The Open-air Market network in Turin:

investigation on environmental quality improvement

Politecnico di Torino

Thesis topic:
The open-air Market network in Turin:
Investigation on environmental quality improvement

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Abstract

This thesis investigates the open-air market network in Turin, focusing on its significance within the urban context and its relationship to environmental quality. The research employs geographical data and case studies of two representative markets, Madama Cristina Market and Sebastopoli Market, to explore the unique attributes and challenges each market poses. The study also examines the potential for integrating mitigation and adaptation strategies to reduce the negative impacts of climate change and urban expansion on these markets. The findings suggest that strategic design interventions, such as pedestrianization and the incorporation of green elements, can enhance the environmental sustainability of open-air markets in Turin. The research concludes with recommendations for future sustainable practices in the design and management of open-air markets.

Research questions

1. What is the significance of Turin’s open-air market network within the urban context, and how does it relate to environmental quality?

2. Based on the findings, what strategies could be recommended to enhance the environmental sustainability of open-air markets in Turin?

Chapter 1

Introduction & Background

1.1 Background of the Open-air Market network

In general, the presence of the markets has a decisive influence on the environmental characterization of the urban space, to the point of becoming the main element for the identification of its image in the city context[1].

In both economic and social life, the market is a complex environment that is essential[2]. Markets have been a reflection of social changes throughout history, tracing the evolution of humanity. In addition to being a hub for trade, markets have also served as a community gathering place and a significant social landmark[3].

Moreover, the environmental attributes of open-air markets might have consequences for urban microclimates. Urban spaces, such as open-air markets, can capture carbon dioxide emissions, generate oxygen in the atmosphere, absorb pollutants from the air, and help mitigate the heat island effect. This enhances the urban environment[4].

Nevertheless, it is crucial to acknowledge that the influence of open-air markets on metropolitan areas is not solely beneficial. Open-air markets may contribute to higher levels of air pollution in the region around them, which might pose health problems [5,6].

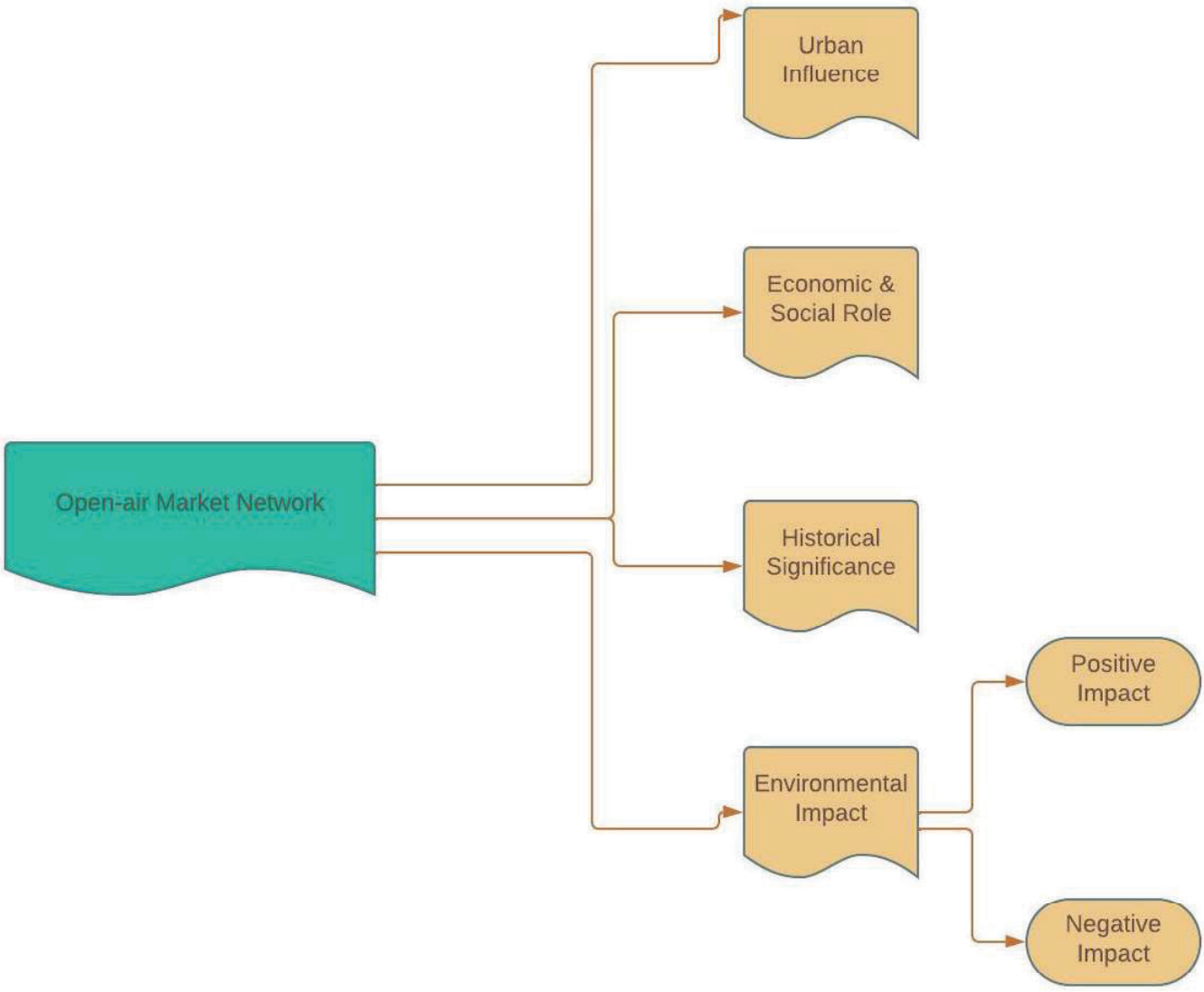


Figure 1 - Background of the Markets Network (by Author)

1.2 Methodoly

Introduction

This research adopts a mixed-methods approach to investigate the environmental quality improvement of Turin's open-air market network. The study is structured to answer two primary questions: the significance of Turin’s open-air market network within the urban context and the strategies to enhance environmental sustainability.

Literature Review

A systematic literature review was conducted using JSTOR, Scopus, and Web of Science, with keywords such as "open-air markets," "urban sustainability," and "climate change adaptation." The selection was based on relevance to market dynamics, environmental impact, and urban design, focusing on the last two decades to establish a theoretical foundation for the study.

Best Practices Analysis

The study identified best practices in sustainable open-air market design through a review of global case studies. Selection criteria included sustainability innovation, community impact, and adaptability to climate change. These practices were analyzed to extract themes and strategies applicable to Turin.

Urban Scale Analysis of Turin

GIS data from the Municipality of Turin was used to do an urban scale study. This meant making a plan of where the markets were located, figuring out how easy they were to get to, and finding places where the surroundings could be improved. It was also thought about how to connect markets to the city's infrastructure and transportation systems. Geographical information from city maps sorted nearby

market areas by things like how easy it was to park, how green the area was, how the markets were grouped, and how congested the area was. The comparative analysis and plan development for improving market sustainability were based on a market analysis and literature study.

Case Study Selection and Analysis

Madama Cristina Market and Sebastopoli Market were selected as case studies. Data collection included site visits, environmental measurements, and analysis of municipal maps. Comparative analysis identified unique and shared challenges and opportunities between the markets.

Detailed drawings based on municipal geographical data visualized the current state of the markets, showing layout, access points, and green spaces.

Integration of Mitigation and Adaptation Strategies

Mitigation and adaptation strategies were developed from the literature review, best practices analysis, and case studies. Design proposals incorporated pedestrianization, green infrastructure, and solar studies for shading impact on thermal comfort. Design proposals were developed using insights from market analysis and literature review, visualized through detailed drawings to show potential changes and interventions. The integration of mitigation and adaptation strategies within the design proposals, such as pedestrianization and green infrastructure, demonstrates a forward-thinking approach to enhancing the sustainability of these vital urban spaces. The mixed-methods approach, blending both qualitative and quantitative data, has provided a robust framework for understanding the multifaceted nature of open-air markets and their potential for

environmental quality improvement.

Conclusion

The methodology employed in this research has been instrumental in dissecting the complexities of Turin's open-air market network and its interplay with environmental quality. Through a systematic approach that combined literature review, best practices analysis, urban scale analysis, and detailed case studies, this study has illuminated the unique challenges and opportunities inherent in Madama Cristina Market and Sebastopoli Market. The research has underscored the critical role of sustainable design and management in the evolution of urban markets, setting a precedent for future initiatives aimed at fostering the resilience and sustainability of open-air markets in Turin and potentially other urban contexts.

However, this research is not without its limitations. The scope of the study, focusing on two specific markets, may not encapsulate the full diversity of market environments within Turin or other cities. The reliance on available geographical data and the current state of the markets introduces a degree of variability that could influence the outcomes. The subjectivity inherent in the design recommendations reflects the researcher's interpretation and vision of environmental sustainability, which may differ from other scholarly or practical perspectives.

Moreover, while this study offers actionable recommendations for market enhancement, the practicality of implementing these interventions remains untested, with factors such as economic viability, public acceptance, and regulatory frameworks posing potential barriers.

It has also identified areas for future inquiry, emphasizing the need for continued exploration of sustainable practices in the design and management of open-air markets. The insights gained from this study contribute to a growing body of knowledge on urban market sustainability and serve as a catalyst for further research in this dynamic field.

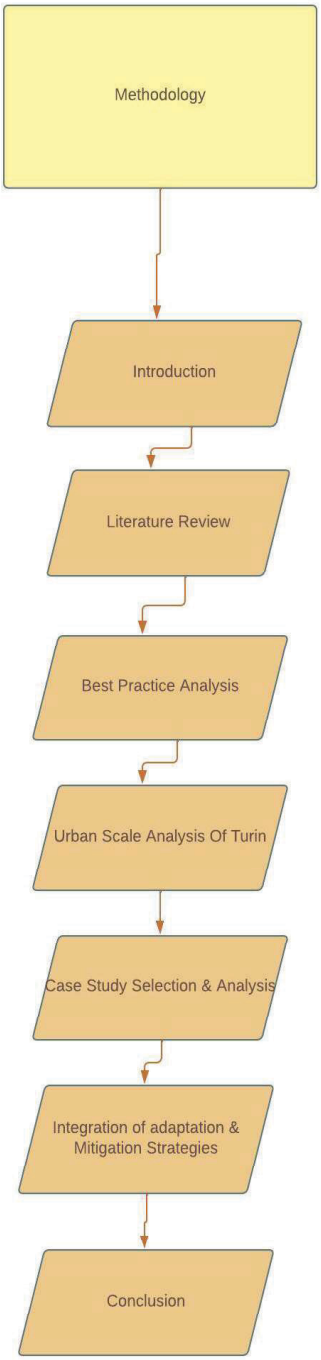


Figure 2 - Methodology (by Author)

Chapter 2

Literature Review

2.1 Definition and historical development of open-air markets

Markets are more than just places to buy and sell things; they are important public spaces where people meet and interact. Street markets are places where people from different backgrounds can come together. These markets can help people feel included and be places where cultural differences are bridged, although sometimes they can be places where conflicts arise[7,8]. The open-air markets help local economies and also help people feel a sense of belonging and togetherness in their local areas[9].

Although not immediately evident, open-air marketplaces and supermarkets are fundamentally different from each other. Open-air markets and supermarkets are both commercial centers that function as meeting points for different companies. The conditions of the transaction at an open-air market contrast with those in a single owner-operated supermarket, where the owner has the authority to guide consumers' actions and organize specific products in designated areas. These characteristics, known as commercial factors, affect the physical layout of the market[10].

2.1.1 Development of open-air markets throughout history

During the Middle Ages, local markets played a pivotal role in transitioning societies from subsistence living to a profit-focused commercial economy. Goods initially created by English peasants for these markets fostered trade links between rural and urban areas. This period marked a commercial revolution characterized by the rise of merchants and craftsmen, leading to a reduced reliance on agriculture[11].

Significant economic and commercial growth in the Middle Ages was evident in the sprawling global trade networks[12]. The dynamic phases of growth and recession in urban areas of medieval England underscored the thriving nature of markets and the spirit of commercialization during this era[13].

As argued by (Hiebert, D., Rath, J., & Vertovec, S.)[14], markets exist in various forms, including night markets, farmers' markets, urban street markets, open-air markets, and indoor food markets, often situated in historical buildings or areas.

Markets have been crucial for urban development for centuries, strategically located in areas where commercial services were scarce or in high demand. The current locations of markets indicate the transformation of urban areas from peripheral to central[1].

2.2 Examples of markets around the world

2.2.1 Markets in the United States

Pike Place Market, founded in 1907 and located in Seattle, is one of the largest and oldest public markets in the United States that is still in operation. It boasts a variety of structures and stalls, such as the iconic Public Market Clock Sign, Corner Market, Sanitary Market, and Athenian Inn. Despite facing challenges, including proposed redevelopments in the 1960s and a substantial $135 million renovation in 1974, the market remains a beloved and successful landmark[15].

2.2.2 Markets in Papua New Guinea

Open-air marketplaces in Papua New Guinea (PNG) are vital for guaranteeing food security, supporting livelihoods, and contributing to the national economy. Nevertheless, economists and policymakers frequently underestimate their importance. The origins of PNG's marketplaces may be traced back to the 1950s and 1960s when the Australian colonial administration established urban markets for the sale of fresh food. A historical study spanning from 1961 to 2022 underscores the necessity of augmenting financial resources in infrastructure to facilitate diverse market participation, with a particular emphasis on women[16].

2.2.3 Markets in Europe

The history of street markets in Europe is an intricate fabric that reflects the cultural, economic, and social progress of the continent. Street markets have had a substantial impact on the growth of urban areas from the early colonization of German, Austrian, and Scandinavian minority in the New World[17]. This is evident from the presence of street names and the representation of street markets in London between 1850 and 1939[19].

2.2.3.1 Markets in France

The Saint-Ouen Flea Market, close to Paris, is home to the biggest antique market on the planet. Its beginnings may be found in the late 1800s when thieves, criminals, and ragpickers would stalk Paris's streets in seek of hidden riches. Driven out, they settled themselves north of Paris, which grew to be a popular holiday destination. After World War I, merchants descended upon the region to set up shop, resulting in the development of the markets in Biron, Vernaison, Malik, and Vallès. It is still a popular destination today, with its own ambiance, eateries, cafes, vintage clothing stores, and antique book dealers[18].

2.2.3.2 Markets in England

London's street markets, a vital part of the city's commercial and social fabric from 1850-1939, were temporary outdoor structures that served as daily shopping lifelines for residents. Despite legal oversight in 1927, these markets largely represented informal trade and marginalized sections of society, reflecting the city's retail pulse[19].

2.2.3.3 Markets in Spain

Barcelona, has a unique system of 43 markets, with 39 dedicated to food. These markets experienced a decline in the late 20th century due to factors like changing buying habits, supermarkets, urban sprawl, and women's participation in the workforce. Central Barcelona hosts four primary food markets: La Boqueria, Santa Caterina, La Barceloneta, and Sant Antoni. La Boqueria is on the verge of excessive touristification, while Sant Antoni maintains its traditional essence, catering primarily to locals[20].

2.2.3.4 Markets in Italy

The origins of open-air markets in Italian cities are tightly connected with the urban growth and economic success of these cities. Historically, traditional markets have served as significant indicators of urban wealth, reflecting the economic and social dynamics of the respective era[21]. Before the eleventh century, there was a scarcity of food markets in early medieval Italy, and the growing of specific products for market needs was not widespread[22]. The exact beginnings of the market remain a mystery, although there is sufficient written proof from the 11th century onwards that shows the establishment of officially recognized marketplaces and new cities throughout Western Europe[23].

One of Italy's most famous and important outdoor marketplaces is the Mercato di Porta Palazzo in Turin. It is a bustling center for farmers, street sellers, and street food dealers, showcasing the area's rich gastronomic and cultural legacy. Fresh fruit, apparel, and street food are just a few of the many goods sold at the market, which also helps to reduce food waste and support locally grown practices[24]. Moreover, the market has a crucial role in defining the character of the old city, symbolizing the level of urban lifestyle and serving as a significant attraction for tourists[21].

Also, the Mercato di San Lorenzo in Florence is a crucial component of the San Lorenzo area, which holds the status of a World Heritage Site in Florence, Italy[25].

2.3 Climate change issues and approaches

Persistent changes in the climate, such as those brought on by energy usage and deforestation or by natural processes, are referred to as climate change[26]. These alterations may be regional or worldwide in scope and may be brought about by natural or man-made causes[27]. These changes can affect regions and countries worldwide, resulting in consequences such as damage to ecosystems, agricultural production, water resources, human health, and other systems and sectors[28]. However, the conflicting interests of wealthy and developing nations have impeded international accords to address it[29]. In order to combat climate change, education is essential because it may increase public awareness and foster the values, knowledge, and skills that are required[30].

2.3.1 Drivers and causes of climate change

The regulation about climate change is shaped by several factors, including political consensus, the enforcement of framework laws, and regional and global consequences[31]. Nevertheless, new research highlighting alternative possibilities for contributing to global warming sheds uncertainty on the success rate of the international goal of reaching net zero emissions as a strategy for addressing climate change[32]. Public perception of climate change is also molded by a tapestry of influences such as personal values, ideals, personal weather experiences, community growth, social interaction, and climate change knowledge[33]. Notably, climate change is primarily driven by carbon dioxide emissions and fluctuations in the Earth's high-atmosphere magnetic field[34].Addressing climate change necessitates a dual approach that encompasses both adaptation to its impacts and mitigation of its causes[35].

2.4 Adaptation and mitigation of climate change impacts

Mitigation aims to limit the flow of gases that trap heat into the atmosphere, either by decreasing emission sources or by enhancing natural “sinks” like oceans, forests, and soil. Its goal is to minimize considerable human involvement with the climate system[37].

The concept encompasses the measurement of emissions, the establishment of regulations, the promotion of sustainable urban development, and the implementation of mechanisms such as carbon trading or taxes. Additionally, it requires collaboration between cities[36].

Adaptation involves adjusting to current and anticipated climate conditions to minimize vulnerability to climate change effects. It is a reactive strategy that varies by location based on financial and technological resources, aiming to lower the risks associated with climate change consequences[37].

To prepare for the implications of climate change, adaptation methods are essential. These include limiting negative impacts and taking advantage of opportunities[38]. Even though these strategies are the most vulnerable to the impacts of climate change, developing nations have difficulty putting these methods into practice[39].

2.5 Adaptation and Mitigation Strategies in response to climate change

Adapting infrastructure to climate change in markets: The importance of a balance between traditional and modern design paradigms and the need to integrate climatic data and hazards into infrastructure planning and design[40].

Urban Greening: Public health, environmental sustainability, and urban planning are all significantly impacted by the UHI effect. To address the UHI effect and improve urban resilience, mitigation and adaptation techniques have been recommended, including the use of green infrastructure, features of urban parks, and sustainable stormwater management[41].

Water Resource Management: Developing mitigation strategies that reduce vulnerabilities to shifts in hydro-meteorological trends and assess the enduring impacts of climate change on water resource management[42].

The advantage of using green roofs as a solution for urban runoff issues brought on by rainfall lies in their capacity to enhance water evaporation, thereby possibly lowering the energy expenses associated with heating and cooling buildings. This method promotes sustainable management of urban water by mitigating the negative effects of urbanization on water resources[43]. Additionally, rainwater harvesting systems are acknowledged as a successful way to mitigate urban stream deterioration, save drinking water, and reduce existing water shortages[44].

