

ANKARA YILDIRIM BEYAZIT UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES



**EVALUATING THE RELATIONSHIP BETWEEN
SUSTAINABILITY AND URBAN FORMS: INSIGHTS FROM THE
CASBAH OF ALGIERS**

M.Sc. Thesis by

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November, 2024

ANKARA

**EVALUATING THE RELATIONSHIP BETWEEN
SUSTAINABILITY AND URBAN FORMS: INSIGHTS
FROM THE CASBAH OF ALGIERS**

**A Thesis Submitted to
The Graduate School of Natural and Applied Sciences of
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in Architecture, Department of Architecture**

**by
Anis HAMOUDI**

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M.Sc. THESIS EXAMINATION RESULT FORM

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November 2024

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EVALUATING THE RELATIONSHIP BETWEEN SUSTAINABILITY AND URBAN FORMS: INSIGHTS FROM THE CASBAH OF ALGIERS

ABSTRACT

Urban sprawl, characterized by unplanned, low-density growth, challenges sustainable development by increasing land consumption, infrastructure costs, and environmental degradation. While much research focuses on environmental and economic aspects of urban sustainability, the social dimension, especially historically, is less studied. This research addresses this gap by examining the impact of urban sprawl on modern cities, using Algiers as a case study, and proposing solutions through sustainable urban forms.

The study focuses on the historical Casbah of Algiers to assess how traditional urban designs can inform contemporary sustainable practices. It investigates whether Casbah's development aligns with sustainable urban principles like mixed land use, sustainable transportation, and compactness. It also uses resilience to evaluate social sustainability, analyzing how urban layouts promote community flexibility, social connections, and problem-solving abilities. The methodology includes theoretical framework development, stakeholder interviews, on-site observations, and literature review, assessing Casbah's sustainability through compactness, sustainable transportation, mixed land use, and resilience.

Findings show that the Casbah exemplifies sustainable urban characteristics with its dense layout, pedestrian design, and diverse land use integration, promoting social interaction and community resilience. This research contributes to urban planning by demonstrating how traditional urban forms can address contemporary sustainability challenges, highlighting the integration of heritage preservation with modern needs, and providing insights for planners and policymakers on implementing socially sustainable and resilient strategies.

Keywords: Algiers, casbah of algiers, sustainability, sustainable urban development, urban sprawl, sustainable urban forms, social sustainability, resilience.

SÜRDÜRÜLEBİLİRLİK VE KENTSEL FORMLAR ARASINDAKİ İLİŞKİNİN DEĞERLENDİRİLMESİ: CEZAYİR'İN KASBAH'INDAN İÇGÖRÜLER

ÖZ

Plansız, düşük yoğunluklu büyüme ile karakterize edilen kentsel yayılma, arazi tüketimini, altyapı maliyetlerini ve çevresel bozulmayı artırarak sürdürülebilir kalkınmaya meydan okumaktadır. Birçok araştırma kentsel sürdürülebilirliğin çevresel ve ekonomik yönlerine odaklanırken, özellikle tarihsel olarak sosyal boyut daha az incelenmiştir. Bu araştırma, kentsel yayılmanın modern kentler üzerindeki etkisini inceleyerek, Cezayir'i bir vaka çalışması olarak kullanarak ve sürdürülebilir kentsel formlar aracılığıyla çözümler önererek bu boşluğu ele almaktadır. Çalışma, geleneksel kentsel tasarımların çağdaş sürdürülebilir uygulamaları nasıl bilgilendirebileceğini değerlendirmek için Cezayir'in tarihi Casbah'ına odaklanmaktadır. Casbah'ın gelişiminin karma arazi kullanımı, sürdürülebilir ulaşım ve kompaktlık gibi sürdürülebilir kentsel ilkelerle uyumlu olup olmadığını araştırıyor. Ayrıca, sosyal sürdürülebilirliği değerlendirmek için esnekliği kullanarak, kentsel yerleşim planlarının topluluk esnekliğini, sosyal bağlantıları ve sorun çözme yeteneklerini nasıl teşvik ettiğini analiz ediyor. Metodoloji, Casbah'ın kompaktlık, sürdürülebilir ulaşım, karma arazi kullanımı ve esneklik yoluyla sürdürülebilirliğini değerlendiren teorik çerçeve geliştirme, paydaş görüşmeleri, yerinde gözlemler ve literatür taramasını içermektedir.

Bulgular, Casbah'ın sürdürülebilir kentsel özellikler sergilediğini ve sosyal etkileşimi ve direnci teşvik ettiğini göstermektedir. Bu araştırma, geleneksel kentsel formların modern sürdürülebilirlik zorluklarını nasıl ele alabileceğini göstererek kentsel planlamaya katkıda bulunmaktadır.

Anahtar Kelimeler: Cezayir, cezayir casbahı, sürdürülebilirlik, sürdürülebilir kentsel gelişme, kentsel yayılma, sürdürülebilir kentsel formlar, sosyal sürdürülebilirlik, dayanıklılık

CONTENTS

M.SC. THESIS EXAMINATION RESULT FORM.....	II
ETHICAL DECLARATION	III
ACKNOWLEDGMENTS	IV
ABSTRACT.....	V
ÖZ	VI
LIST OF TABLES	IX
LIST OF FIGURES	X
LIST OF ABBREVIATIONS	XII
CHAPTER 1 - INTRODUCTION.....	1
1.1 Problem Definition.....	1
1.2 Aim and Objectives	3
1.3 Methodology	4
1.4 Disposition	6
CHAPTER 2 - LITERATURE REVIEW.....	8
2.1 Sustainability.....	8
2.1.1 The concept of sustainability	8
2.1.2 Historical evolution of sustainability	15
2.2 Urban Sprawl	19
2.2.1 Impact.....	20
2.2.2 Urban and City Development.....	24
2.2.3 Assessment.....	26
2.3 Sustainable Urban Development.....	27
2.3.1 Principles of sustainable urban development.....	28
2.3.2 The Concept of Sustainable Neighborhoods.....	30
2.3.3 Assessment.....	35
2.4 Urban Forms	37
2.4.1 Concepts of Sustainable Urban Forms.....	38
2.4.2 Models of Sustainable Urban Form	44
2.4.3 Assessment.....	54
2.5 Resilience in Urban Contexts	56
2.5.1 Introduction to Urban Resilience	56
2.5.2 Resilience as a Measure of Social Sustainability.....	57
2.5.3 Resilience, Social Cohesion, and Urban Form	58
CHAPTER 3 - MATERIAL AND METHOD.....	61
3.1 Methodology	61
3.2 Material: Case Study	63

CHAPTER 4 - FINDINGS AND RESULTS	68
4.1 Urban Sprawl's Impact on Algiers	68
4.2 Evaluation of The Casbah	79
4.2.1 Compactness	81
4.2.2 Sustainable Transportation.....	92
4.2.3 Mixed Land Uses	99
4.2.4 Social Resilience and Spatial Organization in The Casbah	102
 CHAPTER 5 - CONCLUSION.....	 108
5.1 Summary of Research	108
5.2 Major Findings	109
5.3 Implications.....	111
5.4 Limitations of The Study	112
5.5 Future Research Directions	112
 REFERENCES.....	 113
 CURRICULUM VITAE.....	 124

LIST OF TABLES

Table 2.1 Key definitions of sustainable development from leading organizations ...	9
Table 2.2: Sustainability historical milestones.....	18
Table 2.3 Different between the different sustainable urban forms concepts	44
Table 2.4 Design concept indicators	54
Table 2.5 Comparison of different models.....	55
Table 4.1 Population density of the casbah.....	90
Table 4.2 Bus service by operator	94



LIST OF FIGURES

Figure 1.1 Methodological framework.....	5
Figure 1.2 Structure of the thesis	7
Figure 2.1 Pillars of sustainable development	10
Figure 2.2 Holistic image of sustainable urban development	28
Figure 2.3 Ecological system	29
Figure 2.4 Illustration of a sustainable and social neighborhood.....	32
Figure 2.5 The Compact City and the Goals of Sustainable Development.....	48
Figure 2.6 The compact city concept	49
Figure 2.7 Smart city concepts	52
Figure 3.1 Situation of the casbah	64
Figure 3.2 Historical evolution of the casbah	65
Figure 3.3 Map of the casbah upper and lower part.....	66
Figure 4.1 Sidi abdellah city plan.....	72
Figure 4.2 Habitation in the city of sidi abdellah	73
Figure 4.3 The dormitory city	74
Figure 4.4 Water supply issues	75
Figure 4.5 Distance between the center of algiers and sidi abdallah	76
Figure 4.6 Road congestion.....	76
Figure 4.7 The city of haouch arih	77
Figure 4.8 Manifestation of residents.....	78
Figure 4.9 Urbanization toward different centers	81
Figure 4.10 Different hubs in Algiers	82
Figure 4.11 Algiers ‘the casbah’ before 1830	83
Figure 4.12 Precolonial casbah	84
Figure 4.13 Example of urban layout.....	85
Figure 4.14 Lower part of the casbah.....	86
Figure 3.15 Plan of the new bab azoun district. 1865.....	86
Figure 4.16 Plan of the casbah and algiers evolution.....	87
Figure 4.17 Expansion of algiers after independence	88
Figure 4.18: Evolution of Algiers	89
Figure 4.19 Population density by municipality 2020	91

Figure 4.20 Principal roads in the casbah	93
Figure 4.21 Map of the maghreb region.....	94
Figure 4.22 Martyrs square and transit.....	95
Figure 4.23 Algiers Subway map	95
Figure 4.24 Cable car system in algiers	96
Figure 4.25 Narrow pedestrian street of the casbah	96
Figure 4.26 All transportation projects of algiers	98
Figure 4.27 Mixed land uses of the historic casbah	100
Figure 4.28 Commercial activity in the casbah.....	101
Figure 4.29 Public life in the street of the casbah	103
Figure 4.30 Formal and informal activities	104
Figure 4.31 Community engagement	104
Figure 4.32 Women suing the terrace as commune place.....	105
Figure 4.33 Dar mustapha pacha museum	106
Figure 4.34 Public spaces in the casbah.....	106

LIST OF ABBREVIATIONS

GHG	Greenhouse Gas
IEA	International Energy Agency
IUCN	The International Union for the Conservation of Nature
NTD	Neo Traditional Development
OECD	Organization for Economic Co-operation and Development
TOD	Transit-Oriented Development
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Program
WCED	World Commission on Environment and Development
WWF	World Wildlife Fund

CHAPTER 1

1. INTRODUCTION

1.1 Problem Definition

In an era marked by rapid urbanization, accelerating climate change, and growing social inequality, the idea of sustainability has emerged as a key topic of discussion worldwide. How can humanity survive on a planet with limited resources while guaranteeing a livable future for future generations? Sustainability is a holistic strategy that incorporates ecological balance, economic growth, and social justice to protect the environment and human well-being. It is not just an environmental issue. The need for sustainable urban development has grown as urban areas continue to grow, frequently in unsustainable ways.

Urban sprawl is a problem to be addressed, which is defined as the growth of a city and its suburbs over rural land on the outskirts of an urban area is a result of changes made to urban layouts, especially with rapid urbanization. In this process, rural, open space land gradually transforms into developed, built-up land. It makes the state of the environment worse. Studies show that this growth exacerbates air pollution and increases energy consumption, both of which are factors in global warming. The expansion of cities results in a decrease in arable land and an intensification of developed area fragmentation, which exacerbates climate change.

As a result of urban sprawl, communities' social cohesiveness also declines. Sprawling cities' low-density developments are linked to a higher rate of urban decay, a decline in community involvement, and a decline in interpersonal trust.

Cities continue to be essential to social and economic advancement despite these obstacles. They draw talent and investment because they act as centers of innovation, creativity, and economic growth. In addition, urban areas provide access to vital services like public transportation and healthcare, as well as cultural and educational opportunities. Because of this phenomenon, the idea of sustainability is now seen as a tool to help with a variety of urban problems. It needs to be assessed considering how urban transformations affect cities, resulting in the realization of sustainable urban

development via a dynamic framework that calls for an all-encompassing strategy that incorporates various tenets and adjusts to local circumstances. Urban form shapes how people live in urban areas, and this has important implications for energy use, transportation systems, overall urban livability, and social equity.

Discussions about sustainability frequently focus on economic and environmental aspects, but social sustainability places more emphasis on the welfare of individuals and groups. It acknowledges that the needs, goals, and social fabric of its citizens must come first in a truly sustainable city. Social sustainability, which includes important components like equity and inclusion, community and participation, cultural preservation, safety and security, is the cornerstone upon which all other aspects of developing vibrant urban neighborhoods rest. Moreover, a community needs resilience in a term that is closely related to social sustainability to be able to adjust, transform, and overcome obstacles to achieve social sustainability. These intangible metrics, which are difficult to measure and frequently vary depending on cultural and socioeconomic context, are useful for assessing the social sustainability of urban neighborhoods.

Using design concepts, a review of the literature, the city is examined to mitigate the negative effects of urban sprawl on its urban model and social sustainability. These ideas come from a thorough review of the literature on sustainable urban forms. The fundamental ideas include mixed land uses, compactness, sustainable transportation, and resilience as a gauge of social sustainability.

With a population of over three million and a land area of 276 square kilometers, Algiers is well-known for its historic Casbah district, which is located on the northern coast. With its winding streets and a citadel from the 16th century, this historic district perfectly captures the city's rich past. The Casbah is an essential part of Algeria's cultural legacy, having been built in the sixth century BC and perched on a steep slope with a view of the harbor and the Mediterranean Sea. The Casbah is still in serious deterioration even after being named a UNESCO World Heritage site in 1992. With 70,000 inhabitants in 1980, double the number in 1830, the population has grown significantly from 60,000 in 1969 [1,114,117,119, 122,124,125,136,140]. According [1], the Casbah is one of the most densely populated urban districts in the world due to its increasing population density, which in some places reaches 4,000 people per

hectare. The Casbah's fragmented governance, incomplete urban records, and informal settlements make data collection there especially difficult.

The Casbah's dynamics require in-depth interviews with local stakeholders, including residents, heritage conservation specialists, and urban planners, to be fully understood. By guiding the implementation of sustainable urban designs and strategies, these qualitative methods provide insights into how cultural heritage preservation and sustainable development can coexist. These results will support Algiers' larger sustainability agenda by offering helpful advice on how to integrate sustainable practices into important urban settings.

To address the issues raised by urban sprawl, this research project investigates sustainable development, with an emphasis on sustainable urban models that are currently being discussed in the literature. The study highlights design techniques meant to lessen sprawl and look at the complex relationships between sustainable urban design principles and the control of urban expansion. The study applies important sprawl-addressing urban design principles to analyze and assess the sustainability of the Casbah's urban growth through interviews and a thorough review of the literature.

Mixed-use land planning, environmentally friendly transit systems, and urban forms are among the major themes found in the literature. In addition to highlighting the vital role cities play in creating creative answers to global sustainability challenges, the study highlights the importance of flexible urban neighborhoods in promoting social sustainability.

1.2 Aim and Objectives

This research primarily seeks to assess the sustainability of Algiers' Casbah, with specific emphasis on its social aspects. While current studies extensively cover environmental and economic sustainability in urban development, there is often a significant oversight regarding the crucial role of social sustainability and community resilience. This investigation aims to address this gap by examining how the Casbah's urban development aligns with established sustainable urban frameworks, particularly focusing on concepts such as diverse land usage, eco-friendly transportation, and urban concentration.

The study highlights resilience as a crucial indicator for evaluating the efficacy of the Casbah's urban structures in nurturing social interactions and sustaining a dynamic community. By investigating the interplay between neighborhood design and resident social dynamics, this research strives to enhance our comprehension of how urban layouts can foster enduring sustainability.

In particular, the study will:

1. **Assess compactness:** Examine the dense urban structure of the Casbah, which features a high concentration of residents and tightly packed buildings. This characteristic will be assessed for its capacity to enhance community bonds and decrease dependence on personal vehicles.
2. **Evaluate sustainable transportation:** Examine Casbah's transport system, with a particular focus on walkability and mass transit alternatives. The objective is to assess how these components support eco-friendly urban movement and minimize environmental consequences.
3. **Examine mixed land use:** Examine how residential, commercial, and recreational areas are combined within the Casbah. This study will evaluate the ways in which diverse land usage promotes social interaction, bolsters local businesses, and improves the overall quality of life in the region.
4. **Measure resilience:** Employ resilience as a lens to assess social sustainability in the Casbah. This approach involves analyzing how the urban layout promotes community flexibility, social connections, and the ability to tackle obstacles.

The research endeavors to shed light on the connection between urban design and social sustainability by examining these crucial aspects. In doing so, it seeks to make a significant contribution to the ongoing conversation about sustainable urban growth. The results of this study will not only emphasize the Casbah's role as a potential exemplar of sustainable urban practices but also suggest strategies for future urban planning that emphasize resilience and community cohesion in response to persistent urban challenges.

1.3 Methodology

This study employs a comprehensive approach to assess the sustainability of the Casbah of Algiers, with a focus on its urban structure and social aspects. The research

utilizes a qualitative case study method, enabling an in-depth analysis of the intricate factors related to urban sustainability within a historical setting. The study's framework consists of four key elements: a theoretical foundation, qualitative interviews, a review of existing literature, and assessment techniques (Figure 1.1).

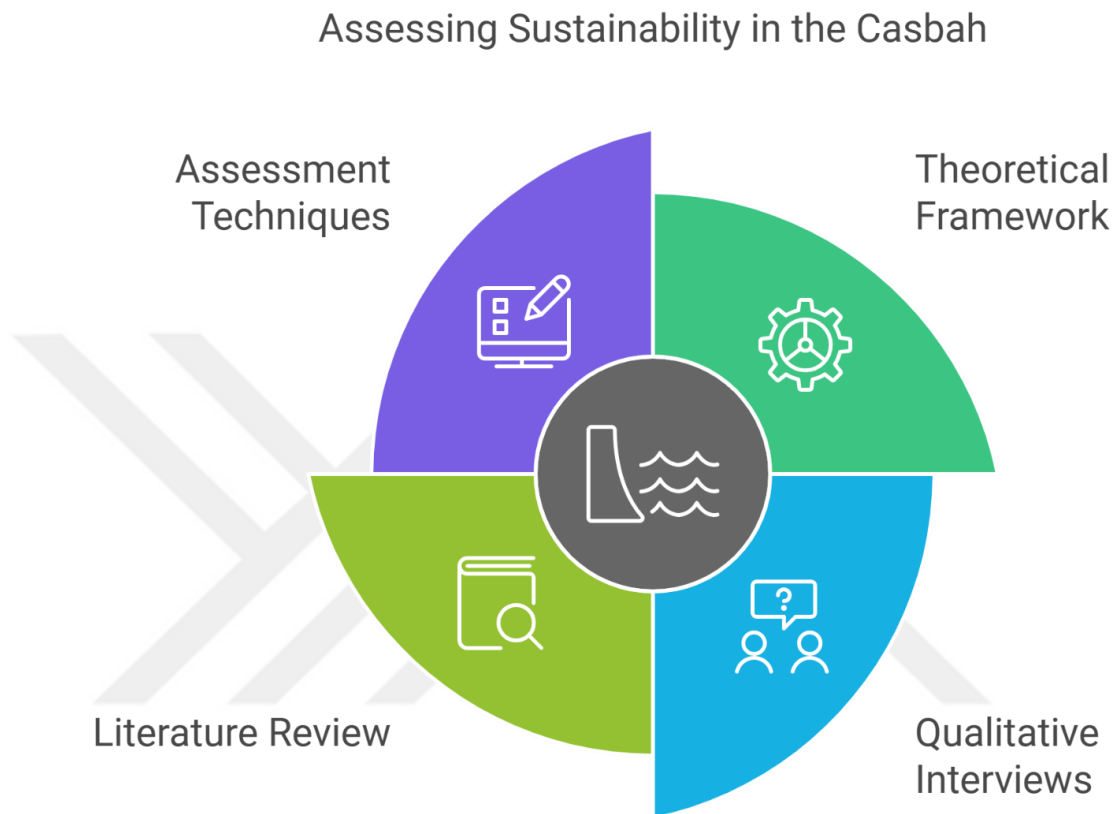


Figure 1.1 Methodological framework (Author)

The investigation commences with a chronological examination of sustainability, tracking its development through crucial global events. This background is vital for comprehending the principles of sustainable urban design and their applicability to the Casbah. The theoretical framework incorporates essential concepts such as density, diverse land usage, eco-friendly transportation, and adaptability, which are fundamental in evaluating the urban sustainability of the Casbah.

A diverse group of stakeholders, including residents, participated in thorough interviews. These discussions aim to collect qualitative data on the Casbah inhabitants' views, experiences, and difficulties. The gathered information offers a detailed

understanding of how urban design affects social interactions, community resilience, and overall sustainability.

The research's theoretical framework and assessment methods are informed by a thorough examination of current literature on sustainable urban design. This review covers studies on urban sustainability, social cohesion, and the impact of urban forms on community dynamics. It helps contextualize the findings within broader academic discussions and identify successful practices and lessons from other urban settings.

The research employs a range of assessment methods, adapted from prior studies, to assess urban sustainability. These techniques measure indicators linked to compactness, mixed land usage, and sustainable transportation. The research investigates how certain design principles contribute to social sustainability in the Casbah, with a particular emphasis on using resilience as a measure of social cohesion, while also considering its historical background and how its distinctive urban structure contributes to its durability and sustainability.

The methodology incorporates various data gathering methods, including qualitative interviews, literature surveys, and case study examinations, to develop a comprehensive understanding of Casbah's sustainability. By emphasizing the relationship between urban design and social dynamics, the research aims to offer valuable insights into sustainable urban practices that can guide future city planning efforts.

1.4 Disposition

The study comprises five parts. The first chapter presents a definition of the problem, aim of the study, methodology, and disposition. The second chapter reviews literature on various essential concepts, including sustainability, urban sprawl, sustainable urban development, urban forms, and resilience. The third chapter delineates the methodology and materials related to the case study. The fourth chapter presents findings and results of the casbah's analysis. The fifth chapter concludes with key takeaways from the analysis, implications, limitations, and future research directions (Figure 1.2).

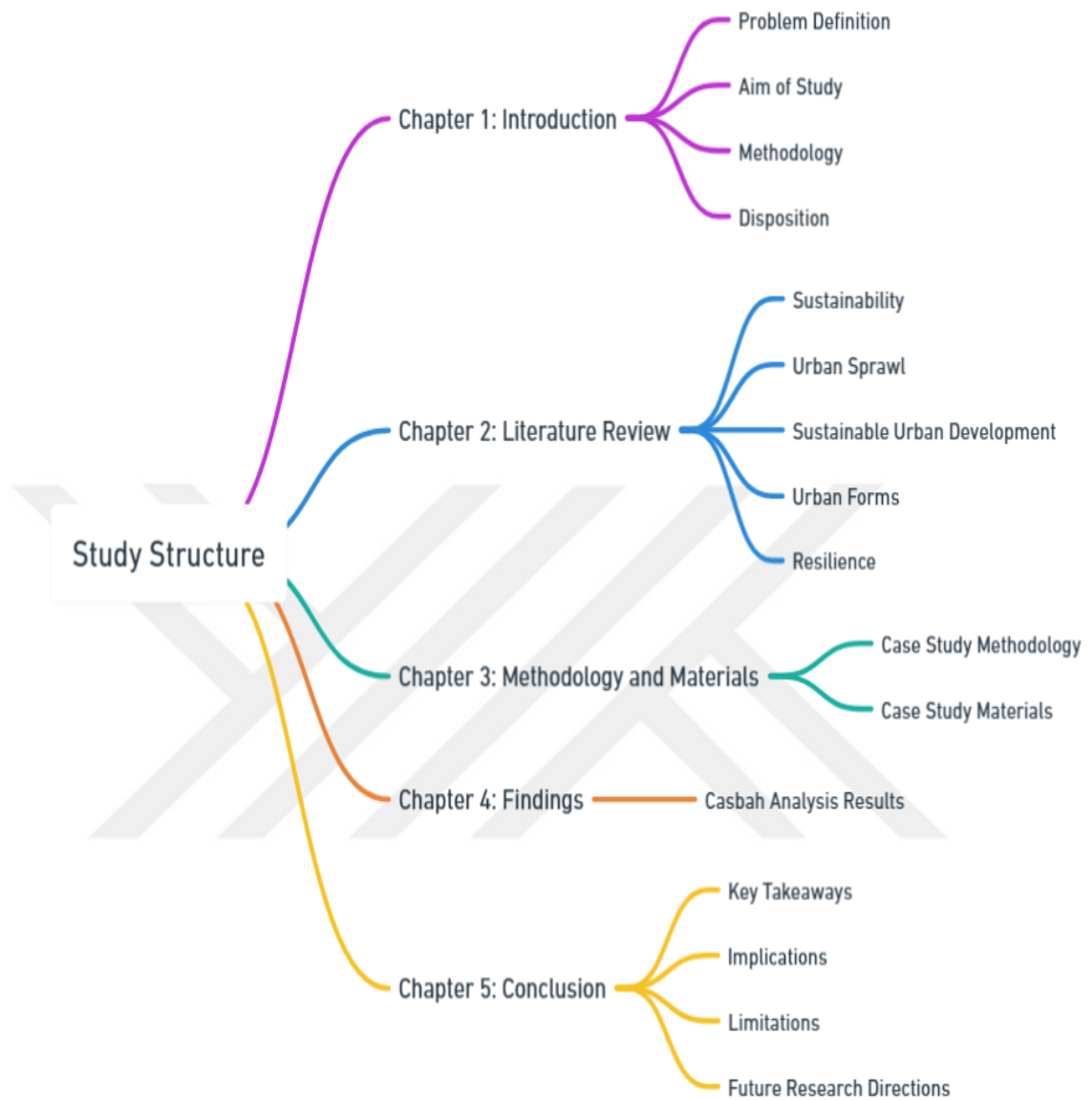


Figure 1.2: Structure of the thesis (Author)

CHAPTER 2

2. LITERATURE REVIEW

2.1 Sustainability

2.1.1 The concept of sustainability

The Brundtland Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" in its landmark 1987 report, *Our Common Future*. This definition emphasizes two important points: first, the importance placed on meeting the basic needs of the world's impoverished, and second, the constraints placed on the environment's ability to meet demands in the present and the future by social structure and technology. The idea, which was later reaffirmed at the Rio Earth Summit in 1992, seeks to balance social justice, economic growth, and environmental preservation to improve the standard of living for present and future generations [2]

Global issues like resource depletion, urban sprawl, and climate change have made sustainable development even more urgent. With urban dwellers now making up most of the world's population (which surpassed 7 billion in 2011), demographic changes have accelerated urban sprawl and environmental degradation. Along with increasing greenhouse gas emissions and causing the loss of natural habitats and agricultural land, this unchecked urbanization of rural areas also contributes to climate change. Additionally, urban sprawl leads to segregated communities, social inequality, and restricted access to services, especially for those living on the outskirts of cities [3-4].

