic needs, the goal of effective health care, and the goal of supporting diversified livelihoods. Security and the rule of law (as for the principle of infrastructure and environmental systems, its main objectives are the availability of public services, the objective of transportation and communications, and the objective of supporting risk and crisis management). According to the principles of the assessment tool, each of the twelve main objectives includes other sub-goals, which total 52. Figure 2 illustrates the measurement and evaluation of those objectives. The sub-objectives of CRF are a set of indicators proposed by the global organization, which numbered 150 (indicators) [13, 14].

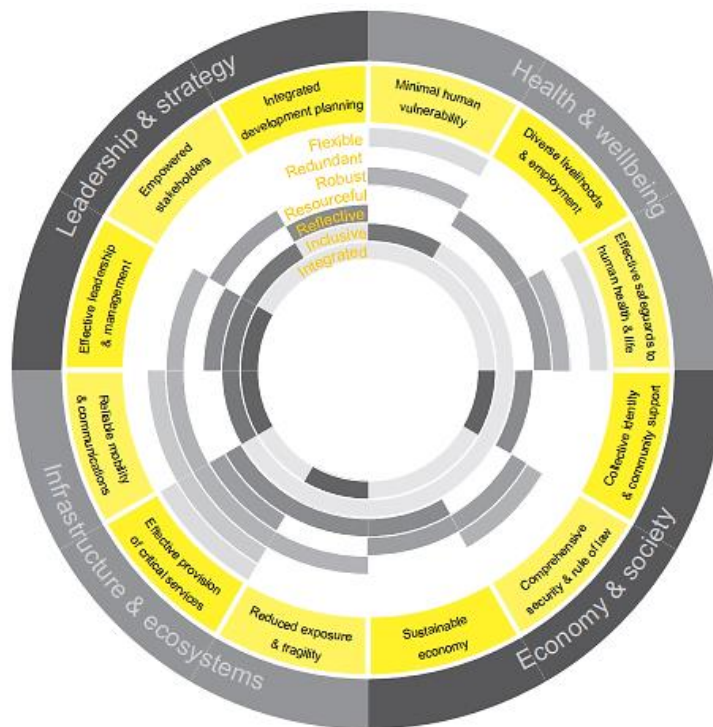


Figure 2. The main and sub-objectives of the principles of resilience in the CRF tool [17]

Measurement and evaluation of the objectives and sub-objectives of the CRF tool involve a set of indicators proposed by the global organization. In the next part, the CRF resilience assessment tool will be applied to the city of Kufa in Iraq to determine the extent to which each of these goals has been achieved in the city and whether the principles of resilience are considered or not in its urban planning.

3. Measuring and Evaluating the Principles of Resilience

The evaluation of all 150 indicators included in the assessment tool, CRF, was not an easy task due to the lack of updated and conflicting data by the official authorities; so, many indicators were searched for to be able to get the required data. The data were of two types, numeric and descriptive, some of which were obtained by the Ministry of Planning, the Central Statistical Organization, and others through the Najaf Planning Directorate for the evaluation. The indicators included in this evaluation are the standard indicators of CRF. The descriptive data were collected through a questionnaire from 20 forms distributed to officials in the planning and engineering departments with a direct relationship to the subject of urban planning. The answers to the questions were arranged with a value of (none - very poor - poor - medium - good - very good) / (0-1-2-3-4-5), respectively. Figure 3, shows the flowchart of the research methodology through which the objectives of this study were achieved.

Objective Rating

The objectives were evaluated by calculating the averages of the indicators under study, evaluating the main and subsidiary objectives of all the four principles.

Develop Mechanisms to Raise the Efficiency of Urban Resilience

Recommendations were made for mechanisms to raise the efficiency of resilience after knowing the strength or weakness of applying each principle.

