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THE ROLE OF COMPACTNESS IN ACHIEVING URBAN SUSTAINABILITY

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Abstract:
The compact city is one of the leading models of sustainable urbanism. Over the past thirty years, the planning and development of compact cities have been a primary response to the challenges of sustainable development. This model has received substantial support from global policies due to its effective contribution to achieving environmental, economic, and social sustainability goals. The compact city represents the ideal city for achieving urban sustainability. to respond to many urban problems through high densities, mixed use and integration of urban elements., In order to ensure easy access to services and more efficient use of infrastructure, and its reliance on sustainable means of transportation to preserve the environment from polluting emissions. The research deals with the compact city model and its characteristics in urban planning and development in relation to the three dimensions of sustainability. and study the possibility of having a high-density city as a sustainable urban model. To shed light on this urban phenomenon, the theoretical framework extract was applied to a compact Arab city model, namely the city of Dubai, Business Bay area.

Introduction

Cities are facing increasing pressures due to current global trends, encountering multiple challenges that require effective responses. Among the most prominent of these challenges is the urgent need to accommodate growing populations while maintaining environmental sustainability, promoting economic prosperity, ensuring political participation, and fostering cultural diversity in the future. **(Ibrahim,2020, p:145)**

In the process of future planning, urban planners aim to design and organize cities with sustainability dimensions in mind. This includes reducing economic costs while enhancing vitality, minimizing environmental impacts while increasing resilience, and improving social equity while raising the quality of life. **(James, 2014, p:232)**

Since the early 1990s, compact cities have emerged as a prominent model for sustainable urban expansion. This model is considered one of the most effective approaches for achieving urban sustainability. Many researchers believe that compact cities enhance resource efficiency, stimulate economic growth, improve public health, strengthen social cohesion, and support cultural development. **(Jabareen, 2006, p:38-48) (Bibri, et al.,2020, p:2)**

A compact city can enhance sustainability by reducing travel distances and commute times, decreasing reliance on cars, lowering individual energy consumption, reducing the need for construction materials and infrastructure, and minimizing pollution. It also helps preserve diversity in employment and social services, and mitigates the loss of green and natural spaces. This is attributed to the fact that the compact model focuses on intensifying development and activities, setting boundaries for urban growth, encouraging mixed land use, and promoting the importance of public transportation and well-designed urban planning. **(Alkinani, et al.,2020, p:2)**

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In general, a compact city benefits from the advantages of clustering, achieving a wide range of environmental, economic, and social benefits through effective planning and development.

Keywords: (Urban sustainability, compactness, urban form, compact city

urban compactness

Compactness refers to the efficiency of land planning, the density and intensity of the built environment, its diversity, the mix of land uses, and sustainable transportation.
(Bibri, et al.,2020, p:6)

Urban compactness is typically defined by the development of high-density areas with mixed uses, focusing on improving access to amenities and public transportation, and developing central areas around public transit systems.
(Rahman, et al.,2022, p: 7)

Urban compactness also refers to cities with high population density and diverse land uses, where development takes place within the city limits.
(Holuj & Lltynski, 2015, p. 87)

Urban compactness is typically defined based on the degree of land use diversity, or indirectly through economic indicators. It is assumed that increasing land use diversity in urban areas enhances the efficiency of urban functions and makes them more integrated.
(Lan, et al., 2021, p:121)

Compactness can be described as the degree to which development is clustered by the density and intensity of the built environment, the efficiency of land planning, the diversity and mix of land uses, and the efficiency of transportation systems. Despite the different definitions, one of the most common themes is the idea that compactness involves the concentration of development.

Advantages and disadvantages of urban compaction

Compact, high- density compact cities offer numerous advantages, which can be categorized into different areas such as environmental, social, and economic sustainability. Despite the benefits provided by high urban density, there are also some persistent drawbacks, some of which conflict with the advantages, as in Table No. (1) **(Boyko & Cooper, 2011, p: 1-61)**

Table No. (1) Advantages and disadvantages of urban compaction according to sustainability aspects

Environmental	Economic	Social	Advantages/Disadvantages
Advantages			
_ Reduce fuel emissions and reduce pollution. _Walkable and bikeable neighborhoods.	_ Transportation is more efficient. _ Reduce fuel consumption.	- Accessibility: Residents live close to their workplaces and needs. - Proximity to public transportation.	**Transport**
_ Reducing pressure on agricultural lands	_ More efficient use of land. _ Infrastructure is	_ Increase social interaction.	**land use**

