Urban regeneration in Lisbon and Environmental Park

Design for transforming "Antiga GALP" site in an environmental urban park

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Abstract

This research investigates the transformation of Lisbon's "Antiga GALP" site into an environmental urban park, addressing the pressing challenges of urbanization, food security, and sustainable development. The study emphasizes that urban agriculture policy development is a key element of successful urban revitalization and aims to explore innovative ways to achieve urban revitalization by integrating urban agriculture, environmental restoration and community-centered design.

Employing a multidisciplinary methodology, the research analyzes Lisbon's climatic conditions, policy frameworks, and urban agriculture history. Comparative case studies from Barcelona, Montreal, and Yarra provide insights into best practices for integrating urban agriculture within urban regeneration projects. Additionally, site-specific analyses, including soil quality, green space connectivity, and infrastructure potential, underpin the project's design framework.

Key findings demonstrate that well-crafted urban agriculture policies can bolster food security, enhance local ecosystems, and strengthen community participation in urban development. The proposed master plan incorporates mobility, water management, and biodiversity while prioritizing environmental education and agricultural productivity in phased developments. The policy framework aligns these elements with Lisbon's broader urban planning objectives.

This study contributes to urban planning discourse by presenting a scalable model for transforming post-industrial sites into multifunctional urban landscapes that address contemporary socio-environmental challenges. The findings underline the significance of aligning local needs with global sustainability goals to achieve resilient urban ecosystems.

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Chapter 1

Research General Overview

1. Research General Overview

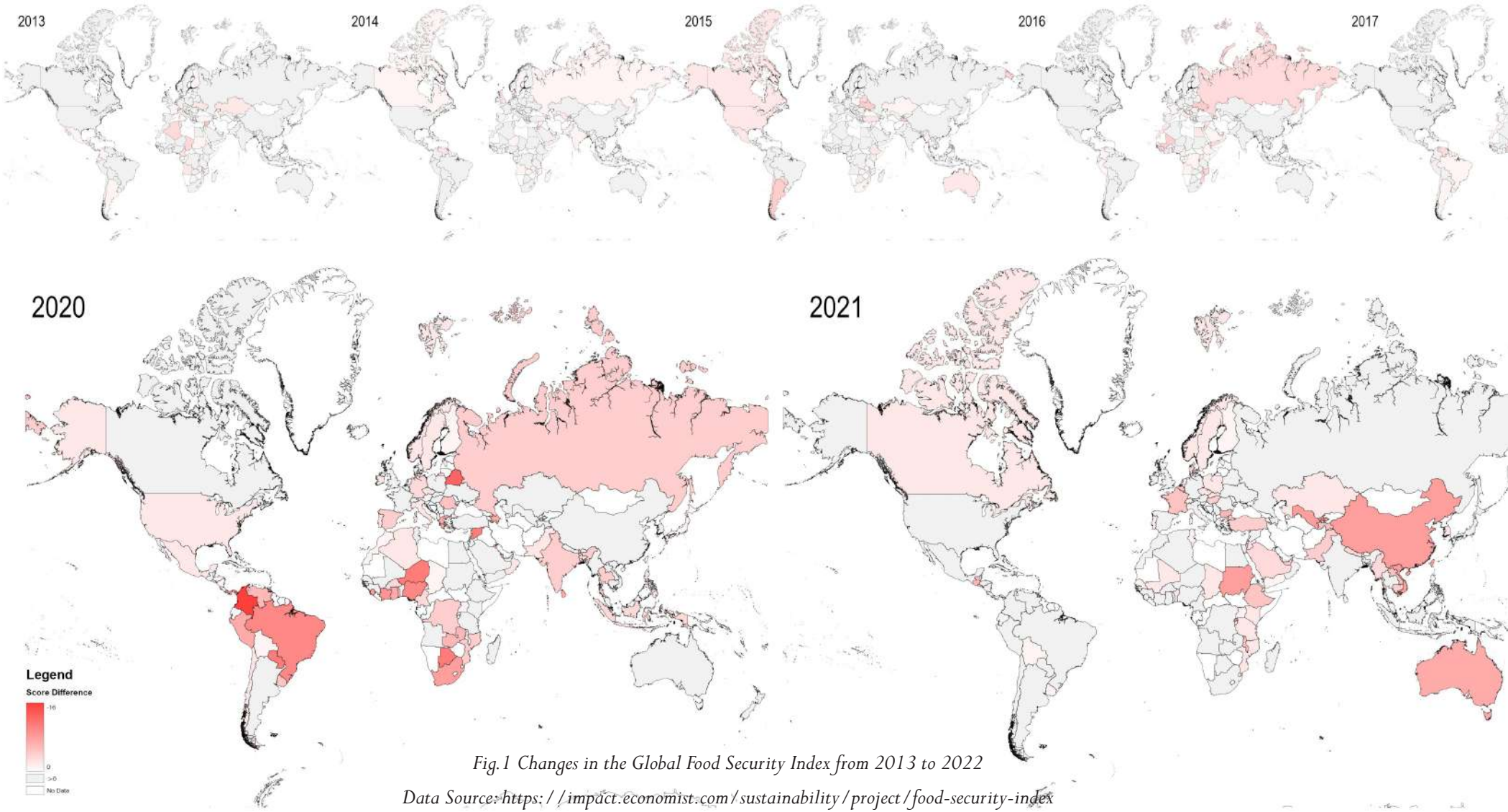
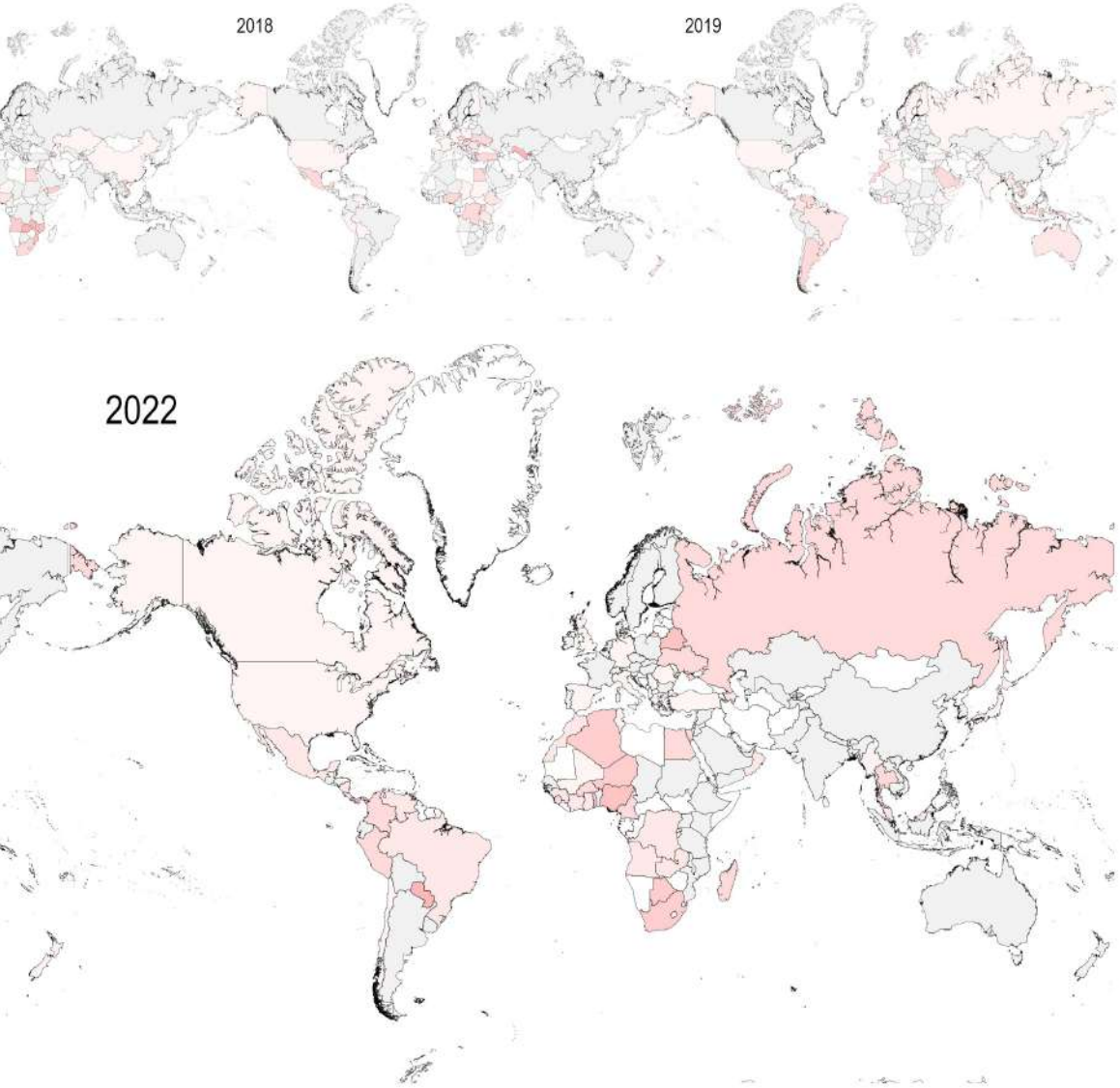


Fig.1 Changes in the Global Food Security Index from 2013 to 2022

Data Source: https://impact.economist.com/sustainability/project/food-security-index



1.1 Food Security

Urbanization is the result of urban population growth, urban sprawl, and rural-to-urban migration. The process of urbanization is changing rapidly, and it varies from place to place, and is promoted by the interweaving of various factors. In many parts of the world, urbanization is increasing rapidly, with the proportion of the world's population living in cities increasing from 30% in 1950 to 57% in 2021, and with increasing levels of urbanization, an estimated 7.0% of the population will live in cities by 2050. In most regions, urbanization has led to a structural and economic transformation of cities away from agriculture, and food security is threatened by natural and man-made disasters as food supplies are threatened by growing urban populations, inadequate urban food sources, and rising costs for some urban communities that cannot afford food.

From 2013 to 2019, the global food security index fluctuated within the normal range for most of the rest of the year, except for 2015 and 2016 (the shade of red in the legend indicates the extent of the decline in the food security coefficient compared to the previous year), and the global food security index fell sharply between 2019 and 2022.

In 2015, the Latin America region experienced the most widespread and severe decline, mainly due to severe drought in South America that year began and the currencies of many Latin America countries experienced significant depreciation in 2015, notably the Brazil real and the Argentina peso. This has led to a significant increase in the cost of imported food and agricultural inputs, affecting the affordability of food. This was followed by a significant decline in the food security index in North America, mainly due to the United States and Canada, as United States' food safety standard ratings declined in 2015 and the Canadian dollar depreciated significantly, which led to higher costs for imported food and agricultural inputs. As Canada relies on imports of many food and agricultural supplies, the depreciation of the currency has directly led to higher food prices, affecting food affordability. The country with the worst decline in the food security index in 2016 was Russia, mainly due to the economic sanctions imposed on Russia by Western countries, especially those related to the conflict in Ukraine, which had a significant impact on the Russia economy. The depreciation of the ruble has led to an increase in the price of imported food, which has affected the affordability and availability of food. Since many food and agricultural inputs (such as seeds, fertilizers, and agricultural technology) are dependent on imports, currency depreciation increased the cost of these commodities, and the economic downturn at the time further affected food prices.

In 2020, more than half of the regions experienced a sharp decline in food security indices compared to 2019, most likely due to the 2019 COVID pandemic, which led to lockdowns and restrictions imposed in many countries, leading to reduced international trade activities and instability in food supply chains, exacerbating food security in some countries. During this period of 2021, we can see that the countries with the worst declines in the food security index have eased the situation during the year, but there are still some countries that have become more severe than the previous year, such as China and Australia. Countries that are recovering rapidly have a fairly high degree of food security resilience, and we speculate that most of them are large agricultural producers, and their pillar or main industries are mostly agriculture. However, it is still important to note that food insecurity did not improve much in 2021, as the COVID-19 pandemic peaked this year. In 2022, we can see that the areas where the food security index has fallen have become more widespread than in the previous year. Although the global impact of COVID-19 is becoming smaller, the war between Russia and Ukraine, the world's two largest producers of agricultural products and grains, has led to food and energy market shocks, supply shortages, further driving up food prices, and the globalization of trade has also spread the risk of food insecurity more widely.

Overall, although countries around the world are gradually recovering from the global pandemic, the pace of recovery varies from

country to country and region to region. And the global food security index is still well above pre-COVID '19 levels. Although it now appears that by 2030 it is possible to end hunger, achieve food security, improve nutrition and promote sustainable agriculture (SDG2 of the 2030 Agenda for Sustainable Development).It may well be out of reach, but that does not mean that progress towards this goal should be stopped. Now, more than ever, more countries need to determine how to deploy these strategies domestically to end ongoing hunger and make economies and populations more resilient to shocks like COVID-19. While the scale of the pandemic may make it a once-in-a-century event, there are certainly more economic, climate, and geopolitical shocks ahead, making it necessary to increase the resilience of food systems.

Therefore, we have tried to review how the pandemic has affected food security and food supply chains in various countries, especially when implementing movement control order policies. The resulting panic buying led to some food shortages and, more importantly, severe disruption to the fresh food supply chain in the early days of implementation, especially in urban areas. In this regard, urban agriculture, although a simple concept, can have a significant impact in securing a source of food for urban households, as a way to ensure food security in the midst of rapid urbanization, it is promoted by the Food and Agriculture Organization of the United Nations. Therefore, we wanted to select a country for the pilot idea of urban agriculture and explore the feasibility of its future scaling.

1.2 Urban Agriculture

1.2.1 Definition of urban agriculture

Currently, there is no universal consensus on the definition of urban agriculture. There are significant differences in the interpretation of urban agriculture by different scholars and organizations: academics often view it as an integrated activity that encompasses production, processing, distribution and consumption, and emphasizes its contribution to urban ecosystems and social structures. For example, Mougeot considers UA to be an activity located in a town, city or metropolis (within the city) or on the edge (around the city) that grows, produces, processes and distributes a variety of food and non-food products, (re)using human and material resources, products and services in and around the urban area, which in turn provides the urban area primarily with human and material resources, products and services.[1] Smit, Ratta and Nasr emphasize that urban agriculture is not just a way to produce food, but also an integral part of a complex urban ecosystem that involves land use, social interactions, and economic activities.[2] Governments and public agencies such as the United States Department of Agriculture define urban agriculture as a variety of agricultural activities carried out in urban and peri-urban areas, emphasizing their impact on sustainable urban development and community welfare.[3] NGOs and community-based organizations such as RUAF define UA as: "the cultivation of plants and the rearing of animals in and around a city." The most striking feature that distinguishes urban agriculture from rural agriculture is its integration into urban economies and ecosystems: urban agriculture is embedded in and interacts with urban ecosystems. Such linkages include the use of urban dwellers as labor, the use of typical urban resources (such as organic waste as compost and municipal wastewater for irrigation), direct linkages with urban consumers, direct impacts on urban ecology (positive and negative), and being part of the urban ecosystem. Urban food systems, competition for land with other urban functions, being influenced by urban policies and planning, etc. Urban agriculture is not a relic of the past and will not disappear (urban agriculture increases with the development of cities), nor is it brought about by cities. Over time, rural migrants will lose their rural habits".[4] They are more concerned about their role in improving the security of the food supply and promoting social inclusion and community development.[5] In addition, international organizations such as the Food and Agriculture Organization of the United Nations (FAO) have introduced peri-urban agriculture, defining UA as: through

agricultural production and related processes (transformation, distribution, marketing, recycling..... The practice of producing food and other outputs, which take place on land and other spaces in and around cities.[6] It also pointed out that urban agriculture includes cropping, animal husbandry, aquaculture and forestry, etc., and aims to meet the food needs of urban residents and promote sustainable urban development.[7] Academic books and research reports further emphasize its versatility, such as Sarah Taylor Lovell, who mentions that urban agriculture is not only about producing food, but also about improving the environment, promoting social equity, and supporting economic development.[8] In contrast to these perspectives, community advocacy organizations are more focused on how urban agriculture can serve urban dwellers, especially low-income and disadvantaged groups. For example, Growing Power defines urban agriculture as an agricultural activity that takes place in an urban environment through community collaboration and sustainable practices that provide fresh food, create jobs, and strengthen community cohesion.[9]

This difference in definition may stem from different contexts in their respective research and practice. For example, government agencies may focus more on policy development and urban planning, while community organizations focus more on operational and community welfare. Although there is currently no unified global definition of urban agriculture, in combination with the above expressions of urban agriculture, for the purposes of this study, we define urban agriculture as agricultural activities aimed at the production of edible animals and plants or other uses in or around cities in any form and scale, and in the process, the activities will mainly rely on the resources and space of the city itself and will eventually feed back to the city.

1.2.2 Background and development of urban agriculture

Urban agriculture has been around since the days of cities [10], dating back to ancient civilizations, dating back as far as about 3,500 BC, when Mesopotamian farmers began setting aside land for cultivation in growing cities. Subsequently, ancient Egypt became one of the birthplaces of several agricultural practices in the Western world, and its irrigation engineering and urban agriculture demonstrated the deep understanding and technological innovation of ancient Egypt in agriculture. In urban agriculture in ancient Egypt, fruit trees and medicinal plants were widely cultivated in home gardens and temples. [11] The "hanging gardens" of Babylon, which existed in the sixth century BC, are considered one of the Seven Wonders of the World and are likewise a famous example of early urban agriculture. These gardens demonstrate the ability to grow crops in an urban environment, providing food and aesthetics for city dwellers. Ancient Roman cities also had extensive horticultural practices. The Romans cultivated a variety of vegetables and fruits and established gardens in the city to meet daily needs. [12]

By the Middle Ages, monastic gardens and citizens' home gardens were common in European cities. [13] These gardens not only provide food but also grow medicinal plants. Around 1400 AD, a self-sufficient city emerged: Machu Picchu in Peru. Subsequently, Greece, Romans, Byzantines, and Persians also developed agroforestry gardens, often used for the survival purposes of monasteries and monasteries. [14] By the end of the Middle Ages, some countries in Europe already had gardens that combined aesthetics and functionality. Although more common in monasteries and castles, some community gardens are also beginning to appear in urban centers and on the outskirts of towns. [15] Renaissance urban gardens were more intricate and elaborate in design, not only for food production, but also for beautifying the urban environment and providing recreational spaces.

The enclosure movement in United Kingdom is considered an important pioneer in the development of urban agriculture. This movement provided an opportunity for urban agriculture by redividing land ownership and privatizing large tracts of land. Subsequently, events such as the Midland Revolt led to some concessions, such as the allocation of public spaces for food production in the city, which provided support and space for the development of urban agriculture.

With the advent of the Industrial Revolution, cities expanded rapidly, and many city dwellers began to grow food on the fringes of cities or on vacant land to cope with food shortages brought about by rapid urbanization. Later, the concept was gradually associated with

urban agriculture by urban planners, designers, and theorists, such as Ebenezer Howard's Garden Cities theory.

During the First and Second World Wars, urban agriculture was significantly promoted.[16] During World War I, President Woodrow Wilson called on United States citizens to use any available land to grow food in response to a potential food shortage crisis. Since then, the land planted by the family has become known as the Freedom Garden and has become an important part of food security. With the advent of war and economic depression, the phenomenon of distributing gardens began to appear in countries such as Germany, aiming to alleviate the food shortage of urban residents. Western governments have gradually supported urban agriculture, pushing it forward on unused land. After the First World War, in 1926, several countries established the Federation of Distribution Gardens in Luxembourg, an organization that evolved into the Coin de Terre et des Jardins Familiaux in 2014, made up of more than 3 million people from 14 countries.During World War II, the concept evolved into Victory Gardens, and in response to food shortages, the government encouraged city dwellers to grow vegetables in their homes and public open spaces. This has not only helped to solve the food supply problem, but also strengthened community cohesion and self-sufficiency.

In the second half of the 20th century, urban agriculture was revitalized with urban revitalization movements and increased environmental awareness. The community gardening movement, which originated in the United States in the 1960s, grew rapidly around the world, and people began to establish community gardens within cities to improve food self-sufficiency and promote community interaction, marking the beginning of the current urban agricultural revival. And the culmination of the revival began in the 90s of the 20th century, when the United States connected urban farms and gardens to address food insecurity in the mid-90s. There is a growing recognition that urban agriculture not only provides fresh food, but also improves the urban environment, promotes social interaction and community development.

Today, advances in modern technology, such as vertical farming, roof gardens, and smart farming technologies, make it possible to produce efficiently and sustainably in limited urban spaces. At the same time, the policy support of local governments has also provided a solid guarantee for the development of urban agriculture, which has led to the rapid development of urban agriculture, which not only provides fresh food for urban residents, but also improves the urban environment and promotes social equity and community cohesion. Urban agriculture is increasingly linked to environmental justice actions, local food promotion, urban sustainability efforts, community health campaigns, and FOOD JUSTICE* actions.[17]

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* *FOOD JUSTICE: Access to healthy, affordable, culturally appropriate food in the context of institutional racism, racial formation, and racialized geographies.*

1.2.3 Types and models of urban agriculture

There are many types of urban agriculture, including community gardens, vertical farms, food forests, urban farms, rooftop farming, urban aquaculture, urban bee farming, and indoor farming, among which rooftop farming, vertical farms, and community gardens are the most widely used.

Rooftop farming is a form of urban agriculture based on buildings that includes both protected and unprotected farming practices such as rooftop greenhouses and open-air rooftop gardens and farms. The use of underdeveloped urban space on buildings for farming is considered an effective strategy for addressing global concerns such as food security and land access constraints, the effects of climate change, or social exclusion.[18] Vertical farming is a concept that aims to increase the amount of arable land by "growing upwards", and the vast literature on this topic distinguishes three types of vertical farming. The first type refers to the construction of high-rise buildings with multi-story grow beds, often with artificial lighting. Such urban farms, which are often modestly sized, have sprung up all over the world. Many cities have implemented this model in both old and new buildings, including warehouses that owners reuse for agricultural activities. The second type of vertical farming occurs on the roofs of old and new buildings, the roofs of commercial and residential buildings, and the roofs of restaurants and grocery stores. The third type of vertical farm is the visionary multi-storey building.[19] A community garden is a piece of land that is planted or cultivated by a group of people, individually or collectively. Usually in community gardens, the land is divided into separate plots. Each gardener is responsible for his own plot, the yield or production of which belongs to the individual.[20] Most community gardens are self-organized by community residents, and everyone jointly funds and cooperates in planting various plants. In addition, the rise of home gardens in recent years is also noteworthy, with the definition of an "urban family food garden" defined as a garden managed by a family on owned, leased, or borrowed land that is either located on the same property as a residence or on adjacent land, such as a vacant lot, lawn, or right-of-way. Outdoor home food gardening can be done on the ground, in raised beds, or in containers on the surface of buildings. Urban family food gardens not only provide food for families, including vegetables, fruits, and cooking herbs, but also provide food to the larger community by gifting, selling, or bartering garden products.[21] Also the type that needs to be supplemented are guerrilla gardens, the main motive of which is the assertion of food sovereignty and space. It refers to gardening activities on land where the gardener does not have legal right to cultivate, such as abandoned sites, unattended areas or private property, and this type of garden is more common in Spain and

is known as "Horts a precari". These types provide a variety of ways to grow vegetables, fruits, herbs, aquatic plants and bees, etc., in the urban environment, enriching the food source for urban residents, improving the urban environment, and promoting community interaction and social development.

Each type has its own unique characteristics and advantages, and urban agricultural production can be selected according to the characteristics and needs of the city.

Urban agriculture also has a variety of operating models, such as the most common commercialization, community-led and hybrid models, as well as cooperative models, education models, tourism models, etc. The commercialization model is dominated by enterprises or individual operators, and adopts large-scale commercial cultivation and sales; The community-led model is self-organized and managed by community residents, focusing on cooperation and participation within the community. The hybrid model combines commercialization and community engagement, and is run by a partnership between business and the community. The cooperative model is formed spontaneously by farmers or residents, emphasizing the sharing of resources and benefits; The education model combines urban agriculture with environmental education to cultivate participants' agricultural knowledge and environmental awareness; The tourism model integrates urban agriculture with leisure tourism to provide tourists with experiential agricultural activities. These diversified operation models enable urban agriculture to achieve agricultural production in a limited urban space, meet the needs of residents for healthy food and green environment, and reflect the concept of urban-rural integrated development.

1.2.4 The impact of urban agriculture

Urban agriculture is not just about growing food in cities, it is also linked to the economic, ecological, social, and physical infrastructure components of urban environments[22], and is considered an effective strategy to address global issues such as climate change, mitigate climate change, and improve food security and food system sustainability. COVID-19 in particular has made city dwellers aware that over-reliance on external food supplies could threaten urban resilience and food security.[23] The development of urban agriculture can help reduce dependence on external food, alleviate domestic food security pressure, reduce public waste management costs, and promote the reuse and recycling of resources.

In terms of economy, urban agriculture is small in scale and has a variety of spatial options, which makes it easier to carry out high-quality management, thereby reducing management costs. In their study, Mok and Hoi-Fei point out that urban agriculture has significant potential in terms of job creation and can significantly improve local economic conditions.[24] Because all links from production to sales require labor. Especially in low-income communities, these programs can provide much-needed jobs and help reduce unemployment. Kaufman et al. point out that because agricultural produce from urban agriculture is consumed within cities, reducing the expense and energy consumption required for long-distance transportation not only helps to reduce food costs, but also reduces carbon emissions, with positive environmental and economic impacts.[25] At the same time, urban agriculture projects can breathe new life into the local economy through direct sales and agricultural markets.[26] Local agricultural markets and farmers' markets not only provide fresh produce to city dwellers, but also support small-scale farmers and entrepreneurs, providing entrepreneurial opportunities for local residents, especially in food processing and direct marketing, and promoting diversification and innovation in the local economy.[27] During economic crises, urban agriculture can serve as an important source of food, alleviate disruptions in food supply chains[28], increase food self-sufficiency, and strengthen the resilience of cities in the face of external economic shocks. In addition, urban farms can be an important tourist and educational resource, generating additional income for the local economy.[29] Some urban agriculture projects can also become new highlights of urban tourism, attracting tourists to visit and experience. Through farm tours, agricultural markets, educational workshops and other activities, urban agriculture not only promotes the development of local tourism, but also increases the cultural and educational resources of the city.

On the social front, community-generated social spaces have

become key places for gathering and enhancing social interaction between communities in urban areas [30] , and urban agriculture projects such as community gardens can promote interaction and cooperation among community members by providing common activity spaces [31] , helping to enhance community cohesion and social capital. And because it provides a platform for people from different social classes and cultural backgrounds to participate together, it can help community members from different backgrounds to participate together, reduce social barriers, and play a significant role in social inclusion. [32] Linking urban agriculture to urban planning can support the identity, social participation, job opportunities and living environment of vulnerable groups in cities. Urban agriculture can provide a stable working and living environment for migrants, ethnic minorities and low-income people, help them save money on food, and provide opportunities for mental health and social inclusion for people with mental disorders. Urban agriculture projects can improve the diet and health of urban residents by providing fresh and healthy local produce, as research by McCormack et al. shows that residents who participate in urban agriculture tend to have higher intakes of vegetables and fruits. [33] It can significantly improve food availability in low-income communities, improve the food security level of these communities, and effectively reduce food insecurity in cities. [34] Studies have also shown that children who participate in community gardens have significantly improved their agricultural literacy and environmental awareness, and that these programs can also contribute to environmental awareness. [35] Urban agriculture can serve as an educational hub for cities, providing opportunities to learn about gardening, food, nature, sustainable development, developing the skills and knowledge of urban citizens [36] , and also creating cultural connections between urban dwellers and the urban hinterland. [37]

Ecologically, urban agriculture can use limited space and resources to improve air quality and mitigate chemical pollution in more economical ways. In particular, there are significant advantages in the efficient use and management of water resources [38] , as urban agriculture projects often use sustainable water management practices, such as rainwater harvesting and reuse. There is also a significant contribution to municipal waste management and soil remediation [39] , as urban agriculture can promote waste management through composting and organic waste reuse, and improve urban soil quality through soil remediation through crop cultivation. At the same time, urban agriculture is also an important factor in shaping urban landscapes [40] , and urban agriculture projects can provide important habitats and resources for urban ecosystems, promoting biodiversity by increasing green space and diversifying plant planting.[8] This helps to promote the balance of urban ecosystems, protect rare species and maintain ecological balance. By increasing the amount of greenery in the city and helping to absorb pollutants and carbon dioxide from the air, it

can significantly reduce urban air pollution levels and improve air quality. Since agricultural produce from urban agriculture is consumed within cities, it reduces the city's overall carbon footprint by shortening the food supply chain, reducing food losses and greenhouse gas emissions from long-distance transportation, [41] and thus reducing the city's overall carbon footprint. [42]

Urban agriculture is more important about providing personal satisfaction, physical and mental health, and a connection to nature to meet people's spiritual needs. [43] Public participation has shifted urban agriculture from meeting material needs to meeting spiritual needs, while also providing impetus for the development of urban communities and the practice of sustainable lifestyles. By participating in gardening activities, people are able to build connections and communication with others, enhance social skills and self-confidence, and thus promote healthy relationships.

Chapter 2

Research General Overview

2. Why Lisbon?

2.1 Why Portugal

Countries that lack food security strategies may face greater food security challenges, which means they may lack the necessary planning and commitment to the long-term sustainable development of urban agriculture projects. Choosing such countries can increase the uncertainty and risk of the project, so out of the 113 countries for which data are available (see Appendix 1), we first screened out countries that did not have a food security strategy, and because in general, high-income countries have advantages in technology, finance, markets, and awareness, which can help drive the development of urban agriculture in these countries. So, out of the remaining 68 countries, we selected 19 high-income countries as candidates.