Heat-Related Health Precautions: Heat response plans should incorporate early warning systems, develop local capability, and disseminate information[45]. Heat-health action plans (HHAP) are crucial for preparing the health system for heat-related disasters. These initiatives include decreasing exposure to heat, altering buildings to have lower internal tempetures, and enhancing transportation, energy, and urban planning regulations[46].

Renewable Energy Integration: The need and potential of increasing energy production through clean technologies, which will encourage the expansion of power distribution networks that use renewable energy. This emphasizes how crucial it is to include sustainable energy sources, such solar panels, into metropolitan infrastructure in order to satisfy energy demands[47 ,48].

Sustainable Transportation: The contribution of bicycle infrastructure to transportation cycling(using bicycles as a mode of transport for everyday travel), is consistent with increasing environmentally friendly transportation options to lower carbon emissions[49]. The advantages of cycling and walking are beneficial to both health and the environment, as these green modes of transportation help cut down on carbon emissions[50].

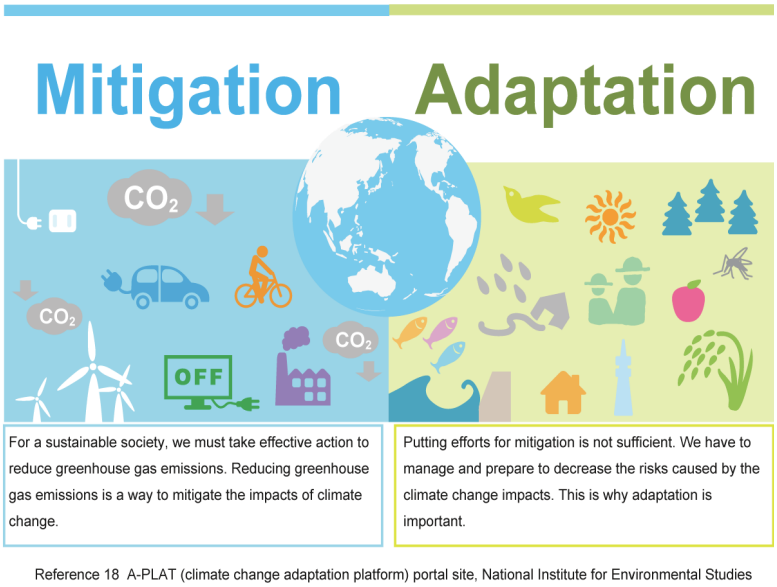
Waste Reduction and Recycling Programs: The significance of the 3R strategy (reduce, reuse, and recycle) as a crucial component of environmentally friendly waste management, offering insightful information on methods for cutting waste and developing environmentally friendly waste management plans[51]. Conversion of waste management procedures into a sustainable system that incorporates material recycling methods, biological and thermal processes, and waste reduction strategies. It offers perceptions of

the challenges facing intelligent waste management and the shift to a circular economy[52].

Climate-Resilient Buildings: The cruciality of climate change's influence on the resilience and efficiency of energy use of buildings is emphasized in decreasing energy consumption and increasing overall durability[53].

The evaluation of zero-energy construction certification regulations currently focuses on sustainable construction methods that use efficient energy utilization to lower energy consumption while strengthening overall resilience[54].

Design specialists in the construction sector are currently utilizing resilience domains, which provide valuable information on strategies for adapting to climate change and implementing sustainable building practices[55].



Reference 18 A-PLAT (climate change adaptation platform) portal site, National Institute for Environmental Studies

Figure 3 - Adaptation & mitigation approaches[56].

2.6 Relationship between open-air markets and climate change

Changes in air quality due to climate change can affect the health and well-being of individuals frequenting open-air markets, potentially leading to negative health outcomes [57,58].
Moreover, the interplay of climate change and air pollution can have implications for open-air markets. Air pollution can influence the overall environmental conditions of open-air markets, potentially affecting the experiences of market-goers and the quality of products sold[59].

On the positive side, climate change can also present opportunities for open-air markets. For example, the mitigation of the heat island effect in urban areas can be relevant to open-air markets located in urban settings. Strategies to mitigate the heat island effect can contribute to creating more comfortable and sustainable environments for open-air markets, potentially enhancing the overall market experience for visitors[60]. Additionally, the impact of climate change on tourism can have implications for open-air markets in tourist destinations. Changes in tourism patterns due to climate change can influence visitor demographics and market demand, potentially presenting new opportunities for market vendors and local economies[61].

In conclusion, the relationship between open-air markets and climate change is complex, with potential impacts on air quality, health, environmental conditions, and market demand. Understanding and addressing these impacts are essential for ensuring the resilience and sustainability of open-air markets in response to climate change.

Chapter 3

Best Practices

3.1 Best practices in sustainable open-air markets

Investigating international best practices in sustainable market operations and their connection to the enhancement of environmental quality serves as the theoretical foundation for this study. This chapter aims to provide a thorough methodology for analyzing open-air market data in the context of urban sustainability and climate change adaptation and mitigation. It starts with referencing a wide range of effective models and programs applied in various geographic and cultural contexts. It has been demonstrated that these techniques improve marketplaces' environmental performance. They range from the implementation of sustainable economic ideas to the integration of green infrastructure.

3.1.1 Encants Market

Location: Barcelona, Spain

Commissioned by: BIMSA – Mercats de Barcelona

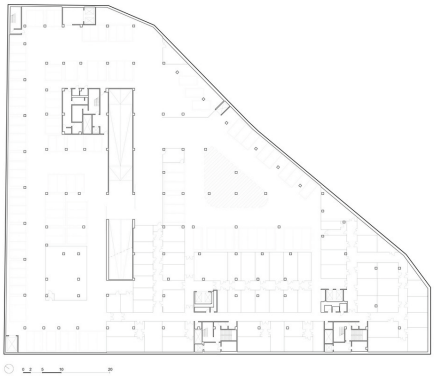
Total Area: 35,440 m²

Year: 2013

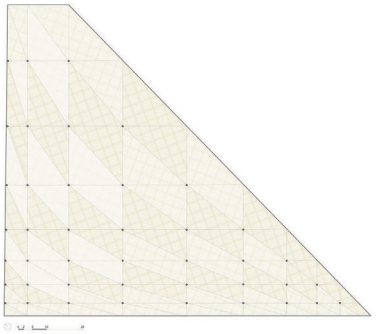
The Encants Market in Barcelona exemplifies a modern approach to market design that harmonizes with the urban environment while promoting sustainable commercial activities. Strategically situated next to Plaza de les Glòries, the market features an innovative “folded street” concept, creating a continuous pedestrian pathway that encourages dynamic commercial interactions. Its distinctive, reflective canopy not only provides shelter but also enhances the market’s visual impact, reflecting the bustling activity below and contributing to the market’s identity as a vibrant urban landmark. Recognized for its architectural excellence with multiple awards, the Encants Market stands as a testament to the successful integration of traditional market functions within a contemporary urban setting, offering valuable insights for sustainable market development[62].

Figure 4 -
Encants market, photography
by Rafael Vargas[62].

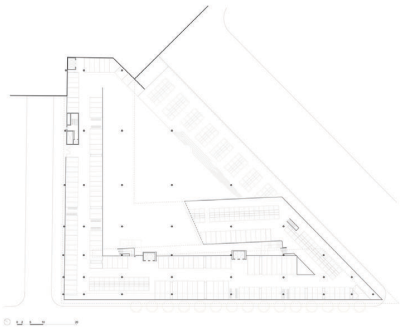
The design and renovation of Barcelona's Encants Market demonstrate a proficient equilibrium between the preservation of historical elements and the fulfillment of contemporary urban requirements, encompassing aspects such as urban density, space optimization, and environmental concerns. The market's creative design incorporates ramps, optimized topography, and a 25-meter-tall canopy. This design not only improves the urban environment but also offers shelter and maintains the flow of market activities. It demonstrates a commitment to adapting and mitigating challenges in urban market design. This approach is consistent with critical urban theory, which highlights the uncertain and dependent character of urban politics and policy, as well as the influence of social power on constructing urban environments. As a result, it contributes to the current discussions about climate change and methods for adapting cities to it[63].



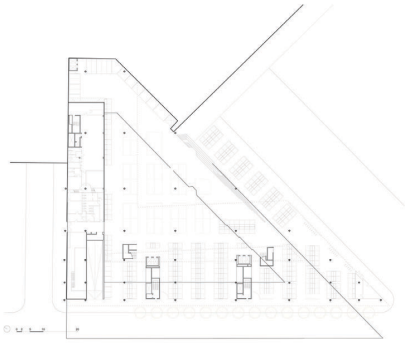
floor plan



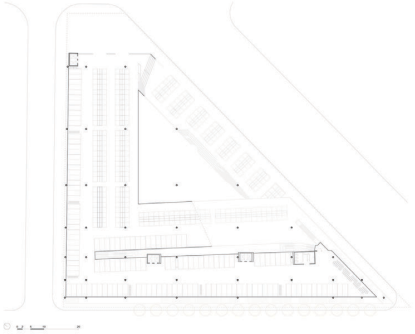
Detail



floor plan (2)

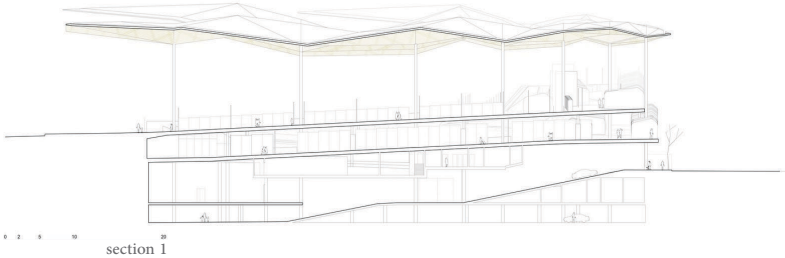


first floor plan

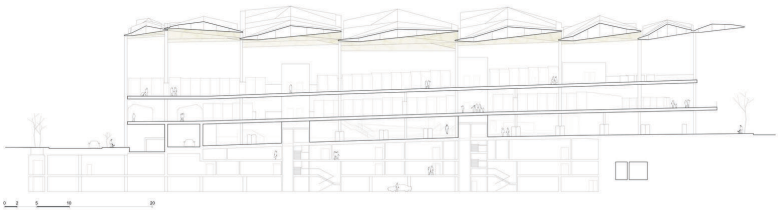


second floor plan

section



section 1



section 2

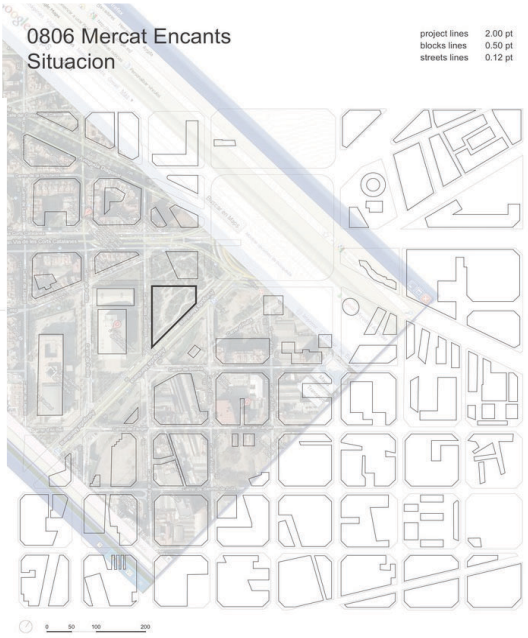


Figure 5 -
Encants market -
plans & sections[62].

3.1.2 Targ blonie Market

Location: Błonie, Poland

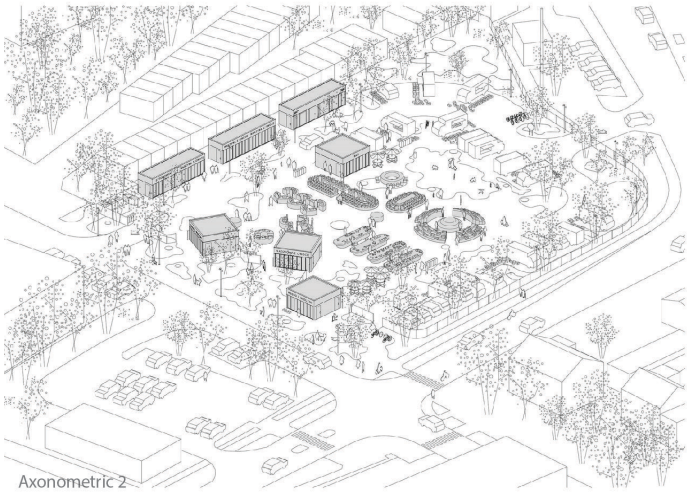
Lead Architect: Aleksandra Wasilkowska

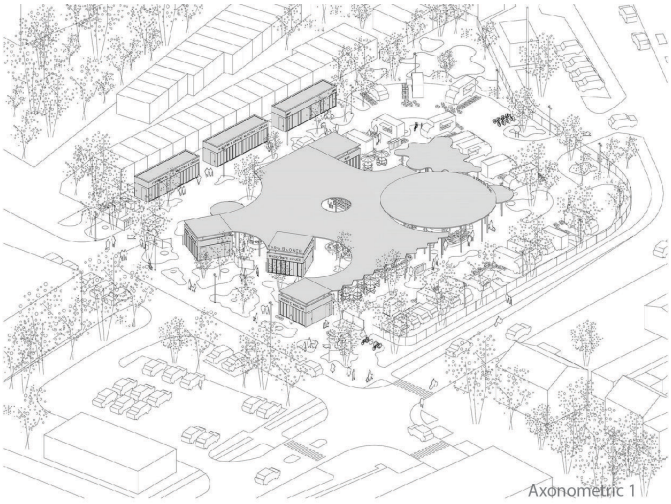
Total Area: 1453 m²

Year: 2022

Aleksandra Wasilkowska's studio revitalized Targ Blonie, an integral open market in the Blonie commune, enhancing its infrastructure and sanitary conditions. This market, deeply rooted in the community's history of fairs, offers affordable, quality produce from local farmers. The redesign transformed Targ Blonie into a park-market hybrid. Innovative white roofs reflect sunlight and provide weather protection, complementing the surrounding commercial pavilions with their bright, corrugated exteriors. The redesigned square prioritizes accessibility and movement, while rain gardens and plants boost biodiversity and manage water sustainably. The addition of street furniture, a play area, and environmental features bolsters the market's role as a community hub, contributing to the city's resilience and supporting local food systems during crises[64].

The Targ Blonie's market redevelopment exemplifies adaptive design by incorporating ecological features and an accessible layout, aligning with climate adaptation goals. The market's white roofs reflect heat, offer shelter, and manage water sustainably through rain gardens, enhancing biodiversity and mitigating environmental impacts[65]. This transformation not only elevates the market's environmental role but also reinforces its social function by supporting local economies and fostering community resilience in the face of urban challenges[66].





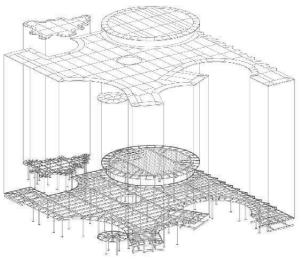


Figure 6 -
Plan, axonometric views & images of the market - Aleksandra Wasilkowska architectural studio - photography : Nate Cook[62].

3.1.3 Casablanca Sustainable Market Square competition

Location: Casablanca, Morocco

Architect: Nikolova/Aarsø

Total Area: 790 m²

Honor: Prize of a competition honorable mention

Type: Movable market stalls

Figure 7 -
Casablanca sustainable
market[67].

Nikolova/Aarsø's Casablanca Sustainable Market Square design merges sustainability with cultural heritage, drawing inspiration from Islamic girih tiles for its geometric aesthetic. These tiles shape the market's architecture, enhancing both its function and sustainability. The design includes tree-like structures that modulate light and provide shade, equipped with Smart-glass for energy, and rainwater harvesting systems. Recognized in the [AC-CA] competition, the project exemplifies innovative, sustainable urban design that respects tradition while fostering community engagement[67].

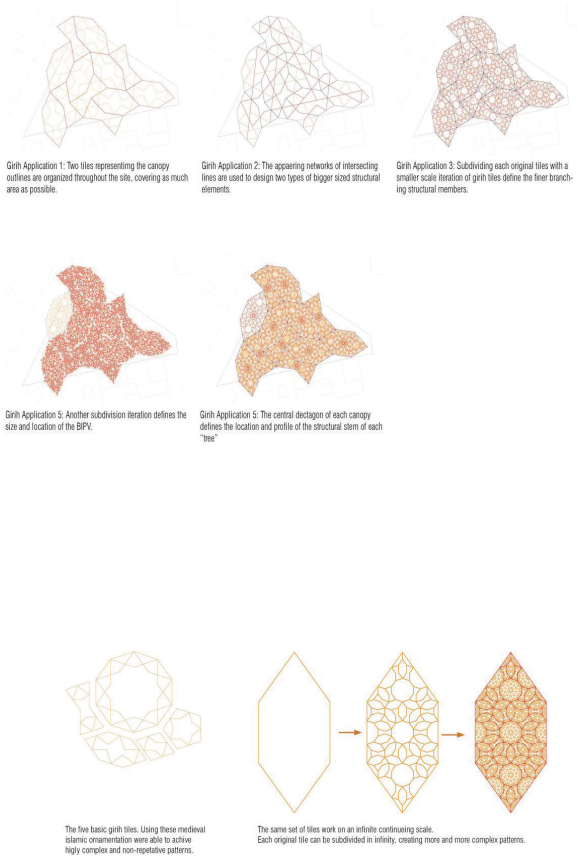


Figure 8 -
Girih tile concept - Casablanca sustainable market[67].

1 market stall 53 sq.m.
2 cafe first level 50 sq.m.
3 cafe second level 75 sq.m.
4 refuse pickup 20 sq.m.
5 water fountains
6 washrooms 40 sq.m.
7 news/information 43 sq.m.
8 cafe seating
9 social space

Figure 9 -
Plans & images-before&after-
Casablanca sustainable
market[67].

Chapter 4

Markets in Turin

The city of Turin, the fourth most populous city in Italy, faces environmental and climate change challenges that necessitate a comprehensive understanding of its urban dynamics and climatic conditions. Studies have highlighted the significance of urban heat islands in Turin, emphasizing the need for strategies to mitigate their effects. Research on the effects of green roofs on outdoor thermal comfort and urban heat island mitigation in Turin has demonstrated the potential of green technologies to contribute to energy savings and enhance outdoor thermal comfort[68].

Figure 10 -
Turin location [GIS].

The relationship between open-air markets and environmental quality in Turin can be further examined through the lens of urban greening and environmental monitoring. Open-air markets in Turin have the potential to act as nodes of urban greening, contributing to the city's green infrastructure. By incorporating vegetation and green spaces within and around market areas, these markets can help mitigate the urban heat island effect, improve air quality, and enhance the overall urban microclimate [69,70].

