IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

Resilient cities to mitigate effects of climate change

To cite this article: Muna M N Al-Sayed and Arshad Alanizi 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1129** 012029

View the article online for updates and enhancements.

You may also like

- From managing risk to increasing resilience: a review on the development of urban flood resilience, its assessment and the implications for decision making
Viktor Rözer, Sara Mehryar and Swenja Surminski
- The role of local narratives in emerging climate governance
Rosalind Donald, Camila Young and Katharine J Mach
- A Study on the Idea of Resilient City and Its Application in Planning and Practice in China
Weichao Gao

The Electrochemical Society
Advancing solid state & electrochemical science & technology

DISCOVER
how sustainability intersects with electrochemistry & solid state science research



This content was downloaded from IP address 188.119.36.18 on 07/06/2024 at 16:38

Resilient cities to mitigate effects of climate change

Muna M N Al-Sayed[1] and Arshad Alanizi[2*]

[1] Al-Farahidi Univrrsity, Technical College of Engineering, Department of Architecture, Iraq
[2] Al-Nahrain Univrrsity, College of Engineering, Department of Architecture, Iraq

[*] E-mail: dr.arshad.alanizi@nahrainuniv.edu.iq

Abstract. The concept of resilient cities can be considered as a way of enabling not only dealing with added and severe shocks but also tackling the many challenges that constrain businesses, jobs and livelihoods. Hence, a major part of the building is resilience, which aims to find solutions to reduce poverty levels and find more general solutions to improve the quality of human life. There are more interventions in urban areas - conducted by stakeholders everywhere to achieve a certain level of resilience through the development of housing, infrastructure and services. The objectives are to develop knowledge about the contributions of cities to mitigating the impacts of climate change for urban planners and all those interested in urban development, climate change, environmental sciences and engineering. This research shows the most important factors that cities take, and what actions are taken to mitigate and adapt to climate change. It also identifies promising mitigation and adaptation strategies that promote sustainable development and are geared towards resilience.

1. Introduction

Changes in land and ocean temperatures have caused significant damage to the world's cities. The effects of these changes vary locally from one city to another, according to its location and its preparations to withstand fluctuations in climatic conditions, including rising sea levels, increasing cases of severe precipitation, severe drought, increasing frequency of floods and negative effects, and then increasing infectious diseases and natural disasters, which are the most prominent challenges of cities in our time. Therefore, cities had to respond to many changes such as technological change and globalization and deal positively with the social effects of change. Urban areas can also play a pivotal role in successfully addressing global environmental challenges, as cities produce nearly 70% of all gas emissions. Development in urban planning, housing, transportation, disaster and waste management is one of the most important strategies to combat global warming. And if cities fail to deal effectively with environmental challenges, they will inevitably be in “serious trouble”, and this is what prompts us to ask many questions:

- What types of urban infrastructure improvements to avoid avoidable damage?
- What sectors should governments prioritize in terms of cost and CO2 emissions mitigation?
- What are the policies needed to promote energy-efficient buildings in the residential and commercial sectors?
- How planners and officials can encourage greater use of renewable energy sources to meet growing energy demand?
- What are the possibilities for improving urban planning and the built environment?

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

- What are the most important efforts that cities give to activate mass transit systems and reduce the use of private cars?
- How to make the city more convenient for pedestrians and bicycles, encourage citizens to choose these options?
- What experience do we have at the local level to take sustainable development measures and plan for future adaptation?

These questions are in addition to many other questions that may be raised that integrate the goals of growth and sustainable development with possible solutions to avoid the effects of climate change. The purpose of this research is to extract what can be included in urban planning in order to adapt as much as possible to climatic developments, because the world is witnessing a rise in temperatures with the melting of ice in the two polar continents, and this, in turn, leads to floods and the intensification of seasonal storms, which raises growing concern among Governments and stakeholders. And if the oceans continue to rise, there will be no appropriate time to prepare to avoid damage if the necessary precautions are not taken and strongly, and Antarctica recorded the highest temperature at 18 degrees Celsius, the highest it reached in 2020, which was rarely recorded above 10 degrees Celsius.