	Uruguay	Oman	Czech Republic	Sweden	Portugal	Ireland	Chile	Singapore	Azerbaijan	Finland	United Arab Emirates	Saudi Arabia	Qatar	France	Japan	Netherlands	Canada	Switzerland	United Kingdom
2012	60.9	57.4	72.3	75.7	74.8	76.9	68.3	68.4	56.9	78.4	63.2	58.1	69.9	76.8	75.4	73.4	72.1	73.2	71.6
2013	66.9	59.4	71.3	75.8	74.4	78	69.6	70.1	61.6	78.2	61.4	61	70.1	76.3	77.6	76.7	72.8	72.8	74.9
2014	67	64.6	73.5	75.2	73.6	78.2	71.6	72.3	63.8	78.3	62.1	62.9	72.8	77.2	77.3	76.2	72.5	74.3	73.9
2015	68.6	64.4	74.5	77.5	76.7	78.5	69.5	72.1	65.4	80.7	61.5	65.3	72	77.5	77.2	76	71.1	73.4	76.5
2016	69.8	70.1	78.9	78.7	77.3	80.7	69.6	70.8	62.8	83	60.3	64.5	72	76.9	77.8	76.2	72.6	74.2	77
2017	70.5	71.3	79.4	80.4	78.1	81.6	73.6	70.2	59	84	63.9	66.1	73	78.6	78.5	76.6	74	74.8	77.7
2018	75.3	73.3	77.4	80.9	79.2	82.4	75.4	72.4	58.2	83.8	71.6	67.3	73	78.4	79.8	80.7	76.1	78.5	76.9
2019	74.2	72.2	79	80.4	78.8	82.7	75.7	74.7	62.4	83.6	72.9	65	73.8	77.9	79.7	80.9	77.8	77.8	78.4
										Predicted									
2020	76.8	76.9	81.7	82.2	79.3	84.0	76.6	75.1	62.1	84.7	74.3	66.4	74.2	79.3	80.3	80.8	78.7	78.4	78.2
2021	78.5	79.2	82.9	83.1	82.6	84.9	77.6	75.7	62.1	85.7	75.8	67.4	74.7	79.7	80.8	81.7	79.5	79.2	79.9
2022	80.3	81.6	84.1	83.9	82.7	85.8	78.6	76.2	62.2	86.7	77.2	68.5	75.2	79.1	81.4	82.6	80.4	79.9	79.7
										Actual									
2020	69.5	70.4	77.6	78.9	77.7	81	74.3	71.5	56.3	83.1	76.7	70.7	70.8	82.4	78.9	80.7	80.6	78	78.8
2021	69.2	72.3	76.6	77.7	77	81.6	74.4	72.8	60.8	82.7	73.6	68.2	74.6	78.3	79.5	79.9	79.5	78	79.3
2022	71.8	71.2	77.7	79.1	78.7	81.7	74.2	73.1	59.8	83.7	75.2	69.9	72.4	80.2	79.5	80.1	79.1	78.2	78.8
										Difference									
2020	7.3	6.5	4.1	3.3	1.6	3.0	2.3	3.6	5.8	1.6	-2.4	-4.3	3.4	-3.1	1.4	0.1	-1.9	0.4	-0.6
2021	9.3	6.9	6.3	5.4	5.6	3.3	3.2	2.9	1.3	3.0	2.2	-0.8	0.1	1.4	1.3	1.8	0.0	1.2	0.6
2022	8.5	10.4	6.4	4.8	4.0	4.1	4.4	3.1	2.4	3.0	2.0	-1.4	2.8	-1.1	1.9	2.5	1.3	1.7	0.9
Total	**25.1**	**23.8**	**16.9**	**13.5**	**11.2**	**10.5**	**9.9**	**9.6**	**9.4**	**7.7**	**6.6**	**6.5**	**6.4**	**5.6**	**4.6**	**4.4**	**3.3**	**3.3**	**2.0**

Fig.2 Food security vulnerability analysis

Data Source: https://impact.economist.com/sustainability/project/food-security-index

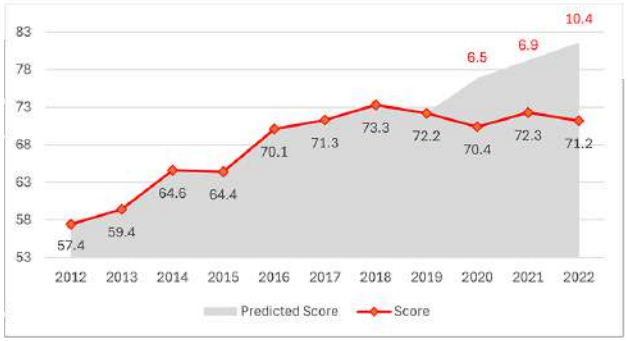
Uruguay

Regression Statistics	
Multiple R	0.945069948
R Square	0.893157207
Adjusted R Square	0.875350075
Standard Error	1.599206152
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	128.2752381	128.2752381	50.15727408	0.00039747
Residual	6	15.3447619	2.557460317		
Total	7	143.62			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-3453.17619	497.350879	-6.943138811	0.000442629	-4670.14995	-2236.202431
Year	1.747619048	0.246762867	7.082180037	0.00039747	1.143812065	2.35142603



Oman

Regression Statistics	
Multiple R	0.959262737
R Square	0.920184999
Adjusted R Square	0.906882499
Standard Error	1.845054522
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	235.4833929	235.4833929	69.17383854	0.00016389
Residual	6	20.42535714	3.40422619		
Total	7	255.90875			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-4705.828571	573.8093786	-8.201031121	0.000177243	-6109.88954	-3301.767603
Year	2.367857143	0.284698094	8.317081131	0.00016389	1.671226003	3.064488282

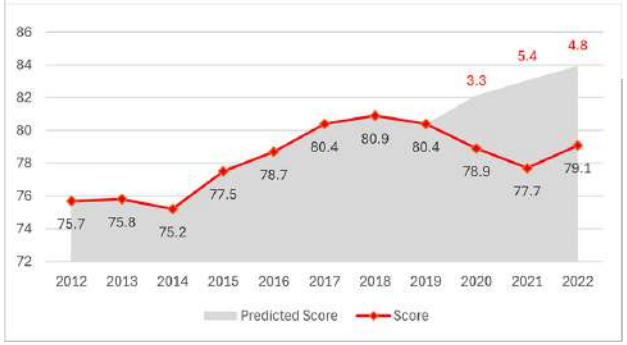
Czech Republic

Regression Statistics	
Multiple R	0.88731161
R Square	0.787321893
Adjusted R Square	0.751875542
Standard Error	1.628838568
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	58.93005952	58.93005952	22.21164848	0.003281941
Residual	6	15.91869048	2.653115079		
Total	7	74.84875			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-2311.620238	506.5665187	-4.56331035	0.003837478	-3551.143856	-1072.09662
Year	1.18452381	0.251335248	4.71292356	0.003281941	0.569528614	1.799519005



Sweden

Regression Statistics	
Multiple R	0.933894198
R Square	0.872158372
Adjusted R Square	0.850851434
Standard Error	0.906830342
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	33.66095238	33.66095238	40.93306954	0.000686869
Residual	6	4.934047619	0.82234127		
Total	7	38.595			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1726.277381	282.0229695	-6.121052424	0.000868339	-2416.362727	-1036.192035
Year	0.895238095	0.13992696	6.397895712	0.000686869	0.552849159	1.237627031

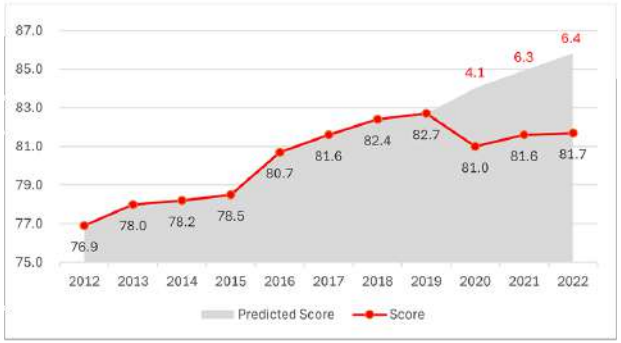
Portugal

Regression Statistics	
Multiple R	0.909668727
R Square	0.827497192
Adjusted R Square	0.798746724
Standard Error	0.950574179
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	26.00720238	26.00720238	28.78204256	0.001720114
Residual	6	5.421547619	0.90359127		
Total	7	31.42875			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1509.394048	295.6272416	-5.105733963	0.002208927	-2232.767848	-786.0202467
Year	0.786904762	0.14667678	5.364889799	0.001720114	0.42799961	1.145809914



Ireland

Regression Statistics	
Multiple R	0.977029738
R Square	0.954587109
Adjusted R Square	0.947018294
Standard Error	0.515243817
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	33.48214286	33.48214286	126.1210762	2.97801E-05
Residual	6	1.592857143	0.26547619		
Total	7	35.075			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1719.678571	160.2401071	-10.73188606	3.86648E-05	-2111.771988	-1327.585154
Year	0.892857143	0.079503847	11.23036403	2.97801E-05	0.698318238	1.087396048

Fig.3 Regression analysis for countries with a difference greater than 10

Data Source: https://impact.economist.com/sustainability/project/food-security-index

Based on a regression analysis of the food security indices of the remaining 19 countries from 2012 to 2019 (pre-pandemic), we predict the food security indices of each country in 2020, 2021 and 2022 if there is no epidemic at the end of 19, and compare them with the actual food security indices of each country in these three years. In the three years 2020-2022, we conclude that the top five countries with the most food security vulnerabilities are Uruguay, Oman, Czech Republic, Sweden, and Portugal.

Overall, the climatic conditions in Portugal are more favourable for the development of urban agriculture in the five countries, as Portugal has a Eastern Mediterranean climate and a temperate maritime climate, with a mild climate and moderate precipitation, suitable for the growth of a variety of plants. The climate of Sweden can be described as temperate continental and temperate oceanic, characterized by significant seasonality, large temperature differences and uniform precipitation distribution. This climatic condition does not mean that agricultural production is impossible, but it has an impact on vegetation growth and agricultural production. The climate of the Czech Republic is mainly temperate continental, and some areas, especially the mountainous areas in the south and west, belong to the mountain climate, which is characterized by cold winters, cooler summers, more precipitation, and usually variable and unstable climates. Oman's climate is predominantly desert and tropical desert, mainly characterized by hot and dry, with scarce precipitation and large temperature differences. This climatic condition is not conducive to plant growth. Uruguay has a diverse climate, mainly temperate oceanic and temperate continental, but most areas are generally drier, with shorter summers and higher temperatures, cold winters and less precipitation, and only some areas may have climatic conditions suitable for the cultivation of certain crops.

Policy and historically, Portugal has a long history and tradition of urban farming, and has more policies and resources for urban planning and support for urban agriculture, as well as more social support and recognition, with the active participation and support of government and social organizations that have made encouraging progress in this area. The Sweden government has also taken a number of measures to support and promote the development of urban agriculture, although these policies may not be specifically focused on urban agriculture, but touch on all aspects of agriculture and urban development. The Czech Republic has a relatively rich history of urban agriculture policies and history, and the government and social organizations have been actively promoting the development of urban agriculture in order to improve food security, improve the urban environment and promote community development. In contrast, Oman's urban agriculture policy and history is relatively limited, probably due to the local climate, but in recent years the government has begun to realize the importance of urban agriculture and has taken some steps

to promote the development of this field. Although Uruguay has also taken some measures to develop urban agriculture, its technology is still immature and the level of development is relatively low.

All things considered, Portugal has considerable advantages both in terms of climatic conditions and policy history, so in the end we chose Portugal as our pilot city.

2.2 The reason of choosing lisbon

When developing an urban agriculture strategy for a city in Portugal, the selection of specific cities generally takes into account the size of the city, population density, geographical location, existing urban agriculture infrastructure, government support, community participation and natural resources. Considering all of the above, Lisbon and Porto are the most suitable options.

• Lisbon

As the capital of Portugal, Lisbon has abundant resources and strong government support, which provides favorable conditions for the implementation and promotion of urban agriculture policies. The Municipality of Lisbon has several policies in place to promote sustainable development and green cities to promote the development of urban agriculture. In terms of topography, Lisbon is located at the mouth of the Tagus River and is relatively rich in water resources, which is suitable for the development of diverse forms of urban agriculture. In addition, there are many community gardens and urban farms in Lisbon, and citizens have a high enthusiasm and awareness of urban agriculture.

• Porto

Porto is the second largest city in Portugal, an economic and cultural centre, with strong potential for the implementation of urban agriculture strategies. Porto has a number of existing community gardens and agricultural projects that can serve as a basis for the development of urban agriculture. Porto's climate is mild and humid, which favors the growth of a wide variety of crops. The inhabitants of Porto have a high level of concern for ecology and sustainability, which helps to promote urban agriculture projects.

As the capital city, Lisbon has strong resources and government support, as well as a good foundation for urban agriculture and community participation. If the focus is on promoting policies and large-scale urban agriculture projects, Lisbon is the first choice. If you're looking to pilot and roll out on a smaller scale, Porto is a good choice.

For this reason, we chose Lisbon as the city to develop an urban agriculture strategy, not only because of its economic and resource advantages as the capital, but also because of its favorable climatic conditions, high community participation, strong educational and research support, application of innovative technologies and potential for integration with tourism. By implementing an urban agriculture strategy in Lisbon, the Sustainable Development Goals can be more effectively promoted, the vision of a green city can be realized, and it can be set as an international model.

2.3 The main targets of urban agriculture policy

The Lisbon Urban Agriculture Strategy aims to build a healthy, sustainable and inclusive agricultural system by increasing local food production, promoting environmental sustainability, supporting community participation, driving economic development and innovative technology applications.

Chapter 3

Lisbon Overview

3. Lisbon Overview

3.1 Geographic Location

Fig.4 Geographic location of Lisbon

Lisbon is the capital and largest city of Portugal, located in the southwest of the country at the mouth of the Tagus River, facing the Atlantic Ocean. It belongs to the Lisbon Region and is the administrative and economic center of the Region. The Tejo is the longest river in the Iberian Peninsula, originating in Spain, flowing through Portugal and finally emptying into the Atlantic Ocean. Lisbon faces the Atlantic Ocean directly, and the coastline to the west of the city is one of Lisbon's important geographical features, making it an important seaport and shipping center.

3.2 Population

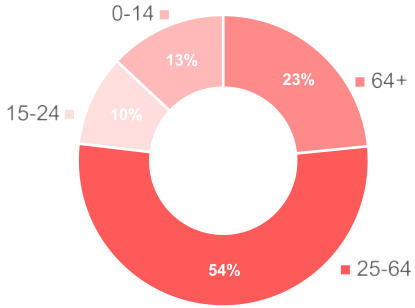


Fig.5 Lisbon population age distribution in 2021

Date source: https://censos.ine.pt/xportal/xmain?xpgid=censos21_produtos&xpid=CENSOS21&xlang=pt

With a total population of 546438 in 2021, 54% of the population is between 25 and 64 years old, with the smallest proportion being young people aged 12-24, while 23% of the population is over 64 years old.

3.3 Lisbon Urban Agriculture History

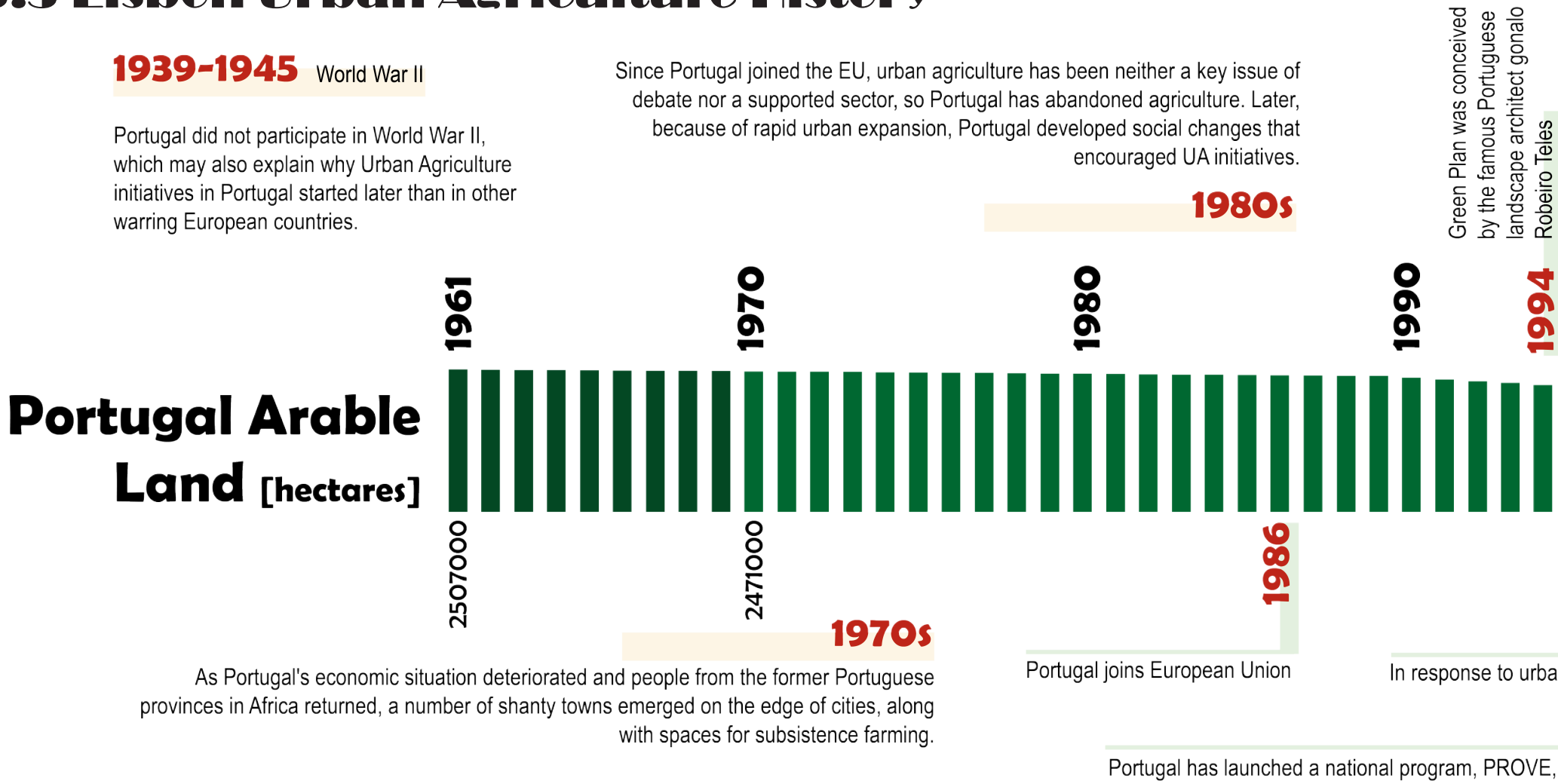
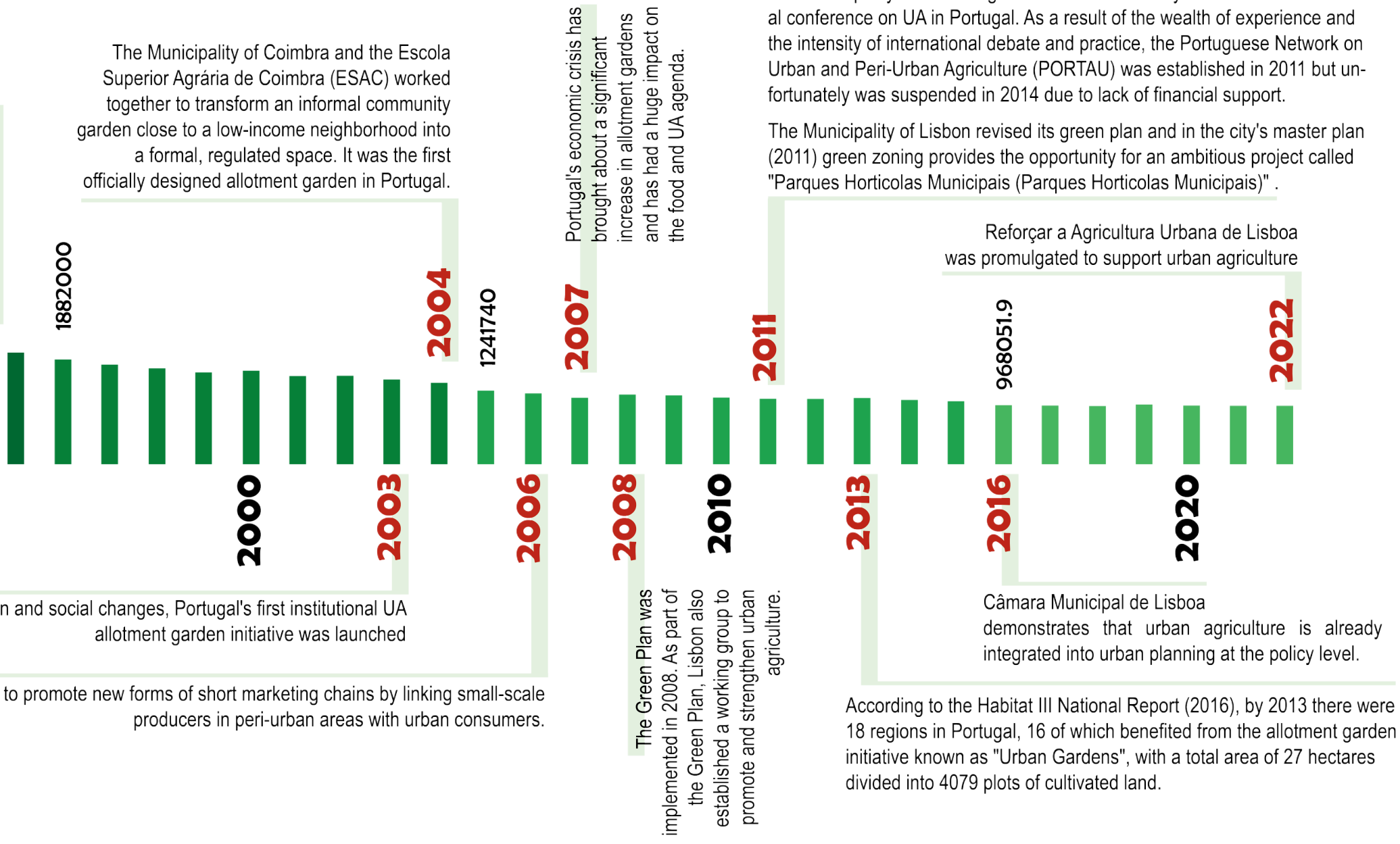


Fig.6 Lisbon Urban Agriculture History


1882000
2000
2003
2004
1241740
2006
2007
2008
2010
2011
2013
968051.9
2016
2020
2022
The Municipality of Coimbra and the Escola Superior Agrária de Coimbra (ESAC) worked together to transform an informal community garden close to a low-income neighborhood into a formal, regulated space. It was the first officially designed allotment garden in Portugal.
n and social changes, Portugal's first institutional UA allotment garden initiative was launched
to promote new forms of short marketing chains by linking small-scale producers in peri-urban areas with urban consumers.
Portugal's economic crisis has brought about a significant increase in allotment gardens and has had a huge impact on the food and UA agenda.
The Green Plan was implemented in 2008. As part of the Green Plan, Lisbon also established a working group to promote and strengthen urban agriculture.
The Municipality of Seixal organizes the first and only national and international conference on UA in Portugal. As a result of the wealth of experience and the intensity of international debate and practice, the Portuguese Network on Urban and Peri-Urban Agriculture (PORTAU) was established in 2011 but unfortunately was suspended in 2014 due to lack of financial support.
The Municipality of Lisbon revised its green plan and in the city's master plan (2011) green zoning provides the opportunity for an ambitious project called "Parques Horticolas Municipais (Parques Horticolas Municipais)" .
Reforçar a Agricultura Urbana de Lisboa was promulgated to support urban agriculture
Câmara Municipal de Lisboa demonstrates that urban agriculture is already integrated into urban planning at the policy level.
According to the Habitat III National Report (2016), by 2013 there were 18 regions in Portugal, 16 of which benefited from the allotment garden initiative known as "Urban Gardens", with a total area of 27 hectares divided into 4079 plots of cultivated land.

3.4 Climatic Conditions

• Temperature

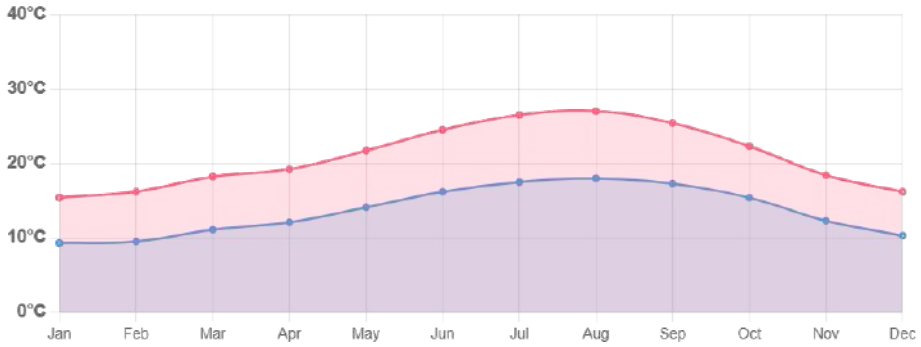


Fig.7 Average temperature in Lisbon

Source: https://weather-and-climate.com/average-monthly-min-max-Temperature,lisbon,Portugal

Lisbon's climate is Eastern Mediterranean, with warm and humid winters and hot and dry summers. On average, the hottest month is August with temperatures of 27°C. The coolest month is January with temperatures of 15°C. The average annual maximum temperature is 21°C, and the minimum temperature is 14°C. This climatic condition allows for a longer planting season for crops, which is conducive to the growth and development of plants.

• Sunshine

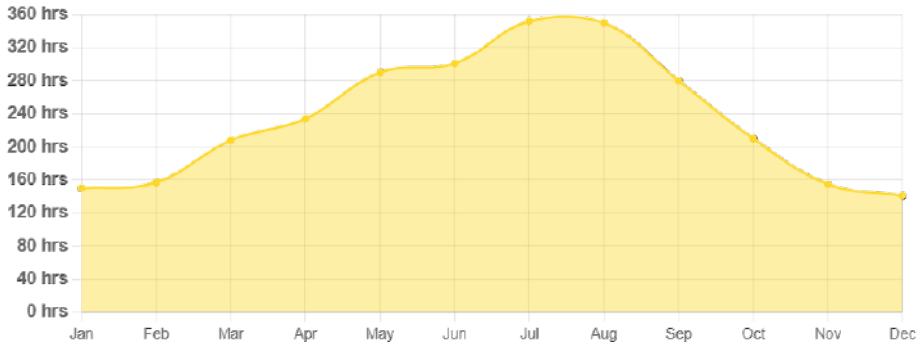


Fig.8 Average monthly hours of sunshine in Lisbon

Source: https://weather-and-climate.com/average-monthly-hours-Sunshine,lisbon,Portugal

Lisbon has the longest average annual sunshine hours, with an average of 2,801 hours of sunshine per year, with July being the sunniest month with 352 hours of sunshine. December has the least average hours of sunshine at 141 hours. Sufficient sunlight is conducive to the progress of photosynthesis and improves the yield and quality of crops.

• Snow and rainfall

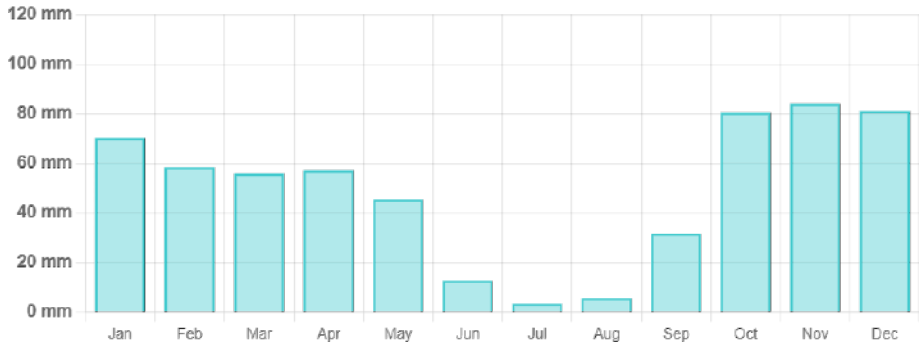


Fig.9 Average monthly snow and rainfall in Lisbon

Source: https://weather-and-climate.com/average-monthly-precipitation-Rainfall,lisbon,Portugal

Precipitation in Lisbon is evenly distributed, with an average annual precipitation of 587 mm. Winter is characterized by more precipitation, with November being the wettest month with 84 mm of precipitation. Summers are relatively few, with dry seasons in June, July and August, with July being the driest month with 4 mm of precipitation. This distribution of precipitation favors the growth of crops and also helps to reduce water wastage.

3.5 Policy

- **Recommendation 011/01 (PEV) – Strengthening Urban Agriculture in Lisbon (2022)**

    1. Identify and evaluate open spaces that can be demarcated for urban agriculture
    2. Promote the use of suitable and non-hazardous vacant land for urban agriculture
    3. Increase the area of municipal urban gardens
    4. Catalyse action to encourage more citizens to use their courtyards and balconies for urban agriculture and self-sufficiency
    5. Liaise with the school to create a garden within its space
    6. Develop a plan to ensure that irrigation water is collected and used rationally through various means

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Recomendação 011/01 (PEV) - Reforçar a Agricultura Urbana de Lisboa
Intervenção da deputada municipal do PEV Cláudia Madeira
Assembleia Municipal de Lisboa, 22 de Março de 2022

Os Verdes trazem hoje, através de uma recomendação, o tema da agricultura urbana, sendo reconhecida a sua importância como meio de desenvolvimento sustentável nas cidades, com múltiplas vantagens nas áreas sociais, económicas e ecológicas.

O cultivo de legumes, cereais e frutas em locais de elevada densidade populacional é hoje em dia uma prática regular, com diversos benefícios para as populações e para a sustentabilidade das cidades.

A prática da permacultura, onde o uso do solo se relaciona com o clima, os nutrientes, as plantas e os animais, a adequada gestão da água e as necessidades humanas, permite-nos ter cidades mais resilientes, ao mesmo tempo que promove a planificação e a reconversão de espaços em locais naturais mais sustentáveis e mais bem adaptados às alterações climáticas e promotores da biodiversidade. Esta prática pode estar presente em diferentes espaços das cidades, como nas hortas urbanas, nos jardins, nas arborizações das ruas com árvores de fruto ou nas varandas e terraços.

E há um conjunto de benefícios, por exemplo, em termos sociais. Através da implementação das hortas urbanas, podemos criar uma maior aproximação e ligação com a natureza, melhorando a qualidade de vida e aumentando o bem-estar, além de permitir dinâmicas de partilha de saberes.

Mas também em termos económicos permite apoiar famílias com menores recursos, visto que a maioria das hortas se destina à produção dos próprios alimentos, potenciando a auto-suficiência e uma maior resiliência caso ocorram dificuldades de abastecimento alimentar.

E em termos ambientais permite diminuir a pegada ecológica dos alimentos, eliminando os transportes desnecessários; permite a utilização de resíduos orgânicos produzidos na cidade como fertilizantes naturais e permite ainda a utilização racional e adequada de baldios ou zonas vazias, evitando a acumulação de resíduos e entulhos e o crescimento de pragas e infestantes com impactos na saúde pública. Promove também a protecção do solo, favorecendo a infiltração das águas das chuvas.

Na realidade, a existência de hortas sempre fez parte da vida da população de Lisboa, o que ficou bem patente na exposição promovida pela Câmara Municipal no âmbito da Capital Verde Europeia, revelando-se entre outros temas, a evolução da ocupação deste território e das práticas agrícolas que ocorreram desde a idade média até ao século XXI.

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A disponibilização de espaços na cidade para a produção agrícola local é de valorizar e, uma vez que a procura continua a aumentar, é importante reforçar essa oferta.

Importa ainda destacar que a adaptação às alterações climáticas nos exige uma adequada gestão e protecção dos recursos naturais, como os solos e a água e esta recomendação procura dar resposta a esse desafio.

Assim, e tendo em conta todos estes aspectos, Os Verdes propõem que a CML implemente um conjunto de medidas, como a identificação e avaliação de espaços livres passíveis e propícios de demarcação para uso como agricultura urbana; a promoção do uso de terrenos baldios adequados e isentos de perigos para a agricultura urbana e o aumento da área de hortas urbanas municipais; a promoção de acções que incentivem o aumento do número de cidadãos que recorram aos seus pátios e varandas para efectuarem agricultura urbana de autoconsumo; a articulação com as escolas para que se possam criar hortas nos seus espaços e, por fim, o desenvolvimento de um programa para que a água de rega, fundamental para o crescimento e desenvolvimento das culturas nas hortas, seja recolhida por vários meios e utilizada de modo racional.

Fig.10 Recommendation 011/01 (PEV) - Strengthening Urban Agriculture in Lisbon (2022)
Source:https://www.am-lisboa.pt/documentos/1648066174N1mOO8nt5Ma98DB0.pdf

• Green Corridors (2008)

1.Since 2007, Lisbon has implemented the Urban Agriculture Strategy, which integrates urban agriculture into the urban ecological fabric and provides better ecological flow and landscape functions together with other green spaces and corridors.

2. Lisbon also established a working group (Working Group on Urban Agriculture Facilitation and Development) in 2009 to promote and strengthen urban agriculture.

Green corridors are urban areas designed to promote biodiversity, ecological connectivity, and human well-being. Nine green corridors with a total length of more than 100 kilometres have been built, and the Lisbon City Government plans to further expand the coverage of the green corridors in the coming years, and continue to promote the implementation of the project in combination with urban renewal and community participation.

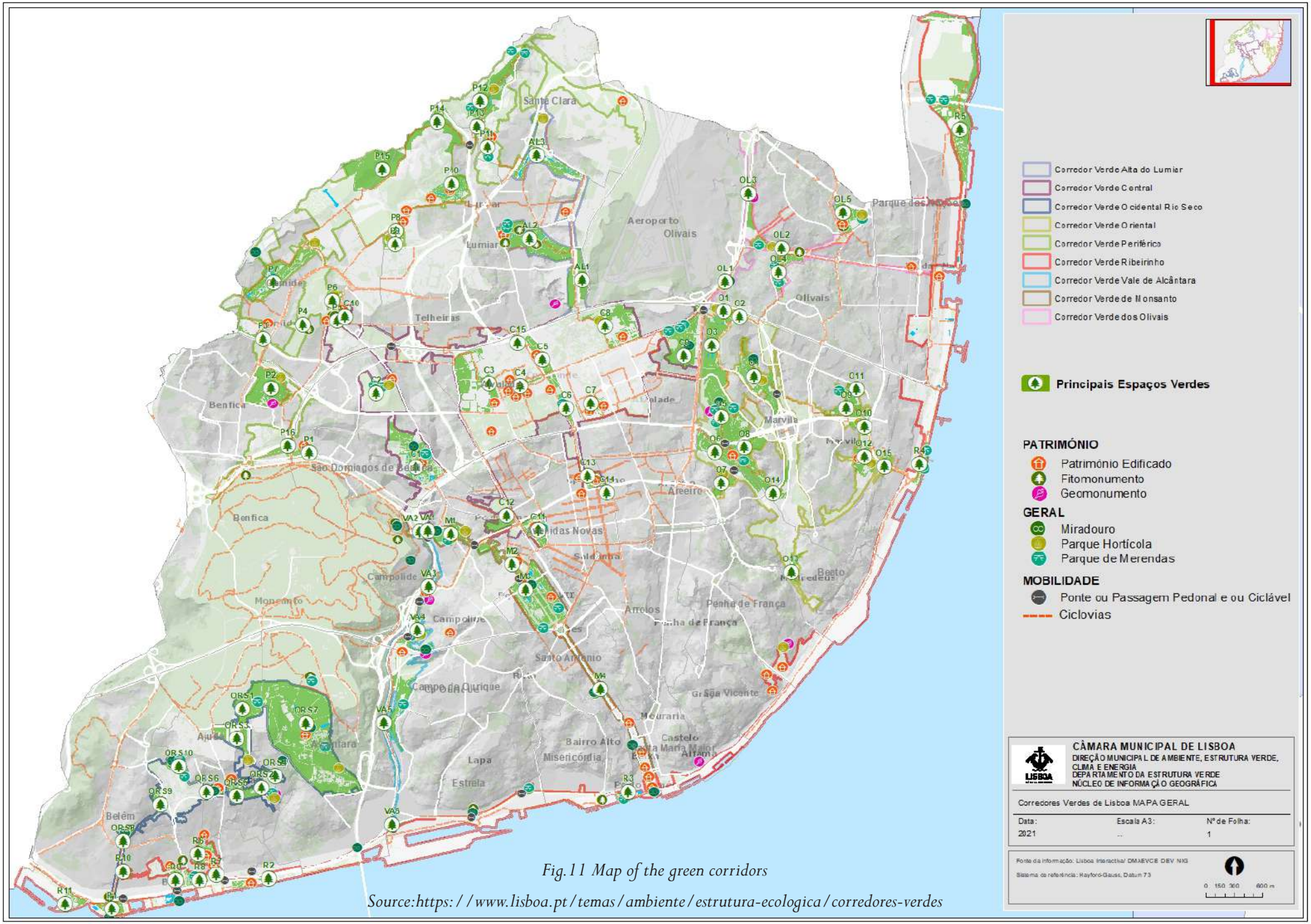


Fig.11 Map of the green corridors

Source:https://www.lisboa.pt/temas/ambiente/estrutura-ecologica/corredores-verdes

• Municipal Horticolas(2011)

Currently, Lisbon has 22 municipal horticultural parks, 888 plots of land, and a total of 9.9 hectares dedicated to agricultural production.

In general, the "Hortas Comunitárias de Lisboa" project has achieved great results in Lisbon and has been widely recognized by citizens. It not only promotes sustainable urban development, but also strengthens the cohesion of local communities. The project is becoming an important microcosm of Lisbon's green transition.

Fig.12 Map of Horticultural Parks

Source:https://www.lisboa.pt/temas/ambiente/estrutura-ecologica/parques-horticolas

• Municipal Master Plan(2023)

Lisbon has incorporated urban agriculture into the urban ecological fabric and, together with other green spaces and corridors, provides better ecological flow and landscape functions. This information is already presented in the municipal master plan.

