Resilient housing system strategies: Baghdad governorate as a model

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Abstract: The housing sector needs start adopting effective strategies to develop the housing system and increase its resilience of economic crises. The concept of resilience as a comprehensive term for planning strategies provides assistance to help cities develop their capacity to meet challenges in meeting housing needs. Over the coming decades, capacity building will be needed for more resilience in cities developing strategies to deal with crises and shocks and developing their housing system. The research attempts to shed light on the concept "the resilience of the housing system" and how to achieve it as a new method to address the housing deficient. The research found that comprehensive resilience strategies are more capable of creating a dynamic and interactive housing system among its components to address the imbalances that accompanied the housing system in Iraq in the previous period, the research aims at developing housing strategies to increase the resilience of the housing system of Baghdad governorate through quantitative analysis of the housing reality of the study area and identify the strategies necessary to increase the resilience of the housing system and develop its capacity to meet future housing needs.

1. Introduction
Increased attention to issues of improving the capacity of city systems; especially the housing system in the face of various economic turmoil and crises through the adoption of concepts and measures of resilience in housing strategies for the purpose of protecting or preventing the failure of the housing system due to global transformations and abnormal conditions that have produced problems that are difficult to deal with traditional strategies that may be useful in preventing expected negative outcomes and not dealing with unexpected events.

The housing system in Iraq during sixteen years after the end of the economic embargo on Iraq, has failed to return to its previous state or adapt and recover from the effects of the economic blockade as a result of reliance on traditional policies to improve the performance of the system and increase housing production, Therefore; the introduction of the concept of resilience into the housing sector has become an urgent need in the development of the performance of the housing system, adapting to the new conditions in order to continue to meet the housing needs and restore balance in the housing market (demand and housing supply) through a set of measures included in the strategies that increase
their resilience to risks and thus to achieve a new state of balance between housing supply and demand.

2. The concept of the housing system

The provision of housing containing the meanings of safety and facilitation which is one of the basic needs of man, and within this framework which is defined as housing of an integrated system[1], increasing interest in the issues of improving the capacity of the housing system in the face of various economic turmoil and crises is linked to meet the basic need of man, shelter in the narrowest sense of life, but the broad meaning of housing which goes beyond shelter to an important economic sector contributes with other sectors of the city in the development of social-economic development, it is linked to functional relationships with other sectors and effects and influences within the urban system on the one hand, and the secondary systems of the main system on the other hand. The main housing system is composed of a number of secondary systems which are interrelated and affect the performance of the main system as follows:-

1- Residential Land: The residential land is one of the strongest secondary systems affecting the balance of the housing system. The availability of residential land is sufficient to meet the needs and which is considered one of the biggest problems facing the housing sector and contribute to the intensification of the housing crisis. The increasing of population and migration leads to an increase in the demand for residential land in urban areas, which causes the rise of prices of these lands and thus the price of the housing unit which deprives low-income people from competing in the housing market as the land for those who can pay according to the mechanisms of the housing market. The price of land in some countries, constitutes a small part of the total cost of building housing is up to (20-30%), while in some countries is up to (50%) or more of the total cost [2],[3].

2- Housing finance: The financing system plays an essential role in housing development as it is considered the cornerstone in the implementation of government policies and programs. The housing sector needs funds to finance housing construction, infrastructure and social services to create an integrated housing environment. This system operates through banks (financial intermediaries), collecting funds of savers customers (as inputs), and providing loans (as outputs) to those who wish to obtain them whether they are developers (individuals or real estate companies), or building contractors. Housing finance markets can be divided according to the method of raising and financing mortgages into two types of markets as follows: 1-the primary finance market 2- the secondary finance market[4].

3- Production of housing units: This system is the final outcome in which the outputs of all components of the main system are poured into. The housing system serves the housing needs of individuals. In the market economy, the construction sector cannot be separated from housing development as a risky business. Increasing profitability will attract private investment in the housing sector and increasing housing production in addition to housing supply which thus reducing the gap between supply and demand [5].

4- Housing infrastructure: The term “services” refers to the basic services of the infrastructure, as defined by the United Nations Environment Program (UNEP) for water supply, electric power, waste collection, sanitation, transport and communications. As it is needed, these basic services, if available, are working to convert undeveloped (raw) land to land suitable for different urban uses, including residential. It is worth of mentioning that the cost of developing the land and providing services constitutes a large proportion of the cost of housing, as it is considered to be high cost which increases if it is extended over long distances. At the same time, it becomes more economical if it serves high-density residential sites[6].

5- Housing and building materials: Building materials are important elements that affect the cost of building a housing unit and directly it reflects on the fund capacity of the family. The availability of building materials in the required quantities and appropriate prices are basic
vocabulary of housing policies of any country [7]. Many countries in the world have developed ambitious housing production plans based on the industrial production of components or building units by choosing the appropriate manufacturing system as an attempt to provide housing for a large number of people who do not have a suitable house or shelter, and this process is characterized by high productivity, additionally, the product is of good quality and the cost as little as possible [8].