As a result, the ideas of sustainable development provide a framework for dealing with these problems. To reduce urban sprawl and create resilient, just, and ecologically conscious cities, sustainable development emphasizes compact urban forms and advocates for laws that strike a balance between economic, social, and environmental demands. In the table a summary of all the definitions from different organizations (Table 2.1)

Table 2.1 Key definitions of sustainable development from leading organizations (Author)

Organization	Definition
WCED (1987)	Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
IUCN, UNEP, and WWF (1991)	Sustainable development means improving the quality of human life while living within the carrying capacity of supporting ecosystems.
International institute for sustainable development (2004)	For businesses, sustainable development means adopting strategies and activities that meet their needs and those of their stakeholders today while protecting, sustaining, and enhancing human and natural resources for the future.
HMG (2005)	Sustainable development aims to enable all people worldwide to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations.

According to [5-6], sustainability or sustainable development is generally understood to consist of three main elements: social, economic, and environmental sustainability. These pillars all focus on various aspects of sustainability, frequently with conflicting priorities (Figure 2.1).

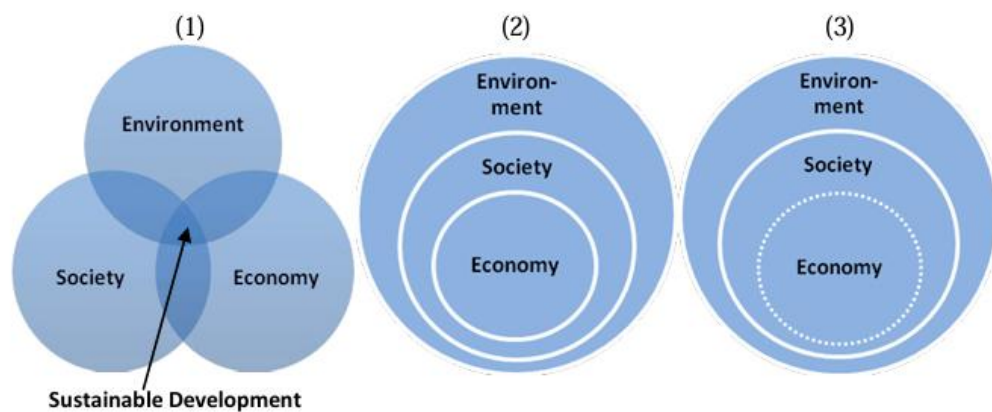


Figure 2.1 Pillars of sustainable development [51]

2.1.1.1 Environmental sustainability

The idea that human development must operate within the constraints imposed by natural systems is the foundation of environmental sustainability. Sustainability initiatives now prioritize biodiversity conservation and greenhouse gas emission reduction due to the pressing need to address environmental crises like resource depletion, species extinction, and climate change [3,7]. According to [8], this idea is essential for connecting human activity with ecological interdependence. It includes a number of important practices, such as managing waste within ecosystems' assimilation capacities, harvesting renewable resources sustainably, and creating substitutes for non-renewable resources [9]. Such a strategy protects human health and environmental integrity in addition to guaranteeing resource availability.

Furthermore, social and economic sustainability are inextricably linked to environmental sustainability, and together they constitute the larger framework of sustainable development [9]. It tackles critical issues like the depletion of fossil fuels, climate change, and the rising costs of water and energy. Sustainability is therefore becoming a higher priority for businesses and governments, who aim to maximize social, environmental, and economic aspects simultaneously rather than seeing them as conflicting interests. One example of how these ideas can be successfully applied to produce favorable effects on travel destinations and local communities worldwide is the emerging field of sustainable tourism.

While the more inclusive term "ecological" stresses the interdependence of different system elements, the term "environmental" is frequently linked to the effects of human activity on natural systems. [8] makes the case for a more complex definition of sustainability, arguing that it ought to be more in line with the ideas of biological conservation, especially in ecological contexts. According to him, ecological sustainability is "fulfilling human needs without jeopardizing ecosystem health.". This definition, though, has drawn criticism for possibly restricting the wider meaning of "ecological" to an anthropocentric perspective. The word "environmental," on the other hand, is primarily associated with how people interact with ecological systems. Therefore, it is crucial to consider the "environmental" domain as a subset of the broader "ecological" framework, signifying the interface between ecological systems and human activities.

The concept of "sustainable" and "sustainability" has changed significantly since the 1987 release of *Our Common Future*. However, current discourse suggests that these terms have become less precise, frequently reducing them to a nebulous synonym for "good" without taking into account their ecological implications. A fundamental understanding of "environmental sustainability" emerges as various professions try to define sustainability within their respective contexts, elucidating the connection between ecological interdependence and human activities. The limits of "sustainability" are drawn by this framework to account for the interactions between human activity and the ecosystems that sustain it. The commonly accepted definition of sustainable development is thus enhanced when environmental sustainability is defined as a subset of ecological sustainability, namely "meeting the needs of the current generation without compromising the ability of future generations to meet their needs.". "Meeting the resource and service needs of current and future generations without compromising the health of the ecosystems that they provide" is another way to put this idea into words.

2.1.1.2 Economic sustainability

A crucial component of the triple bottom line strategy is economic sustainability, which highlights companies' ability to meet present demands without endangering the welfare of future generation [10]. This idea is essential to avoiding early company

failure [11] and includes long-term financial and marketing strategies [12]. However, a widespread emphasis on short-term profits and a general lack of awareness makes it difficult and elusive to implement economic sustainability [10]. It is positioned within a dynamic, multifaceted framework that encompasses institutional, social, economic, and environmental aspects [13].

Due to the lack of widely recognized management tools, evaluating economic sustainability presents substantial difficulties [11]. Additionally, different business functions frequently handle different aspects of economic sustainability [11]. Researchers support the use of Orientor Theory and systems analysis, which offer a thorough framework for examining the sustainability of intricate, dynamic systems like the economy, in order to assess economic sustainability [13].

To fully comprehend economic sustainability, it is necessary to look at the various definitions that have been put forth by academics and researchers over the years. Although there are differences in specifics and focus, most definitions agree that economic sustainability is using resources to meet current needs without sacrificing the ability of future generations to do the same. The preservation of natural capital is a prerequisite for economic sustainability, a trailblazer in ecological economics. This viewpoint emphasizes the relationship between economic activity and environmental health, arguing that environmental health shouldn't be sacrificed for economic growth. According to [14], Daly supports a steady-state economy where resource consumption stays within the planet's carrying capacity.

Expanding upon Daly's work, [15] contended that economic scale must be preserved in order to sustain ecosystems, guarantee equitable resource distribution, and encourage effective allocation. He popularized the term "environmental sustainability," arguing that environmental preservation and economic sustainability cannot coexist. Furthermore, Stiglitz, Sen, and [16] argued that assessments of economic sustainability need to include metrics for well-being, sustainability, and resource distribution in addition to GDP. According to [10], this viewpoint emphasizes the necessity of a comprehensive understanding of economic sustainability that incorporates economic indicators with quality-of-life considerations.

Economic sustainability is important for more than just business; eventually, it is essential to the well-being of society. A thriving society is predicated on economic

sustainability, which guarantees steady employment, fair income distribution, and the provision of necessary public goods and services [17]. Intergenerational equity is promoted by ensuring that future generations inherit an economy that can support their well-being [10].

2.1.1.3 Social sustainability

The three pillars of sustainable development are wellbeing, unity, and social justice. This idea places a strong emphasis on the preservation and equitable distribution of resources, placing the needs of the present and future generations above their wants. "Humanity stands at a defining moment in its history," reads the United Nations Habitat Agenda (1996), emphasizing the urgency of this approach. The issues we face are the continuation of national and international inequality, the deterioration of the ecosystems that support our existence, and the escalation of poverty, hunger, disease, and illiteracy. This statement emphasizes the need to address systemic social injustices and environmental degradation that threaten global sustainability.

Achieving a balance between production and consumption necessitates a fundamental change in individual lifestyles, beliefs, and behaviors in addition to advancements in technology and legislative changes. According to [18], people have an ethical duty to adopt more sustainable practices and cut back on excessive consumption to promote sustainable development. This call for change advocates for a cultural shift in how society views and uses resources, going beyond simple policy changes. [19] It goes on to say that social sustainability is a subjective and qualitative idea that has its roots in democratic principles and inclusiveness. This viewpoint is essential since people's attitudes and actions toward their surroundings have a considerable influence on their quality of life and the general well-being of their communities.

Social sustainability is a crucial facet of sustainable development that strives to mitigate environmental injustices, guarantee equitable resource distribution, and lessen economic inequalities. Global poverty intensifies sustainability issues because of the disproportionate impact of climate change in vulnerable regions such as South Asia and Africa [20]. Furthermore, environmental policies may unintentionally exacerbate social inequality through the use of urban planning techniques like exclusionary zoning in the United States. Ensuring the participation of marginalized

groups in decision-making processes is crucial in incorporating social equity and participatory governance principles into sustainability strategies to counteract these effects [3].

Compared with environmental and economic sustainability, social sustainability tackles a wider range of concerns such as social justice, access to healthcare and education, human and labor rights, and education. Generating flexible social structures that can endure change without endangering development objectives or social cohesion is its main goal. Ensuring that future generations have equal or better access to social resources is one way to promote inclusion, diversity, and participation—all of which help to foster this flexibility. The main tenets of social sustainability are often addressing poverty, promoting equity, and increasing community involvement, as [21] have noted. The complexity of social sustainability assessment presents special difficulties. [22] emphasizes how critical it is to strike a balance between material necessities like housing and work and intangibles like happiness, social capital, and community cohesion. Forging a sustainable society requires these intangible elements as much, even though they may be more difficult to quantify. Keeping the complex relationships between social under control is fundamental to social sustainability.

Although they may vary depending on the circumstances, social sustainability indicators generally assess how well societal structures uphold equity, cohesion, and human welfare. Public health, social justice, inclusivity, educational attainment, workers' rights, and governance quality are examples of common metrics. Metrics like the proportion of workers living below the poverty line or the degree to which workers believe their contributions are valued can be used to quantify these ideas in business settings. Indicators like security, safety, and health are highlighted in a wastewater management study, highlighting the significance of clearly defining the relationships between these elements for thorough evaluations of social sustainability [23]. Additionally, supply chain-specific research emphasizes the significance of human rights and labor practices in social sustainability, with researchers creating 31 quantitative indicators to assess the social impact throughout the supply chain [23].

Several key principles form the foundation of social sustainability:

1. **Equal opportunity and inclusiveness:** A socially sustainable society guarantees equal access to opportunities, resources, and decision-making

participation for all people, irrespective of their social standing or background. Fighting social marginalization and fostering an environment that is fair to all community members are the goals of this principle.

2. **Public engagement:** To ensure social sustainability, community members must actively participate in forming their surroundings. Communities become more cohesive and resilient when residents feel more ownership over their surroundings and have a say in planning decisions.
3. **Preservation of culture:** Social sustainability depends on a community's cultural heritage and customs being acknowledged and valued. This entails establishing venues for cultural representation, promoting regional artistic expressions, and preserving historic sites like those in the Casbah of Algiers.
4. **Protection and well-being:** Every member of the community can live in safety and security in a socially sustainable community. This commitment goes beyond just lowering crime rates; it also includes encouraging a community spirit of trust and assistance among neighbors.

Over the past few decades, the idea of sustainability has changed dramatically, reflecting shifts in societal values, advances in science, and increased awareness of environmental issues on a global scale. Contextualizing sustainability's current applications and implications across various sectors requires an understanding of its history. This historical synopsis will follow the inception of sustainability as a concept, highlighting significant turning points and noteworthy occurrences that have influenced its evolution. The journey toward sustainability highlights the growing understanding of the interconnectedness of economic, social, and environmental dimensions, starting with the early conservation movements and continuing with the creation of international frameworks like the 1987 report of the Brundtland Commission. We can gain a better understanding of the complexity of sustainability today and the need for a comprehensive strategy that tackles the many issues our world faces by looking at this evolution.

2.1.2 Historical evolution of sustainability

Over time, historical occurrences, sociopolitical movements, and environmental concerns have all influenced the idea of sustainability. A limited range of

environmental issues were reflected in the early environmental consciousness that developed prior to the 1960s and was mainly concerned with wildlife protection and wilderness conservation [24]. But by the 1960s and 1970s, discussions about the necessity of sustainable development and the boundaries of growth were starting to change the conversation on a global scale. The seminal work “The Limits to Growth” in 1972 served as an example of this period's transition from regional conservation initiatives to a wider understanding of the need to strike a balance between environmental preservation and economic growth [5].

The 1972 Stockholm United Nations Conference on the Human Environment was a turning point in the history of environmental issues because it established the notion that environmental sustainability should not be sacrificed for economic growth. The outcome of the conference placed emphasis on the necessity of preserving, enhancing, and expanding the planet's ability to generate essential renewable resources [25]. After this conference and the United Nations Habitat Conference in 1976, urban issues like poverty, squalor, and access to clean water were brought to light, and sustainable development was suggested as a remedy for the mounting problems associated with human settlements.

Due to economic downturn and a lack of environmental consciousness being adequately incorporated into economic planning, environmental issues lost political significance in the middle of the 1970s. However, the publication of the Brundtland Commission's “Our Common Future” report in the 1980s rekindled these worries. The concept of sustainability was widened in this report, which also called for international cooperation to strike a balance between economic growth and environmental protection by connecting it to global issues like resource depletion, pollution, and poverty [26].

Additional turning points in the development of sustainability occurred in the 1990s and early 2000s, such as the Rio Earth Summit in 1992, which established the integration of the economic, social, and environmental pillars of sustainable development through Agenda 21 and the Rio Declaration. Countries were urged to adopt tangible steps to promote sustainability at the national and local levels by later international initiatives, such as the World Summit on Sustainable Development in 2002 [27]. But as demonstrated in the U.S., the disconnect between policy statements

and actual implementation continued to be a major obstacle. S. The Kyoto Protocol's denial of ratification by Congress and the glacial pace of climate change accords such as the Copenhagen.

Environmental concerns, socio-political movements, and economic dynamics have all influenced the development of sustainability, and social sustainability. In response to the damage brought about by the Industrial Revolution, early environmental movements progressively developed into comprehensive frameworks such as the Paris Agreement and the Kyoto Protocol, which established international collaboration towards sustainability. Landorf's study of social sustainability shows how contemporary socioeconomic systems have facilitated unsustainable practices by examining the co-evolution of technology, social organization, and cognition. Landorf contends that tackling today's sustainability issues requires an awareness of how these systems have evolved historically, especially in regard to information processing and technological advancements [28]. According to a study that mapped sustainability programs from the Industrial Revolution onward, sustainability science is still struggling with the inherent complexity of integrating environmental and social objectives, underscoring the need for holistic thinking, In the Following Table 2.2 a summary of all the milestone.

Table 2.2: Sustainability historical milestones (Author)

Year	Milestone	Description
1962	Silent Spring by Rachel carson	Modern environmentalism emerged from public awareness of pesticide impacts on ecosystems
1972	Stockholm conference (UN Conference on the Human environment)	The first global summit produced the Stockholm declaration on human environmental impact
1987	Brundtland report (Our Common Future)	Sustainable development is meeting present needs without compromising future generation's ability to meet theirs.
1992	Rio earth summit (UNCED)	Agenda 21 was established along with the convention on biological diversity and the climate change framework.
1997	Kyoto protocol	The first international treaty to legally binds nations to reduce greenhouse gas emissions.
2000	Millennium development goals (MDGs)	Global development goals aimed at addressing poverty, hunger, disease and sustainability.
2015	Sustainable development goals (SDGs)	Replaced the MDGs with 17 goals encompassing social equity, environmental protection, and economic growth.

2.2 Urban Sprawl

Urban sprawl denotes the uncontrolled and unplanned expansion of urban areas into surrounding rural land. Characterized by low-density, automobile-dependent development, it encompasses the spread of residential, commercial, and industrial zones over extensive areas. This phenomenon results in inefficient land use, fragmented habitats, increased infrastructure costs, and frequently involves low-density development of single-family dwellings with large lots, dependence on automobiles, zoning segregation of different land uses, peripheral growth that bypasses undeveloped land, and significant environmental impacts such as habitat destruction, pollution, and loss of agricultural and natural lands [29,30].

This phenomenon is primarily driven by population growth, economic development, and preferences for suburban living; however, it often leads to challenges such as traffic congestion, social inequality, and strain on public services.

According to [30], this process deteriorates the environment while increasing land consumption and infrastructure costs. Excessive dependence on automobiles and residents residing at considerable distances from employment opportunities or other essential amenities are additional characteristics of urban sprawl, which contribute to increased traffic congestion, environmental pollution, and social isolation [31]. Furthermore, urban sprawl results in inefficient land utilization, disrupts ecosystems, and diminishes green spaces, all of which render cities more challenging to manage and less sustainable. From a social perspective, sprawl exacerbates inequality by isolating communities and segregating neighborhoods based on socioeconomic status [32]. From an economic standpoint, sprawl increases the cost of maintaining public utilities, infrastructure, and services over larger areas, which places strain on local governments' budgets and threatens the vitality of urban centers.

Urban sprawl is attributed to multiple factors. Increasing incomes enable individuals to acquire larger residences in suburban areas where land is more economically viable, thereby attracting developers and promoting expansion [33]. Suburban growth is facilitated by the capacity of individuals to reside at greater distances from urban centers due to extensive road networks and the prevalence of automobile usage [34].

Zoning regulations that support low-density development, through the segregation of residential, commercial, and industrial areas, also contribute to urban sprawl [35]. This outward expansion is predominantly driven by population growth, a societal preference for suburban living, and the advancement of remote work technologies [36].

This chapter examines the causes and effects of urban sprawl, contrasts them with ideas of sustainable urban development, and suggests ways to reduce its harmful effects while promoting socially and ecologically inclusive urban forms.

2.2.1 Impact

2.2.1.1 Environmental impact

Urban sprawl is a major cause of environmental degradation, mainly because it results in the loss of agricultural land and an increase in urban voids, which are underutilized spaces scattered throughout the urban fabric [32]. Intermunicipal disputes frequently occur as urban areas encroach on rural areas, worsening environmental degradation by encroaching on farmlands and natural ecosystems. This process erodes not only the sustainability of the environment but also the cohesion of neighborhoods and the continuity of space [37]. The negative effects of urban sprawl on biodiversity are among its most harmful effects. The process of urban densification frequently results in the disappearance of green spaces, like parks and squares, which are vital to the preservation of ecosystem services like temperature regulation, air purification, and recreational opportunities. Though the percentage of green spaces in Londrina, Brazil, is generally acceptable, only 16 percent of the urban landscape is made up of these unevenly distributed green spaces. Therefore, they further jeopardize the environment by failing to lessen the detrimental effects of greenhouse gas emissions in the most affected zones.

Cities' problems with waterproofing and drainage are further aggravated by urban sprawl. Increased risks of flooding, soil erosion, and runoff are brought on by the expansion of impermeable surfaces and inadequate drainage systems, especially in regions with little vegetation cover. For example, Londrina confronts serious problems with inadequate storm sewer capacity and a deficiency of green spaces to absorb rainwater runoff, which exacerbates soil impermeabilization and runoff. The concerns

highlight the wider environmental consequences of haphazard urban growth, whereby inadequate infrastructure and the excessive extension of water and sewage services into designated urban voids exacerbate the strain on urban ecosystems [37].

The problems caused by urban sprawl are made worse by the decentralization and lack of coordination in metropolitan-level planning. Inefficient land use and segregationist occupation patterns result from the development of non-contiguous urban forms, such as gated communities and isolated housing projects. Urban sprawl frequently makes a heavy reliance on private vehicles necessary, which increases transportation dependency and raises air pollution, traffic congestion, and greenhouse gas emissions. For instance, although there are green spaces in Londrina, their poor distribution and closeness to major highways encourage car dependence, worsening the city's environmental impact.

Urban sprawl's negative environmental effects are exacerbated by the division of municipal zoning and urban planning responsibilities, especially in peri-urban areas. The attempts to conserve ecological corridors and biodiversity are hampered by this fragmented approach. [38] draws attention to the challenge of preserving urban peripheral green spaces (UPGS) in the face of fast urbanization, which jeopardizes their crucial function in preserving agriculture and controlling air quality.

Urban sprawl not only exacerbates environmental degradation but also puts pressure on infrastructure and threatens the long-term viability of urban ecosystems. The negative effects of urban sprawl will continue to present major challenges for cities around the world in the absence of coordinated planning and effective land use strategies.

2.2.1.2 Economic impact

Urban sprawl has complex economic ramifications that vary depending on the scale, both macroeconomically and microeconomically. Macroeconomically speaking, moderate urban sprawl may promote economic growth, whereas excessive sprawl may have the opposite effect [39]. Recent research conducted in Poland suggests that urban sprawl has no negative impact on the country's economy or public finances, in contrast to certain previous studies [40]. However, households living in sprawling urban

environments often face significant financial challenges on a microeconomic level, especially when it comes to regular expenses and home maintenance [40].

Local governments believe that urban sprawl results in higher per-unit costs for public services, which makes the development model less economically efficient. Significant heterogeneity exists in the economic effects of urban sprawl; larger cities and those dominated by secondary industries are particularly negatively impacted [39]. These results highlight the necessity for cautious thought in the formulation of economic policies, urban planning, and the encouragement of sustainable urban development.

Furthermore, there are both favorable and unfavorable economic effects of urban sprawl. Positively, it can encourage economic growth and development in these areas and lower housing and living expenses for households due to declining suburban land prices [34]. On the other hand, because urban areas grow, urban sprawl can increase public spending on services and infrastructure [41]. It can also result in higher personal transportation costs for people because of longer commutes and a greater reliance on cars. The overall economic assessment is further complicated by the environmental effects of urban sprawl, which include increased land consumption and pollution. Urban sprawl and economic development have a complex relationship. However, by boosting worker productivity and encouraging investment and consumption, moderate urban sprawl may boost economic growth [39], there is a connection between higher labor productivity and greater sprawl and increased financial expenses that may impede general development.

2.2.1.3 Social impact

Urban sprawl presents several challenges for social sustainability. First, it exacerbates inequality by establishing remote, automobile-dependent communities that restrict access to opportunities and essential services, especially for those with low incomes. Access to vital resources like jobs, healthcare, education, and transportation is hampered by this spatial disparity. Second, by physically dividing communities and increasing reliance on cars, sprawl weakens social cohesion by decreasing opportunities for face-to-face interactions and community building. Thirdly, it lowers livability by causing long commutes, gridlock, and environmental damage, all of which lowers the overall quality of life. Because there are fewer opportunities for

walking and cycling in these environments, health issues, such as obesity, also rise. Finally, urban sprawl accelerates inner-city decline and creates economic imbalances by diverting funds from urban renewal projects.

Dense urban areas, on the other hand, promote social sustainability by fostering community engagement and a greater sense of belonging through walkable neighborhoods with shared public spaces. Urban sprawl erodes social cohesiveness and communal life as cities grow farther apart. In neighborhoods that lack a sense of community, car dependency increases, spatial segregation deepens, and interpersonal interactions diminish [42]. According to Wheeler (2004), homogeneity and disrespect for regional identity and cultural uniqueness create sterile environments in which natural public life finds it difficult to thrive. The social fabric of communities is weakened by the sprawl's car-oriented layouts, expansive superblocks, and large-scale residential complexes. These features also reduce opportunities for unplanned social interaction.

The development of a lively community life is hampered by the reliance on cars, which not only exacerbates traffic congestion but also limits opportunities for informal interactions. Social interaction is restricted to designated areas in places that are more geared toward cars than people, which leaves little opportunity for natural community development. Because they don't embrace the local identity and cultural distinctiveness that usually define human-centered urban spaces, these settings frequently struggle to foster a sense of belonging [5,42]. Urban sprawl has effects that go beyond its actual design. It frequently shows a lack of consideration for regional contexts and the blind acceptance of global urban norms, leading to boring, ugly communities devoid of human-centered architecture [43-44]. Attempts to promote social sustainability and community involvement are made more difficult by the fact that these regions usually turn into desolate areas with disproportionate space-to-population ratios [45].

Furthermore, by establishing remote, low-density neighborhoods that divide inhabitants according to socioeconomic status and income, urban sprawl exacerbates social injustices and erodes community ties. People from diverse backgrounds find it difficult to interact because of this physical distance, which hinders the growth of solid social bonds and the feeling of community [32,36]. Sprawl's reliance on cars only

serves to increase this loneliness by restricting access to public transit and decreasing opportunities for casual social interactions, both of which are essential for fostering social cohesiveness [34]. Low-income groups are disproportionately impacted by urban sprawl since they are frequently forced to live on the outskirts of cities. These communities face barriers to employment, public transit, and essential services, which impedes social advancement and sustains disadvantage [32]. The lack of pedestrian-friendly infrastructure in expansive suburbs erodes community ties and lowers the standard of living in general.