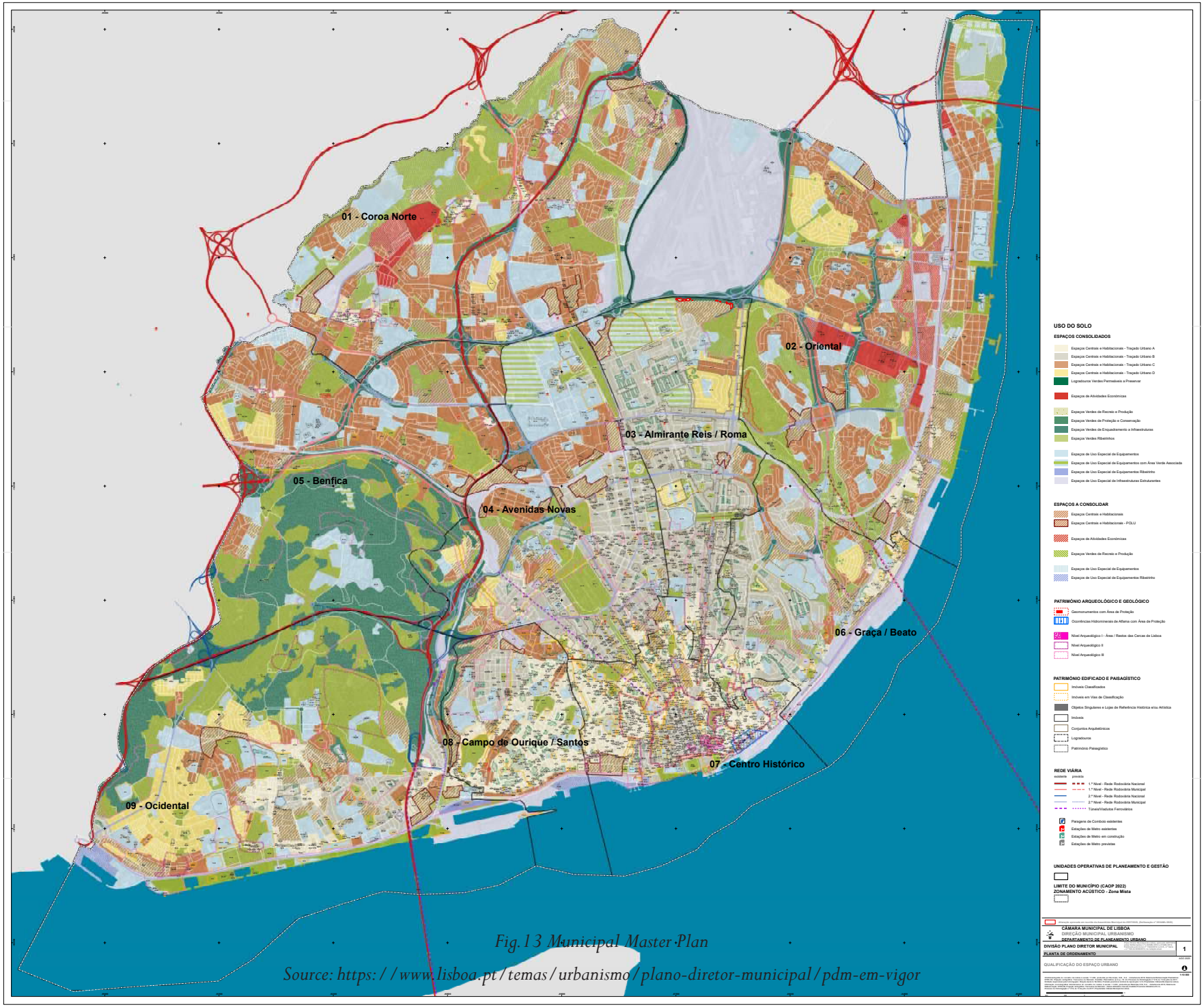


Fig.13 Municipal Master Plan

Source: https://www.lisboa.pt/temas/urbanismo/plano-diretor-municipal/pdm-em-vigor

3.6 Current Situation

Lisbon is located at the mouth of the Tagus River, and the city's topography is mountainous, especially in the western region. The streets in the central area are narrow and steep, giving them the texture of a medieval city. As the city expanded, modern residential and commercial areas developed on the periphery of the city, such as the Belém district and the Parque das Nações.

Lisbon's landmarks are mainly concentrated in the Belém district and the city center, showing a coherent layout from the historic center to the modern area. The Torre de Belém, Mosteiro dos Jerónimos, Padrão dos Descobrimentos are all located in the western riverside area of Lisbon, mainly in the maritime history of Portugal and the Age of Discoveries, with a high degree of historical thematic coherence, which makes it easy for visitors to explore the area on foot. These landmarks in the city center are clustered together to form a compact tourist area within walking distance of all major attractions. Downtown landmarks range from historic buildings, such as the Castle of São Jorge and the Cathedral of Lisbon, to modern landmarks, such as the Santa Justa Lift, showcasing the interweaving of Lisbon's history and modernity. The landmarks of the city center are highly coherent and connected by pedestrian streets and squares, forming a convenient tourist route. Belém is far from the city centre and can be connected by public transport, but from our field trips, Lisbon's bus punctuality rate is very low, and tourists and visitors to both locations often drive or take a taxi.

Lisbon has several large parks and green spaces, mainly in the west and around the airport, and the municipality has in recent years committed to creating green corridors connecting these main parks and green spaces in order to improve the city's ecological network and the quality of life of its residents. Most of the vegetable gardens are located on the edge of the green corridor, and the urban centers are few and scattered, mostly concentrated in the east and north, forming a large urban agricultural area.

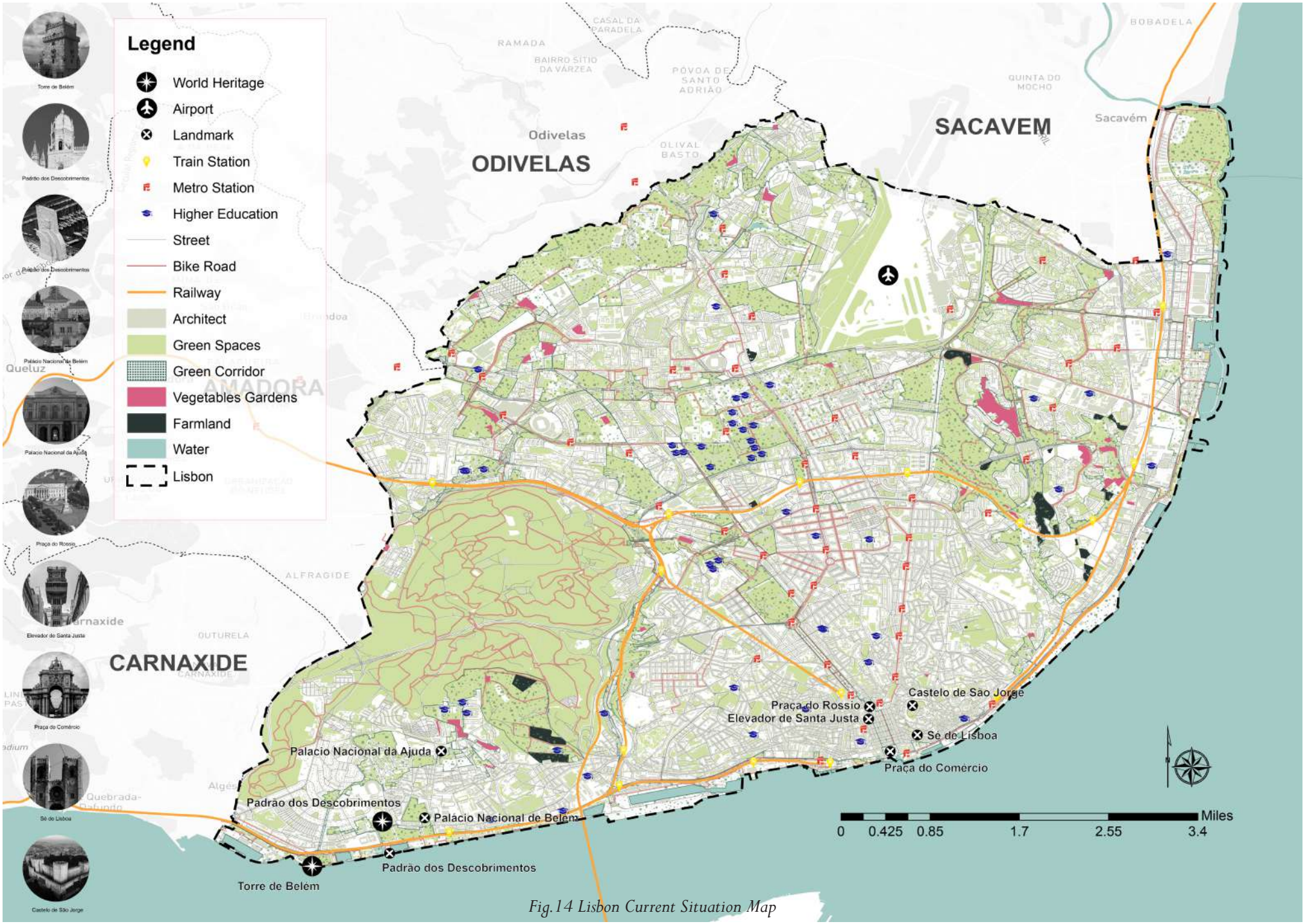


Fig.14 Lisbon Current Situation Map

3.7 SWOT

• Strength

1. The City of Lisbon attaches great importance to and actively promotes the development of urban agriculture and provides policy support.
2. Citizens generally support urban agriculture and have a high level of participation.
3. Successful demonstration projects such as the "Lisbon Community Gardens" have been established.
4. Lisbon has abundant sunshine, evenly distributed precipitation and favorable climatic conditions, making it ideal for the growth of a wide range of crops.
5. Lisbon has a long history and culture of agriculture and has a certain sense of identity and interest.
6. There is a lot of idle land and vacant houses within the city.
7. Having an urban agriculture information platform to help drive urban agriculture in Lisbon.

• Weakness

1. Insufficient capital investment and policy support.
2. There is no complete system of urban agriculture policies.
3. There is a lack of experience in modern urban agriculture and the spread of technology.
4. There is less public awareness of urban agriculture.
5. The infrastructure for urban agriculture is not perfect.

• Opportunities

1. After the impact of food insecurity during the pandemic, there is a high demand for urban agriculture.
2. Urban agriculture is still in its infancy and has great potential for development.
3. The Lisbon government's "BIP/ZIP" program finances urban agriculture projects in communities.
4. Tourism can increase the economic benefits and public support of urban agriculture projects by increasing tourist interest and participation in these projects.
5. Universities in Lisbon have incorporated urban agriculture into their training programs.
6. The potential to repurpose idle industrial or commercial land for urban farming.

• Threats

1. Urban agriculture can bring environmental pollution.
2. Consumers' trust in urban produce is insufficient.
3. Extreme weather and climate change can adversely affect crop production and agricultural activities, such as heat waves.
4. Urban sprawl and real estate development could further squeeze space for urban farming.
5. The profitability of urban agriculture is currently debatable and may be at risk of bankruptcy.

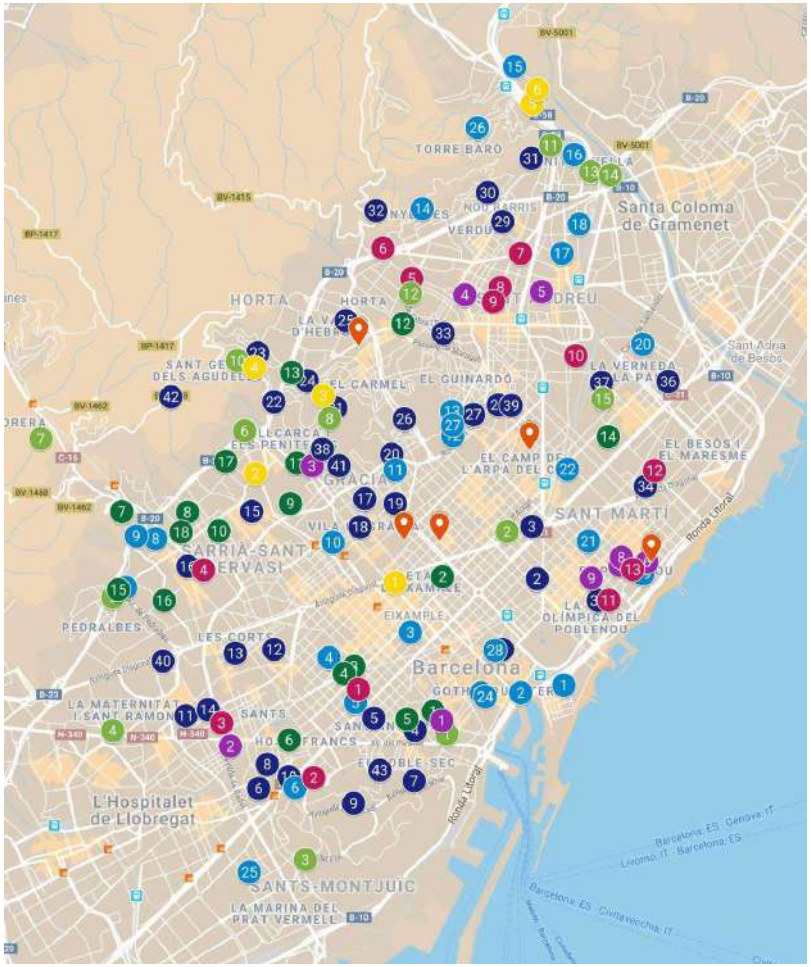
Chapter 4

Policy Case Study

This thesis selects three case studies of cities that are in a similar situation to Lisbon, Portugal, but that already have a well-developed urban agriculture policy, from which policies applicable to Lisbon are summarized as references

4. Policy Case Study

4.1 Barcelona, Spain



ESTRATÈGIA D'AGRICULTURA URBANA A LA CIUTAT DE BARCELONA

2019-2030

ABRIL DEL 2019

Ajuntament de Barcelona

4.1.1 Similarities

- Coastal, undulating, hilly
- Eastern Mediterranean climate with favorable weather
- A long history of urban farming
- There is a lack of recognition of agricultural work and agricultural culture
- There is a lack of communication at the municipal level
- All face the problem of soil/air pollution that urban agriculture can bring
- Urban agriculture is facing the problem of dependence on funding
- Urban agriculture is facing the problem of climate change
- While both Spain and Lisbon have a large number of community gardens, both rely on political mandates and have ad hoc, volatile and legally complex issues
- There is general public support for urban agriculture and there is a strong public demand
- There are numerous municipal garden projects, all of which are financially supported by the government
- At present, the municipal government supports the vigorous development of urban agriculture and provides policy support
- Both have green plans and biodiversity plans to better promote the development of urban agriculture
- can work with groups at risk of exclusion and create jobs
- There are online platforms related to urban agriculture that facilitate the synergy of citizen participation in planning and urban policy
- The urban layout is compact, and there is not much room for urban agriculture

4.1.2 Overview of Urban Agriculture Strategies

• Mission

Promote agroecology and food sovereignty by bringing citizens closer to urban gardens and supporting citizens' initiatives in urban agriculture to contribute to building healthier, fairer, and more sustainable cities.

• vision

An ecological, healthy, inclusive, cohesive, equitable and resilient city where citizens participate in orchard management and promote agroecology and food sovereignty.

The main values that guide strategic action are as follows:

1. Ecological justice. Driven by organic and ecological agriculture, urban agriculture must contribute to the sustainable management of urban green infrastructure and improve the quality of urban spaces, promote people's health and mitigate climate change.

2. Inclusivity and social justice. In the context of the current eco-social crisis, urban agriculture must promote inclusivity and social cohesion through community revitalization, ensure that urban gardens are equal, pluralistic and democratic spaces, and guarantee equitable access to resources.

3. Participatory democracy. Urban agriculture initiatives must be based on shared governance and promote citizen participation and shared responsibility

• Overall objectives

1. Increase the area of urban cultivated land and improve the quality of urban space.
2. Achieve an agroecological model that enhances biodiversity.
3. Promote agroecology to influence agricultural products and consumption patterns.

4. Maximize the social, therapeutic, and emotional benefits of urban agriculture by promoting civic engagement, increased active population, community management, and networking.

5. Promote the shared governance model and establish a support mechanism for urban agriculture.

- **Strategic axis**

The strategic axis is the main line of work or area in which actions are formulated.

Throughout the diagnostic and engagement process, four axes of work were identified:

Axis 1. Territory:

Promote an increase in the area of urban cropland.

Axis 2. Agro-ecological

Promote organic agriculture and consolidate and expand initiatives to improve biodiversity in urban agricultural spaces. Promote urban eco-agriculture models and urban-scale eco-agriculture networks.

Axis 3. Society and community modeling:

Promote activities that increase social, therapeutic, emotional and community benefits.

Axis 4. Governance and coordination:

Promote shared governance models based on participatory democracy and foster empowerment of community structures. Establishment of the necessary municipal tools for the realization of urban agriculture

4.1.3 Actions that can be learned

- Creating new gardens using semi-urbanized or abandoned unplanned areas, and restoring abandoned gardens, etc
- Create a new garden with existing equipment (patio or ventilation patio, balcony, terrace, roof, etc.) and support the strategy
- Increase the presence of edible plants in urban green infrastructure
- Develop common technical standards (e.g. management of plant residues, water recycling, etc.) to make urban gardens sustainable
- Promote projects to improve biodiversity in urban gardens with the support of environmental and conservation organizations
- Consolidate and expand urban composting initiatives related to urban gardens, especially community composting
- Create or enable a space to install a seed bank
- Enhance synergies between urban gardens and other responsible consumption initiatives and encourage short-distance urban circulation
- Promote and raise the visibility of the city's agricultural experience and raise public awareness of its benefits
- Provide tools and meeting spaces to encourage networking and knowledge exchange
- Promote the creation of new social and therapeutic gardens and tools for the implementation of these gardens
- Promote the creation of more community gardens and the construction of community dimensions
- Streamline and facilitate administrative procedures for reaching agreements with groups and entities on access and management of urban gardens
- Establish an Urban Agriculture Coordination Group to provide municipal support and create possibilities for participation at the community, district and city levels
- Explore synergies with other city council programs and strategies, and coordinate with other agencies and networks involved in urban agriculture
- Clarify aid and subsidies and provide advice on how to access them
- Strengthen urban agriculture service networks in districts and communities to support the strategy
- Deploy differentiated messaging tools according to the target audience (e.g. creation of an internal website for internal municipalities, telephone hotlines for citizens with questions about urban agriculture, etc.)
- Create a network map that updates information about the city garden in real time (e.g. changes in location, changes in environment)
- Implement a web app or mobile device to link citizens' offers and needs related to urban farming

- Carry out strong and extensive urban agriculture publicity activities
- Improve and expand the training provided to the public, with a special focus on orchard-related personnel
- Promote collaboration with research organizations and contribute to science communication

4.2 Yarra, Australia

4.2.1 Similarities

- There are vacant and underutilized urban lands that can be repurposed for urban farming
- The climatic conditions are ideal for a wide range of agricultural activities
- There are existing municipal policies and strategies to support urban agriculture
- There are community gardens that are developed
- Local stakeholders lack the technical expertise and experience to commercialize urban agriculture
- Lack of infrastructure and support services suitable for urban agriculture
- All have the potential to repurpose idle industrial or commercial land for urban farming
- Both government and private sources provide funding and incentives to support urban agriculture
- Other real estate developments focus on competition for limited urban land
- Potential contamination of urban soil and water resources due to urban agriculture
- are at risk of crop damage or loss due to pests, diseases and extreme weather events
- Consumers' trust in urban produce is insufficient.
- The profitability of urban agriculture is debatable and it may be at risk of bankruptcy.

4.2.2 Overview of Urban Agriculture Strategies

- **Target**

1. Promote and facilitate urban agriculture with a focus on expanding the size and uptake of communities.
2. Build resilience by providing opportunities and places for people to meet, participate, and connect with their communities.
3. Support and empower a more sustainable council and community.
4. Encourage and promote environmentally sustainable architecture, urban design, placemaking, and public realm outcomes.
5. Reduce the amount of waste to landfill, with a focus on improving recycling and organic waste disposal.
6. Maintain and enhance Yara's network of open spaces for a variety of community uses. Promote an inclusive, resilient, interconnected, and strong community of physical and mental health and well-being.
7. Provide a health-promoting environment that encourages healthy eating and active living.
8. Provide opportunities for people to participate and connect with the community.
9. Research strategies and initiatives to better manage the long-term impacts of climate change.
10. Facilitate people's access to spaces where food is grown
11. Improve food skills and knowledge through education and training
12. Establish partnerships with other organizations and groups
13. Advocate for the adoption of food systems approaches within and outside the Council

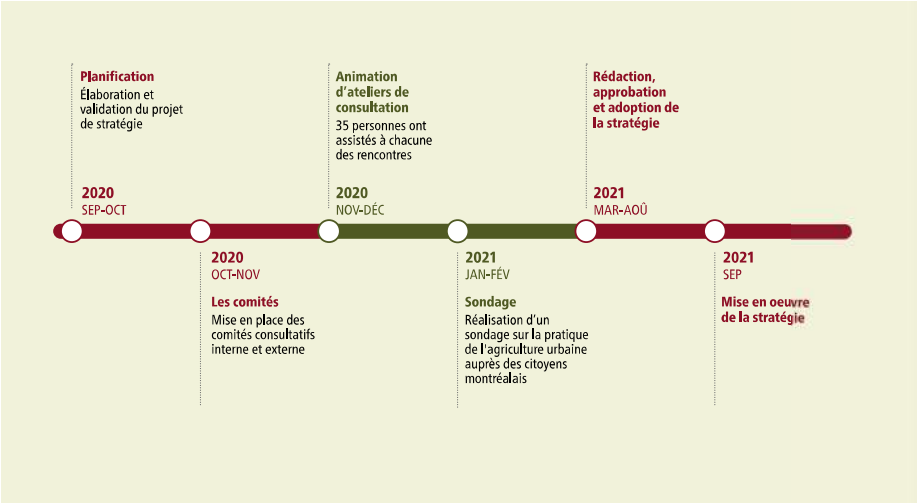
4.2.3 Actions that can be learned

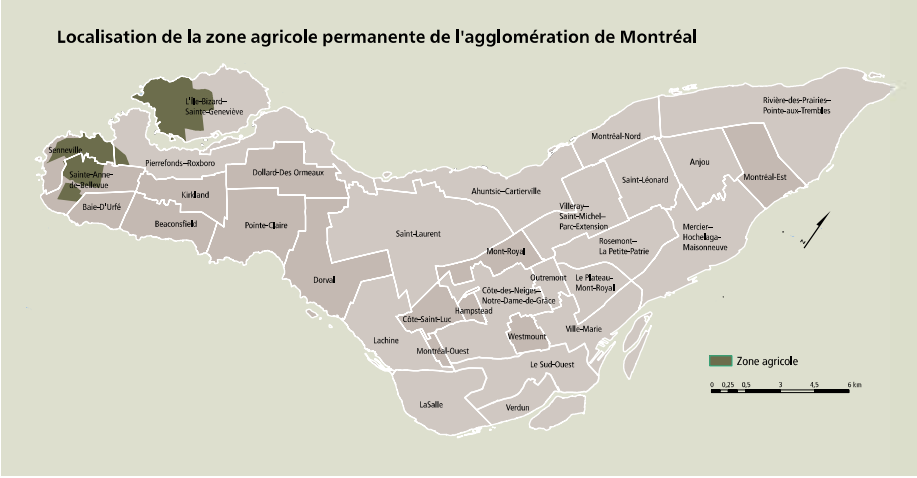
- Continue to provide and manage community planting space programs
- Support for existing community gardens and community planting spaces (in accordance with the agreement)
- Review and update guidelines for urban agriculture, including community composting
- Support new projects in accordance with the Community Garden Guidelines
- Streamlining the application process for community planting space programs, including community composting
- Work with planners to include urban agriculture in the planning recommendation process and support mechanisms to provide opportunities for urban agriculture through the Yara Planning Plan Survey.
- Explore potential food growing sites in open spaces owned or managed by the City of Yala
- Conduct a feasibility study on the list of land availability in Yarra City
- Develop an annual communication plan to raise awareness of Yarra's urban agriculture efforts, such as food exchanges, farmers' markets, community composting
- Develop an annual workshop plan that is appropriate for different ages, demographics, and groups within the community
- Investigate the feasibility of partnerships with higher education institutions
- Promote the existing school horticulture teaching materials to local schools.
- Review and update UA-related content on the website
- Investigate the possibility of providing seed start-up kits to residents to encourage people to grow food locally
- Work with partners to develop educational materials to increase community awareness of traditional food and agricultural practices
- Partnering with Collingwood Children's Farm and other leading community organizations to work together to achieve the goals of this strategy
- Opportunities to promote urban agriculture through activities, policy reviews, and other opportunities
- Evaluation of urban agriculture projects delivered to date
- Develop and disseminate best practice guidelines
- Establish a database to guide action and decision-making, including conducting research, collecting and interpreting data on urban farming

opportunities and levels of participation in Yala City

- Set up a dedicated urban agriculture promotion organization to advise residents on how to start and maintain community planting spaces/ gardens.
- Establish a community planting space project to help residents set up communal planting boxes, laneways, and natural strip gardens.
- The Yarra Urban Agriculture Advisory Committee was established to support the community and advise the council on local urban agriculture issues.
- Various workshops are held throughout the year to equip residents with skills on topics such as small space gardening, organic gardening, beekeeping, composting, and chicken raising.
- Support schools, neighborhood homes, and nonprofit community organizations in starting or managing public food gardens through grants, resources, and community relations.
- Worm farms and compost bins are available for purchase.
- Reduce nutrient loss in food systems by exploring and promoting local and urban composting solutions.
- Collaborate with local, municipal, and regional networks to promote and develop sustainable food systems.
- Collaborate with our partners and communities to explore opportunities and create innovative solutions that help promote circularity in local food systems.
- Reduce food waste by providing education and information to residents through programs such as "Food Know-how" and "Grow Your Own Food".
- Promote land sharing within the community for food cultivation and recycling.
- Work with developers to facilitate the provision of land for growing food and recycling for new developments.

4.3 Montreal, Canada





4.3.1 Similarities

- Both have an abundance of community gardens and urban farm projects to encourage residents to participate in urban agriculture.
- The presence of important rivers and the diversity of terrain, including hills, plains and river valleys, open up the possibility of developing many forms of urban agriculture.
- Urban agriculture has a long history, dating back to community gardens and home farming projects, and has received renewed attention and development from governments and communities in recent years.
- Although urban agriculture in the two cities has been effective in supplementing local market demand, it is still dependent on external supply and has a low rate of food self-sufficiency.
- Land scarcity poses a major challenge to the development of community gardens and urban agriculture in Montreal. Access to arable space is often cited as an obstacle to the development of urban farming practices and new ventures. This obstacle is largely due to pollution, the high cost of available space, and the scarcity of the area.

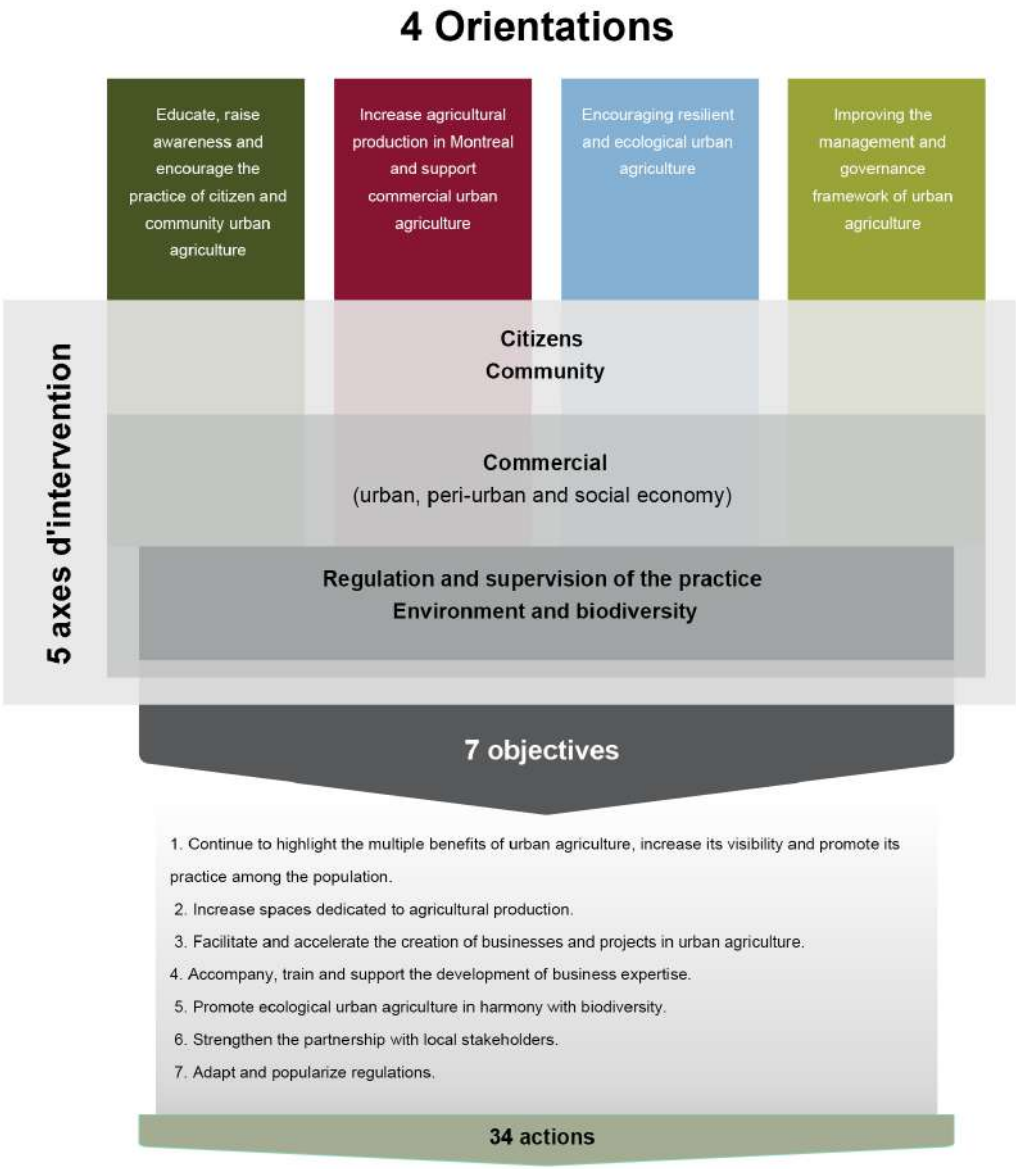
4.3.2 Overview of Urban Agriculture Strategies

- **vision**

Strengthening Montreal's role as a leader in urban agriculture makes this practice more achievable and ensures that it develops in a harmonious and sustainable way

- **Strategic framework for urban agriculture**

Montreal's Strategic Framework for Urban Agriculture has a total of 4 directions, 5 intervention areas, 7 targets and 34 actions, which will be implemented over a five-year period.



• Target

Several actions were taken to realize the city's vision for urban agriculture. Three goals were identified to measure the success of the strategy implemented by 2026:

1. In 2021, Montreal will have nearly 120 hectares of arable land, reaching 160 hectares by 2026.
2. There were 40 urban agriculture companies in Montreal in 2020 and 55 in five years.
3. Develop a new urban agriculture project in Montreal schools, increasing existing school initiatives to 50.

4.3.3 Actions that can be learned

- Support initiatives aimed at informing, raising awareness, educating and developing civic and community skills for urban agriculture
- Provide new gardening spaces for civic and community groups and integrate existing gardening spaces
- Montreal campus gardening is encouraged
- Encourage the development of gardening spaces suitable for the elderly and people with reduced mobility
- Increase the visibility and accessibility of local products and support their marketing in the region, especially in the public market network
- Develop a route of discovery to introduce the public to the agricultural areas in the western part of the island
- Create a catalogue of industrial and commercial spaces that are usable and suitable for urban agriculture and encourage their temporary use (allowing for a transitional occupation of the territory
- Supporting the creation of urban agriculture clusters
- Creation of facilitation units to accelerate the analysis and implementation of urban agriculture projects
- Support the development of adaptive support programmes for urban agriculture entrepreneurs
- Supporting the presence of emerging farmers and the marketing of urban produce in the Montreal Public Market Network
- Strengthen Montreal's network for healthy and local food supplies
- Support initiatives to promote research in urban agriculture
- Encourage continuous training and transfer of expertise
- Develop a regulatory framework for the development of urban beekeeping in harmony with biodiversity
- Promote the production of local high-quality compost and facilitate its distribution
- Citizens are encouraged to create biodiversity gardens
- Encourage food development and small-scale edible forest projects
- Promote the integration of fruit trees into greening projects
- Adoption of agricultural practices that promote biodiversity (pollinator reflection 14, honey plants)
- Establish and strengthen exchanges between central services and regions

- Create spaces to share and consult with local partners
- Urban farming practices in the region are documented, and the strategy is reviewed every two years
- Build a portal with centralized access to all information related to urban agriculture
- Adaptation and improvement of urban agriculture related to urban planning tools in municipal planning tools, in particular urban planning and mobility plans, and use categories including temporary uses
- Administrative regions are encouraged to adopt convenient and uniform regulations
- Supporting the regulatory change process in the boroughs and promoting urban agriculture practices
- Develop integrated projects that engage communities, businesses, and stakeholders.
- Partnering with community-based organizations to optimize access to financing for urban agriculture.
- Collaborate with other local governments to support and promote urban agriculture.
- Collaboration opportunities for organizations working in urban agriculture.

Chapter 5

Policy Proposal

5. Policy Proposal

5.1 Vision

Develop Lisbon into a model of urban agriculture with sustainability and food security at its core. By promoting innovation, community engagement and environmental protection, Lisbon is committed to building a green, healthy and thriving urban agriculture system that provides fresh, nutritious and affordable food to all citizens.

5.2 Strategic framework for urban agriculture

Lisbon's Strategic Framework for Urban Agriculture has 6 directions, 14 targets and 87 actions.