6- Management and maintenance of housing: This system is linked to the situation of the housing stock, whether it is in good or acceptable condition. The maintenance of the housing stock requires funding for the rehabilitation and the rehabilitation of housing. They make no investment in housing maintenance and rehabilitation [5].

The research suggests that the housing system, with its traditional components, needs add new inputs affecting the housing sector due to the current economic and social variables, which caused the state of imbalance in the performance of the system which should have components related to institutions for the purpose of restoring the balance to the system through programs to revive the systems in case of weakness or support and to support some of the secondary systems to develop their performance and noting that these additions are already on the ground they are not treated as a secondary system or a component of the system, as they must be included in the policies and studies, as follows:

1- Laws and Legislation: Legislation and laws have become one of the important means to prepare countries, including the standards and planning controls which imposed to improve the urban environment, as urban planning cannot play its role as a tool of change, improvement and rehabilitation of the urban environment only and if is based on a set of binding laws and legislation, putting into force, the decisions of urban planning [9]. That because of its importance, its role in guiding and controlling the process of urban development (planning or construction). The Iraqi government has paid much attention to the planning legislation in general and residential in particular since 1935. These laws have imposed standards regarding on the size of residential plots and densities for the purpose of organizing residential areas in the city, but these laws can be more resilience for the purpose of providing more residential land. [4].

2- Residential Investment: The housing sector is a service investment that has an impact on residential production [10]. Housing units are capital assets and are used to satisfy the consumer need by providing housing service to the individual and the community, and the exercise of their lives therein, as well as in the investment preference which topped the expenditure on housing after food in the items of the family budget, especially poor families [11]. The number of housing projects that got an investment license in the governorate of Baghdad only 26 housing projects for the period from 2011-2016 which are still under implementation [38].

2.1 The reality of the housing system in Iraq during the economic siege (1990-2003)
The economic embargo imposed on Iraq by the Security Council is the most severe economic crises that have passed on Iraq and caused a state of total paralysis of all economic sectors. The housing sector is one of the most affected by the economic blockade and the consequence rose in inflationary waves after 1990 and the scarcity of locally produced and imported building materials and the disruption of the contributions of the real estate bank and the decline in the value of the loan made the construction process marred by many difficulties and obstacles, especially for the private sector, which is represented by individuals. Although the states distributed large numbers of plots of land, the construction of housing units fell to the lowest levels to stop in 1996-1998, which made housing production to zero level. The components of the housing system have witnessed a significant decline in performance and the system has suffered from a complete operational imbalance, which has clearly reflected on the residential production. It witnessed a significant decrease due to the high construction costs versus lower income for the vast majority of Iraqi families as a result of the siege which is imposed [37].
3. The concept of resilience in the housing system

The concept of Resilience depends on the nature of the shocks and the characteristics of the desired outcomes; hence the definition of elasticity is inconsistent and agreed, as many researchers believe that flexibility is "stability", referring to the system's return to its initial state, while others see it as resilience. In general, ecologists use the term resilience to express a long-term evolutionary process, the resilience of the housing system can be defined by understanding the concepts of recovery and stability. Recalling the resilience of the system as "The system's feedback capacity is to return to the former situation quickly and maintain the stability of the housing market affected by demographic, social and economic conditions," to give the varying degrees of resilience is based on population, social, economic and political characteristics inherent in societies, and the resilience in housing systems can be considered a relative term, according to the definition of the concept of “stability”, and the systems can be considered resilient when the housing market remains relatively stable in most urban areas, whereas they cannot be considered resilient when experiencing a decline in urban areas alone [12].

3.1 System resilience attributes

Although, objectively, determining the resilience of the housing system is a major challenge. This concept can be explained by relying on a set of key features (capabilities) that must exist in the resilience system as follows [13].

1. Withstanding capability: the ability of the system is to endure during exposure to risks and disorders, and maintains its function.
2. Absorptive capability: Absorption of hazards and disruptions in addition to minimizing the negative impact, which make ability to enable the system with a high absorption capacity to absorb the initial and sudden disturbances without causing a significant deterioration in the functions of the system and reduce the loss of some functions of the system.
3. Restorative capability: Recover from relics and return to an acceptable situation. Traditional risk management and prevention strategies with predictive estimates cause systemic function failures as a result of uncertainty, The disruption is exceeded by the expected events, therefore; the effective method of treatment follows resilience in the treatment of disorders.
4. Adaptive capability: Adapt to changing conditions as well as disturbances and maintain system functions at an acceptable level under changing conditions and uncertainty results, therefore maintenance is a consistent function within longer ranges. Most internal and external disturbances (for example, economic crises, landslides, and climate change) have unpredictable effects on the housing system. Disturbances and crises can affect on the functioning of the system in a complex way (for example, the internal deterioration of the state of the system with wars) thus, The resilience scale needs to address different disorders with different scenarios. Different time periods can help assess the level of resilience, through which the system seeks as a long-term goal.

