THE 'GREEN' DIMENSION OF THE 15-MINUTE CITY. THE CASE STUDY OF ATHENS MUNICIPALITY, GREECE

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Geronta Eirini Chrysovalanto
Senior Student, Department of Architecture, University of Patras, Greece
eirinigeronta@gmail.com

Abstract
Urban areas are not only major contributors to the climate change crisis but are also among the most vulnerable to its impacts. Urban planning is increasingly focused on adopting more sustainable strategies, enhancing green infrastructure, and boosting energy efficiency. Among these innovative approaches is the concept of the "15-minute city".

The present research explores the 15-minute city concept, emphasizing the significance of green spaces within its framework. Athens is chosen as a case study to assess the distribution of green spaces following the 15-minute city model. By mapping these green areas and generating 15-minute walk isochrone maps, it aims to evaluate the sufficiency of public open spaces in central Athens. The approach considers several criteria, such as building density, the size and type of green spaces, and their accessibility to residents.

The Athens core features some notable green spaces due to its hills and archeological sites, however, the availability of green areas significantly diminishes in the dense urban fabric. The rapid, uncoordinated development and insufficient urban planning in Athens have led to dense urbanization with limited green spaces, making it one of the most densely populated cities in Europe, with one of the lowest ratios of green space per capita.

First, the research paper reviews international literature on chrono-urbanism, focusing on 15-minute cities. Then, tools used included data mapping software and building zone data from the Athens Municipality. A total of 170 green and public open spaces were recorded and categorized into the following typologies: squares, parks, gardens, hills, groves, and archaeological sites. Findings show that green spaces vary within a 15-minute walk radius, with squares dominating.

Further applications of the developed methodology could include urban areas of similar densities and development patterns to identify inequalities in the distribution of green spaces and for the state to create new ones.

Key words: *Chrono-Urbanism, 15-Minute City, Isochrones, Green Spaces, Athens*

Introduction

Climate change is one of the greatest challenges of our time and cities play a crucial role in addressing it. They are home to over half of the global population, generate 80% of global GDP, consume two-thirds of the world's energy, and account for more than 70% of annual carbon emissions. These figures are expected to rise significantly in the coming decades, with estimates suggesting that by 2050, over 70% of the world's population will live in cities, leading to a sharp increase in energy demand and infrastructure needs (G20, 2023). To reduce their environmental impact, cities must implement smart urban planning solutions that enhance sustainability and resilience (Ramirez Lopez & Grijalba Castro, 2020). One such approach is the 15-minute city model.

This concept, reintroduced in 2016 by Franco-Colombian urban planner Carlos Moreno, envisions an urban design where residents can access essential services and infrastructure within a 15-minute walk, bike ride, or other forms of active mobility. This model reduces dependence on motorized transport, minimizes cities' environmental impact, and enhances quality of life (Allam et al., 2024).

This research examines the application of the 15-minute city model in the Municipality of Athens, with a particular focus on green spaces, which are a key component of sustainable urban development (WHO Regional Office for Europe, 2023). The research aims to explore the distribution and adequacy of green spaces in the city within the framework of this urban model. To achieve this, mapping techniques were applied, and isochrone maps were created to depict 15-minute walking accessibility zones. Additionally, the relationship between green spaces and building density was analyzed to assess Athens' alignment with the principles of the 15-minute city.

The research methodology follows a case study approach, involving the mapping of all public open spaces in the Municipality of Athens. Geographic Information Systems (GIS) tools, such as Quantum GIS (QGIS) and the Iso4App API, were utilized, along with online mapping platforms like Google Maps and Google Earth. Furthermore, data from the digital services of the Municipality of Athens, including the e-POLEODOMIA information database, were used to map the different Floor Area Ratios (FAR). The findings were analyzed using Microsoft Excel, while green spaces were digitally represented at a 1:1 scale in AutoCAD to accurately calculate their area and percentage relative to the total urban space.

This research paper seeks to contribute to the discourse on sustainable urban development by highlighting the significance of green spaces in the Municipality of Athens. Through cartographic analysis, it aims to evaluate the extent to which Athens meets the criteria of the 15-minute city model and to identify challenges and opportunities for designing a more sustainable and resilient urban environment.Through this analysis, the research develops a tool that can be utilized to identify, map, and assess the distribution of green spaces across Athens. This tool offers valuable insights into the city's current urban structure and serves as a foundation for planning future improvements.

Chrono - Urbanism

The term Chrono-Urbanism refers to a comprehensive approach that explores the benefits cities offer to their inhabitants in relation to the use of their lifetime. The legacy of Fordism, which established a lifestyle based on a highly specialized production model and produced spatially fragmented urban environments, has led to the loss of valuable and meaningful time from people's daily lives (Moreno, 2020). Chrono-Urbanism, as a form of urban planning, designs urban spaces based on time and distance, analyzing the relationship between temporal factors and spatial organization. It focuses on structuring key urban components such as circulation, transport, and land use across different time frames, adapting them to people's evolving needs. Chrono-urbanist approaches aim to challenge traditional urban design principles by shifting away from car-oriented planning, which often leads to dysfunctional cities that restrict social interactions and undermine urban sustainability (Allam et al., 2022).

Comparable urban design models such as the Green City and the Walkable City share common planning principles but often lack the realism and immediacy demonstrated by cities that have embraced chrono-urbanist strategies. These approaches became particularly relevant in the aftermath of the COVID-19 pandemic, when societies faced new urban realities, and the ability to meet basic needs quickly and efficiently became a critical necessity. This context gave rise to models such as the 10, 15, and 20-minute cities, with the 15-minute city becoming the most widely recognized and frequently referenced in international literature,

often referred to as either the 15-minute city or the 15-minute neighborhood (Moreno et al., 2021).

15–Minute City

The concept of the 15-minute city began with American urban planner Clarence Perry in 1929, who developed the idea of neighborhood units. This urban planning concept promotes walkability in cities by designing self-sufficient neighborhoods, as urban areas became industrialized. These units included cores such as schools, shops, and community centers, while the plan also included a road network, green spaces, and housing (Perry, 1929).