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and green spaces.	more efficient and less costly.		
A more livable environment.	_ Diversifying housing options and enabling purchasing power. _ Increase the overall value of nearby detached housing in the long term. _Providing job opportunities.	_ Guaranteed housing. _Providing security and vitality and reducing crime. _ Diversity in providing public services and facilities.	**Diversity**
Flaws			
_Creating congestion for pedestrians.	_ Increased congestion in public transportation facilities.	_ Increased traffic congestion and parking problems.	**Transport**
_ Loss of open and green spaces. _Pollution and increased noise.	_ Lack of agricultural areas. _ Higher cost to build and maintain high-density projects. _ High cost of services and land.	_ Limit entertainment opportunities. _ Loss of privacy.	**land use**

Source: Researcher based on (Boyko ,Cooper, 2011,p: 1-61)

Different forms and models of urban compactness contribute in various ways to achieving sustainability. Planners and researchers develop a range of design concepts to meet sustainable development goals, with each form and model emphasizing different concepts. However, all of these forms should positively contribute environmentally to serve both current and future generations.

Urban Sustainability

The concept of urban sustainability is relatively new in urban planning principles, drawing from the global concept of sustainable development. This concept integrates environmental, economic, and social needs and goals, aiming to improve the quality of life for residents across various environments. **(Ben Omairah, And others, 2021, p:4)**

It is the development through which people can live and work in cities now and in the future. It includes the infrastructure, opportunities and capabilities needed by the population. **(Sabra, et al.,2024, p:3**)

The principles for achieving urban sustainability are: **(Jenks,2005, p:311)**

1- Focus on humanitarian activities according to the current and future outlook.

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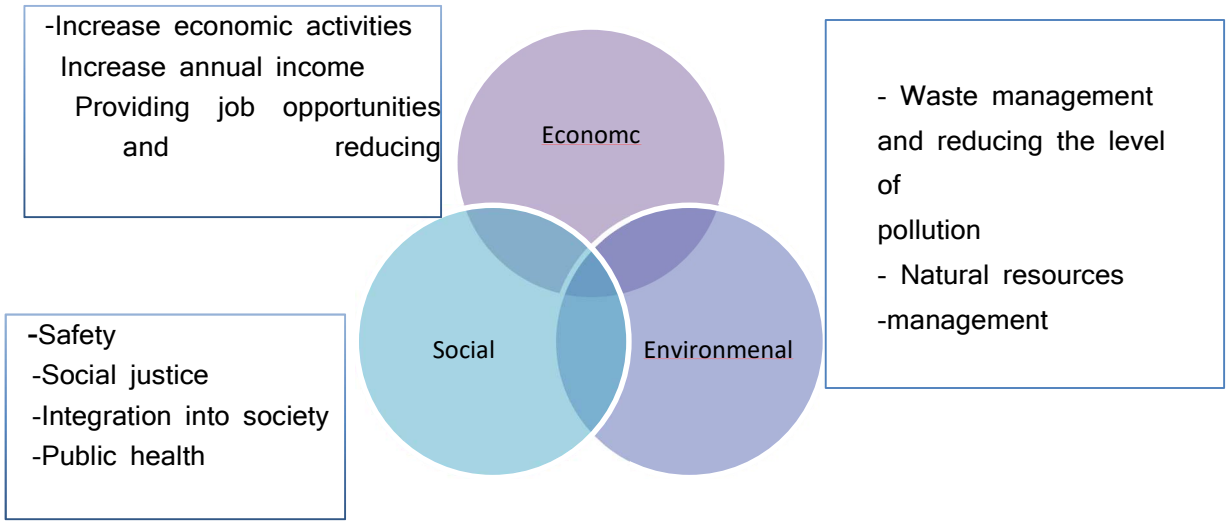
2- Achieving environmental, social and economic justice.
3- Adoption of high building densities.
4- Interest in participating in decision-making.