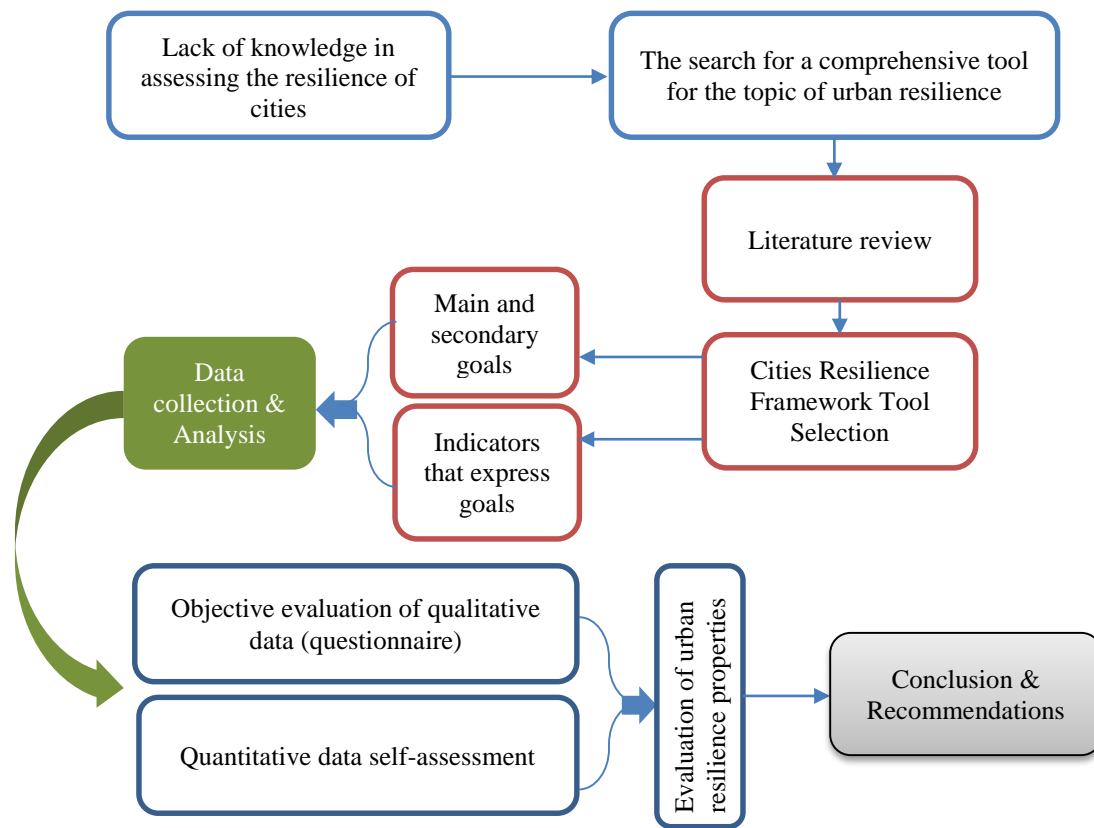


Figure 3. A flow chart for the research process

4. Study Area and Data Required for Analysis

The study area (Kufa city) is one of the most important cities of Al-Najaf in Iraq. It is located in the south-western part of Iraq, bounded by lat. 32° and long. 44° and at an altitude of 24 m A.S.L. The city is situated on one of the Euphrates River's significant branches; from the north, it is bordered by Al-Kifl district in the city of Babylon, and on the south by the district of Al-Manathera; on the east, it is bordered by the Abbasid region, and on the west by the center of the city of Najaf. Thus, it is located in the south-western part of Iraq and the eastern side of Najaf. As it is an urban center for the province of Najaf and on the western side of the Shatt al-Kufa, it is one of the Euphrates River's significant branches. The total area of the city of Kufa is 437 km², which constitutes 1.5% of the area of the city of Najaf [18] Its historical importance characterizes Al-Kufa, but it also faces some urban challenges that most Arab cities suffer from.

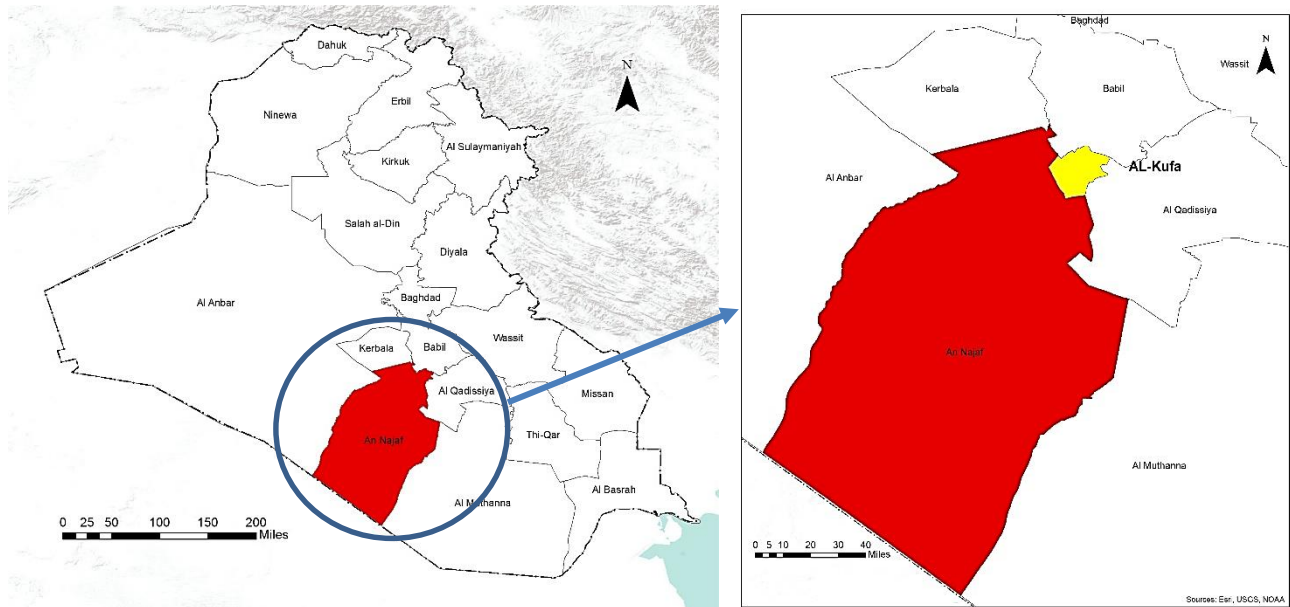


Figure 4. Location of Najaf city from Iraq, and Location of Kufa city from Al-Najaf

The population of the city of Kufa, according to the 1997 census, was about 97,626 people, and its population, according to 2003 statistics, was estimated at 110,000; however the population, according to estimates in 2007, was about 183,507 people, which represents approximately 17% of the total population of Najaf Governorate, Table 1 showed the noticeable increase in the population of the city due to its religious and historical importance.