The concept of the neighborhood, as proposed by Perry, was adapted to address the issues of low density and uncontrolled urban development in the 1960s through the "New Urbanism" movement, focusing on the creation of cohesive communities through spatial organization (Kafkalas et al., 2015). According to this approach, the neighborhood is a small, clearly defined unit with a central point, allowing residents easy access to daily services. This idea was applied in urban development strategies such as "Transit Villages,""Urban Villages," and "Traditional Neighborhood Design." These approaches aim to create dense, mixed-use, sustainable, walkable, and well-connected urban environments (Pozoukidou & Chatziyiannaki, 2021).

The idea of the 15-minute city was revived in 2016 by Carlos Moreno, a French - Colombian urban planner andassociate professor at IAE Paris Sorbonne - Université Paris 1 Panthéon Sorbonne in France and gained significant attention after the COVID-19 pandemic (Moreno et al., 2021). It is a concept of urban planning in which small, self-sufficient communities are created, allowing residents to meet all their basic needs within a 15-minute walk, bike ride, or other forms of active mobility. These needs include work, education, shopping, entertainment, healthcare, access to parks and green spaces, as well as transportation networks (Moreno, 2021). This approach supports human-centered urban design, where social, cultural, and health-related needs are accessible and easily met (Pozoukidou & Angelidou, 2022).

The 15-minute city incorporates the concept of the “human scale,” providing a modern interpretation of the ideal city, focusing on health and environmental risks reduction. Time is no longer simply the twin concept of “space” but becomes a factor that influences the city’s climate and health outcomes (Abdelfattah et al., 2022). The core of this concept is direct and easy access to all essential urban functions. The design of 15-minute cities prioritizes the reorganization of urban functions to ensure easy access to amenities and services for residents.

Ultimately, this approach envisions the creation of small “neighborhoods” where residents can meet all their needs within 15 minutes, whether on foot, by bike, or through active mobility. The strict zoning in urban planning is eliminated, and mixed-use spaces are created, reducing unnecessary movement and strengthening the sense of community. The goal is to improve the quality of life and enhance community cohesion. In modern cities, areas are often segregated and used primarily for specific purposes, such as businesses or entertainment, which forces residents to travel long distances to reach their destinations. With this new approach, cars no longer play a dominant role in city planning and mobility, as more pedestrian paths and bike lanes are created. The core of this new approach is the individual and the need for a more sustainable and healthier urban environment (Allam et al., 2022).

The Functional Analysis of 15-Minute Cities

The 15-minute city or 15-minute neighborhood aims to reconnect people with their neighborhoods by promoting a new approach to urban living. In terms of urban design, the

15-minute cities are based on principles that have been used as design cornerstones in the past, such as accessibility, walkability, density, land-use mix, and design diversity. Their main difference is that they focus on bringing activities into the neighborhoods, rather than moving people to activities, thereby reintroducing the concept of proximity-based urban design (Pozoukidou & Chatziyiannaki, 2021).

In a later model, the concept of the 15-minute city is expanded to include four key principles that characterize the city of the future. The first principle is proximity, which refers to the short distances between different destinations, allowing easy and quick access. The second principle is density, which signifies high population concentration, enabling the support of various businesses and services. The third principle is diversity, which refers to the variety of urban amenities and design, ensuring that all residents' needs are met locally. Finally, the principle of ubiquity (digitalization) ensures that the city is accessible and affordable to everyone, allowing anyone to reside in it (Allam et al., 2022).

Definition of Green Spaces

There is no single definition of green spaces, as their meaning varies depending on the environment and their use. According to the World Health Organization (WHO Regional Office for Europe, 2016), green spaces are defined as "all urban areas covered with any type of vegetation." This includes parks, gardens, street trees, green areas around buildings, sports fields, flower beds, ponds, green roofs, and individual plants.

Additionally, urban green spaces encompass both natural surfaces and various types of urban greenery, such as tree-lined streets. The concept also extends to so-called "blue spaces", which include water elements such as lakes, rivers, and coastal zones. The most common types of green spaces include public parks, private and public gardens, forests, playgrounds, riverbanks, trails, and beaches (WHO Regional Office for Europe, 2016).

Categories of Green Spaces

Green spaces can be divided into two main categories, which also serve as different interpretations of the concept. The first category refers to natural landscapes that include bodies of water or areas with vegetation, such as forests, wilderness areas, geological formations, agricultural land, coastal zones, and food cultivation areas. This interpretation of green space could be considered synonymous with nature and opposed to urbanization. The second category represents urban vegetation, including parks, gardens, courtyards, and urban forests. This understanding of green space can be seen as a subset of the broader concept, as it is limited to the urban environment and is a part of open space. It also reflects the dominant role of green spaces within cities and the inevitable human influence on them (Taylor & Hochuli, 2017).

The first category can be classified as natural green spaces, which include forests, beaches, and natural parks. In contrast, the second category consists of human-made green spaces, such as agricultural areas, archaeological sites, public flower beds, public gardens, urban parks, and squares.

The Contribution of Green Spaces

The contribution of green spaces to urban environments is significant, as they intersect multiple aspects of city life, including environmental, social, health, cultural and economic dimensions. Their role extends far beyond aesthetics, influencing various sectors that contribute to the overall well-being and sustainability of urban communities.

Green spaces play a crucial role in shaping the urban environment, offering a dynamic balance between nature and the built environment. By integrating into the urban fabric, they break the monotony of constructed surroundings, providing aesthetic, ecological, and social benefits that enhance the city's sustainability. In addition to their visual appeal, green spaces serve as essential connectors that influence mobility, accessibility, and transport networks, helping create a more functional, inclusive, and human-friendly urban system (Crăciun, 2014).