2. A resilience city

A resilience city can be defined as a city that is able to withstand or quickly return to normal, meaning that it is the ability of the urban system to continue despite crises, and these strategies are translated into projects that solve several challenges at the same time, and one of the characteristics of resilient cities is that they learn from experiences The former find alternatives in the use of their resources, they have strong well-studied systems. They have reserves that exceed the immediate need in anticipation of emergencies, and they have participatory institutions [1]. The people who live and work in cities, especially those with low incomes, are able to obtain a decent living despite the stresses or shocks facing cities. Resilience is a term that emerged in the field of ecology in the 1970s, to describe the ability of a system to maintain it. On the other hand, restoring functions in the event of disturbances or shocks. It is applicable for cities because of the complex systems that constantly adapt to change [2].

3. Why resilience city?

With the development of the twenty-first century, the population living in urban cities continually is increasing. People are drawn to cities as centres of economic activity and opportunity. However, cities are also places. Sudden stresses or shocks accumulate. It may lead to economic and social collapse unless the city is resilient [1]. Cities usually face many risks and disasters due to climate change and the spread of epidemics, and this poses new challenges that lead to the need to take new measures in urban planning, which makes cities more resilient [3]. With the development of the twenty-first century, the population living in urban cities continually is increasing. People are drawn to cities as centres of economic activity and opportunity. However, cities are also places. Sudden stresses or shocks accumulate. It may lead to economic and social collapse unless the city is resilient [1]. Cities usually face many risks and disasters due to climate change and the spread of epidemics, and this poses new challenges that lead to the need to take new measures in urban planning, which makes cities more resilient [3].

4. Climate change

With the exacerbation of the effects of climate change on urban areas, living will become more dangerous and the manifestations of climate change become evident in many urban areas, especially with the large population increase. Most of these effects appear in the following climate changes:

- The warmest and most frequent hot days and nights over most land areas.
- Decreased number of cold days and nights in many parts of the world.
- Increased warm frequencies/high temperatures in most cities.
- Increasing the frequency of heavy rainfall events in most regions.

- An increase in drought-affected areas.
- Increasing intense activity of tropical cyclones in some parts of the world.
- Increasing cases of rising sea levels in some lands.

In addition to the physical risks arising from the climate changes mentioned above, Cities may face challenges in delivering infrastructure, such as transportation and health supplies [4].

4.1. Urban centers and climate change

The question that arises now is about the relationship between urbanization (by which we mean an increase in the urban population) and climate change and how urban centres contribute to climate change. To answer this question, we say that it is necessary to study and understand all urban systems such as the transportation and transportation system, heating and cooling systems, industries and other activities and infrastructure that act as emitters of gases in urban areas, which will inevitably affect climate change directly or indirectly [5]. The impacts on the carbon cycle and climate namely changes related to atmospheric air emissions, greenhouse gases and solid waste, changes related to land use within cities, and the participation of different populations in economic activities and infrastructure, all lead to warming, and the causes of warming vary due to several interrelated factors that determine patterns of energy use, and emissions. Urban development can also bring multiplier effects to climate hazards, but focusing on the exposure of urban areas and settlements to climate change risks alone is not sufficient to understand the effects of climate change. Resilience, development, social and economic justice, gender, and governance structures are essential determinants of adaptation, capabilities, and necessary actual adaptation actions [6].

4.2. Infrastructure impacts

Climate change has direct impacts on a city's physical infrastructure, utilities, and drainage and energy systems - which in turn affects the well-being and livelihoods of its residents. These effects will be severe in low-altitude coastal areas. Although they represent only about 2% of the world's total land area [7]. People who live in these areas, and are vulnerable to severe damage to the residential and commercial environment with an increased incidence of risks and disasters associated with climate change. In this regard, floods are one of the most devastating natural disasters, which are likely to increase in many regions of the world with the increase in the intensity of rainfall. Coastal erosion, saltwater intrusion, and building destruction make some areas uninhabitable. The subsidence or subsidence of the Earth's surface is another "slow start". The factor that poses a threat to the residential and commercial environment and urban structures is subsidence or subsidence, which may be rapid, and may lead to significant damage to pipelines, building institutions and other infrastructure [8]. The effects of climate change often disrupt transportation systems through weather conditions that have immediate impacts on travel and damage that causes outages. Rising water levels in the seas and oceans may lead to flooding coastal cities and causing significant damage to road infrastructure and bridge foundations, causing major collapses and uncontrollable material and human damage. On the other hand, compromising the safety of paved roads needs successive reforms. This is in addition to the potential to threaten, destroy or damage transportation systems and service disruptions that are much needed in all aspects of urban life, not to mention the damages of rising temperatures, especially long periods of drought and high daily temperatures [9]. Cities are usually strong economic centres and forces, as there is a great demand for energy and this demand may be affected by climate fluctuations. An increase in temperatures will inevitably lead to a significant increase in energy demand. Climate change also affects energy generation and distribution, for example, transportation infrastructure may become more vulnerable to damage such as storms and floods becoming more severe. Climate change affects water supply and distribution, particularly with the intensification of rising temperatures. Other changes are expected, such as an increase in rainfall in some areas and an increase in sea level levels, and this leads to disasters, including the deterioration of sewage systems, especially in developing countries [10].