Urban sprawl has a major general effect on livability. The infrastructure and amenities required to create vibrant, sustainable communities are often lacking in sprawling suburban areas. Car dependence lengthens commuting, adds to air pollution, and causes traffic congestion, all of which lowers quality of life. Furthermore, the lack of walkable neighborhoods encourages sedentary lifestyles, which can result in obesity and other health problems [32]. Additionally, because resources are allocated to suburban growth rather than inner-city revitalization, urban sprawl leads to economic imbalances. Both urban and suburban areas suffer from this resource diversion, which speeds up urban deterioration. It is especially evident that social cohesiveness is declining in expansive suburban settings. These isolated areas of development reduce social interaction and community involvement opportunities, undermining the social networks that are essential to resilient and thriving neighborhoods. Due to fewer opportunities for interaction and relationship-building, the absence of common public areas in expansive suburbs exacerbates social isolation. On the other hand,

More compact, walkable, and inclusive development models must be used to mitigate the negative effects of urban sprawl and advance socially sustainable urban neighborhoods. These methods put the needs of the locals first, strengthen social ties, and build lively, livable communities. By moving toward sustainable urban forms, neighborhoods can become more resilient, equitable, and socially sustainable while mitigating the negative effects of sprawl.

2.2.2 Urban and city development

Cities, which are crowded hubs of social and economic activity, have seen tremendous change because of urban sprawl. The dominance of the automobile as the main form

of transportation is largely responsible for the low-density, decentralized development patterns that define this phenomenon. The widespread use of automobiles has reduced the cost of commuting and eliminated the economies of scale that were previously available for modes of transportation like streetcars and trains [46]. Wide-ranging suburbs and edge cities have resulted from people and businesses moving farther and farther away from urban centers. Larger homes and shorter commutes for some residents are two advantages of this change, but it has also brought up significant questions about the long-term viability of such development methods.

Urban sprawl has many different effects on cities. One way that sprawl has influenced migration away from city centers is by making housing more affordable and facilitating access to larger living spaces, especially in suburban areas. Furthermore, since they can frequently avoid the traffic jams that are typical of commutes from city centers, many people who have moved to the suburbs also benefit from shorter commutes. These benefits come with some serious disadvantages, though. For those who cannot afford to live close to their places of employment, urban sprawl adds to traffic congestion, especially in places with few public transportation options. This means that commutes become longer. Consequently, there is an increase in air pollution and greenhouse gas emissions. Moreover, urban sprawl is frequently associated with social exclusion because people without access to cars have difficulty finding work and other necessities that are in dispersed areas [46].

The effects of urban sprawl on the environment are also significant. Climate change is being made worse by the increased reliance on cars, which has increased greenhouse gas emissions. Furthermore, the creation of large suburbs has led to the loss of agricultural and green space, worsening the state of the environment. More sustainable urban development methods that put an emphasis on compactness, mixed-use developments, and easily accessible public transportation options are becoming increasingly demanded considering these difficulties. Sustainable urban development promotes just and efficient urban forms to alleviate the problems brought on by urban sprawl. This means moving away from automobiles and toward higher-density, mixed-use developments that encourage bicycling, walking, and public transportation. Such programs, regardless of a resident's income level or ability to drive, can help reduce greenhouse gas emissions, protect green spaces, and enhance access to employment

and services for all citizens. In addition, coordinated land-use planning and transportation policies that improve accessibility and connectivity are crucial for sustainable urban development.

Sustainable urbanization, in contrast to urban sprawl, promotes compact, high-density cities that combine commercial, residential, and recreational areas. This model reduces reliance on private vehicles and reduces emissions by promoting walkability, efficient land use, and the development of strong public transportation systems [47]. Sustainable cities aim to reduce their environmental impact while also improving the quality of life for their citizens by promoting renewable energy sources and protecting natural areas [48]. Furthermore, by concentrating on people in walkable, community-focused neighborhoods that foster interaction, improve social cohesion, and give residents a sense of belonging, sustainable urban development strengthens social ties. Compact urban forms are more economical to manage and maintain, which lessens the financial strain on local governments and enhances residents' access to services.

Urban sprawl and sustainable urban development are two opposing theories of urban growth. Sustainable development promotes compact, well-planned urban forms that improve social cohesion, lessen environmental harm, and save costs, whereas urban sprawl promotes unplanned and inefficient growth. Planning techniques must fundamentally change as sprawling urban areas give way to sustainable cities, with a focus on better public transportation and higher population densities. Policymakers, urban planners, developers, and residents must work together to achieve sustainable urban development. This entails rethinking how cities are planned, built, and used to promote more livable, just, and ecologically conscious communities. Cities can pave the way for a sustainable future that benefits both current and future generations by addressing the underlying causes and negative impacts of urban sprawl. This endeavor, according to [46], calls for an all-encompassing strategy that combines land-use planning, transportation systems, and economic development, with an emphasis on lowering the demand for automobiles.

2.2.3 Assessment

Urban sprawl is a problem that needs to be addressed through sustainable urban development, adversely affecting environmental health, social fairness, and economic

productivity. A more comprehensive solution is offered by sustainable urban development, which combines compact design, efficient land utilization, and community involvement. Sustainable urban neighborhoods can mitigate the adverse effects of sprawl by encouraging walkability, public transit, and mixed-use developments, resulting in more dynamic, fair, and eco-friendly cities. However, for long-term success, sustainable development principles must be adapted to local circumstances, especially in developing nations where social and cultural elements significantly influence urban expansion.

Future urban planning should prioritize location-specific sustainable practices, adjusting insights from global sustainable development initiatives to meet each area's distinct requirements. This approach allows cities to expand in ways that are both socially and environmentally sustainable, enhancing the quality of life for all inhabitants. Various methods exist to promote sustainable urban development, with sustainable urban forms being one such approach. Urban forms, which are the physical layouts of cities, have a dominant impact on various aspects of urban life. The subsequent chapter will examine sustainable urban development.

2.3 Sustainable Urban Development

Modern cities face intricate challenges that sustainable urban development aims to address. This approach revolves around four key concepts: enhancing quality of life, promoting social equity, safeguarding the environment, and ensuring economic sustainability [36,47]. This chapter delves into these principles and their implementation at the neighborhood level. It highlights how sustainable neighborhoods play a crucial role in creating more habitable and environmentally responsible urban spaces. The complex issues confronting contemporary cities are tackled through sustainable urban development strategies. These strategies focus on four primary aspects: improving living standards, fostering social fairness, protecting the environment, and maintaining economic feasibility. This chapter explores these principles and their practical applications in neighborhoods. The significance of sustainable neighborhoods in shaping more livable and ecologically mindful urban environments is underscored. [49] definition appears to be the most comprehensive, encompassing the general aspects of development, including physical, social,

economic, and environmental dimensions, which are regulated and backed by local authorities (Figure 2.2).

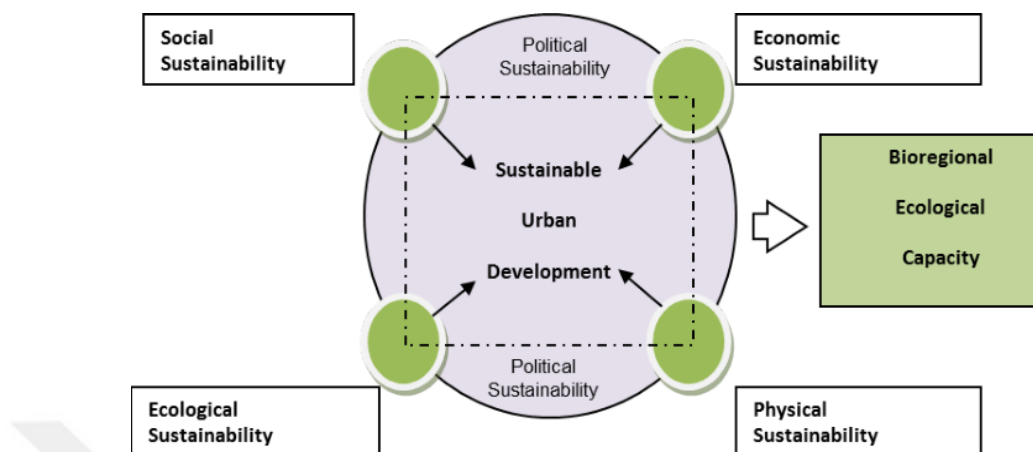


Figure 2.2 Holistic image of sustainable urban development [38]

2.3.1 Principles of sustainable urban development

2.3.1.1 *Environmental preservation*

Sustainable urban development relies heavily on protecting the environment. Cities significantly contribute to carbon emissions and resource depletion through industrial activities, transportation systems, and construction projects. To minimize their ecological impact, urban areas should implement strategies such as dense urban planning and the repurposing of brownfield sites. [3] assert that these approaches reduce environmental damage and promote efficient resource utilization. [50] argue that environmental policies should focus on ensuring sustainable growth. They propose developing programs to enhance energy efficiency, improve waste management quality, and encourage material recycling (Figure 2.3). To decrease energy usage and foster more sustainable urban expansion, compact development plays a crucial role [3].

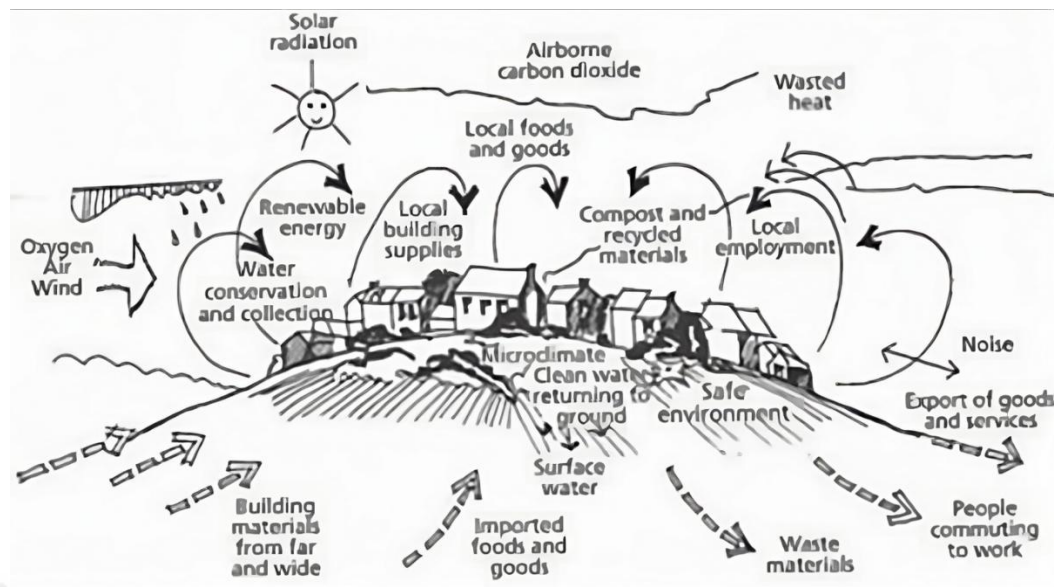


Figure 2.3 Ecological system [13]

2.3.1.2 Sustainable economic growth

For urban development, economic growth is essential, but it needs to be carefully controlled to maintain sustainability. As centers of talent and innovation, cities can stimulate economic activity that is socially and environmentally responsible. Unsustainable practices, however, have resulted from unbridled economic growth, especially in developing nations [3]. To achieve sustainable economic growth, developed countries must collaborate with developing cities to reduce their ecological footprints, offering financial and technological assistance [51]. Prosperity should be balanced with social and environmental obligations to meet the needs of coming generations.

2.3.1.3 Social equity

Providing social justice is essential to sustainable urban development. To create inclusive and sustainable cities, it is imperative that the advantages of urban growth be distributed equally among all segments of society. Social equity must be incorporated into urban planning since disadvantaged groups are frequently the ones who suffer the most from environmental degradation [20]. Building communities that provide equal access to basic services like healthcare, housing, and education requires a focus on

intra-generational equity, which is the equitable distribution of resources within the current generation [52]. Within this framework, achieving social equity is both an objective and a means to achieve urban sustainability.

2.3.1.4 Quality of life

Sustainable development encompasses more than just economic and environmental considerations. It also seeks to raise urban dwellers' standard of living. In addition to fostering economic productivity, the Brundtland Commission stressed the need for cities to advance public health and social welfare. To do this, public services and infrastructure that raise city dwellers' standards of living should be given top priority in urban planning. Achieving a high quality of life in sustainable cities requires fostering civic engagement and a sense of community.

2.3.1.5 Participatory democracy and governance

The paradigm of urban governance has changed from being top-down to being more inclusive and participatory. This gives people more influence over how their cities are planned and developed. This inclusive strategy, which strengthens the credibility of urban policies and guarantees that a variety of viewpoints are considered during the decision-making process, is highlighted in the Rio Declaration [53]. Collaboration between NGOs, local communities, and the private sector are all necessary for effective urban governance [54]. Although resource-constrained developing nations find this collaborative framework especially difficult, it is nevertheless essential for promoting sustainable urban development.

2.3.2 The concept of sustainable neighborhoods

For a considerable amount of time, neighborhoods have shaped both the social and physical environment of urban communities [55]. Even though it can be difficult to define a neighborhood, they are usually understood to be separate entities that are defined by things like resident perceptions, neighborhood amenities, and social interactions [56-57]. Two fundamental elements are necessary to comprehend neighborhoods: the physical layout and the social setting. According to the physical view, a neighborhood is a functional and spatial entity that is characterized by the

services and built environment that it offers. The social view [56-61] places a strong emphasis on interpersonal relationships and community dynamics. It is critical to understand the difference between communities and neighborhoods. Communities are networks of people with similar interests, whereas neighborhoods refer to specific geographic areas [57,61]. New planning techniques have evolved to support sustainability at the neighborhood level since the introduction of sustainable development in 1987 [62].

A sustainable neighborhood creates areas where people can thrive by balancing social, economic, and environmental factors. Beyond environmentally friendly structures, this idea emphasizes promoting social interaction and a high standard of living. Walkability, accessibility to facilities, and a variety of housing and employment options should be given top priority in sustainable neighborhoods, according to [63]. Along with promoting social interactions, these communities ought to give locals a chance to get involved in local politics. Indicators of social cohesion, economic sustainability, and environmental performance have all been developed to gauge the success of sustainable neighborhoods. By using these metrics, urban planners can assess how well a community fits with sustainability objectives and establish a framework for ongoing development. Sustainable neighborhoods must be able to adapt to future issues like resource depletion and climate change in addition to meeting the needs of their current residents.

The pursuit of sustainable urban development necessitates striking a balance among various elements, such as social fairness, environmental protection, economic growth, and enhanced quality of life. Although urban centers contribute to global sustainability issues, they also present opportunities for creative solutions and problem-solving. By implementing sustainable development approaches at both city and local scales, urban planners can design more eco-friendly, inclusive, and resilient communities. As cities continue to expand, successfully incorporating sustainable practices into urban planning will be essential for securing a well-balanced future that serves both human populations and the environment, utilizing fundamental strategic principles to attain sustainability (Figure 2.4).

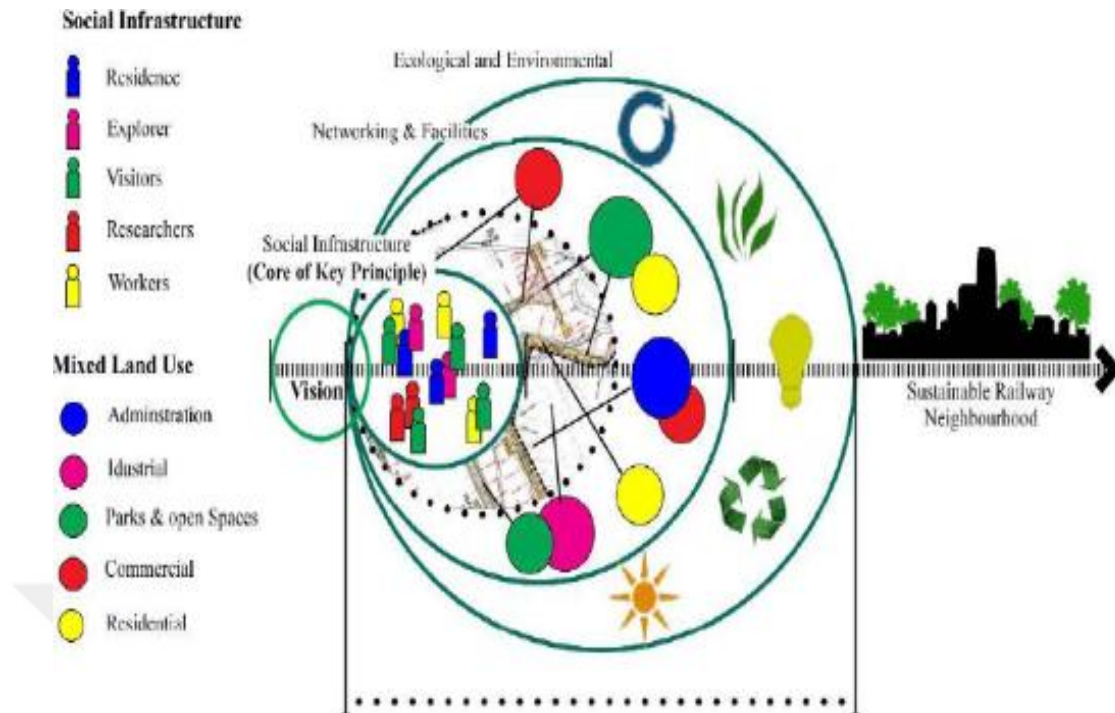


Figure 2.4 Illustration of a sustainable and social neighborhood [133]

2.3.2.1 Principles

To fulfill the lofty objectives of sustainable neighborhoods. To understand its implementation, one must delve into the core ideas that form the basis of sustainable cities: these principles.

Sustainable urban metabolism: Sustainable urban metabolism proposes a cyclical approach to resource management, aiming to maximize efficiency by repurposing outputs as inputs. This framework encompasses several key strategies: incorporating renewable energy for local power generation to decrease reliance on non-renewable sources; encouraging urban farming and local food systems to reduce the environmental impact of long-distance food transport; implementing efficient water management practices, such as collecting rainwater and recycling stormwater, to decrease overall water usage and environmental effects; adopting waste sorting and recycling methods, including converting waste into energy or fertilizer for nearby agricultural use, thus minimizing pollution and enhancing environmental resilience; and employing bioclimatic design principles that use recyclable and low-embodied energy materials while reducing heating, cooling, and water needs, thereby improving

resource efficiency and lessening the ecological impact of urban areas. By implementing these approaches, sustainable urban metabolism seeks to create a more circular and resource-efficient urban ecosystem, simultaneously reducing waste production and environmental impact while promoting local resilience and sustainability.

Sustainable built environment: The sustainable built environment is characterized by six essential elements: compactness, sustainable transport, density, mixed land uses, diversity, and passive solar design [64]. Urban areas with condensed layouts reduce energy usage and transportation requirements by improving connectivity and land use efficiency, which encourages social interaction, walkability, and access to services, resulting in dynamic, livable communities. Integrating mixed-use developments that blend residential, commercial, industrial, and institutional spaces generates economic prospects while minimizing the need for extended commutes [63-64]. These developments bolster local economies, offer vital services within walking distance, and decrease reliance on cars, thus promoting sustainable urban mobility. Implementing transport systems powered by renewable energy further contributes to emission reduction and enhances urban accessibility and livability [64]. Density plays a crucial role in neighborhood vitality, as high-density urban configurations foster social interaction, sustainable mobility, and reduce energy consumption compared to low-density areas [62]. Urban planners can promote inclusivity across various social groups and construct more resilient urban communities by supporting diverse housing options, including affordable and accessible dwellings.

Satisfaction of human needs: The concept of sustainable neighborhoods demands a focus on inclusivity, safety, and accessibility to meet the varied requirements of community members. Urban design strategies should be crafted to support diverse populations, including seniors and individuals with disabilities, ensuring fair access to housing, amenities, and community activities. Offering affordable and flexible housing options is crucial for fostering social diversity and enhancing accessibility across different economic groups. Neighborhood security and safety are essential elements of sustainability, which can be achieved through appropriate population density, mixed-use development, and well-designed street layouts that encourage walking and the use of local facilities [64]. In specific cultural contexts, such as Arab

and Muslim communities, incorporating privacy considerations into neighborhood design is crucial, requiring careful planning of street arrangements and communal areas to respect cultural values and expectations [65]. This comprehensive approach to sustainable neighborhood development not only improves residents' quality of life but also contributes to the creation of robust, inclusive, and culturally appropriate urban environments.

Urban social sustainability: The foundation of socially sustainable urban neighborhoods rests on the core principles of fairness and community unity. These urban areas are defined by several crucial components that enhance their social sustainability: lively communal spaces, varied housing alternatives, and easily accessible green zones, which collectively nurture a feeling of community and shared identity among inhabitants [66]. Implementing dense, pedestrian-friendly urban layouts that encourage social interaction is essential for boosting neighborhood liveliness and security. The restoration of public areas, such as parks and town square, acts as a driving force for social engagement and reinforces community ties, thus significantly contributing to overall social cohesion [65]. Furthermore, actively involving residents in the decision-making processes related to their neighborhood's growth and administration enhances their sense of ownership and belonging, which is crucial for building resilient and inclusive communities [67]. This collaborative approach not only empowers local inhabitants but also ensures that urban development is in line with the community's needs and aspirations, thereby strengthening the social fabric of the neighborhood and promoting long-term sustainability.

Natural environment: Incorporating resilience strategies into urban planning is essential for improving neighborhoods' ability to adapt to natural disasters and maintain their functionality. A key element in building urban resilience is the implementation of green spaces, which serve multiple purposes in addressing environmental challenges and enhancing social welfare. These areas effectively reduce flood risks, improve air quality, and contribute significantly to residents' psychological well-being by offering accessible recreational venues. Furthermore, well-designed green spaces play a vital role in supporting biodiversity and act as community gathering points, thereby fostering social interaction and unity [67]. However, the effectiveness of these spaces depends on careful upkeep to avoid their deterioration

into abandoned or dangerous areas. To optimize their benefits, green space designs should incorporate a wide range of activities and ensure accessibility for all, thus reinforcing their importance in enhancing the neighborhood's vitality and social fabric [57]. This comprehensive approach to green space design and management not only strengthens environmental resilience but also promotes social sustainability, creating a mutually beneficial relationship between the urban environment and its residents.

Economic sustainability: The development of sustainable urban communities hinges on the incorporation of mixed-use projects that strategically place essential services and job opportunities within walking distance [67]. This urban planning strategy not only improves residents' convenience and quality of life but also helps reduce car dependency and its associated environmental consequences. Encouraging local food production, markets, and artisanal industries acts as a driver for economic diversification, strengthening the local economy's resilience and self-reliance. By nurturing a localized economic ecosystem, neighborhoods can effectively decrease their reliance on external resources while creating job opportunities that directly benefit residents. The purposeful integration of employment options into local development plans ensures that economic activities are accessible to all community members, regardless of their socioeconomic background or mobility limitations. This inclusive approach to economic growth not only enhances the neighborhood's overall vibrancy but also significantly contributes to its long-term sustainability by creating a self-sustaining cycle of local prosperity and community involvement [67]. As a result, this comprehensive urban development strategy addresses immediate economic needs while also establishing a foundation for lasting social and environmental sustainability within the urban landscape.

2.3.3 Assessment

Sustainable urban development requires a holistic and integrated strategy that balances environmental, social, and economic factors within city settings. By employing sustainable urban metabolism concepts, creating dense and multifunctional spaces, focusing on human requirements, fostering community bonds, and ensuring financial sustainability, cities can cultivate resilient, inclusive, and livable neighborhoods. As worldwide urbanization continues to advance, incorporating sustainable methods

becomes increasingly vital for nurturing flourishing communities that reduce their environmental impact while promoting social equality.

The future of urban planning necessitates the ongoing transformation of urban areas through the incorporation of these sustainable practices. This progression is crucial to ensure that urban environments remain flexible, resource-efficient, and capable of meeting the diverse needs of various populations in an increasingly complex and interconnected world. By adopting this comprehensive approach to sustainability, urban planners and policymakers can create resilient, equitable, and environmentally responsible urban landscapes that address current demands while safeguarding the welfare of future generations. Consequently, the sustainable urban neighborhood emerges as a critical focal point for tackling the intricate challenges of modern urbanization while laying the groundwork for a more sustainable and inclusive urban future. This comprehensive approach to sustainable urban development is fundamentally connected to the physical layout and design of urban structures. The implementation of sustainability principles in the built environment is essential for achieving the goals of resilience, inclusivity, and livability. Urban forms act as the concrete expression of sustainable practices, influencing how residents interact with their environment and each other.

The spatial arrangement of cities, including aspects such as density, mixed-use zoning, and transportation systems, plays a crucial role in determining the effectiveness of sustainable urban initiatives. For example, compact urban designs promote efficient resource use and encourage social interaction, while diverse and multifunctional developments support local economies and decrease transportation needs. Furthermore, the integration of green spaces and sustainable infrastructure within urban forms significantly contributes to environmental resilience and community well-being.

As we explore the connection between sustainable urban development and urban forms, it becomes clear that the physical structure of cities is both a result of and a driving force for sustainability efforts. The design and organization of urban spaces directly affect the ability of neighborhoods to adapt to changing environmental, social, and economic conditions. Therefore, a thorough assessment of urban forms is crucial for comprehending and implementing sustainable urban development strategies.

2.4 Urban Forms

Sustainable urban form plays a crucial role in discussions about sustainable urban development, as it significantly affects the environmental and social sustainability of cities. The way urban areas are structured shapes the spatial distribution of human activities, which in turn has substantial impacts on energy use, transportation networks, and urban quality of life. This portion examines different models and key principles of sustainable urban design, offering a thorough evaluation of how they contribute to broader sustainability objectives.

The spatial arrangement of cities, including land use patterns, transportation networks, and infrastructure design, is referred to as urban form. [68] describe urban form as the spatial organization of human activities at a specific time, emphasizing its significant environmental impact. Urban form design plays a crucial role in determining energy usage, transportation efficiency, and residents' daily experiences, making it a vital tool for promoting sustainable development. [69] identifies three key factors in urban form development: transportation infrastructure, economic efficiency, and socio-cultural perceptions of space. These factors reflect the diverse elements shaping urban forms, underscoring the need for careful planning that balances economic growth, social equity, and environmental protection.