Beyond their structural role in urban planning, green spaces are also among the most valuable natural resources in cities. Due to issues such as climate change, global warming, and environmental pollution in urban areas, the importance of these spaces has significantly increased, as they help reduce heat and air pollution. The discussion about sustainable development and the well-being of cities has become crucial in recent decades, aiming to achieve sustainable development goals. Therefore, urban green spaces play a central role in the sustainable development of cities. Proper care and improvement of these spaces make cities more pleasant and sustainable, contributing to the enhancement of quality of life and public health in urban areas (Aram, 2024).

Regarding the social contribution of green spaces, they play a crucial role in urban environments, whether independent or combined with other public areas. These spaces create opportunities for social interactions, recreation, and relaxation, fostering stronger connections between residents. By offering a place for people to meet and engage, green spaces encourage community building and promote inclusivity. They also contribute to improving both physical and mental health by reducing stress and promoting physical activity. When managed properly, green spaces enhance social cohesion, improve the overall quality of life, and make cities more livable and sustainable for their inhabitants (Aram et al., 2019).

Regarding the benefits of green spaces for health, they significantly contribute to improving both physical and mental well-being. The modern urban lifestyle is associated with increased stress, reduced physical activity, and exposure to harmful environmental factors. Urban green spaces, such as parks, playgrounds, and green neighborhoods, provide a natural environment that enhances relaxation, reduces stress, promotes social interaction, and encourages physical activity. At the same time, they help reduce residents' exposure to air pollutants, noise, and excessive heat, thus improving the overall quality of life in cities (WHO Regional Office for Europe, 2016).

An equally important aspect is that green spaces play a significant role in the cultural development of a community, as they serve as venues for cultural activities such as festivals, concerts, theatrical performances, and art exhibitions. Through these activities, environmental awareness is promoted, and sustainable development is reinforced, making these spaces hubs of cultural expression and social interaction.

The economic contribution of green spaces is linked to the financial and economic benefits that arise directly from their presence. These include enhancing the image of an area, increasing tourism, and attracting foreign investments. Additionally, green spaces have a positive impact on property values in the surrounding area (Juaneé Cilliers, 2015).

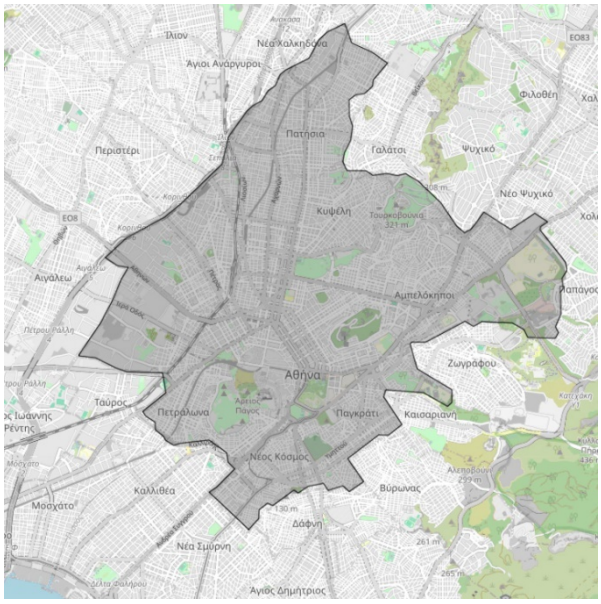
In conclusion, green spaces and public open spaces provide a wide range of benefits that extend beyond their aesthetic and recreational value. They play a crucial role in enhancing the quality of life and well-being of individuals by promoting physical and mental health, fostering social interactions, and creating opportunities for cultural and community activities. Additionally, they contribute significantly to economic growth by increasing property values, attracting tourism, and encouraging investment. At the same time, they serve as vital components of environmental sustainability, supporting biodiversity, improving air quality, and mitigating the effects of climate change. Their multifaceted impact highlights their essential role in shaping healthier, more resilient, and more sustainable urban environments.

Case Study: Municipality of Athens

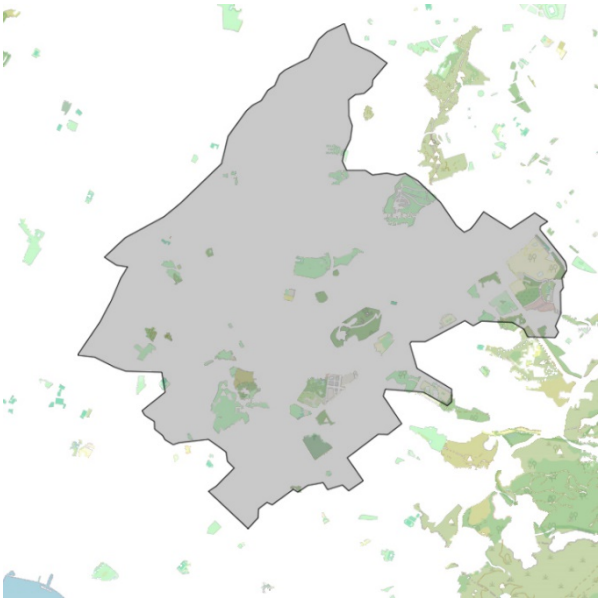
The case study focuses on the Municipality of Athens, located in the Attica region, covering an area of 38.96 km² with a permanent population of 637.798 residents and an elevation of 90 meters (Hellenic Statistical Authority, 2021).

For this study, isochrone maps were created to cover the entire Municipality of Athens, resulting in a total of 12 maps. These maps depict the areas that are accessible within a 15-minute walk from their center, considering factors such as changes in the route, inclines, declines, and obstacles. The analysis assumes a walking speed of 5.4 kilometers per hour, and the final result is represented by a polygon that defines the areas covered within the 15-minute walking distance.