Table 1. Population growth of Kufa district center during the years (1997 – 2019)

Year	Population
1997	97888
2003	110,000
2007	223307
2013	808093
2016	240497
2019	367558

4.1. The Master Plan of Kufa City

The city of Kufa was founded in a planned manner that remained clear and unaltered for the next two centuries. It started to gradually grow and develop, going through numerous stages as the land’s usage grew and took shape. These phases took the shape of a variety of fundamental designs for the city to manage the expansion and development of land uses within the city. The previous plans show the gradual change of land uses in the city over the years (See Table 2). The urban structure in the city of Kufa is limited to residential and commercial use, as the commercial area was in the middle of the city evidenced by the establishment of some simple industries in it. The state has established guidelines for allocating residential lots to workers. As the rate of migration from the countryside to the city has increased, so have the living conditions and service needs there. This has resulted in an expansion of land uses, and this expansion has taken on a random character based on the number of decisions and organizational schemes of a planning nature from the legitimate authority, but the practice of transgression and haphazard growth persists today [19, 20].

Table 2. The area of urban land uses in hectares for each base plan of the city of Kufa

Year	Public building	Residential	Road	Green area	Archaeological and religious areas	Commercial	Industrial	Master plan area
1958	-	-	-	-	-	-	-	-
1974	57.1	280.2	382	167.1	73.4	9.1	30.3	999.2
1982	51.3	673	426	168	200.7	6	8	1533
2007	864.34	1556.8	771.03	431.5	230.82	54.02	58.93	4911.02

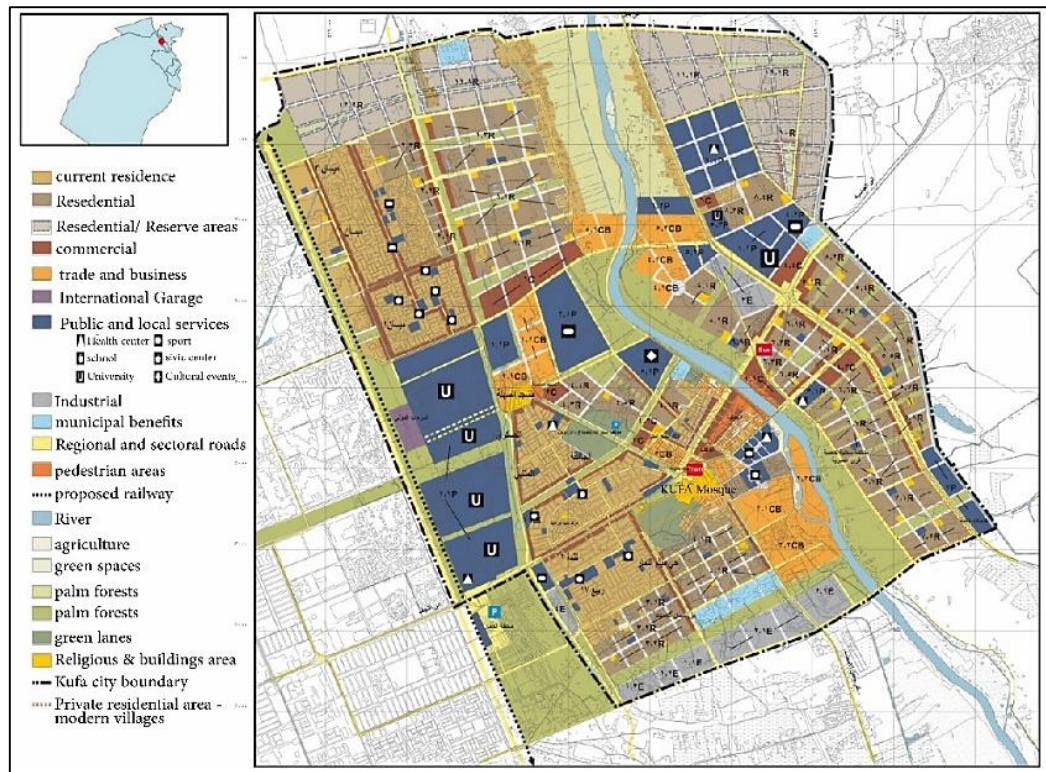


Figure 5. Master plan of Kufa city 2007-2030

5. Analysis

Each indicator was evaluated individually, and the information related to it was analyzed. However, due to the difficulty of attaching it to the research due to the large data table, we put the details of the indicators only with the evaluation rate. By standardizing and evaluating the resilience indicators of the city of Kufa for the principle of health and quality of life (see Table 3), the results showed, as illustrated in Figure 6, that the highest goal in this principle is the goal of achieving basic needs which came with the highest achievement of resilience requirements according to the CRF tool (the ratio reached about 47.5%), followed by the goal of health care 26.5% and the goal of diversifying livelihoods 26%.