Table 1. Sectors and strategies.

Sector	Options/Strategies
Water	Expanded rainwater harvesting; water storage and conservation techniques; water reuse; desalination; water-use and irrigation efficiency National water policies and integrated water resources management; water-related hazards management
Infrastructure	Regulating sea and technological barriers to prevent storm and flood flow, protection and sand dune buffers, achieving sustainable development goals and smart technologies in land use policies
Human health	Emergency health plans; urgent medical services; Monitoring outbreaks of diseases and preparing for epidemics, providing safe drinking water and improve sanitation. Public health policies to confront the epidemics resulting from climate change Regional and International Cooperation
Tourism	Integrated tourism planning / focus on "new" attractions and revenues; (For example, enhancing carrying capacity; factors of attraction and preservation of tourist attractions from the factors of erosion due to climate change due to dust, storms and heat; participation of stakeholders and the private sector.
Transport	Re-planning transportation routes by taking climate change into account and using advanced technologies, modern design standards and smart roads
Energy	Diversity in the uses of alternative energy and not relying on a single source, with a focus on the development of utilities infrastructure and the use of smart technologies.

Source: Based on Parry et al, 2007, Table SPM4 6 Crisis and disaster management, p49. [15]

5. Disaster management

The 1990s brought about a shift in the way disasters are dealt with, with more attention paid to the links between development and disasters. Some governments have included disaster management in development plans, upgraded infrastructure, housing in vulnerable informal settlements, urban improvement and land use management with associated zoning [5]. This led to the need for governments to take measures to consider the nature of the risks and disasters resulting from them and to take the means to avoid or reduce those risks. However, there are new other risks that may differ significantly from those in the past. Among the most important disasters that may occur as a result of climate change in cities are: [11]

- Earthquakes, which may lead to primary and secondary effects:
  Basic effects such as:

  1. Collapse of buildings
  2. Destruction of infrastructure
  3. People trapped
  4. Disruption of normal life and public services
  5. Change in the level of the earth's surface and the occurrence of cracks and fissures

  Secondary effects such as:

  1. Seismic sea waves
  2. Fires
  3. Landslides
  4. Flood

- Tsunami: It is a huge series of waves that overwhelm the coasts and destroy large areas of land.
- Volcanoes
- Hurricanes and storms
- Desertification and drought
- Landslides and floods
- Fires
- Epidemics

The goal of dealing with disasters and crises is to stop the deterioration and reduce losses to the minimum possible while taking advantage of the situation resulting from the crisis in reform and development attempts. The strategy for dealing with the crisis represents the losses or reforms that the disaster or crisis leads to, and this requires successful management [10]. The disaster management process is an administrative process consisting of an integrated team of disciplines, and the disaster management is carried out by a team of highly trained administrators aimed at mitigating the effects of the disaster, reducing the risks arising from it and helping to restore the normal situation to the affected area in the shortest possible time. Crisis management aims to achieve a rapid and effective response to the rapidly changing conditions of the disaster in order to mitigate its risks. Here we point out that it is necessary to form a national center for crisis management in each country, in addition to establishing similar centers in all ministries and institutions, as well as in each governorate or sector [11]. The element of surprise is one of the characteristics of the crisis, but it has some indicators and evidence. Sometimes the crisis passes through a series of stages, namely:

- Early warning stage
- The stage of evolution and crystallization
- The stage of development of the crisis
- Explosion stage
- 3-6-2 Stages of disaster response

Any efforts to confront disasters, to be effective, must take place in three phases:

- Pre-disaster stage: It aims to achieve the following objectives:

    1. Analysis of potential risks and their causes.
    2. Preparing the necessary plans.
    3. Providing all human, material and financial capabilities.
    4. Defining the terms of reference and responsibilities for each entity.
    5. Take all necessary measures to prevent disasters.