Urban sustainability emphasizes that it is a state of balance and reformulation of the economic, social, environmental, political and institutional objectives and determinants of the city, through which it provides a greater opportunity to achieve sustainable development. **(Ramadan, 2022, p. 13)**

Figure (1) shows the indicators of urban sustainability according to the three axes of sustainability as follows:



FigureNo. (1) Urban sustainability indicators Source: The researcher based on (pleasantJamal, 2023, pp. 206-208)

Sustainability relies on a set of interconnected factors that must align with the local conditions of each city. Each city must leverage its potential and local resources while assessing challenges and opportunities from a comprehensive perspective. Due to the complexity of social, economic, and environmental dimensions, cities need to address their unique urban characteristics when developing and implementing development policies to improve urban health and enhance the quality of life for residents.

(Alkinani & Alrawi,2021, p:34-35)

It shows indicators of urban sustainability in all its social, economic and environmental aspects, which aim to achieve sustainable development. There are many areas that contain the concept of sustainability in its comprehensive sense, as it appears within the urban environment in the city with its physical and material content, which is represented by the urban form, And also with its

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invisible, immaterial content represented by society.

Urban form and sustainability

Urban form has a strong and complex relationship with urban sustainability. Urban form can be defined as the spatial distribution of human activities over a specific period of time.
(Tsai, 2005, p:142)
Various approaches aim to achieve sustainable urban forms and models, focusing on specific concepts. Many urban planners believe that sustainable urban design can be realized through a range of planning and design strategies, utilizing appropriate tools and concepts. This leads to the development of sustainable urban models both theoretically and practically.
(Jabareen, 2006, p:38-48)

Basic dimensions of sustainable urban form

Upon reviewing the literature on sustainable development and environmental planning, it is evident that sustainable urban forms share fundamental dimensions, with slight variations in details. Numerous studies have been conducted on the sustainable city based on a diverse range of concepts, as shown in Table (2).

Table No. (2) Common dimensions of sustainable urban form in previous literature

Researchers and planners	Studies axis	Dimensions
Jabareen, 2006	Sustainable Urban Design Concepts and Their Contribution to Sustainability	stacking Density Mixed ground use Diversity Sustainable transportation
Jones & MacDonald, 2004	Components of sustainable urban form and economic sustainability	Mix of land uses Density Transport infrastructure Characteristics of the built environment Planning
Dempsey, et al.,2010	Components of sustainable urban form	Density mixed land use Transport Ease of access Characteristics of the built environment

Source: The researcher based on the mentioned literature

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Compact urban forms and models play a diverse role in promoting sustainability. Planners and researchers develop various design concepts to achieve sustainable development goals, with each concept offering different forms and models that focus on various aspects. However, all of these forms must contribute to achieving significant environmental benefits for both current and future generations.

The compact city as an approach to sustainable urbanism

In the context of studying the relationship between urban planning and sustainable development in an era characterized by rapid urbanization, the concept of sustainable urbanism focuses on analyzing cities, practices, and strategies related to their design and development. The goal is to enhance urban resilience and long-term viability by reducing material usage, lowering energy consumption, mitigating pollution, and minimizing waste, while also promoting social equity and well-being. Among the models adopted, the compact city is considered a fundamental example of sustainable urban development.

(Bibri, et al.,2020, p:3)

A suitable summary of the compact city as a city **(Daneshpour, & Shakibamanesh,2011, p:3)** He presents
It is an urban model characterized by high population density and mixed land uses. In this model, growth and expansion are encouraged within existing urban areas without extending into unoccupied surrounding regions. This design aims to enhance sustainability by focusing on optimizing the use of current spaces and avoiding sprawl.

Many urban planners see compact cities as more socially sustainable high-density urban models because local amenities and services can be maintained and easily accessible due to the high population density. In addition, high density is seen as a prerequisite for the vitality of urban living, cultural activities and social interaction.
(The Kanani, Enas, 2019, p. 119)

It can be concluded that a compact city is a city with high density and has the following characteristics:

- **An active area characterized by high density growth.**
- **Multi-use development.**
- **Availability of services and facilities and ease of access to them.**

The compact city principle is the ambition to create a high-density, multi-use urban model. The idea of the city is based on the convergence of urban activities, in order to ensure easy access to services and more efficient use of infrastructure. The compact city is based on the human factor from the perspective of achieving a better life and providing a sustainable environment. Figure (2) represents the characteristics of compact cities.