4.1 Overview of Turin's open-air market network

In a detailed 1994 study by the National Research Council (CNR), the landscape of daily markets in major Italian cities was mapped out, with a particular focus on those with populations over 250,000. This study included markets that were either established or underwent significant refurbishments after 1971. The CNR's findings are considered both reliable and neutral, offering a clear picture of the market scene. The research identified around 420 daily markets, which collectively host approximately 20,400 vendors across the 13 cities included in the survey. These marketplaces serve as a central location for commercial transactions, representing an essential element of Turin's metropolitan retail environment. More precisely, the survey discovered that Turin accommodates 40 marketplaces that take place on a daily basis. In 2002, the quantity of street markets in Turin had risen to 42, demonstrating a noticeable increasing trajectory in the presence of open-air marketplaces[10].

The market organization in Turin encompasses four main categories: metropolitan, urban, neighborhood, and specialized product markets. Metropolitan marketplaces are strategically located along major communication routes and offer a wide range of commodities and products. Urban marketplaces attract a diverse consumer base due to the variety of goods available. Neighborhood markets cater to a smaller consumer base by providing essential items at the district level. Additionally, special markets in Turin offer specialized product varieties[71].

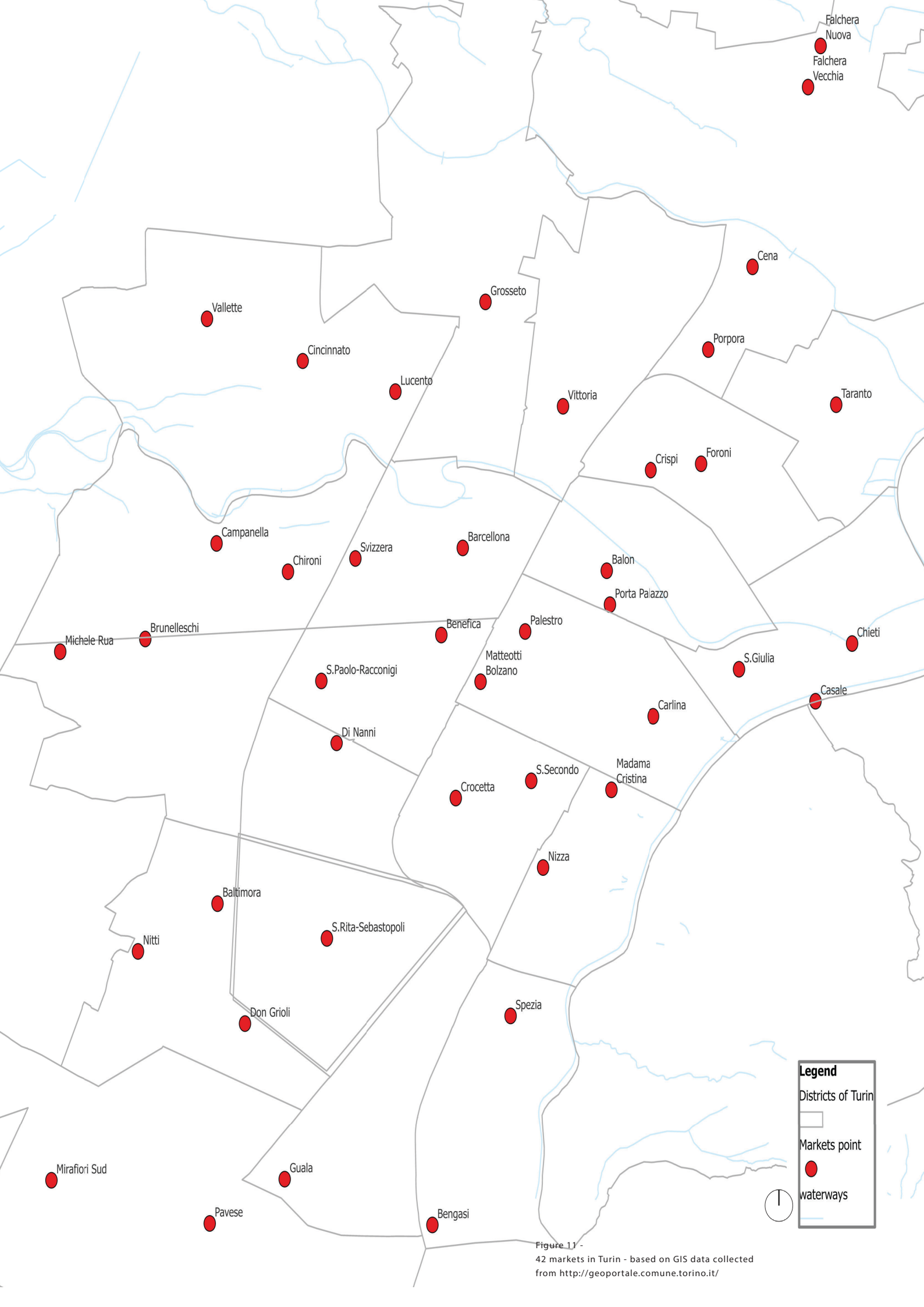


Figure 11 -
42 markets in Turin - based on GIS data collected from http://geoportale.comune.torino.it/

The historical context of Turin as a center of Italy's industrialization has influenced market dynamics. The city's industrial sector and inventive activity concentrated in the "industrial triangle" during the early twentieth century, contributing to the city's market evolution[72].

The localization of the markets in part of the city dates back to the seventeenth century, when the main markets, located mainly in the city center, began to gradually move northwards following urban expansion[73], as King Vittorio Amedeo II ordered works on the city's access gates to modernize Turin and promote it as a modern capital. Porta Palazzo was opened in 1701 as a result[74].

The Municipal Administration created new neighborhood markets to meet the high demand for commercial services. 42 identifiable markets located on the main city arteries that historically played a primary role as road connections between the established city and the expanding areas or within the urban fabric in centrally located nodes. Turin's markets, named after goods sold, were developed within city walls, separated into wholesale and retail activities. The mid-nineteenth century covered market structures were influenced by architectural theories and new technologies, affecting market lifespan and city transformation[1].

NAME	LOCATION	DISTRICT
Don Grioli	vie don Grioli don Grazioli	2
S.Rita-Sebastopoli	corso Sebastopoli tra corsi IV Novembre e Orbassano	2
Chironi	piazza Chironi	4
Cena	via Cena angolo via Bollengo	6
Chieti	corso Chieti	7
Casale	piazza Borromini	7
Pavese	via Pavese	2
Balon	vie Borgo Dora Lanino Mameli Andreis Canale Molassi	7
Nitti	via Nitti	2
Svizzera	corso Svizzera tra piazza Perotti e via Bianze'	4
Bengasi	piazza Bengasi via Onorato Vigliani	8
Falchera Vecchia	viale Falchera via dei Pioppi	6
Guala	via e piazza Guala	8
Mirafiori Sud	via Plava vicino via Negarville	2
Porpora	via Porpora	6
Porta Palazzo	piazza della Repubblica	7
Carlina	piazza Carlina	1
Matteotti Bolzano	corsi Matteotti Vinzaglio	1
Palestro	corso Palestro	1
Di Nanni	via Di Nanni tra corso Peschiera e via S.Bernardino	3
Brunelleschi	corso Brunelleschi tra corso Peschiera e via Vandalino	3
Benefica	piazza Martini - Benefica	3
Michele Rua	via Michele Rua	3
Barcellona	piazza Barcellona	4
Campanella	piazza Campanella	4
Cincinnato	corso Cincinnato tra corso Toscana e via ValdellaTorre	5
Lucento	corso Toscana vie Forli' Borgomasino	5
Falchera Nuova	via degli Abeti	6
Crispi	piazza Crispi	6
Taranto	corso Taranto tra piazza Sofia e via Corelli	6
Madama Cristina	piazza Madama Cristina	8
Nizza	piazza Nizza	8
Spezia	corso Spezia piazza Bozzolo	8
Baltimora	vie Baltimora Castelgomberto	2
Foroni	piazze Foroni Cerignola vie Baltea Monterosa Santhia'	6
S.Paolo-Racconigi	corso Racconigi tra corsi Vittorio e Peschiera	3
Crocetta	largo e vicolo Cassini via Marco Polo vicolo Crocetta	1
Grosseto	corso Grosseto via Lulli	5
S.Giulia	vie S.Giulia Balbo piazza S.Giulia corso Regina	7
S.Secondo	vie S.Secondo Legnano	1
Vallette	piazzale don Pollarolo vie delle Verbene dei Mughetti	5
Vittoria	piazza e via Vittoria via Villar piazza Chiesa della Salute	5

Figure 12 -
Location of the markets in Turin - based on GIS data collected from http://geoportale.comune.torino.it/

4.2 Markets' Typology and Spatial Organization

The standard form of the markets has always been adorned with porticoes, creating covered spaces where different kinds of products can be held indoors, neatly organized into categories such as fish, meat, dairy products, grains, herbs, fruits, and utensils. This well-ordered arrangement reflects the careful consideration of architectural design to accommodate the functional typology of the markets and the technology available at the markets[75].

4.2.1 Typology of the markets in Turin

There are two main forms of market Typology organization that may be distinguished schematically as : Linear and Compact.
Linear marketplaces serve both wholesale and retail sales and are made up of establishments that are lined up along a walkway.
Whereas the Compact market is set up in an orthogonal network.
The linear market system consists of permanent or portable platforms[1].

Name	Typology
Don Grioli	compact
S.Rita-Sebastopoli	linear
Chironi	compact
Cena	linear
Chieti	linear
Casale	compact
Pavese	linear
Balon	compact
Nitti	linear
Svizzera	linear
Bengasi	linear
Falchera Vecchia	linear
Guala	compact
Mirafiori Sud	linear
Porpora	linear
Porta Palazzo	compact
Carlina	linear
Matteotti Bolzano	linear
Palestro	linear
Di Nanni	linear
Brunelleschi	linear
Benefica	compact
Michele Rua	compact
Barcellona	compact
Campanella	compact
Cincinnato	linear
Lucento	compact
Falchera Nuova	linear
Crispi	compact
Taranto	linear
Madama Cristina	compact
Nizza	compact
Spezia	linear
Baltimora	linear
Foroni	compact
S.Paolo-Racconigi	linear
Crocetta	compact
Grosseto	compact
S.Giulia	compact
S.Secondo	linear
Vallette	compact
Vittoria	compact

Figure 13 -
Markets' typology in Turin based on GIS data from http://geoportale.comune.torino.it/ and Author elaboration

The figure14, integrates the operational analysis of market days and stall numbers, providing a holistic view of the markets' environmental and functional attributes. It emphasizes the importance of understanding both the physical and operational aspects of the markets to inform sustainable urban planning in Turin.

In addition, the spatial distribution and density of open-air markets in Turin, Italy, are examined. Utilizing GIS data, the study conducts a typological investigation of market locations across the urban landscape. Figure11, is generated to visualize the concentration of markets, revealing a gradient of market density from the city center outward. The analysis indicates a higher clustering of markets near the city center, a pattern that may correlate with factors such as population density, economic activity, and accessibility. This central concentration suggests that markets are strategically placed to cater to the higher footfall and demand in these areas.

NAME	DAYS	STALLS
Don Grioli	Monday to Saturday	136
S.Rita-Sebastopoli	Monday to Saturday	168
Chironi	Monday to Saturday	6
Cena	Monday to Saturday	9
Chieti	Monday to Saturday	37
Casale	Monday to Saturday	68
Pavese	Monday to Saturday	90
Balon	Saturday	69
Nitti	Wednesday Friday	100
Svizzera	Monday to Saturday	145
Bengasi	Monday to Saturday	182
Falchera Vecchia	Wednesday Friday	14
Guala	Tuesday Thursday Saturday	118
Mirafiori Sud	Monday to Saturday	16
Porpora	Monday to Saturday	100
Porta Palazzo	Monday to Saturday	934
Carlina	Monday to Saturday	5
Matteotti Bolzano	Monday to Saturday	2
Palestro	Monday to Saturday	105
Di Nanni	Monday to Saturday	99
Brunelleschi	Monday to Saturday	160
Benefica	Monday to Saturday	127
Michele Rua	Monday to Saturday	29
Barcellona	Monday to Saturday	75
Campanella	Monday to Saturday	37
Cincinnato	Monday to Saturday	119
Lucento	Monday to Saturday	14
Falchera Nuova	Monday to Saturday	2
Crispi	Monday to Saturday	22
Taranto	Monday to Saturday	82
Madama Cristina	Monday to Saturday	135
Nizza	Monday to Saturday	54
Spezia	Monday to Saturday	112
Baltimora	Monday to Saturday	60
Foroni	Monday to Saturday	169
S.Paolo-Racconigi	Monday to Saturday	395
Crocetta	Monday to Saturday	159
Grosseto	Monday to Saturday	18
S.Giulia	Monday to Saturday	62
S.Secondo	Monday to Saturday	58
Vallette	Monday to Saturday	14
Vittoria	Monday to Saturday	171

Figure 14 -
Days of activity and number of stalls of open-air markets in Turin based on GIS data from http://geoportale.comune.torino.it/ and Author elaboration

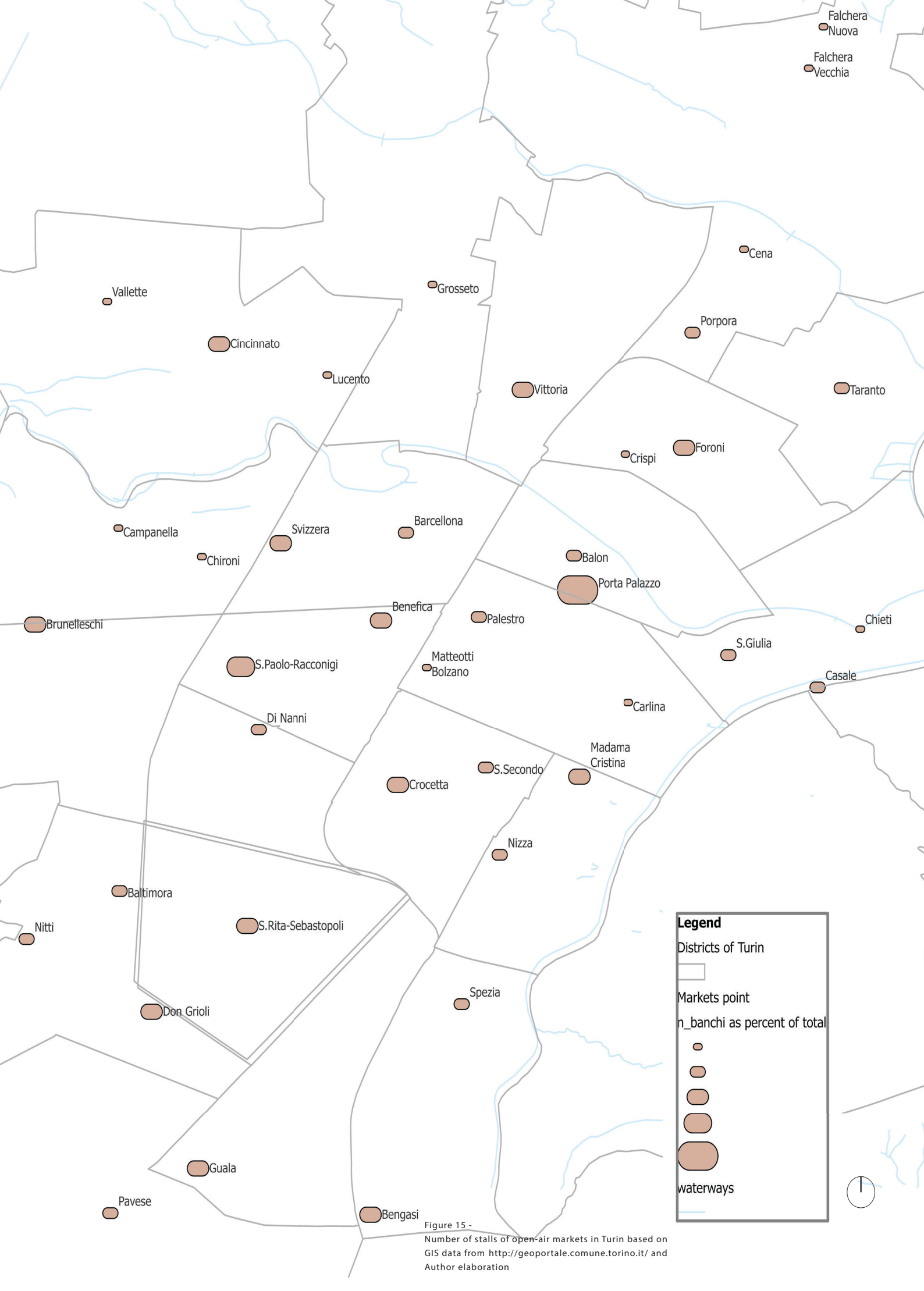


Figure 15 -
Number of stalls of open-air markets in Turin based on GIS data from http://geoportale.comune.torino.it/ and Author elaboration

4.2.2 Assessment of environmental features

The spatial examination of Turin's open-air markets has been done by assessing additional environmental and infrastructural features that influence their sustainability potential. The investigation encompasses the presence of greenery, market typologies, parking availability, canopies, and pavement materials. Moreover, the presence of shops and facilities within the market areas has been considered to suggest intervention strategies (Figure17).

Greenery within and around market spaces was cataloged to identify which markets are greener and could thus contribute more significantly to urban greening initiatives. This analysis is crucial for understanding how markets can enhance biodiversity and provide ecosystem services (Figure19).

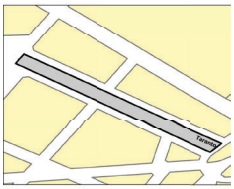
Regarding the possible decrease in emissions from cars and the encouragement of environmentally friendly transportation choices, the availability of parking facilities was taken into consideration as well. The reason could explained as easy access to parking can influence the transportation choices of market visitors. Well-planned and accessible parking can help reduce traffic congestion around market areas (Figure18).

As a crucial part of climate adaptation plans, shading systems as to provide thermal comfort and lower the risks of heat-related problems has been observed As shown in Figure17, an assessment of open-air markets in the vicinity of Turin revealed that while some markets are equipped with shading provisions, the majority lacks such systems. This evaluation was conducted using Google Earth and GIS to survey the areas surrounding each market.

Moreover, the majority of pavement materials were found to be asphalt and stone, despite their varying implications on storm-water management and urban heat island effects. This part has been signed by the stars according to the observations on google earth.

The findings also prompt a discussion on the environmental implications of market density. The central markets, due to their number and proximity, present unique challenges and opportunities for sustainability. The need for sustainable practices becomes more pronounced in these densely packed areas, where the environmental impact of market activities is potentially magnified. The presence of shops in the market area could also suggest the improvement of accessibility through pedestrianization fostering the quality and efficiency of the commercial activities.