- A stage during the occurrence of the disaster: The purpose of this stage:

    1. Saving lives and relief for the afflicted.
    2. Minimizing losses.
    3. Reducing the extent of the disaster.
    4. Preserving the environment.

- Post-disaster phase: It aims to restore the natural balance to the disaster area as soon as possible.

So far, most cities in the world have not adopted effective strategies to deal with disasters, only a very few cities have developed coherent strategies for adaptation and mitigation of crises and disasters. These strategies are beginning to show an impact on investments or required changes in building

standards, infrastructure and land use management. These strategies focus on the need to build commitment among the various stakeholders, begin by identifying strengths, weaknesses/opportunities and threats, assess underlying weaknesses and risks, and develop strategic plans for the city as a whole that surround and support local responses to climate change. . Moreover, the process of adapting to climate change is a necessary task in almost all sectors related to local urban government [12].

6. Resilient cities and adaptation strategies

A resilience city can be defined as a city that is able to withstand or quickly return to normal, meaning that it is the ability of the urban system to continue despite crises, and these strategies are translated into projects that solve several challenges at the same time, and one of the characteristics of resilient cities is that they learn from experiences The former find alternatives in the use of their resources, they have strong well-studied systems, they have reserves that exceed the immediate need in anticipation of emergencies, and they have participatory institutions [5]. Some cities have developed strategies to adapt to the climate that can have a real impact on public investment or the desired impact of changes in building standards, infrastructure and land use management. It is possible to identify the main components of the development and strengthening of adaptive strategies in the city. These strategies will include some prerequisites such as the need to build commitment among the various stakeholders, develop or expand the information based on current conditions, initiate a risk assessment, assess vulnerabilities and response for a particular sector, and develop strategic plans for the city as a whole in a way that supports local responses to climate change. Moreover, climate change adaptation strategies are essential in almost all sectors related to local urban government. The sum of these requirements will lead to the so-called "resilient city" [1]. The ability to carry out risk assessments and optimal design for adaptation strategies represent a major challenge in identifying measures that enhance the well-being of the city and increase competitiveness. Policies should be developed to mitigate climate change and adapt to its effects in an effective manner. Work is also done to design policies to achieve the main objectives, which are mitigation (through declining current emissions of greenhouse gases and sequestering carbon into the atmosphere) and adaptation to the effects of climate change [9]. Developing human capital and mitigating social and economic vulnerabilities, is the only truly sustainable way to maintain competitiveness in cities that have limited physical resources. Despite the urgent response of resilient cities to climate change, the expected negative effects of climate change and its variability are inevitable, and urban centres may be at risk despite all the means of response, because the risks arising from this may not be controlled, so the responsibilities of cities With regard to the built environment, the infrastructure and services that it has related to the basic tasks, which are:

- Develop planning tools to contribute to the availability of land, legal permits, supervision, and the reduction of Dangerous activities that are likely to lead to hazards.
- Providing and developing public services, infrastructure and various resources.
- Enabling, facilitating and coordinating proactively risk management actions through partnerships with the private sector, academia, and non-governmental institutions.
- Encouraging entrepreneurship, new technologies and patents, especially the participation of stakeholders and the private sector.

Encouraging community participation to cooperate and conduct workshops and conferences to achieve a kind of knowledge exchange as well as expression, which is a best practice [9]. A resilient city is resilient when leadership is strong and coordination and responsibilities are clearly defined. This includes the effective participation of stakeholders, defining policies to facilitate the effective management of risks, and the city having continuous knowledge about the risks, and it works to evaluate risks on a routine basis, considering that this is the basis of urban planning and sustainable development. Activating mechanisms to enhance activities of resilience by creating an appropriate financial plan, carried out by urban planning based on recent information related to risks, with a focus on the most vulnerable groups. Cities in general are severely affected by climate change. Therefore, efforts to enhance the ability to adapt to these impacts are as important as emission reduction measures, and here

we review the city's most important strategies that work on mitigation and adaptation measures to climate change [1].

6.1. Wastewater sector

The sanitation sector includes the promotion of national policies for public energy with higher temperatures and sanitation for all cities with emphasis on critical situations (such as permafrost areas) and includes access to new alternatives, transportation and distribution regulations, financial and technological techniques, local energy use, infrastructure strengthening groundwater, development of new resources, cables for utilities, and other infrastructure in research and development.[8]. It also includes addressing precipitation and floods that are potable water resources may recede, due to the difficulty of dealing with existing and old sewage systems, but some of the effects can be mitigated through the rehabilitation of advanced infrastructure, and through renewable economic and social mechanisms that reduce water consumption, or by improving environmental systems. This contributes to benefits for the environment, individuals and societies [1].