Table 3. The principle of health and quality of life in CRF

Objectives	Sub-goals	Indications	Value	Analysis	Evaluation
Achieving the minimum basic needs	Availability of safe housing	Availability of safe and affordable housing.	Weak	Construction of affordable housing complexes by investors, under government supervision	2
		Percentage of the number of families living in informal housing.	30%		2
		Percentage of cracked buildings	0.03%		4
		Percentage of the area of unplanned areas.	37%		3
		Percentage of income spent on residential rent.	33%		2
	Safe supply of drinking water	Existence of plans to supply alternative water sources.	N/A	The number of drinking water projects is (1), water scarcity is about 20% that are not served	0
		Percentage of the population connected to the safe water network.	80%		3
	Availability of energy sources	Percentage of the population connected to the city's electricity network.	100%	There are (3) electric power plants and (4) power distribution stations. There is a shortage of daily operating hours, as the national power cuts off for homes about 12 hours a day.	5
		Availability of plans for alternative solar energy sources.	N/A		0
	Sanitation services	Percentage of the population connected to sewage water.	99%	The deficit is about 1%, mostly in the areas located on the outskirts of the city	4
		Having a contingency plan in the event of a drainage system failure.	N/A		0
	Availability of food at reasonable prices	Sufficient food supplies are available to everyone.	Average	800 m	3
The average distance between the dwelling and the market.		1.5 km	3		

Supporting diversity of livelihoods	Availability of income and employment policies	There are labor policies and laws.	weak		2	
		The minimum wage for a work.	10000ID		2	
	Develop training and skills	Presence Effective mechanisms to match skills with the labor market		N/A		0
		Existence of plans to train young people in the labor market		Very weak		2
	Develop the local economy and support innovation.	The unemployment rate in the city		38%	The number of the population covered by the social care network until 2019 is about (1221), and their percentage constitutes about 1.32% of the total population of the city of Kufa.	1
		Percentage of the population living below the poverty line		30%		2
		Percentage of moderately poor families.		48%		2
	Availability of supportive financing mechanisms.	Existence of mechanisms to provide financial support in emergencies		Very weak		2
		Business support is available		weak		2
		There are productive loan programs for youth employment		weak		2
Percentage of local businesses owned by women			1.5%		2	
Protecting the population after crises	Existence of mechanisms to protect the population in crises		Very weak		1	
	There is awareness among the population to deal with risky situations		Very weak		1	
Availability of effective health insurance systems	Existence of effective health insurance systems for the population		N/A	There is only one home for the elderly	0	
	The existence of insurance systems for the care of the elderly		N/A		0	
Availability of effective healthcare	There are public health awareness and education programs		Weak	The city needs (5) hospitals and (23) health centers	2	
	The number of doctors in the city		293		3	
The efficiency of emergency health	The presence of emergency buildings to help citizens during epidemics and crises		Very weak		1	
	Rapid response in health emergencies		Very weak		1	
Effective emergency response	Adequate resources are available from emergency medical services		Weak		1	
	Number of hospital beds per 100,000 people		180		3	

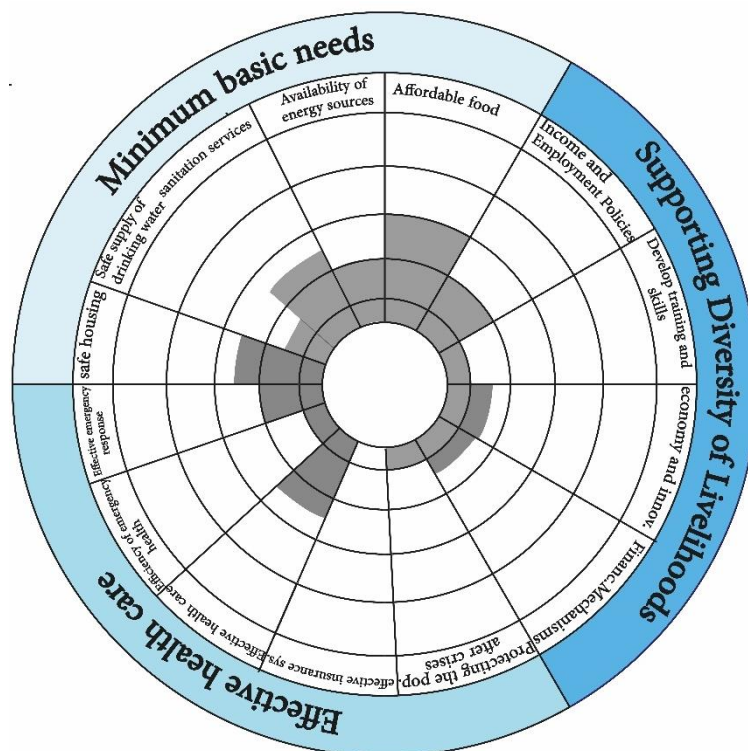


Figure 6. Evaluation of resilience sub-goals for health and quality of life

The high rate of poverty and unemployment is one of the most important things that constitute a clear challenge in the city of Kufa, there is a shortage in the housing supply offset by the inability to purchase for citizens, forcing them to live in slums or bear the burden of renting housing units. There is weakness on the part of the state departments in providing services, especially infrastructure services, and the weakness of examining their efficiency and finding an emergency plan. The allocated funding is not sufficient to establish projects; however, the annual budget during the current year 2022 achieved higher amounts than planned, but this is not reflected in the provision of services to the citizen and their improvement. Future crises are not planned for; that. There is difficulty in absorbing the epidemic crisis and running out of the state emergency fund when needed; there is also lack of health insurance systems, and high food prices may pose significant difficulties for low-income families (Table 4).