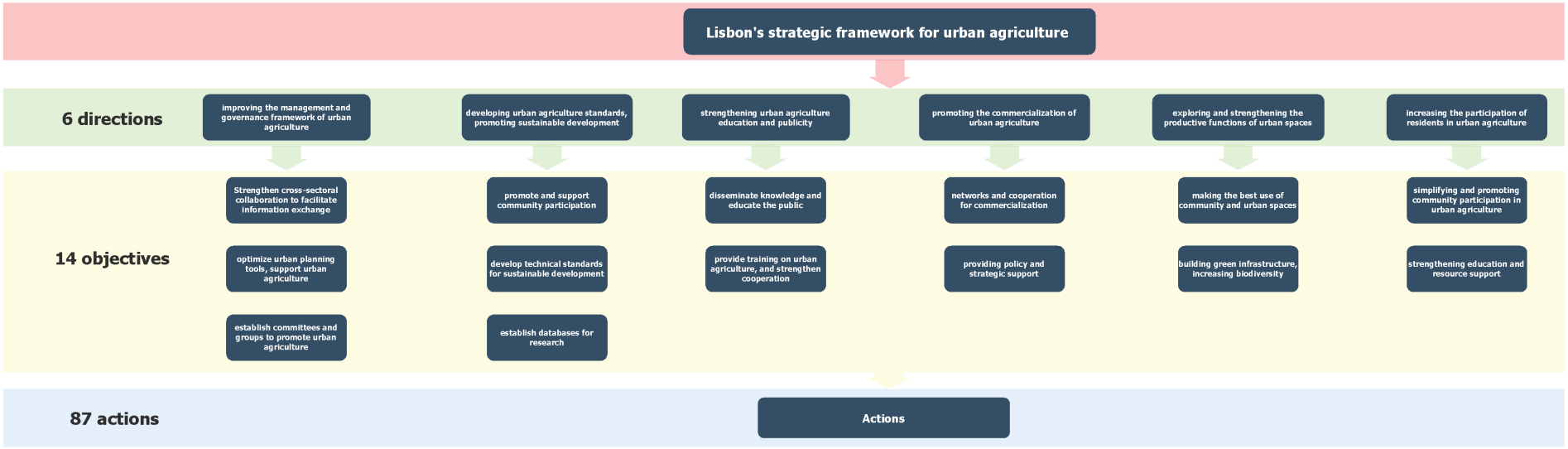


Fig.15 Lisbon Strategic Framework for Urban Agriculture

5.3 Detailed text

Improve the management and governance framework for urban agriculture

Strengthen cross-sectoral collaboration to facilitate information exchange

1. Promote information exchange and collaboration through regular inter-departmental training and seminars.

2. Develop and publish guidelines for cross-sectoral collaboration to clarify the roles and responsibilities of each department in urban agriculture projects to ensure effective collaboration.

3. Promote inter-departmental cooperation in the implementation of joint projects or pilot projects, and focus resources on solving key problems in urban agriculture.

4. Establish a regular reporting and assessment mechanism, requiring all departments to regularly report on the progress and results of urban agriculture-related work, and strengthen collaboration and information exchange.

5. Ensure the coherence of urban agriculture policies and regulations across sectors through legislative or policy adjustments to avoid conflict and duplication.

Optimize urban planning tools to support urban agriculture

6. Integrate urban agriculture into the planning advice process and optimize urban planning tools to support urban agriculture, especially urban planning and use categories, including temporary uses.

7. Review and update guidelines for urban agriculture

8. Develop regulatory frameworks to promote harmonization of livestock and biodiversity, and encourage the adoption of simple and harmonized regulations across jurisdictions.

9. Create a unified digital platform for all industries to share and access data and information related to urban agriculture and ensure that the

platform is easy to use.

10. Provide and manage community planting space plans and build and maintain the necessary urban agricultural infrastructure.

11. Promote innovative planting methods such as vertical farming (especially wall farming) and rooftop farming in densely built urban areas, and promote policies that promote community participation in urban agriculture.

12. Establish land banks to collect and manage idle land that can be used for urban agriculture, making it easier for citizens and organizations to apply

Establishment of committees and groups to promote urban agriculture

13. Establish a coordination committee composed of relevant departments to meet regularly to discuss issues related to urban agriculture.

14. Establish an Urban Agriculture Research Group with a focus on innovative technologies, best practices and sustainable development models in urban agriculture.

15. Establish Community Agriculture Advisory Committees to provide technical support, guidance and training

16. Create a networking platform to facilitate communication and collaboration between different groups and committees

17. Establish a policy review group to regularly evaluate existing urban agriculture policies and regulations.

Setting standards for urban agriculture and promoting sustainable development

Promote and support community engagement

18. Create or enable spaces to install seed banks to provide communities with local, adaptable seed resources and promote diversity and sustainability in urban agriculture.

19. Establish a community resource sharing platform to facilitate residents to share agricultural resources such as farm tools, seeds, and fertilizers, promote land sharing within communities, and improve land use efficiency.

20. Work with community-based organizations to optimize financing opportunities for urban agriculture by providing loans, grants and other financial instruments through partnerships, establishing a dedicated fund to support the start-up and development of community-based urban agriculture projects, and advising on how to access these assistance and subsidies.

21. Promote and develop sustainable food systems in collaboration with local, municipal and regional networks, integrating resources and policies at all levels to build efficient and sustainable urban food production and supply systems.

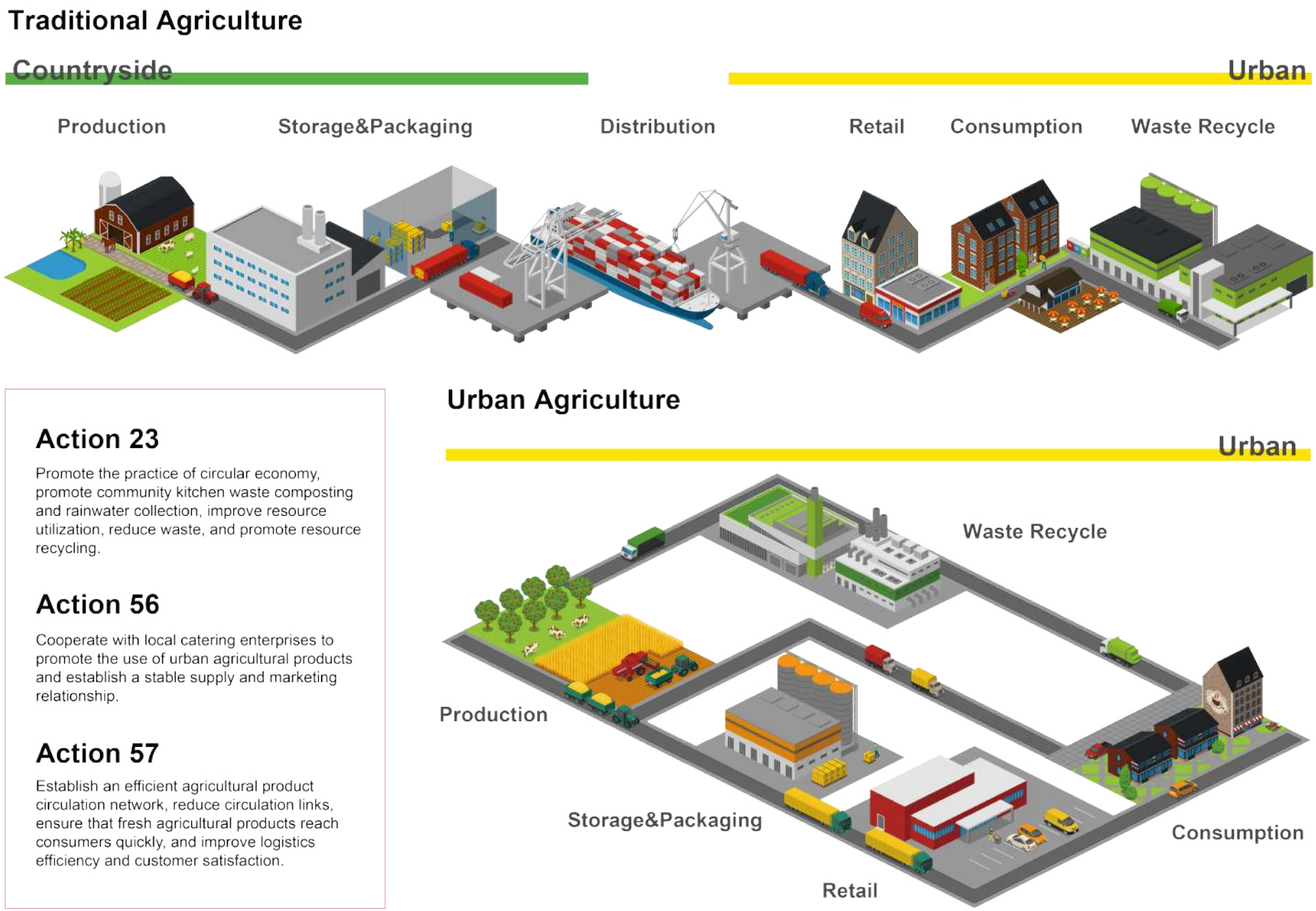
22. Support and fund urban agriculture research projects to explore new planting techniques and management methods, and disseminate research findings to the public to promote knowledge sharing and technological advancement.

Develop technical standards for sustainable development

23. Promote the practice of circular economy, promote community food waste composting and rainwater collection, improve resource utilization, reduce waste, and promote resource recycling.

24. Develop common technical standards (e.g. plant residue management, water management, etc.) to make urban agriculture sustainable, set standards for urban agriculture and ensure that all projects follow the principles of sustainable development.

25. Invite community representatives, farmers, volunteers and residents to participate in discussions and decision-making in the process of developing standards for urban agriculture. Through questionnaire surveys, focus group discussions, public meetings and other forms, collect opinions



Action 23

Promote the practice of circular economy, promote community kitchen waste composting and rainwater collection, improve resource utilization, reduce waste, and promote resource recycling.

Action 56

Cooperate with local catering enterprises to promote the use of urban agricultural products and establish a stable supply and marketing relationship.

Action 57

Establish an efficient agricultural product circulation network, reduce circulation links, ensure that fresh agricultural products reach consumers quickly, and improve logistics efficiency and customer satisfaction.

Fig.16 Comparison between traditional agriculture and urban agriculture

and suggestions from all walks of life on urban agriculture standards to ensure the rationality and feasibility of the standards.

26. Establish a certification and evaluation system to conduct certification and evaluation of projects that meet the standards, and regularly evaluate urban agriculture projects involving communities to enhance market recognition and ensure that they meet the requirements of sustainable development.

27. Promote energy-saving and emission-reduction technologies (such as the use of new energy and energy-saving equipment), and encourage urban agriculture projects to adopt clean energy and high-efficiency equipment to reduce their impact on the environment.

28. Publicize progress in the development and implementation of standards for urban agriculture to ensure that community members are informed and participatory, and to increase transparency and public participation.

29. Evaluate the pilot projects, summarize the lessons learned, provide a basis for the improvement and promotion of the standards, gain practical experience through the pilot projects, and continuously improve the standards.

Establish a database for research

30. Establish a database to guide action and decision-making, and collect and interpret data on opportunities and participation levels in urban agriculture to provide data support.

31. Provide and introduce advanced data analysis tools to conduct data mining and trend analysis to reveal the potential patterns and opportunities for the development of urban agriculture.

32. Develop an open data policy to allow research institutions, enterprises and the public to access and use data in databases, and promote the widespread use and sharing of data.

33. Establish a mechanism for regular data updates: ensure that the information in the database is timely, accurate and complete to meet the needs of ongoing research and decision-making.

34. Documenting urban agriculture practices, which are reviewed every two years to evaluate the urban agriculture projects implemented to date and gain practical experience.

35. Establish a data feedback mechanism to collect users' opinions and suggestions on the database, continuously improve the database

function, and improve the user experience.

36. Promote academic cooperation, cooperate with universities and research institutions, and use databases to carry out research related to urban agriculture and promote innovative development of urban agriculture.

Strengthen education and publicity on urban agriculture

Disseminate knowledge and educate the public

37. Publishing popular science articles, documentaries and news reports on urban agriculture through various media channels to share the latestdevelopments, success stories and practical tips on urban agriculture, so as to expand the scope and impact of publicity.

38. Workshops on agricultural practices, environmental protection and sustainable development are regularly organised by the community to disseminate relevant knowledge to community members.

39. Regularly offer courses on urban agriculture and organize hands-on workshops in places such as cultural centres, libraries or community centres to impart practical knowledge on planting techniques, eco-horticulture, organic farming, composting and rainwater harvesting.

40. Establish virtual learning platforms and provide interactive online courses and discussion forums to facilitate public communication and learning.

41. Adaptive reuse of abandoned industrial sites into urban agricuture experience parks to attract people from the surrounding area as wellas tourists in order to promote the popularization and propagation of urban agriculture.

42. Create a network map to update the information of the urban garden in real time (e.g. location changes, environmental changes).

43. Develop mobile applications related to urban agriculture that provide practical tools such as planting guides, plant identification, weather forecasting, etc.

44. Design and develop discovery routes to showcase the richness and diversity of urban agriculture in Lisbon

We have designed three unique exploration routes to showcase the richness and diversity of urban agriculture in Lisbon. Route 1 is suitable for urban explorers, history enthusiasts and those interested in agricultural education. Visitors can visit community vegetable gardens, participate in agricultural workshops, experience markets and cooking classes, and gain a deeper understanding of the history, current situation and future development of urban agriculture, and integrate into the local community. Route 2 is designed for families and children, combining education and entertainment. In a safe environment, children can experience interactive farmland experiences and market visits, which can enhance their understanding of nature and agriculture. Route 3 perfectly combines urban agriculture with Lisbon's historical and cultural attractions. It is suitable for cultural enthusiasts and

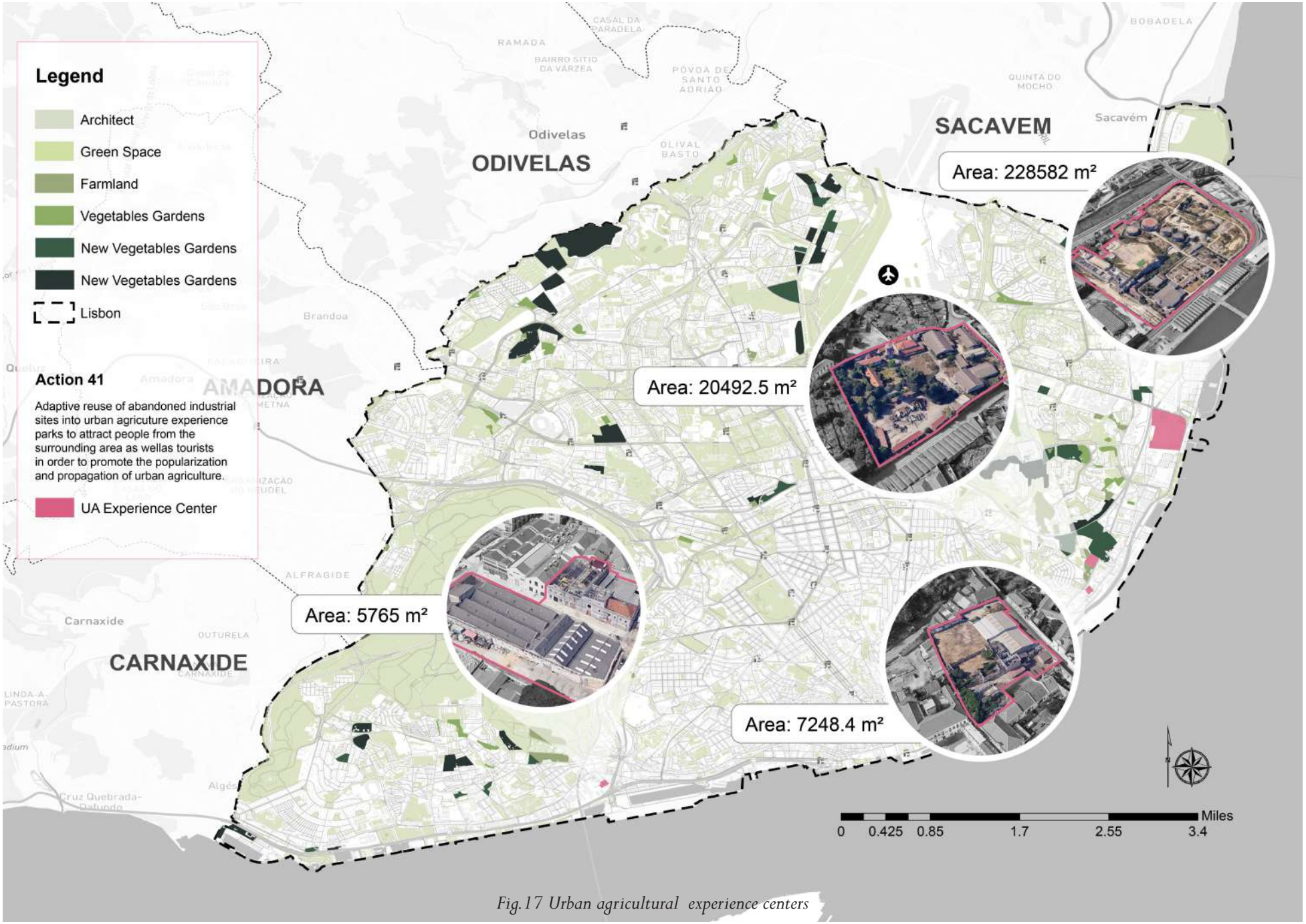


Fig.17 Urban agricultural experience centers

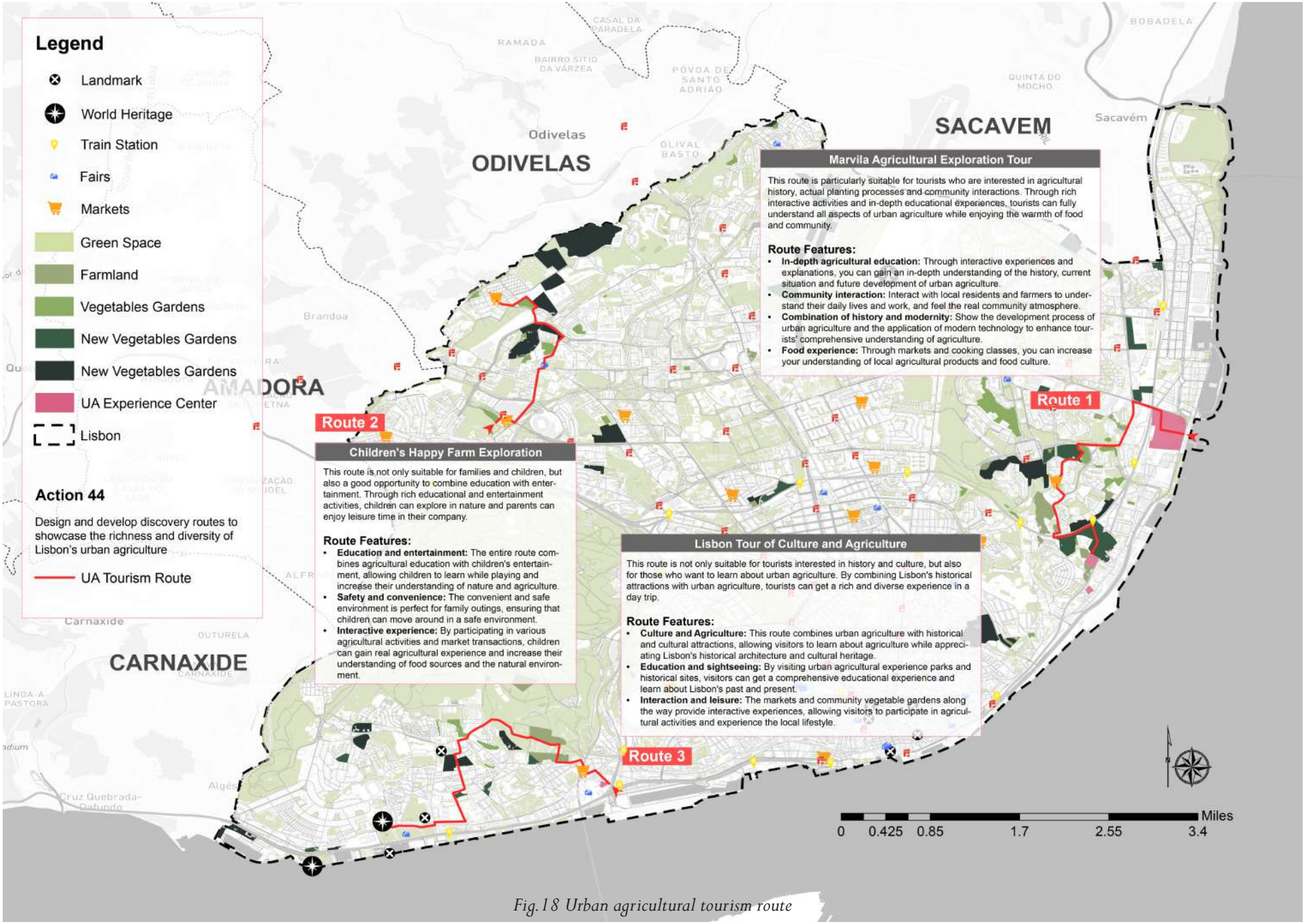


Fig.18 Urban agricultural tourism route

historical explorers. Visitors can participate in agricultural activities, appreciate the city's historical buildings and cultural heritage, and enjoy a fulfilling interactive and sightseeing experience. The three routes are unique and diverse, meeting the interests and needs of different tourists.

- **Route 1**

Target Audience: Urban explorers, history buffs, agricultural education enthusiasts

This route is especially suitable for those interested in the history of agriculture, the actual cultivation process, and community interaction. Through a wealth of interactive activities and in-depth educational experiences, visitors can learn all aspects of urban agriculture while enjoying the warmth of food and community.

Starting Point: Urban Agriculture Experience Park, located in the district of Marvilla. Visitors will learn more about the history and knowledge of urban agriculture and begin their journey of discovery. Malvilla was one of the first areas in Lisbon to start a community garden project. The community garden not only provides space for local residents to grow vegetables and fruits, but also serves as a hub for community gatherings and activities.

By: This precinct contains an abundance of pristine farmland and community gardens that have been in operation for many years, as well as many newly opened open spaces and green space gardens. Visitors can see the cultivation and management of various vegetables and learn about local agricultural production.

Agricultural Workshops and Interactive Experiences: Arrange interactive activities in the field, such as participating in planting, harvesting and agricultural workshops, so that visitors can experience the joy of agricultural production first-hand. Interactions with local community garden managers and farmers can be arranged to learn about their work and life stories.

Combining History and Modern Agriculture: Explain the historical background of the Marvilla district, show the development of urban agriculture and the application of modern agricultural technology. It is possible to join in agricultural development lectures and exhibitions that show the evolution of agriculture from tradition to modernity.

Culinary Experience: Passing by a market on the way, visitors can feel the lively atmosphere of the local produce trade and buy the desired products. Farm-to-table cooking classes can be arranged, allowing visitors to make and taste delicious farmhouse dishes using fresh, local ingredients.

Destination: The train station, from where visitors can conveniently start other trips.

Route features

In-depth agricultural education: Gain insight into the history, current and future development of urban agriculture through interactive

experiences and explanations.

Community Interaction: Interact with local residents and farmers, learn about their daily lives and work, and feel the authentic community atmosphere.

Combination of history and modernity: show the development process of urban agriculture and the application of modern technology, and enhance visitors' comprehensive understanding of agriculture.

Culinary Experience: Increase your knowledge of local produce and food culture through markets and cooking classes.

- **Route 2**

Target Audience: Family outings, children's education, parent-child activities

This route is not only suitable for families and children, but also a great opportunity to have fun and educate. Through a wealth of educational and recreational activities, children can explore nature and parents can enjoy leisure time in company.

Starting point: Metro station, located around Quinta da Granja Children's Park, Military College (Metro). It is conveniently located for tourists coming from all over the city.

By: This area has a large green space and a beautiful setting that is perfect for hiking and family activities. The surrounding facilities are abundant, especially suitable for families. There are several kindergartens, primary schools and amusement parks nearby, such as Quinta da Granja, which offer child-friendly activities and educational programs. These facilities provide a safe play space and educational experience for children to engage in fun farming experiences, learn about organic farming and meet farm animals (Time Out Lisboa).

Visitors can bring their children to roam freely in the green space and enjoy the beauty of nature. Here, children can participate in various activities in the field, learn about the process of growing vegetables, and experience the fun of planting and harvesting with their own hands. The playground facilities and educational programs in the park will bring endless fun and knowledge to the children.

Passing by a market along the way, visitors can experience the bustle of local produce trading and buy fresh produce. The market is not only a part of the daily life of the locals, but also a great opportunity for children to learn about local food sources and market deals (Pacer Walking App) (Time Out Lisboa).

Destination: The market, where visitors can buy fresh produce and return with a full load.

Route features

Combination of education and entertainment: The whole route combines agricultural education with children's entertainment, allowing children to learn through play and increase their understanding of nature and agriculture.

Safety & Convenience: The convenient and safe environment is perfect for families, ensuring that children can move in a safe environment.

Interactive Experience: By participating in a variety of agricultural activities and market transactions, children can get an authentic agricultural experience that increases their awareness of food sources and the natural environment.

- **Route 3**

Target Audience: Culture lovers, historical explorers, all-round experiencers

This route is not only suitable for tourists interested in history and culture, but also for those who wish to learn about urban agriculture. By combining Lisbon's historic attractions with urban agriculture, visitors can have a rich and varied experience in a one-day itinerary.

Starting Point: Urban Agriculture Experience Park, located in the Alcatara district. Visitors will learn about the history and knowledge of urban agriculture here, and begin their journey of discovery. The Alcatara district is not only an important starting point for urban agriculture in Lisbon, but it also has a rich historical and cultural background. Community gardens and green spaces in this area have been important places for urban agriculture activities for local residents for many years, contributing to the development and popularization of urban agriculture in Lisbon.

By: From the Urban Agriculture Experience Park, visitors will walk through a green space that connects pristine farmland with community vegetable gardens that have been in operation for many years, as well as newly opened open spaces and vegetable gardens. Visitors can learn about the cultivation and management of various vegetables during the hike and learn about local agricultural production.

Passing by the Palácio Nacional da Ajuda and Palácio Nacional de Belém, these historic palaces not only showcase Lisbon's rich cultural heritage, but also provide great photo opportunities. Visitors can learn about the history and architectural beauty of Portugal while enjoying the beauty of the city.

Continuing on, visitors pass by the market, where they can experience the bustling scene of local produce trading and buy fresh produce. Not only is this a great opportunity to shop, but it's also a great time to learn about the local lifestyle and economic activity.

Destination: World Heritage Site Mosteiro dos Jerónimos. This magnificent monastery is an outstanding example of late Gothic architecture in Portugal and one of Lisbon's most famous tourist attractions. Visitors can end their journey here and soak up the wonderful atmosphere of history and culture.

Route features

Culture and agriculture combined: This route combines urban agriculture with historical and cultural attractions, allowing visitors to learn about agriculture while also admiring Lisbon's historic architecture and cultural heritage.

Combining education and tourism: By visiting the Urban Agriculture Experience Park and historical sites, visitors can get a comprehensive educational experience about Lisbon's past and present.

Interaction and leisure: The marketplace and community vegetable garden provide an interactive experience that allows visitors to get hands-on with agricultural activities and get a feel for the local way of life.

45. Create an urban agriculture experience hall to provide interactive learning opportunities for the public to experience the planting and harvesting process.

46. Exemplary urban farms and community gardens are regularly selected to showcase different growing techniques and sustainable practices.

47. Develop and disseminate best practice guidelines. Through community bulletin boards, social media, news media and other channels, the importance and successful cases of urban agriculture are widely publicized to inspire residents to participate in social responsibility.

Provide training on urban agriculture and strengthen cooperation among all parties

48. Invite experts to present the latest research, technologies and policies in the field of urban agriculture and promote knowledge exchange and experience sharing.

49. Popular science books, manuals and guides on urban agriculture are developed and published and made available to the public free of charge or at low cost.

50. Establish partnerships with higher education institutions, promote collaboration with research organizations, and contribute to science communication.

51. Establish partnerships with children's educational institutions to develop children's environmental awareness and agricultural knowledge from an early age

52. Organize and train urban agriculture volunteers to help disseminate knowledge and assist communities in planting activities.

Promote the commercialization of urban agriculture

Leverage networking and collaborations to promote commercialization

53. Develop web pages or applications that connect citizens with offers and needs related to urban agriculture.

54. Improve the visibility and accessibility of local agricultural products, promote the branding of agricultural products, build local urban agricultural product brands through certification, packaging, publicity, etc., and support the marketing of local agricultural products in the region.

55. Create a special online marketplace platform to connect urban farmers with consumers and facilitate the online trading and distribution of local agricultural products.

56. Cooperate with local catering enterprises to promote the use of urban agricultural products and establish a stable supply and marketing relationship.

57. Establish an efficient distribution network for agricultural products, reduce circulation links, ensure that fresh agricultural products reach consumers quickly, and improve logistics efficiency and customer satisfaction.

58. Support urban farmers in establishing cooperatives to share resources, reduce costs, improve bargaining power, and promote intensive management and commercialization of agricultural products.

59. Support the establishment of urban agriculture clusters and the integrated development of multiple industrial chains such as production, processing, experience, leisure and tourism, increase diversified sources of income for urban agriculture, and improve the level of commercialization.

We have roughly defined an urban agriculture cluster based on the distribution of vegetable gardens, farmland, and new vegetable gardens in Lisbon. Markets, bazaars and higher education institutions are located in the vicinity of the cluster, which support the marketing and distribution of agricultural products and the development of agricultural science and technology. The establishment of urban agriculture experience centers has increased the educational and tourism functions of these areas. Overall, these clusters increase agricultural income and commercialization of agricultural products by integrating multiple industrial chains such as production, processing, experience and leisure, and promote community participation and maximize ecological benefits.

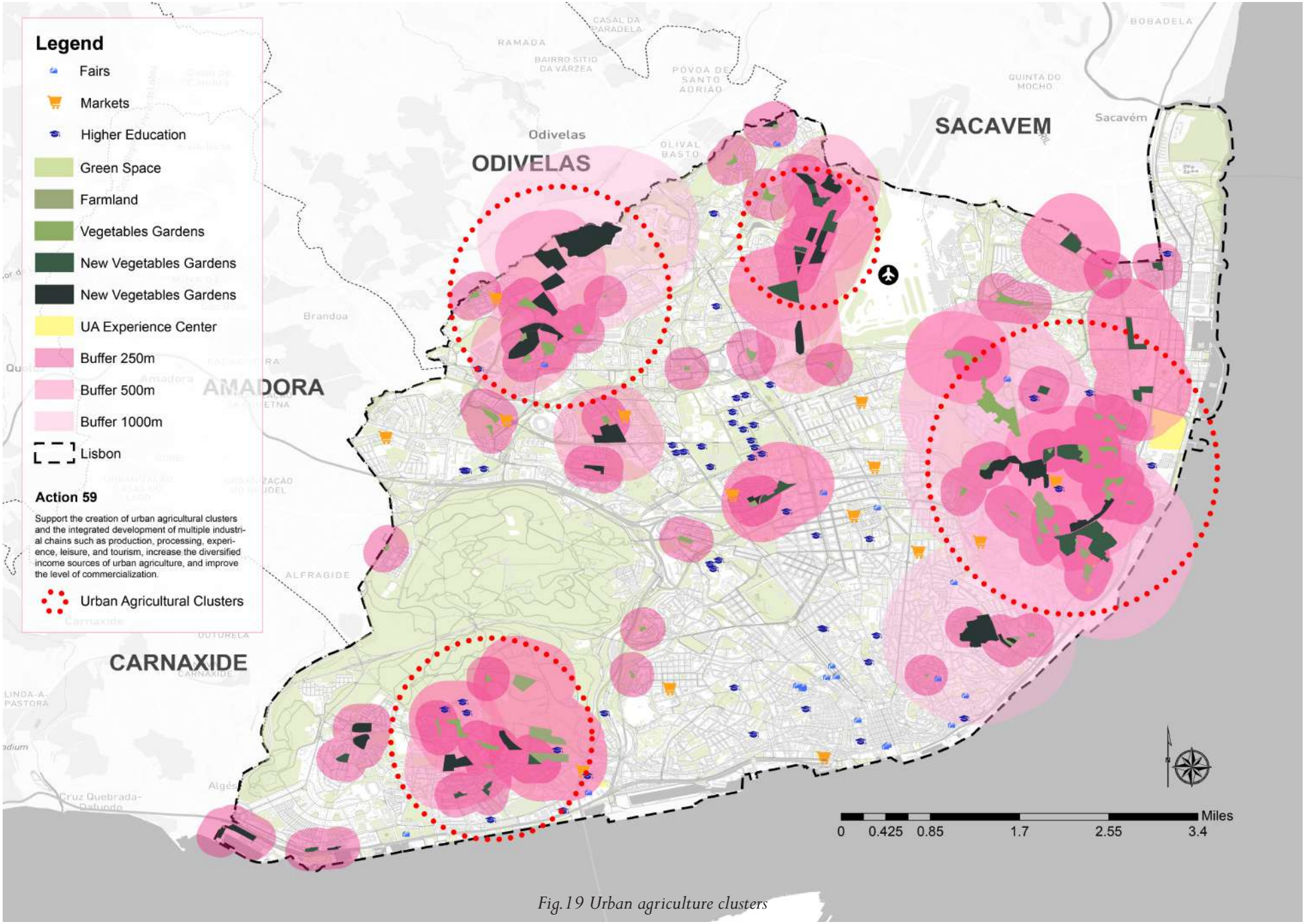


Fig.19 Urban agriculture clusters

Provide policy and strategic support

60. Establish a preferential tax system, such as reducing or exempting land use tax and value-added tax, to reduce the operating costs of urban agricultural enterprises and rural households.

61. Provide subsidies and financial support for the construction of urban agriculture infrastructure, technological upgrading, market promotion, etc., to enhance the development capacity of enterprises.