Linear types of Markets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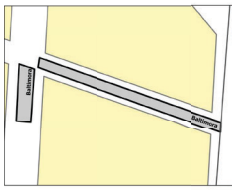
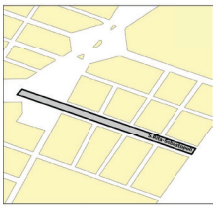

Baltimora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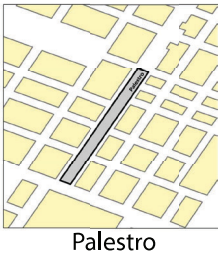
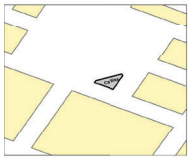
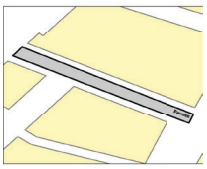
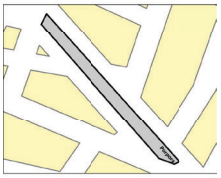
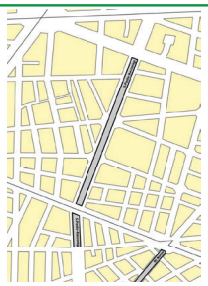
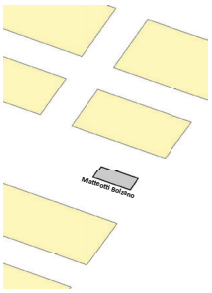

Palestro

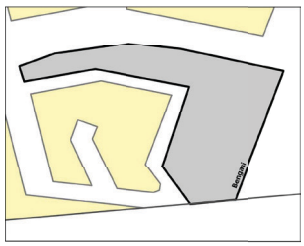

Carlina

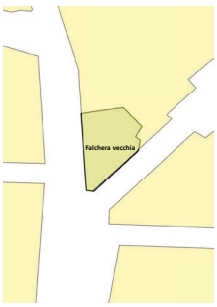

Pavese


Porpora


Racconigi


Matteotti Bolzano


Bengasi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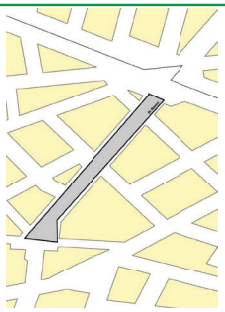
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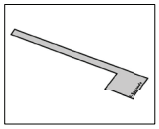
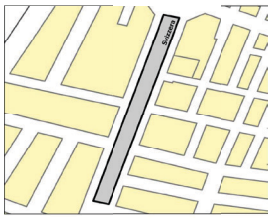
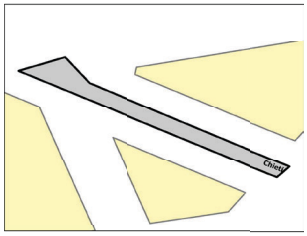

S.Secondo


Svizzera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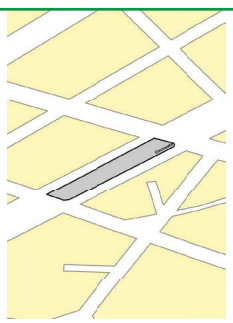
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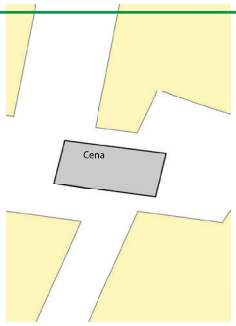
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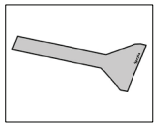
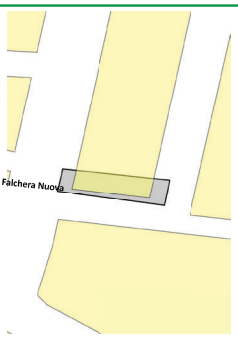
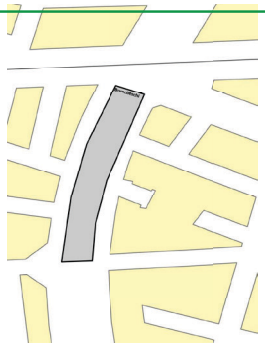
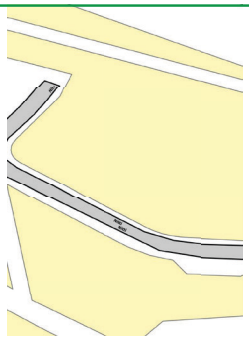

Spezia


Falchera Nuova


Brunelleschi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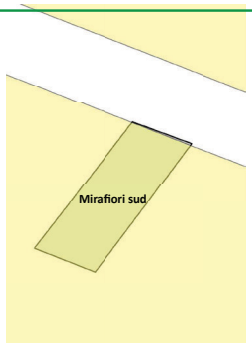
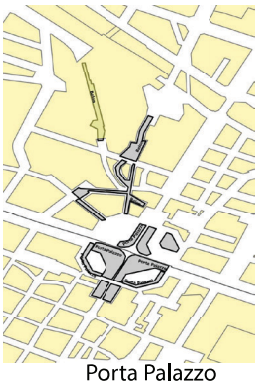
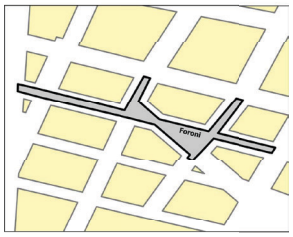

Mirafiori sud

Compact types of Markets



Porta Palazzo & Balon



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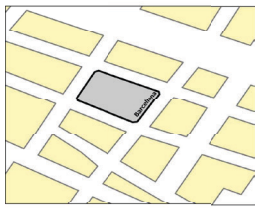

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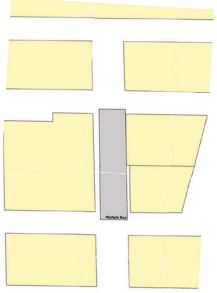
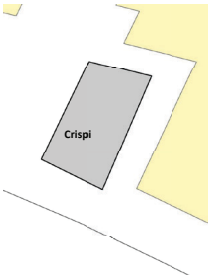


Michela Rua



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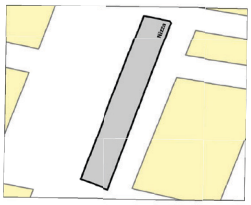

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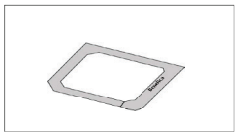
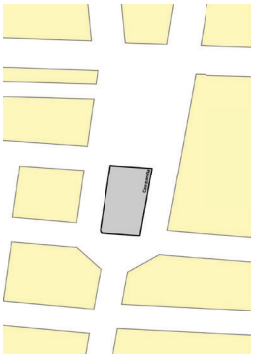
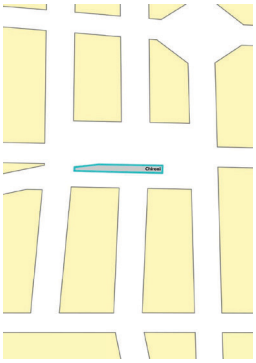


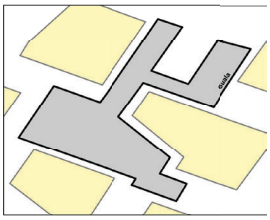
Benefica



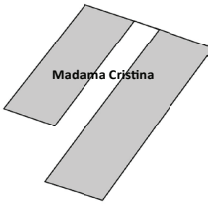
Campanella



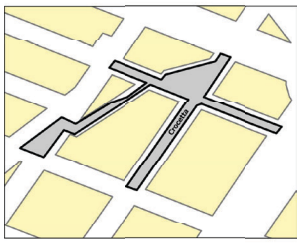
Chironi



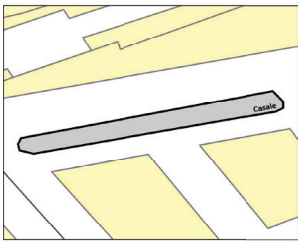
Guala



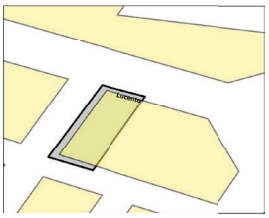
Madama Cristina



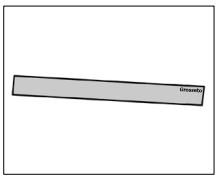
Crocetta



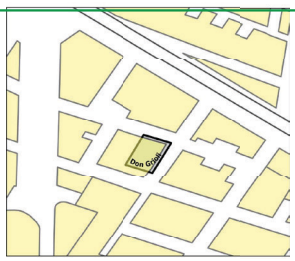
Casale



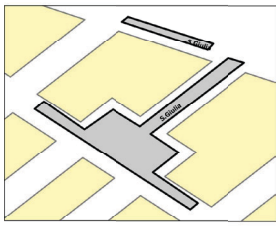
Lucento



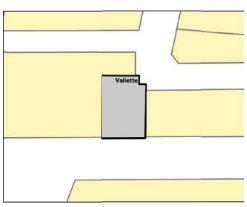
Grosseto



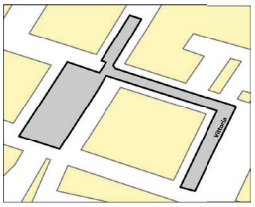
Don Grioli



S.Giulia



Vallette



Vittoria

Figure 16 - Linear & Compact Market Typology (GIS Data)

Name	Canopy	Greenary	Shops	Parking	Pavement
Don Grioli	yes	no	yes	yes	stone
S.Rita-Sebastopoli	no	yes	yes	yes	Asphalt
Chironi	no	yes	yes	no	Asphalt*
Cena	no	no	no	no	Asphalt*
Chieti	no	no	no	yes	Asphalt
Casale	no	no	yes	yes	Asphalt
Pavese	no	yes	yes	yes	Asphalt - stone
Balon	no	no	yes	yes	Asphalt / stone
Nitti	no	yes	no	yes	Asphalt
Svizzera	no	yes	yes	yes	Asphalt
Bengasi	no	no	no	no	Asphalt*
Falchera Vecchia	no	no	no	yes	Asphalt
Guala	no	no	no	yes	Asphalt
Mirafiori Sud	no	yes	no	no	Asphalt*
Porpora	no	no	yes	yes	Asphalt
Porta Palazzo	no	no	yes	yes	Asphalt
Carlina	no	no	no	yes	stone
Matteotti Bolzano	no	yes	yes	no	Asphalt*
Palestro	no	yes	yes	yes	Asphalt
Di Nanni	no	no	yes	yes	Stone
Brunelleschi	no	yes	yes	yes	Asphalt / stone
Benefica	no	yes	yes	yes	Asphalt / stone
Michele Rua	no	no	no	yes	concrete*
Barcellona	no	yes	yes	yes	Asphalt
Campanella	no	yes	yes	yes	stone
Cincinnato	no	no	yes	yes	Asphalt / stone
Lucento	no	no	no	yes	Asphalt*
Falchera Nuova	yes	no	no	yes	Asphalt*
Crispi	yes	no	yes	yes	stone
Taranto	yes	yes	yes?	yes	Asphalt / stone
Madama Cristina	yes	yes/trees	yes	yes	Asphalt / stone
Nizza	no	yes	yes	yes	Stone
Spezia	no	yes	yes	yes	stone
Baltimora	no	no	no	yes	Asphalt
Foroni	no	no	yes	yes	Asphalt / stone
S.Paolo-Racconigi	no	yes	yes	yes	Asphalt
Crocetta	no	yes	yes	yes	Asphalt / stone
Grosseto	no	yes	yes	no	concrete*
S.Giulia	no	no	yes	no	stone
S.Secondo	no	no	yes	yes	Asphalt
Vallette	no	no	no	yes	Asphalt
Vittoria	no	no	yes	yes	Asphalt

Figure 17 -
Environmental Features based on GIS data from http://geoportale.comune.torino.it/ and Author elaboration signed by*

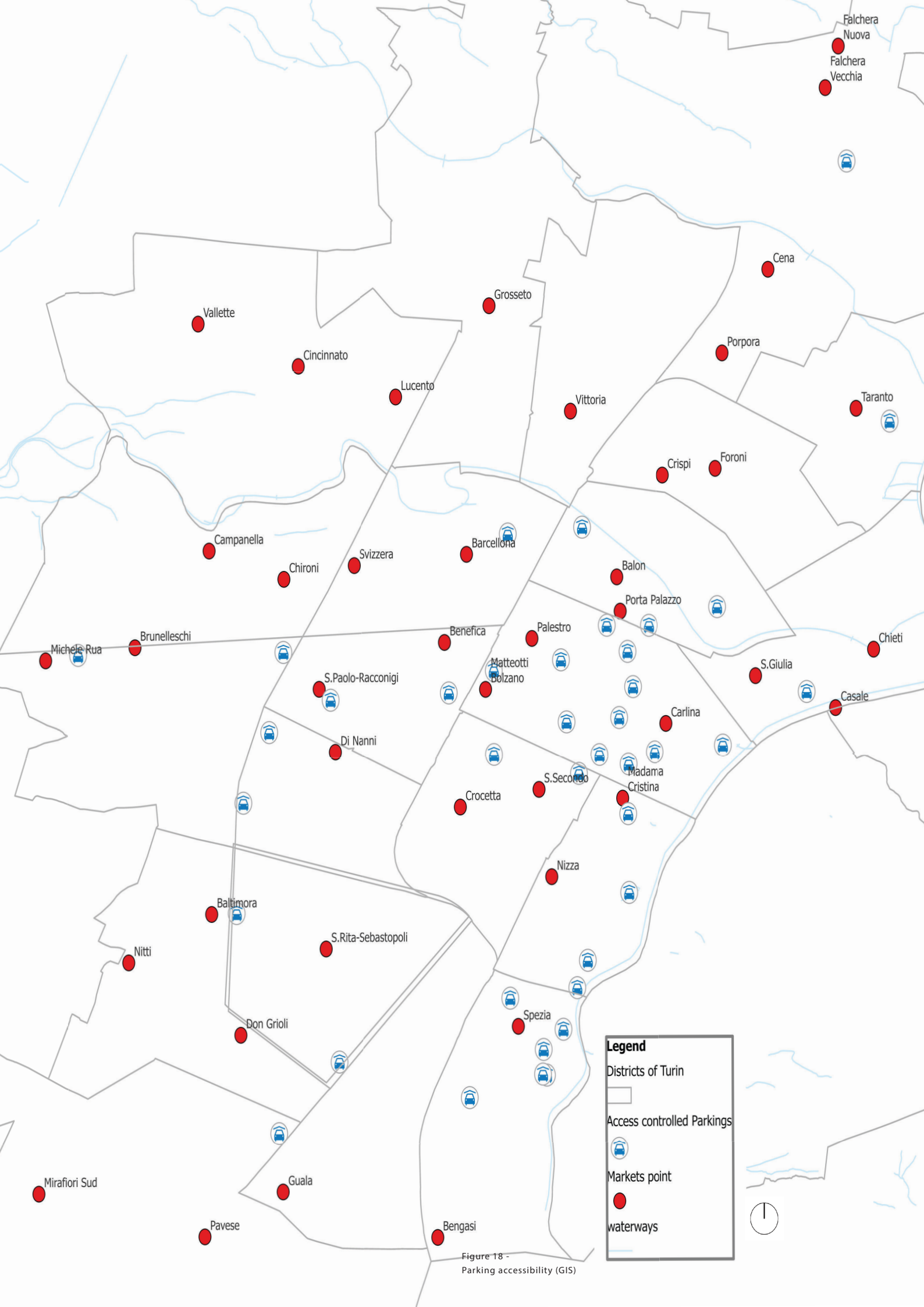


Figure 18 -
Parking accessibility (GIS)

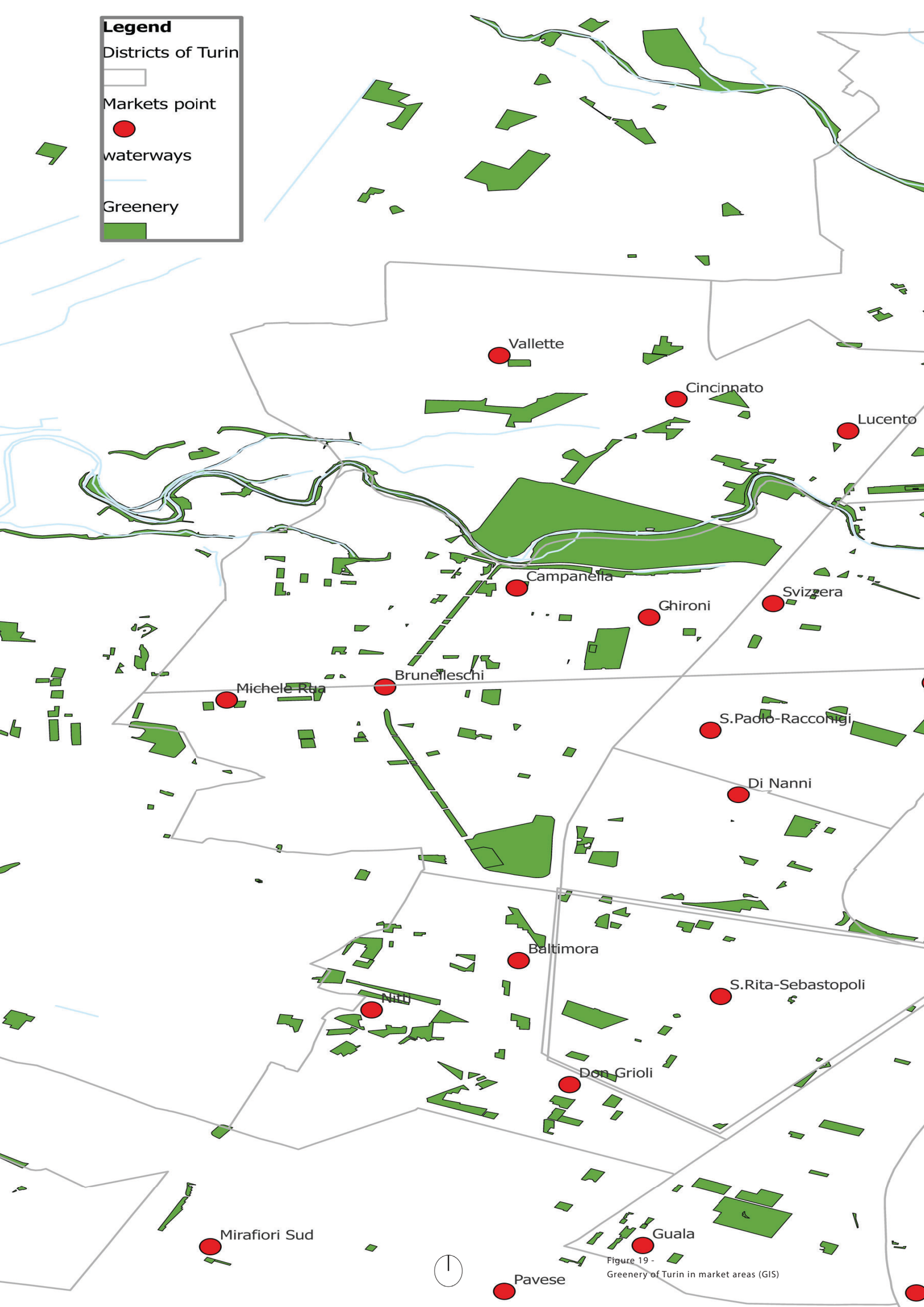


Figure 19 -
Greenery of Turin in market areas (GIS)


Falchera
Nuova
Falchera
Vecchia
Cena
Grosseto
Porpora
Vittoria
Taranto
Crispi
Foroni
Barcellona
Balon
Porta Palazzo
Benefica
Palestro
Chieti
Matteotti
Bolzano
S.Giulia
Casale
Carlina
Madama
Cristina
S.Secondo
Crocetta
Nizza
Spezia
Bengasi

Chapter 5

Case Studies in Turin

5.1 Selection and Mapping of case studies

This chapter outlines the approach to choosing representative case studies of open-air marketplaces in Turin for a thorough investigation. The study employs geographical data acquired from municipal maps to classify the neighboring regions of different marketplaces to assess many crucial aspects. The factors to consider encompass the accessibility of parking spaces, the existence and amount of greenery, the categorization of the markets, and the concentration of market areas. The evaluation of dense of the markets is especially vital in order to determine the closeness of marketplaces in each region, guaranteeing that the chosen case studies are neither too concentrated nor isolated.