Table 4. The principle of economics and social

Objectives	sub-goals	Indications	Value	Analysis	Evaluation
Preserving identity and society	Support the local community	Presence of women working in economic activities	Good	There are about (1534) working women, about 8.47% in government professions, and the rest in other professions, including selling in women's malls and kindergartens.	4
		Support from local communities for young people	Average		3
		Support from local communities for females	Average		3
		There is a representation of women in management positions	Weak		2
	Tight-knit communities	The presence of orphanages / elderly care homes in the city that provide support to the neediest individuals	Weak	There is one nursing home for the elderly in Kufa and (2) orphanages.	2
	Preserving identity and culture	Organizing workshops that enhance belonging and a sense of identity and culture	Good	Workshops are held in colleges specialized in planning and architecture, through which a sense of identity and culture is enhanced, especially for young college students.	4
	Community participation	Participation rate in municipal elections	There is no data	There are some community activities with the participation of the youth of the city.	0
		Percentage of participants in community activities	N/A		0
		The contribution of the private sector.	Average		3
	Security and rule of law	Effective crime prevention systems	Existence of preventive programs to combat crime	N/A	
Deterring frequent thefts and murders			Average	0	
Fight corruption		The degree of corruption in the city	24%	According to the Transparency Index for Cities by Transparency International, Iraq achieved this percentage, and there is no data at the level of the city of Kufa alone.	2
		The contribution of government programs to combating corruption	Weak		2
Effective security system		Availability of security forces to enforce order in the city	Weak	During the past ten years, several criminal cases were recorded, about 24%, about harassment, about 20% of crimes of battery and assault, 15% of drug use, and some other crimes such as murder and theft.	2
		Residents respect the prestige of the security system	Average		3
Social and criminal justice		Existence of an effective civil justice system	Average	There are some clear differences between urban and rural areas, between residents of the same city, and the spread of slums.	3
		People's sense of justice and equality	Average		3
sustainable economy	Effective financial management	The ratio of net domestic debt to GDP	Average	The local government in Kufa depends on the financial allocations that are allocated to it from the investment and operational budget, that is, on the central government only.	3
		Duration of years for evaluating economic assets	5 years		National Development Plan
	Comprehensive investment planning	There are plans to develop the local economy	Very well	There are plans, but the problem is implementing them.	5
		Attracting foreign investment	Very weak		1
	Attractive work environment	Ease of doing business	Average	A work environment is characterized by the difficulty of administrative procedures and approvals.	3
Integration with global economies	Chances Economic growth	Good	There are opportunities to establish industrial projects, activate suspended ones, and increase the returns of the religious tourism sector.	4	
	A blueprint to attract global investment	Average	The limited role of the private sector in economic activity is affected by the absence of an investment-attractive environment for workers.	3	

By standardizing and evaluating the resilience indicators of the city of Kufa for the principles of economy and society, the results showed, as illustrated in Figure 7, that the highest goal in this principle is the goal of a sustainable economy, which came with the highest achievement of resilience requirements at about 49% according to the CRF tool, followed by the goal of preserving identity at 29%, and then the goals of security and the rule of law at 22%. In some indicators of the goals of this principle, there is progress over the previous goal, especially regarding the economic aspects. The city has made great efforts to address corruption because transparency rates are relatively weak, according to Transparency International’s data for 2021, and the city needs preventive programs to address crime. However, there are also clear challenges in the decline of some indicators from the requirements of resilience, including the lack of data about participants in municipal elections and the presence of women being relatively weak in occupying administrative positions and needs.

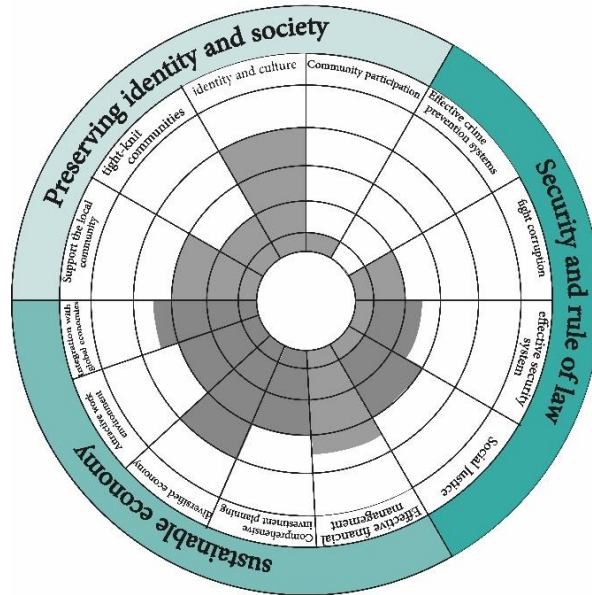


Figure 7. Evaluation of the sub-objectives of resilience of the economic and social principle