6.2. Transport and communications sector

The transport and communications sector represents a key sector of the urban infrastructure sectors. The transport sector includes transport reorganization, financial and technical policies, design standards and considerations within national borders, and other infrastructure in research and development [8]. The transportation and communications sector represent a very large sector of the greenhouse gas emissions sectors, it is a major source of air pollution, and in many cities, traffic congestion poses a major challenge to the quality of economic life, hence mayors have a strong motivation to promote smart energy efficiency and transportation systems. This demand includes managing urban travel through pricing and other means, promoting high-quality public transportation, encouraging the use of sustainable transportation (cycling and walking), as well as the use of energy-saving cars and low-carbon transportation fuels - Especially in public utilities [9]. Many attempts at planning transport policies are using new models and sustainable methods. Although the car is the most popular method of transportation around the world, many enthusiastic fans admit that it has many problems, so the shift is made to sustainable and high-quality transportation. [13]. with steps added to direct land use and urban planning towards reducing the need for travel. These steps can reduce the city's carbon footprint, and can enhance the city's aesthetic and attractiveness, and thus its competitiveness in the global arena [9]. Planning and development processes should reflect the needs and desires of the local target group giving the utmost importance to popular participation in transportation planning [13].

6.3. The housing sector

One of the most important adaptation strategies is to provide emergency housing (or the so-called housing for displaced persons or refugees) for critical and affected situations as a result of floods, hurricanes and other emergency conditions. It provides sufficient space and protection from cold, humidity, heat and rain, as well as a location that allows the possibility of benefiting from work, health services, education...etc. The site must not be polluted or dangerous so that it could threaten the safety and health of the population. Organizations often use tents or other temporary structures or buildings normally used for other purposes, such as schools. The residence in these buildings or structures may take several years until reconstruction takes place, and therefore they should be viewed as settlements rather than shelters, as they need to be planned with regard to water/sanitation and other livelihoods [1].

6.4. Water sector

The water sector includes rainwater, national water policies, financial and human resources, integrated water resources policies and comprehensive management of storage, conservation, and other water-related sectors. As well as techniques for water reuse, risk management, water desalination, water use and irrigation efficiency [8]. It also includes water infrastructure, water transport, sea walls, standards, regulations, and integrated financial and technological policies in the water sector, such as sand dunes barriers that act as flood buffers, with integrated management consistent with the sustainable development goals. It also includes land acquisition and land use policies, swamp/wetland treatment,

buffer barriers against sea-level rise, as well as flood protection, and the erection of existing natural buffers [9]. Climate change, rapid population growth, industrial development, urban development, and demand for agricultural irrigation will all have impacts on water resources in the future. There is concern about an increase in the demand for water needed for agriculture, especially during the summer months which witness high temperatures, and greater rates of evaporation in the event of climate change, which may put more pressure on the scarce groundwater resources. The economic and environmental cost of desalination will also increase with climate change [1].

6.5. Energy and efficiency/green buildings sector

The energy sector includes encouraging the use of alternative technologies, efficient use of renewable sources, integrating different sources, relying on multiple sources of energy, as well as increasing efficiency and improving standards, bearing in mind that future climate change will be more severe for many urban residents. Cities implement more measures to reduce energy and water demand, and comprehensive policies to reduce energy and water demand and promote rational use of resources. This includes many actions such as reviewing and modernizing consumption tariffs and promoting low-carbon development, as well as addressing issues related to energy security while studying building efficiency standards because this sector consumes a large proportion of water and electricity Here, it is necessary to mention the role of the media through raising consumer awareness, reducing water and electricity consumption, rationing procedures, and providing the population with information on sources of consumption and government support. It also includes district cooling strategies due to the harsh climate in some regions in the Arab region, especially Iraq and the Gulf states, where air conditioning consumes a large share of energy [8]. Cities are working to integrate their initiatives related to climate change with several sectors of economic activities, such as the renewable energy sector and everything related to green buildings, building infrastructure, waste treatment technologies and the transportation sector. Sectorial economic development strategies are established as a way for cities or regions to conserve energy. Cities can incorporate this strategy into their efforts to make existing and new buildings more efficient and sustainable. Buildings consume 71% of electrical energy, so cities are setting stricter efficiency standards for new buildings, undertaking initiatives to improve the quality of existing buildings grants aid for the use of renewable energy. For both jobs and economic development and through the areas of renewable energy and green building products, it would be more profitable to shift towards a low-carbon economy, while creating more jobs [1].