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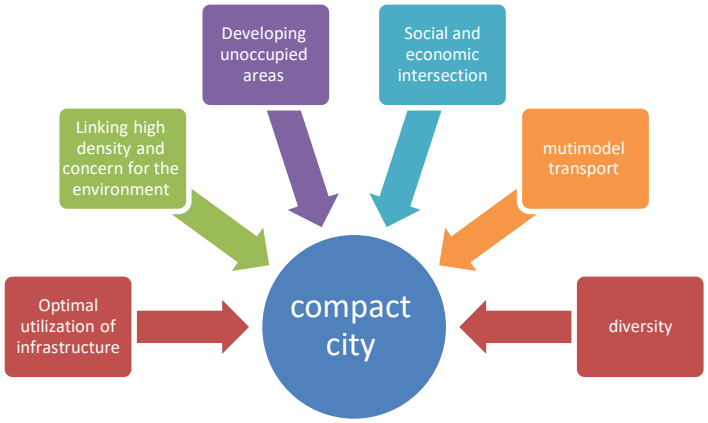

FigureNo. (2) Characteristics of compact cities, source: researcher

The promotion of the concept of sustainable development has supported the idea of urban compactness, as research since the 1990s has highlighted the environmental benefits of this model. The importance of the compactness strategy in achieving urban sustainability is based on four main pillars: First, protecting rural areas by controlling urban sprawl; second, improving quality of life by enhancing social interactions and accessibility to services and amenities; third, reducing energy consumption through higher population density; and finally, minimizing greenhouse gas emissions by decreasing the number and duration of trips using polluting transportation modes. As in Figure (3), which shows the main axes that show
the importance of compactness in achieving sustainable urban forms.

FigureNo. (3) The main axes of the importance of compactness in achieving sustainable urban forms, source: the researcher based on (Jabareen, 2006, p: 40)

**Table (3) shows the characteristics of compact cities and their role in achieving urban sustainability through the basic aspects of sustainability. The research finds that the compact city contributes to creating urban sustainability from the environmental, economic and social aspects, and that the concept of the compact city represents high density and the use of urban space as much as possible and improving the quality of urban life. The compact city appears as a concept that meets sustainability first and
foremost, and thus has taken its role in achieving urban sustainability.**

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Table (3) Analysis of the characteristics of compact cities and their role in achieving urban sustainability

Urban sustainability			Characteristics of a compact city
Environmental	Social	Economic	
●	●	●	Diversity
●	●	●	Sustainable transportation
	●	●	Social and economic overlap
	●	●	Developing unoccupied areas
●	●	●	Linking high density and concern for the environment
	●	●	Optimal utilization of infrastructure

Source: Researcher

Dubai city

Dubai a leading example of growing cities in the Arab world. Cities like Dubai have experienced significant expansion, with their size increasing considerably compared to what it was in the 1970s and 1980s. Today, Dubai holds a prominent place on the global map of emerging locations, and it is now viewed as one of the world's leading cities, thanks to the substantial progress made by the United Arab Emirates over the past three decades, driven by its strong oil-based economy. Despite limited other natural resources, the country has achieved notable results in development indicators due to exceptional economic growth, high per capita income, and strong social development.
(Al Marashi, 2010, p: 1)

With the increasing global focus on sustainability and sustainable design, the main challenge has become how to effectively design and build communities that achieve sustainability, which has called for some interesting ideas. One such city was Business Bay is a planned, compact city and is a densely populated, planned area. It is the central business district of Dubai. the project includes: Several skyscrapers are located along the Dubai Creek. The project contains 240 commercial and residential buildings. Business Bay covers an area of 4.36 km2., an area that can be navigated on foot or by bike, and is planned at a much higher density than other high-density new cities. The net density of Business Bay is 483 people/hectare, In terms of size and density, it has the external requirements of a compact

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city. Business Bay is located in the heart of Dubai and has a well-equipped regional public transport system with Business Bay station as the hub, Deira, Dubai Marina and Jebel Ali. In addition, buses have been operated to each residential complex centered at Business Bay station, and a bus stop has been established..
(Jung & Al Qassimi, 2021, p: 49-50)

(Jung & Al Qassimi, 2021, p: 49-50), Source:Figure No. (3) Business Bay Master Plan

Business Bay was implemented with the planning elements of a compact city and was a pedestrian-oriented city. A pedestrian-centered living environment was created, and the most common approach to reaching the center was walking. Despite the lack of green spaces and open spaces in Business Bay, the surrounding natural environment including the Dubai Water Canal is preserved through integrated development. Table (4) illustrates the application of the abstract of the role of the compact city in achieving sustainability to the case study of Dubai.