The selection was reached after considering all kinds of open-air markets in Turin. Ultimately, one market from the linear type and another from the compact type were chosen, out of the two existent categories examined in this research (linear, compact). An investigation through two case studies was carried out to determine the integration of mitigation and adaptation approaches in each type and the other design features to improve the quality of spaces. In the following chapters different strategies will be outlined for a compact market as well as for a linear one.

5.2 Analysis of the case studies

The two selected marketplaces are ‘Madama Cristina Market’ and ‘Sebastopoli Market’.The Market at Corso Sebastopoli is a prime example of linear marketplaces, which are distinguished by their stretched layout along streets or avenues.

The second case study, the Market in Piazza Madama Cristina, exemplifies a fusion of linear and compact market typologies, providing a distinctive combination of both arrangements. The forthcoming examination of these two case studies will explore the different attributes and difficulties that each market poses. This will establish the framework for evaluating potential adaptation and mitigation solutions customized to the distinct requirements and arrangements of each market category. The objective is to discover strategies for reducing the negative impacts of climate change and urban expansion on Turin’s open-air markets, while also improving their ability to withstand and recover from these challenges.

5.2.1 Case Study 1: Madama Cristina Market

Location :	Piazza Madama Cristina
Market area :	5786.76 sqm
Market Type :	Linear/Circular
Year :	since 1876
Square Revitalization :	1999-2001

The Madama Cristina market is located in the San Salvario region. In 1876, it relocated from Piazza Bodoni to its present day location. During that period, it held its place as the city's second-biggest market. The market's expansion was facilitated by a substantial workforce engaged in the unloading of goods at the railway yards adjacent to the Porta Nuova station.
Various traditional crafts continue to exist in the surrounding region of the market and are essential to its functioning. These encompass conventional artisanal practices such as mattress production, rope fabrication, and chair weaving, with modern ones like elaborate hairstyling and repair services. Furthermore, there are also personal services offered. The market is also beneficial since it has brick shelters and a multi-storey parking facility. The client base is characterized by its diversity and multiculturalism, with stalls providing a vast array of items, including commodities sourced from Africa and the Middle East[76].

5.2.1.1 Present state of the Market

The research seeks to provide a complete understanding of how various market structures might be adjusted to positively contribute to the urban fabric and environmental quality of Turin.
The municipality provides maps that indicate the exact location of the market and its stalls. These maps also show the designated walking areas for people and the number of stalls. Additionally, they specify the daily accessible location of the stalls and the parking spaces available for the vendors to conveniently access their stalls and arrange their products for sale. The market designs are based on the DWG maps and Shapefiles of GIS given by the municipality.
Moreover, according to the examination of GIS data, there are a total of four trees inside the market area. The height of the trees in both the northern and southern portions of the market varies between 13 and 16 meters. The trees belong to the species “Platanus occidentalis”. These trees have importance since they are being evaluated throughout a solar study on the area of the warmest and coldest days of the year to investigate the shadow and sun direction which is going on the direction of the soround of these four trees. The objective is to carefully place these four trees inside the area of the market since they have a vital function in improving the overall visual appeal and ecological condition of the vicinity.

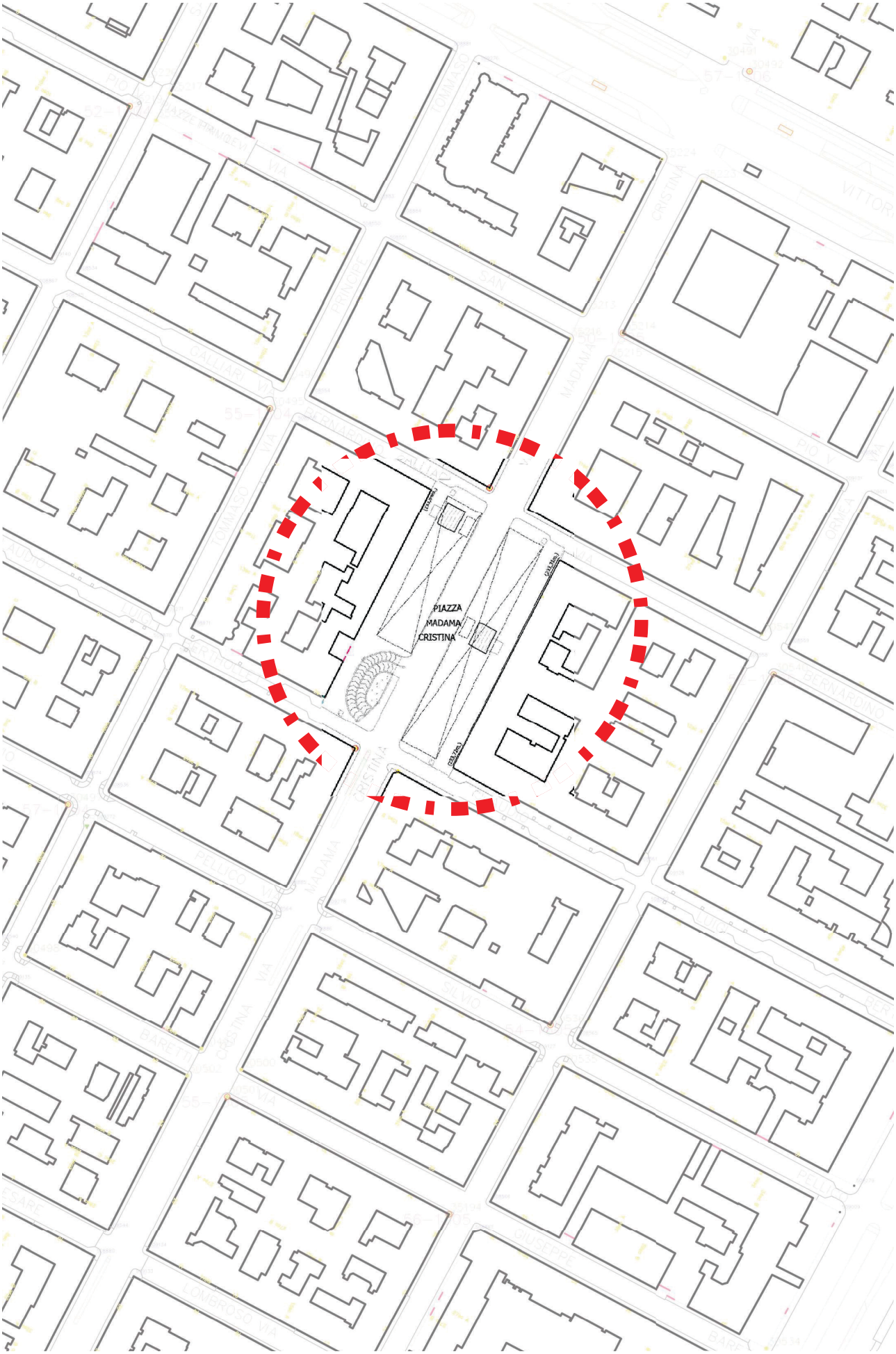


Figure 20 -
Madama Cristina market map area in Turin (municipality of Turin)

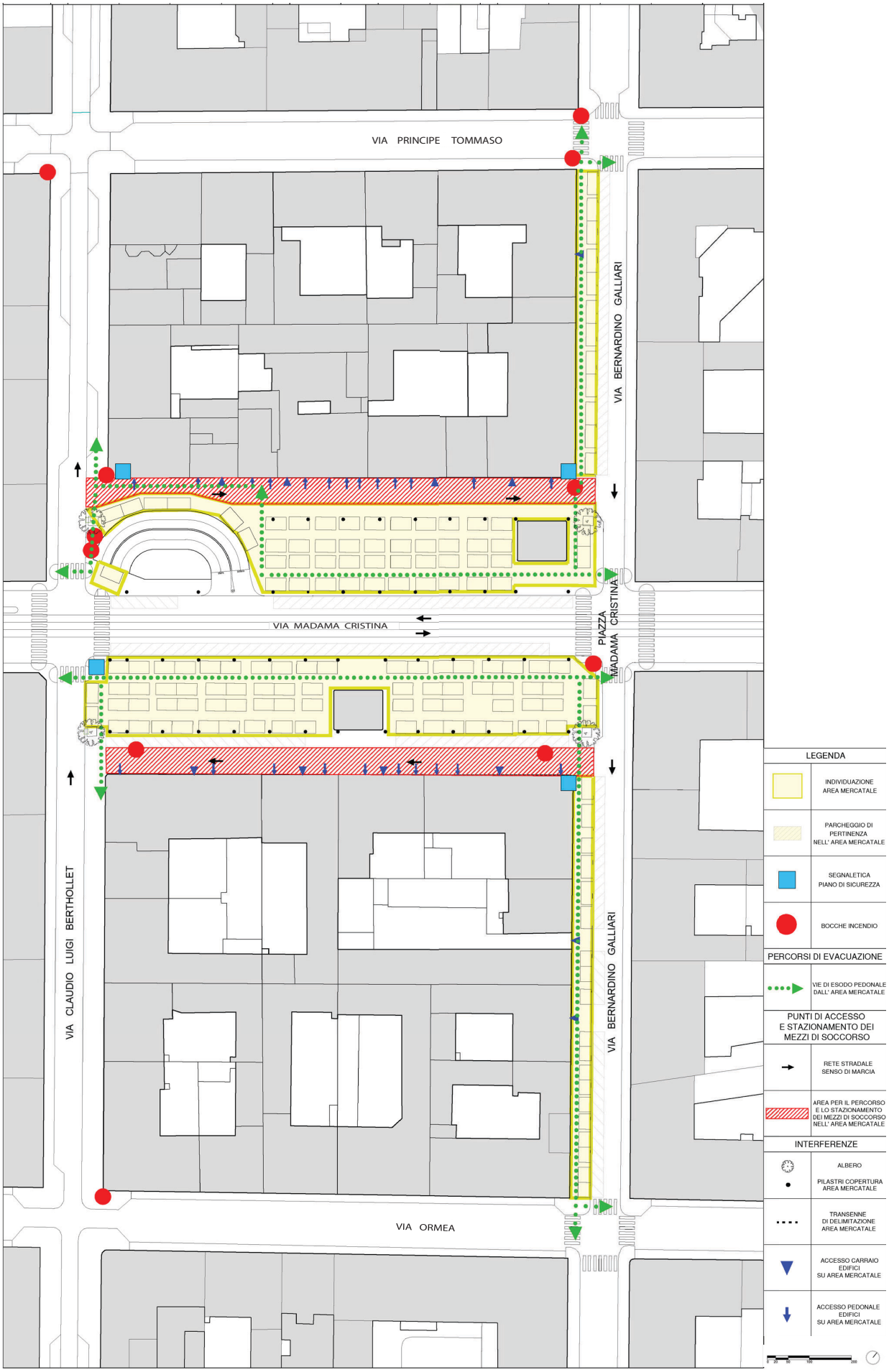


Figure 21 -
Madama Cristina market map - commercio e Impresa. (n.d) (https://commercio.comune.torino.it/mercati/mercati-allaperto/mercato-madama-cristina/)

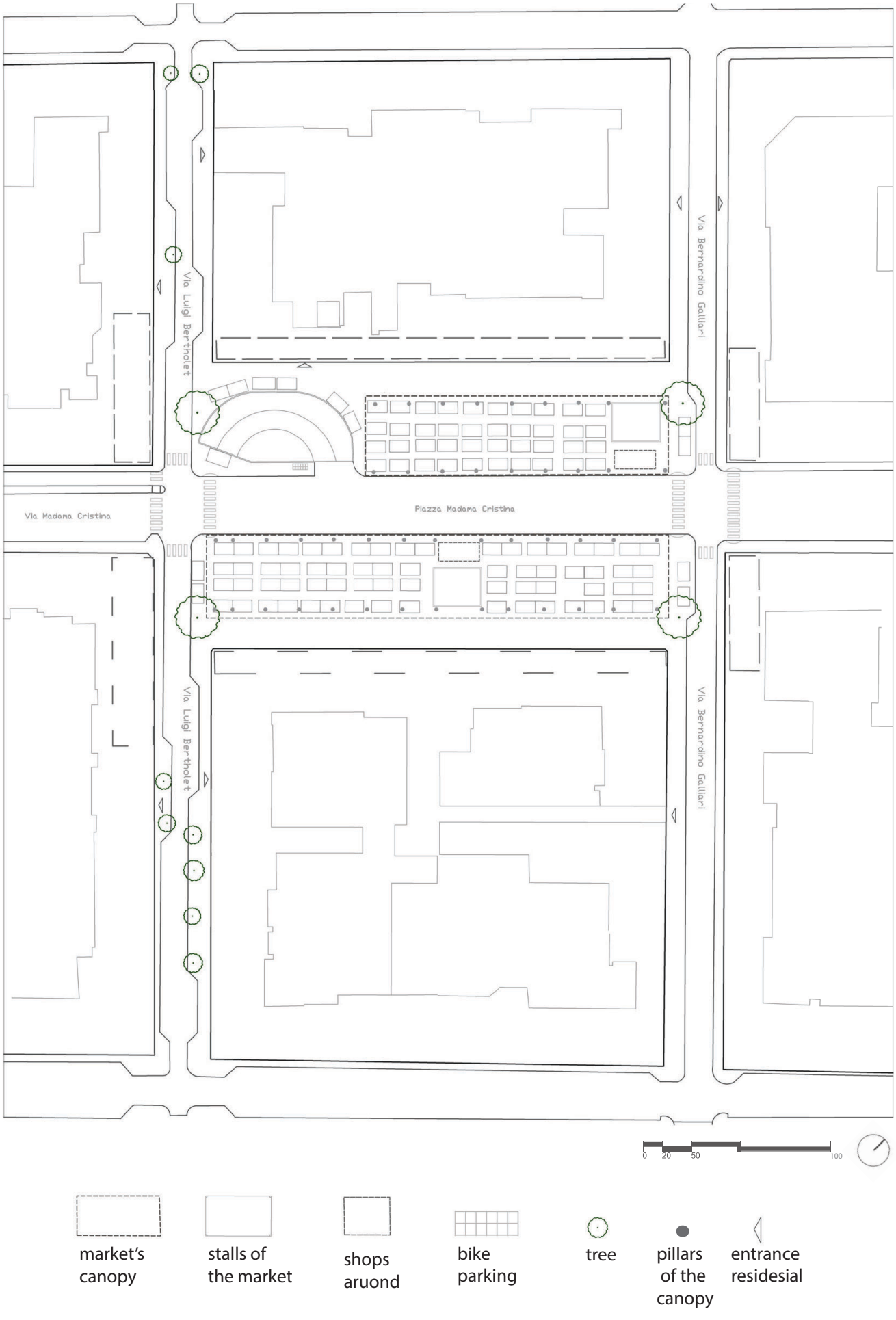


Figure 22 -
Present state plan - Madama Cristina market area in Turin
(Author drawing)

Figure 23 -
Madama Cristina market area in Turin
Entrance of the north(Author)

Figure 24 -
Inside the market (Author)

Figure 25 -
Eastern area of the market
(Author)

Figure 26 -
Canopy of the Market
(Author)

Figure 27 -
North west area (Author

Figure 28 -
Inside the market & the street Via
Madama Cristina (Author)

Figure 29 -
Northern east area of the market
(Author)

5.2.1.2 Solar Study

The summer solar study is analyzed to take place on June 21, 2024, at 4:00 PM. To figure out the position of the trees in a region with minimal shadow, it is necessary to evaluate the location with the least amount of shadow over the year. The solar study analysis will help determine whether the position of the trees is suitable for the implementation of adaptation and mitigation strategies aimed at improving the market's greenery area (Figure30).

Furthermore, The winter solar study is analyzed to take place on January 21, 2024, precisely at 12:00 AM. To determine how is the positioning of the trees during the period when the region experiences the maximum shadow, it is essential to analyze the area that exhibits the highest degree of shadow throughout the whole year (Figure31).

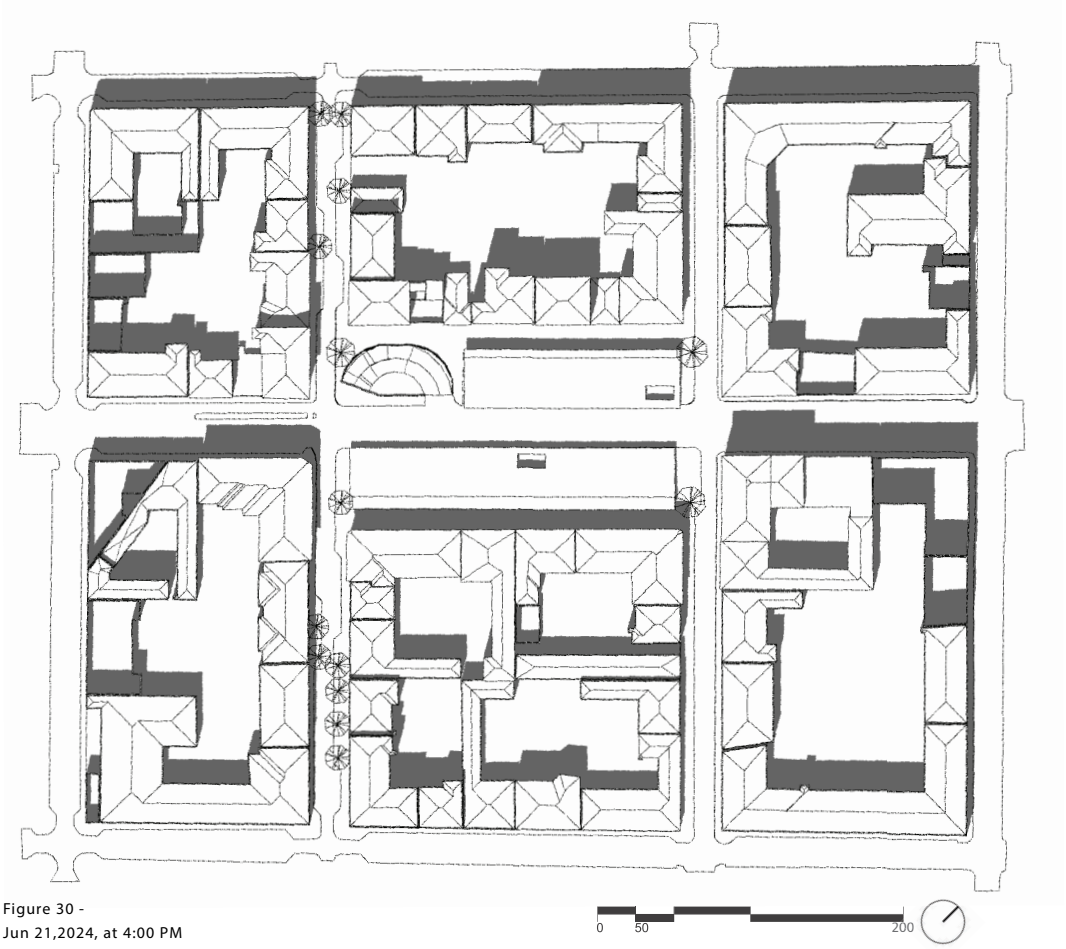


Figure 30 -
Jun 21,2024, at 4:00 PM
Site plan solar study of summer (Author drawing)