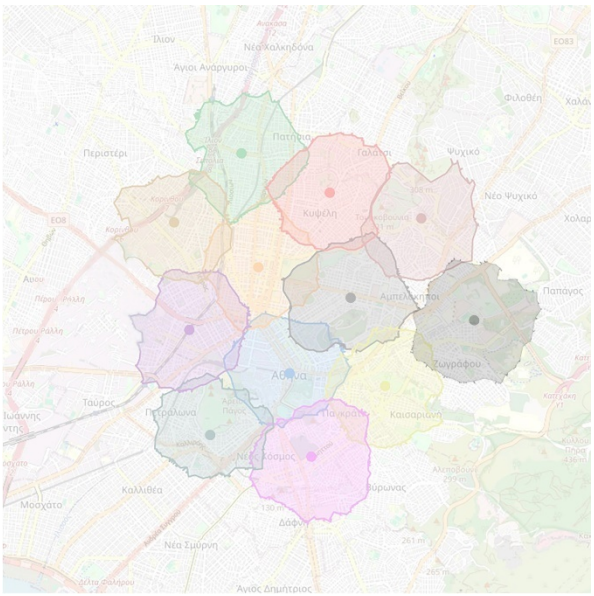
Map 1: The Outline of Athens Municipality



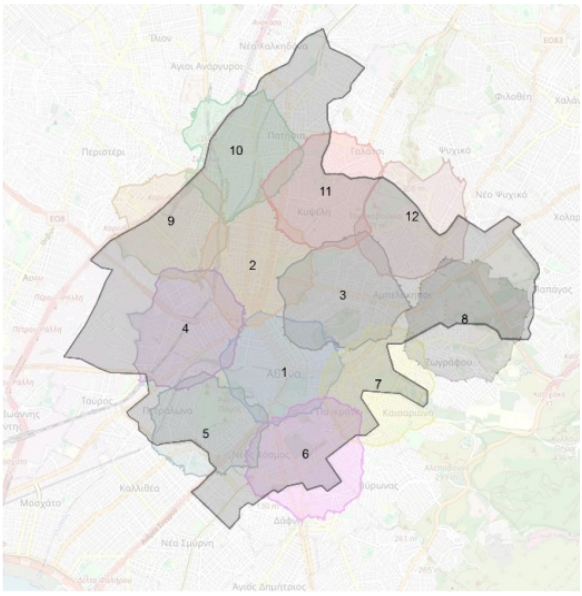
Map 2: The main Green Spaces in Athens Municipality



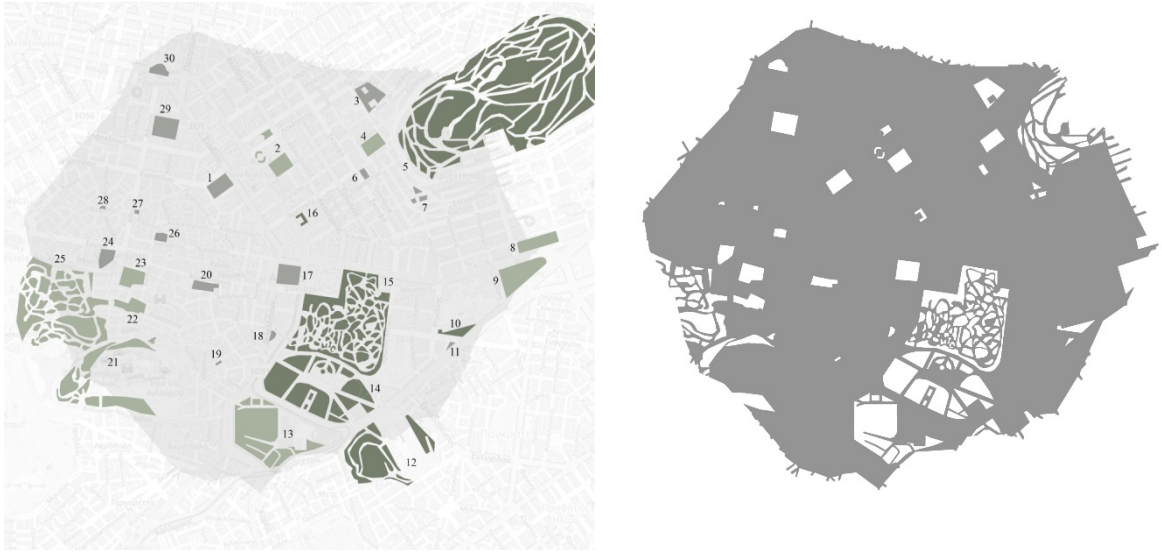
Map 3: The 12 Isochrone Maps



Map 4: The 12 Isochrone Maps within Athens Municipality



Map 5: National Garden Area (Isochrone 1), 30 Green Spaces 21,5%



Map 6: Pedion Areos Area (Isochrone 2), 14 Green Spaces 8,6%

Map 7: Lycabettus Hill Area (Isochrone 3), 16 Green Spaces 21,9%

Map 8: Thissio Area (Isochrone 4), 16 Green Spaces 3,9%

Map 9: Philopappou Hill Area (Isochrone 5), 15 Green Spaces 22,2%

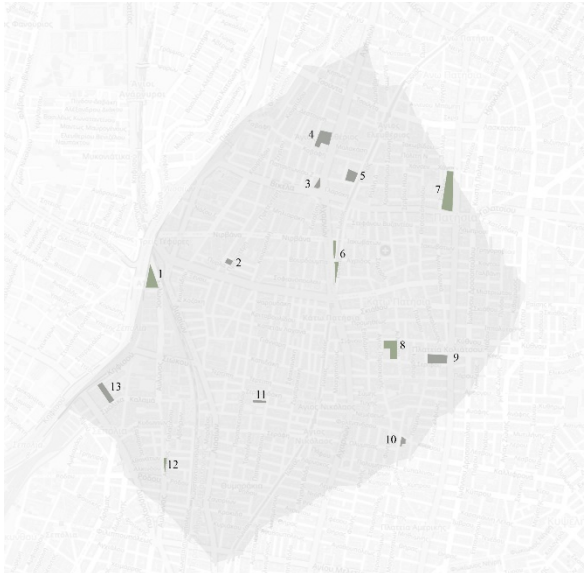
Map 10: Adritos Hill Area (Isochrone 6), 17 Green Spaces 5,4%