The connection between city design, particularly in terms of land use and transportation systems, and urban sustainability is deeply intertwined. [70] suggests that land use planning can influence up to 70% of a city's energy consumption, while [71] estimates that spatial planning affects approximately 15% of urban sustainability outcomes. Consequently, urban form design is essential in reducing emissions, energy use, and resource consumption—key components in achieving sustainable development.

The scholarly discourse on sustainable urban development encompasses a variety of models and frameworks that reflect diverse global viewpoints. Instead of promoting a single ideal approach, advocate for the consideration of multiple strategies, configurations, and paradigms that can be tailored to different environments and settlement types. This approach acknowledges the intricate and multidimensional nature of urban sustainability, highlighting the necessity for customized solutions that tackle the specific challenges encountered by individual cities and regions.

Scholars have identified several sustainable urban form models, each emphasizing distinct design principles to enhance environmental, social, and economic sustainability. While some models prioritize minimizing transportation-related emissions, others concentrate on density, mixed-use development, or ecological harmony. Despite their varying focuses, all these models contribute to the broader objective of creating sustainable urban environments.

2.4.1 Concepts of sustainable urban forms

The shape of a city's urban landscape is shaped by factors such as land use, transportation networks, infrastructure, population density, and the characteristics of its built environment. These elements are crucial for sustainable urban growth and addressing climate change impacts at the city level. Urban planning research presents various frameworks to evaluate the sustainability of urban configurations. [48] Suggesting a sustainable metropolis should have high-density, diverse-use, and centralized structures. Conversely, [57] argues that mixed land use is the most sustainable approach. [63] advocate for denser, more compact urban areas with distinct identities, promoting walkability and public transit to ensure sustainability. [72] supports mixed-use development, asserting that separated land uses necessitate more frequent and longer trips.

[73] underscores the significance of parks and green spaces in promoting clean air, physical activity, wildlife habitats, and urban unity, aiding in local climate regulation and natural environment conservation. [74] recommend moderate lot sizes as a sustainable urban feature due to reduced natural landscape disruption. [75] emphasize the role of environmental technologies, such as solar panels and specialized designs, in mitigating climate change effects. [5] identifies the characteristics of a sustainable city as compactness, diverse land uses, and convenient access to amenities.

In urban planning, the focus on sustainable city design highlights the importance of compactness, sustainable transportation options, and mixed land usage. These key principles, derived from sustainable urban models, are considered effective approaches to mitigate the adverse effects of urban sprawl and tackle its challenges. [64] suggests that the urban form integrating the most design concepts better promote sustainability.

This section examines crucial elements and measures serving as metrics for assessing sustainable urban forms, particularly within the existing urban structure, exemplified by the Casbah of Algiers case study.

2.4.1.1 Mixed land use

Combining living spaces, business areas, and leisure facilities in mixed-use developments contributes to a more environmentally friendly urban landscape. These developments reduce the need for long-distance travel for daily activities, thereby encouraging walking, biking, and the use of public transportation. This, in turn, decreases reliance on cars, lowers carbon emissions, and creates a lively community environment [76] Furthermore, mixed-use areas promote social inclusivity by creating spaces where diverse groups of people can live together and interact.

The concept of mixed land use, which blends residential, commercial, civic, and recreational spaces, is particularly advantageous in densely populated urban centers. In these areas, the considerable distances between different facilities often lead to increased car usage and carbon dioxide emissions. Urban planners focus on sustainability view mixed-use development as a key strategy to alleviate traffic congestion, reduce travel times and expenses, and ultimately achieve environmental goals by decreasing transportation-related CO₂ emissions (Breheny & [77]. However, it's worth noting that the proximity of various land uses can also result in traffic jams, air quality issues, and increased noise levels. The Congress for the New Urbanism (2001) supports the development of neighborhoods that are dense, easy to navigate on foot, and feature a mix of different uses.

There are three primary interpretations of mixed land use in sustainability arguments:

1. **Varied and plentiful supply of facilities and services:** An urban area featuring a well-distributed combination of housing and commercial zones.
2. **Horizontal mix of uses:** The combination of diverse land uses within neighborhoods or street areas.
3. **Vertical mix of uses:** The combination of diverse land uses within single structures, typically across distinct levels [71].

According to [78], mixed-use development encompasses three key aspects: intensity, diversity, and integrability. This approach can enhance the concentration and variety of land uses while merging previously separated areas.

The concept of mixed land use is intrinsically connected to density and compactness, forming a crucial component of sustainable urban growth. All models of sustainable urban design promote mixed-use development, which has a substantial impact on how people travel. By implementing mixed-use designs, communities can experience an improved quality of life through shorter average travel times and a heightened sense of community cohesion.

2.4.1.2 Compactness

Urban areas characterized by well-defined limits and concentrated mixed-use zones, known as compact cities, play a crucial role in curbing urban expansion and safeguarding natural environments. This approach not only promotes environmental sustainability through ecosystem preservation but also enhances social cohesion by concentrating on amenities, services, and public spaces within easy reach, fostering community interaction [64]. The concept of compactness is widely acknowledged as a key element in achieving sustainable urban growth, as it reduces the necessity for transporting energy, materials, products, and individuals. [5] Envisioned sustainable urban development as encompassing efficient land use, reduced car dependence, resource optimization, and decreased pollution and waste.

The advantages of compact urban design are diverse. From an environmental standpoint, it cuts down on CO₂ emissions by shortening travel distances and reducing automobile usage. Economically, it decreases infrastructure and transportation expenses. Socially, it improves access to local services and employment opportunities by bringing amenities closer to residents. Moreover, compact urban form is a proven strategy to combat urban sprawl, commonly described as the expansion of urban areas into rural landscapes, characterized by low-density growth and fragmented development with minimal planning oversight [79].

[80] emphasizes compactness as a fundamental characteristic of sustainable cities, noting that compact, polycentric, and pedestrian-friendly urban layouts promote economic vigor, effective governance, and social inclusion. [63] Similarly identifies

key benefits of compact urban form, including the reuse of existing infrastructure, reduced energy consumption, availability of affordable public transportation, and the potential for social integration.

The definition of compactness varies among experts. [81] described it as high-density or monocentric development, while [29] stressed the concentration of housing and employment, along with mixed land uses. [68] expanded the definition to include both monocentric and polycentric forms. More quantitative approaches include Bertaud and [82] compactness index, which compares average distances from residences to the central business district (CBD) in each city to those in a hypothetical, evenly distributed city. [83] also proposed indicators measuring the distance between residential areas and city centers, while [56] suggested that compact development minimizes land consumption per square mile.

At a smaller scale, compactness defined as a two-dimensional concept, relating to the ratio of urban space's length to width, while [70] highlighted high-density, mixed land use, and intensification as key indicators. Further classified compactness into three categories at the neighborhood level: density, diversity, and design.

Empirical studies have often focused on measuring compactness through population densities, although cautions that gross densities alone may be misleading. Compactness, as a dynamic concept, must be evaluated in conjunction with factors such as urban form development, mobility, and energy consumption at the metropolitan level.

Compactness plays a crucial role in addressing challenges related to population growth, high-density areas, and limited resources in sustainable urban development. Strategies such as neo-traditional development, urban containment, and compact city designs offer viable approaches to these issues. According to [70], compact urban forms contribute to sustainability by lowering transportation-related CO₂ emissions. However, cautions about potential negative environmental impacts, including a decrease in open spaces, while [84] highlights economic difficulties associated with excessively large central structures. Despite these reservations, compactness remains a vital element in promoting urban sustainability, particularly in terms of enhancing energy efficiency and reducing emissions.

2.4.1.3 Sustainable transportation

Cities that focus on enhancing public transportation networks, creating bike-friendly infrastructure, and implementing pedestrian-centric designs can substantially decrease greenhouse gas emissions and ease traffic jams. These approaches promote both environmental and social sustainability by enhancing urban accessibility and lessening reliance on personal cars, which encourages community interaction and improves public health [48].

The growing use of automobiles, especially in urban environments, has made motor vehicles a significant source of greenhouse gas (GHG) emissions. Transportation is a key factor in climate change, as it is closely connected to land-use patterns and has resulted in a considerable rise in energy consumption and oil dependence [85]. The International Energy Agency (IEA) reports that transportation accounts for 19% of global energy use and 23% of energy-related CO₂ emissions, with these numbers expected to increase by almost 50% by 2030 and over 80% by 2050 [86].

Sustainable transportation seeks to harmonize environmental, social, and economic aspects. While there is no universally agreed-upon definition, sustainable transportation generally refers to the incorporation of these three elements into transportation planning [87]. [88] highlights that sustainability involves systems analysis, examining how environmental, economic, and social systems interact. A truly sustainable system must be able to persist over the long term.

Transportation significantly affects urban populations, contributing to noise and air pollution, as well as public health issues. In response, sustainable transport has been recognized as a crucial priority for enhancing environmental quality, public health, and social welfare. [34] describe the reduction of CO₂ emissions in transportation as a "three-legged stool," comprising vehicle fuel efficiency, the carbon content of fuels, and the amount of driving (measured by vehicle miles traveled). While technological advancements, such as hybrid vehicles and low-carbon fuels, address the first two components, the third is directly influenced by urban form. Compact urban design can reduce urban sprawl and consequently minimize the total vehicle miles traveled.

[89] suggests both simple and comprehensive indicators for assessing sustainable transportation, using readily available data. Examples of simple indicators include transportation-related fossil fuel consumption, CO₂ emissions, vehicle pollution

levels, per capita vehicle mileage, mode split (favoring higher public transit use), traffic crashes, land consumption for transportation, and roadway aesthetics. However, these indicators are influenced by factors such as population size, travel distances, climate, energy sources, and economic activity, which must be considered when evaluating transportation's environmental impact.

The social implications of sustainable transportation are significant, as it enhances accessibility and mobility for all socio-economic groups, particularly marginalized and vulnerable populations. Offering affordable, dependable, and accessible public transportation can reduce social inequalities by ensuring that low-income groups, the elderly, people with disabilities, and those without private vehicles have access to essential services, including employment, healthcare, and education.

Effectively designed transportation networks can enhance community bonds by promoting social interactions in public areas and encouraging active modes of travel, such as walking and biking. This nurtures social relationships, creates inclusive neighborhoods, and enhances the social resilience of urban environments. Fair access to transportation also advances social equity by minimizing spatial disparities and connecting affluent and underprivileged areas.

Implementing public transportation systems, bike-friendly infrastructure, and walkable urban layouts are crucial approaches to decrease reliance on cars and ensure fair access to vital services. These strategies not only reduce individual travel expenses but also promote healthier habits by encouraging walking and cycling. Consequently, this strengthens community connections, improves social cohesion, and supports social sustainability [48].

In the following Table 2.3 a summary of all urban forms concepts.

Table 2.3 Different between the different sustainable urban forms concepts (Author)

Concept	Definition	Key Features	Benefits
Mixed land use	Integrating residential, commercial, and recreational spaces in proximity.	- Diverse building types - Multi-functional spaces - Walkable neighborhoods	- Reduces travel time - Promotes local economies - Enhances community interaction
Sustainable transportation	Transportation systems are designed to minimize environmental impact and promote efficiency.	- Public transit options - Bicycle lanes - Pedestrian-friendly infrastructure	- Reduces carbon footprint - Improves air quality - Encourages active lifestyles
Compactness	Urban design that promotes high-density development to minimize land use.	- High-rise buildings - Limited urban sprawl - Efficient land use	- Reduces infrastructure costs - Enhances accessibility - Preserves green spaces

2.4.2 Models of sustainable urban form

Urban planning and sustainability research has identified four main models for sustainable urban development: neo-traditional development, urban containment, the compact city, and the eco-city [64]. These approaches each provide a distinct

viewpoint on achieving sustainability through urban design, employing specific principles and methods to tackle various urban issues.

2.4.2.1 Neo-traditional development:

Neo-traditional development (NTD) aims to recreate the characteristics of traditional neighborhoods, emphasizing walkability and community engagement. This approach combines diverse land uses, pedestrian-accessible streets, and communal areas that promote social interaction. The goal is to decrease car dependency while encouraging alternative transportation methods like walking, biking, and public transit.

NTD emerged in the 1980s as a solution to urban issues including traffic jams, expensive housing, and budgetary limitations. Its primary objectives are to alleviate traffic congestion, offer affordable housing options, and combat urban sprawl.

This concept shares similarities with other urban planning strategies such as New Urbanism, urban villages, compact communities, and traditional town revitalization. According to [64], NTD can be classified into three main categories: New Urbanism, Transit-Oriented Development (TOD), and Urban Villages.

New Urbanism

Traditional Neighborhood Design (TND), also referred to as New Urbanism, represents a key strategy within the neo-traditional development (NTD) paradigm. This approach arose as a counterpoint to typical suburban expansion, seeking to revitalize urban spaces by promoting a built environment that is more pedestrian-friendly, heterogeneous, and focused on community interaction.

The core features of New Urbanism encompass dense land division, pedestrian-oriented infrastructure, varied land usage, slim streets, communal green areas, and historically influenced housing. These components strive to establish lively, walkable neighborhoods that minimize car dependency and encourage social engagement [90]. Conceived by Andres Duany and Elizabeth Zyberk in the United States, New Urbanism finds its roots in the garden city and modernist urbanism movements [91]. As a reaction to the perceived inauthenticity in modern urban expansion, New Urbanism highlights sustainable practices, such as limiting suburban sprawl, advocating for infill development, and creating diverse, pedestrian-friendly communities [57].

In addition to its emphasis on physical design, New Urbanism values amenities, fair access to walkable spaces, higher density, mixed-use developments, and a strong sense of community [92]. The Congress for New Urbanism [93] has established specific guidelines for New Urbanism, including:

- **Physical form:** Urban design features promoting a diverse community include density, pedestrian-friendly layouts, integrated zoning, varied housing types, and cost-effective living options.
- **Environment:** Green spaces, parks, and interconnected green infrastructure.
- **Transportation:** Emphasizing mass transit systems, discouraging individual car usage, and establishing integrated transportation networks.
- **Urban places:** Celebration of local history, ecology, and building practices.

Transit-Oriented Development (TOD)

As an alternative to urban sprawl, Transit-Oriented Development (TOD) promotes concentrated, transit-friendly urban growth. A key figure in TOD, [47], describes it as a balanced, mixed-use area within walking distance (a quarter mile) of a transit station. TOD emphasizes region-wide strategies that encourage dense development supporting public transportation, blend various land uses, create walkable streets, offer diverse housing choices, protect natural areas, and establish community-centered public spaces. These core principles collectively strive to establish lively, environmentally sustainable urban areas built around transit systems.

Urban Villages

Urban Villages, a British iteration of neo-traditional development (NTD), combine elements of city and countryside living. According to [94], these compact, multifunctional communities emphasize pedestrian-friendly layouts, social interaction, and superior architectural design while accommodating a range of housing types, age demographics, and socioeconomic groups.

Advocates of NTD, including Duany and Pearson, suggest that this approach can reduce the need for extensive transportation, curb urban expansion, and enhance community bonds more effectively than contemporary suburban layouts. However, detractors such as Audirac and Sherman argue that densely populated, compact developments may not match public desires and criticize the top-down planning methods often employed in NTD. [95] notes that the efficiency of the compact city

model remains unproven, emphasizing the necessity for additional research and discussion to evaluate its feasibility.

2.4.2.2 Urban containment

Urban containment is a strategy aimed at curbing urban sprawl by establishing definitive boundaries around urban areas. This approach encourages higher-density development within these limits, optimizing land usage, safeguarding green spaces and agricultural lands, and reducing the environmental impact of urban expansion.

The late twentieth century saw increased urban sprawl and socioeconomic inequalities in the United States and other developed nations, leading to the emergence of environmental concerns and urban containment policies. These initiatives seek to impose physical limits on urban growth while promoting energy and land conservation, pollution reduction, and sustainable urban development, as well as addressing social and spatial equity issues.

Urban containment strategies work to restrict the outward growth of urban development through various means. These include the use of greenbelts and urban growth boundaries to concentrate development inward, while simultaneously using urban areas to attract development to specific locations [64]. The goal is to redirect urban growth towards existing urban centers rather than allowing cities to expand outwards unchecked.

The key aims of urban containment include enhancing the efficiency of public service delivery, protecting farmland and forests, minimizing air and water pollution, ensuring cost-effective provision of public utilities, and fostering a high-quality urban environment [96].

However, critics of urban containment argue that this approach may lead to increased real estate prices due to limited land availability, potentially worsening socioeconomic disparities. Furthermore, they contend that this concept might encourage the construction of high-rise buildings across all areas, instead of promoting mixed-use development in targeted locations [18]

2.4.2.3 The compact City

The expansion of suburban areas, coupled with inefficient transportation systems and their associated carbon emissions, has prompted a quest for sustainable urban solutions, resulting in the emergence of the compact city model. This approach features high-density residential zones, multi-purpose developments, smaller lot dimensions, and pedestrian-friendly infrastructure. The benefits of compact cities include reduced energy consumption and diminished air pollution. As illustrated in Figure 2.5, this concept demonstrates the shift from the "Current Urban Form" to "Sustainable Development" through the implementation of the "Compact City" design.

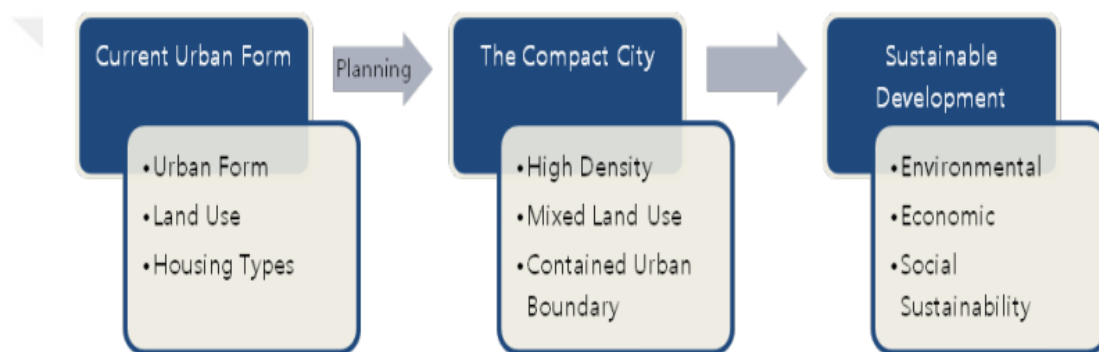


Figure 2.5 The Compact City and the Goals of Sustainable Development [51]

However, as noted by Dempsey and Jenks (2010), it is exceedingly challenging to quantify the comprehensive effects of the compact city's various components on sustainability. [97] identifies the compact city as an urban area of high concentric density around the main public nodes and corridors and gradually lower densities in the external and less accessible areas (Figure 2.6).

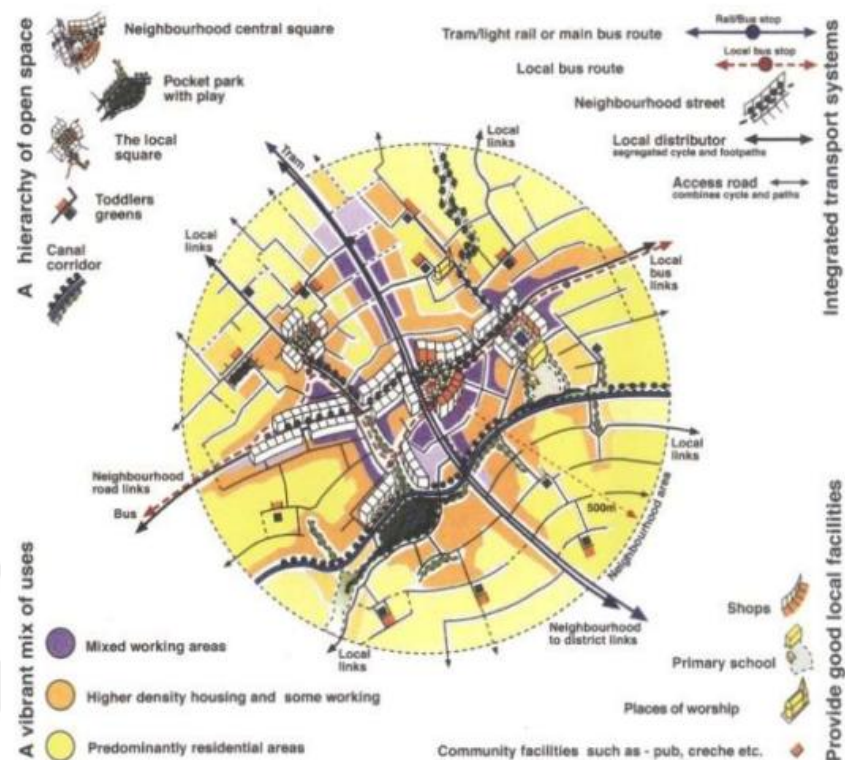


Figure 2.6 The compact city concept [134]

The roots of the compact city concept can be traced to 16th-century fortress cities, which later evolved to emphasize green space conservation and combat urban sprawl through greenbelt policies in the 18th and 19th centuries. The Industrial Revolution of the late 19th century greatly shaped urban development patterns. Ebenezer Howard's "Garden City" concept, which integrated greenbelts with mixed agricultural and recreational zones, laid the groundwork for the compact city. By the 1960s, urban policies began limiting expansion, coinciding with growing discussions on quality of life, livability, and diversity, which align with compact city principles.

George Dantzig and Thomas L. Saaty first introduced the term "compact city" in 1973, which is now linked to sustainability efforts aimed at addressing global warming. [70] categorizes the compact city as one of five archetypal urban forms, distinguished by high population and employment density in central suburbs linked by public transit. The other urban forms include dispersed, edge, corridor, and fringe cities. Compact cities are considered desirable due to several benefits, including:

1. **Modern metropolis in a natural setting:** Facilitating urban development within natural environments.
2. **Cost-effective settlement:** Providing financially advantageous settlement options.
3. **Time efficiency:** Minimizing travel distances and durations.
4. **Land conservation:** Encouraging limited city sizes and efficient land use.
5. **Energy conservation:** Reducing reliance on petroleum-based transportation.
6. **Flexibility:** Allowing adaptable construction techniques to accommodate evolving social needs.
7. **Efficient urban services:** Consolidating services to enhance operational efficiency.
8. **Pollution reduction:** Adopting strategies for recycling, filtration, and waste management that are suitable for dense urban environments.

The framework of compact cities plays a crucial role in promoting a high standard of living. According to [72], four essential components contribute to the quality of life in compact urban areas: fair access to amenities, shorter travel times, better public health due to reduced vehicle emissions, and increased social interactions in communal areas. Numerous studies have outlined the defining features of compact cities. [98] emphasizes characteristics such as high-density and continuous development, efficient public transportation networks, and easy access to nearby services and job opportunities. The OECD (2012) supports these attributes, stressing the importance of density patterns, eco-friendly transportation, and diverse land usage.

In recent years, the notion of sustainable urban environments has garnered more attention due to growing environmental consciousness. This has led to discussions about the actual sustainability benefits of compact cities.

Proponents of the compact city model argue that it offers several benefits, including:

- **Efficient transportation:** Sustainability is enhanced when higher population densities lead to greater use of public transportation.
- **Land use efficiency:** Dense urban areas reduce urban expansion, conserve countryside, and utilize existing city spaces for new developments.
- **Social benefits:** The integration of diverse and mixed land uses fosters social cohesion and cultural development.

- **Economic benefits:** Cities with higher density often demonstrate greater cost-effectiveness due to lower per-capita infrastructure costs.
- **Energy savings:** According to [77], the structure of urban areas affects energy consumption, with centralized destinations and effective public transportation systems contributing to energy savings.

Conversely, critics raise concerns regarding potential drawbacks, such as:

- **Traffic congestion** Higher population density could result in more motor vehicle traffic, negatively impacting the surrounding environment [99].
- **Health concerns:** Densely populated urban areas may present challenges to public health, especially following the rapid increase in population that occurred during the Industrial Revolution.
- **Land use segregation:** Although the New Urbanism movement aims to encourage diverse land usage, separation may still occur, with business and civic functions clustered in city centers while housing areas remain on the outskirts [100].

The compact city model offers a potential answer to the issues arising from urban sprawl and environmental deterioration. Cities such as Curitiba, Brazil, serve as prime examples of successful compact city principal application, showcasing the viability of sustainable urban growth. This swiftly expanding metropolis of 1.5 million residents has effectively combined human and natural elements, mitigating problems of overcrowding, pollution, and lack of open spaces that often plague urban environments. In 2010, Curitiba was awarded the Globe sustainability award in recognition of its urban development approach, which is grounded in sustainability and active community involvement.

2.4.2.4 The eco-city

The eco-city concept exemplifies the ideal fusion of natural and urban environments. Such cities employ local resources and utilize regional energy, air, and water flows to minimize the environmental impact of human activities.

Urban Ecology defines an eco-city as "a human settlement that enables its residents to live a good quality of life while using minimal natural resources" [101].

Richard Register, the founder of Urban Ecology, coined the term "eco-city," emphasizing the need to incorporate ecological principles into the redesign of existing urban areas. While this concept may seem modern, it has historical roots; for example, Arcosanti, an experimental town developed by Paolo Soleri in 1970, embodies the principles of arcology, which combines architecture and ecology.

Scholars and scientists have attempted to define smart and digital cities, claims that the ideal smart city is Trinity City which means either a smart sustainable city, an intelligent eco city, or intelligent eco cyber city, integrating the physical built environment and technological resources, natural assets and knowledge properties, human resources and creative investment (Figure 2.7).