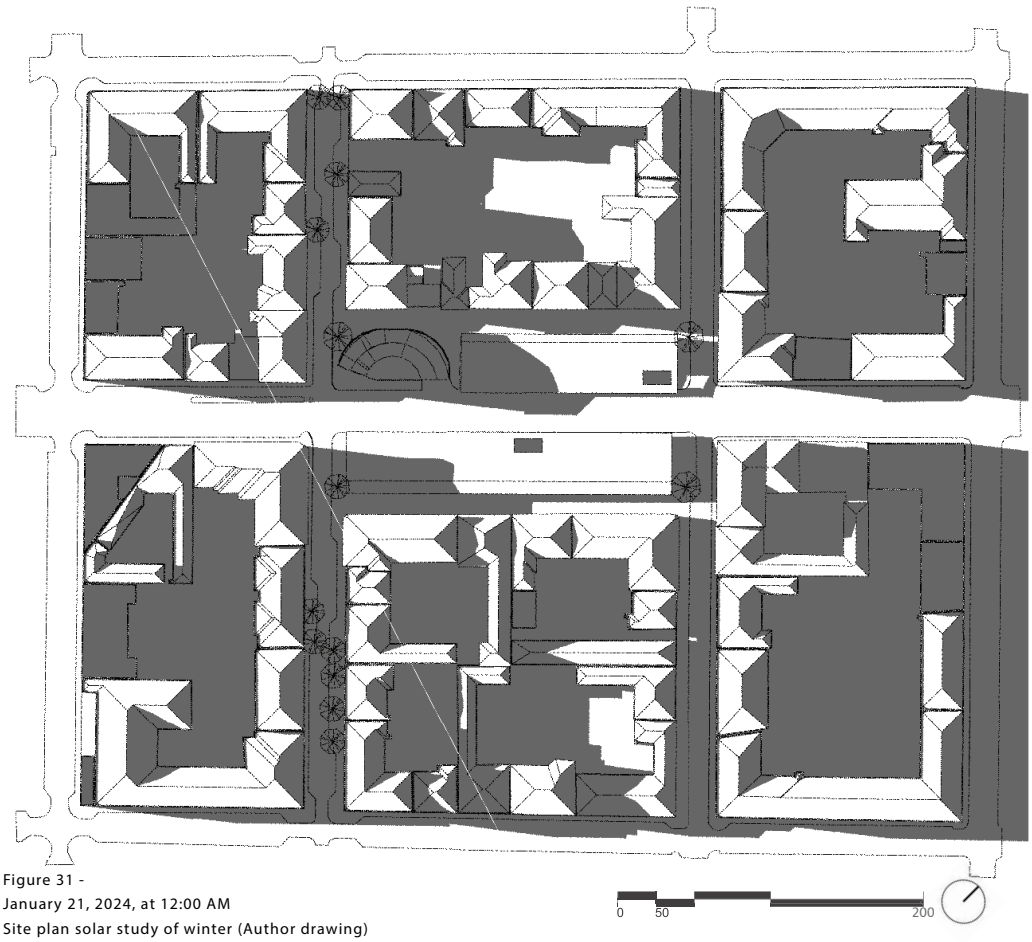


Figure 31 -
January 21, 2024, at 12:00 AM
Site plan solar study of winter (Author drawing)

5.2.1.3 Design scenario for the market

Nowadays the market area is densely provided by shops, bars and the atmosphere is quite vibrant. Nonetheless the traffic of pedestrians and cars is chaotic and the natural elements, the trees on the square and along a street not valuerised.

The idea to re-design this market is firstly emphasize the four trees to make the surrounding area more pleasant for people that are entering the area and the people who are going to the shops and bars on the side of the streets of the market. Such shops and bars are actives all days for many hours and they makes the market more welcoming. The four trees at the four corners of the area of the market are perfect to host bars and outdoor areas, the dehors. The space in the north west corner is a pleasant sunny "winter niche" (Figure 30,31).

At the corner will be placed round benches embracing the trees and allowing seating the above all the elderly people. To accomplish this, the two streets that surround the area, namely via Luigi Bertholet and via Bernardino Galliari, which are located in the north and south parts of the market area, are going to be pedestrian-only.

Residents of the area will be allowed to drive their cars through the streets in order to enter their homes, and the maximum speed that vehicles are allowed to travel is going to be ten kilometers per hour. This will ensure that the elderly people who are passing by, as well as children, will not be put in danger. Moreover, vehicles that are not

residents of the neighborhood are not permitted to cross these two streets by any means.

In order to attract people who are passing by, going shopping, and spending time at the corner, we will plant trees that are of more value to those individuals.

The project will be completed by a green extensive roof on the existing market canopy to reduce the Heat Island Effect within the very dense San Salvario neighborhood.

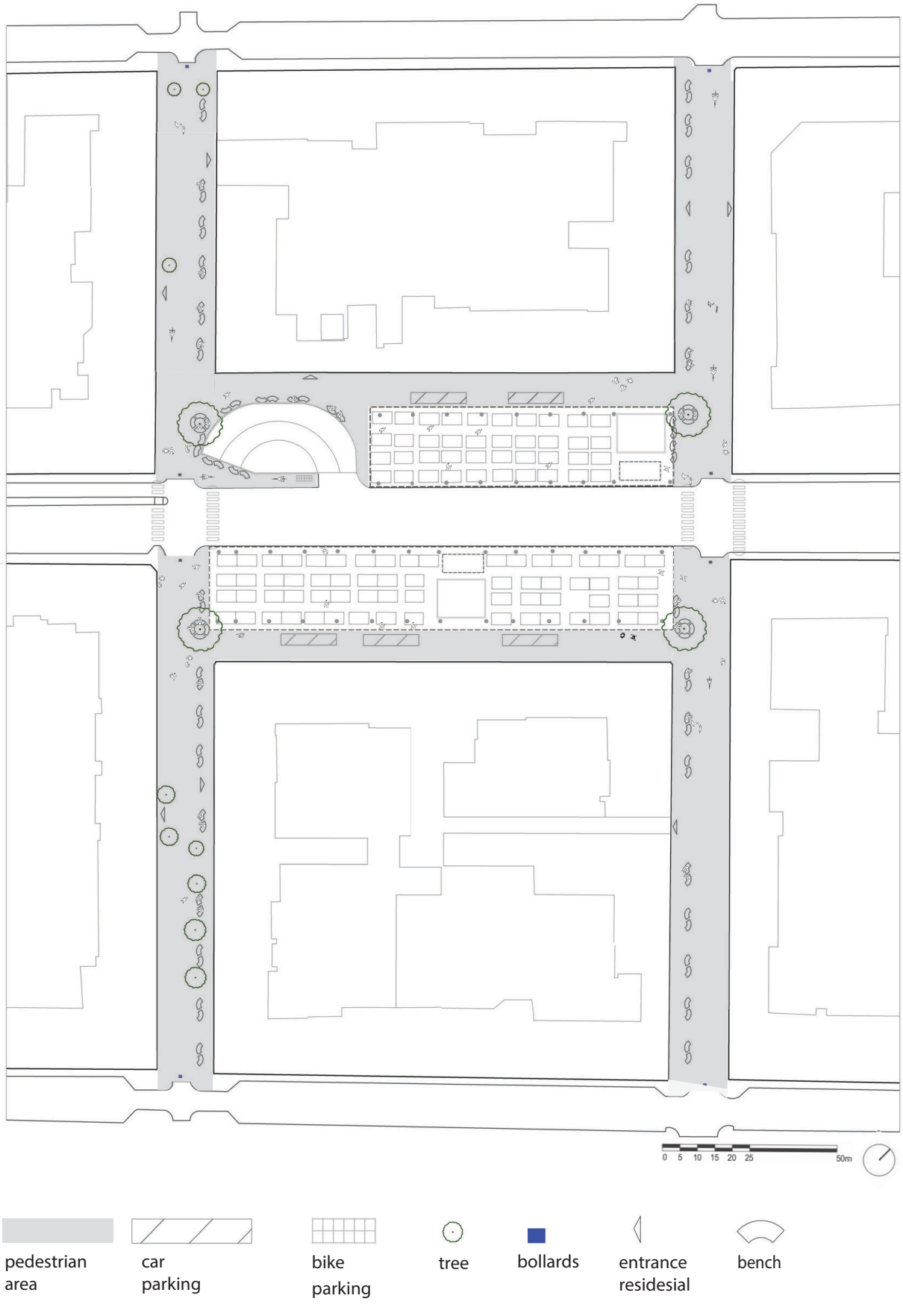


Figure 32 -
Design proposal in Madama Cristina market area (Author drawing)

5.2.1.4 Mobility scheme

In this scheme, the orientation and direction of the movements of the cars is examined to demonstrate the directions that the cars use to pass through the street after the pedestrianization of the four streets around the market area, to link to the other streets in the surrounding area, including how these street connect to each other (Figure33).

5.2.1.5 Functions scheme

Additionally, there is another scheme to show the various functions of the market area, specifically highlighting its predominant commercial nature rather than just being a small open-air market. The pedestrian zone and the market area collectively create a socially interactive environment. There are more stores in the vicinity that are influenced by the market. As people visit both the market and these shops, they are likely to engage more and establish stronger connections, resulting in a more inviting environment (Figure34).

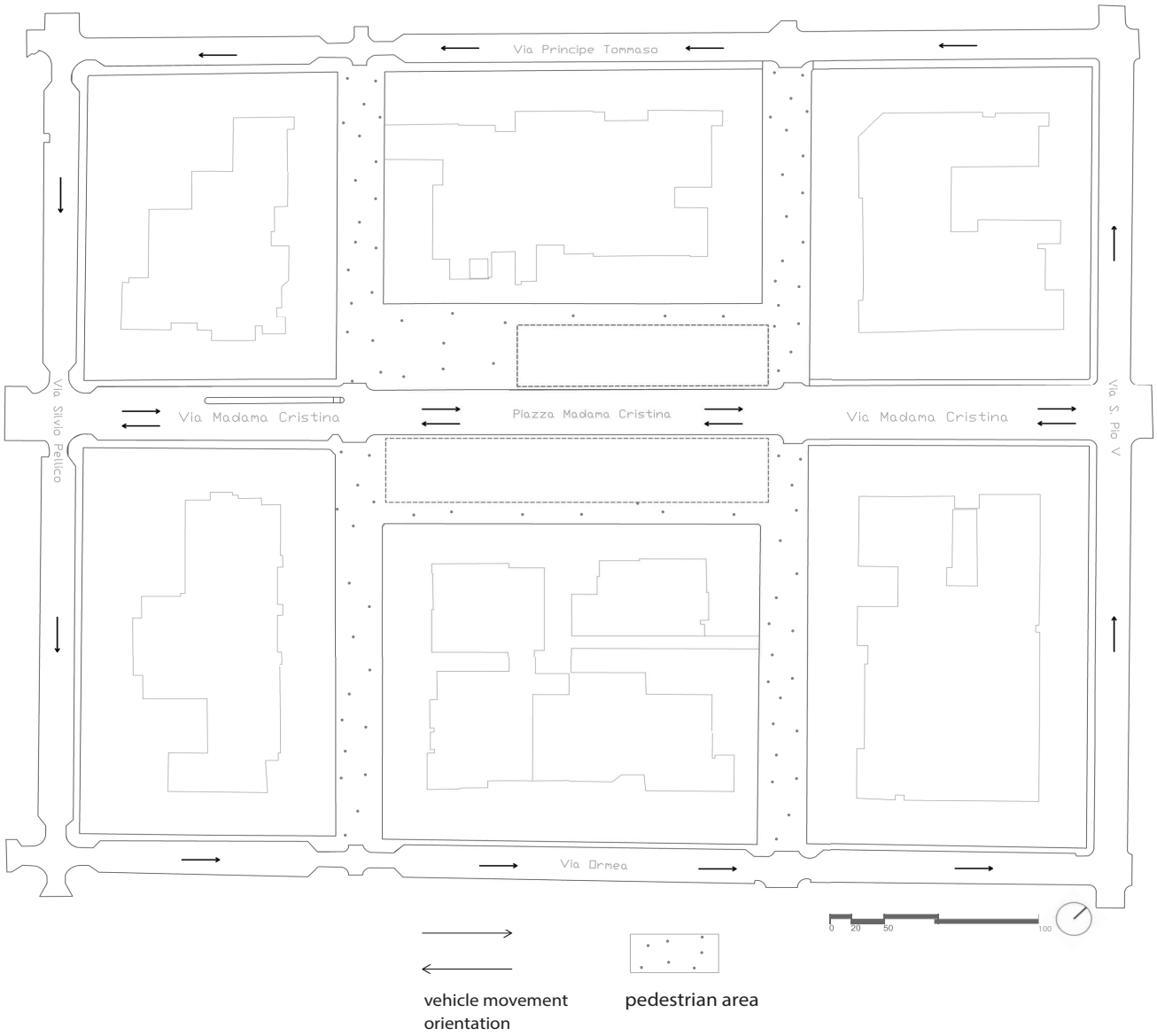


Figure 33 -
Mobility of the streets around market area(Author drawing)

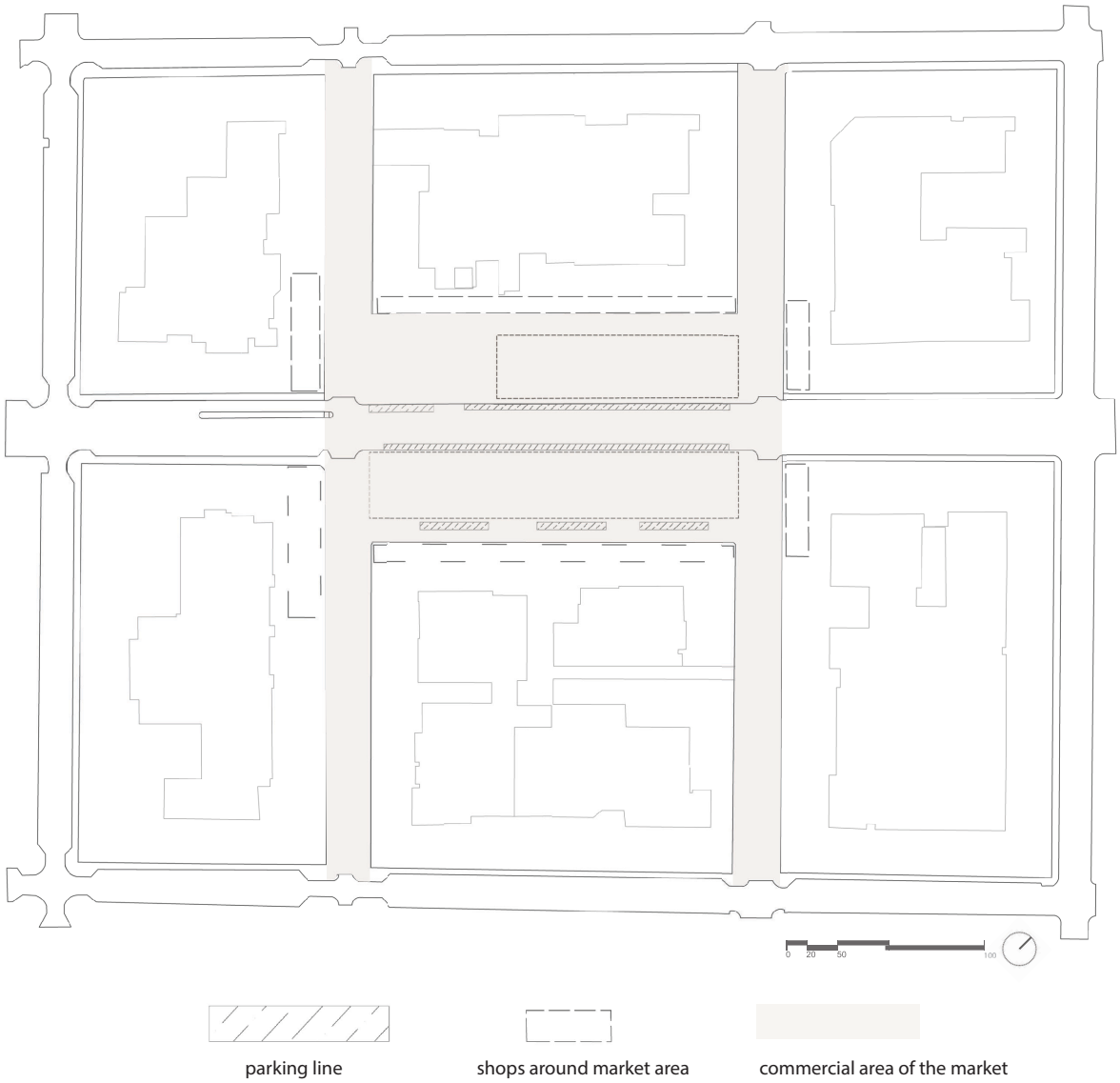
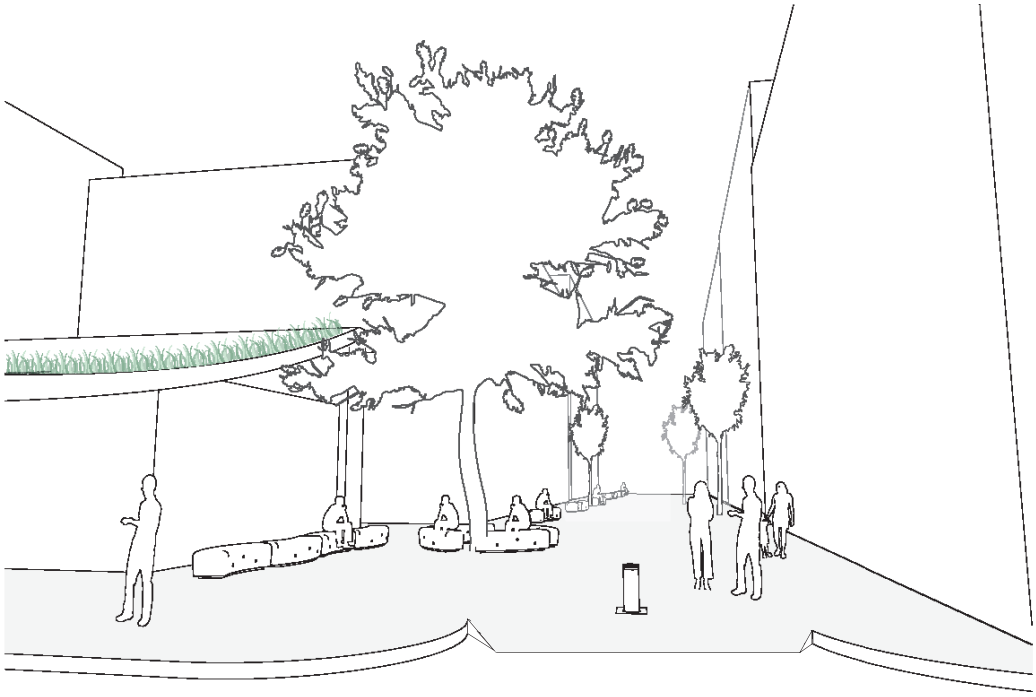
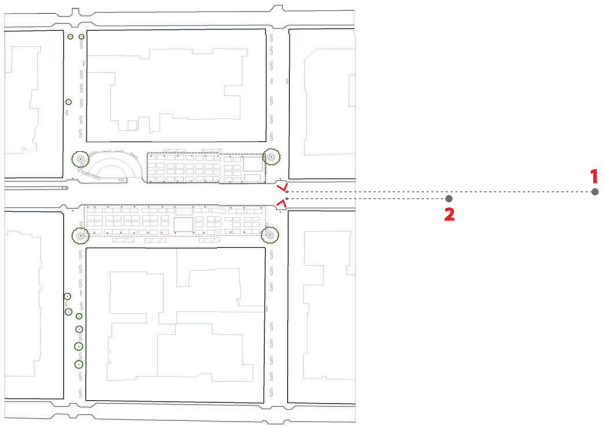
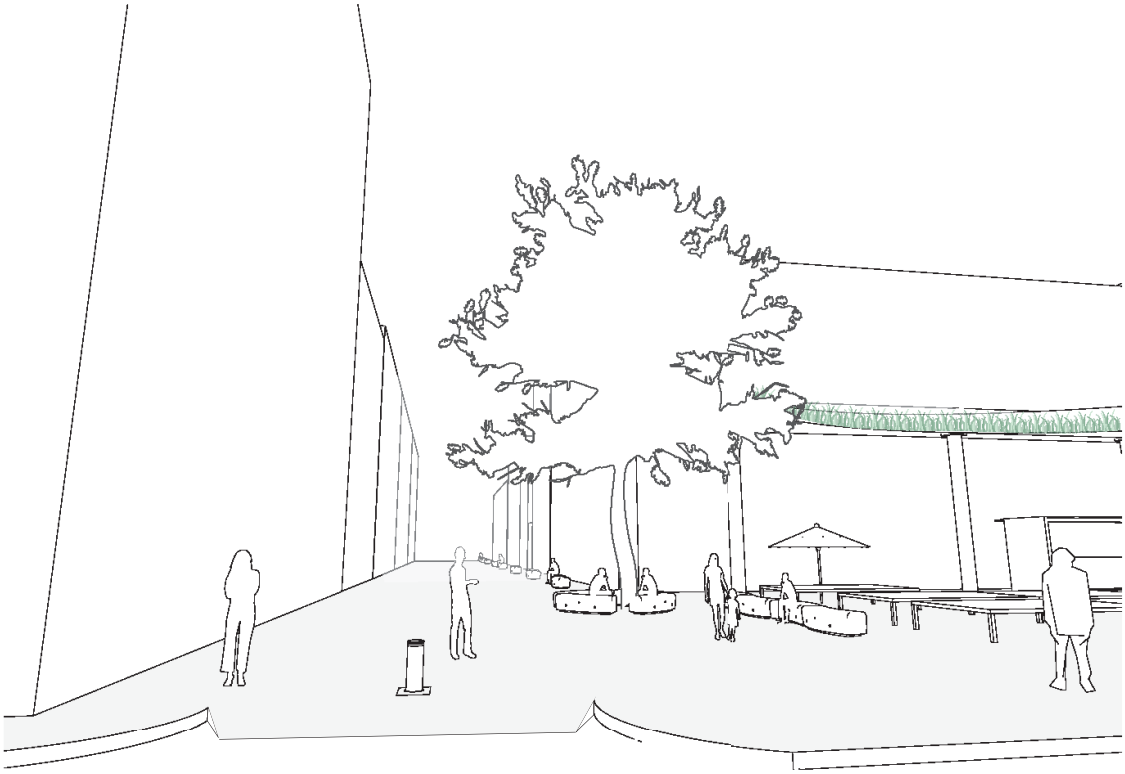