The resilience of the housing system is essentially a traditional housing system that includes all secondary systems with the same characteristics which deal with the concept of housing by meeting the needs within the economic, social and political risks expected to occur as a result of the recurrence of the event, but this system may fail with any kind of unexpected risks. Therefore, the introduction of the concept of resilience of the housing sector has become an urgent need because of the various climatic, economic or political risks that the world is exposed to face, and to be better able to deal with these risks, and the absorption of the housing system of changes and adapt to new conditions in order to continue to meet housing needs and restore balance in the housing market (Residential demand and supply). As described above, the study links the resilience of the housing housing system to regain its ability to meet the housing needs of individuals before the upheaval, by absorbing the upheaval and adapting to any political, economic, social and environmental changes. At the level of the city and its main systems or at the level of secondary systems, to restore its performance through system to the
housing market. The resilience of the housing system is defined as the ability of a set of concepts that increase its resilience to risks and achieve a new state of balance between supply and demand.

3.2 Concepts of resilience of the housing system
Determining whether the system resilience or not, is not only after the occurrence of crises and turbulence, but also we can ask how can be prepared for any kind of risks and pressures, especially economic ones before they occur? Housing resilience within communities can be enhanced through a range of concepts that increase resilience and considered as measures of resilience like table 1:

| measures of resilience | Description |
|------------------------|-------------|
| **Diversity**          | Functional diversity provides different types of functions, as well as response diversity provides similar components of functions but different responses to the disorder, so the job can be maintained if the system contains both functional diversity and response, which increase the degree of resilience[14]. The expansion of this framework into the housing system, can be the diversity of institutions and real estate companies, land and sources of financing, as well the diversity of housing supply which is important to maintain resilience in housing[15]. |
| **Modularity**         | Modularity refers to the way in which system components are linked with each other[14]. Systems with sub-groups have more relationships and self-regulation than those with specific groups after disruption or crisis[16]. A housing system with subsystems and sub-units is more self-organized, for example, the housing system will be much better to accommodate the turmoil if it contains several housing providers such as the public, private sectors, cooperatives residential investment, developed real estate companies and thus more resilience, than those which are few and limited housing providers[17]. |
| **Tightness of feedback** | Eco-systems are controlled through feedback, as the speed at which changes in a part of a system occur are felt in the remaining parts of the system and influenced by it. As a result of globalization, cities are becoming increasingly influenced by what happens globally, and therefore it is difficult to find the cause and appropriate response. Any authors suggest that maintaining resilience should involve increasing the self-sufficiency of systems[16]. Decentralization and globalization weaken systems' ability to respond quickly, while the presence of local institutions and social networks allows for rapid response to events, because they are closer to resources and stakeholders and there is a higher level of communication[15]. |
| **Social cohesion**    | Flexibility is linked to the ability of individuals to respond to mass disorders. The trust, the social networks and the civic organizations are important factors that promote social cohesion or social capital[15] |
| **Innovation**         | Innovation and learning are important factors for achieving resilience in systems and this points to the importance of continuous new inputs so that adaptive systems can change, while providing new ways and means to accommodate disturbances[16]. |
| **correlation**        | It is meant to "unite forces or ties", which can help make the system resilience in meeting challenges. In systems, relationships are a way of creating connections between components or systems[18]. |
| **Redundancy & Overlap** | It is also called "functional redundancy" and denotes "the presence of multiple components that can perform the same function". Overlapping, for example, overlapping roles or governance, is a form of redundancy if there is overlap in roles, but when one party fails to perform a role, the other party can take over the task, as it is important not to stop the system[19],[20,21]. |
| **Modifiability**      | Modifying the ability to change, transform and develop all contribute to the system resilience[22],[23]. |
| **Wide compatibility** | Broad consensus means "the ability of something to work within a range of different situations and is compatible with it to allow continue."[24],[19]. |
High degree of equity  
It includes economic and social justice, poverty reduction, access to resources without exclusion of particular groups, support and assistance to vulnerable groups. The significance and impact of this concept lies in two aspects. First, low resilience leads to poor communities becoming less able to cope with unrest. Second, lack of equity leads to unrest due to the anger of poor classes, so a fair distribution of benefits is required. [25, 24]

Polycentric governance  
The existence of a network of leadership composed of participants in governance, governmental organizations, private foundations and civil society organizations, at different levels allows participants to act collectively to conceptualize problems and solutions while ensuring that actions are taken by the right people at the right time. [20, 25, 24].