62. Promote the establishment of an agricultural insurance system, reduce the risks of agricultural production, and attract more capital to invest in urban agriculture.

63. Carry out research on market demand and trends, guide agricultural enterprises and rural households to adjust their production structure and strategies, and improve the adaptability of their products to the market.

64. Regularly organize activities such as urban agriculture festivals, harvest festivals, and agricultural markets to showcase the achievements of urban agriculture to the public, enhance consumers' trust and recognition of local agricultural products, and enhance community cohesion and participation.

Explore and strengthen the productive functions of urban spaces

Make the most of community and urban spaces

65. Create a small garden using existing facilities (e.g. terraces, balconies, terraces, rooftops, etc.).

66. Encourage the expansion of urban agriculture in abandoned or unused areas, allow for TRANSITIONAL OCCUPATION** of territory, provide flexible land-use options, and restore abandoned gardens, among other things.

By combining government and municipal data analysis, geographic information systems, and field visits and assessments, we identify abandoned or unused areas in cities.

The impact area of the community garden is determined by the size of the vegetable garden, and the impact area is based on the provisions of the "Lisbon 2020 Local Action Plan for Biodiversity".

Classificação dos espaços verdes públicos (área>7500m2)

Espaços verdes públicos	Dimensão	Raio de influência (população residente a menos de X metros)
Parques periurbanos	Área > 50 ha	7000m
Parques centrais	10 - 50 ha	1000m
Parques urbanos	2,5 - 10 ha	500m
Parques de vizinhança	0,75 - 2,5 ha	250 m

Fig.20 Green space radiation range

Source: Lisbon Local Action Plan for Biodiversity 2020.

67. Work with developers to promote the availability of land for food cultivation and recycling in new developments, integrate urban agriculture planning into new developments, and improve land use and community self-sufficiency.

** *TRANSITIONAL OCCUPATION: This is an innovative concept based on a gradual and evolving occupation of the site with a view to identifying a lasting vocation which prolongs the spirit of the place.*

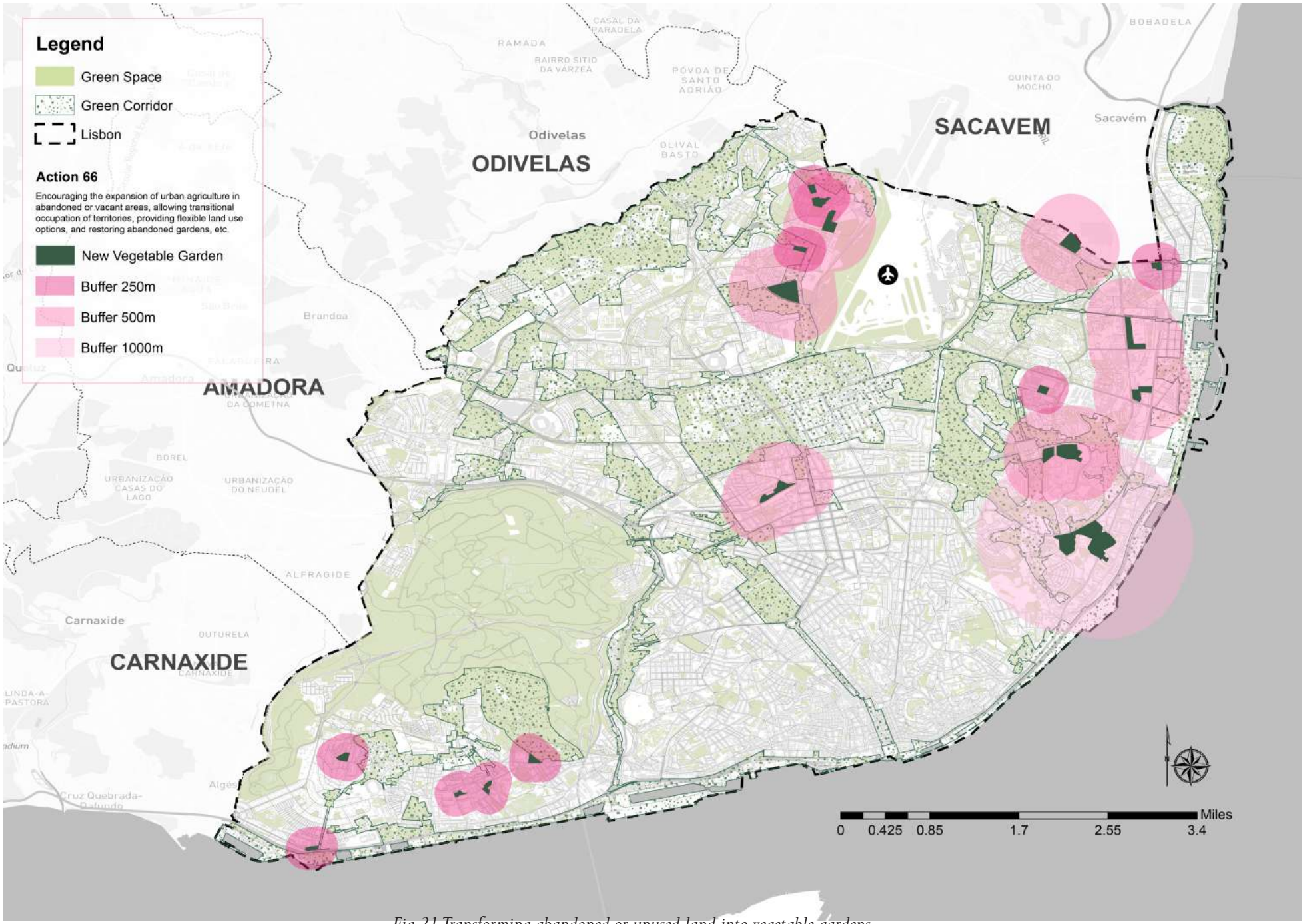


Fig.21 Transforming abandoned or unused land into vegetable gardens

Build green infrastructure and increase biodiversity

68. Transform public spaces such as green parks and green corridors into vegetable gardens.

69. Increase the presence of edible plants in urban green infrastructure, promote the integration of fruit trees into greening projects, and increase the planting of fruit trees and other edible plants in urban greening projects to provide diversified food sources.

According to the statistics of the available tree species in Lisbon, there are a total of 68,956 trees in the city, of which 11,002 are unrecognized. A total of 409 tree species were excluded, with the largest number of 8,908 trees including the fig tree (Celtis australis). This is followed by jacaranda mimosifolia with 3,380 trees and Platanus x hybrida with 2,128 trees.

Of the 409 tree species identified, there are 52 species of fruit trees or edible plants:

1. Celtis australis - Hackberry (edible fruit)
2. Pinus pinea - Stone Pine (edible pine nuts)
3. Prunus cerasifera subsp. pissardii - Cherry Plum (edible fruit)
4. Olea europaea - Olive (olive, edible fruit)
5. Pyrus calleryana var. Chanticleer - Callery Pear (edible fruit)
6. Prunus avium - Wild Cherry (edible fruit)
7. Ceratonia siliqua - Carob Tree (edible pods)
8. Prunus dulcis - Almond (edible seeds)
9. Phoenix dactylifera - Date Palm (date palm, edible date fruit)
10. Punica granatum - Pomegranate (pomegranate, edible fruit)
11. Eriobotrya japonica - Loquat (loquat, edible fruit)
12. Morus nigra - Black Mulberry (Mulberry, edible fruit)
13. Morus sp. - Mulberry (Mulberry, edible fruit)
14. Ficus carica - Fig (Fig, edible fruit)

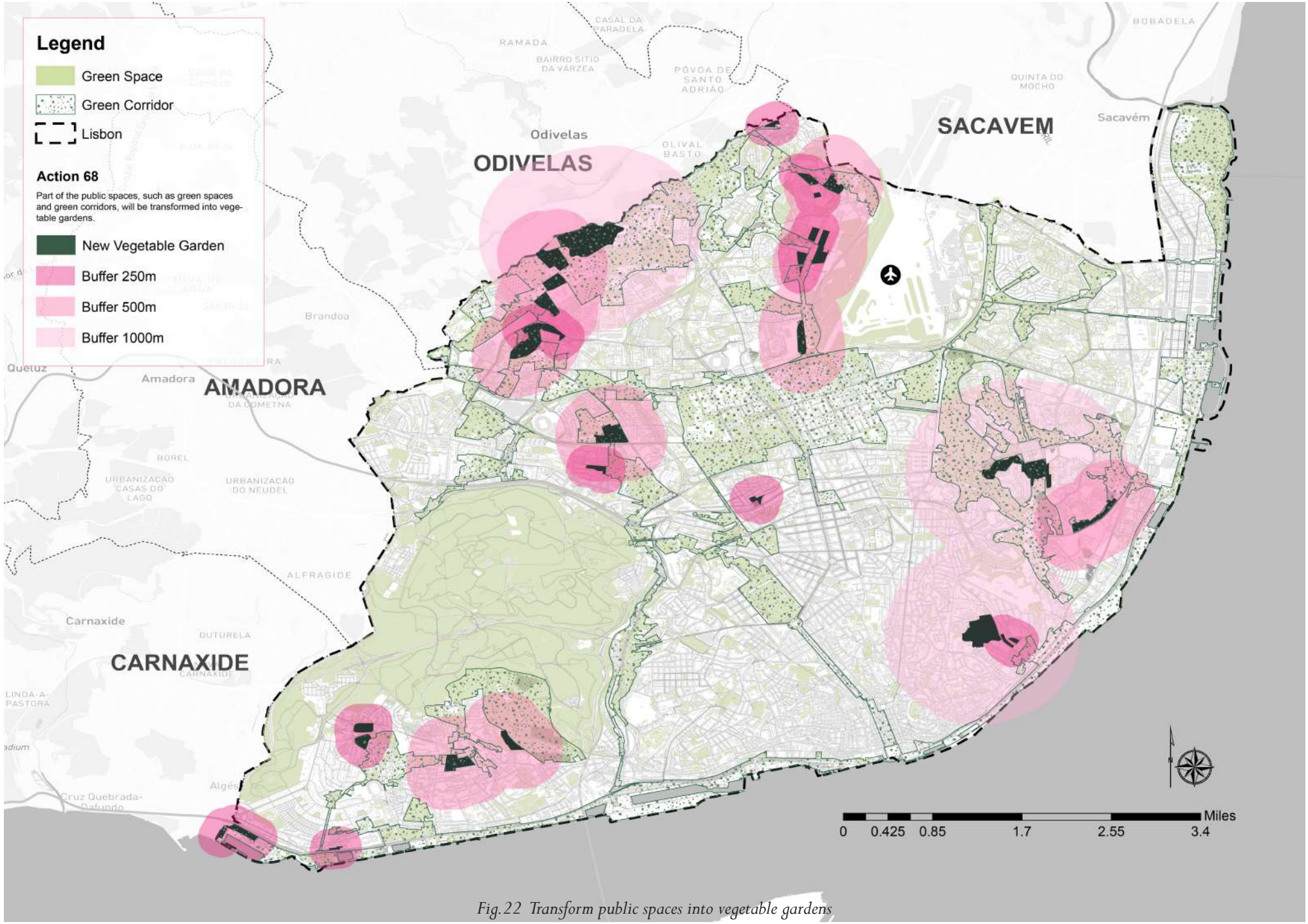


Fig.22 Transform public spaces into vegetable gardens

15. Citrus x aurantium - Bitter Orange (Bitter Orange, edible fruit
16. Citrus sinensis - Sweet Orange (Sweet Orange, edible fruit)
17. Citrus limon - Lemon (Lemon, edible fruit)
18. Ficus benjamina - Weeping Fig (Partial edible fruit)
19. Morus alba - White Mulberry (Mulberry, edible fruit)
20. Elaeagnus angustifolia - Russian Olive (Edible fruit)
21. Ficus religiosa - Sacred Fig (Fig, edible fruit)
22. Pyrus sp. - Pear (Pear, edible fruit)
23. Persea americana - Avocado (Avocado, edible fruit)
24. Juglans nigra - Black Walnut (Black Walnut, edible seeds)
25. Annona cherimola - Cherimoya (Sugar Apple, edible fruit)
26. Prunus armeniaca - Apricot (Apricot, edible fruit)
27. Prunus persica - Peach (Edible fruit)
28. Prunus avium plena - Sweet Cherry (Edible fruit)
29. Prunus domestica - Plum (Edible fruit)
30. Myrtus communis - Myrtle (Edible berries)
31. Punica granatum 'Nana' - Dwarf Pomegranate (Edible fruit)
32. Crataegus monogyna - Hawthorn (Edible fruit)
33. Arbutus unedo - Strawberry Tree (Edible fruit)
34. Malus sp. - Apple (Edible fruit)
35. Psidium guajava - Guava (Edible fruit)
36. Castanea sativa - Sweet Chestnut (Edible nut)
37. Prunus cerasus - Sour Cherry (Edible fruit)
38. Pyrus communis - Common Pear (Edible Fruit)

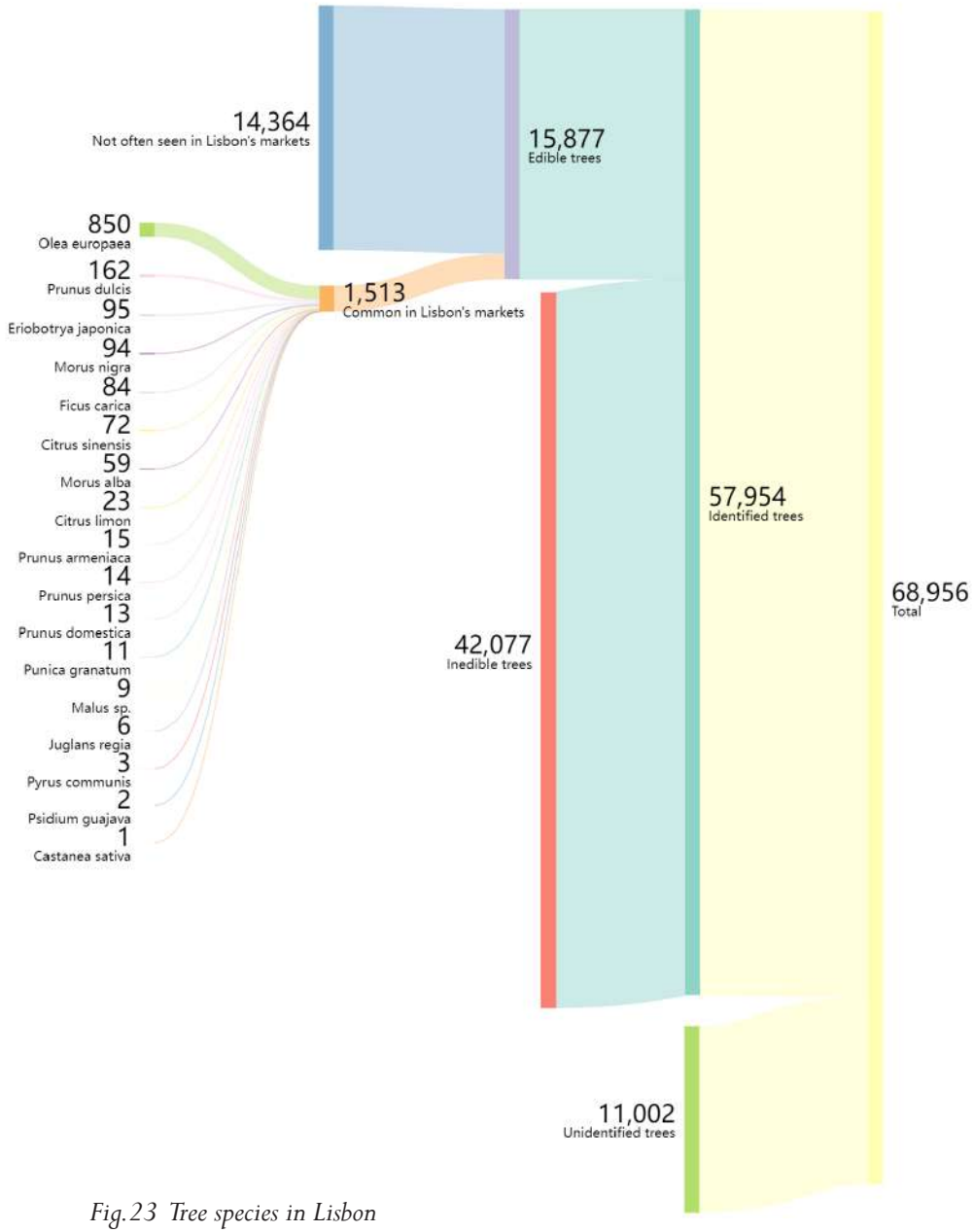


Fig.23 Tree species in Lisbon

39. Cydonia oblonga - Quince (Edible Fruit)
40. Jubaea chilensis - Chilean Wine Palm (Edible Fruit)
41. Eriobotrya deflexa - Bronze Loquat (Edible Fruit)
42. Ficus diversifolia - Laurel Fig (Edible Fruit)
43. Malus sylvestris - European Crab Apple (Edible Fruit)
44. Persea indica - Madeira Laurel (Edible Fruit)
45. Pyrus communis ssp. piraster - Wild Pear (Edible Fruit)
46. Rhamnus alaternus - Italian Buckthorn (Edible Fruit)
47. Prunus spinosa - Blackthorn (Edible Fruit)
48. Robinia pseudoacacia - Black Locust (Edible Flowers)
49. Sambucus nigra - Elderberry (Edible Fruit)
50. Acca sellowiana - Feijoa (Feijo, edible fruit)
51. Casimiroa edulis - White Sapote (White Sapote, edible fruit)
52. Camellia japonica - Japanese Camellia (Camellia, edible seeds)

Among them, the following 17 fruit and nut plants are commonly seen in Lisbon markets, and residents often buy and eat their fruits. Olive oil, oranges, lemons, figs and almonds are an important part of the daily diet of Lisbon residents:

1. Olea europaea - Olives (olive oil and marinated olives) 850
2. Citrus sinensis - Sweet oranges (oranges) 72
3. Citrus limon - Lemons 23
4. Prunus dulcis - Almonds 162
5. Ficus carica - Figs 84
6. Punica granatum - Pomegranates 11
7. Prunus armeniaca - Apricots 15

8. Prunus persica - Peach 14
9. Prunus domestica - Plums 13
10. Malus sp. - Apples 9
11. Pyrus communis - Pears 3
12. Morus nigra - Black mulberries 94
13. Morus alba - White mulberries 59
14. Eriobotrya japonica - Loquats 95
15. Juglans regia - Walnuts 6
16. Castanea sativa - Chestnuts 1
17. Psidium guajava - Guava 2

These edible tree species account for a relatively small proportion of 2.657% of the identifiable trees in Lisbon. It is recommended to increase the planting of these tree species because it will help improve the city's ecological diversity and provide more edible resources for residents. 70. Encourage residents to plant a variety of plants in their own courtyards or public spaces to improve the urban ecosystem.

71. Adopt biodiversity-promoting agricultural practices to improve the ecological efficiency of urban agriculture through diversified cropping, crop rotation and other techniques.

72. Design and install rainwater harvesting systems to use rainwater for irrigation of green spaces and green infrastructure, reduce urban runoff and improve water quality.

73. Invest funds to support innovation and research in ecological technology to improve the efficiency and sustainability of green infrastructure and promote the healthy development of urban ecosystems.

Increase residents' participation in urban agriculture

Simplify and promote community participation in urban agriculture

74. Establish communication channels with the community and the public, regularly disseminate information on urban agriculture, and listen to public opinions and suggestions.

75. Provide convenient approval channels for community-based agricultural projects, reduce administrative barriers, and improve the efficiency of project initiation and operation.

76. Provide free horticultural consultation services to answer residents' questions about urban agriculture and promote scientific planting methods. Set up an urban agriculture consultation center in the community to provide planting guidance, technical support, resource sharing and other services to help residents solve practical problems.

77. Develop different planting models that simulate the relevant life scenarios of different groups, and encourage residents to choose their own practices according to different needs and actual conditions.

78. Streamline the administrative process of agreements for the use and management of horticultural parks to facilitate the smooth development and effective management of urban agriculture in communities.

79. Encourage the development of horticultural spaces suitable for the elderly and persons with reduced mobility

80. Establish horticultural areas in public institutions such as schools and hospitals to combine educational and therapeutic functions.

81. Establish awards related to urban agriculture to recognize individuals and organizations that have made outstanding achievements in the promotion and practice of urban agriculture, and to encourage more people to participate.

82. Organize and hold competitions for urban horticulture and agricultural products, and raise the enthusiasm and technical level of the public through competitions.

Strengthen education and resource support

83. Establish community agricultural education centres or resource centres to encourage continuous training and transfer of expertise, to provide information on planting techniques, resources and community activities, and to serve as centres for learning and communication among residents.

84. Establish dedicated organizations for the promotion of urban agriculture to advise residents on how to develop and maintain community planting spaces.

85. Develop urban agriculture curricula and academic research projects in cooperation with educational institutions such as primary and secondary schools and universities to foster young people's interest in and participation in agriculture.

86. Establish a permanent technical support team or agricultural experts to provide residents with real-time guidance, problem solving, and technical support during the planting process

87. Regularly organize training courses on planting skills, including soil management, seed selection, irrigation techniques, and the use of organic fertilizers, to improve the planting skills of the population.

Chapter 6

The Site Area Overview

According to **Action 41** of the **Lisbon Urban Agriculture Strategy**, *"Adaptive reuse of abandoned industrial sites into urban agricuture experience parks to attract people from the surrounding area as well as tourists in order to promote the popularization and propagation of urban agriculture."*, we decided to select an abandoned factory site for adaptive transformation.

Combined with **Action 59**, *"Support the establishment of urban agriculture clusters and the integrated development of multiple industrial chains such as production processing, experience, leisure and tourism, increase diversified sources of income for urban agriculture, and improve the level of commercialization."*, the Mavila area will be the place with the most and most concentrated urban agricultural plots in Lisbon in the future. At the same time, the Mavila area has convenient transportation, with two railway stations in the area and the largest passenger station in Lisbon not far from the north of the area, which is very suitable for attracting tourists and residents from different parts of the city. This convenient geographical location enables the agricultural experience park to attract a wider audience and is suitable for the vigorous development of urban agricultural clusters.

As a historical industrial area in Lisbon, the Marvila area has a large number of abandoned industrial buildings and sites. With the support of the government, this area is gradually being transformed into a creative park, encouraging the transformation of abandoned industrial parks into other types of parks to revitalize the area. Currently, there are many excellent cases of transformation here.

In summary, we decided to choose the **abandoned refinery Antiga Refinaria GALP** in the Marvila area of Lisbon for the transformation of the urban agricultural experience center.

6. The Site Area Overview

6.1 The connection between landmark and site

Several famous landmarks are listed below the map, such as the Belém Tower and the Monument to the Discoverers. These buildings are not only cultural heritage, but also an important manifestation of urban style, demonstrating the diversity and functional layout of the city, which is an important part of urban planning. And the co-ordination of urban planning and architectural design can contribute to the sustainable development of the city and the quality of life of its inhabitants, and to a certain extent improve the attractiveness and cohesion of the city. Good urban planning thinking should continue to balance historical preservation with modern development to ensure the vitality and liveability of cities.

The location of the design site is away from the landmark and higher education areas, close to the sea and harbour, suitable for the development of the rest of the functional areas, and connected to the landmark or higher education areas through the main transport routes.

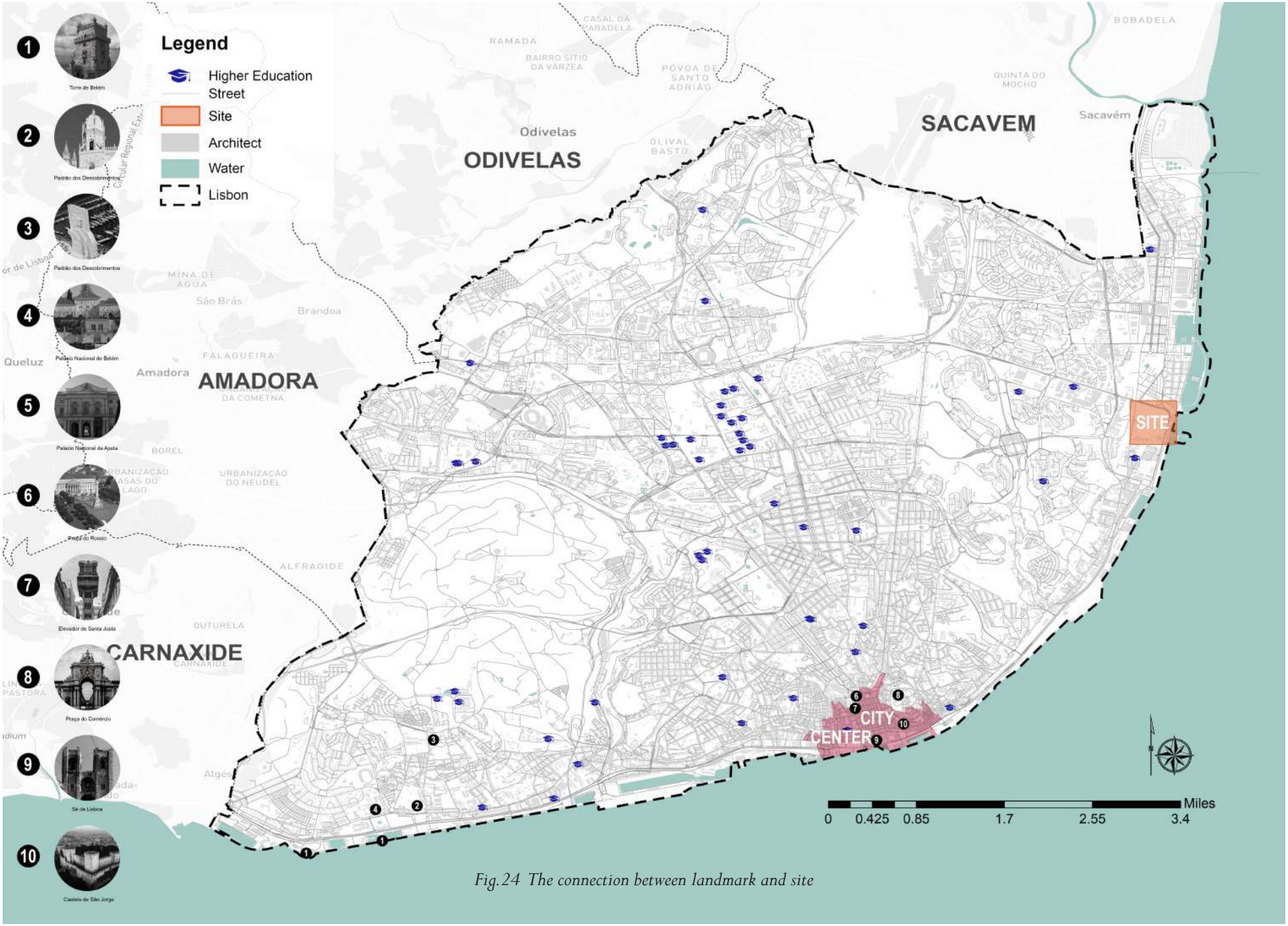


Fig.24 The connection between landmark and site

6.2 The connection between transport and site

The map shows the main road network of the city of Lisbon, as it is located in a hilly terrain and the undulating topography of the city has a significant impact on the layout of the roads, which creates some challenges for modern traffic flow. Lisbon's road network consists of a number of major arterial roads that connect the city centre with other major areas and carry the bulk of the traffic flow. The Lisbon Metro system consists of four lines that cover most of the main areas of the city. The city government has taken some measures to ease traffic pressure, such as encouraging the use of electric scooters and promoting the construction of bicycle paths.

The surrounding area of the design site is well travelled due to the presence of the Parque de las Naciones Unidas, which was built in the last century. It is close to the Lisboa Oriente train station, with the railway on the left. Right sides of the site as well as a major highway and a bus stop at the entrance of the site, which allows people in the neighbourhood to take a bus directly to the site, and across the highway is the small port of Cais da Matinha. The municipality intends to connect this green area through the construction of the coastal area, and the design site can become an important node in this area by relying on the coastal road. There are more than a few cycle paths around the site, but they are not yet complete, and there is an urgent need for a complete cycle path network.

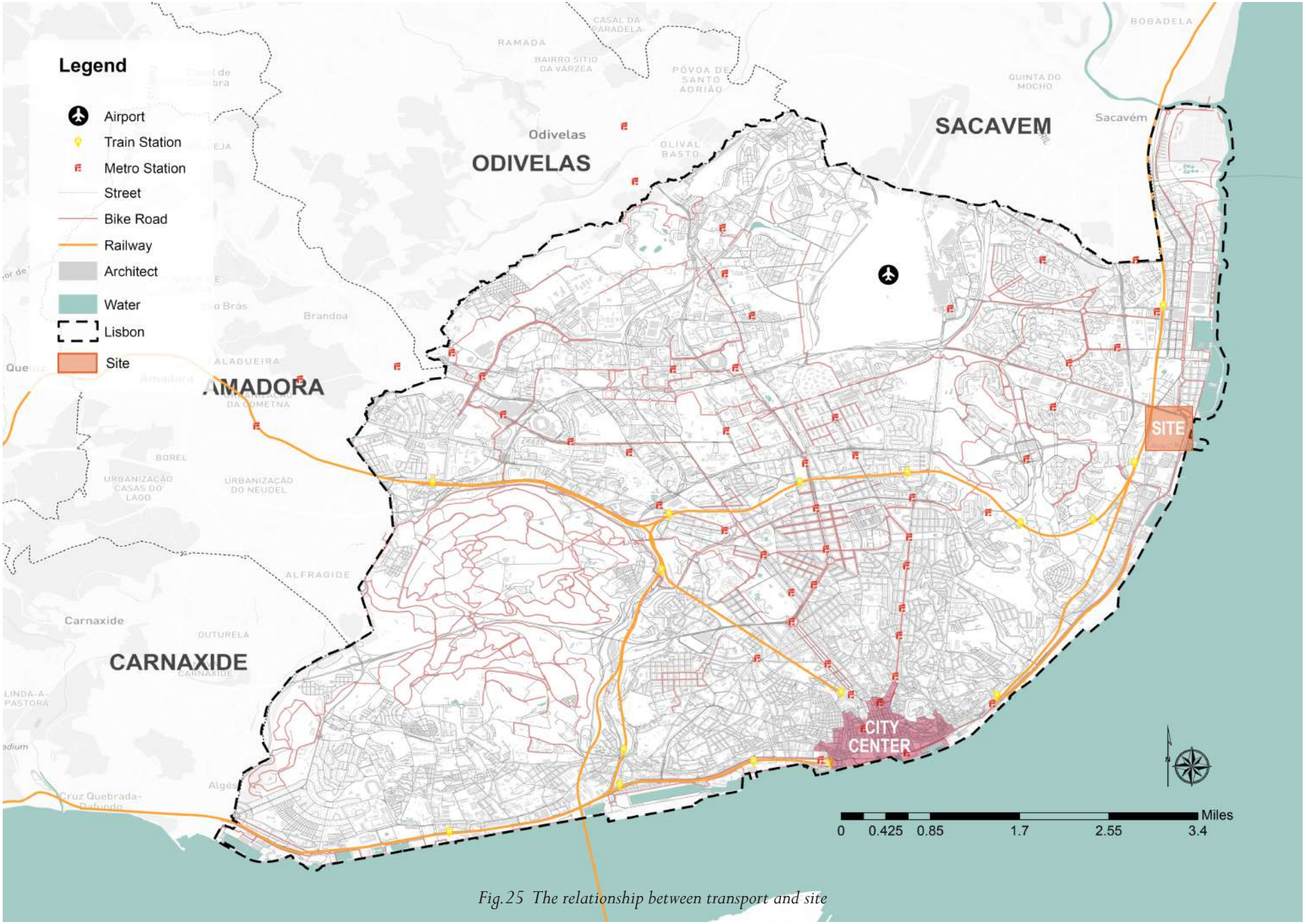


Fig.25 The relationship between transport and site

6.3 The connection between green space and site

The map shows that Lisbon has large areas of green space, including parks and nature reserves. These areas provide ecological services to the city such as air purification, temperature regulation and biodiversity conservation.

And the Lisbon government's Green Corridors program connects different green spaces, contributing to the migration of wildlife and the spread of plants, as well as providing residents with places for recreation and sports.

Meanwhile, thanks to the municipal government's promotion of municipal gardens in urban agriculture, there are decentralized vegetable gardens and farmlands in the city, which not only provide a local food supply, but also contribute to the sustainable development of the community.

The proximity of these agricultural lands to residential areas provides residents with the opportunity to participate in agricultural activities and contributes to community cohesion. Water bodies are distributed along the urban fringe, which not only beautify the urban environment, but also play an important role in flood control and water management, and their ongoing development of waterfront areas can connect green areas along the road, while tourism and recreational facilities can be developed.