Figure 34 -
Functions around market area(Author drawing)



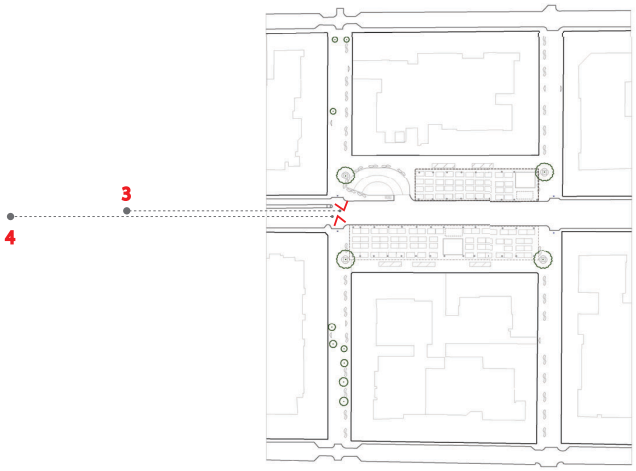
Perspective **1**

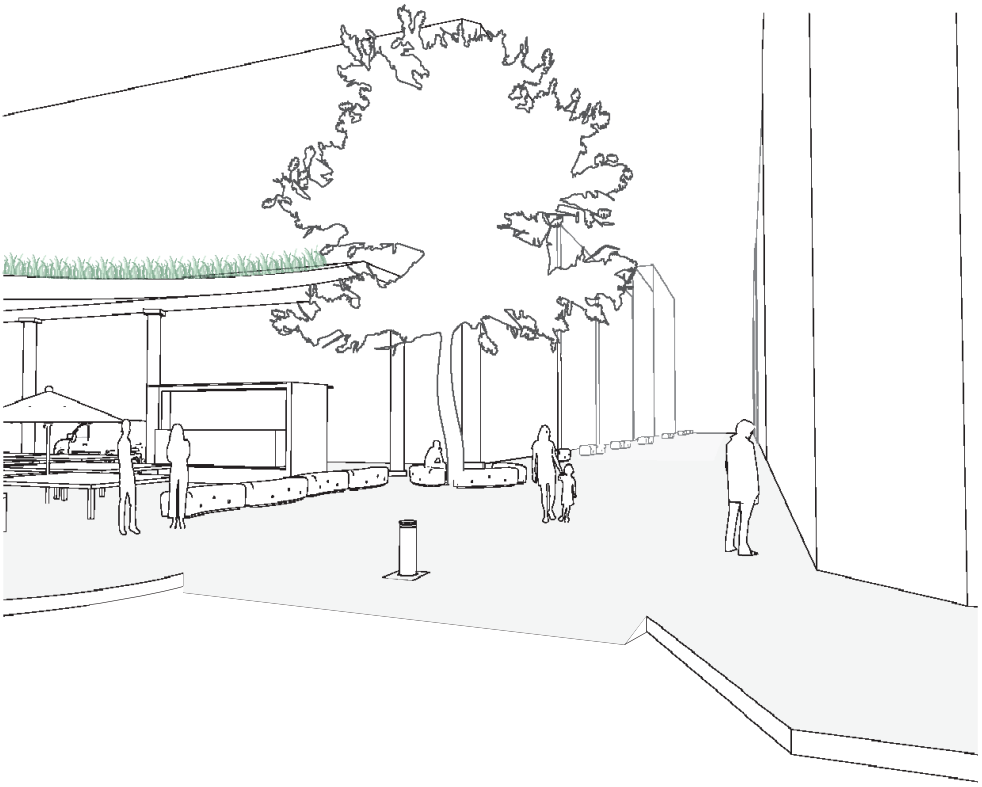




Perspective **2**

Perspective **3**





Perspective **4**

Figure 35 -
Perspective view of four edges of the market area
(Author drawing)

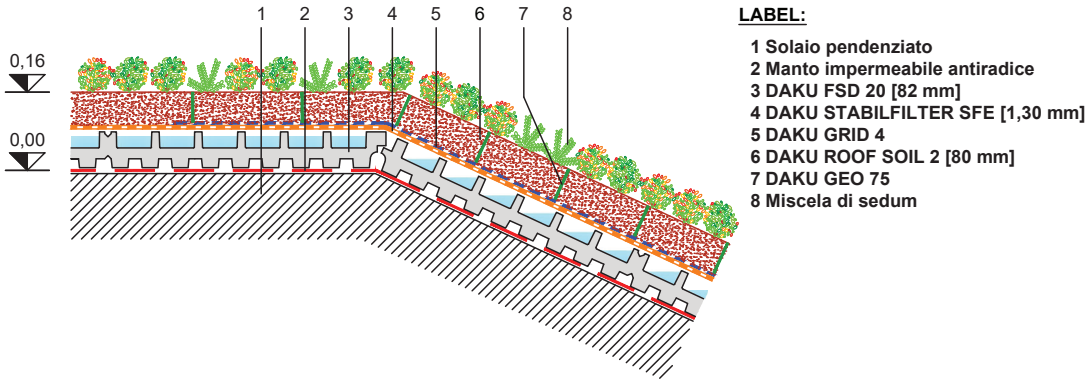


Figure 36 -
extensive pitched joint stratigraphy (SRL, n.d.) [77].

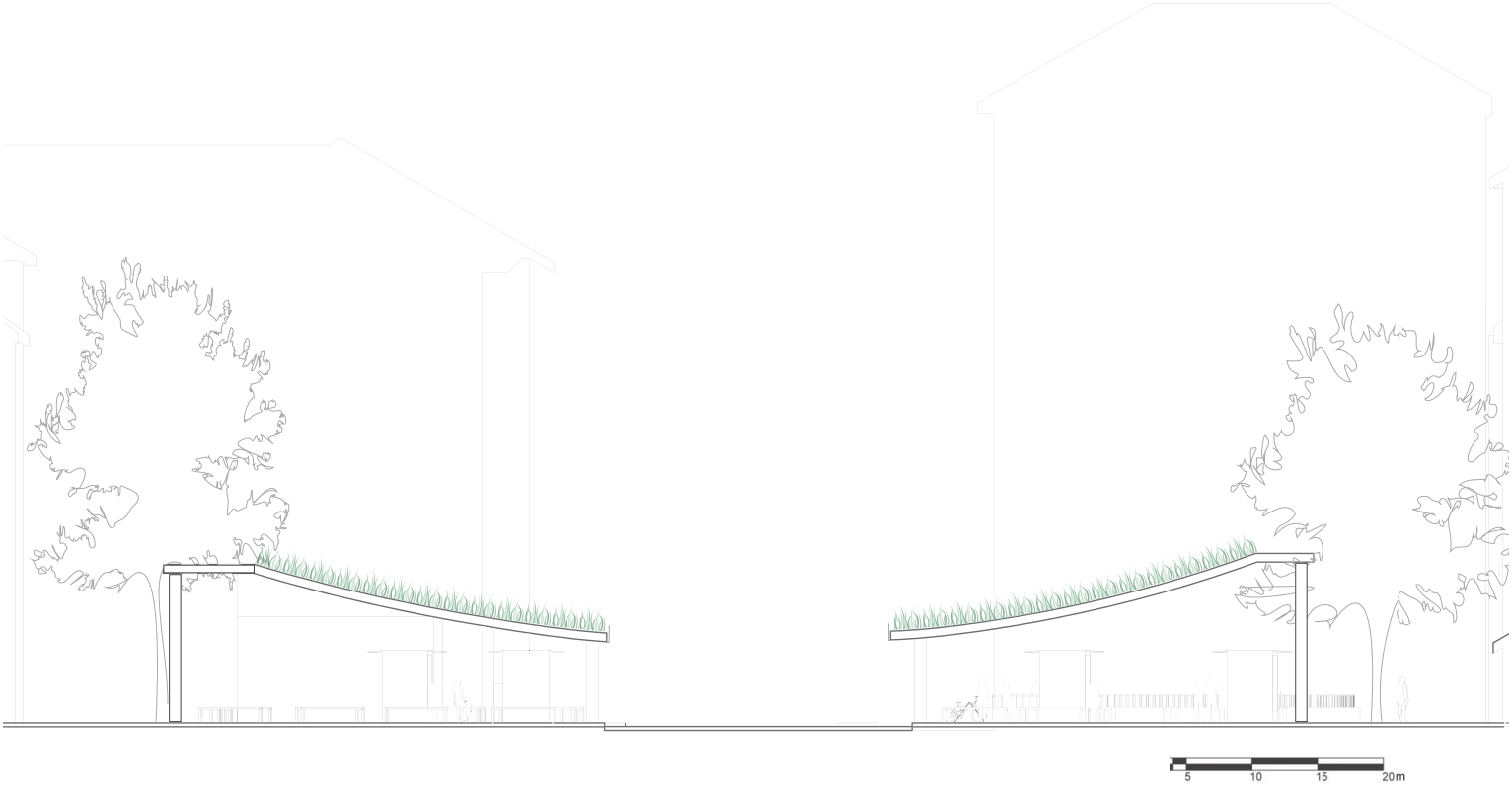


Figure 37 -
Section A-A of the designed plan - Madama Cristina market (Author drawing)

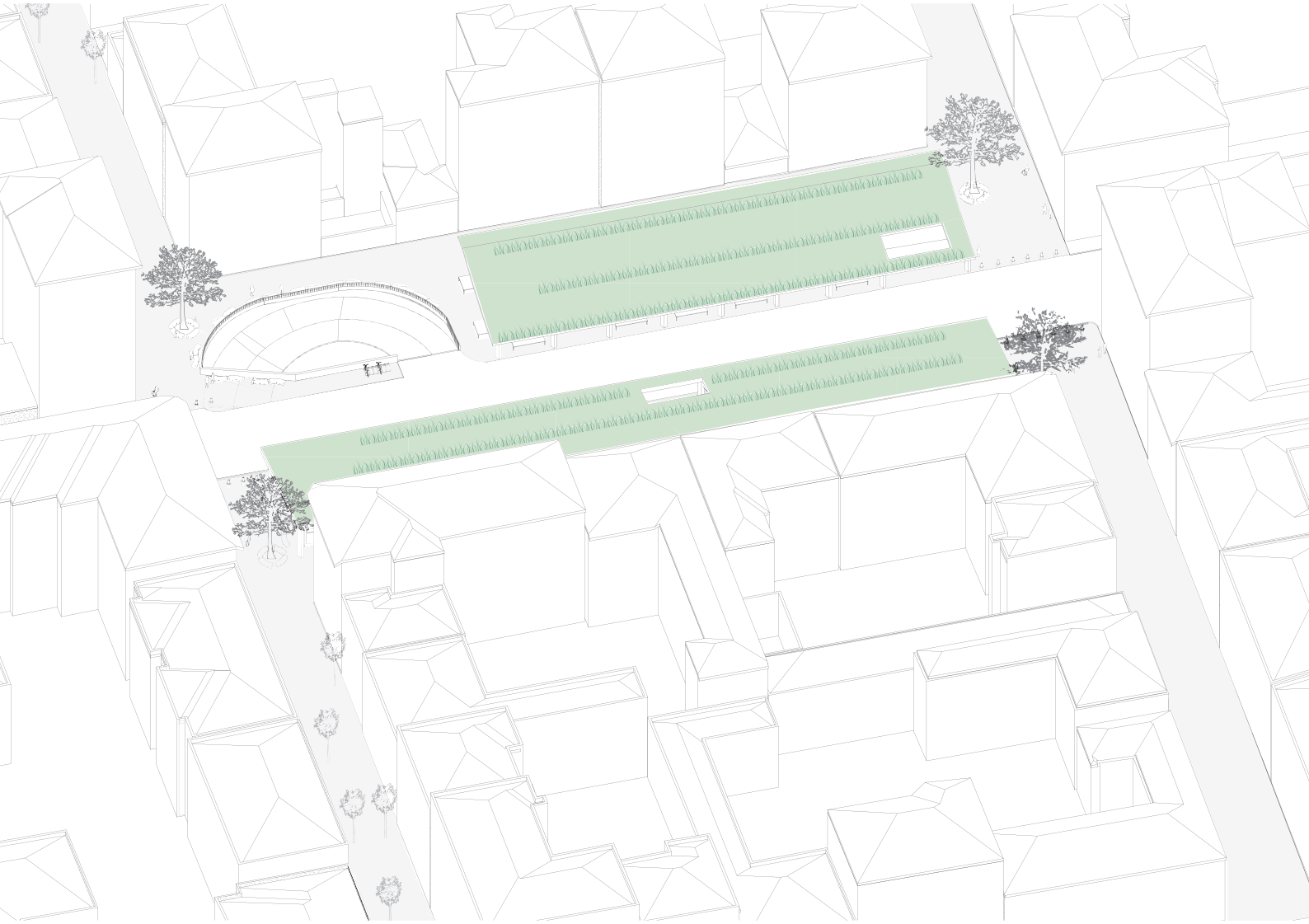


Figure 38 -
Design scenario Madama Cristina market
axonometric view
(Author drawing)

5.2.2 Case Study 2: Sebastopoli Market

Location :	Corso Sebastopoli
Market area :	7403.87 sqm
Market Type :	Linear
Year of establishment:	1946

The market is situated in the area of Santa Rita, specifically on Corso Sebastopoli, between Corso Agnelli and Corso Orbassano. The market was established during the Second World War and is situated in Corso Sebastopoli, spanning around five blocks. Two separate neighborhoods are situated along the borders: on the western side, there is a region that serves as a residential and commercial hub, while on the eastern side, there is a recreational area abundant with parks and sports amenities.

The market is situated around a central quay adorned with trees, and extends beyond the two adjacent streets, hosting a multitude of small stores and companies. It is a prominent market in Turin, known for its expansive size, reasonable pricing, and even distribution of booths. By the end of the day, it is feasible to discover unsold merchandise priced at just a few euro cents. This opportunity entices several clients, including restaurant owners and retailers. The name of the neighborhood is derived from the adjacent Santa Rita da Cascia church, which initiated the development of the region beyond the city walls, currently known as Piazza Omero[78].

5.2.2.1 Present state of the market

The present situation was analyzed based on the maps obtained from the municipality. These details include the placement of the stalls and their organization, as well as the organization of parking spaces for each car to park at the area of the market. Additionally, the location of the trees in the market area, which are the only green in the market area, must be regularly maintained and kept in good condition in order to ensure the market area's continued viability. The vegetation in the market area are several trees located on both sides of the linear path within the market area. These trees, known as "Celtis Australis," are relatively tall, ranging in height from 7 to 15 meters. They are the only greenery present in the market vicinity. In this chapter, the selected area of the whole market is chosen from one block of the area in order to investigation deeply on the details of the market.