Map 11: Ilisia Area (Isochrone 7), 18 Green Spaces 12,4%

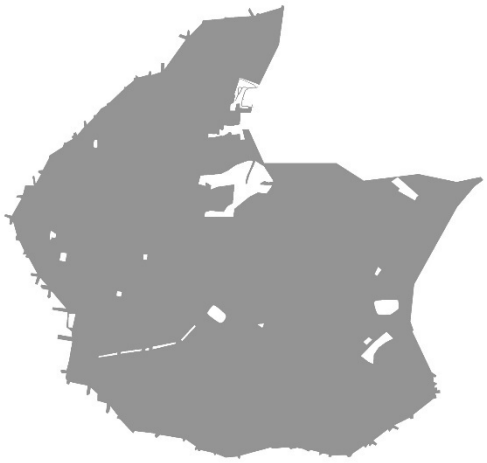
Map 12: Zografou Area (Isochrone 8), 11 Green Spaces 22,2%

Map 13: Plato's Academy Area, (Isochrone 9) 10 Green Spaces 3,6%

Map 14: Kato Patissia Area (Isochrone 10), 13 Green Spaces 1,1%



Map 15: Polygono Grove Area (Isochrone 11), 14 Green Spaces 3,5%

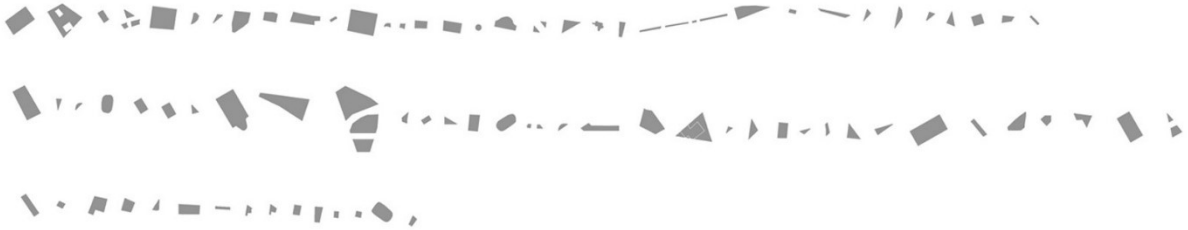


Map 16: Attic Grove Area (Isochrone 12), 14 Green Spaces 15,2%

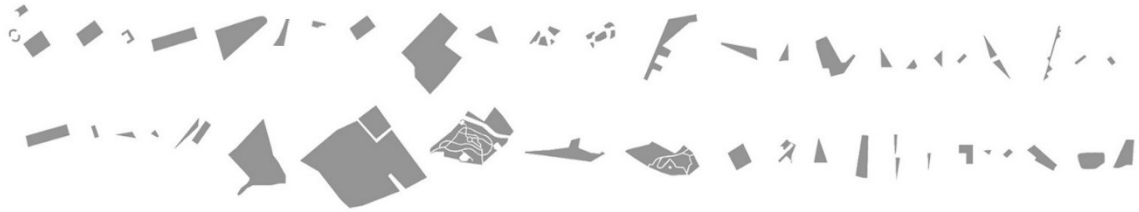
A total of 170 green and public open spaces were recorded and categorized into the following typologies: squares, parks, gardens, hills, groves, and archaeological sites.

List 1: Green and Public Open Spaces

Squares



Parks



Gardens

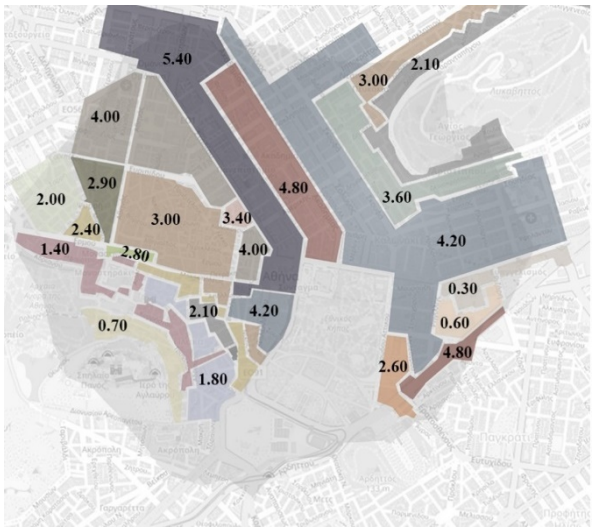
Hills

Groves

Archeological Sites

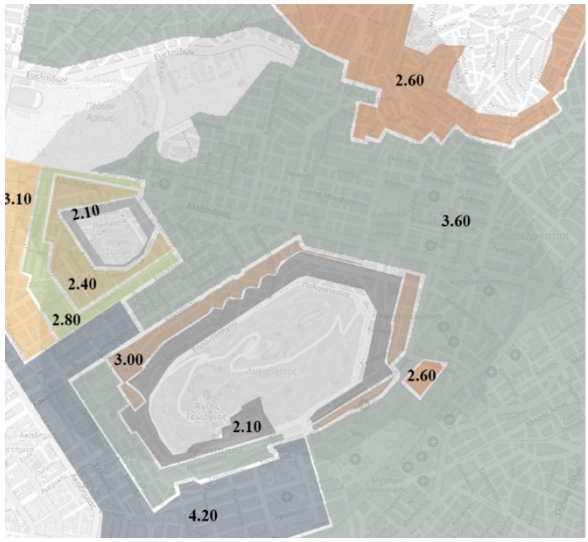
The research continued with the recording of all different Floor Area Ratios through the e-Poliodomia platform for each isochrone map separately. A different color was used for each Floor Area Ratio (FAR).