Risk management  
This concept involves identifying risks, probabilities and weaknesses and taking action to mitigate the effects of risks based on the level of risk [24, 26].

Broad stakeholder engagement  
Stakeholder participation is important because it brings a variety of knowledge and perspectives, stimulates learning through it, and at the same time builds social capital and adds legitimacy to decisions - community participation is essential. [20, 25].

If we can develop indicators to measure these concepts, it is possible to know the resilience of the system. These indicators can be use composite for research and decision-making purposes. The housing system and the housing market in the face of risks and economic crises.

3.3 Shift in strategies from traditional to resilience

A combination of natural and abnormal factors and conditions have stimulated new policies, unlike traditional ones this due to the nature of global transformations that have produced problems that are difficult to deal with in accordance the traditional policies and strategies. They may be useful in preventing undesirable outcomes, but they are not effective when climate hazards, shocks or devastating economic crises occur, take long periods and have profound effects. Over the past few years, attention has shifted more towards resilience-based strategies. The research believes that achieving resilience in the systems depends on a set of strategies and not on policies, as the policies rely on traditional systems before, either at the level of resilience systems which are adopted for operational strategies because they are designed to address the various risks or disturbances, climate or environmental or economic crises [13].

Achieving resilience in systems depends on a set of strategies and not on policies, as policies rely on traditional systems as passed previously. At the level of resilient systems, executive strategies are adopted because they are designed to meet the various risks or disturbances, climate, environmental or economic crises. On three types:

3.3.1 Basic Resilience Strategies

This type of strategy deals with assets that need to be maintained and at the same time a non-renewable resource. This strategy overlaps with the concept of sustainability. This strategy combines the concept of “environmental sustainability with the reduction of adverse effects on health”. If the system is not sustainable (for example, irrational and excessive use of the non-renewable source of the earth), that source will be vulnerable, and will not be resilient [19]. Basic resilience can be likened basically of the system, as the lack of essential resilience will challenge the ability of the system to improve or undermine its resilience, while building resilience will make the system more capable of growing and maintaining resilience. [27].

3.3.2 Specific Resilience Strategies:

These strategies are designed to resist specific pressures or risks, and for the purpose of improving the resilience of the system, this strategy is implemented sequentially after the basic resilience strategies rely on them [7]. Among the strategies used are seven important strategies that clearly relate to which are: diversity, replication, modularity, correlation, broad consensus, adaptability and development, and the “probabilistic 'risk management” strategy that deals with the specific resilience to traditional risks.
which is a Different from "risk management" that is adopted as a strategy within the overall resilience [27].

3.3.3 General Resilience Strategies
They are comprehensive resilience strategies for any type of disturbance or risk which are designed to counter future or unpredictable pressures [7].

4. Analysis of residential reality
The research in this paragraph deals with the reality of population growth, number of households, the development of the housing situation, the housing need and the percentage of housing deficit in the governorate of Baghdad in relation to the development of demand and housing supply, based on the general censuses of 1977,1987, 1997 and 2009.

4.1 Location of Baghdad Governorate
The area of Baghdad governorate is (4999) km ², which is located in the center of Iraq between longitudes (43 ° 50'E-44 ° 56'E), and two latitudes (- 32 ° 48'N 33 ° 46'N)[28]. Baghdad is bordered to the northeast by Diyala, to the northwest by Salahuddin and Anbar governorates, to the southwest by Babylon governorate and to the southeast by Wasit governorate [29], see figure1.

![Figure 1. administrative units of the province of Baghdad [28]](image)

4.2 Population Growth of Baghdad Governorate
The population of Baghdad governorate doubled for the period 1977-1987. For the purpose of determining the total and annual population increase and their percentage, they were calculated according to the following mathematical equations, see table (2):

Total population increase = population in newer census (P2) - population in older census (P1)
Annual Population Increase = Total Population Increase / 10
Percentage of total population increase = ((P2-P1)/ P1 * 100).
Annual Population Increase = (Total Population Increase / 10)

In order to calculate the population growth rate of Baghdad governorate was based on the growth formula [39]:

\[ R = \ln\left(\frac{p_2}{p_1}\right)(T * 100)^{-1} \]

From the analysis of the table, the population in 1977 (3189700) inhabitants, and then increased in 1987 to (4363483) a total increase of (1,173,783) and an annual increase of (117,378) people, and a
growth rate of 3.13%, while the rate of growth in Iraq is estimated at (3.08%), and the increase is attributed to the high rates of immigration to the city of Baghdad from the southern provinces. The highest rate of population growth in the period (1977-1987) due to the effects of migration from the provinces to the governorate of Baghdad, and then this growth began to decline in the period (1987-1997) as it (2.26%) as a natural result of the effects of the Iran-Iraq war for the period (1981-1988) On the one hand, and the economic siege for the period (1990-2003) on the other hand, in the period (1997-2009), the growth rate reached about (2.72%), The fluctuation in population growth is attributed to crises that have affected the overall social structure in Iraq, including the province of Baghdad. see table 2.