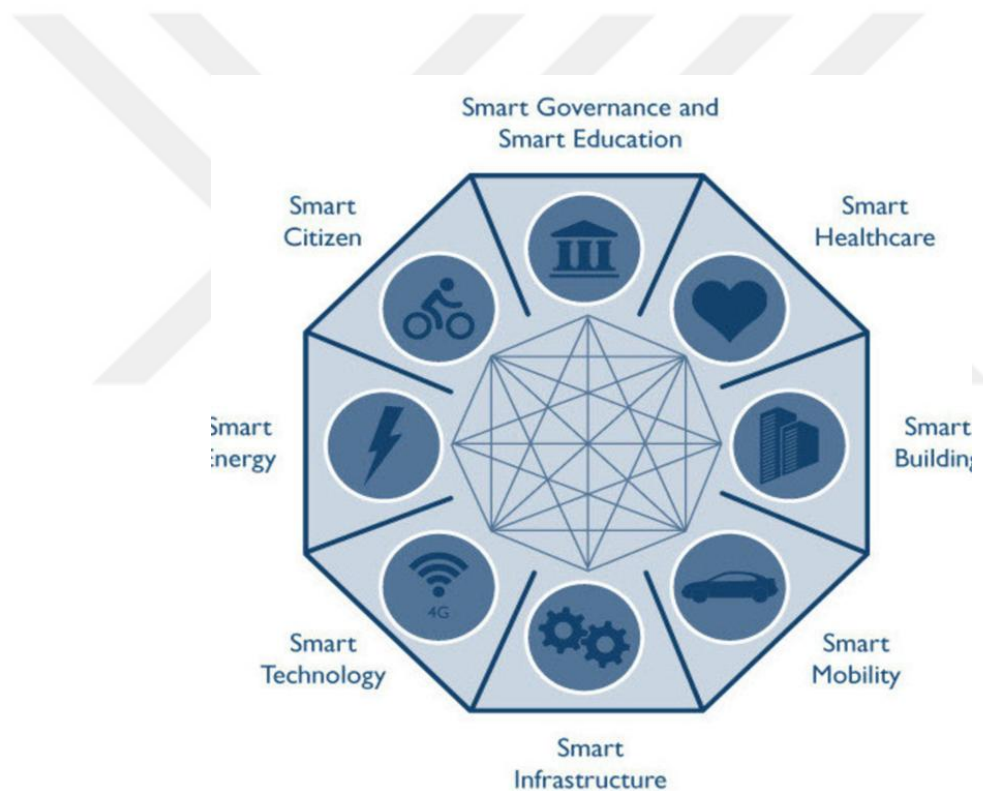


Figure 2.7 Smart city concepts [135]

The current rapid population growth and increasing urbanization in many regions necessitate more sustainable development approaches. The impact of urban elements on the environment, society, and economy has recently intensified significantly. This has led to the emergence of innovative trends, resulting in various models addressing the relationship between urban areas and their surroundings.

These include the "green city" in the UK and China, the "garden city" and "eco-town" in the UK, the "ecological city" in the USA, and the "healthy city" in Europe [102].

Early eco-city projects in the 1900s primarily focused on urban land use patterns. However, contemporary initiatives have shifted their emphasis towards reducing environmental impact, enhancing energy efficiency, and improving waste management practices [57]. The eco-city framework highlights the interplay among the built environment, society, climate, and economy, with a primary focus on ecological perspectives. Urban planners often design new cities by integrating advanced "green" technologies to create sustainable built environments.

[103] expands the eco-city concept, connecting it to various related paradigms and movements such as healthy communities, appropriate technology, community economic development, social ecology, the green movement, bioregionalism, and sustainable development. An eco-city is characterized by the development of sustainable human communities within harmonious and balanced built environments, emerging as a critical concept in urban planning that addresses social and environmental issues [104].

Freiburg, situated in southwest Germany, has earned the title of Germany's "ecological capital," focusing on transportation, environmental protection, and energy conservation. A significant development in Freiburg was the early designation of the old town center as car-free in 1973. Furthermore, the government-led development of the new district of Vauban incentivized residents to forgo car ownership by reducing housing costs for those who signed a contract to live without a car [18]. Freiburg is considered an ecological city rather than a sustainable city because it prioritizes the integration of environmental considerations into land-use planning instead of compromising them. The city actively embraces nature, aiming to operate within environmental limits.

The urban planning strategy of Freiburg centers on existing public transit hubs, including tram and bus stations. The city incorporates mixed-use developments that are linked through green public areas, walkways, and bike paths, all leading to a dense urban core. This approach integrates transportation, land use, and public spaces to create a cohesive and sustainable urban environment.

2.4.3 Assessment

Sustainable urban forms play a pivotal role in promoting environmental responsibility within urban environments. Meticulous planning and development can mitigate the ecological footprint of urban areas, enhance residents' well-being, and foster economic prosperity. While no single approach provides a comprehensive solution, the diverse range of sustainable urban forms strategies underscores the significance of tailored interventions that address the unique challenges of different. Among the various concepts, compactness, sustainable transportation systems, and mixed land use patterns emerge as key strategies to combat the detrimental effects of urban sprawl. By investigating diverse models and applying essential design principles, cities can foster environments that are flexible, welcoming, and environmentally sustainable. When assessing urban forms and their attributes. This thesis will evaluate the Casbah of Algiers using design concepts at the most effective level. To determine compactness, sustainability indicators must be considered within a broader analytical framework. Specific indicators are associated with each design concept (Table 2.4).

Table 2.4 Design concept indicators (Author)

Design Concept	Indicator	Related Level
Compactness	• Urban form • Urban Mobility	Neighborhood level
Mix of uses	• Provision facilities • Horizontal mix of uses. • Vertical mix of uses	Neighborhood level
Sustainable transportation	• Urban mobility • Energy Use	Metropolitan level

This approach emphasizes how the configuration and organization of urban spaces can enhance community adaptability, social cohesion, and overall quality of life in the face of various challenges (Table 2.5). The subsequent section will explore resilience as a measure of social sustainability, utilizing the Casbah of Algiers as a case study to substantiate this perspective.

Table 2.5 Comparison of different models (Authors)

Model	Definition	Key Features	Benefits
Neo-traditional development	A design approach that emphasizes traditional neighborhood layouts and community-oriented spaces.	Walkable streets, Mixed-use buildings, community parks	Fosters social interaction- reduces reliance on cars- Enhances local identity
Urban containment	A strategy that limits urban sprawl by designating boundaries for urban development.	Urban growth boundaries, preservation of open space, Infill development	Protecting natural resources, encouraging efficient land use, supports public transit
The compact city	An urban form that promotes high-density living and efficient land use within a defined area.	High-rise buildings, mixed-use developments, proximity to amenities	Reduces infrastructure costs, minimize environmental impact, enhances accessibility
The Eco-City	A city designed with sustainability at its core, focusing on environmental health and resource efficiency.	Green buildings, renewable energy sources, sustainable waste management	Reduces carbon footprint, promotes biodiversity, improves quality of life

2.5 Resilience in Urban Contexts

2.5.1 Introduction to urban resilience

In recent years, resilience has garnered substantial attention as a critical area of research and discourse across multiple disciplines. Specifically, resilience plays a pivotal role in ensuring the sustainability and longevity of urban environments. This concept enables urban systems to withstand disruptions, adapt to unexpected challenges, and recover from adverse situations [105].

The concept of resilience is fundamental for understanding urban issues and addressing them through sustainable and enduring approaches. This notion equips urban structures with enhanced capacity to withstand disturbances and adapt to unforeseen obstacles.

The concept of "resilience" was initially introduced by ecologist Crawford Stanley Holling in his groundbreaking 1973 work [106-107]. Holling characterized resilience as the ability of an ecological system to sustain its operations and functions during disturbances, or to adapt and reorganize while maintaining its core structure, functions, identity, and feedback. Over time, this concept was adopted and incorporated into various fields, including architecture and urban planning, as a response to worldwide natural calamities and social unrest [108]. In recent studies, urban resilience has become a key area of focus, serving as a crucial principle for ensuring the long-term viability and sustainability of cities, as well as their capacity to adjust to both global and local changes.

The United Nations introduced 17 new Sustainable Development Goals in 2015, with Goal 11 specifically targeting the creation of "inclusive, safe, resilient, and sustainable" cities [109]. Urban resilience, as described by [110], represents a paradigm that allows cities to move beyond traditional planning approaches and the stagnation of conformist urbanism, which has long contributed to increased greenhouse gas emissions and significantly affected human settlements and the socio-cultural lifestyles of residents. According to UN-Habitat (2018a), urban resilience is defined as "the measurable ability of any urban system, with its inhabitants, to maintain continuity through all shocks and stresses, while positively adapting and transforming towards sustainability." This dissertation, therefore, proposes the combination of urban

resilience and sustainability concepts, contending that addressing these ideas together will result in a comprehensive planning strategy that assists urban systems in environmental protection, recovery from disruptions, and the promotion of sustainable living practices.

Urban resilience emerged as a significant concept in United Nations discussions on urban systems, gaining recognition for its role in achieving sustainability. This led to the establishment of objectives aimed at creating cities that are inclusive, safe, resilient, and sustainable. The notion of urban resilience was developed as a response to global challenges, including natural disasters and, particularly relevant to the case study, social disruptions. This concept is intricately linked to sustainability, sharing similar ideals and objectives focused on environmental protection and promoting sustainable living practices.

Urban resilience adopts a holistic approach, incorporating both concrete and abstract elements of urban systems. Its purpose is to ensure that cities can endure, withstand, recuperate from, and adapt to various disturbances. This comprehensive strategy aims to enhance a city's ability to persist and thrive in the face of adversity.

2.5.2 Resilience as a measure of social sustainability

Resilience serves as a metric for evaluating the social sustainability of neighborhoods, with urban resilience being a component thereof.

The concept of sustainability is broad and can be interpreted and applied in many ways. In this context, resilience provides a concrete method to assess how effectively urban systems, specifically urban forms, support the social use of space and emphasizes the concept of a sustainable urban neighborhood focused on social sustainability.

The selection of resilience as a measurement instrument is attributed to its efficacy in physical contexts such as the neighborhood, as the focus is on urban environments, considering elements such as culture, social life, and community, particularly in the case study of the casbah based on the reactivity of the built environment to residents' behaviors.

Measuring social sustainability presents significant challenges due to its complex and multidimensional nature, encompassing elements such as equity, inclusion, community well-being, and governance. In contrast to environmental and economic

sustainability, which can be quantified using concrete metrics like carbon emissions or GDP, social sustainability involves intangible and qualitative aspects such as social cohesion, justice, happiness, and sense of belonging. These intangible indicators are challenging to quantify and often differ across cultural and societal contexts, resulting in a lack of established measurements. Furthermore, the complex relationships between various social factors, for instance, the connection between governance and community trust, contribute to the complexity of measurement, as these elements are deeply interconnected and context dependent. Moreover, current frameworks for evaluating social sustainability often lack consensus on which indicators to prioritize, whether to focus on traditional "hard" themes like poverty reduction or emerging "soft" concepts such as happiness. Regarding the various methodologies for assessing the social dimension of sustainability, the selection of resilience as a measurement instrument is predicated on its efficacy.

This concept and metric will be further emphasized in this thesis. Mediterranean cities have exhibited remarkable versatility and adaptability throughout their extensive and rich history, attributable to a multifaceted urban fabric that can be flexibly adapted to accommodate diverse functions and uses across various temporal periods. However, there exists a longstanding cultural bias in architectural research that tends to focus on Western cultures, as noted by [111], who observed that "Architectural history, as written and thought in the Western world, has never been concerned with more than a few select cultures." This research aims to challenge this paradigm and investigate the city of Algiers, specifically The Casbah of Algiers, as a representative example of Mediterranean urban resilience with a particular focus on its social aspects.

2.5.3 Resilience, social cohesion, and urban form

Resilient urban forms play a critical role in fostering social cohesion and solidarity, enabling communities to support one another during crises. The physical design and spatial organization of cities significantly influence social interactions, which are essential for building resilient communities. The concept of "spatial morphology," which examines the form and structure of urban areas, provides important insights into how urban design can either enhance or undermine resilience. Resilient urban forms are typically characterized by diversity, connectivity, and flexibility, attributes that

allow cities to adapt to change and recover from disruptions. A diverse urban fabric—comprising mixed land uses, varied building types, and ample open spaces—enhances redundancy and creates buffers against potential shocks. Similarly, well-connected street networks facilitate the movement of people, access to resources, and the flow of information, all of which are vital for crisis response.

Moreover, the spatial configuration of cities has a direct impact on social self-organization and the preservation of "urban memory" "the collective knowledge and practices that communities draw upon for adaptation. Spatial redundancy, such as multiple pathways and distributed resources, strengthens flexibility and allows for the reorganization of urban systems following disturbances. However, excessive redundancy may diminish the embedded memory within a city's spatial structure, potentially impeding communities' ability to rebuild based on their existing knowledge and practices.

Community cohesion, defined by the strength of social bonds and shared values within a population, is another key component of social resilience. When individuals feel connected to their community and trust their neighbors, they are more likely to cooperate, offer mutual support during crises, and collaborate to overcome challenges. Resilient urban forms contribute to this sense of cohesion by offering opportunities for interaction and collaboration, facilitated through urban commons, public spaces, and well-connected neighborhoods. These spaces foster the development of social ties and a sense of belonging, strengthening social capital and enhancing the community's capacity to respond to and recover from crises.

Research consistently demonstrates a strong correlation between urban form, community cohesion, and social resilience. The physical configuration of neighborhoods is instrumental in shaping social ties, fostering a shared identity, and enhancing a community's capacity to support one another during periods of adversity. Resilient urban forms, particularly those categorized as "sustainable urban neighborhoods," are characterized by robust social networks and close-knit relationships, which augment the overall resilience of communities, especially during challenging periods.

The sustainable urban neighborhood serves as a conceptual framework for elucidating how specific design elements promote social interaction and a sense of belonging—

both critical for constructing resilient communities. Key principles from literature underscore the role of resilient urban forms in enhancing social cohesion and increasing support during crises. For instance, well-connected streets, public squares, and mixed-use spaces facilitate frequent social interactions, increasing the probability of casual encounters among residents. Over time, these interactions cultivate familiarity, trust, and a shared sense of identity, thereby strengthening the neighborhood's social fabric. Additionally, resilient urban environments foster a powerful sense of belonging through human-scale architecture, recognizable landmarks, and well-maintained public spaces, further encouraging residents to invest in the community and support one another during challenging times.

Furthermore, resilient urban forms accommodate informal urban practices, such as street vending and community gatherings, which contribute to both the economic vitality and social vibrancy of the neighborhood. These informal activities engender a sense of ownership and adaptability, reinforcing the community's capacity to respond to crises. Shared public spaces also function as social hubs, facilitating the development of social capital—characterized by strong social ties, trust, and reciprocity—which forms the foundation of community resilience in times of crisis.

In conclusion, resilient urban forms are essential for fostering social cohesion, solidarity, and the capacity of communities to support one another during crises. By recognizing the interconnectedness of urban design and social dynamics, urban planners and designers can prioritize design elements that encourage interaction, belonging, and adaptability. Ultimately, this approach can lead to the creation of neighborhoods that are not only aesthetically appealing but also socially sustainable, inclusive, and resilient.

As the discussion of resilient urban forms has demonstrated, the design and spatial configuration of neighborhoods play a crucial role in fostering social cohesion, adaptability, and the overall resilience of communities. These principles are especially relevant when applied to historic urban environments that have evolved organically over time, often displaying unique characteristics that contribute to their social and spatial resilience. The following chapter delves into a case study of the Casbah of Algiers, an emblematic example of a sustainable urban neighborhood with a rich cultural and architectural heritage.

CHAPTER 3

3. MATERIAL AND METHOD

3.1 Methodology

This research adopts a holistic method to evaluate the Casbah of Algiers' sustainability, emphasizing its urban layout and community dynamics. The investigation employs a qualitative case study approach, allowing for a thorough examination of the complex factors associated with urban sustainability in a historic context. The research framework encompasses four primary components: a theoretical base, qualitative interviews, literature analysis, and evaluation techniques.

The study begins with a historical overview of sustainability, tracing its evolution through significant global milestones. This context is crucial for understanding sustainable urban design principles and their relevance to the Casbah. The theoretical framework incorporates key concepts such as density, mixed land use, sustainable transportation, and adaptability, which are essential in assessing the Casbah's urban sustainability.

A wide-ranging set of stakeholders, including local inhabitants, engage in comprehensive interviews. These conversations are designed to gather qualitative information about the perspectives, encounters, and challenges faced by those living in the Casbah. The collected data provides an in-depth insight into how urban planning influences social interactions, community resilience, and overall sustainability.

The study's conceptual framework and evaluation techniques are shaped by an extensive review of existing research on sustainable urban planning. This analysis encompasses studies on urban sustainability, social cohesion, and the way urban structures impact community dynamics. It aids in contextualizing the results within broader scholarly debates and identifying effective strategies and insights from other urban environments.

Utilizes various evaluation techniques, derived from previous research, to gauge urban sustainability. These methods evaluate indicators associated with density, diverse land use, and eco-friendly transportation. The investigation explores how specific design

elements contribute to social sustainability in the Casbah, particularly focusing on resilience as an indicator of social cohesion, while also considering its historical context and how its unique urban layout enhances its longevity and sustainability.

The selection of compactness, mixed land use, and sustainable transportation as metrics for assessing urban forms is grounded in their vital roles in fostering sustainability and tackling the issues arising from urban expansion. First, density emphasizes concentrated development, which is crucial for conserving land and reducing the environmental footprint of urban areas. Compact urban designs enable efficient land utilization, reduce car dependence, and encourage walking, thereby strengthening social bonds and community unity. The Casbah of Algiers exemplifies this concept through its concentrated layout, which promotes pedestrian movement and efficient service provision while nurturing a dynamic urban environment. Second, diverse land use combines residential, commercial, and leisure spaces in proximity, significantly reducing the need for extended travel and creating a pedestrian-friendly setting. By placing essential services within walking distance, mixed-use development improves accessibility, bolsters local economies, and facilitates social interactions among residents. The Casbah's urban structure demonstrates effective mixed-use development, contributing to its sustainability by minimizing reliance on cars and fostering community engagement. Third, eco-friendly transportation focuses on developing transit systems that minimize environmental impact and promote efficient mobility. Sustainable transit encourages the use of public transportation, cycling, and walking, which are essential for decreasing greenhouse gas emissions and enhancing air quality. The Casbah's design, which prioritizes pedestrian access and integrates with public transit systems, illustrates how sustainable transportation can improve urban livability and connectivity.

Evaluating the social sustainability of the casbah requires considering resilience due to the challenges in quantifying social aspects. The complex and intangible nature of social sustainability, including community bonds, cultural heritage preservation, and life quality, makes it difficult to measure using standard indicators.

Resilience offers a more comprehensive and context-specific approach to assessing social sustainability. This concept encompasses a community's capacity to adapt, evolve, and surmount obstacles, which is essential for the long-term sustainability and

welfare of urban neighborhoods. By examining the resilience of the Casbah's urban structures and social interactions, researchers can gain valuable insights into the neighborhood's ability to maintain its social fabric and adapt to changing conditions. Although social sustainability metrics can be elusive, resilience provides a concrete framework for understanding how the Casbah's physical design and spatial layout contribute to community adaptability, social cohesion, and overall quality of life. This approach recognizes the context-dependent nature of social sustainability and enables a more nuanced evaluation of the Casbah's sustainable urban development.

The research utilizes diverse data collection techniques, including qualitative interviews, literature reviews, and case study analyses, to gain a comprehensive understanding of the Casbah's sustainability. By focusing on the interplay between urban design and social interactions, the study seeks to provide valuable perspectives on sustainable urban practices that can inform future urban planning initiatives.

3.2 Material: Case Study

Situated in Algiers (Figure 3.1), a metropolis spanning 276 square kilometers with over three million inhabitants, the historic Casbah quarter has been recognized as a UNESCO World Heritage site since 1992. The Casbah, with its origins dating back to the sixth century BC, exemplifies the city's deep cultural heritage. Despite its intricate design and 16th-century fortress, the Casbah has experienced ongoing degradation. Population density has surged to 4,000 individuals per hectare, with the population rising from 60,000 in 1969 to 70,000 by 1980 [113-114].

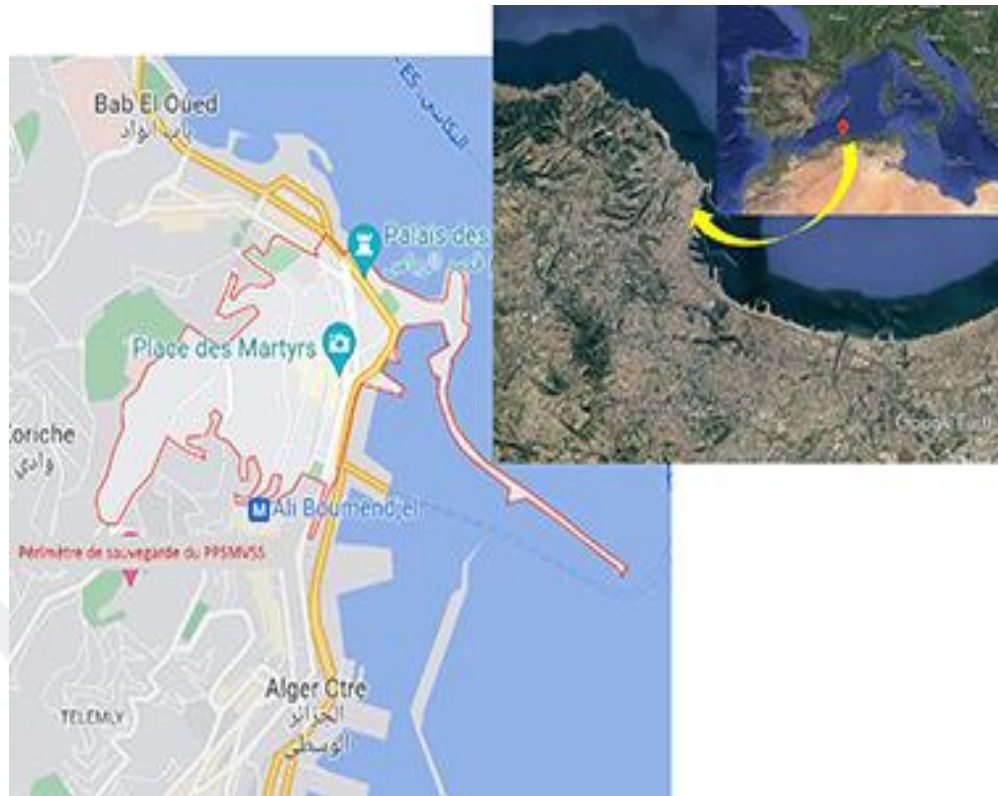


Figure 3.1 Situation of the casbah [136]

Historically, the Casbah evolved under various empires, including the Phoenicians who established "Icosium" in the fourth century BC, as well as the Romans, Vandals, and Byzantines (Figure 3.2). Its current layout was established by Bologhine Ibn Ziri in 944, with significant fortifications added during Ottoman rule in 1516 [115-116]. The Casbah's narrow, winding streets, which provide privacy and channel cool sea breezes, are typical of traditional Arab towns and medieval Mediterranean cities [115]. The architecture is characterized by inward-facing buildings, with courtyards providing natural light and ventilation, while plain exterior facades ensure privacy [117-118].

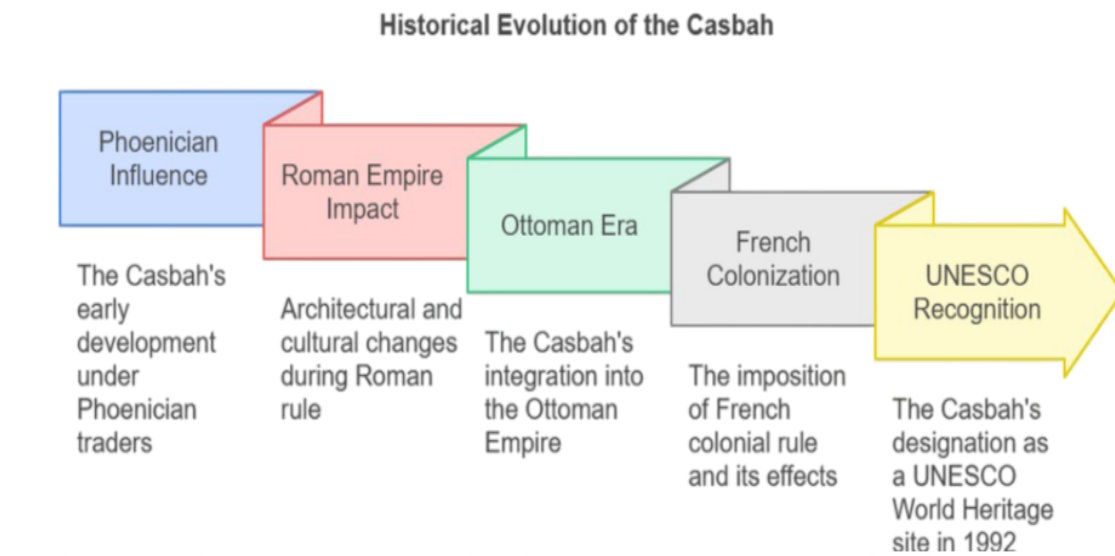


Figure 3.2 Historical evolution of the casbah (Author)

The casbah is divided into two distinct areas. The lower section is characterized by its variety, encompassing commercial, religious, and civic structures. In contrast, the upper portion is predominantly residential, featuring essential amenities such as bakeries, fountains, and mosques (Figure 3.3). Despite their deteriorating condition, these neighborhoods showcase the Casbah's resilience and potential for renewal [119]. At present, the Casbah confronts several issues. Overpopulation and deteriorating infrastructure have resulted in neglect and urban deterioration. Numerous businesses have closed, leaving only artisanal pottery and a few eateries. Nevertheless, the compact urban design serves as a model for sustainable urban planning, fostering social interaction, pedestrian-friendly environments, and efficient land utilization. Although the region faces pressure from urban growth and modernization, its inward-oriented architecture reinforces community ties and enhances resilience [119].