Map 17: Isochrone 1, FAR: 0,3 – 5,4

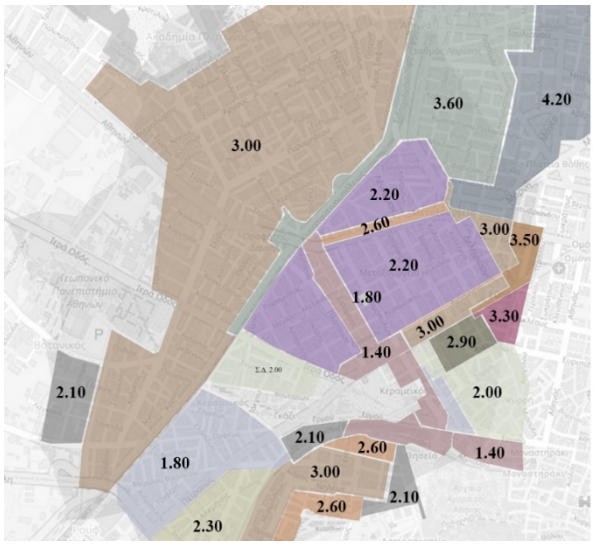


Map 18: Isochrone 2, FAR: 2,1 – 5,4

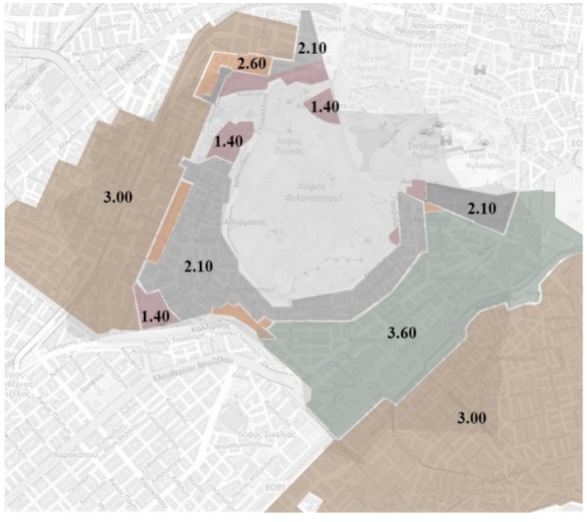
Map 19: Isochrone 3, FAR: 2,1 – 4,2



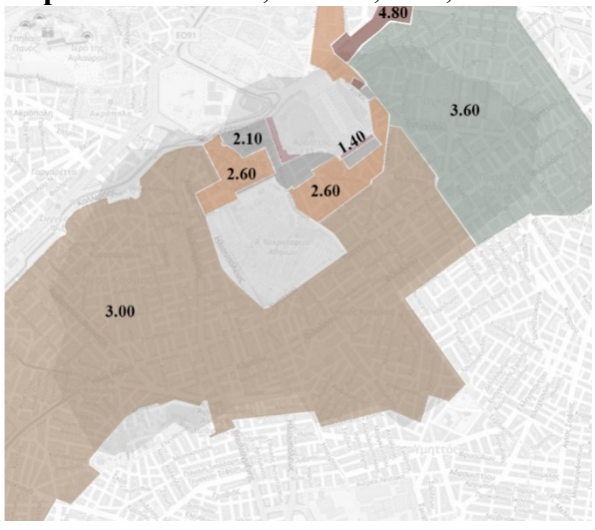
Map 20: Isochrone 4, FAR: 1,4 – 4,2



Map 21: Isochrone 5, FAR: 1,4 – 3,6



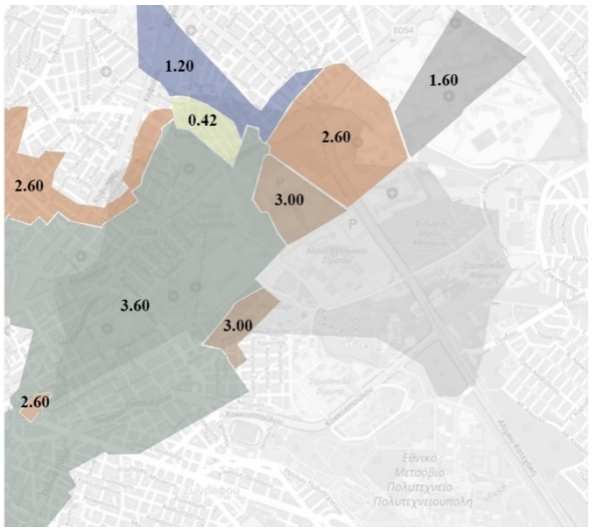
Map 22: Isochrone 6, FAR: 1,4 – 4,8



Some maps present a wider range of Floor Area Ratio (FAR), while others do not. The overall range found across all 12 isochrones is large, varying between 0.3 and 5.4.