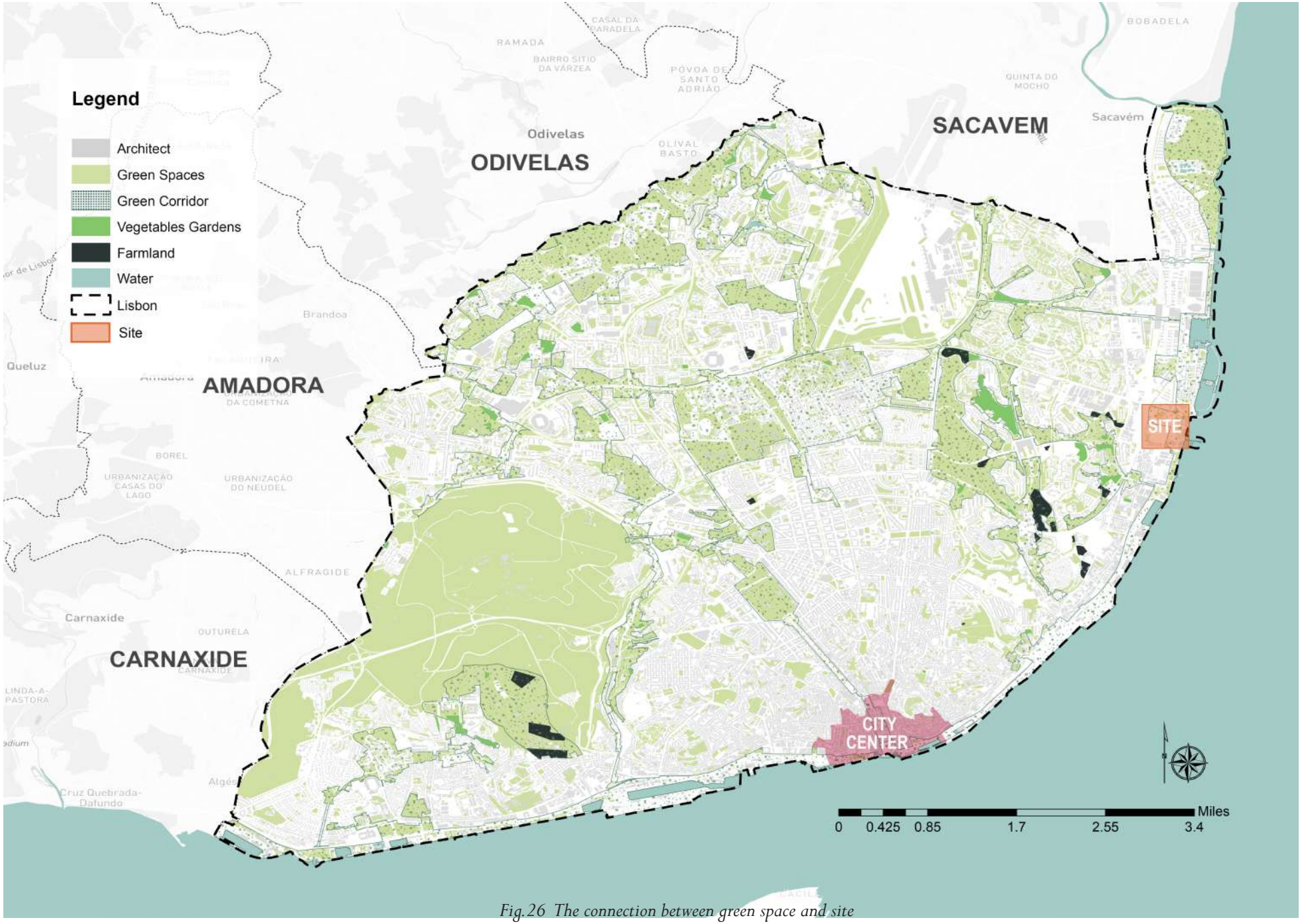


Fig.26 The connection between green space and site

6.4 Marvila Region Backgrounds

Although it's mostly made up of abandoned warehouses and crumbling industrial architecture, Marvila is the neighborhood to watch in Lisbon.

Located on the riverfront, between downtown and the modern Parque das Nações district, it's undergoing a cultural regeneration, after decades of neglect.

This was Lisbon's manufacturing heart, starting in the 1800s, when an agricultural area became the site of a number of factories.

Those closed in the late 20th century, and only in the last few years have artists and investors recognized the potential of the derelict spaces, turning them into galleries, restaurants, and craft breweries.

Fig.27 Regional scale site analysis

6.5 Horticulture Parks

Parques Hortícolas in Lisbon refer to agro-parks within the city that aim to promote urban agriculture and community participation.

These agro-parks provide space to grow vegetables, herbs and fruits, which not only improves the urban environment, but also increases residents' awareness of food security and community cohesion.

The site selection is surrounded by four Parques Hortícolas, creating excellent conditions for creating an urban agriculture cluster in Lisbon.

Currently these horticultural parks are open only to citizens who apply for them and are independent of each other, lacking strong linkages between the parks and a platform for processing and marketing of harvested produce.

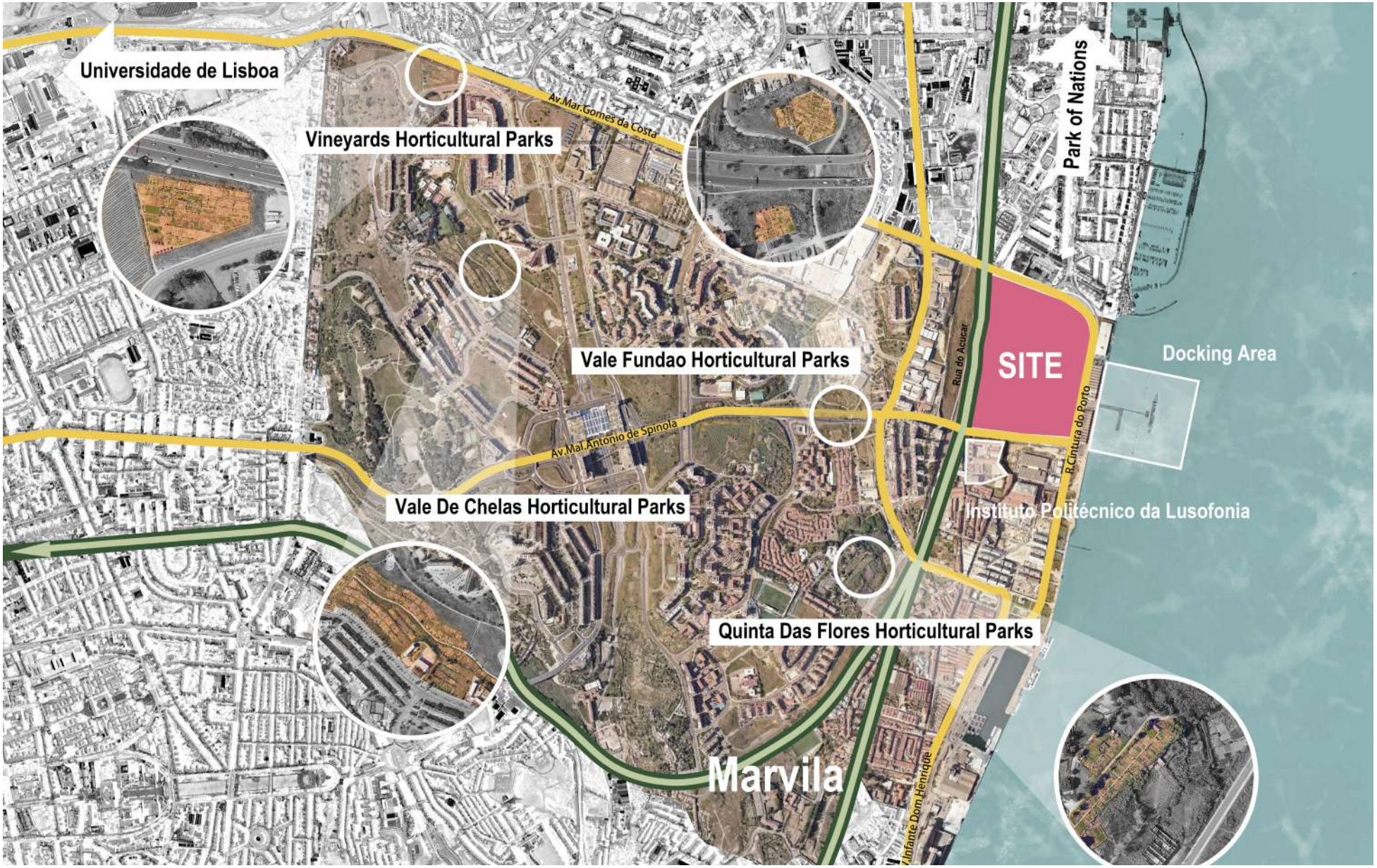


Fig.28 Local scale site analysis

6.6 Municipal MasterPlan

The site have three application modes:

center and residential areas, special use spaces for equipment, recreational and production green spaces

Center and residential areas:The Municipality establishes that, in integrated central and residential areas, in order to promote the revitalization of these areas, priority should be given to the predominantly residential character, to the preservation and rehabilitation of existing buildings, to the infill and compression of the urban fabric, to the compatibility of the various uses, to the creation of facilities and to the improvement of public spaces, i.e., through the increase of their permeability. The coexistence of various urban uses is permitted as long as they are compatible with residential uses, i.e., in terms of safety of persons and goods, noise, vibration, gas, sewage and traffic, and as long as they do not create an imbalance or a loss of harmony with their surroundings, and as long as they satisfy the need for space for public amenities as set out in the Charter of Facilities.

Special use spaces for equipment:means existing or proposed collective use equipment, public service facilities, and security service facilities where the use is expected to remain unchanged, as well as complementary uses, provided they do not occupy more than 20% of the parcel area and do not exceed a buildability index of 1.5 for the area. They may also include isolated buildings allocated to other uses or existing small urban street frontage buildings.

Recreational and production green spaces:means public or private non-built, permeable and cultivated spaces, including gardens, large courtyards of municipal heritage-listed buildings or complexes, historic farms, tapadas and monastic enclosures, on organic soils of natural topography, used for urban agricultural, recreational and productive purposes, which may include collective equipment and infrastructure to support recreation and leisure, including food and beverage venues and tourism related Recreational equipment.

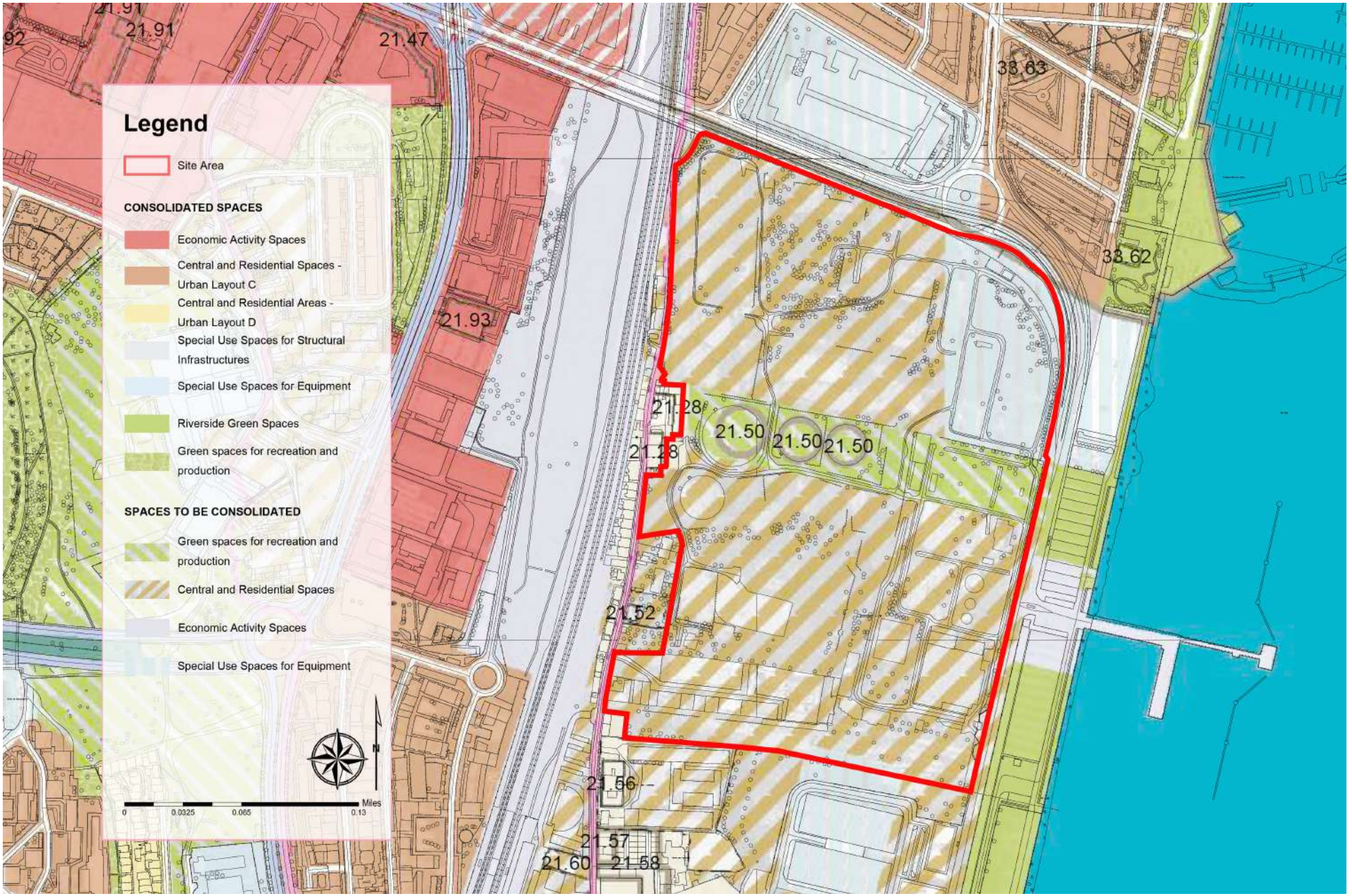


Fig.29 Municipal master plan

6.7 Soil Type Analysis

There are two main types of soil that make up the interior of the site, alluvial and arenític.

Alluvial soil, a type of soil formed by river or flood deposits. This soil is fertile and has a moderate moisture content, making it ideal for planting. It is important to note that alluvial soils, which are formed by the alluvial deposition of clay, are commonly found in areas along rivers and lakes and are susceptible to pollutant inputs from upstream water bodies or floods. Pollutants from water flows (e.g., industrial wastewater, pesticides and fertilizers from agricultural runoff) are deposited in the top layer of alluvial soils on both sides of the river. However, because of their low permeability, especially when the clay content is high, it is more difficult for water to penetrate deeper into the soil, and pollutants are usually retained in the top layer of the soil or in shallower zones, a characteristic that slows down the depth and rate of pollutant infiltration into the ground.

Arenític soil refers to sandy soils, which usually have high permeability. This soil type is characterized by a high sand and gravel content, coarse texture, and high porosity, which allows water to penetrate easily, and the same pollutants can penetrate deeper than in alluvial soils. It is not a naturally high quality arable land, but its suitability for cultivation can be significantly improved by appropriate amendments and management.

To summarise, ranking the three soil types in order of their suitability for cultivation, **Alluvial>Arenitic**

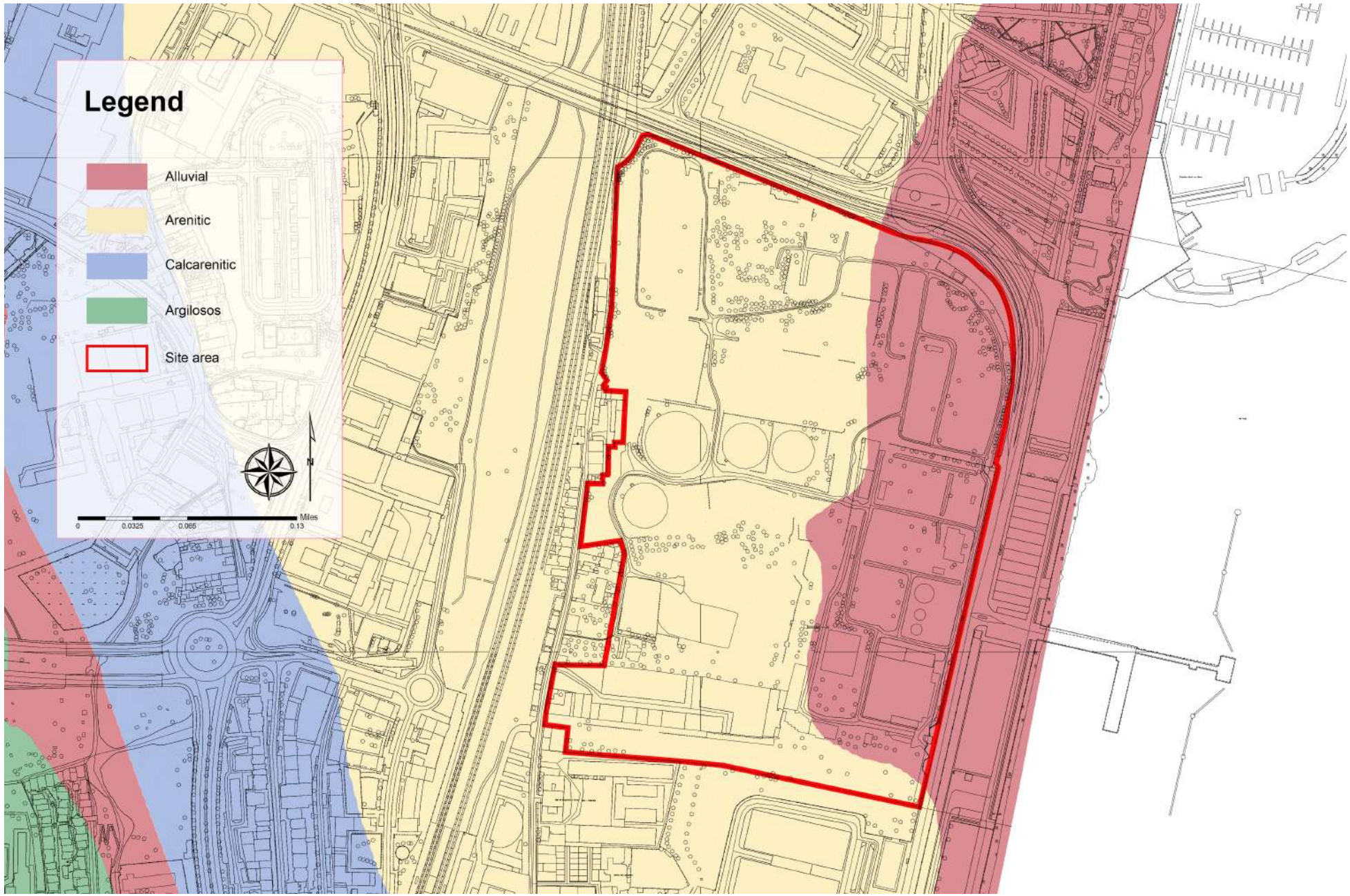


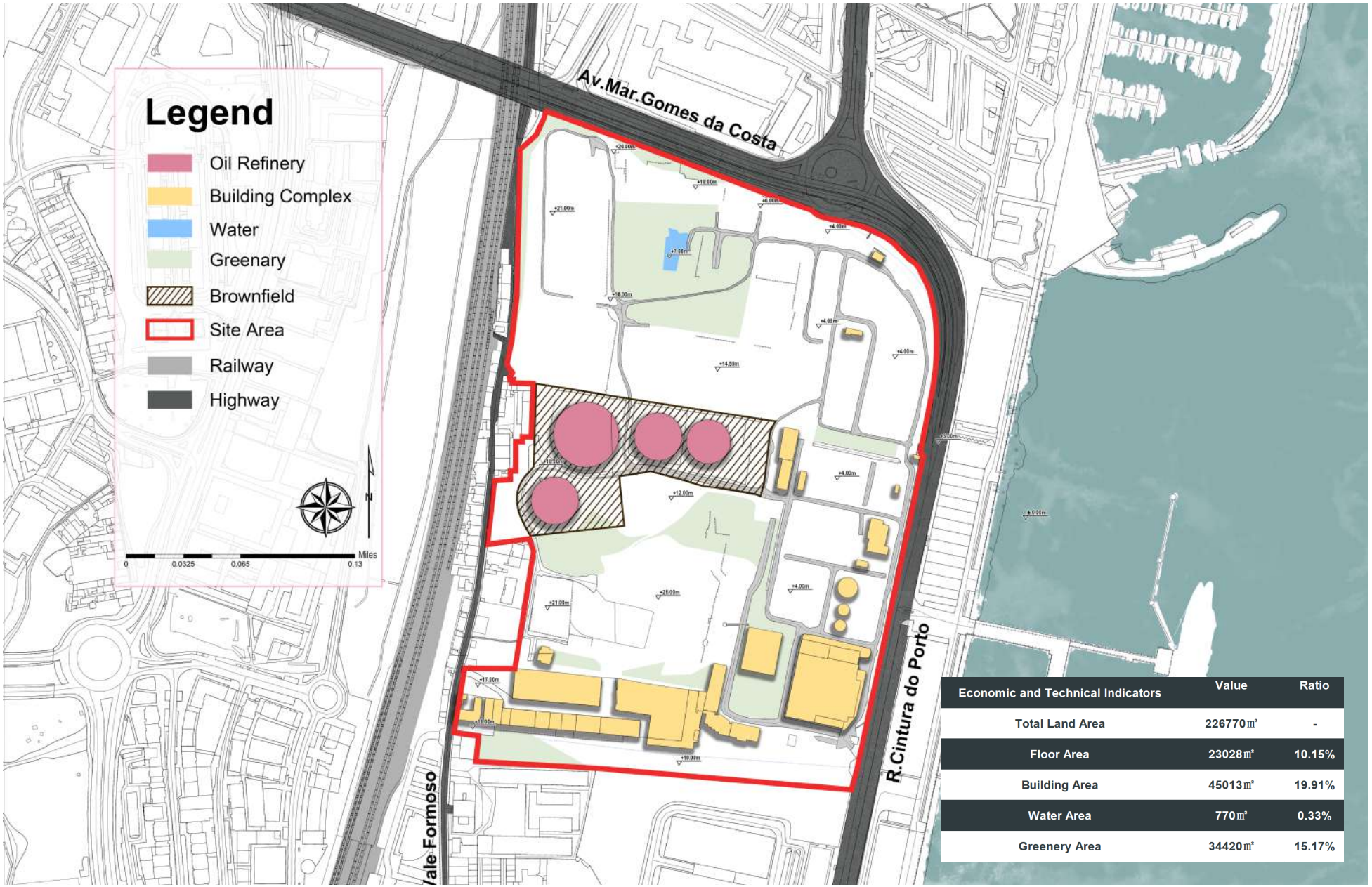
Fig.30 Site soil type

6.8 Antiga Refinaria GALP and Brownfield

TAntiga Refinaria GALP was originally the refinery of GALP Energy. This industrial site occupies an extensive area and the complex is made up of red brick structures and reinforced concrete, typical of the industrial architecture of the early 20th century. After the closure of the refinery, it has been abandoned until now.

The site is surrounded by a number of new modern residential and commercial areas, making the area a bustling living and working community. There are also green spaces and parks nearby, providing space for recreation and outdoor activities. Transport links are convenient, with direct access to the metro and public transport routes.

Typically, abandoned industrial sites need to deal with not only the unused buildings on the ground, but also the pollutants that the industrial buildings bring to the surface and deeper layers of the nearby soil.



Economic and Technical Indicators	Value	Ratio
Total Land Area	226770㎡	-
Floor Area	23028㎡	10.15%
Building Area	45013㎡	19.91%
Water Area	770㎡	0.33%
Greenery Area	34420㎡	15.17%

Fig.31 Site context

• Possible contaminants in the area of the Lisbon refinery

1. Hydrocarbons (Hydrocarbons) According to the EU Brownfield Remediation and Conversion case in the Nation park, the original site also has industrial buildings such as refineries, oil tanks, etc. Hydrocarbons were detected in the soil test in 1993, and their content has exceeded the limit of residential land, so it is assumed that the land of the design site is also similarly contaminated with hydrocarbons.

2. Potentially Toxic Elements (PTE) (e.g. heavy metals) arise from various human activities such as industrial and motor vehicle emissions, waste incineration, smelting and coal combustion, which continuously add Potentially Toxic Elements (PTE) to the environment, such as Pb, zinc (Zn) and cadmium (Cd).

3. Polycyclic Aromatic Hydrocarbons (PAH) Major sources of anthropogenic PAH include vehicle emissions, coal and fossil fuel power generation, petroleum refining, straw and wood combustion, industrial processes, chemical manufacturing, oil spills, and coal tar (Nam et al., 2003; Peng et al., 2011)

4. TPHresidues (total petroleum hydrocarbons)

5. Volatile organic compounds(VOCs such as benzene, toluene, xylene, etc.)

6. The geo-environmental study documented a variety of contaminants: “TPH residues (total petroleum hydrocarbons) polycyclic aromatic hydrocarbons (PAH), benzene, toluene, ethylbenzene, and xylenes (BTEX), and zinc”. According to ZERO, the study also showed that the groundwater at the site is “contaminated with TPH and benzene”.

Articles 2 and 3 are based on the conditions under which these substances were produced, and articles 4 and 5 are based on the records of the geo-environmental studies conducted before construction began, which ZERO, an organization that questioned the lack of cleanup of the park, cited as a reason for the study.

By retrieving the pollutant concentrations in the design site area and comparing them with the EU land contamination standards, we generated the following table

Heavy metal limits for soil		
Heavy metal	**Maximum content (mg/kg DM) EU Standard 2002**	**Heavy metal content in the surface soil of the site**
Cadmium (Cd)	3	0.04100-0.041700
Chromium total (Cr total)	150	14.307600-14.646200
Copper (Cu)	140	3.002000-3.013900
Mercury (Hg)	-	0.023-0.023900
Nickel (Ni)	75	14.446200-14.937000
Lead (Pb)	300	10.003900-10.159600
Zinc (Zn)	300	43.570000-44.589993
Inorganic arsenic (As)	-	1.852900-1.968500

Fig.32 Heavey metal limits for soil table

Source:https://www.researchgate.net/figure/Guidelines-for-safe-limits-of-heavy-metals-mgkg-1_tbl2_287251950

6.9 Site View and Concept

The plot is located in the Mavila district of Lisbon, once an important industrial area in the east of Lisbon, Portugal. As the site of a former oil refinery, the land has a special historical value and geographical advantage. With its proximity to the Tagus River in the eastern part of the city, the area enjoys river views and has great potential for future waterfront development. This area could be transformed into an urban agro-park by transforming the industrial site into an urban agro-park, which would not only provide the city with fresh produce, but also promote community interaction, improve the environment and bring a modern, eco-friendly transformation to Mavila.

The site is large and has the space needed for urban agriculture, making it suitable for rooftop farms, community gardens and vertical farms based on existing industrial facilities. However, as a former industrial site, it has soil contamination issues that require soil remediation and environmental treatment techniques to provide a healthy growing environment for plants. This process not only restores the ecosystem, but also helps to reduce pollution through the purifying effect of plants.

Secondly, the site is easily accessible, with a viaduct set up in the north near the main road leading to Lisbon city center, and public transportation including several bus routes, which may be further improved in the future to facilitate fast transportation of agricultural products.

In future urban planning, the TAntiga Refinaria GALP site could become an eco-community with an urban agriculture theme, injecting a green, environmentally friendly concept into Mavilla.

It could also be linked to other creative spaces, as the surrounding environment still retains some industrial remains and warehouse buildings, and in recent years, the surrounding area has been gradually transformed into spaces for creative industries such as art studios, galleries and cafes. The site will be developed into a mixed-use area combining sustainable agriculture and creative industries, hosting agricultural markets, eco-educational activities, and community celebrations to attract visitors and residents.

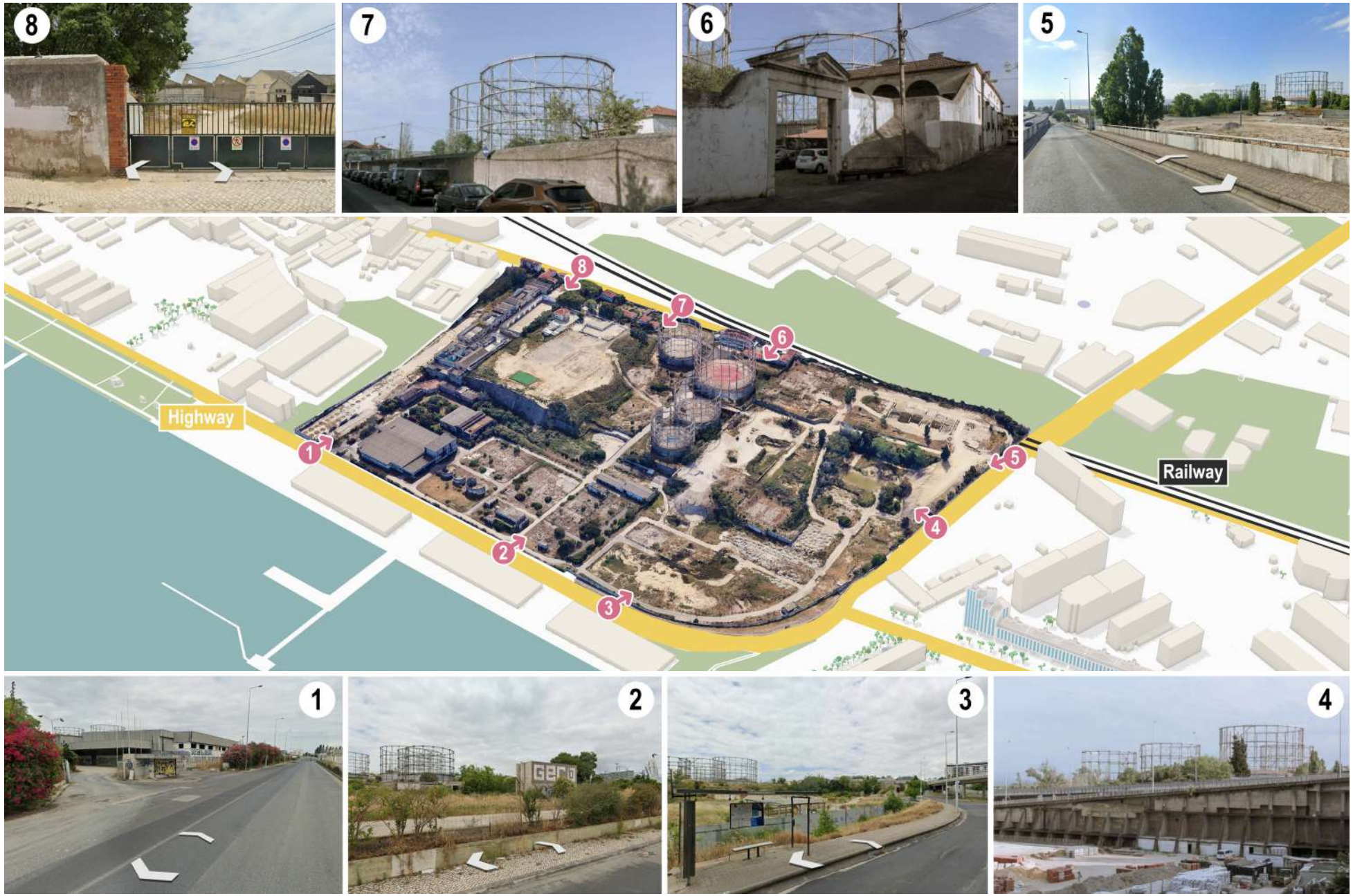


Fig.33 Site view

Chapter 7

Design Case Study

7. Design Case Study

7.1 Coro Field, Thailand

The project aims to introduce a diverse array of agricultural products and a tranquil, idyllic lifestyle to the urban environment. In a well-organized, orderly park, various crops, including vegetables and fruits, are cultivated. Meanwhile, nearby buildings showcase locally grown agricultural products that are both produced and marketed on-site.

Fig.34 Farming life style in the urban

Source: https://www.integratedfield.com/

The first development of the Coro project was a site suitable for plant and human habitation, designed to support different activities for different situations.The farm is transformed into different areas as there are so many activities to do on the farm so you can experience new and different types of farming. From taking a relaxing walk, planting vegetables, picking produce such as melons and tomatoes. Visitors can take part in fun workshops or head to the CORO Field Cafe' restaurant for a meal with a selection of farm fresh ingredients, each dish is homemade. Visitors can then choose to continue on to the CORO Market to purchase produce to take home.

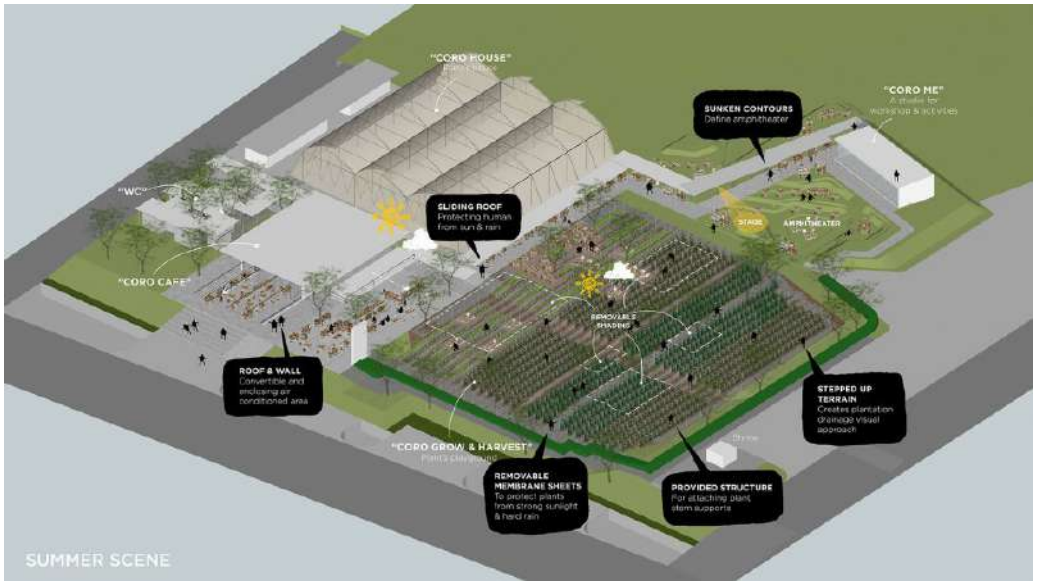


Fig.35 Summer scenes

Source: https://www.integratedfield.com/

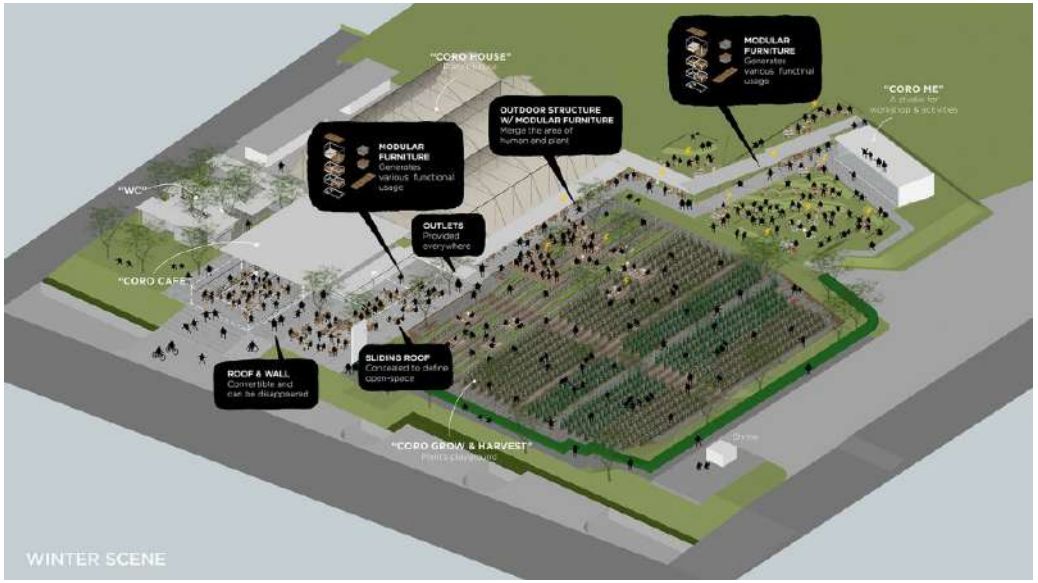


Fig.36 Winter scenes

Source: https://www.integratedfield.com/

The flexible design enables the site to expand as needed to accommodate various events. Rooted in the necessity of crop cultivation, a 1.5-meter grid framework spans the entire area, connecting a mix of open and enclosed spaces. This structural system—comprising frames, skins, utilities, and spatial patterns—works in harmony to define distinct functional zones across the site.