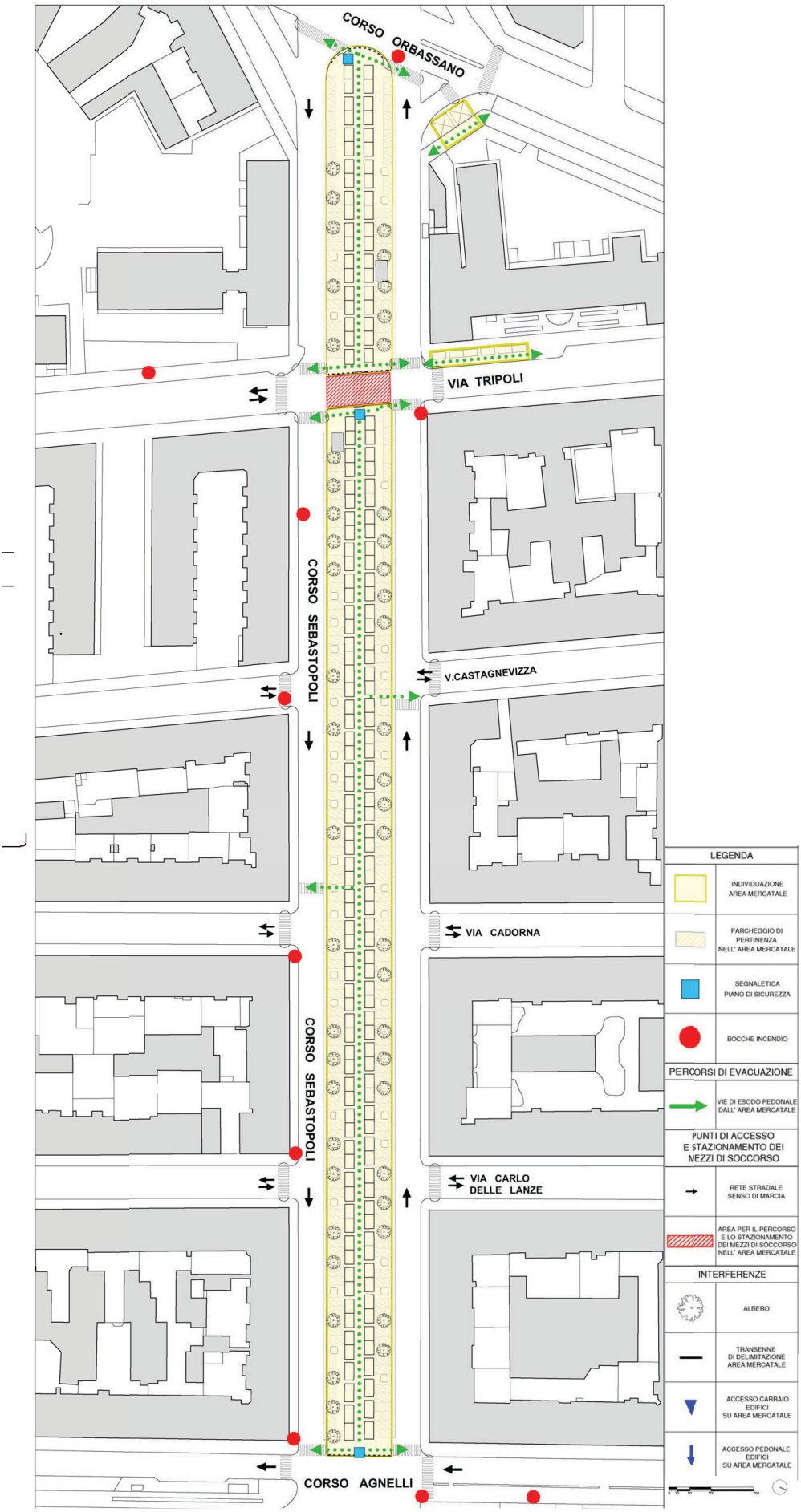


Figure 39 -
Sebastopoli Market map- Commercio e Impresa. (n.d.). (https://commercio.comune.torino.it/mercati/mercati-allaperto/mercato-sebastopoli/)

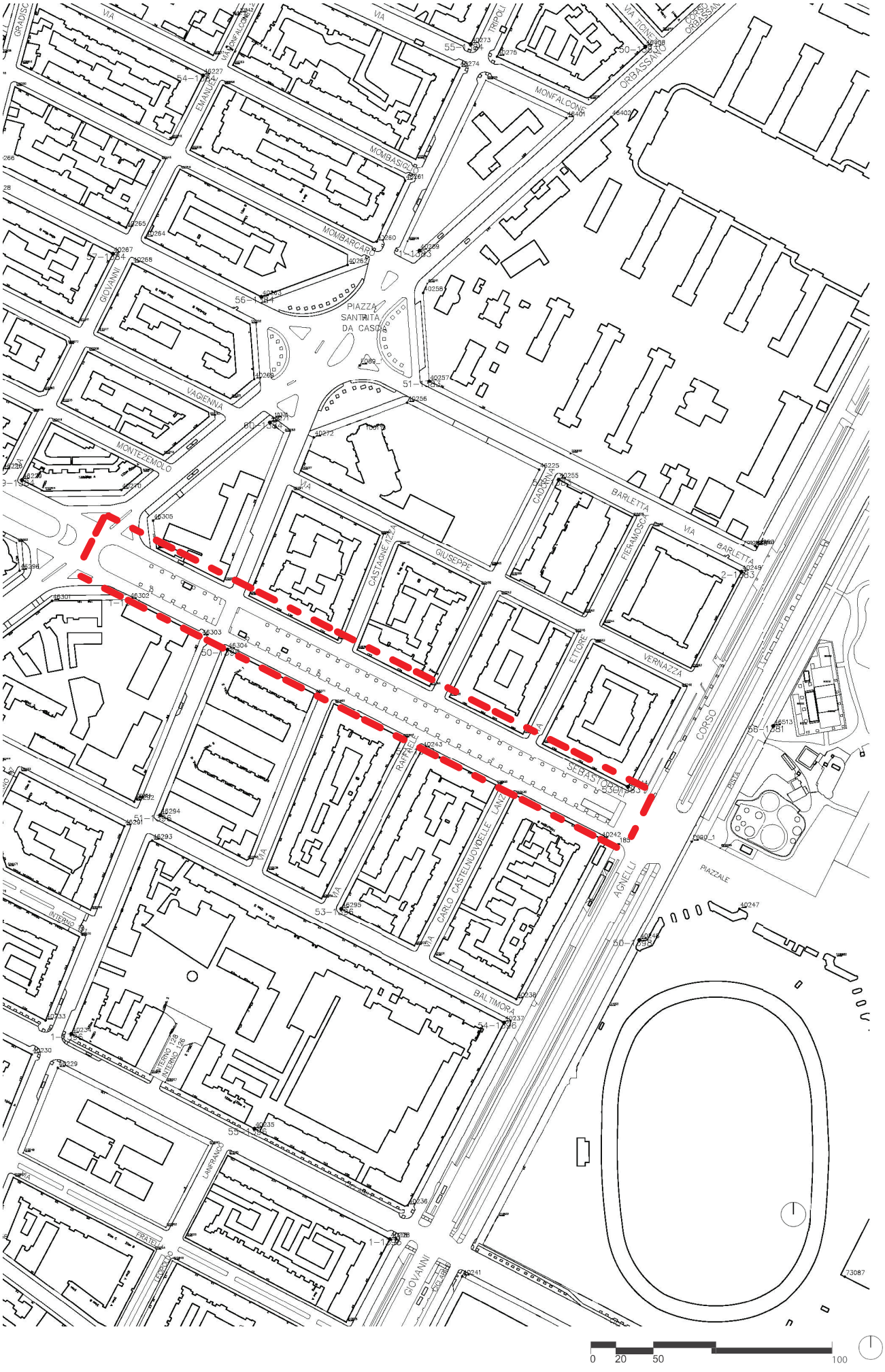


Figure 40-
Sebastopoli Market map (from municipality of Turin)

Figure 41 -
Entrance of the western part of the market Sebastopoli (Author)

Figure 42 -
Entrance of eastern part of the market Sebastopoli

(Author)

Figure 43-
Inside the market- walkable area (Author)

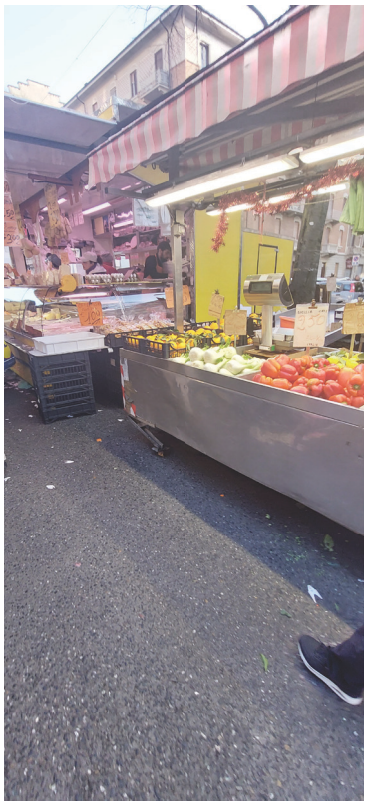
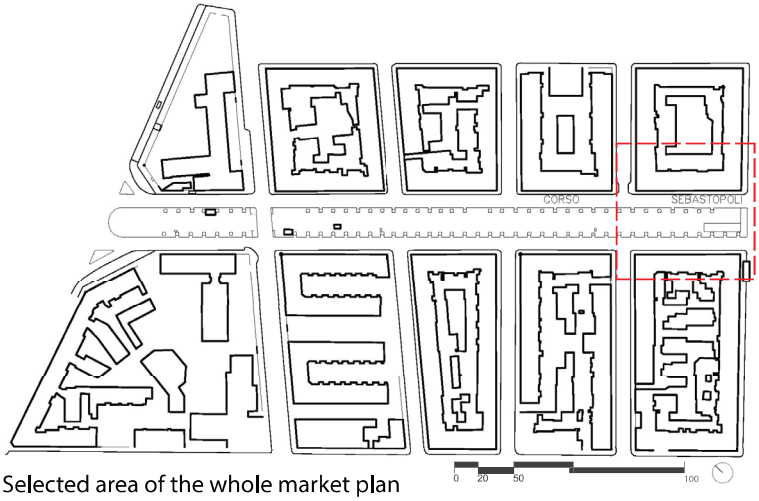
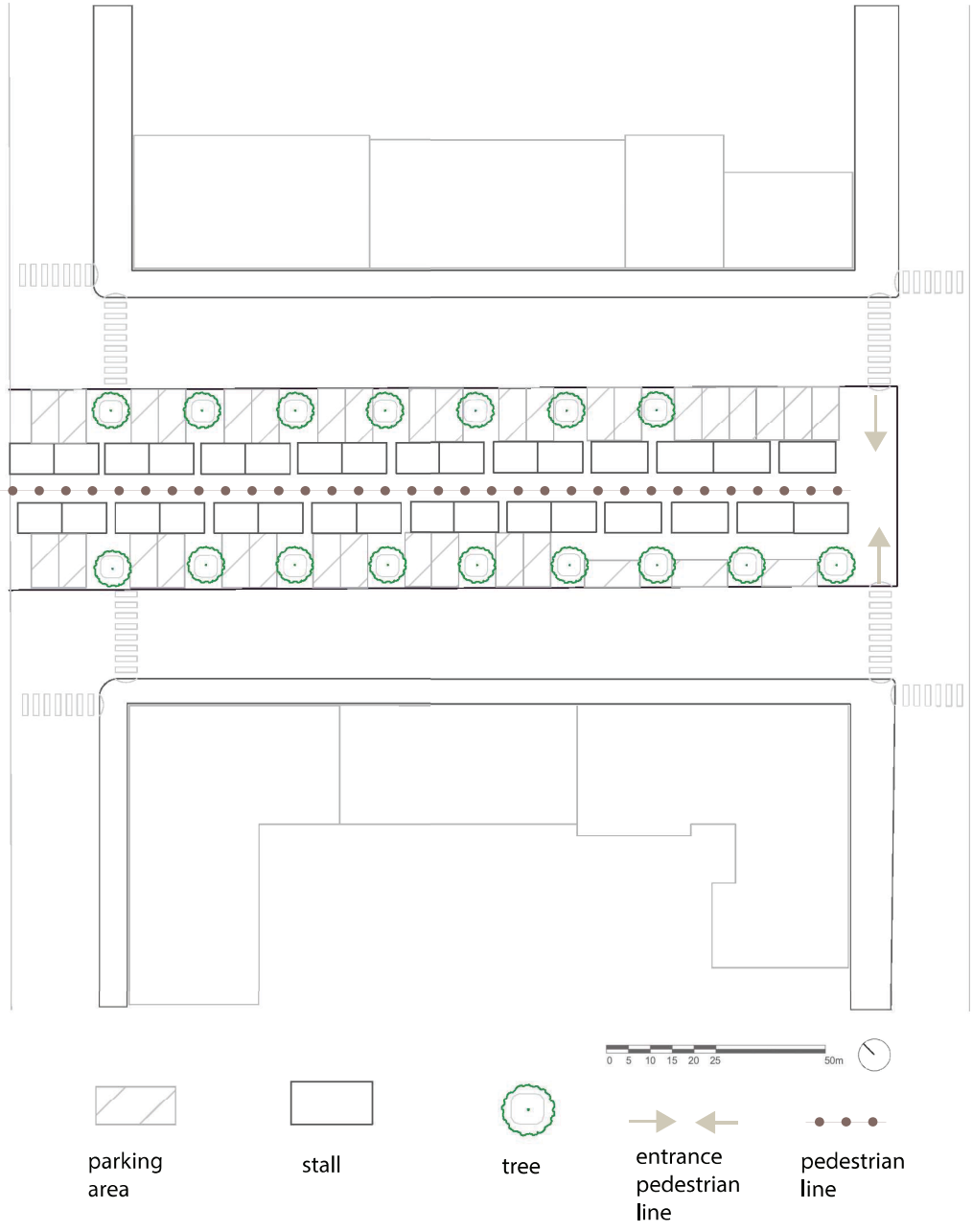


Figure 44-
Various stalls of the market (Author)



Selected area of the whole market plan



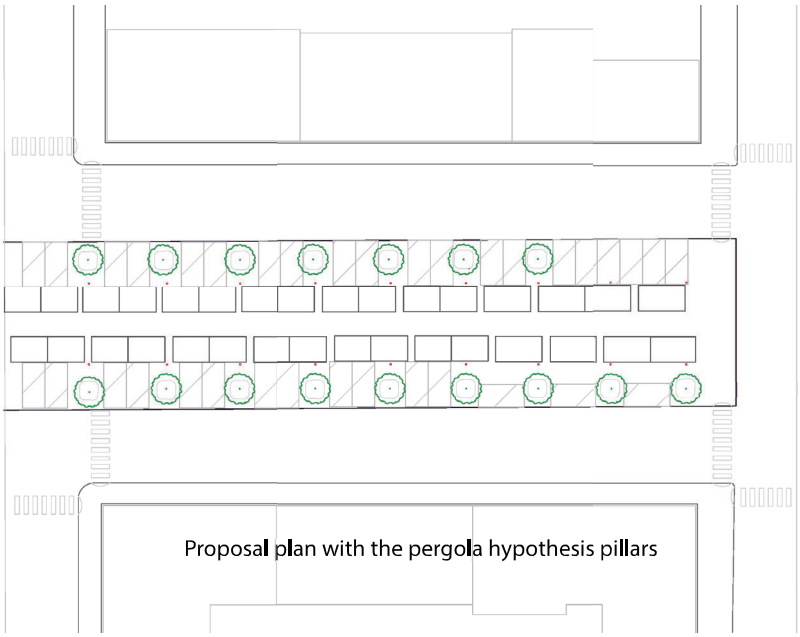
Plan of the Selected area - with pillars the hypothesis pergola

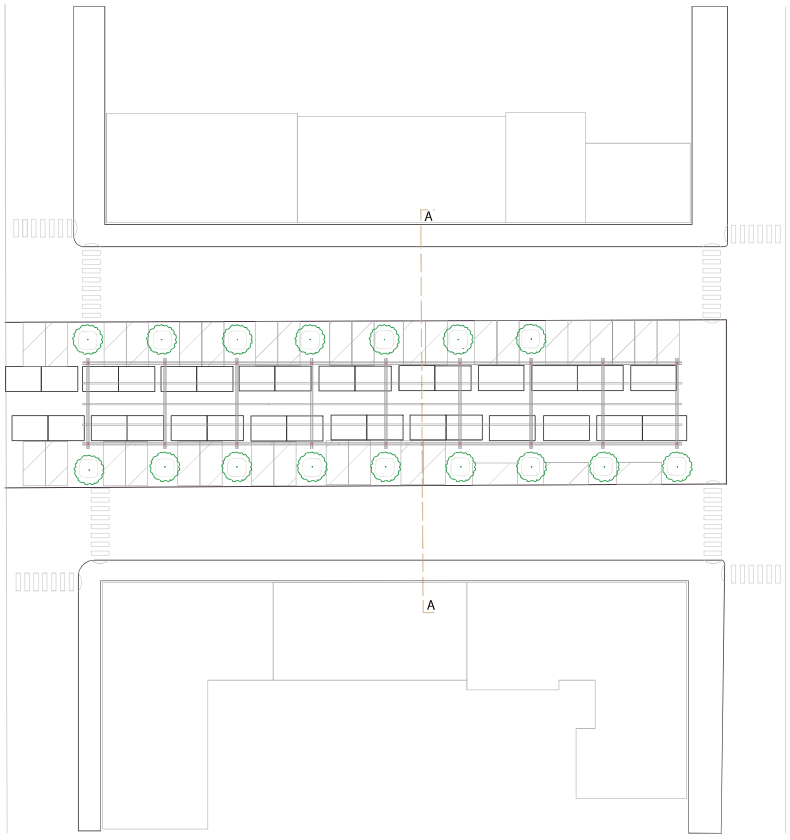
Figure 45 -
Selected are of the market map to study (Author drawing)

5.2.2.2 Design Scenario for the Market

In order to thoroughly examine the design concept, a specific section of the first market plan has been chosen to provide more detailed information for incorporating the idea into the designs. The design concept involves including a pergola inside the pedestrian area between the market stands.

As showing (figure46), the spacing between the placement of the stalls and the dimensions of the parking lines for the automobile parking area to have enough space, has been considered for finding a the proper positioning of the pergola. Additionally, the narrow pedestrian path in the center of the market lacks shade, which is necessary for the comfort of customers, shoppers, visitors, and workers and sellers of the market. The stalls' umbrellas provide some coverage for the products, but additional shade is required. The pergola in this hypothesis is constructed from timber wood and includes plants on top to regulate evaporation on warm summer days and provide fresh air in the market on wet days of the year.





Proposal plan with pergola hypothesis

Figure 46 -
Selected are with the pergola hypothesis(Author drawing)

Designed plan
pergola hypothesis

3D view of the
pergola connections

Figure 47 -
Section A-A, designed pergola hypothesis (Author drawing)

Chapter 6

Synthesis

6.1 Conclusion

This research has provided valuable insights into the significance of Turin's open-air market network within the urban context and its relationship to environmental quality. The examples analyzed, Madama Cristina Market and Sebastopoli Market, and the international best practices have highlighted the unique challenges each market faces, as well as the potential for integrating mitigation and adaptation strategies to enhance their environmental sustainability. The two design strategies suggested, such as pedestrianization and the incorporation of green elements, have the potential to significantly improve the environmental quality and strengthen businesses in these markets. Moreover such strategies can be suggested in the design improvement hypothesis of other market sites, investigated in the first part of the thesis with the same features and potentials. As a general recommendation, in the compact typology surrounded by commercial area the pedestrianization can be considered, while the implementation of trees and pergolas can improve the quality of the linear schemes (see figure 13 and 17). This research underscores the importance of considering environmental sustainability in the design and management of open-air markets. Future research should continue to explore and develop strategies for enhancing the sustainability of open air markets in Turin and beyond.

6.2 Research Limitations

Scope of Study: The research focused on two open-air markets in Turin, which may not be representative of all markets in the city or in other locations. The findings may therefore have limited generalization.

Data Availability: The research relied on available geographical data and the current state of the markets. Changes in these markets or inaccuracies in the data could affect the findings.

Subjectivity in Design Recommendations: The design recommendations provided in this study are based on the researcher's interpretation of the data and understanding of environmental sustainability. Other researchers or practitioners might have different perspectives or suggestions.

Implementation of Recommendations: The study provides recommendations for enhancing the environmental sustainability of the markets, but the feasibility of implementing these recommendations was not assessed. Factors such as cost, public acceptance, and regulatory constraints could affect the implementation of the suggested design interventions.

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