6.6. Urban agriculture

Urban agriculture has become one of the most important means that can contribute to mitigating the effects of climate change, and through which it can achieve environmental as well as social and economic sustainability. Urban planning tactics in new city policies turn to sustainable agriculture and urban agriculture, which helps transform the threat of climate change from a crisis into an opportunity to help tackle the warming crisis by reducing greenhouse gas emissions through sustainable agriculture and feeding the world. Climate and environmental scientists assert that climate change, water, agriculture and food security are a link for the twenty-first century. “We need to create and implement practices that will increase yields and returns while overcoming changing conditions and reducing emissions from the industrial sector. Urban agriculture can also reduce the effects of "heat islands", provide shade, and absorb carbon dioxide and pollutants. One study, for example, suggests that a six-square-meter planted surface can remove pollutants produced by a typical car over a year, and another study suggests that tree-lined streets have a 60% reduction in vehicle exhaust [1]. Of course, open spaces are a valuable resource for cities, especially in densely populated cities, and it is possible to exploit sidewalks, middle islands, and neglected spaces between roads and residential houses in agriculture, in addition to their importance in improving the view and psychological state of the population. As for housing, the vast majority of the population lives. In apartments, their homes do not have gardens or open spaces that might be devoted to potential agricultural activities. Therefore, it is possible to invest the limited resources available, such as neglected spaces, balconies, rooftops and any possible areas in the house that have sufficient lighting [14]. Figure 2 shows the increase in vegetation cover loss since 2001, which leads to losses approximately the size of the area of Italy.

6.7. Food security

The decline in the agricultural yield in food-exporting countries, the restrictions on global food markets and the impact of price fluctuations may lead to many negative effects on cities. These effects may include recurrent increases in retail food prices and the need to provide significant food commodity subsidies. Studies have proven that climate change will have a significant and fundamental impact on public health and quality of life, as it affects important social and environmental factors, such as clean air, safe drinking water, adequate food and a safe haven. Climate change, according to the World Health Organization, is the most dangerous and destructive to the environment and population in the twenty-first century [1]. The impacts of climate change on human health are expected to increase due to rising temperatures and the potential for increased waterborne and vector-borne diseases, reduced water availability and impact on food security. It is difficult to ascertain the total burden of disease caused by climate change, due to the many mechanisms through which climate change may affect public health, decrease the area of arable land, increase the damage caused by fires and the spread of plant and insect diseases. Vegetable cultivation, fruits and field crops are threatened by multiple risks, which increases the vulnerability of these crops to the current pressures [16].

6.8. Innovation, research and development

Cities leaders should develop national plans and strategies for innovation, research and development, establish programs to assess climate change at the local, national and regional levels, motivate innovators through conferences, and launch incentives and rewards such as establishing “sustainable schools” and “sustainable universities”, as well as protect the environmental footprint [1].

6.9. Health and quality of life sector

The health sector includes everything related to human health and health action plans, public health policies, raising the level of health services, emergency medical services, identifying climate risks (especially its impact on vulnerable groups), improving the quality of life, improving enhanced health services that are sensitive to climate, Disease control, regional and international financial capacity, and international regional cooperation towards epidemics and emerging diseases [16]. Climate change will have a significant and fundamental impact on public health, affecting important social and environmental factors, such as clean air, safe drinking water, adequate food and safe-havens. The World Health Organization considers climate change to be the greatest threat to global health in the twenty-first century and has noted that climate change already kills tens of thousands of organisms annually, due to heat waves and other extreme weather conditions, outbreaks of infectious diseases and the effects of malnutrition and environmental pollution [8].