Fig.37 A place for both plant and human
Source: https://www.integratedfield.com/

The movable building skin creates spaces with adaptable boundaries, while the movable furniture system reshapes the site's functionality. A flexible power distribution network, integrated within the frame structure, includes grid-based power outlets to support various activities and adjustments. Together, these reconfigurable elements enable diverse functions and spatial layouts. This layering of adaptable components promotes spatial flexibility, encouraging creativity and variety.

Fig.38 Moveable surfaces define different enclosure

Source: https://www.integratedfield.com/

Fig.39 The connecting open and enclosed spaces

Source: https://www.integratedfield.com/

The unique structure with pulleys makes it possible to move the module, making it portable and lightweight.

Fig.40 Details of the moveable surface

Source: https://www.integratedfield.com/

Layers of functional and architectural elements are seamlessly integrated into a cohesive whole, making the adaptable campus a compact world of creativity and diversity. Movable modular furniture further enhances the site's flexibility and convenience.

Fig.41 Modular furniture system-1

Source: https://www.integratedfield.com/

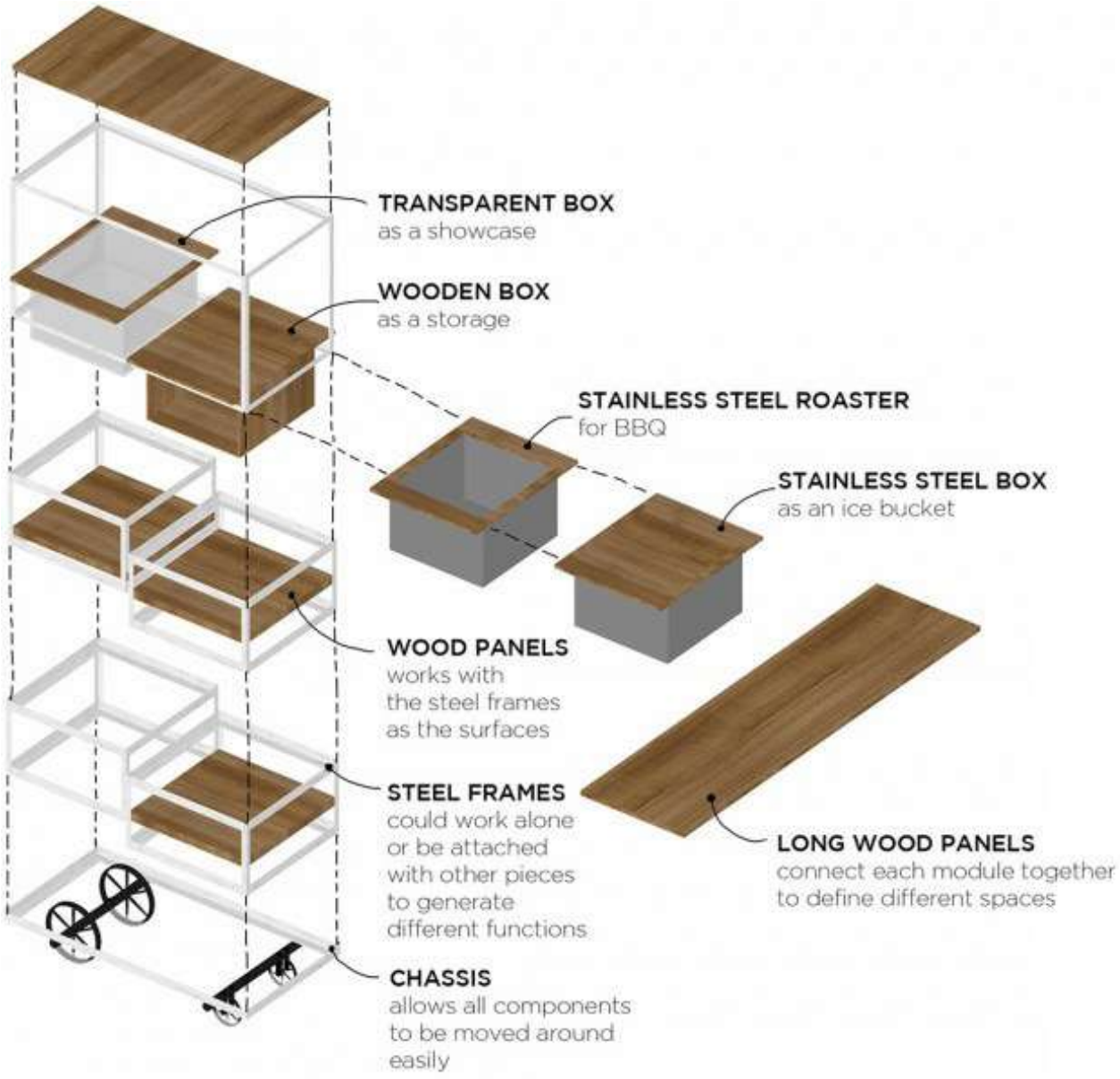


Fig.42 Modular furniture system-2

Source: https://www.integratedfield.com/

7.2 Administration Building with Rooftop Greenhouse at the Altmarkt Oberhausen, German

At the beginning of the design process, the Oberhausen Centre for Historical Research outlined key renovation requirements: the building should remain relevant despite economic shifts, prioritize public-centered spaces over commercial use, support urban densification, and meet the community's need for accessible public space. This office building, located in the heart of Oberhausen, redefines the concept of a public administration facility by integrating multiple functions with a rooftop garden, creating a harmonious dual-purpose structure. The contrast between the solidity of the brick volumes and the lightness of the green gardens generates a compelling tension that not only gives the building a distinct identity but also subtly enhances the urban landscape and texture of Oberhausen.

Fig.43 Sketch of the vertical garden
Source:https://kuehnmalvezzi.com/

The vertical garden connects the ground-level plaza with the rooftop garden, creating a continuous upward flow. As a strategic urban design feature, it unites traditional and modern landscape elements while introducing a new type of public space. Visitors are guided from the tree-lined market square up a series of steps, through terraced areas and rest spaces, and finally to the vine-covered rooftop garden. From this elevated garden, one can enjoy expansive views of the cityscape, offering a peaceful retreat from the urban center.

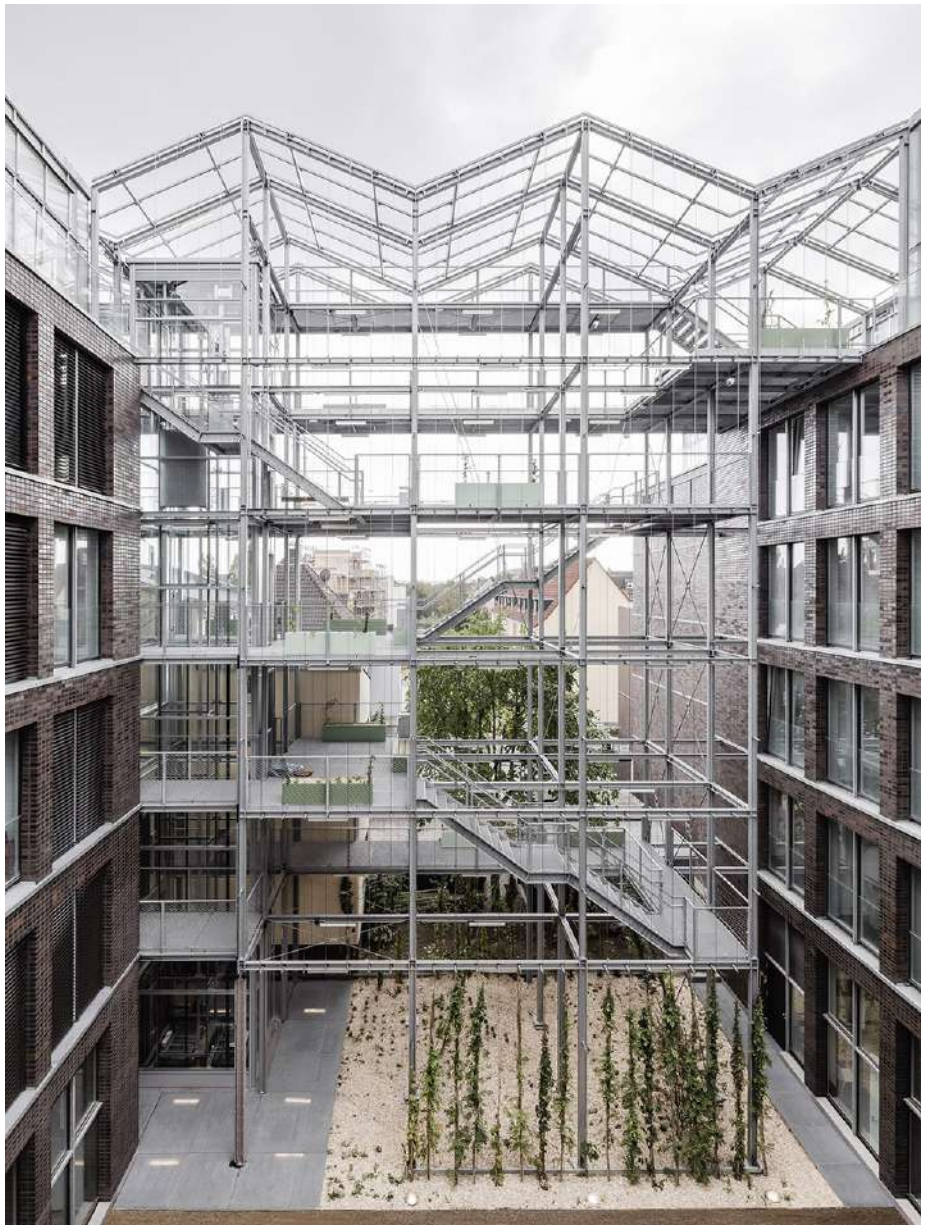


Fig.44 A vertical garden connects the square with the roof garden

Source:https://kuehnmalvezzi.com/

To integrate this building into the urban fabric, the design draws from the unique qualities of its prominent location, balancing the solid presence of the brick building with the delicate lightness of the rooftop greenhouse, developed in collaboration with Haas Architekten. Each side of the greenhouse responds sensitively to its surroundings: on Marktstraße, it stands as a distinct structure; on Altmarkt, its high ridged front grants strong visibility; and on Friedrich-Karl-Straße, it connects through a series of steps to adjacent buildings, beginning at the eaves and aligning with the building's recesses. The vertical garden serves as an open green link to the smaller neighboring building. Together, the office building, greenhouse, and vertical garden form an interrelated modular system. A galvanized steel framework establishes a consistent module, which is expressed in various vertical and horizontal components, such as the divisions in office windows, greenhouse glass panels, metal trellises, and the trellis platforms that extend along the windowsills floor by floor.

Fig.45 North-eastern view of the administration building with the tension between the physicality of the brick building and the delicate lightness of the greenhouse
Source:https://kuehnmalvezzi.com/

The vertical garden acts as a visible spatial link between the traditional Altmarkt—where a market operates six days a week—and the rooftop greenhouse dedicated to agricultural production. Its core structure is an open steel frame that supports platforms, staircases, and a freight elevator, which also serves as a trellis for various climbing plants. A unique feature of this project is the complete omission of sealed surfaces on the exterior. Hardy plants, including the crimson glory vine, common hop, Chinese wisteria, and climbing hydrangea, are rooted at ground level, with a bed of small shrubs and ground cover plants marking the entrance to both the vertical garden and the inner courtyard. Visitors can walk over this entry bed on a seemingly floating galvanized steel grid to reach the first staircase. New plants are introduced at each level, creating a progressive vertical garden experience. At the end of the path, a balcony offers a view over the town and market square. The design introduces variety through its components: vertically, with divisions in the office windows, the greenhouse glass wall, and metal trellis, and horizontally, where trellis platforms continue floor by floor along the surrounding window sills.

Fig.46 Eastern view of the vertical garden

Source:https://kuehnmalvezzi.com/

Fig.47 Viewing the surroundings from the platform of the vertical garden

Source:https://kuehnmalvezzi.com/

The rooftop greenhouse is the focal point of the pathway, designed in a U-shape that mirrors the inner courtyard. Managed by the municipality, it will be open to the public on a regular basis. A seminar and conference room on the fourth floor provides additional space for events, collaborations, and training sessions. Within the greenhouse, visitors can experience the unique perspectives offered by each of the building's three sides, each responding to a different urban context. The section dedicated to research and development is positioned along Friedrich-Karl Straße.

Fig.48 Viewing the courtyard from the rooftop greenhouse

Source:https://kuehnmalvezzi.com/

The courtyard offers a range of perspectives from different levels, each revealing a unique view. A self-binding gravel surface outlines the topography, creating zones that vary in moisture and elevation by up to 60 cm, providing ideal habitats for diverse plant species. The wave-like contouring of the soil emphasizes the interplay of colors and textures among perennials, shrubs, ferns, and grasses. From the Job Center's open foyer, with its floor-to-ceiling windows, visitors enjoy a sweeping view across the courtyard toward the vertical garden.

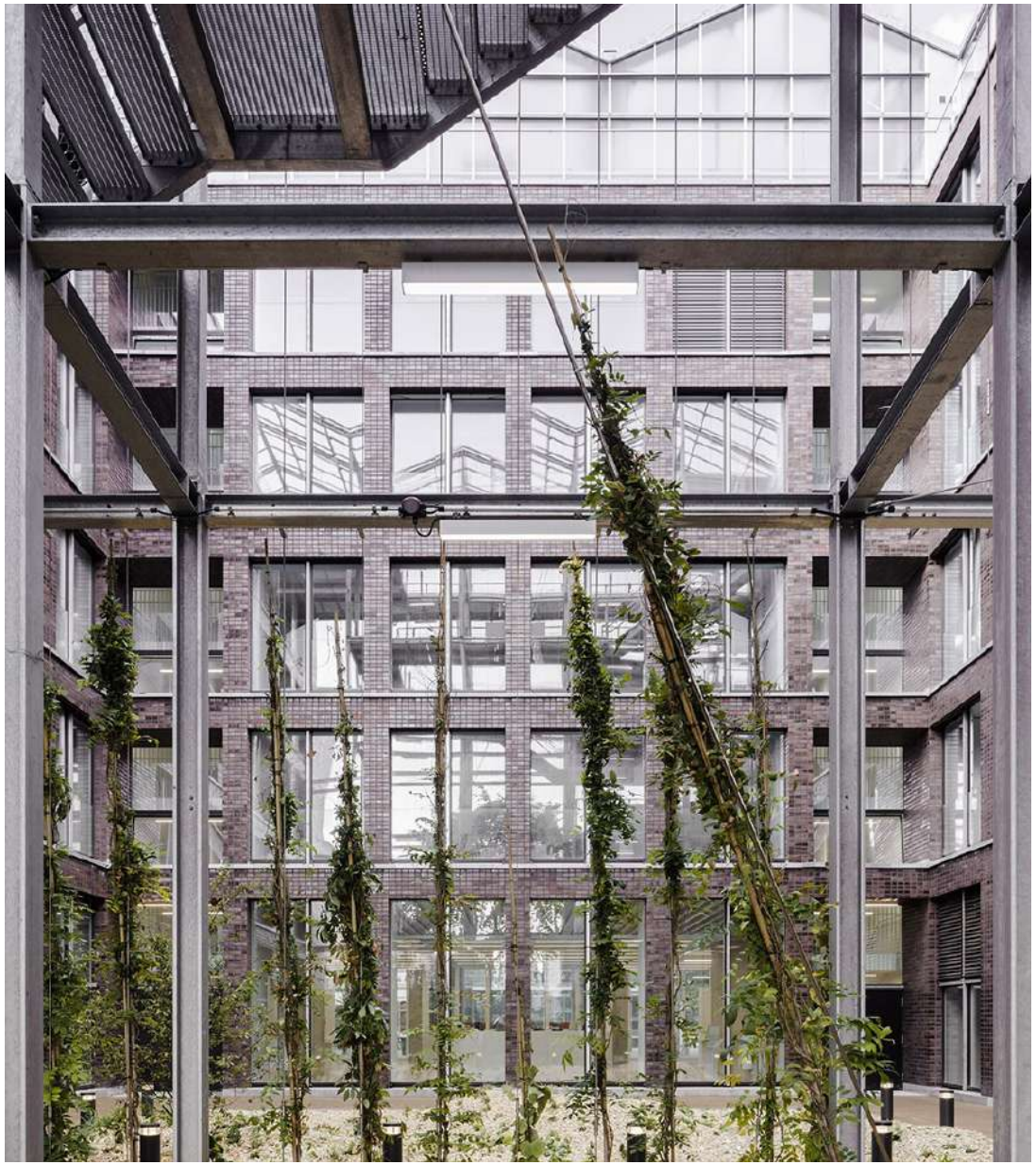


Fig.49 The courtyard and vertical garden on the ground floor

Source:https://kuehnmalvezzi.com/

The integration of building services—first explored in feasibility studies and now implemented here—transforms the office building into a resource for agricultural production. This setup enables various functions to support each other. For instance, air extracted from the offices is directed into the greenhouse, where its waste heat and CO2 help stimulate plant growth. Rainwater collected from the rooftops is stored in a cistern and used to irrigate the plants, while greywater from sinks and washbasins is treated and reused, partly for toilet flushing in the offices and partly in the vertical garden. In the research area, further use in horticultural production is being explored. By separately collecting all types of wastewater, the building is poised to enable even more extensive synergies in the future.

Fig.50 Interior view of the rooftop greenhouse-1

Source:https://kuehnmalvezzi.com/

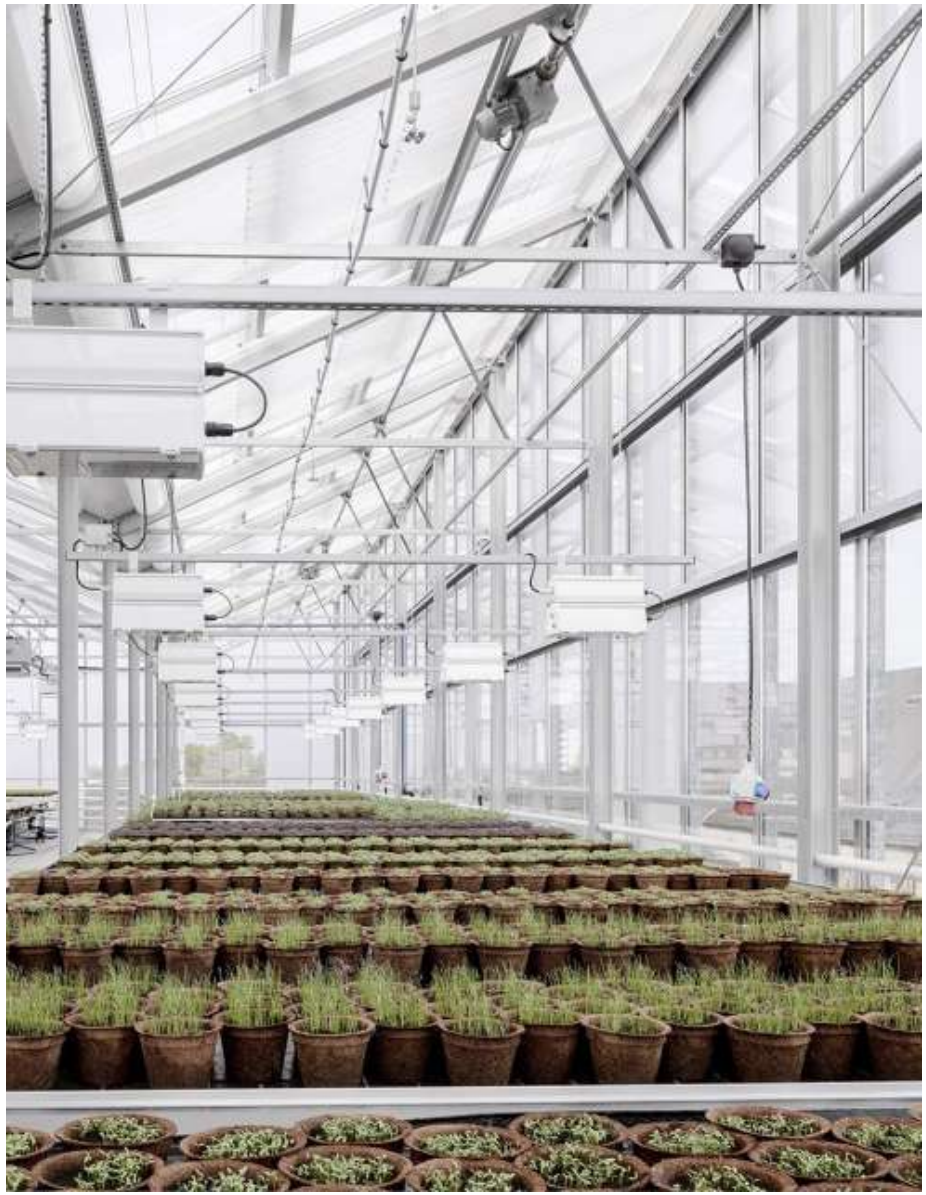


Fig.51 The research area in the rooftop greenhouse-2

Source:https://kuehnmalvezzi.com/

Fig.52 The research area in the rooftop greenhouse

Source:https://kuehnmalvezzi.com/

7.3 Deep Bay Street Park，Shenzhen

Fig.53 Water falls from a height of 10m, creating the cascading waterfalls

Source:https://www.archdaily.cn/cn/939213/shen-zhen-shen-wan-jie-xin-gong-yuan-ou-bo-she-ji

Located on the urban public green axis of the Shenzhen Bay Super Headquarters, west of the Mangrove Bay project, the 1.16-hectare Street Park was completed at the end of 2019, and is the first public space built in the Shenzhen Bay Super Headquarters area, exemplary of ecology and urban vitality.

The project's vitality comes from the city, as it activates neighbourhood socialising with a health theme and stimulates children's interest in nature with a rainwater ecological recycling device. The park is an extension of the life of the neighbouring city residents, a gathering place for community joggers; an expression of the language of nature in a high-density urban core.

A TOD-based public space solution: create a well-established urban public system

The Park provides a well-established public space system that includes diverse public green spaces, pedestrian-friendly neighborhood and urban slow traffic system, transforming all the inactive spaces and grey building spaces into human-oriented pocket parks and street corner parks.

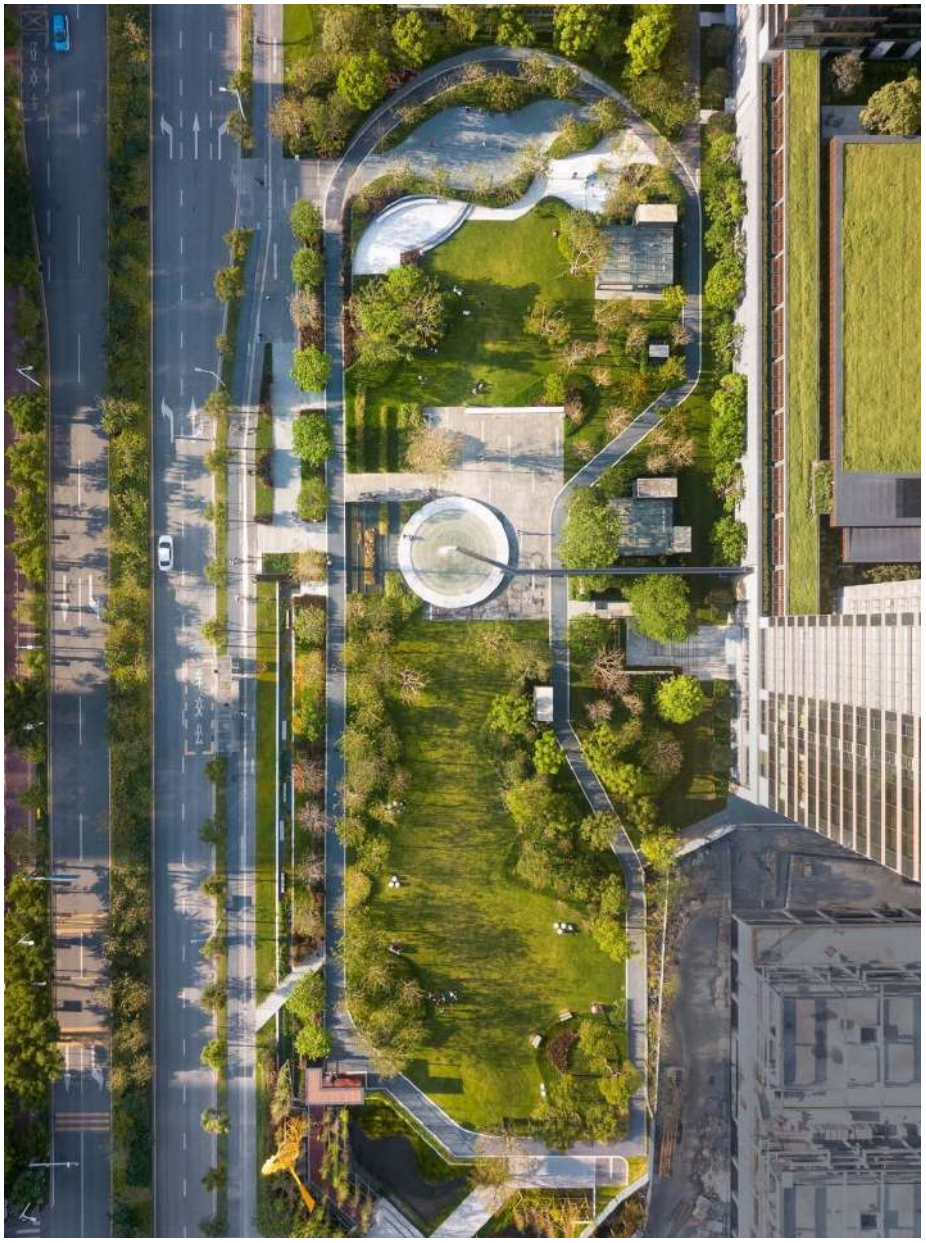


Fig.54 Bird's eye view of the park

Source:https://www.archdaily.cn/cn/939213/shen-zhen-shen-wan-jie-xin-gong-yuan-ou-bo-she-ji

Shenzhen's Deep Bay Street Park uses ecological methods to store and purify water, utilizes the water when needed, and collects rainwater that can be used for green watering and landscape replenishment. The sponge system utilizes natural work, realizing the recycling of rainwater, wind energy and kinetic energy in the natural system. The distinctive logo windmill in the site can convert wind energy into kinetic energy, and pump the rainwater accumulated in the wetland to the bridge of the water channel, which becomes the starting point of the water landscape. 10m-high waterfalls fall down, and are retained and purified by layers of terraces, forming the superimposed waterfalls, which ultimately return to the wetland's water cycle to nourish and water the wetland water landscape.

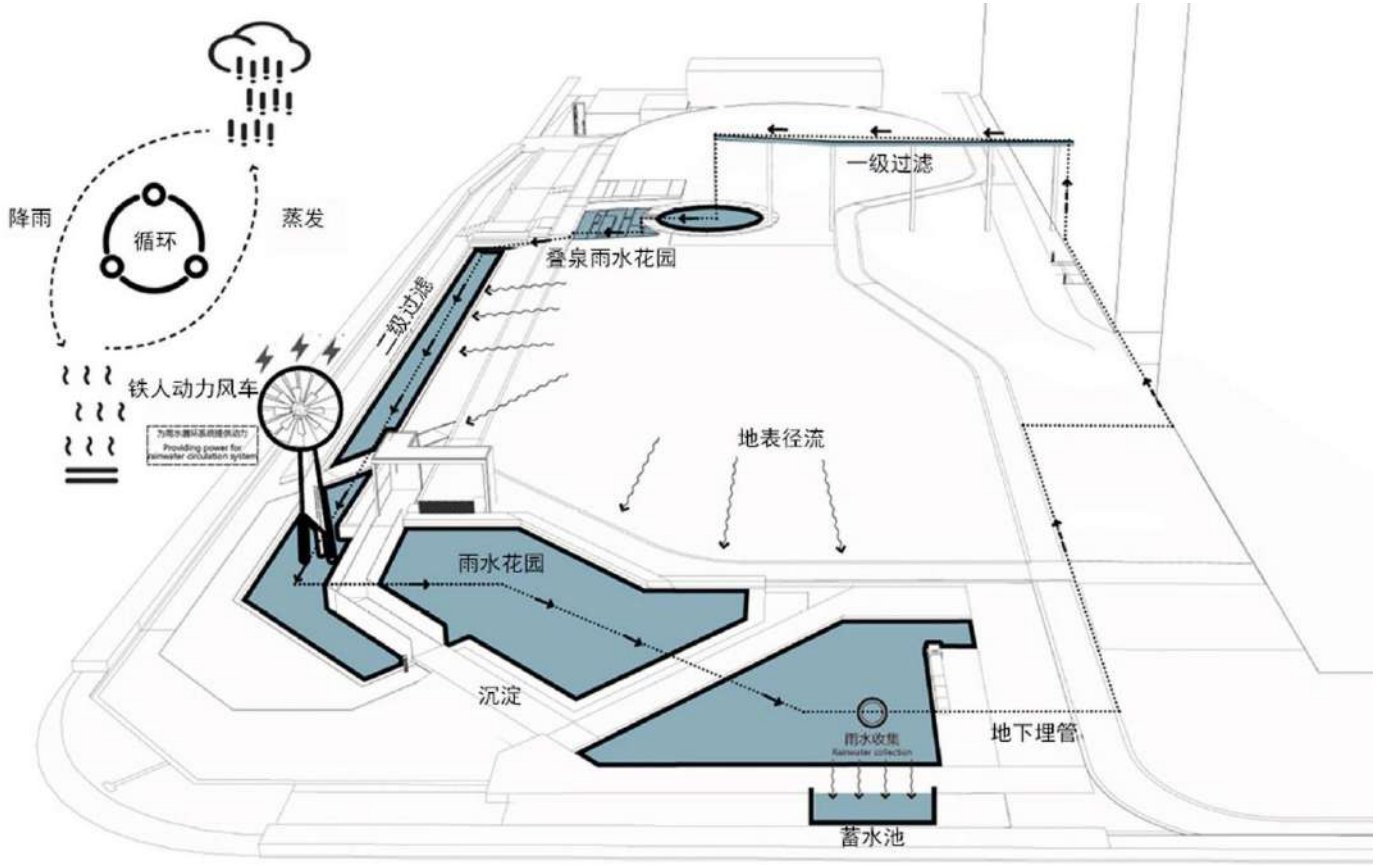


Fig.55 Rainwater circulation system of sponge city

Source:https://www.archdaily.cn/cn/939213/shen-zhen-shen-wan-jie-xin-gong-yuan-ou-bo-she-ji

The 320M long jogging track runs through a forest of bluebells and manzanita grass. The permeable concrete material meets the demand for rainwater infiltration while attracting community walkers and joggers.The white sand pit in the pet park is a new gathering space for pet lovers and pets, and also a popular destination for children.