The results of the standardization and evaluation of the resilience indicators of the city of Kufa for the principles of infrastructure and environmental systems are illustrated in Figure 8. The remaining two of its main objectives, namely, the objectives of risk and crisis management and the availability of public services, scored 36.5% in terms of achieving resilience requirements according to the CRF tool, followed by the goal of transport and communications at 27%. The role played by the city in order to confront climate change is very weak, and it needs to activate the effective management of ecosystems and increase the percentage of green spaces and afforestation. The aspect of resilience is weak or almost non-existent in the resilience of infrastructure and the generation of electric power from multiple sources or relying on clean energy and waste treatment. It is by burning, whereas if better treatment mechanisms had been developed, it would have been an important resource for generating electric power for the city instead of importing it from outside Iraq. The roads specified for emergencies do not exist, and there are no emergency transport networks (Tables 5 and 6).

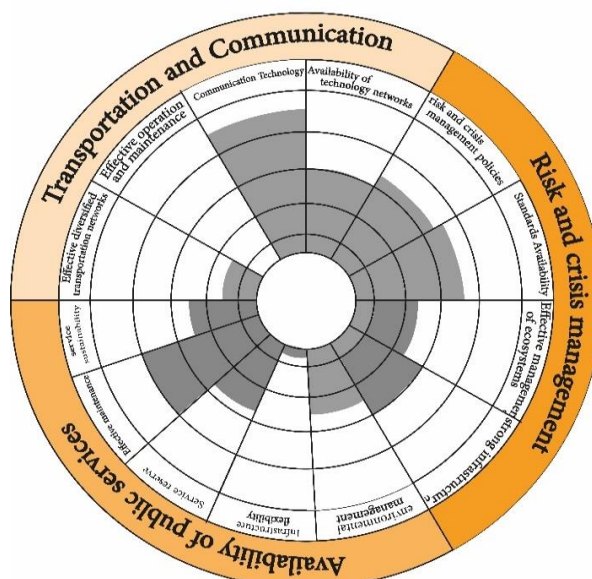


Figure 8. Evaluation of the sub-objectives of resilience of the environment and infrastructure

Table 5. The principle of environment and infrastructure

Objectives	Sub-goals	Indications	Value	Analysis	Evaluation
Risk and crisis management	Policies for managing risks and crises	There is an inventory of the potential dangers of the city	Good	When developing and updating the master plan for the city, it is studied from all sides, including the risks and challenges.	4
		There are policies for managing risks and crises	Good		4
		Climate change crises strategy update	Weak		2
	Availability of appropriate rules and standards	Percentage of infrastructure networks conforming to the standards	Average	Many infrastructure networks do not conform to the standards, and this causes pressure on services, especially when slum areas encroach on those services.	3
		Percentage of public service areas in the city	41%	From the total area of land use	4
		Percentage of licensed buildings in the city	82%	Based on the secret maps and building permits in the Town Planning Division / Kufa Municipality Directorate	4
	Effective management of ecosystems	There is an assessment of the city's environmental systems	Average	There are areas designated as green areas, but they are either empty or liable to be overrun during the construction of some violating facilities such as electricity generators and some commercial activities	3
		The percentage of green areas increase in five years	20%		2
		There is an Environmental Systems Department in the city	Weak		2
	Provides a strong infrastructure	There are effective operating and maintenance systems for the infrastructure	Weak	Maintenance is continuous for the efficiency of the infrastructure, and it is updated every five years by studying the modernization of the basic plan.	2
		Duration for an infrastructure efficiency review	25 years		3
	Availability of public services	Environmental management of ecosystem services	There are plans to protect ecosystems	Average	
Number of years since ecosystem services were assessed			5 years	4	
Using advanced technical means to monitor ecosystems			Weak	2	
There is a role for the private sector and civil society organizations			Very weak	1	
Infrastructure resilience		There is a variety of sources of electricity generation	N/A	Only heavy industrial waste, as for household waste, is collected in a site designated for incineration later in sites outside the master plan	0
		Percentage of energy from renewable sources	N/A		0
		There is a variety in the water distribution system	N/A only 1		0
		There is a variety of waste management systems	Weak		2
Efficient standby capacity of services		There is a plan for electricity services in the city	Very weak	Represents the proportion of public areas of the total area.	1
		There are plans for public services	Average		3
		There is a willingness for families to donate to services sites	Average		3
		Percentage of the area of public services in the city	41%		4
Effective maintenance of services	There is maintenance for electrical services	Good		4	
	There is maintenance for water and sewage networks	Very well		5	
	There are maintenance services for ecosystems	Average		3	
	There is periodic maintenance of public services	Good		4	
Service sustainability	Safe disposal methods for waste	Weak	Plans are available by the state, but the implementation is defective due to the lack of sufficient financial allocations	2	
	There are plans for the development and maintenance of services	Average		3	