Table 2. [29]

| Year | The oldest census (P1) | The most recent census (P2) | Absolute total population increase | Annual absolute population increase | Percentage of total population increase | Annual population increase | Population growth rate |
|------|------------------------|-----------------------------|----------------------------------|-----------------------------------|--------------------------------------|----------------------------|------------------------|
| 1977 | 3,189,700              | 4,363,483                   | 1,173,783                        | 117,378                           | 36.8                                 | 3.7                        | 3.13                   |
| 1987 | 4,363,483              | 5,468,804                   | 1,105321                         | 110532                           | 25.3                                 | 2.5                        | 2.26                   |
| 1997 | 5,468,804              | 7,180,889                   | 1,712,085                        | 171,209                           | 31.3                                 | 3.1                        | 2.72                   |

The population density, which is expressed by the number of individuals per square kilometer in the governorate of Baghdad (1297) person / km², and recorded the highest governorate of Baghdad use values of the actual utilized area, where the population density reached (2208) person / km², see table 3.

Table 3. Population density in Baghdad Governorate in 2009[30]

| Governorate | The total area | Actual space utilized | Population density |
|-------------|----------------|-----------------------|---------------------|
| Baghdad     | 5169           | 3035                  | By total area: 1297 | According to the actual space utilized: 2208 |

As shown in Table 4 the development of the population of the governorate of Baghdad for the period (1981-2016), and the increase in the number of families and the development of family size. It is noted that an increase in the number of households in the study area is due to population growth and is one of the important and influential factors in the high housing need.
Table 4. Population Development in Baghdad Governorate and Number of Households (1981-2016) [31]

| Year | population | No. households | Year | population | No. households |
|------|------------|----------------|------|------------|----------------|
| 1981 | 3857015    | 593,387        | 1999 | 4687400    | 616,763        |
| 1982 | 4038430    | 621,297        | 2000 | 4788500    | 630,066        |
| 1983 | 4234060    | 651,394        | 2001 | 6062619    | 797,713        |
| 1984 | 4437603    | 682,708        | 2002 | 6222186    | 818,709        |
| 1985 | 4648609    | 715,171        | 2003 | 6386067    | 840,272        |
| 1986 | 4868455    | 748,993        | 2004 | 6554126    | 862,385        |
| 1987 | 3844608    | 519,542        | 2005 | 6726432    | 885,057        |
| 1988 | 5348117    | 722,719        | 2006 | 6962650    | 916,138        |
| 1989 | 4053740    | 547,803        | 2007 | 7145470    | 940,193        |
| 1990 | 3815200    | 515,568        | 2008 | 7137777    | 939,181        |
| 1991 | 3910900    | 528,500        | 2009 | 6702538    | 1,000,379      |
| 1992 | 4000500    | 540,608        | 2010 | 6875555    | 1,026,202      |
| 1993 | 4093200    | 553,135        | 2011 | 7055196    | 1,053,014      |
| 1994 | 4182400    | 565,189        | 2012 | 7255278    | 1,082,877      |
| 1995 | 4279000    | 578,243        | 2013 | 7457777    | 1,113,100      |
| 1996 | 4380700    | 591,986        | 2014 | 7665292    | 1,144,073      |
| 1997 | 5423964    | 713,679        | 2015 | 7877888    | 1,175,804      |
| 1998 | 4585000    | 603,289        | 2016 | 7710001    | 1,150,746      |

4.3 The housing situation of Baghdad governorate

When we are considering the housing situation of any city, the housing need to calculate everything, and the housing need overlaps with the size of the demand and the housing supply and the extent of its suitability for the housing stock and the size of the housing supply for the new housing units that are supposed to be built for the purpose of meeting the housing need.

4.3.1 Housing Need for Baghdad Governorate

The National Housing Policy has determined the need for housing in Iraq in 2016 amounting to (2) million housing units in urban areas (National Housing Policy, 2010), while the study of the housing market in Iraq has determined the housing need over ten years from 2006-2016 to about 1.27 million housing units in the urban areas of Iraq[31]. Table (5) shows the promising population Families and the balance of housing and housing deficit for the period (1977-1997).

1 In the annual statistics (1998-1999) the Baghdad Municipality appeared instead of the Baghdad governorate
Table 5. Housing need in Baghdad governorate for the period 1977-1997[30]

|          | 1977       | 1987       | 1997       |
|----------|------------|------------|------------|
| population | 3,189,700  | 4,363,483  | 5,468,804  |
| households | 471,189    | 511,948    | 774,637    |
| Housing balance | 352,869    | 432,880    | 619,055    |
| Housing need | 118,320    | 79,068     | 155,582    |
| Percentage of household need | 25.1       | 15.4       | 20.1       |

Table 6 shows the housing deficit of Baghdad governorate according to the updates of the report of the Department of Housing and based on the data of the inventory and numbering conducted by the Ministry of Planning in 2009 and published in 2011.