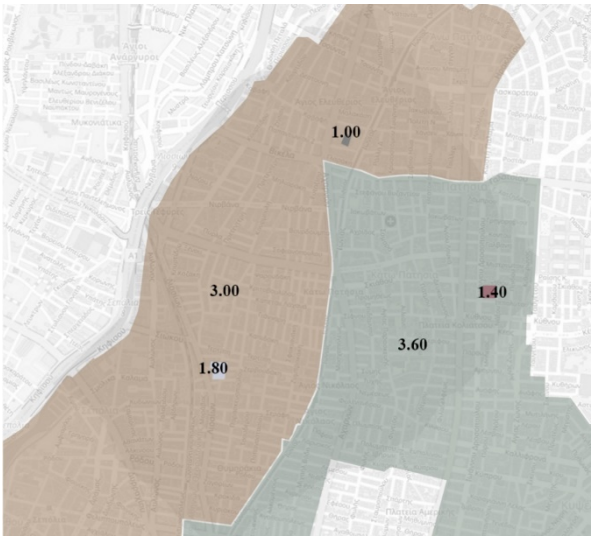
Map 23: Isochrone 7, FAR: 0,3 – 4,8

Map 24: Isochrone 8, FAR: 0,42 –3,6

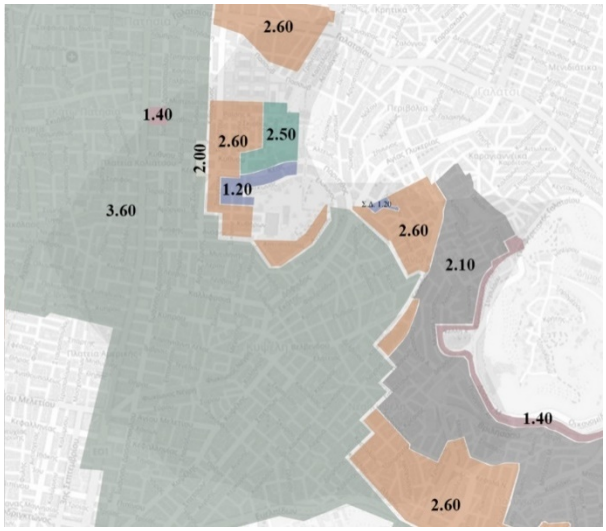


Map 25: Isochrone 9, FAR: 1,4 – 3,0

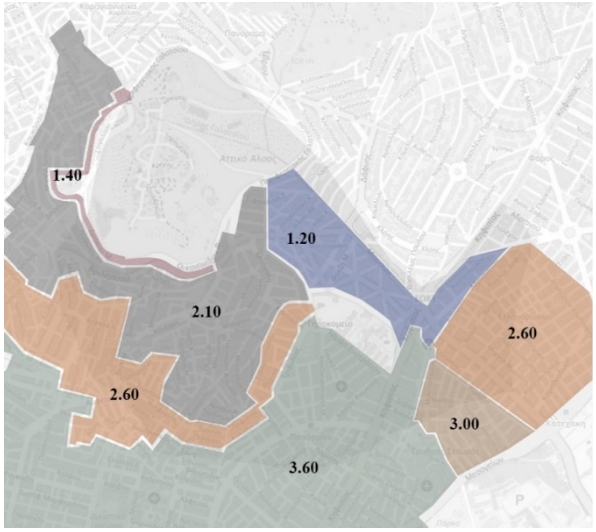
Map 26: Isochrone 10, FAR: 1,0 – 3,6



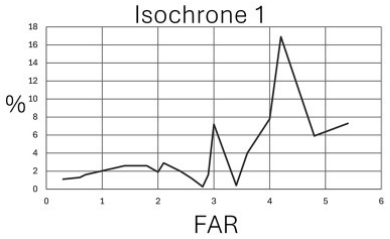
Map 27: Isochrone 11, FAR: 1,2 – 3,6



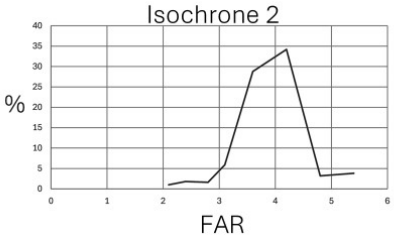
Map 28: Isochrone 12, FAR: 1,2 – 3,6



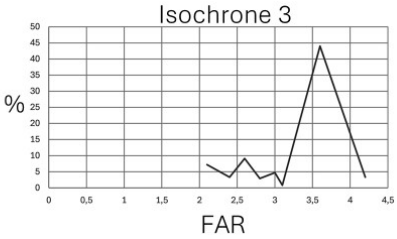
A recording of all different Floor Area Ratios was conducted and the percentage of area for each one was calculated in each isochrone map separately. The results were presented in graphs, clearly showing the sharp variations and the wide range. The horizontal axis represents the FAR, while the vertical axis indicates its percentage of occurrence. The numbering of the diagrams corresponds to the order of presentation of the above maps.



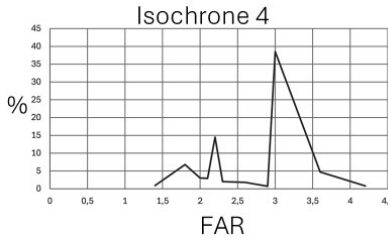
1. Green space: 21.5%. The prevailing floor area ratio is 4.2 with a percentage of 16.9%.



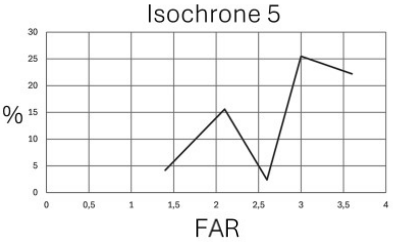
2.Green space: 8.6%. The prevailing floor area ratio is 4.2 with a percentage of 34.2%.



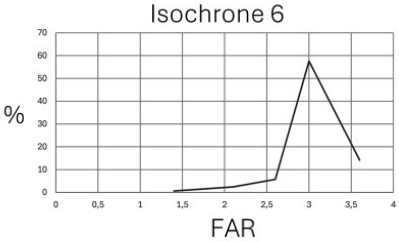
3.Green space: 21.9%. The prevailing floor area ratio is 3.6 with a percentage of 44%.



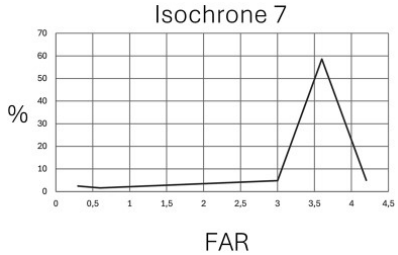
4.Green space: 3.9%. The prevailing floor area ratio is 3 with a percentage of 38.5%.



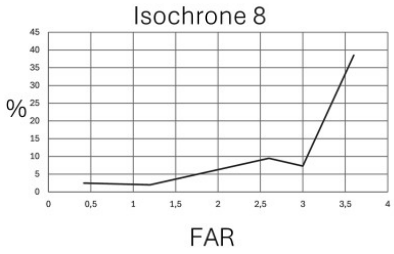
5.Green space: 22.2%. The prevailing floor area ratio is 3 with a percentage of 25.5%.



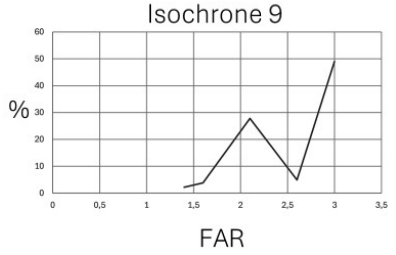
6.Green space: 5.4%. The prevailing floor area ratio is 3 with a percentage of 57.6%.