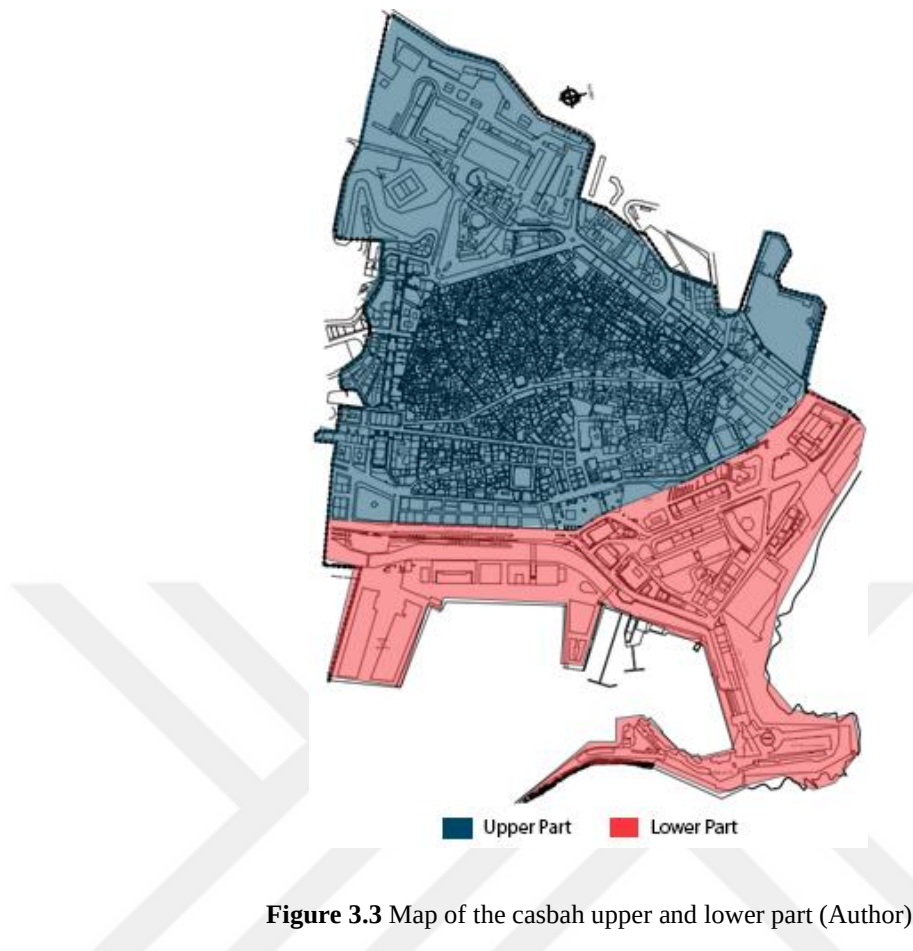


Figure 3.3 Map of the casbah upper and lower part (Author)

The rapid expansion of Algiers presents significant challenges to sustainable growth due to the urban sprawl phenomenon, impacting Casbah's structural and demographic dynamics. As affluent residents migrate to suburban areas, the Casbah experiences neglect and a decrease in population. The city's outward expansion exacerbates environmental degradation, encroaching on natural areas and agricultural lands. The widespread utilization of personal vehicles amplifies socioeconomic disparities and increases the likelihood of air pollution, traffic congestion, and health concerns. Many low-income residents continue to reside in central or peripheral regions, often lacking access to essential services such as employment opportunities and educational facilities.

Despite these urban challenges, the Casbah offers potential for long-term revitalization. Economic growth could be stimulated through cultural conservation and heritage tourism, enhancing social cohesion and livability. By emphasizing the restoration of its architectural heritage to prevent its disappearance and leveraging its

unique urban layout, the Casbah could serve as an exemplar of sustainable urban development, balancing historical preservation with contemporary requirements. To ensure the Casbah's resilience in an increasingly modernized Algiers, sustainable regeneration programs must emphasize compact, mixed-use development, efficient public transit systems, and enhanced social integration.

This study seeks to examine the casbah, focusing on its urban structure and social sustainability, utilizing various metrics to highlight its significance as a model for designing future cities in Algiers. The research aims to promote a sustainable urban approach that fosters social equity and cohesion while exploring essential design principles to address the adverse effects of urban expansion.



CHAPTER 4

4. FINDINGS AND RESULTS

4.1 Urban Sprawl's Impact on Algiers

The unplanned and unregulated expansion of cities into surrounding undeveloped regions, known as urban sprawl, is a global challenge for urban planners and environmental scientists. Characterized by low-density residential, commercial, and industrial growth, urban sprawl poses significant environmental, social, and economic challenges [112] defined as a problem that need to be addressed. In contrast, sustainable urban development advocates for planned, compact, and environmentally responsible growth. This chapter investigates the root causes and impacts of urban sprawl, contrasts them with sustainable urban development principles, and proposes strategies to mitigate sprawl's negative effects while promoting socially and environmentally inclusive urban forms.

Urban sprawl refers to the unconstrained expansion of cities, typified by low-density development that increases infrastructure and land use costs while contributing to environmental degradation [29-30]. This pattern of growth often results in residents living far from workplaces and essential services, leading to heavy reliance on automobiles and contributing to social isolation, pollution, and traffic congestion [31]. Furthermore, sprawl damages ecosystems, reduces green spaces, and promotes inefficient land use, hindering sustainable urban development efforts. It also intensifies socioeconomic disparities by segregating neighborhoods based on class and income, resulting in isolated communities [32]. From an economic perspective, sprawl increases the cost of public utilities, services, and infrastructure across extensive areas, straining local government budgets and diminishing urban vitality.

Urban sprawl is influenced by multiple elements. As incomes rise, individuals can afford larger homes in more cost-effective suburban areas, attracting developers [33]. Extensive road networks and widespread car usage enable people to reside further from city centers, promoting suburban expansion [34]. Zoning regulations that support low-density development separate residential, commercial, and industrial zones [35].

Additionally, population growth, a cultural inclination towards suburban living, and the increase in remote work technologies are driving this outward expansion [36]. In Algiers, for instance, urban sprawl is negatively influencing the city's shape, transportation system, and social fabric, alongside deforestation linked to the construction of new, inadequately equipped cities.

Algiers, currently a city of 5 million inhabitants, face continued growth due to the challenges of urban sprawl problem influencing a lot of aspects that must be resolved. Originally, the city consisted solely of the Casbah, constructed prior to the Ottoman era, which has withstood the test of time and its implications; now the Casbah serves as the historic center. This study examines the Casbah as a potential model for future urban development in response to urban sprawl.

The negative impact of urban sprawl on both the Casbah and the larger city, in environmental, economic, and particularly social terms, has led the analysis to focus on various urban and social perspectives, utilizing metrics to assess its viability as a reference point for future city planning.

Algiers have experienced significant urban expansion, particularly in the post-colonial period, primarily due to population growth and increased housing demands. The government's response has been characterized by unplanned urban design following the principles of the modern movement, utilizing concepts such as zoning, which has affected the mixed land uses of the cities, resulting in environmental, economic, and social complications. Prior to independence, Algeria was colonized by France from 1830 to 1962. During French colonial rule, the city known as the Casbah, which at the time constituted the entirety of Algiers, underwent rapid changes in urban form as the French sought to modernize the area to accommodate the growing European population. This modernization followed European architectural styles, such as Haussmann architecture, like that of Paris, with wide boulevards and parks. To exemplify the impact of French colonization, the Casbah was divided into two parts: the first retained its urban layout and remained largely unaltered, known as the Muslim city, while the lower part was demolished to make way for the French vision of a European city. However, this urban development largely neglected the needs of the native Muslim population, as Muslims at the time had no rights and were considered Indigenous, presenting a clear manifestation of colonialism. This resulted in the

growth of informal settlements as rural migrants moved to Algiers seeking economic opportunities and safety, particularly during the Algerian War of Independence (1954–1962).

The departure of Europeans from Algeria following its 1962 independence intensified the strain on Algiers' urban infrastructure. A new influx of Muslim residents, coupled with rapid population growth, led to uncontrolled suburban expansion characterized by informal settlements on the city's periphery. This unchecked growth severely impacted Casbah and other historic areas of Algiers, as resources were redirected to suburban development.

Although numerous proposed modernist projects were never realized, French colonial urban planning, influenced by architects such as Le Corbusier, significantly shaped suburban development. The legacy of these colonial urban strategies and Algiers' rapid post-independence urbanization have created challenges for sustainable urban growth and the preservation of the city's cultural heritage.

The urban sprawl in Algiers is a complex issue rooted in historical, political, and socioeconomic factors. The mid-20th century population increase, and housing shortage resulted in substantial growth in suburban regions, characterized by large-scale housing projects and informal settlements. As economic activities and residential preferences shifted towards the periphery, traditional urban centers such as the Casbah began to deteriorate. Government-initiated modernization efforts further accelerated suburban expansion while neglecting the city's historic fabric, exacerbating urban decay and social marginalization in areas such as the Casbah.

The involvement of private developers, particularly during economic downturns in the 1980s and 1990s, resulted in fragmented urban growth that frequently contravened existing regulations. The diminished role of the public sector in housing provision and the subsequent transfer of urban planning responsibilities to private entities prioritized profit maximization over sustainable development. This fragmentation is evident in the heterogeneous quality of infrastructure and urban layouts across various areas of the city. Despite initiatives to address these challenges, such as the 2030 plan "Plan Directeur d'Aménagement et d'Urbanisme" (PDAU), which advocated for public spaces and polycentric growth, Algiers' urban landscape continues to be characterized by socioeconomic disparities and spatial segregation. While large-scale urban projects

like the tramway aimed to enhance connectivity, they occasionally had the unintended consequence of further isolating disadvantaged neighborhoods.

To further illustrate the impact of urban sprawl on contemporary Algiers, which is the primary focus of this study, an example of Sidi Abdellah city and other new urban developments designed and constructed to address the issue of overcrowded centers and resolve informal settlements. This overcrowding is a result of several factors, including population growth, which increased from 516,450 in 1950 to over 3 million in 2019. Another contributing factor is the migration pattern, specifically the rural-to-urban exodus driven by the pursuit of improved living conditions and economic opportunities, as well as the attraction of industrial growth. These elements collectively impact the physiognomy of the city, leading to overcrowding and necessitating the decision to decentralize the urban core by designing new centers.

Urban sprawl, characterized by its unplanned urban layout, is exemplified by the new Sidi Abdellah city, which comprises a maximum of 90,000 habitations. This development highlights various issues in terms of sustainable transportation, mixed land uses, and social cohesion, collectively impacting livability.

The new cities, such as Sidi Abdellah in Algiers, are part of a program called AADL and LPP initiated by the Algerian government from 1991 to the present to address housing needs in Algeria, particularly in Algiers. This initiative plays a crucial role in promoting land transactions and implementing social and promotional housing programs. The program is proposed as a significant opportunity for Algerian citizens to access affordable housing in a legal and secure framework, necessitated by the low income of citizens leading to their inability to purchase their own homes.

The different formulas, such as AADL and LPP, are based on personal income to provide a more tailored experience, which inadvertently creates segregation among residents. This contrasts with the situation in the Casbah, where residents share the same social life and livability regardless of income.

The chosen example, Sidi Abdellah (Figure 4.1), consists of a combination of AADL and LPP habitations in a 7,000-hectare area, designed to accommodate 450,000 inhabitants.

Additionally, the habitation program launched in 1991 is currently in its third project, initiated on July 5, 2024, mobilizing 4,700 hectares for housing construction, including



Figure 4.2 Habitation in the city of sisi abdellah [144]

In 2019, 255 families from Casbah were relocated to the new city due to the deterioration and overcrowding, with up to 15 members residing in a single house. These residents are predominantly young individuals who return daily to their former neighborhood for economic and social purposes, reinforcing the concept of Sidi Abdellah as a dormitory city (Figure 4.3).



Figure 4.3 The dormitory city [144]

In terms of social interactions, the community environment falls short of ideal conditions due to insufficient or repetitive activities. This situation obstructs the formation of strong bonds among residents and leads to reduced community participation when compared to the Casbah.

Continuing with the mixed land use issues are further exacerbated by a deficiency of educational institutions in the current days even if a university and school project is planned, resulting in overcrowded classrooms or students undertaking extensive commutes to attend school. Recreational spaces are virtually non-existent; when established, parks exist but due to insufficient maintenance and the absence of a system focused on the actual liability +6of residents, these spaces remain unutilized.

This problem extends to essential amenities, such as water supply (Figure 4.4), where water is available every two days, compelling residents to purchase cisterns as a remedial measure.



Figure 4.4 Water supply issues [145]

These factors collectively contribute to increased pressure on transportation emphasized by the 25 km distance from the center of Algiers (Figure 4.5), which is another consequence characterized by mediocre quality and lack of coordination. Buses and trains are not punctual, creating additional strain on other schedules and inadequate programming, as the number of trips is insufficient to meet demand. Residents resort to alternative routes, which in turn affect other trips and prove more expensive. The sole remaining transportation system consists of vehicles (Figure 4.6), resulting in high gas emissions, congested routes, and increased pressure. Sustainable transportation is neither guaranteed nor implemented within the current system of buses and trains, in contrast to other modern cities in Europe and Asia.



Figure 4.5 Distance between the center of algiers and sidi abdallah [144]



Figure 4.6 Road congestion [144]

The development of the new urban area has taken place on land previously allocated for farming purposes, raising environmental concerns. This construction has led to the destruction of numerous hectares of verdant spaces, resulting in a reduction of both green zones and farmland.

City of the. It is the best example of its own. All the cities. Face the same problems. In accentuate way. Knowing that. The city. It is made to replace. The actual center. Where were they? Important administration. Would be moved. To it. Hence. Or despite. It's important. Major problems. Exists. And impact. The livability. Off President. Hence. Imagine. How are the rest of the cities like this one? Which are less important? Looks like. Specifically. In other cities outside Algiers. Like blida Where a new City called haouch arih (Figure 4.7) is contested with manifestations by residents due to the intensity of problems (Figure 4.8) some people called them habitations life graves.



Figure 4.7 The city of haouch arih [146]



Figure 4.8 Manifestation of residents [147]

Therefore, due to repetitive decisions and issues, specifically by initiating the third iteration of the program, the problem will be further emphasized. This study is essential to identify solutions to this phenomenon and provide improved housing options where individuals can reside based on sustainable principles.

The urban growth trajectory of the city demonstrates the intricate interplay between population shifts, residential demands, economic influences, and municipal policies in shaping its developmental course. Tackling the diverse challenges stemming from urban expansion requires a deliberate shift towards a more resilient and inclusive urban development paradigm. This approach should harmonize ecological, societal, and economic considerations to safeguard the city's future viability. Implementing fundamental design concepts for sustainable urban landscapes is crucial to fostering long-term sustainability. As previously outlined, these core principles include compactness, sustainable transportation, mixed land use, and resilience as a measure of social sustainability. The following section will assess the Casbah of Algiers, the city's historic core, in terms of urban sustainability. This evaluation will utilize the

earlier stated design concepts, examining the urban structures and changes from each period and their societal impacts, while applying these established design principles.

4.2 Evaluation of The Casbah

The preceding sections have established crucial concepts relevant to the Casbah of Algiers case study, setting the stage for this chapter's focus on research methodology and design. This section addresses the challenges associated with the study's research questions, particularly examining the potential link between the Casbah's dense urban structure and sustainability in urban settings. Due to the intricate and multidimensional nature of urban sustainability, a case study approach is considered the most appropriate for this research [120]. This method allows for a comprehensive exploration of complex phenomena within real-world contexts [121]. The case study design is particularly useful for investigating multiple variables in a single instance, especially when the researcher lacks control over the events under scrutiny. By focusing on the Casbah of Algiers, this approach enables an in-depth analysis of the urban development processes and features that influence its sustainability. This method provides detailed insights into how the Casbah's design may contribute to sustainable urban practices.

This study adopts a qualitative approach rooted in case study methodology. The research framework consists of four main elements: (1) A theoretical foundation that begins with a chronological examination of sustainability, emphasizing crucial global events and establishing a basis for assessing sustainable urban structures; (2) Comprehensive interviews with experts and stakeholders, aimed at collecting qualitative information about the Casbah's design and its connection to sustainability principles; (3) An extensive review of existing literature on sustainable urban design, which informs the theoretical framework and assessment methods used in this research; and (4) A set of evaluation techniques adapted from previous studies to measure urban sustainability. The primary objective of this methodological approach is to combine various aspects of sustainable urban design into a unified theoretical framework, which is then applied to the Casbah case study.

The research begins with a historical overview of sustainability, tracking its progression through significant global milestones. This background is essential for

comprehending the evolution of sustainable urban forms, including their fundamental principles, benefits, and constraints. The study then narrows its focus to Algiers, particularly the Casbah, as an exemplar of sustainable urbanism. Algiers, a metropolis of roughly 3.2 million inhabitants, has experienced substantial urban growth due to its economic attractiveness. The Casbah, serving as the city's traditional center, offers a potential model of urban sustainability. The study evaluates Casbah's sustainability by applying key design principles associated with sustainable urban structures.

Prior to this assessment, the research provides crucial background information on the history of sustainable urban development in both Algiers and the Casbah, underscoring the importance of this historical context in understanding the current state of sustainability in the area. The evaluation concentrates on several critical design principles, such as population density, environmentally friendly transportation infrastructure, and diverse land use patterns, examining how these factors align with sustainable urban practices. Furthermore, the study employs a 'multiple case embedded design', allowing for a more detailed examination of smaller units within the broader case. This approach enables the analysis of specific neighborhoods and infrastructure elements within the Casbah, facilitating a nuanced evaluation of the compact city model's applicability to Algiers and contributing to the wider theoretical discourse on urban sustainability [120].

The research employs a variety of data collection techniques, reflecting the multifaceted nature of the case study. These include an extensive literature review to establish the methodological framework, comparative case studies to investigate the urban structure and land use within the Casbah, and qualitative interviews with stakeholders and experts to provide firsthand insights. This combination of data sources is intended to yield a comprehensive understanding of Casbah's sustainability. In conclusion, this chapter outlines the methodological framework and research design that underpin the study's investigation of urban sustainability in the Casbah of Algiers. Through a case study approach and the integration of diverse data collection techniques, the study aims to provide a thorough analysis of the Casbah's urban sustainability, setting the stage for subsequent sections that will explore the research findings and address key methodological considerations.

4.2.1 Compactness

Urban design's principle of compactness is crucial for promoting sustainability. It encompasses high-density development, efficient land utilization, and reduced urban sprawl, with the aim of creating pedestrian-friendly cities that decrease car reliance and foster social engagement. The Casbah of Algiers, a UNESCO World Heritage site, exemplifies compactness through its dense, non-uniform urban layout, tight alleyways, and closely situated buildings, all of which contribute to its distinctive social and cultural resilience [122].

Prior to examining the casbah, which constitutes the historic core of Algiers, the city underwent various transformations due to colonization and modernization efforts. The expansion of urban areas significantly affected Algiers, particularly following its independence, as population growth led to degradation that impacted sustainable transportation, land use patterns, and population density. The emergence of multiple urban centers (Figure 4.9) resulted in the current challenges associated with urban sprawl and the development of various hubs (Figure 4.10) Situated at a distance from both the Casbah and the city's central district, these new hubs and centers characterize the impact of urban sprawl.

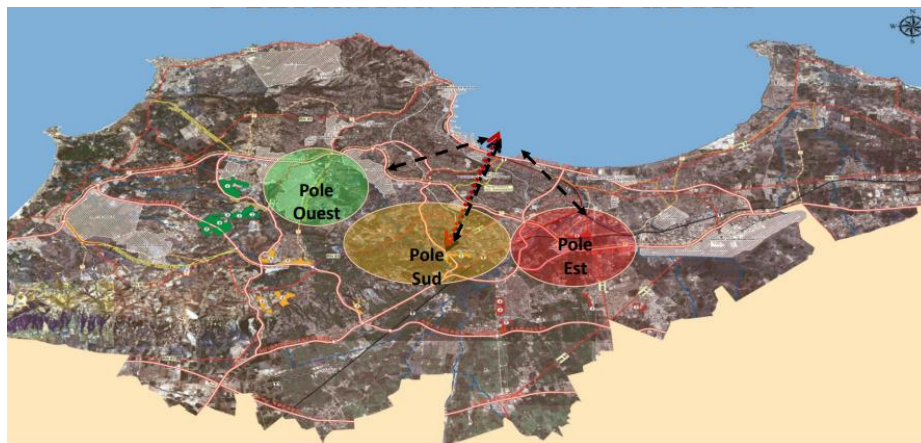


Figure 4.9 Urbanization toward different centers [142]

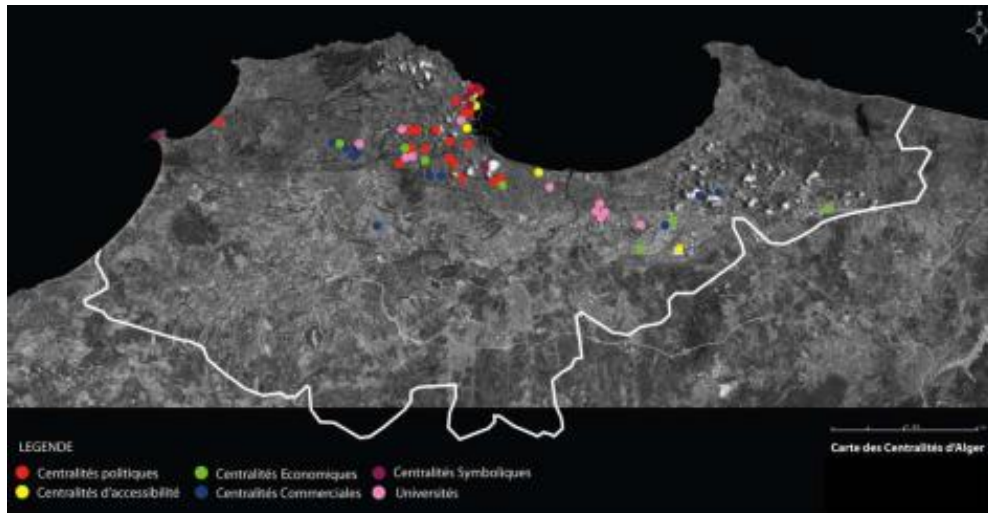


Figure 4.10 Different hubs in Algiers [141]

In terms of urban sustainability, compactness is essential for tackling issues like urban sprawl, inefficient infrastructure, and environmental deterioration. Highly compact neighborhoods such as the Casbah typically consume less energy due to shorter travel distances and an environment that encourages walking and efficient public transit [122].

Analyzing the Casbah's historical development reveals significant changes across various eras, with different approaches leading to a decline in its residential structures. The urban fabric of the Casbah underwent substantial alterations during three main periods: precolonial, colonial, and post-independence.

Precolonial period started with the Casbah of Algiers, even if it is built in 997 it is established in the 16th century during Ottoman rule, developed organically, influenced by its topography and Islamic law (Figure 4.11). Its intricate network of narrow streets and tightly packed houses was shaped by natural elements like terrain and water sources, as well as social and legal norms, including inheritance laws and waqf (endowments), 7 doors assure the connection of the casbah and its environment (Figure 4.11) [122]. The combination of Ottoman architectural influence and Islamic social practices resulted in a compact urban environment where residents lived in proximity. This structure encouraged communal living and social sustainability through shared public spaces and a strong connection between inhabitants and their surroundings [119].



Figure 4.11 Algiers ‘the casbah’ before 1830 [141]

Its urban configuration was influenced by natural features and Islamic legal customs like pre-emption, inheritance, endowments, which shaped the arrangement of streets, land parcels, and building groups. This led to a practical yet uneven urban layout (Figure 4.12) [122]. The city's design was additionally affected by the undulating landscape, which determined the positioning of buildings and water infrastructure, creating a plan that was both sustainable and environmentally adaptable [122-123].

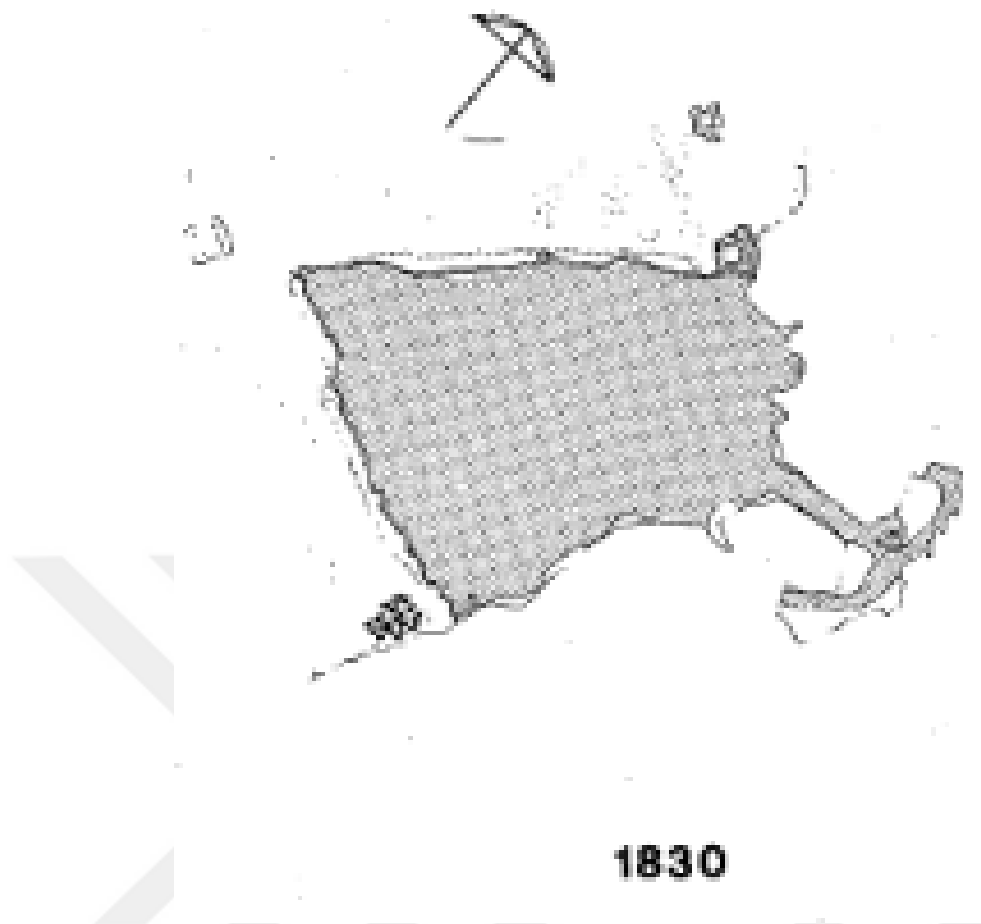


Figure 4.12 Precolonial casbah [140]

The compact urban environment featured tight, serpentine alleys, closely spaced structures, and minimal open areas, designed to optimize shade and promote communal living. Homes typically stood two to three floors tall and incorporated internal courtyards, addressing the need to accommodate a large population in a limited space (Figure 4.13). These architectural elements facilitated social interaction and community cohesion, as evidenced by women utilizing the terrace as a communal space and men employing the intricate alleys for the same purpose., while mosques and public baths (hammams) served as vital communal and religious centers [124]. The design of these dwellings also reflected environmental considerations, utilizing thick walls and shaded courtyards to facilitate natural cooling.