Transportation and Communication	Effective diversified transportation networks	Percentage of non-private vehicle users	40%	Relying heavily on private transportation	2
		Availability of various transportation networks in the city	Very weak	There is a regional and urban transport network, but at the level of the details of the network itself, there is no separation between car transport and public transport, and there are no designated paths for pedestrians and bicycles.	1
	Effective operation and maintenance	Having maintenance during the past five years	N/A		0
		Develop alternative transportation options	N/A		0
		There are programs in the transport networks for emergencies	N/A		0
		Specific routes for emergency services	N/A		0
	Availability of communication technology	Internet users	87%	Wired and wireless optical services	4
		Places where the air networks of the Internet	100%		5
	Availability of technology networks	Availability of a wireless fiber-optic network	40%	The project continues to be covered, and it is hoped to complete the coverage for the entire urban space by 2025	3

Table 6. The principle of governance and strategic leadership

Objectives	sub-goals	Indications	Value	Analysis	Evaluation
Effective leadership and management	Make the right decisions	There is a periodic update of the data and the chart	Average	The master plan is updated every five years.	3
		Census data available for planning	Average	There is no recent census of the population and there are inconsistencies in the planning data between state institutions, some of which are inaccurate.	3
		Monitor urban indicators	Good	There are attempts to monitor urban indicators and issue voluntary reports to achieve the sustainable development goals and the rates of achieving them	4
	Coordination between the parties involved	Coordination between the parties involved in the planning process	Weak		2
		Plans for coordination between the concerned parties	Good		4
	Coordination between agencies and stakeholders	There is coordination between agencies and stakeholders	Good		4
		Periodic meetings between bodies and stakeholders	Good		4
	Monitor and assess risks	Existence of policies to address any anticipated risks	Average		3
		Do periodic risk assessments	Weak		2
		Conducting investigations on encroached lands	Good		4
		Existence of programs and mechanisms to avoid risks	Weak		2
	Effective crisis management	Projects submitted to the Emergency Services Agency	N/A		0
		Effective interaction with global emergency agencies	N/A		0
	Empowering stakeholders	Education for all	Gross enrollment ratio in education	80%	About 20% of the population can neither read nor write.
Percentage of those with above-average and university education			60%	3	
There are cultural development programs for the elderly			N/A	0	
Raising social awareness		Existence of mechanisms to raise social awareness among the population	Average		3
		An active role in community organizations	Good		4
Community engagement event		Youth participation in the proposed projects	Very weak		1
	Participation of stakeholders in the proposed projects	Very weak		1	
	Percentage of participants in community services	Weak		2	
	Percentage of females participating in community services	Weak		2	

	Follow-up and data management in the city	The data is updated periodically	Good	Every five years	4
		Updated data is monitored and reviewed	Very weak		1
	The effectiveness of participatory planning	There is a post for those interested in planning	Weak		2
		The opinion of those concerned is adhered to	Weak		2
Integrated strategic planning	Land use and proper planning	Rate of slums area	7.5%		2
		The existence of an integrated plan for land uses	Very well		5
		The existence of mechanisms that determine the uses of the land	Very well		5
		Mechanisms that determine building patterns according to risk assessments	Very weak		1
		Approval of the planning process	Presenting charts to experts and stakeholders	Average	
		Presenting projects to the relevant agencies	Weak		2

The result of the standardization and evaluation of the resilience indicators of the city of Kufa for the principles of governance and strategic leadership is shown in Figure 9; The goal of effective leadership and management scored a high achievement of resilience requirements (42.7%) according to the CRF tool, followed by the goal of integrated strategic planning (33.1%) and the goal of empowering the concerned parties (24.2%). The analysis indicates a weakness in coordination between the concerned parties in the planning process. The risk assessment aspect is very weak, and buildings are not provided that take the risk assessments into account. Therefore, there must be programs to avoid risks. Effective crisis management needs to work seriously to improve them and for youth to have a greater role through the participation of stakeholders and allowing them to express their opinions, ideas, and suggestions. The Population data needs to be updated continuously, especially those related to the population, and the implementation of planning standards for their necessary needs.