Table 6. Housing need in Baghdad governorate 2009[32]

| Governorate | population | households | Total housing balance | Old-fashioned housing | Marginal housing + other buildings | Extended families role + buildings | Urban mud dwelling s | Current housing need |
|-------------|------------|------------|-----------------------|-----------------------|-----------------------------------|----------------------------------|---------------------|---------------------|
| Baghdad     | 6,702,538  | 1,037,189  | 1,064,175             | 77,392                | 18,598                            | 71,595                          | 17,060              | 184,645             |
| Iraq        | 27,275,208 | 3,884,826  | 3,994,803             | 193,484               | 85,058                            | 243,634                         | 227,920             | 750,096             |
| Ratio of Governorate to Iraq | %25        | %27        | %27                   | %40                   | %22                               | %29                            | %7                  | %25                 |

As shown in the table, the housing deficit until 2009 in the study area is about 184,645 housing units. This data was updated in 2017 on the basis of the approved growth rate of the population by 3% and an annual increase of 900-1000,000 people as in table 7.

Table 7. The expected housing need in Baghdad until 2020[32]

|          | 2014       | 2015       | 2016       | 2017       | 2018       | 2019       | 2020       |
|----------|------------|------------|------------|------------|------------|------------|------------|
| population | 7,544,000  | 7,770,000  | 8,003,200  | 8,243,300  | 8,491,000  | 8,745,300  | 9,008,000  |
| households | 1,202,400  | 1,238,500  | 1,276,000  | 1,314,280  | 1,353,710  | 1,393,900  | 1,435,720  |
| Housing balance | 795,030    | 779,124    | 764,000    | 748,720    | 733,750    | 719,075    | 704,694    |
| Housing need | 407,370    | 459,400    | 512,000    | 566,000    | 620,000    | 674,825    | 731,026    |

It is noted that there is a large gap between the housing demand in front of the housing supply and the continued rise in the housing need index.
4.3.2 Residential Demand and Supply

The demand for housing units is measured by the number of building permits. As for the housing supply side, the number of completed housing units can be counted during the study period. These are important factors that reflect the market's ability to meet the demand and thus cover the housing need [33]. Table 8 shows a number of indicators as follows:

1 - Housing demand: the existence of fluctuation in the number of building permits, as the index of building permits began to rise from 1981 to 1984, and this indicates that the availability of a number of factors affecting housing demand, including the availability of residential land and in addition to the high level of income and loans and then the index begins to decline gradually starting from 1985. The reason is due to the circumstances of the Iran-Iraq war (1981-1988) and its repercussions on the economic situation of the country and the economic blockade for the period (1990-2003).

2 - Housing supply: There is fluctuation in the number of completed housing units, and it can be explained by the impact of a number of factors, including the availability of building materials, manpower, financial liquidity and mortgages. Note that the average of period of completion of housing units is 414 days, within the expectation that the construction of housing units in any year will be associated with the number of building permits for the same year and the following year [34].

The housing supply is influenced by the cost of construction, land secretions, the size of housing loans, the number of households and other factors.

Table 8. Number of building permits and residential production for the governorate of Baghdad for the period (1981-2016) [35,36].

| Year | Building permits | Residential production | Year | Building permits | Residential production |
|------|-----------------|------------------------|------|-----------------|------------------------|
| 1981 | 25307           | 13262                  | 1999 | 6422            | 548                    |
| 1982 | 17881           | 15876                  | 2000 | 9763            | 658                    |
| 1983 | 9983            | 19351                  | 2001 | 5099            | 1688                   |
| 1984 | 13455           | 21877                  | 2002 | 7858            | 2596                   |
| 1985 | 15276           | 12276                  | 2003 | 1967            | 623                    |
| 1986 | 12330           | 10650                  | 2004 | 1887            | 835                    |
| 1987 | 15286           | 7271                   | 2005 | 3691            | 923                    |
| 1988 | 9050            | 5549                   | 2006 | 1439            | 2473                   |
| 1989 | 9615            | 6357                   | 2007 | 1706            | 1411                   |
| 1990 | 8343            | 4848                   | 2008 | 1994            | 1648                   |
| 1991 | 3964            | 2216                   | 2009 | 2408            | 2418                   |
| 1992 | 5430            | 2942                   | 2010 | 1887            | 1609                   |
| 1993 | 16269           | 3061                   | 2011 | 3999            | 2007                   |
| 1994 | 10649           | 616                    | 2012 | 6375            | 5293                   |
| 1995 | 3652            | 71                     | 2013 | 4737            | 3932                   |
| 1996 | 932             | 21                     | 2014 | 3340            | 2769                   |
| 1997 | 2607            | 230                    | 2015 | 3641            | 2930                   |
| 1998 | 3882            | 321                    | 2016 | 3196            | 2473                   |