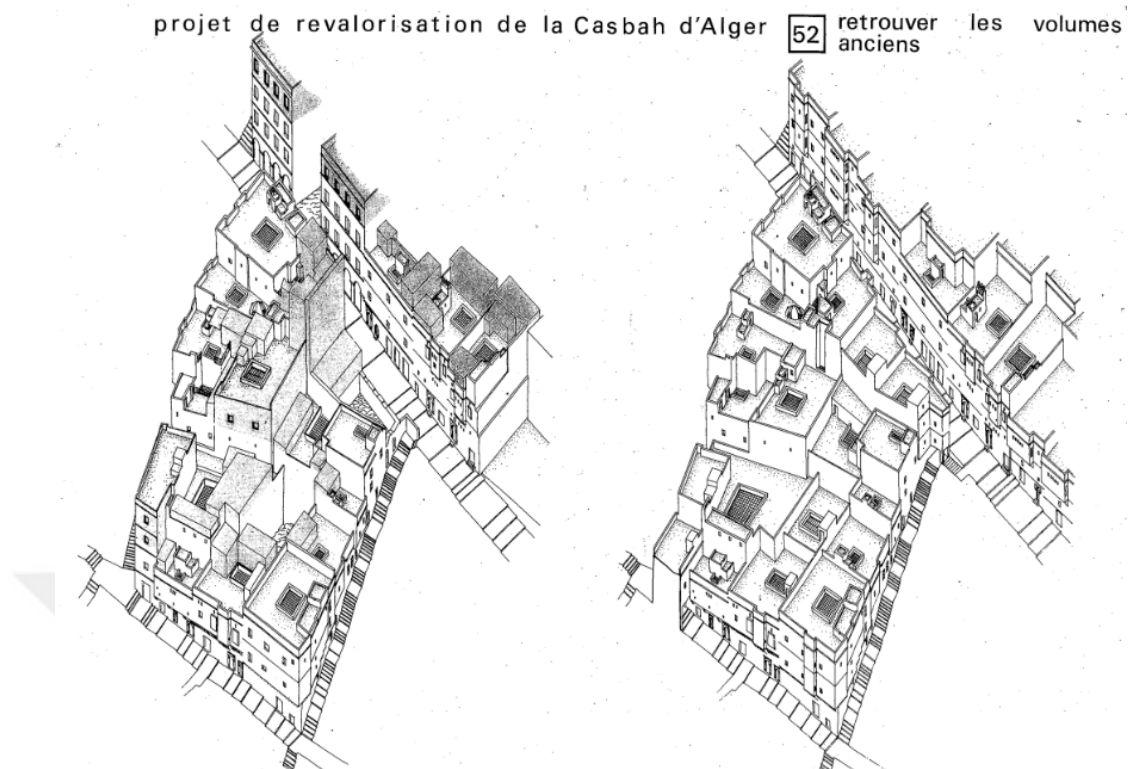


Figure 4.13 Example of urban layout [140]

By 1830, Casbah had exceeded even Cairo in population density, with an estimated 646 inhabitants per hectare. Historical accounts suggest Algiers' population ranged from 100,000 to 150,000 in earlier centuries, equating to densities of 2,174 to 3,261 residents per hectare—levels unparalleled in pre-modern times. Variations in the number of residents over time, fluctuating between 4,000 and 5,000 houses during the Ottoman era, offer a plausible explanation for these high-density figures. The close-knit social fabric of the Casbah, with extended families residing in close proximity, nurtured robust social cohesion and a sense of shared responsibility.

The colonial period starts in the 1830 French takeover of Algiers brought about major alterations to the Casbah's cityscape, primarily through urban renewal programs initiated by the colonial government. A key project was the establishment of Place du Government (now Place des Martyrs), which required demolishing existing buildings to create new public areas especially in the lower part [125] (Figure 4.14). The French planners sought to implement European standards in the city, emphasizing hygiene, transit, and visual appeal. These transformations were most evident in the lower

Casbah, where European settlement and business growth intensified (Figure 4.15), while the upper Casbah maintained more of its native characteristics of the Muslim and ottoman times [117]

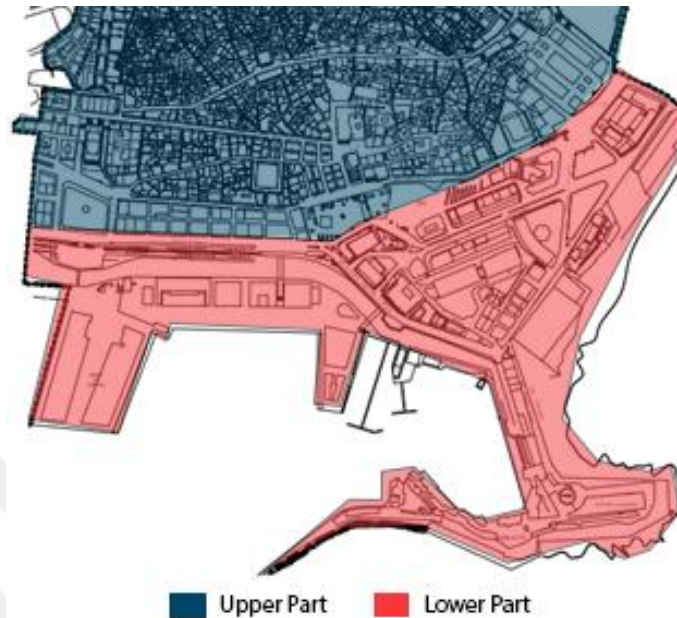


Figure 4.14 Lower part of the casbah (Author)



Figure 4.15 Plan of the new bab azoun district. 1865." [139]

European architectural and urban planning concepts, such as broad streets and covered walkways, began to influence the Casbah's development, with extensions that extended beyond the boundaries of the casbah as shown in the image with red (Figure 4.16), resulting in a European-style city characterized by expansive boulevards and parks. increasing building density and promoting economic growth [117]. French colonial policies, particularly the 1859 expropriation decree, further accelerated urban redevelopment, leading to higher building concentrations and more crowded living spaces. By 1947, certain areas of Algiers had reached a population density of about 3,500 people per hectare [125], reflecting the social and spatial changes brought about by colonial interventions.

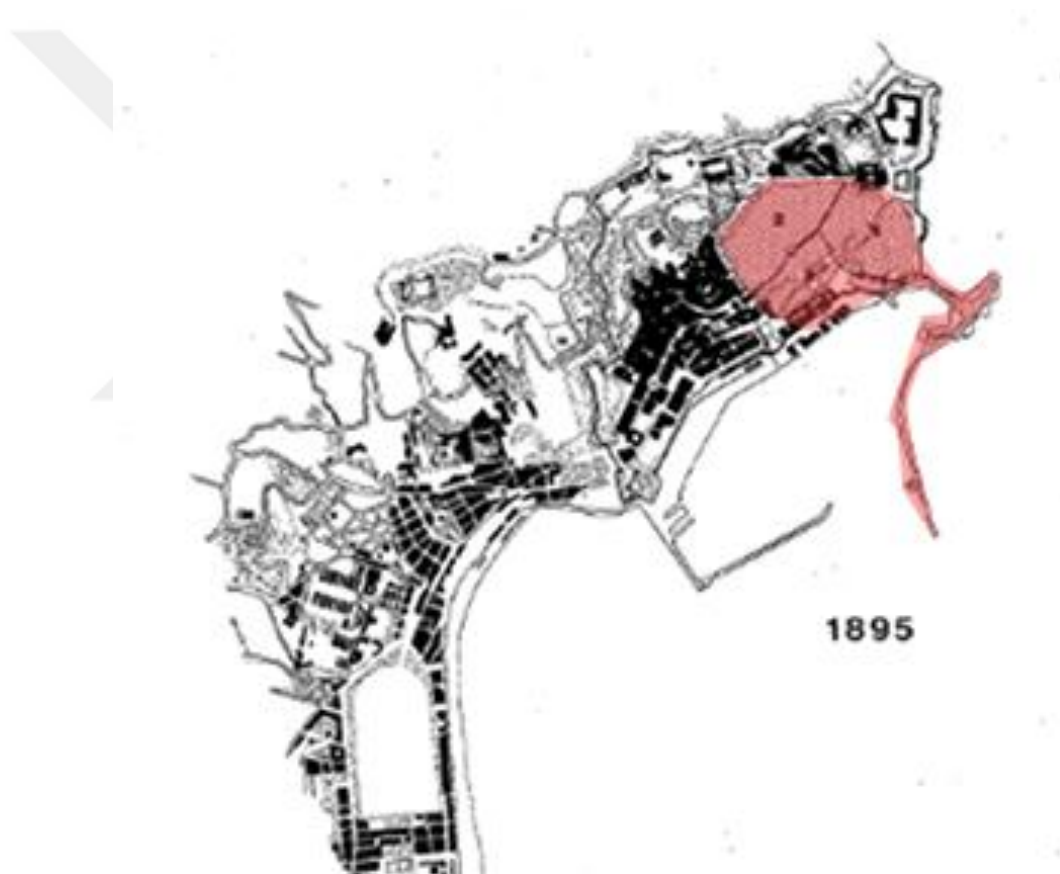


Figure 4.16 Plan of the casbah and algiers evolution [140]

During this period, French colonization transformed the Casbah's core structure from a tree grid layout to large thoroughfares with wide boulevards, emphasizing European architecture and setting the stage for the modern movement after independence.

For Post-Independence period happened After gaining independence in 1962, Algeria's Casbah emerged as a symbol of national identity, cultural preservation, and urban development challenges. The newly independent government struggled to balance the preservation of the Casbah's historical significance with the need to address its socio-economic isolation and crumbling infrastructure [125]. Instead of revitalizing the crowded Casbah, urban development plans during this time prioritized expanding Algiers' outer limits, the map's brown areas indicate the initial expansion from 1962 to 1972, which persisted until 2004, extending 30 km or more from the Casbah such as The Sidi Abdellah city is presented as an exemplar of urban sprawl's impact (Figure 4.17). In 1991, a program called AADL was initiated, leading to the development of new housing complexes and government buildings. These structures featured more open floor plans compared to the dense layout of the Casbah, subsequently giving rise to urban expansion challenges.

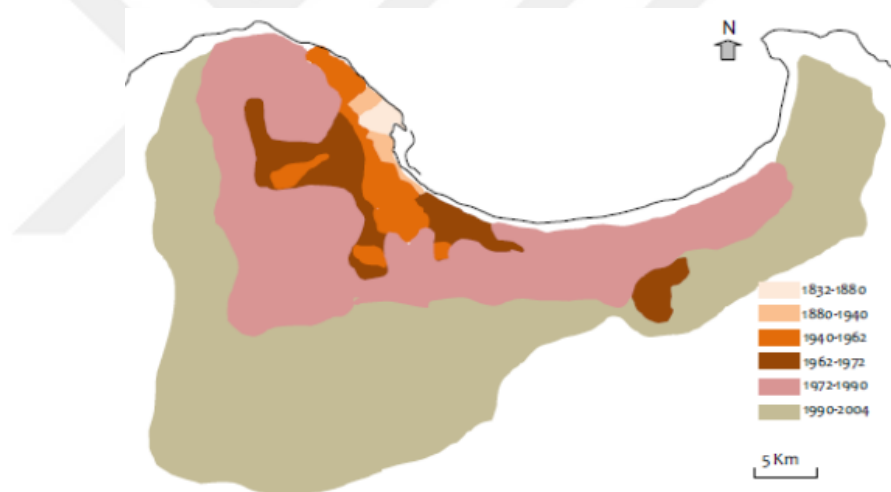


Figure 4.17 Expansion of algiers after independence [138]

The Casbah's population started to decrease as residents relocated to these newer areas. Nevertheless, economic marginalization and deteriorating infrastructure continued to impede efforts to modernize the neighborhood. The difficulties faced by Casbah residents were further compounded by social unrest, including the 1985 riots and the surge in terrorism during the 1990s. Despite attempts at urban renewal, the Casbah remains a densely populated, overcrowded area, reflecting ongoing socio-economic challenges and its isolation from the broader urban landscape of Algiers, Despite the

significant changes that occur to it, exerting a substantial impact on the Casbah itself as it progresses through various periods, and notwithstanding the French demolition of the lower part in the post-colonial period, all urban changes occurred outside the Casbah, fostering the development of modern Algiers through expansion into previously rural areas following modern movement principles with zoning. In this instance, the casbah remained unaltered, preserving its compact urban form. (Figure 4.18).

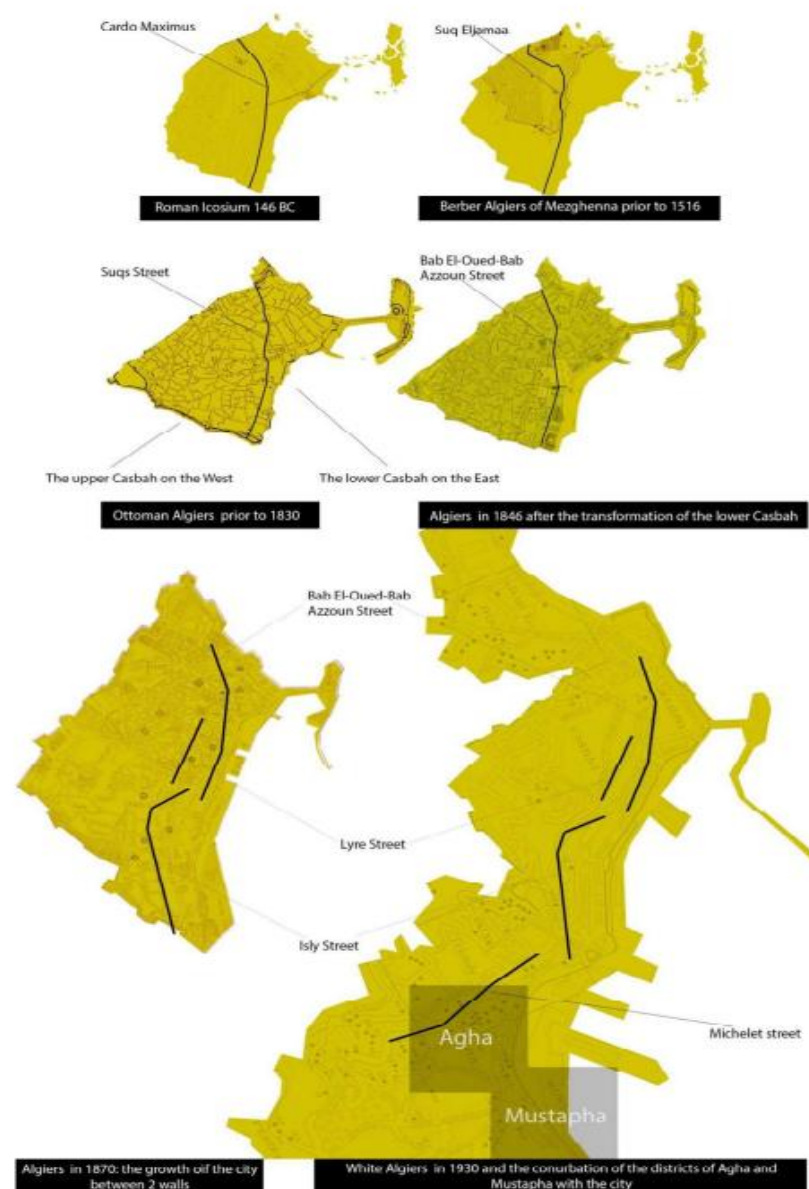


Figure 4.18: Evolution of Algiers [137]

Population Growth and Urbanization

The concept of compactness plays a crucial role in urban sustainability, serving as a primary approach to address the unsustainable nature of cities and combat urban sprawl, which is characterized by uncontrolled expansion [24]. A notable illustration of compactness in action is the Casbah of Algiers, a historic district in Algeria's capital. Despite undergoing significant changes, particularly during French colonial rule that modified its original design, the Casbah has continued to support a growing population and a high-density building. The area's inhabitants increased from 60,000 in 1969 to roughly 70,000 by 1980 (Table 4.1), almost doubling within this period. Although the number of residences is declining, population density is rising, reaching up to 4,000 inhabitants per hectare in some areas, making it one of the world's most densely populated regions [1]. In 1962, the Casbah contained approximately 1,200 traditional Ottoman-era structures. By the early 1990s, 250 of these buildings had vanished, representing a 20% reduction from the initial total (Ministry of Culture and Communication, 1992: 27). The remaining houses have largely been rented to rural families relocating to the city, further contributing to the population increase.

Table 4.1 Population density of the casbah (Wilaya of Algiers directory)

Year	Population
1969	60.000
1980	70.000
1998	50.453
2000	47.580
2002	44.707
2004	41.834
2020	40.734

Comparing the density of the casbah data on the population and population density of various communes in the Wilaya of Algiers as of December 31, 2020. Among these, the Casbah stands out with a population of 40,734 inhabitants and a remarkably high population density of 37,716 inhabitants per square kilometer (Figure 4.19).

Despite reductions in the Casbah's population density due to recent urban development initiatives, its exceptionally high concentration of inhabitants marks it as one of

Algiers' most crowded areas. This intense population density suggests a remarkably compact urban environment, potentially leading to issues related to quality of life, infrastructure capacity, and service provision. The Casbah's population density significantly surpasses that of the Wilaya, which averages 4,090 residents per square kilometer. This stark contrast underscores the Casbah's distinctive urban composition and may indicate strain on its historic layout, which was likely not intended to accommodate such many inhabitants.

► **REPARTITION DE LA POPULATION PAR COMMUNE DE LA WILAYA D'ALGER**
AU 31/12/2020:

Commune	Population estimée 2020	Densité (Hab/Km ²)	Commune	Population estimée 2020	Densité (Hab/Km ²)
ROUIBA	68 680	1 669	S. M'HAMED	75 206	34 498
REGHAIA	94 685	3 475	ALGER CENTRE	83 703	22 623
HERAOUA	30 543	2 463	EL MOURADIA	25 278	13 234
BIRTOUTA	33 879	1 254	EL MADANIA	44 656	20 579
OULED CHBEL	22 168	757	BAB EL OUED	71 725	59 277
T-E-MERDJIA	17 559	856	CASBAH	40 734	37 716
DAR EL BEIDA	88 680	2 664	O. KORRICHE	51 172	22 845
BORDJ KIFFAN	168 367	7 759	BOLOGHINE	48 571	17 598
BAB EZZOUAR	107 034	13 005	R. HAMIDOU	31 524	6 381
MOHAMADIA	69 300	8 673	BOUZAREAH	92 851	7 464
EL MARSA	13 407	3 455	B. MESSOUS	40 101	5 070
BORDJE.BAHRI	58 522	7 824	BEN AKNOUN	20 873	5 450
AIN TAYA	38 228	4 003	EL BIAR	52 446	12 854
BARAKI	128 949	4 011	DRARIA	48 911	3 494
EUCALYPTUS	128 652	4 243	DOUERA	63 157	1 540
SIDI MOUSSA	45 153	1 044	BABA HACENE	26 322	2 393
B. M. RAIS	50 243	12 107	EL ACHOUR	45 508	3 792
HYDRA	34 497	5 637	KHERAICIA	30 925	1 546
BIR KHADEM	86 149	9 691	CHERAGA	89 557	2 488
SAOULA	46 194	1 848	DELY IBRAHIM	39 036	5 057
G/CONSTANTINE	147 643	10 154	HAMMAMET	26 582	3 113
EL HARRACH	54 148	54 148	AIN BENIAN	75 739	4 734
OUED S'MAR	35 526	35 523	OULED FAYET	30 575	1 223
BACHDJERRAH	102 277	102 277	ZERALDA	57 122	1 904
BOUROUBA	79 403	79 403	SOUIDANIA	18 953	1 264
HUSSEIN DEY	45 095	45 095	STAOUELI	52 814	2 401
BELOUIZDED	48 809	48 809	MAHELMA	23 000	657
MEGHARIA	34 851	34 851	RAHMANIA	8 195	911
KOUBA	116 021	116 021	TOTAL WILAYA	3 309 896	4 090

Figure 4.19 Population density by municipality 2020 (Wilaya of Algiers directory)

The urbanization plan and urban expansion triggered various changes, resulting in a complex balance between conservation and modernization efforts, which continue to pose challenges for urban planners and preservationists in the present day. The Casbah's winding alleys, historic buildings, and lively cultural scene stand in stark contrast to the broader urban sprawl and modernization initiatives in Algiers. This stark difference not only showcases the Casbah's resilience and ability to adapt but

also emphasizes the importance of thoughtful and comprehensive urban planning that honors both historical heritage and current needs.

4.2.1.1 *Assessment of compactness*

The Casbah exemplifies urban density through its tightly packed residential areas, slim thoroughfares, and versatile use of space. This design promotes land efficiency and community interaction, which are crucial for sustainability. The condensed layout of the Casbah reduces reliance on automobiles and encourages walking. Nevertheless, contemporary challenges such as overcrowding threaten its sustainable nature. This high density might present both opportunities (for efficient service delivery) and challenges (such as overcrowding, infrastructure strain, and reduced livability).

The Casbah's compact design fostered enhanced community cohesion, with communal spaces such as public squares and rooftop terraces functioning as social centers. Furthermore, the historical heritage effectively exemplifies the concept of compactness through its high population density and architectural concentration, as well as the multifunctional utilization of space.

4.2.2 Sustainable transportation

The Casbah of Algiers, a neighborhood with deep historical and cultural roots, continues to play a crucial role in the city's transportation network, even as modern urban areas expand. Its prime location ensures it serves as a link between new developments and the city center through existing roads. The Casbah's impact on Algiers' urban layout is clear, with major routes like National Routes 11 (N11) and N41 enabling movement between the historic area and neighboring districts, effectively incorporating it into the larger urban landscape [125] (Figure 4.20).

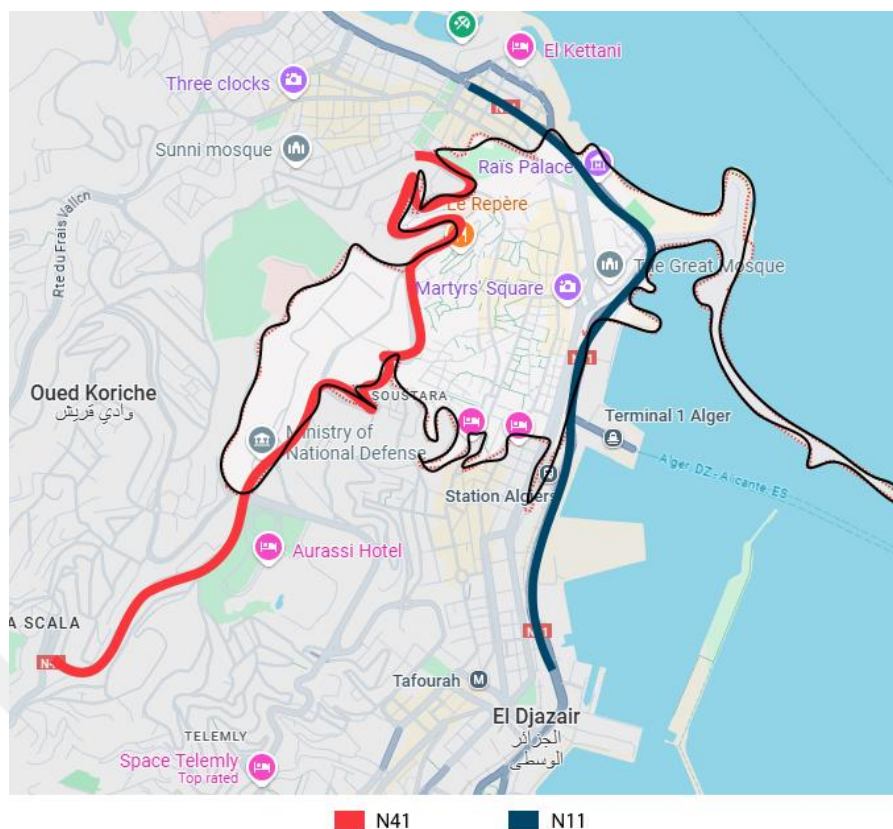


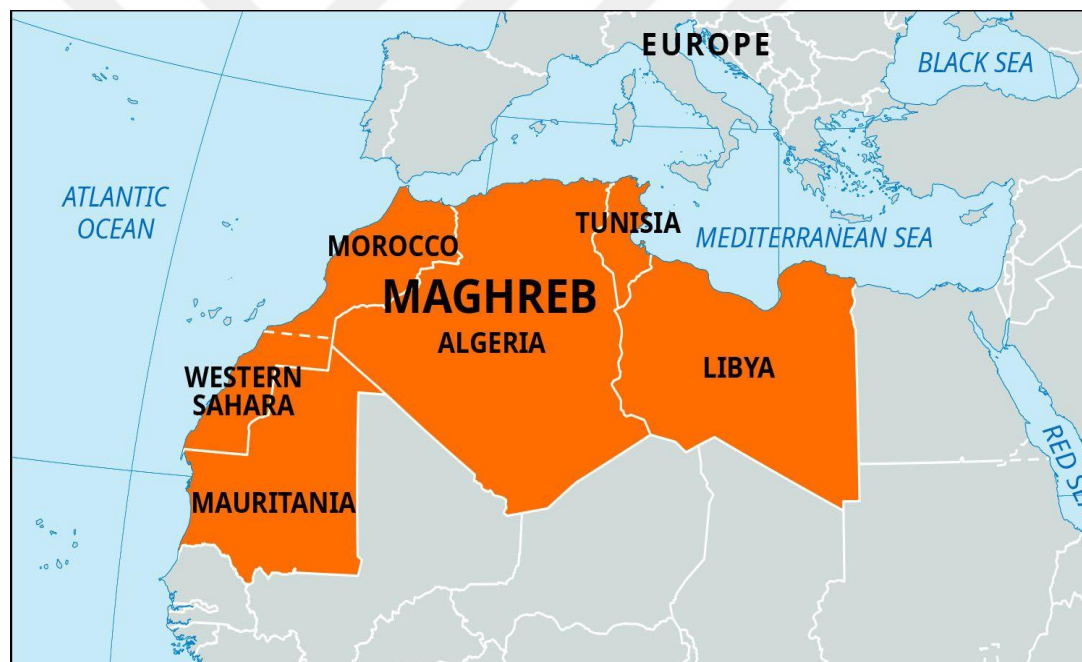
Figure 4.20 Principal roads in the casbah (Author)

An extensive review of Algeria's vehicle fleet in December 2004 reveals a diverse range of transportation options, including 481,823 cars, 57,989 commercial vehicles, and 706,713 motorcycles (Ministry of Transport, 2005). Urban transportation demand saw a notable increase, rising from 3.4 million daily trips in 1990 to 6.5 million in 2014, driven by population growth and changing travel needs [126]. In the Casbah's core, where vehicles are unable to enter, walking accounts for 56% of journeys, while motorized transport makes up the remaining 44%. Of the motorized trips, public transit constitutes 54%. The Casbah plays a vital role in the transportation system, particularly through its heavily used roads and bus services. These services are operated by various companies, including ETUSA, TRANSUB, SNTF, RATP El Djazair, SETRAM, and private entities (Table 4.2).