6.10. Tourism sector

The tourism sector includes attractions and revenues (such as carrying capacity, attractions, financial capabilities, participation of a wider group of stakeholders, diversification of tourism, integrated planning, marketing of new revenues, tourism natural resources such as heights and glaciers, industrial sectors); Potential financial incentives (such as subsidies and tax credits) combined with other logistical and technical challenges (such as diverting ski runs). This is in addition to other sectors such as the waste sector, where laws have been established to regulate and supervise waste management, a federal roadmap for integrated waste management, and a database to collect and arrange waste-related information and the wild species and habitat sector, where the resilience of wild species and habitats to the impacts of climate change is being stimulated through local and national biodiversity strategies. Work is also underway to enhance resilience by establishing a network of nature reserves [1]. Urban planning to adapt to climate change includes not only protecting existing urban areas, but also ensuring future urban expansion, and this requires a participatory process, especially in the field of spatial planning and organization. It also needs to make great efforts to achieve the best policy integration, in all relevant sectors, especially the integration of energy policies with other climate-related areas. Adequate institutionalization of climate protection is crucial to implementing climate policy programmers, there is an urgent need for governments to take new ways, means and plans in partnership

with climate change risk management in urban planning, and this requires an integrated study of city geography, infrastructure and demographics and public health systems [8].

7. A local case study

After the research reached the most important strategies for resilient cities to reduce the effects of climate change, the research will review some of those strategies in our Iraqi cities. Let's take, for example, the Yarmouk neighbourhood in the city of Baghdad to investigate the quality of the city in the transition to a resilient city. Al-Yarmouk neighbourhood was chosen because of its peculiarity in the presence of dense afforestation in its streets, its air quality and urban life, due to the presence of green and open spaces in it. It was initially called the Officers City, and through it, the main street is known until now as (The Four Streets), and then changed its name to the Yarmouk neighbourhood, and the area belongs to the Mansour district, which in turn belongs to the Karkh side of Baghdad.

7.1. Urban agriculture

The density of trees in the area and the plantations in the central islands, especially in the four-street area, are among the areas of urban agriculture, which mitigate the effects of climatic changes, storms and dust, and reduce the air temperature, especially in the summer. See Figure 1.



Figure 1. Urban agriculture in Yarmouk neighborhood. The photo was taken on 15th of May 2022.

7.2. Energy sector and green buildings

It appears that there is a need to use alternative energies due to the increasing pressure on energy as a result of the population increase and the increase in the number of housing units, which constitutes a burden on the region in energy consumption. The need to improve energy performance is to achieve increased levels of energy performance beyond the pre-requisites criterion to reduce. Environmental and economic damages associated with excessive energy use.

7.3. Housing sector

The area is not among the dangerous areas or threatened by floods or disasters, but rather it is a safe residential area, and it is advisable to provide emergency housing due to the harsh climatic conditions from other areas if necessary to receive displaced persons, due to the presence of spaces that can be exploited.

7.4. Transport sector

Traffic congestion poses a new and major challenge in the region as a result of the increasing population, which requires the promotion of smart energy efficiency and transportation systems. Managing urban travel like pricing, encouraging sustainable transportation promoting high-quality public and smart

transportation (cycling and walking), and moving toward the use of energy-efficient cars and low-carbon transportation fuels.



Figure 2. The four streets in Yarmouk. The photo was taken on 15th of May 2022.

7.5. Health sector and quality of life

There are a number of health centers in the area, and it is characterized by its wide streets, squares and markets. Figure 5 shows the wide, spacious and planted streets that provide fresh healthy air in the Yarmouk area.



Figure 3. Wide healthy streets in Yarmouk. The photo was taken on 15th of May 2022.

The presence of afforestation provides an appropriate and pure air quality, with an emphasis on the use of ventilation systems for closed places such as garages, basements and the like so that it matches or is less than the specified level for the concentration of air pollutants.



Figure 4. Afforestation in Yarmouk. The photo was taken on 15th of May 2022.

8. Conclusions

The impacts of climate change are a very important challenge in urban development, and the more severe the climate change, the more times more cities are at risk. Therefore, adapting to climate change is one of the most difficult challenges for cities in many countries, however, there is limited capacity to identify vulnerabilities, adaptation pathways and plans to deal with crises, along with the limited capacity to adapt to small and medium cities, with many problems In these cities it includes the need for infrastructure (such as sanitation and roads, piped water supply), and urban social infrastructure.

Rapid urban growth is causing pressures on land and services if it is not matched by sustainable planning and special decisions. This often results in migrant populations being located in precarious areas, such as coastal lowlands, floodplains or unstable and steep slopes, which must begin to adapt to the impact of climate change living, however direct impacts on urban infrastructures. Other cities have demonstrated the ability to adapt to climatic conditions, using several sustainable methods and approaches.