Table (4) Analysis of the case study of Dubai City - Business Bay

Dubai City - Business Bay		**Characteristics of a compact city**
Case Study	**Description**	
	Diversity in distribution Residential, commercial, office spaces, open spaces, and achieving different types of housing and diversity in activities. The main towers of the Business Bay consist of 12 towers. They include residential, commercial and office towers. Which form the entrance to the Business Bay area.	Diversity

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	Bay Square is a mixed-use business complex within Business Bay as a pedestrian-only area with walkways over canals and waterways. It contains canals and walkways in addition to restaurants, cafes and retail shops. It includes various small and medium-sized companies.	
 	Connected to the public transport system, Business Bay is located in the heart of Dubai and has a public transport system. Well equipped regionally with Business Bay station as the hub and Deira, Dubai Marina and Jebel Ali. In addition, buses are operated to every residential complex centered at Business Bay station, A pedestrian-centric living environment has been created, The most common approach to reach the center was walking. Add to Dubai Water Canal and play Serving as a major water transport point, the pedestrian path is very well connected to	Sustainable transportation

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	the Dubai Water Canal.	
	The presence of a mix of activities, their proximity and mixed use The land creates a sense of security and renews life within the city due to the frequent use and in addition to the population capacity of the project, which exceeds 191,000 people. The number of employees, workers and others reaches 110,000. Which makes the total human capacity 300,000 people.	Social and economic overlap
	The commercial development will include 246,494.4 square meters, accounting for 18.5% of the development. The Dubai Creek expansion is part of the Business Bay development. The plan includes extending the 14 km of the creek to 26.2 km. It will extend from its original location to Dubai Creek and from there to the Arabian Gulf via Safa Park and Jumeirah.	Development of unoccupied areas

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	Business Bay is densely populated. The net density of Business Bay is 483 people/hectare, and since Safa Park is adjacent, it is an added advantage to the environment of the area, and the green areas surrounding the Dubai Water Canal have been preserved in the form of a small park , so it can be assessed that it has an excellent environment in terms of the natural environment.	Linking high density and environmental concern
	Providing inexpensive public services, improving the efficiency of investment in infrastructure, facilitating access to services for the population, activating social networks and providing job opportunities.	Optimal utilization of infrastructure

Source: Researcher

Conclusions:

- Compaction contributes to achieving urban sustainability in all its economic, social and environmental aspects.

-The compact city is one of the new global trends that achieve urban sustainability.

- The compact city is an urban model with high density and multiple uses. The idea of the city is based on the convergence of urban activities, in order to ensure easy access to services and use of infrastructure more efficiently, thus achieving the aspirations of sustainable cities.

-The compact city achieves sustainable urban form by relying on the principles of compactness, diversity, mixed use, and sustainable transportation.

-Compactness is a strategy for achieving sustainable urban forms.

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- The compact city is an effective means of protecting rural areas and enhancing quality of life by improving social interactions and facilitating access to services and amenities. It also helps reduce energy consumption due to high population density and mitigates greenhouse gas emissions by decreasing the number and duration of trips using polluting transportation modes.

- The compact city is based on the human factor from the perspective of achieving a better life and providing a sustainable environment.
- High density contributed to social and economic interaction, which has a positive role in the quality of urban life from a social and economic perspective.
- Compactness is of great importance in providing inexpensive public services, improving the efficiency of investment in infrastructure, facilitating the population's access to services, and providing job opportunities.

Recommendations:

-Investing research results and encouraging the design of projects that work on the principle of compactness for the purpose of achieving urban sustainability.
- Renewing and redeveloping existing cities, filling in unused areas and planning them in an integrated manner..
- AUse flexible methods of urban densification, conduct appropriate diagnosis of the initial situation and anticipate the development scenario, and apply compaction within the limits set by sustainability criteria.
- High-density, mixed-use development, mix of forms, mixed land use, and multi-storey buildings that achieve high occupancy density in a given location.
- Create an environment that prioritizes pedestrians and bicycles, and create a transportation system oriented towards public transportation.

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