Table 4.2 Bus service by operator (Wilaya Transport Department 2007)

Operators	Lines numbers
ETUSA	44
TRANSUB	10
PRIVATE	145

The launch of Algiers' subway system, a first in the Maghreb region (Figure 4.21), marked a crucial development in urban mobility when it began operating in November 2011 [126]. The new metro system in the lower casbah represents a major advancement in urban transportation. This project aims to improve connectivity and accessibility in the historic district, potentially transforming daily life for residents and visitors. Integrating modern transit into the traditional urban fabric offers opportunities.

**Figure 4.21** Map of the maghreb region [148]

Initially consisting of three lines covering 56 kilometers, the system incorporates the Casbah into the broader transit network, aiming to reduce road traffic and improve connectivity. Place des Martyrs (Figure 6.14), a major transfer point, connects the Casbah to Algiers' international airport and more stations and sees significant foot traffic, with an average of 35,000 daily users between November 1, 2011, and October

31, 2012, [126] (Figure 4.22). This subway system has decreased the city's reliance on private cars and buses, easing road congestion and encouraging public transportation use.

Algiers also features a tram system, accessible via the subway, which links Place des Martyrs to other urban areas [122] (Figure 4.23).



Figure 4.22 Martyrs square and transit (Author)



Figure 4.23 Algiers Subway map [149]

The cable car (téléphérique) system further enhances urban mobility, offering both efficient and scenic transportation options [127] (Figure 4.24).



Figure 4.24 Cable car system in algiers (Author)

These systems enhance accessibility throughout the urban environment while supporting the objective of sustainable transportation. It is noteworthy that within the upper section of the casbah, pedestrian access is prioritized due to the physical impossibility of vehicular entry into this area. This prioritization extends to such an extent that even for sanitary purposes, such as waste removal, the municipality employs animal-based transportation. (Figure 4.25).



Figure 4.25 Narrow pedestrian street of the casbah (Author)

Sustainable transport is a crucial element in urban development, requiring a balance between economic growth and environmental impact. The increase in private car use has led to higher greenhouse gas (GHG) emissions, highlighting the need to reduce automobile dependence and improve walkability [125]. The Casbah's urban layout, characterized by tree-lined streets and limited car access, promotes walking, which already accounts for 56% of trips (Ministry of Transport, 2005). This design not only encourages pedestrian activity but also shortens commute distances and reduces emissions, providing environmental benefits.

Nevertheless, Algiers faces ongoing issues related to urban sprawl and growing car dependence. The city's population, now more than 3 million, has resulted in increased GHG emissions from the transportation sector. While public transit contributes 32.56% of Algeria's CO₂ emissions, Algiers' transportation-related emissions remain lower than those in more developed countries [126]. The expansion of public transit systems, such as the subway and buses, has already helped reduce congestion, and promoting the use of eco-friendly vehicles alongside developing charging infrastructure could further advance sustainability.

The Casbah of Algiers showcases a complex transportation landscape that reflects its historic urban design and modern challenges. Its pivotal role in connecting the city to surrounding regions underscores the need for an efficient and environmentally friendly transit system (Figure 4.26).



Figure 4.26 All transportation projects of algiers [142]

4.2.2.1 Assessment of sustainable transportation

The Casbah of Algiers is a complex transportation environment blending historical urban design with modern mobility needs. This UNESCO World Heritage site, with 56% pedestrian traffic, has been incorporated into Algiers' metro network, reflecting efforts toward sustainability. Increasing car use and urban sprawl challenge sustainable growth in the Casbah, a crucial urban connector (Ministry of Transport, 2005). While diverse transit options exist, balancing cultural preservation with sustainable transportation is challenging. Key issues include greenhouse gas emissions, infrastructure limits, and rising private vehicle use. A holistic strategy is needed, emphasizing walkability, enhanced public transit, and innovative solutions that respect historical importance and current mobility needs. This approach requires empirical research, community involvement, and aligned policy measures.

The Casbah exhibits sustainability in terms of transportation, primarily due to its pedestrian-oriented design. Additional infrastructure was developed to connect it with

other parts of the city, with the aim of reducing vehicular traffic. However, the presence of vehicles remains substantial, largely because of urban sprawl.

Based on the analysis, the Casbah demonstrates sustainable transportation infrastructure, with its upper section predominantly pedestrian-oriented and the lower section incorporating new transportation systems such as the metro. This approach emphasizes sustainability to a greater extent than new cities, which predominantly focus on automobile-centric design.

4.2.3 Mixed land uses

The urban morphology of Algiers, historically centered around the Casbah, has undergone significant transformations over time, resulting in a distinct bifurcation of its spatial configuration. This division is manifested in the presence of a lower area predominantly oriented toward administrative and official functions, juxtaposed with an upper residential sector that faces the Mediterranean Sea [128]. This spatial arrangement exemplifies the city's adaptation to its topographical constraints.

The Casbah's urban layout features a sophisticated system of interlinked streets that, despite appearing disorganized, represents a purposeful adjustment to the area's unique geographical characteristics [129]. This elaborate street system progresses from main roads, considered public spaces, to more secluded secondary and tertiary paths, often ending in dead-ends. This gradual shift from public to private spaces exemplifies traditional Arab urban planning principles, with a higher number of cul-de-sacs in the upper district reflecting a cultural preference for privacy [128].

The Casbah's urban design embodies mixed-use development, combining residential, commercial, and recreational spaces at a local level (Figure 4.27). This integration serves as a model for efficient land use, with low car ownership rates as a key indicator of its effectiveness. By placing essential services and amenities within walking distance of homes, this urban configuration significantly reduces car dependency. The presence of a daily market near residential areas further enhances this integration, promoting a pedestrian-friendly environment and minimizing vehicle use.

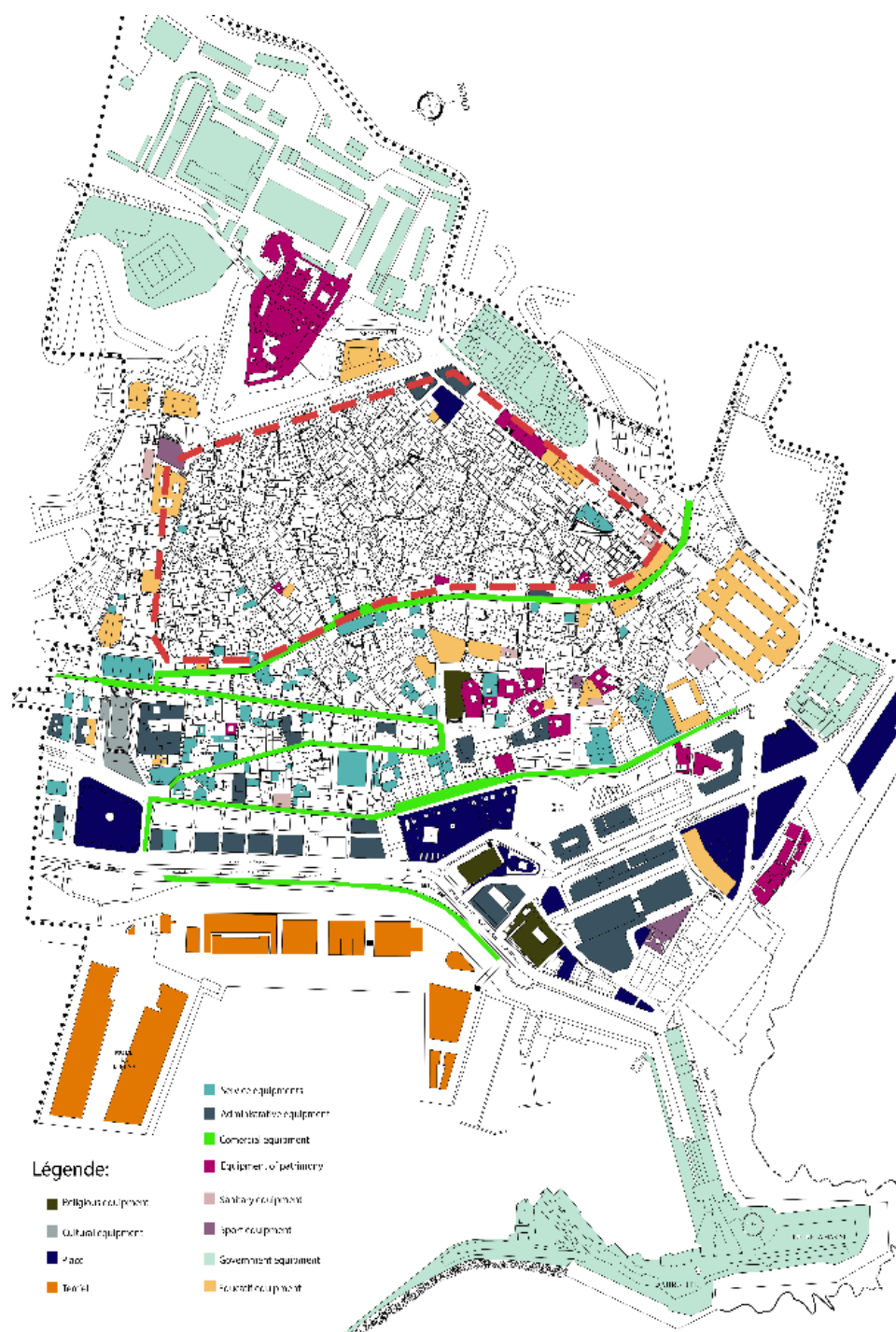


Figure 4.27: Mixed land uses of the historic casbah (Author)

Research indicates a significant correlation between travel behaviors and mixed-use developments. Regions characterized by higher density and a diverse combination of residential, commercial, workplace, and recreational facilities demonstrate increased pedestrian and cycling activities [130] as exemplified in the Casbah (Figure 4.28). This

approach has resulted in a predominance of non-motorized transportation, with 56% of daily trips conducted on foot. This pedestrian-oriented model not only establishes equilibrium between commercial and residential zones but also promotes sustainable urban development.



Figure 4.28 Commercial activity in the casbah (Author)

The prevalence of mixed-use zoning in the casbah, where civic, institutional, and commercial facilities are situated within walking distance, exemplifies an urban design strategy that prioritizes sustainable transportation, including metro, tram, train, and cable car networks. This approach complements the pedestrian-oriented environment by providing viable options for longer journeys and facilitates a synergistic relationship between diverse land uses.

4.2.3.1 Assessment of mixed land uses

The Casbah of Algiers exemplifies the advantages of integrated land use, combining housing, business, and public spaces within a dense urban layout. This approach not only promotes a walkable environment that lessens reliance on automobiles but also incorporates easily accessible public transportation options, supporting sustainable mobility patterns. The proximity of community facilities and daily markets to residential areas promotes social engagement and convenience, improving residents' overall well-being. By effectively utilizing its distinctive terrain and cultural heritage,

the Casbah stands as a noteworthy example of sustainable urban design, showcasing how mixed-use development can create well-balanced, adaptable, and habitable urban environments.

4.2.4 Social resilience and spatial organization in the Casbah

The Casbah's layout is characterized by a distinct separation between public and private domains, which shapes the distribution of activities in the area. The upper section is predominantly residential, where inhabitants socialize and relax. Shaded areas created by narrow streets and overhanging vegetation encourage continuous use throughout the day. Residents often congregate near their homes and shops to converse, while wall fountains serve as social hubs for interaction, drinking, and washing. Demolished buildings have been transformed into small soccer fields or public spaces with seating and trees, providing additional leisure options. The lack of vehicle access, due to narrow streets and staircases, increases safety, allowing children to play in the streets, though some secluded alleys remain underutilized due to darkness and confinement.

Activity mapping in the upper Casbah shows a lively mix of formal and informal interactions, including domino games, commerce, dining, and street art, which contribute to vibrant tourist entry points as answered by a group of residents. At the highest point of the Casbah, is broader and features urban furniture supporting various activities, enhancing the area's liveliness alongside eateries and artisan shops (Figure 6.32). Hanging vines, trees, and wall fountains create a pleasant microclimate, enriching social interactions. The lower Casbah, in contrast, has a more cosmopolitan feel, with local markets, mosques, and eateries contributing to its vitality. Residents engage in informal economic activities, adapting to unemployment and enhancing neighborhood vibrancy by claiming urban spaces. Observations emphasize the importance of shade in public life, as people frequently gather under trees in Martyrs' Square, while other areas remain underused (Figure 4.29).



Figure 4.29: Public life in the street of the casbah (Author)

Research conducted in the Casbah documented a variety of formal and informal activities, revealing patterns of exaptation that support both resilience and urban vibrancy (Figure 4.30). Although some areas show signs of neglect due to their historical significance and lack of upkeep, the strong community spirit among residents has led to collective beautification efforts aimed at improving the neighborhood's appearance, promoting safety, and attracting tourism to boost the local economy (Figure 4.31).



Figure 4.30 Formal and informal activities (Author)



Figure 4.31 Community engagement [150]

The strong attachment of inhabitants to their eco-friendly community drives them to utilize and adapt spaces according to their requirements. For instance, the rooftop area functions as a shared environment for women from different households, made possible by the linked nature of residences at the terrace level (Figure 4.32).

Additionally, there has been a rise in street artwork and displays on the exterior walls of homes. These walls, traditionally viewed as dividers between private and public areas, have been transformed into informal exhibition spaces.



Figure 4.32 Women using the terrace as commune place [151]

The Casbah's walls serve multiple community functions, including hosting funeral ceremonies and informal trade activities. Neighbors demonstrate unity by congregating outside the homes of bereaved families as a mark of respect. Residents often occupy streets using both fixed and portable seating, emphasizing a shared sense of ownership. The architectural significance of the Casbah is showcased in its winding, constricted alleyways bordered by homes with courtyards that epitomize Moorish architecture. Notably, some of these residences have been converted into museums and eateries, attracting tourists and promoting awareness of the city's historical and architectural legacy (Figure 4.33). Residents have been observed repurposing architectural features for social interactions, such as using urban staircases as areas for relaxation and dialogue.



Figure 4.33 Dar mustapha pacha museum (Author)

Given the Casbah's high-density urban configuration and limited open spaces, wall-mounted fountains situated at street intersections have evolved into informal social centers. These fountains, initially constructed to provide potable water, facilitate ablutions, and enable religious rituals, have transformed into small-scale public spaces that promote social interactions (Figure 4.34).



Figure 4.34 Public spaces in the casbah (Author)

4.2.4.1 Assessment

The Casbah's urban design, marked by a clear distinction between public and private areas, fosters community cohesion, flexible space use, social interaction, resilience, and dynamism, despite its historical significance and aged infrastructure. Its pedestrian-friendly environment, with narrow, winding streets shaded by overhanging plants, encourages outdoor activity and social encounters, making the neighborhood a vibrant social and cultural hub. The Casbah's strength is its ability to repurpose spaces, converting open areas into soccer fields, seating zones, and green spaces, and transforming historic buildings into museums and eateries. This adaptive reuse demonstrates residents' strong sense of ownership, creatively altering their environment to meet contemporary needs, showcasing the Casbah's resilience and capacity to evolve with its inhabitants' requirements.

The Casbah's layout facilitates a vibrant mix of societal, commercial, and artistic pursuits within a compact urban setting. Its innovative use of space, backed by a strong community, highlights Casbah's capacity to serve as an exemplary for enduring city living.

CHAPTER 5

5. CONCLUSION

5.1 Summary of Research

Sustainability, a multifaceted concept, is employed across disciplines to describe efforts aimed at ensuring a just and livable world for present and future populations. Definitions like the Brundtland Commission's highlight the need to meet current needs without compromising future generations. Sustainability includes environmental, economic, and social dimensions, addressing issues like climate change, urban expansion, and resource depletion. Urban areas, major contributors to greenhouse gas emissions, are pivotal in global sustainability efforts. Cities must adopt sustainable strategies to mitigate environmental impact, improve economic conditions, and foster social equity and cohesion, focusing on compact urban designs, green transportation, and diverse land use.

Urban sprawl, characterized by uncontrolled, low-density development, challenges sustainable urban growth by increasing land use and infrastructure costs, while contributing to environmental degradation is the main issue that needs to be tackled in the study. Heavy reliance on automobiles due to distant residences from workplaces and services exacerbates traffic congestion, pollution, and social isolation [131]. Urban sprawl disrupts ecosystems, reduces green spaces, and leads to inefficient land use, complicating urban management and sustainability. Socially, it creates isolated communities that hinder interpersonal connections and segregate neighborhoods economically, increasing social disparities [32]. Economically, urban sprawl raises costs for maintaining public infrastructure, utilities, and services over large areas, straining city budgets and weakening urban core vitality.

The Algiers case study, particularly its historic Casbah, illustrates how sustainable urban design can reconcile heritage preservation with contemporary requirements. Despite experiencing deterioration and uncontrolled growth, the Casbah maintains essential characteristics of density, walkability, and diverse land uses that align with

sustainable urban development principles, while also exemplifying a socially sustainable urban neighborhood.

This study examines the sustainability of Algiers' historic Casbah, focusing on its social aspects and compatibility with sustainable urban models. The research explores how Casbah's features, including its compact layout, eco-friendly transportation, diverse land use, and adaptability, could exemplify a socially sustainable urban neighborhood. By examining these elements, the study aims to showcase how traditional urban designs can positively impact sustainability efforts.

The research methodology employs qualitative analysis to thoroughly evaluate Casbah's urban structure and its sustainability implications. This approach incorporates extensive interviews with community stakeholders, literature surveys, and case study examinations, offering insights into the Casbah's dynamics as a living urban environment.

The Casbah serves as a compelling case study, highlighting the convergence of heritage conservation and modern sustainability within a densely populated urban setting. The results indicate that the Casbah's distinctive qualities not only address urban sprawl challenges but also enhance social unity and maintain cultural identity. By investigating the relationship between the Casbah's physical design and its inhabitants' social interactions, the study contributes to a broader understanding of implementing sustainable strategies in historic urban contexts.

5.2 Major Findings

The findings from the Casbah case study contribute valuable insights into sustainable urban development, particularly in mitigating urban sprawl and fostering socially inclusive environments. The primary concepts for analysis are compactness, sustainable transportation, mixed land uses, and resilience, viewed from the perspective of core design concepts related to sustainable urban forms. The first principle relates to the Casbah's density, evident in its crowded living areas, narrow thoroughfares, and multipurpose spaces. This layout optimizes land use and encourages social interaction, key elements of sustainability. The condensed design reduces car dependency, promoting walking. However, increasing population density and aging infrastructure challenge its sustainability. At the end, the Casbah's compact

design enhanced community cohesion, with public squares and rooftop terraces serving as social hubs. Its historical heritage exemplifies compactness through high population density, architectural concentration, and multifunctional space usage.

The second principle concerns Sustainable Transportation. The Casbah of Algiers highlights a fusion of traditional urban design and modern transit needs. With most trips made on foot and metro connectivity, the area has potential for sustainable transit. However, growing car use and urban expansion due to urban sprawl threaten this progress. While the Casbah's central position in Algiers' transport network is advantageous, it also exposes the area to increasing traffic and pollution. The casbah's is sustainable in transportation due to its pedestrian-centric design. Infrastructure was added to connect it with other city areas to reduce vehicle use.

The third principle involves Mixed Land Use. The Casbah's urban layout demonstrates a seamless blend of residential, commercial, and leisure spaces. This mixed-use development reduces the need for long commutes and improves walkability, contributing to a sustainable urban environment. Vital services are within walking distance, complemented by public transportation. The district's mixed land use enables shorter travel times, less traffic congestion, and a pedestrian-oriented atmosphere. However, enhancements are needed, particularly in expanding pedestrian and cycling infrastructure and addressing congestion in certain areas. The key takeaway is that the casbah demonstrates sustainability through its efficient combination of living spaces, business areas, and leisure facilities, maximizing the use of available land. This sustainable design is further enhanced by a walkable internal transportation system, complemented by a metro network, which together promotes eco-friendly mobility within the casbah.

The fourth principle is Resilience. The Casbah's layout promotes community interaction and flexibility. Its narrow, shaded walkways and pedestrian-centric design facilitate social connections and support informal economic activities. The neighborhood's capacity to repurpose architectural elements and open areas, including transforming neglected spaces into public venues and museums, showcases its adaptability. The upper section of the Casbah is predominantly residential, while the lower part is more commercial, creating a multifaceted social environment. The community's initiatives to preserve and rejuvenate the area demonstrate Casbah's

potential as an exemplary of sustainable urban living. By tackling these challenges, the Casbah can continue to flourish as a socially sustainable and dynamic community.

5.3 Implications

Its compact layout and diverse land usage promote efficient space utilization and minimize the need for extensive travel, enhancing walkability and fostering a pedestrian-friendly atmosphere. The district's design encourages foot traffic, and its connection to public transit systems such as the metro demonstrates potential for sustainable transportation. Moreover, Casbah's spatial arrangement facilitates community interaction and adaptability, with the capacity to repurpose areas and sustain social connections through its narrow streets and public squares, underscoring its resilience. The casbah, at its core, is a compact urban area reflects various concepts of urban forms to a significant extent.

A set of sustainable strategies inspired by the Casbah's design principles can foster a more connected and sustainable urban environment. Increasing density through updated zoning laws that support multi-story, mixed-use buildings in suburban areas near transit hubs, allowing for residential, commercial, and recreational spaces in the same buildings, can replicate the Casbah's compact design, reducing automobile dependency by bringing residential, commercial, and recreational spaces into closer proximity. Expanding pedestrian and bicycle infrastructure, commencing with areas experiencing the highest traffic congestion and expanding as pedestrian demand increases, will further enhance this effect by encouraging non-motorized travel and reducing pollution, in alignment with the walkable layout of the Casbah. Introducing small grants for businesses that create accessible pathways to these zones will additionally support this objective.

A well-integrated public transit network, with transport hubs that combine metro, bus, and tram services in suburban areas, starting with metro-adjacent suburbs, offering seamless transit to urban centers and frequent feeder buses or shuttles to reach surrounding residential areas, can support reduced vehicle reliance, emulating the Casbah's pedestrian-centric environment. Additionally, encouraging mixed-use development through tax credits or reduced land prices can promote the creation of neighborhoods where essential services are within walking distance by launching pilot

programs in newly developing neighborhoods to test the viability and appeal, adjusting incentives based on resident feedback, mirroring the Casbah's balance between commercial and residential spaces. Community-centered adaptive spaces that can serve multiple purposes, such as markets and recreational areas, will enhance social connections and economic activity, reflecting the Casbah's communal hubs. Consultation with local communities to prioritize their specific needs for adaptive spaces and select areas that encourage foot traffic is essential. Finally, preserving cultural identity through design that incorporates Algerian architectural elements in new developments, partnering with local architects and historians to incorporate design elements such as shaded pathways, courtyards, and local materials in new developments, will foster community pride and maintain continuity with Algiers' heritage, connecting newer suburban areas to the city's cultural roots.

Collectively, these measures leverage the sustainable design features of the Casbah to mitigate urban sprawl, promoting a sustainable and cohesive urban fabric for Algiers.

5.4 Limitations of The Study

Several limitations restrict the research's reach and applicability. Data collection challenges in the Casbah and the lack of comprehensive metrics for certain sustainability indicators limit the depth of the analysis. These limitations underscore the need for caution when applying Casbah's findings to contemporary urban settings without appropriate modifications.

5.5 Future Research Directions

Additional studies could build upon this research by examining comparable historic urban districts to identify universally applicable sustainability approaches grounded in traditional urban planning. Comparative analyses might reveal how dense, culturally significant designs can be modified for emerging or expanding urban centers, especially in rapidly growing cities. Exploring community-led resilience tactics in modern contexts could also enhance our understanding of integrating social sustainability into urban planning. This line of inquiry would contribute to the creation of sustainable, inclusive, and culturally sensitive urban spaces, drawing inspiration from the lasting principles exemplified by the Casbah

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