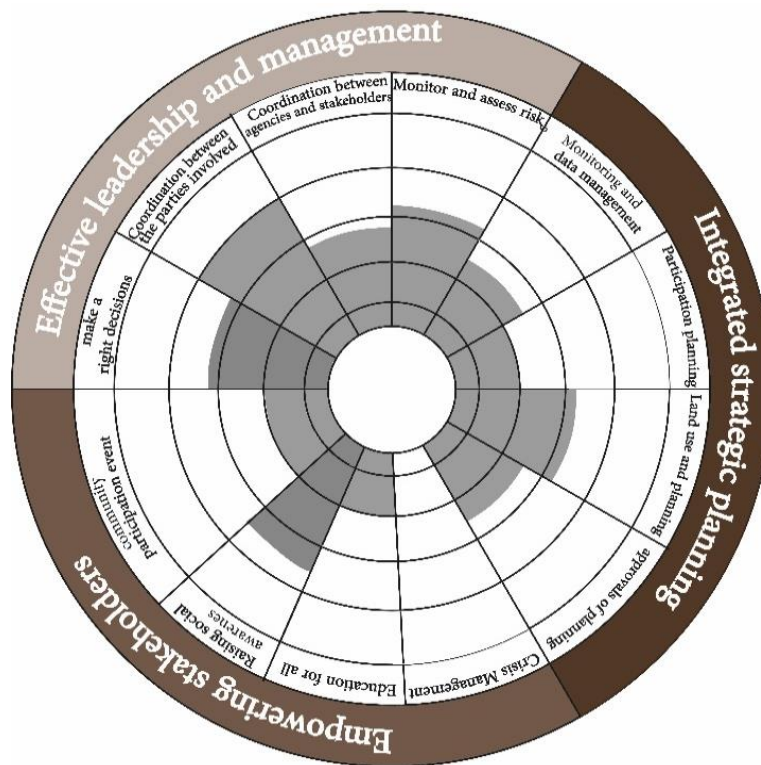


Figure 9. Evaluation of the sub-objectives of resilience of governance and strategic leadership

6. Discussion

The research concluded the possibility of relying on the CRF tool to assess the degree of resilience of cities. and recommends for specialists and workers in the field of urban planning in Kufa city to adopt indicators of resilience in future planning and when developing basic plans because they are indicators that support urban sustainability and achieve a higher quality of life while focusing on points of weakness, according to the CRF tool: The principle of health and quality of life:

- Establishing affordable housing complexes for slum dwellers or state-supported complexes within a plan divided into three operational phases (short-term, medium-term, and long-term) and identifying mechanisms to solve them (removal or redevelopment) according to their status in the master plan and the ownership of the land and placing them within the city of Kufa to support the poorest groups; this requires comprehensive information collection for priority families that do not have housing and do not have opportunities to work, elimination of poverty by providing job opportunities for the current unemployed population and an attempt to popularize the local industry and the private sector, which contributes to providing job opportunities and encouraging investment.
- Attempt to introduce alternative solar energy into clean energy resources to generate electricity and meet its need.
- Pay attention to the youth and train them to match skills with the labor market.
- Raising awareness among the population to deal with cases of risk and developing mechanisms to deal with emergencies that the city may witness in the field of services or in the field of health and epidemics.
- The necessity of having health insurance for citizens, especially the elderly.

The principle of economics and sociology:

- Activating more community participation: the establishment of programs to address crimes requires the application of transparency to reduce administrative corruption when there is an effective administrative system in performance evaluation to improve business efficiency. Administrative corruption is one of the most influential things in cities, which prevents their development and progress.
- Attempt to attract foreign investment and facilitate business procedures.

The principle of environment and infrastructure:

- Achieving diversity in water distribution systems and electrical energy sources, , as well as trying to introduce energy from renewable sources to fill the energy need in the city; recycling of wastes, and finding ways of safe waste disposal.
- Provide an effective maintenance and operation system, alternative and sustainable transportation options, and create particular roads for emergency services.

The principles of governance and strategic leadership:

- Establishment of cultural development programs for young people and the elderly.
- Work on monitoring and reviewing updated data to support integrated strategic planning with the participation of planning stakeholders.

7. Conclusion

In recent years, the city of Kufa has witnessed major changes in the level of urban uses, an increase in the poverty rate, and the spread of slums in remarkable ways; a general weakness in infrastructure services also exists despite the tireless efforts of workers in the planning and engineering departments of the state. However, it was found that it is simple and does not take into account the concept of enhancing the resilience of cities to address them. For these urban problems, one of the major obstacles noted by the research is the lack of a database for urban services and its availability, as well as the difficulty of obtaining it to conduct the assessment process; if there is one, it is not standardized and varies from one department to another. The data analysis showed that, through the CRF-based analysis, there is the possibility of using resilience measurement tools to develop future mechanisms for spatial planning and its importance in developing the appropriate mechanisms to support urban sustainability. The analysis also showed that the principles of economy and society achieved the highest evaluation of the global requirements for flexibility (28%), while the principles of health and quality of life achieved the lowest percentage of flexibility requirements (19%). The flexibility should receive more attention as it achieved the lowest evaluations. For future studies, it is recommended to build locally appropriate flexibility indicators for the city of Kufa and develop an immediate plan to address them. It is also recommended to build resilience city assessment tools and determine the most applicable ones to the case of Middle Eastern cities. It is also recommended to build resilience city assessment tools and determine the most applicable ones to the case of Middle Eastern cities.

8. Declarations

8.1. Author Contributions

Conceptualization, S.M.A. and N.A.A.; methodology, S.M.A.; software, O.J.M.; validation, S.M.A., and O.J.M.; formal analysis, S.M.A.; investigation, S.M.A. and O.J.M.; resources, O.J.M.; data curation, S.M.A.; writing—original draft preparation, S.M.A.; writing—review and editing, S.M.A.; visualization, N.A.A.; supervision, S.M.A. and N.A.A.; project administration, S.M.A., N.A.A. and O.J.M.; funding acquisition, S.M.A. All authors have read and agreed to the published version of the manuscript.

8.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

8.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

8.4. Conflicts of Interest

The authors declare no conflict of interest.

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