The research emphasizes the trend toward new and innovative philosophies towards a promising future with the integration of popular participation and all levels of government and diverse parts of urban society. Among the new philosophies is what we mean today by the concept of resilient cities, which is one of the viable solutions for resilient urban development based on risk-aware urban plans, and one of the fundamental things to reduce current disaster risks and prevent future disasters.

The trend toward urban and sustainable agriculture, which would have a significant impact on temperatures, resist drought and reduce the impact of harmful emissions, and this means changes in how urban areas are directed to work on closer coordination between local governments and local economic institutions and build new connections between central authority structures and parts of the population that they often remained outside the circle of consultation and discourse.

Emphasis on the role of public participation and the role of the private sector, grassroots groups especially those with low and middle incomes, as well as opinion leaders of all kinds to ensure that a broad range of viewpoints is brought together.

Pay special attention to the importance of adding climate-sensitive features to existing core infrastructure and making improvements to it, because adding these features will always be less costly than building new infrastructure and new facilities.

Organizations can be mobilized to invest in the development of new technologies, climate-resilient housing and infrastructure projects, and to assist in the development of climate change risk assessments by investing in technologies, infrastructure, and housing.

9. References

[1] Alsayed, Muna M N 2021 *Cities and Climate Changes* (Ashtar Printing and Publishing). Deposit number in the House of Books and Documents in Baghdad (1846).
[2] Salman, Somaya 2018 *Resilient Cities*, article published on the website https://www.alyaum.com/a/6064394.

[3] Lamia Kamal-Chaoui (lamia.kamal-chaoui@oecd.org) and Jan Corfee-morlot, *Cities and Climate Change: Key Messages from the Oecd*
[4] Hilda Blanco (Los Angeles), JoAnn Carmin (Cambridge), Michelle Colley (Montreal). 2011 *Cities and Climate Change*. The challenges for governance.
[5] City Resilience Index.April 2014, https://www.arup.com/projects/city-resilience-index.
[6] OECD: *Cities and Climate Change*: Key Messages From the OECD, for These and Related Publications: www.oecd.org/gov/cities/climatechange and www.oecd.org/env/cc/cities.
[7] Matthias Ruth and Rebecca Gasper, *Water in the Urban Environment: Meeting the Challenges of a Changing Climate*, Center for Integrative Environmental Research, University of Maryland. College Park, United States
[8] OECD 2008 *Competitive Cities and Climate Change*, OECD Conference Proceedings, Milan, Italy, 9-10 October.
[9] Fitzgerald, Joan 2011 *Cities and Climate Change*: *Global Report on Human Settlements*. United Nations Human Settlements Programme UN-HABITAT, by Earthscan Copyright © United Nations Human Settlements Programme (UN-Habitat).
[10] Jessi Gowan and Filed Under General 2017 *Global Warming/Climate Change, Urban Projects, Why Permaculture?,* March 22, https://permaculturearabia.org/.
[11] Network of Experts on Climate and Environmental Change: Climate-Related Risks and Environmental Changes in the Mediterranean Region, Preliminary Assessment by the Network of Experts on Climate and Environmental Changes in the Mediterranean, 2019.
[12] Matthias Ruth and Rebecca Gasper, *Water in the Urban Environment*: Meeting the Challenges of a Changing Climate, Center for Integrative Environmental Research, University of Maryland. College Park, United States.
[13] Alrawi,Firas. Hardan, Khalid. Alacash, Hamid. Mesrop, Seda 2020Community Participation Towards Sustainability Enhancement of Transportation Sector for Baghdad City. DOI: 10.1007/978-3-030-61075-3_11. In *Advances in Mobility-as-a-Service Systems, Proceedings of 5th Conference on Sustainable Urban Mobility*, Virtual CSUM2020, June 17-19 , Greece.
[14] Al Assd, Muhammad, Zureikat, Lara. Urban Agriculture in Oman: An Overview, Center for the Studies of the Built Environment, CSBE, December 2018https://news.un.org/ar/story/2020/03/1050931.
[15] Parry, M. L., O. F. Canziani, J. P. Palutikof, P. J. van derLinden and C. E. Hanson. *Climate Change: Impacts, Adaptation andVulnerability.* (Contribution of Working Group II to Cambridge University Press, Cambridge).
[16] United Nations UNISDR: Empowering Cities Resilience, Handbook of Local Government Leaders Contribution to the 2010-2020 Global Campaign My Cities Prepares, United Nations Office for Disaster Risk Reduction.