Comparing the size of the housing need with the size of the housing supply and demand indicates the magnitude of the housing problem, as the number of housing units the governorate needs until 2017 is 1,944,770 housing units due to the accumulation of housing need, while the number of housing units implemented during this period is (11055) housing units (0.57%), and the number of building permits (13842) leaves, or (0.71%). The table shows a very large gap between the demand and housing supply on the one hand and the housing need on the other hand during different periods of time, the housing supply was able to cover the housing demand and there was a balance in the housing market during the

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2 Residential production for the private sector only
1980s. The housing deficit index continued to rise, and the housing need is to be accumulated. Despite the rise in the housing units index implemented for the period from 2006 to 2017, this does not cover an acceptable percentage. Of need minting Intention indicating weak residential stock, With the incomplete implementation of any residential investment projects in the governorate of Baghdad, which will contribute a significant and important part in balancing the housing supply in front of the housing demand for the large production of housing units, it is expected to continue the housing situation in this style.

The research shows that the population of Baghdad governorate has doubled, this increasing the number of households during the study period (1981-2016) and decreasing the population growth. This caused the development of the housing crisis and reached the stage of housing deficit, whether at the level of the country in general or at the level of the governorate of Baghdad, as the highest rate of housing deficit exists in the governorate of Baghdad.

As mentioned above, the best strategies to enhance resilience are carried out through a set of concepts that serve as measures of resilience within the strategies directed to the system that has already been subjected to disturbances or economic crises that have a state of paralysis or discontinuity. A state of equilibrium and these concepts within the space-time dichotomy help to create correlative relationships between components for the purpose of creating compatibility and compatibility between systems that will help to sequence the results and thus achieve synchronization in the system.

Table 9 shows the concepts that achieve the compatibility between the components of the housing system, as a new processes of these components contribute to the possibility of synchronization between them through the results that will appear sequentially over time, as the concepts that serve as measures of flexibility make the objectives in these systems in some occasionally they occur far apart but appear in the results almost simultaneously from the perspective of a system, for example, that government discharges new land in various areas will lead to a diversity in the housing units in the housing market meet the housing needs of community groups with different incomes, as well as Secure the distribution of land with the release of a batch of housing loans to the beneficiaries of these lands and encourage individuals to take advantage of the services of construction companies to reduce the cost and time with a large supply of construction materials in the market. These near-simultaneous measures will affect the stimulation of the rest of the components of the housing system, allowing By activating the systems as a whole and later the performance of the main housing system will affect the rest of the city's systems such as transportation.

| Secondary system | the scale | Resilience strategies in housing systems                                      |
|------------------|----------|--------------------------------------------------------------------------------|
| Residential land | Diversity| - The diversity of land areas displayed in the land market                     |
|                  |          | - Diversity of residential offer (titling, rent)                               |
|                  |          | - Different types of housing units in terms of types, shapes and sizes.        |
|                  |          | - Different properties and commensurate with the entry.                        |
|                  |          | - Mixed use of land                                                            |
| Reserve redundancy|Availability of stock of served land ready for distribution                      |
| Modification     | Overrun on land weakens the flexibility of the system                           |
| Connectivity     | - Utilization of land located in the so-called urban edges of cities for development |
| Correlation | The distribution of land to community groups was accompanied by the availability of loans and building materials |
|-------------|--------------------------------------------------------------------------------------------------|
| Wide compatibility | Land distribution policies and initiatives are consistent with different levels of individual incomes |
| High degree of fairness | Providing plots of different sizes at subsidized prices for marginalized and low income groups |
| Effective communication network | The existence of accurate data on the distribution of land at the level of the state and developed land untapped within the limits of the basic design - Identify areas of expansion according to logical and rational directions |
| Comprehensive monitoring | Comprehensive monitoring of the land market and price fluctuations |
| save | Dealing with land as a non-renewable resource must be maintained. |
| Diversity | - Diversity of loans |
| Reserve redundancy | - Banks have backup balances in case of stopping support |
| Modification or modulation | - Adjust interest rates and facilitate lending conditions in private banks to encourage borrowing |
| Connectivity | - Achieving self-sufficiency in loans through encouraging private banks and benefiting from the funds of institutions (retirement and social security) |
| Correlation | - The existence of a culture of bank managers of the importance of supporting low-income through soft loans |
| High degree of fairness | - Allocating state-subsidized loans to vulnerable groups |
| Effective communication network | - All banks to provide the Urban Observatory with details of loans provided |
| Simplicity and simplification | - The existence of clear laws reduce confusion in understanding |
| Modification or modulation | - Amendment and modernization of laws on housing |
| Wide compatibility | - The need for a consensus between the housing laws |
| Diversity | - Diversity of bodies responsible for providing social services and infrastructure (government institutions / individual developers) |
| Reserve redundancy | - Implementation of residential projects and cities provides an increase in serviced areas |
| Connectivity | - Encourage developers to provide technical and social |
| Building Techniques and Techniques | Diversity | - Diversity in construction methods and methods |
|------------------------------------|-----------|-----------------------------------------------|
| Reserve redundancy                 | - Diverse sources of raw materials |
| Simplicity and simplification      | - The existence of a reserve of building materials |
| Modification                       | - The presence of more than one hand to provide building materials |
| Connectivity                       | Modernize building techniques with simple technology and encourage the population to use them |
| High degree of fairness            | - The existence of more than technology for the implementation of residential projects and not limited to specific technology |
| Innovation                         | - The existence of modern construction methods and economics reduce the cost of construction and the need for traditional building materials |