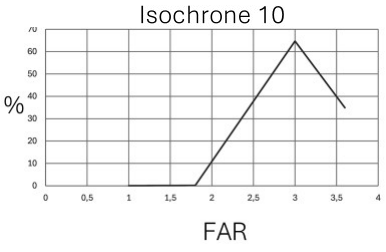
7.Green space: 12.4%. The prevailing floor area ratio is 3.6 with a percentage of 58.6%.



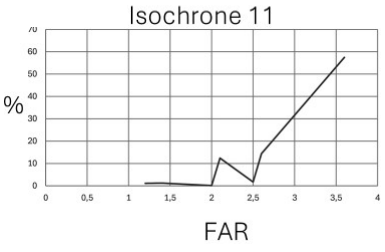
8.Green space: 22.2%. The prevailing floor area ratio is 3.6 with a percentage of 38.5%.



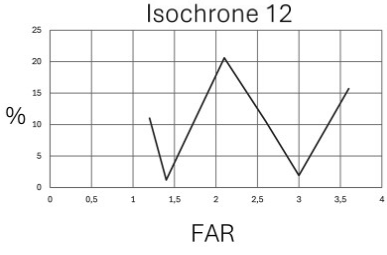
9.Green space: 3.6%. The prevailing floor area ratio is 3 with a percentage of 49%.



10. Green space: 1.1%. The prevailing floor area ratio is 3 with a percentage of 64.7%.



12.Green space: 3.5%. The prevailing floor area ratio is 3.6 with a percentage of 57.5%.



12.Green space: 15.2%. The prevailing floor area ratio is 2.1 with a percentage of 20.6%.

Findings

From the overall research, a total of 170 green and public outdoor spaces were recorded across the different neighborhoods. These spaces were classified into six categories based on their characteristics and function. Specifically, 82 squares, 49 parks, 7 gardens, 11 hills, 13 groves, and 8 archaeological sites were identified. The outlines of these spaces are presented in the above maps and the list showcasing the distribution and variety of these public areas throughout the studied region (Municipality of Athens). The second part of the findings relates to the corresponding Floor Area Ratios on the different maps and accessibility within a 15-minute walking distance. As recorded on the 12 maps, the FAR values vary significantly, ranging from 0.3 to 5.4.

Conclusions

From the above research on green and public outdoor spaces, we conclude the following: Squares dominate in relation to other types of public outdoor spaces and constitute the most common type of green space in the study area, namely the Municipality of Athens. Additionally, from the recorded data, it appears that hills and groves occupy the largest area, followed by public gardens and archaeological sites. Parks follow, while squares, although numerically greater, occupy a smaller total area compared to the other spaces.

The range of green space distribution varies significantly from neighborhood to neighborhood, with the number of spaces ranging from 1 to 30 within a 15-minute walking distance. However, the presence of many green spaces on each map does not necessarily mean that they cover a large percentage of the total area. For example, in the fourth map, covering the area of Thissio, 16 green spaces were recorded, but the coverage percentage is only 3.9%. In contrast, in the eighth map, covering the area of Zografou, 11 green spaces were recorded, but their coverage percentage is more than five times higher (22.2%).

Regarding the different values of floor area ratios, from the above data, we conclude that, despite the broad range of values observed, the FAR values mainly range between 2.1 and 4.2. Furthermore, the need for more green spaces arises from a combined analysis of multiple parameters and is not solely dependent on the percentage of existing green space. For example, an area with fewer green spaces does not necessarily have a greater need for new green spaces compared to a densely populated area with more such spaces. This need is shaped by factors such as population density, urban development, quality of life, accessibility to public open spaces, as well as environmental and climatic conditions of the area.

Therefore, in order to determine the size and priority for the creation of new green spaces in each area, a comprehensive assessment of all data, such as population density, land use, and availability of other public resources, is required. Such a holistic approach is necessary to accurately determine the need for enhancing green and public outdoor spaces in each neighborhood or area of the city.

General Conclusions

Athens has developed with high urban density, with cars serving as the primary means of transportation for decades. This approach has had immediate consequences, such as traffic congestion, air pollution, a lack of green spaces, and long distances that often do not favor walking or cycling. Although efforts have been made to promote public transportation and alternative modes of mobility, the city’s infrastructure remains largely oriented toward private vehicle use, which negatively impacts residents’ daily lives.

The lack of public green spaces is one of the biggest issues in the urban fabric. While the historic center offers some significant green areas, such as the National Garden and the hills of Lycabettus and Philopappou, these are not sufficient to meet the needs of the population.As the distance from the city center increases, the problem intensifies, with many neighborhoods having limited or neglected public spaces.

The Municipality of Athens, particularly in its surrounding areas, faces a severe shortage of greenery. The available spaces are often small, limited, and inadequately maintained, while in some cases, they have been abandoned. Residents of these areas have few options for recreation and exercise, which worsens their quality of life, especially during the hot summer months when temperatures in the city become unbearable.

The lack of comprehensive planning and investment in urban greenery makes the Municipality of Athens one of the most densely populated areas in Europe, with one of the lowest percentages of green space per capita.

Further Questions and Applications

This research raises an important question: Is it better to have many small public outdoor spaces or a few large ones? The answer depends on various factors, including community needs and accessibility. Smaller green spaces are typically closer to residents, making them more accessible, especially in densely built areas. They ensure that more people have access to some form of outdoor public space, even if small. On the other hand, larger green spaces are better suited for bigger activities and provide more room for nature to thrive. However, they are often less accessible for those living farther away and are sometimes visited only on weekends or special occasions.

Further applications of this methodology could extend beyond the Municipality of Athens to the entire metropolitan area of Attica and other urban regions with similar density and development patterns. This could help identify inequalities in green space distribution and support authorities or urban planners in designing and creating new public open spaces to improve accessibility and quality of life.

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