| Residential production             | Diversity | - Diversification of housing providers (public sector, private sector, cooperative societies) |
|------------------------------------|-----------|------------------------------------------------------------------------------------------|
| Reserve redundancy                 | - Reliance of the relevant institutions on the existence of more than one option in the implementation of housing projects to avoid any interruption in projects because of the multiplicity of problems and economic and political conditions |
| Simplicity and simplification      | - Institutions have ideas and solutions that are easy to apply to the continuation of residential production and not to stop when crises occur |
| Connectivity                       | - When developing solutions to housing problems, institutions rely on the international knowledge and experience of international organizations |
| Social capital                     | - Increased areas of population participation in planning processes |
|                                    | - Build community trust in institutions |
|                                    | - Work with community-based organizations to increase population awareness about the impact of crises |
| Residential investment | Wild compatibility | The existence of points of contact between the various relevant institutions helps to consensus and experience on initiatives to increase housing production |
|-------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Multiple levels of government | -Work within a leadership network rather than entrusting the decision to a single institutional structure - The diversity of levels and decentralization of the decision helps to implement decisions |
| Potential risk management | - Introduce potential risk management within the institutional structures to ensure that the system recovers quickly |
| Innovation | - Supporting various institutions for modern trends in urban and regional planning and sustainable development |
| Diversity | The multiplicity of beneficiaries of investment projects enhances social flexibility |
| Simplicity | - Adopting future designs for future expansions - Implementation of housing projects for middle-income groups at affordable prices and designs that meet the needs of the family |
| Connectivity | - Encourage investors to provide short-term loans to the beneficiaries of their projects. - Encourage investors to agree with banks to provide loans to beneficiaries |
| Social capital | Encouraging investors to support low-income groups by implementing affordable housing projects. |
| High degree of fairness | Provide a package of exemptions to investors in return for allocating a percentage of housing projects for low-income groups at reasonable prices |
| Potential risk management | Involve investors in potential risk management processes |
| Innovation | Encourage investors to adopt smart technologies and designs for the purpose of introducing modern technologies |

| Housing management and maintenance | Diversity | Diversity of loan sources for housing maintenance |
|------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Reserve redundancy | Maintenance and maintenance of housing helps maintain housing and provide a good stock of housing |
| Connectivity | Encouraging investors to support low-income groups by implementing affordable housing projects. |
| Social capital | - Provide loans for the maintenance of housing and directed to low-income groups to keep housing from extinction - Encouraging private sector banks to provide loans for housing maintenance and to create a competitive environment among banks |
| Multiple levels of government | The involvement of government organizations and associations associated with relevant ministries helps to benefit from a variety of expertise |
5. Conclusions

1. The housing system of Baghdad governorate suffered from the effects of the economic blockade, which caused a complete paralysis of the system during the period from 1990-2003.
2. The inability of the housing system to recover from the effects of the economic blockade and to restore the housing system and its components the ability to change and adapt to reach a state of balance.
3. The inability of traditional policies and strategies to address problems facing systems that have been exposed to economic turmoil and crises due to their inability to deal with unexpected events.
4. The continued high need for housing indicated the imbalance in the performance of the components of the housing system and the need to introduce the concept of resilience and its measures in the operational strategies to address the state of imbalance in performance.
5. Resilience strategies adopt an infrastructure that allows any system to withstand future economic challenges and crises.
6. Increasing in the need for housing index in Baghdad governorate with continuing high population growth and the number of households.
7. The existence of a large gap between the volume of demand and residential supply of the province of Baghdad contributed to the high levels of housing need and with low levels of housing production, which indicates weak housing stock.
8. Incomplete implementation of any of the residential investment projects in the governorate of Baghdad, which would have contributed a significant and important part in balancing the housing supply in front of residential demand.

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