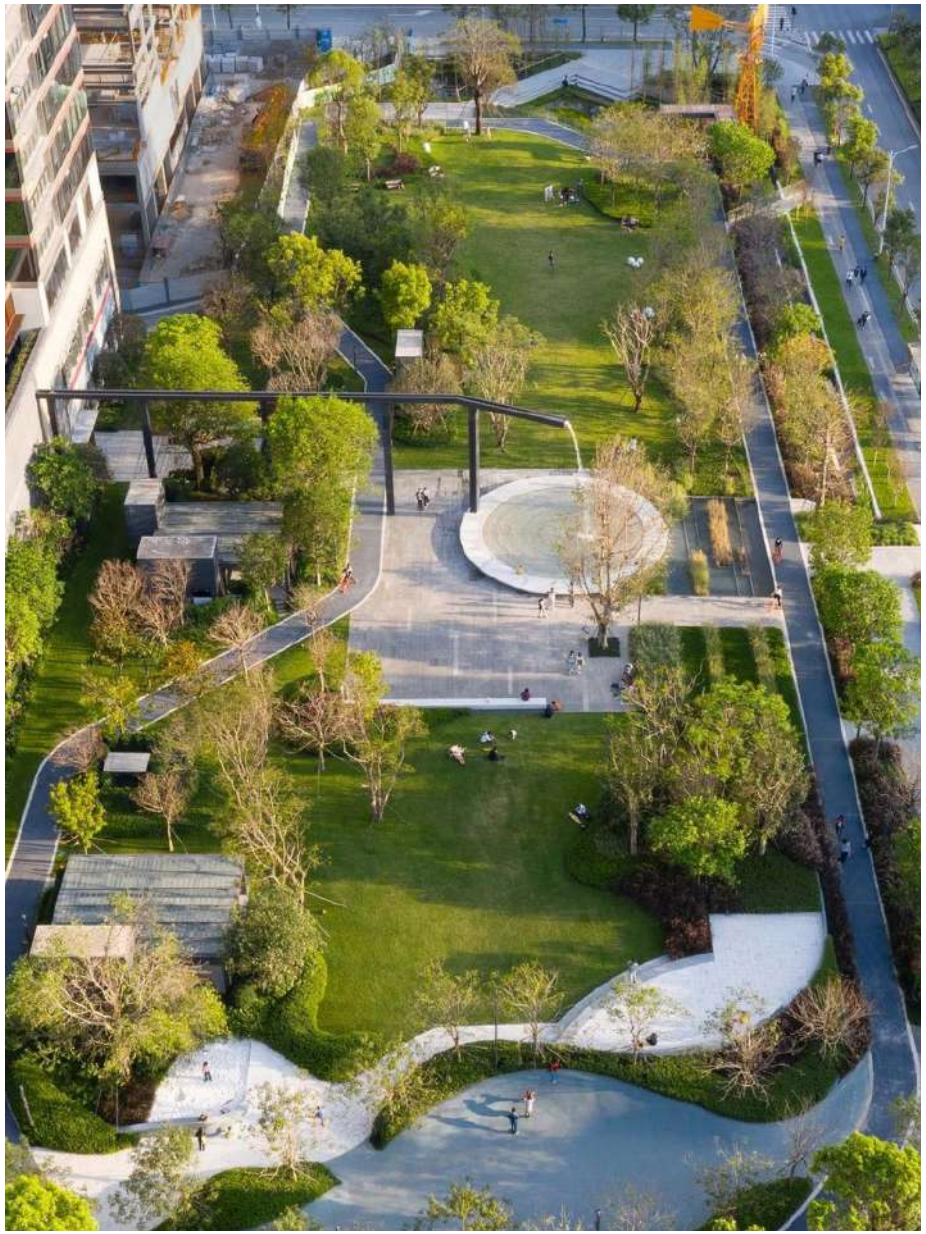


Fig.56 The park provides a well-established public space system

Source:https://www.archdaily.cn/cn/939213/shen-zhen-shen-wan-jie-xin-gong-yuan-ou-bo-she-ji

7.4 Brownfield Remediation Case Study - Park of Nation

Fig.57 Aerial view of the park of nations in Lisbon

Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

Lisbon's Park of Nations is an example of brownfield regeneration, transforming a former industrial area into a vibrant urban district with residential, cultural and recreational spaces. Originally a vast expanse of warehouses, factories, and a polluted port area along the Tahoe River, it was repurposed after the 1998 World Expo, focusing on environmental restoration and the reimagining of public spaces. Park of Nations is today a residential neighbourhood and an office centre located in the eastern part of Lisbon capital city. It was constituted as a civil parish in 2013, counting now about 21,000 inhabitants, a significant number compared to other Lisbon civil parishes.*** In 1992, when Lisbon's candidature to host the International Fair was accepted, the Park of Nations area was subjected to one of the largest urban actions ever undertaken on Portuguese territory. Along the 4-kilometer-long riverbank, 330 hectares of land were completely transformed and renewed, and a new metropolitan center emerged: the old industrial area and the degraded eastern part of the city were replaced by a bright and modern multifunctional urban structure, in which the public space plays an important role. **Utilizing existing abandoned industrial areas, this initiative provides an opportunity to recycle large quantities of contaminated soil, rather than depleting natural and agricultural land. Instead of depleting natural and agricultural land.**

The development of the area of the old Park of Nations

*** *DATA SOURCE: INE (2013). Censos 2011 - População residente por freguesia, CAOP 2013 (CSV)*

Fig.58 Aerial view of earthworks at Park of Nations
Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

site can be traced back to the end of the nineteenth century. With the onset of industrialization and the presence of railroads in the vicinity, the establishment of factory districts was facilitated.In the early 1940s, a number of heavy industries and infrastructures settled in the area, including an oil refinery, a collection of tanks and fuel containers, and an industrial abattoir. Thereafter, in the absence of any spatial planning standards, the industrial area continued to be driven by major factories and core activities, with a range of other small and medium-sized industries emerging. Illegal housing and slums emerged as a result of the overall industrial development, and the illegal process of urbanization underwent a remarkable process of growth and consolidation until the late 1970s. Nonetheless, over time, a number of industries became obsolete and entered a period of decline, leading to the closure of some factory units, which were replaced by port facilities, other industries and sanitary landfills.

The lack of environmental regulation at the time opened the door to all this without regard for the consequences on the environment and the public health.[44] When Portugal applied to participate in the World Expo, the area of intervention was an old abandoned industrial area in the Lisbon metropolitan area, which had housed industrial facilities such as abandoned oil refineries and a naval warehouse. The area had also been converted in a deposit of shipping containers and open dumps, which represented a real danger to the environment and the public health.[45]

Fig.59 Contaminated soil

Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

Before this area could be transformed, a huge challenge had to be faced. In addition to the presence of industrial facilities and infrastructure, the biggest problem is the presence of soil contamination, which is mainly due to the uncontrolled operation of refineries, sanitary landfills and poor labor conditions.

In 1993, an Urbanization Plan (UP) was issued in order to regulate the entire eastern part of Lisbon.According to this strategy, existing industrial buildings were dismantled, with some structures decommissioned, demolished, and relocated to other areas within the metropolitan region. During demolition, innovative recycling techniques were employed: reclaimed building materials were reused in new construction, minimizing the consumption of non-renewable resources and reducing landfill waste.

The soil purification process was the most crucial and challenging step in the recycling strategy. Diagnostic studies confirmed that hydrocarbon levels in the soil exceeded the permissible limits for residential use. However, the pollution was not as deep as initially anticipated. The clay-rich alluvial composition of the soil has low permeability, likely contributing to the pollution's limited depth.

LOCATION	Lisbon, Portugal
POLLUTANT	Hydrocarbons
SOURCE	Deposit of shipping containers, open dumps, heavy industries, oil refinery, oil tanks, fuel containers industrial, slaughter and urbanization
GENERAL CLEAN UP OBJECTIVES	Remediation of groundwater and soil contamination
REMEDIATION ACTIONS	Excavation, removal of contaminated groundwater (including pumping, separation of water/oil, free product removal and water treatment), construction of a waterproof surface water drainage system
SITE/END USE	Expo exhibition 1998 and new city neighbourhood
SOCIAL-LEGAL ISSUES	Land reclamation
KEY LEARNING/ EXPERIENCE TO SHARE	Involvement of different stakeholders (public, private and research institutions), city image regeneration

Fig.60 Contamination of the Park of Nations and its treatment
Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

Among the measures for contaminated sites are:

- removal of contaminated soil (including removal of free product, transportation to landfill, and collection of samples for analysis in a Dutch laboratory);
- removal of contaminated groundwater (including pumping, separation of water/oil, removal of free products, separation of water/oil, removal of free products, and water treatment);
- deposition of contaminated soil in the containment unit of the existing landfill;
- construction of a watertight surface water drainage system;
- restoration of the landfill site through green areas using high quality topsoil, land modeling using soil from the cells.

Fig.61 From left to right: Recovered landfill and Tagus

Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

Today, Lisbon's Park of Nations is a vibrant urban community with green spaces, an oceanarium, cultural venues, public art facilities and a scenic riverfront promenade. Its transformation from a degraded industrial area to a thriving community center serves as a model for sustainable brownfield redevelopment, providing lessons for ecological restoration and sustainable urban planning. The park is not only a popular destination for locals and tourists, but also demonstrates the potential for re-imagining industrial landscapes as sustainable, livable spaces.

The design site is located in the vicinity of the Park of Nations, which is an industrial area with an abandoned oil refinery, and the brownfield remediation case of the Park of Nations will serve as a good reference for soil remediation of the design site.

Fig.62 Views of the current Park of Nations

Source:https://publications.jrc.ec.europa.eu/repository/handle/JRC98077

Chapter 8

Design Proposal

8. Design Proposal

Combined with the municipal plan and the soil heavy metal contamination indicators, the soil contamination of our site is still within control.

Although the surface test values of the soil at the site were below the EU standard for heavy metal contamination in soil, the future planning of the site was divided into four phases, taking into account the uncertainty of residual heavy metal contamination in the deeper layers of the soil at higher concentrations.

Phase 1: pollution diagnosis

Phase 2: stabilize the pollutants by chemical treatment of the contaminated soil

Phase 3: Plant management, because different plants absorb different chemical elements, we will configure plants to purify the land. At this stage, we will build the site into an urban park, the main function of which is environmental education.

Phase 4: After 5-10 years, we plan to conduct in-depth soil testing on the site again. Once it meets the standards, we will transform the site into an urban agricultural experience park to integrate all urban agricultural resources around the site.

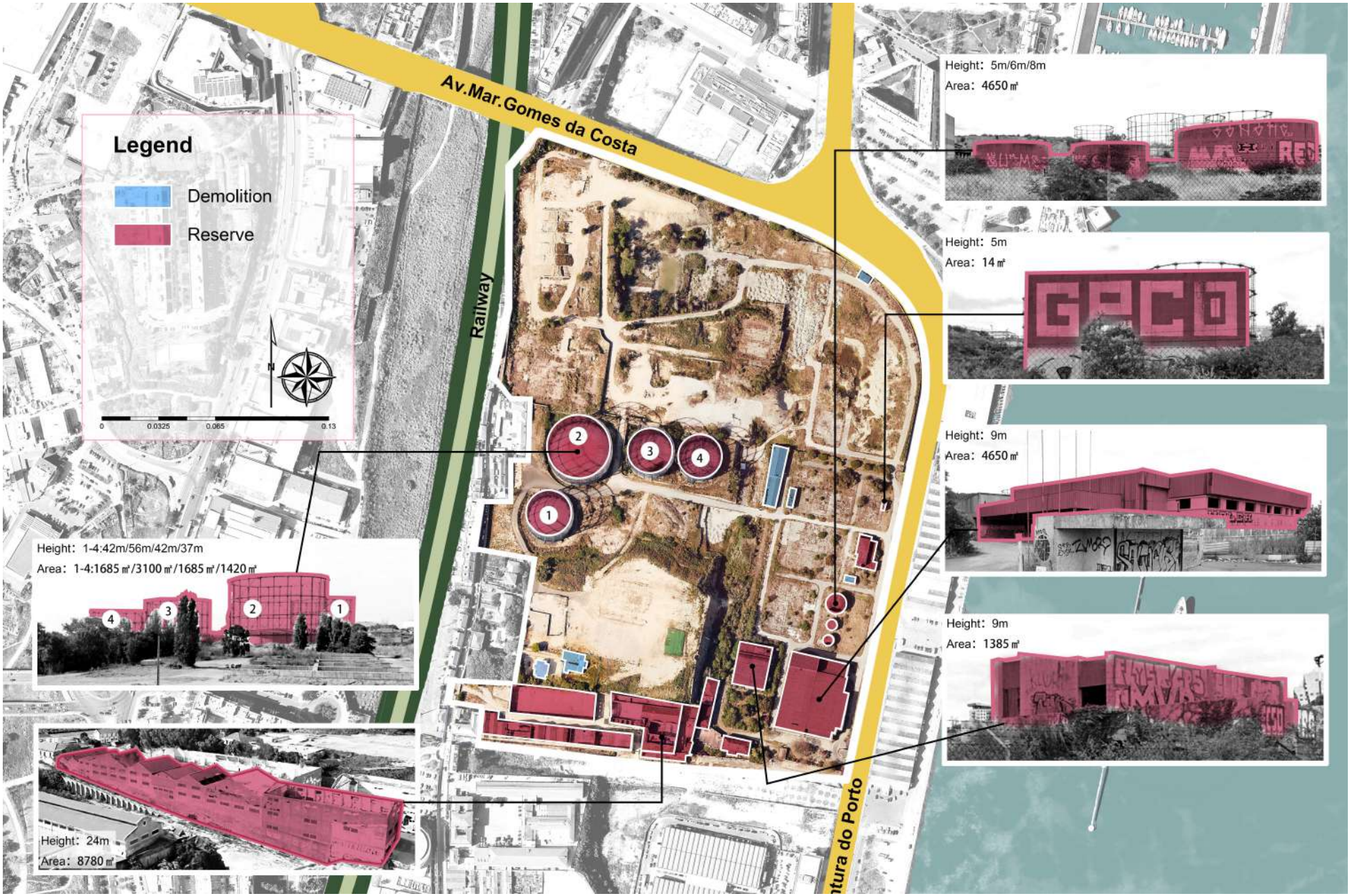


Fig.63 Preservation and demolition of buildings

8.1 Identification and selection of buildings

The site has many industrial sites and old buildings, and it was decided to preserve these historical architectural elements in order to show the industrial history of Mavila, and to contribute to the creation of a unique urban agricultural park in an industrial retro style.

Being an old industrial site with decades of history, the buildings within the plant have a special meaning for the local residents, as we can see the impressive oil refinery barrels and some abandoned buildings with graffiti patterns.

After evaluating the quality of the buildings and their historical significance, we chose to retain the majority of the buildings on the site from the point of view of sustainable development and the preservation of the historical buildings, and to demolish only a small portion of the buildings that are of poor architectural quality.

Even for the buildings where only the walls remain, we decided to utilize the enclosed spaces within them to redesign the form and function of the buildings with new structures and materials, creating a visual combination of old and new.

By means of urban agriculture, this historical industrial site can be successfully transformed into a part of a modern city, setting a new example of environmentally friendly and sustainable development for Mavila and Lisbon as a whole.

- Total area covered by retained buildings: 27355 m^2
- Total number of buildings retained: 15

8.2 Environmental Education Park (phase 3)

8.2.1 Master Plan

From the general plan of phase3, the idea is to transform the old industrial site into an environmental education park, remediate the contaminated soil with different special plants, and at the same time set up a number of ponds in the park, linking them with each other in a sustainable water recycling system, so as to collect and purify and store the excess water resources.

A terrace for agricultural cultivation will be set up away from the contaminated area, and a market area will be planned in the vicinity, containing planting, processing and selling areas to facilitate the transportation and sale of agricultural products on the spot, and to serve as a hub for municipal agricultural gardens in the vicinity of the site, providing the basis for the creation of an urban agricultural cluster.

In addition, a livestock area and fishponds will provide multiple ecological and social values, enriching the functionality of the environmental education park and adding unique educational, ornamental and ecological benefits.

As the core building of the park, the oil refinery barrels were given different functions according to their size, such as meeting rooms, catering and multi-media projection, etc. The iconic shape of the barrels not only preserves the historical and cultural value of the site, but also has a good effect on the convergence of people.

As the site is classified as a center and residential area in the municipal plan, we also planned a hotel function for this park to enhance the tourist experience of the park.

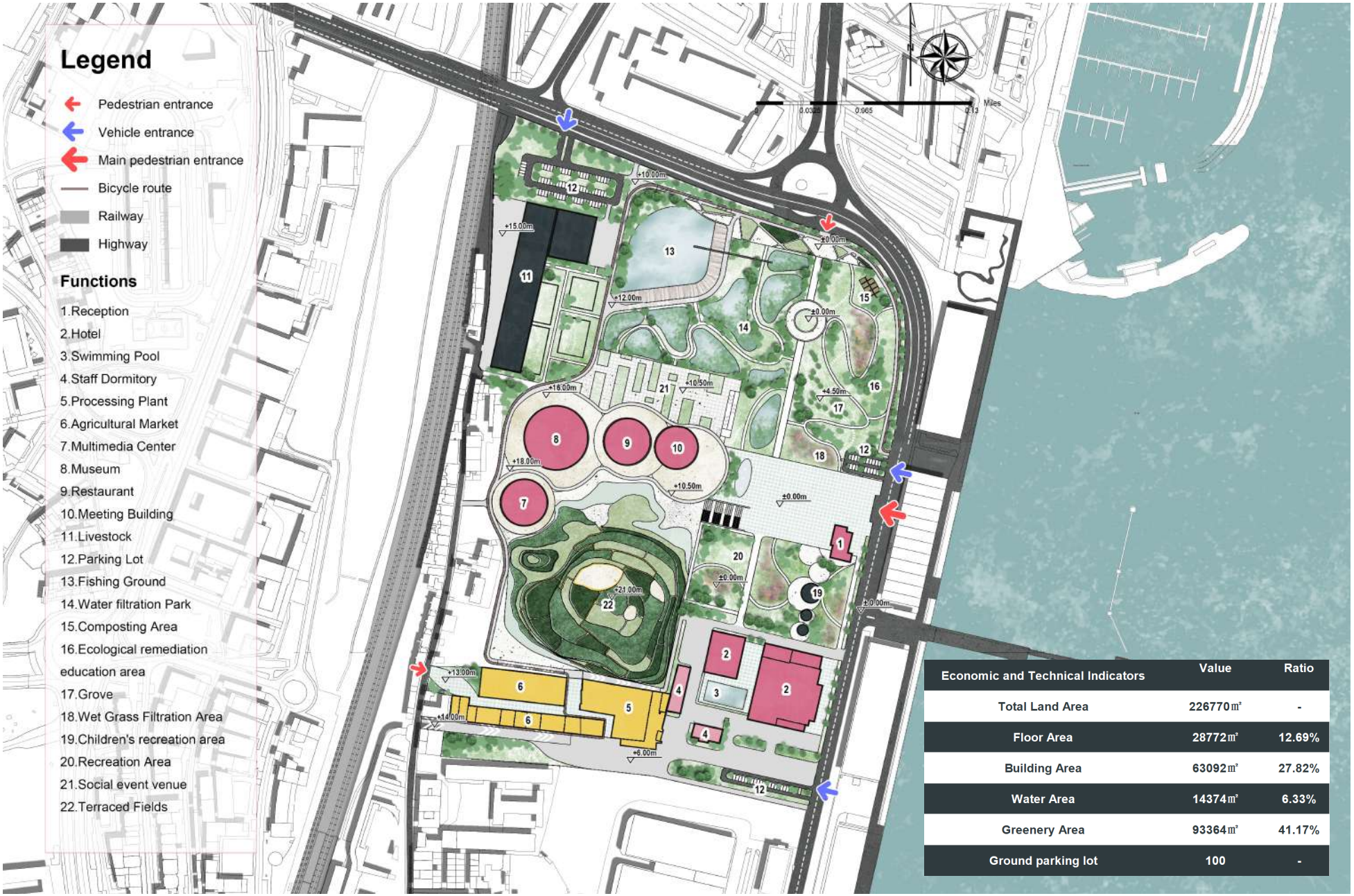


Fig.64 Masterplan of environmental education park

Fig.65 Aerial View

8.2.2 Mobility analysis

The main entrance to the park is located in the eastern part of the site, with the main plaza leading to the core of the refinery and eight secondary entrances. There are two parking lots in the northwestern and southeastern portions of the site near the entrances, separated from the sidewalks, with approximately 100 parking spaces. Separate freight routes for the livestock, market and employee areas provide easy access to the park for the transportation of large shipments.

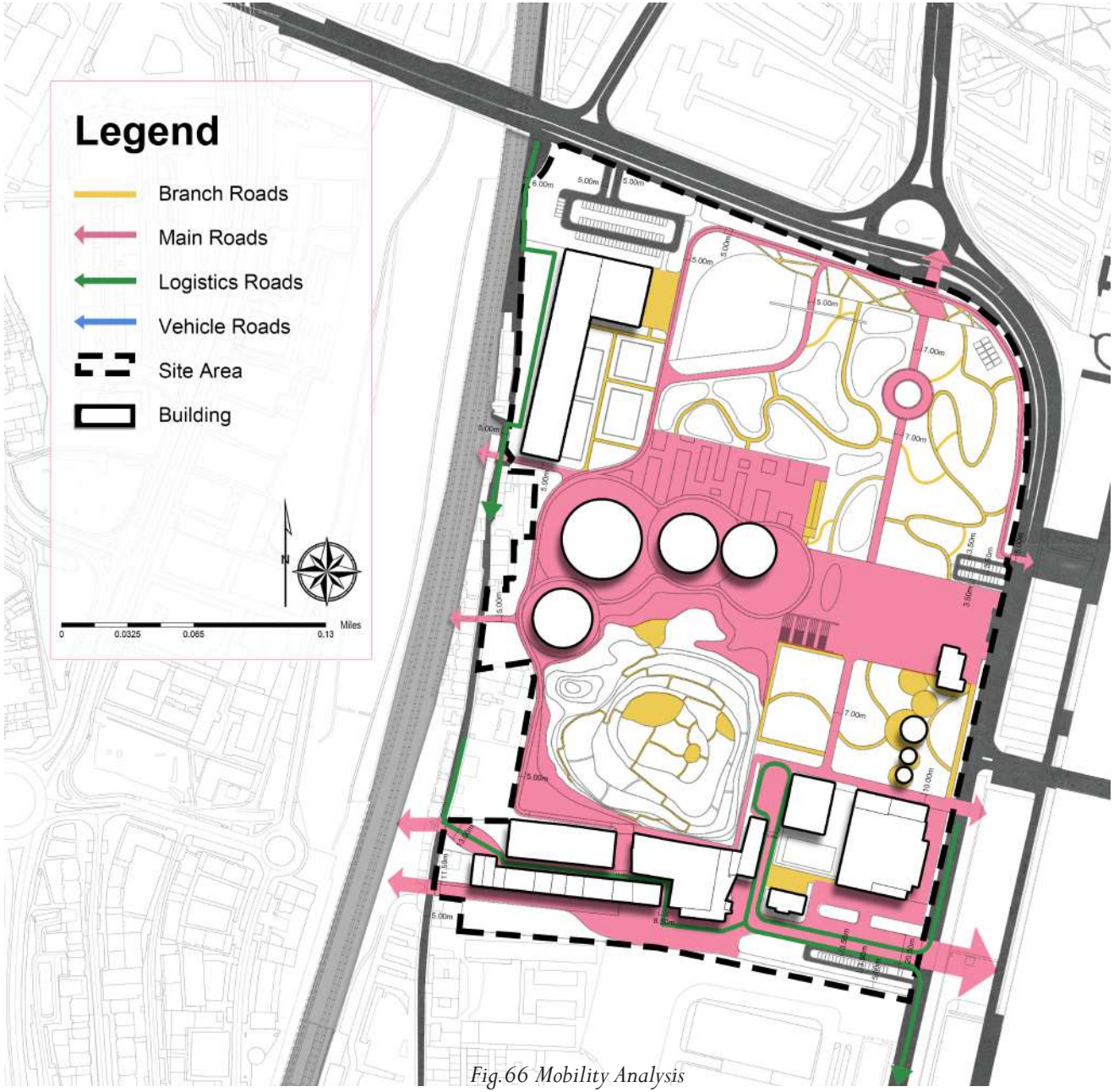


Fig.66 Mobility Analysis

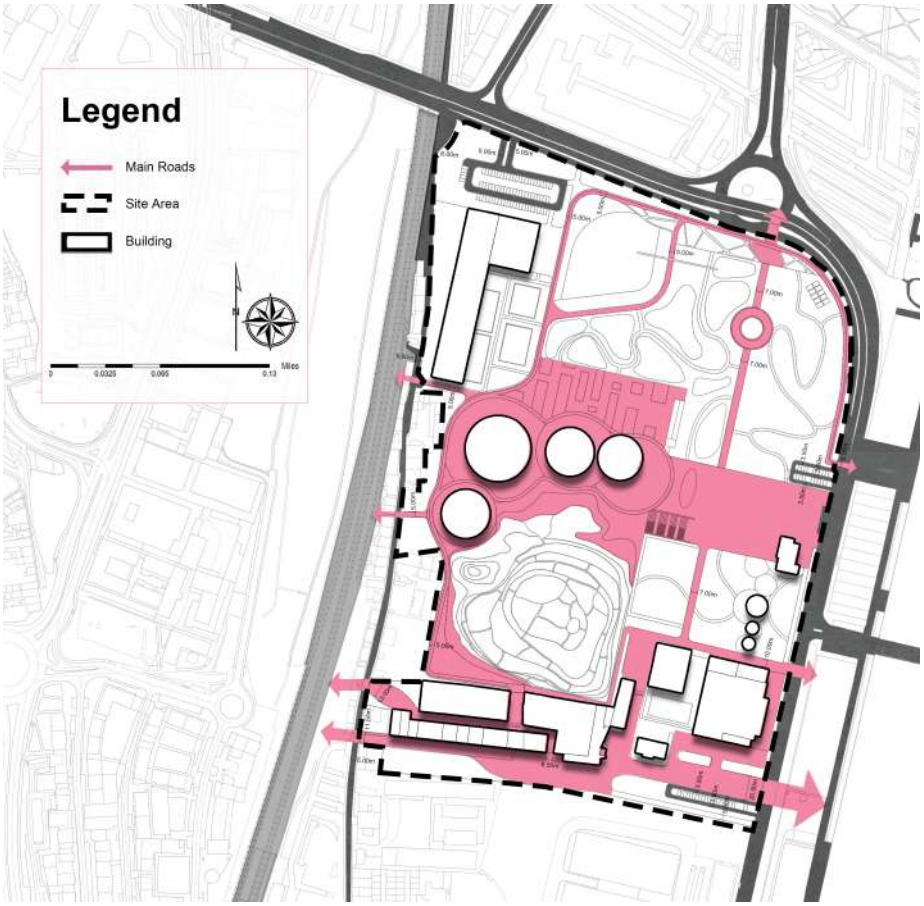


Fig.67 Main Roads

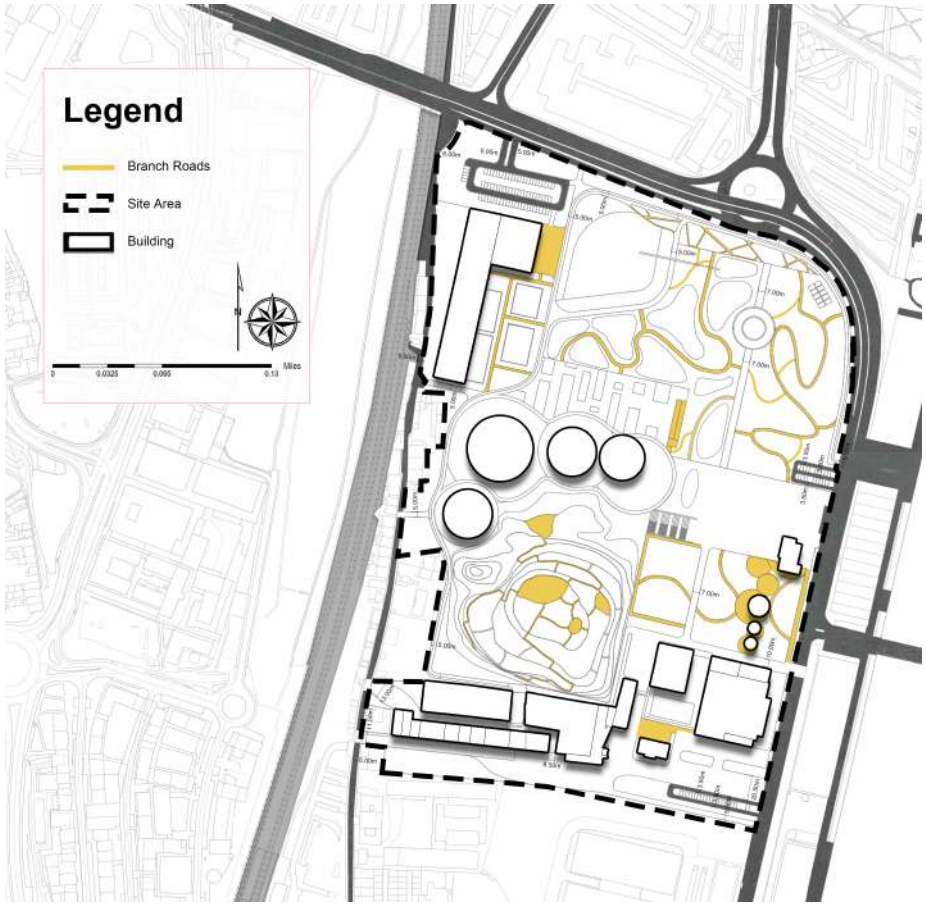


Fig.68 Branch Roads

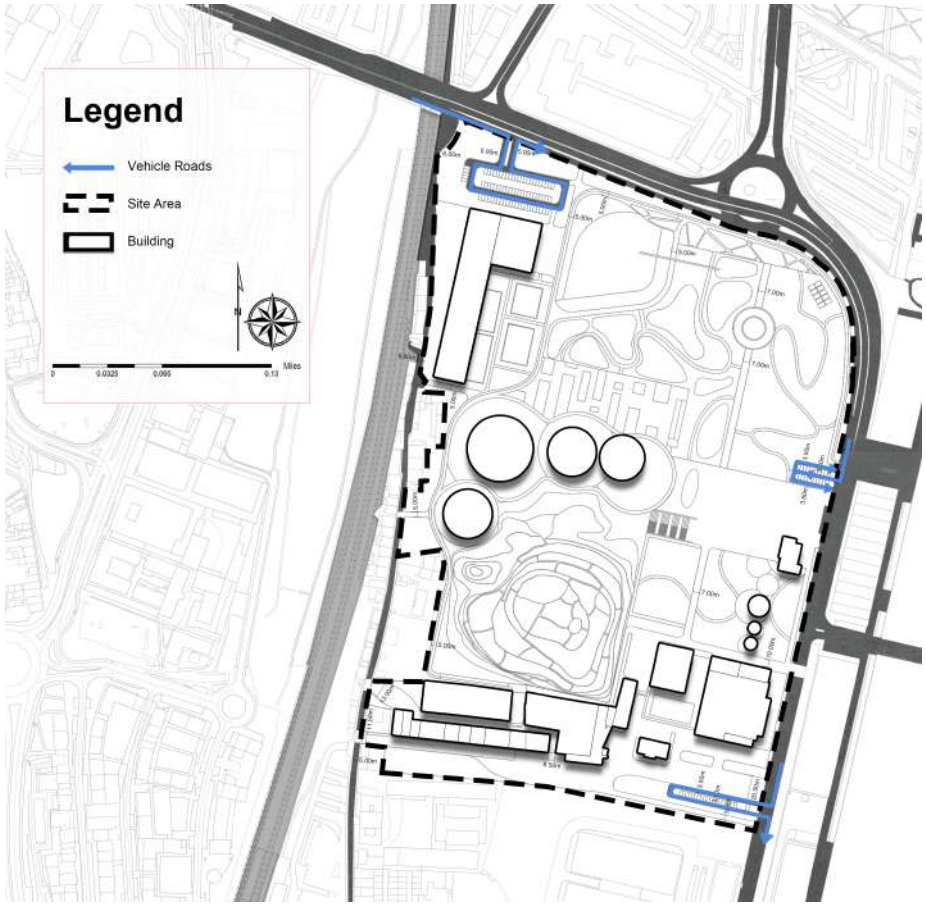


Fig.69 Vehicle Roads

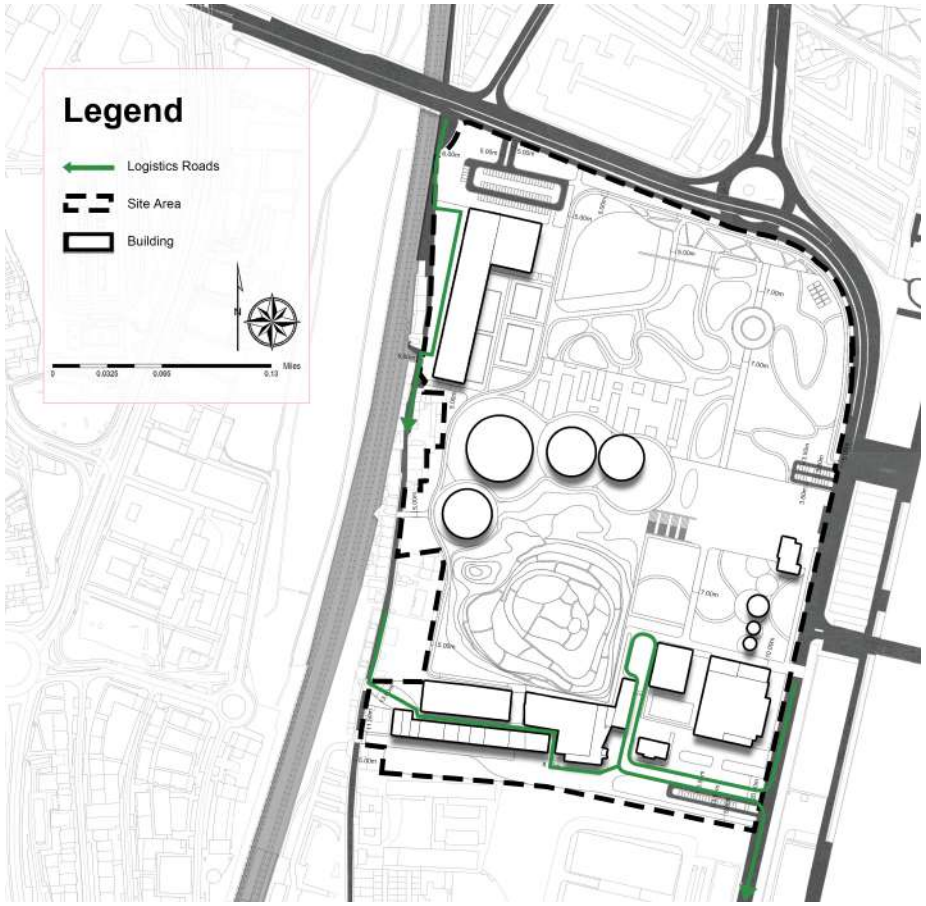


Fig.70 Logistics Roads

Fire safety is critical in urban agricultural parks, where plants, composting areas and greenhouses are set up, all of which are potential fire hazards. Therefore, a total of six fire exits and corresponding fire lanes are set up in the park, which are arranged through the whole park so that fire engines can reach any part of the park. At the same time, between high-risk areas (such as composting areas and planting areas, greenhouses, etc.), a certain width of fire prevention isolation zones have been set up, which can also be used as walking paths during normal times, thus improving the fire prevention ability.

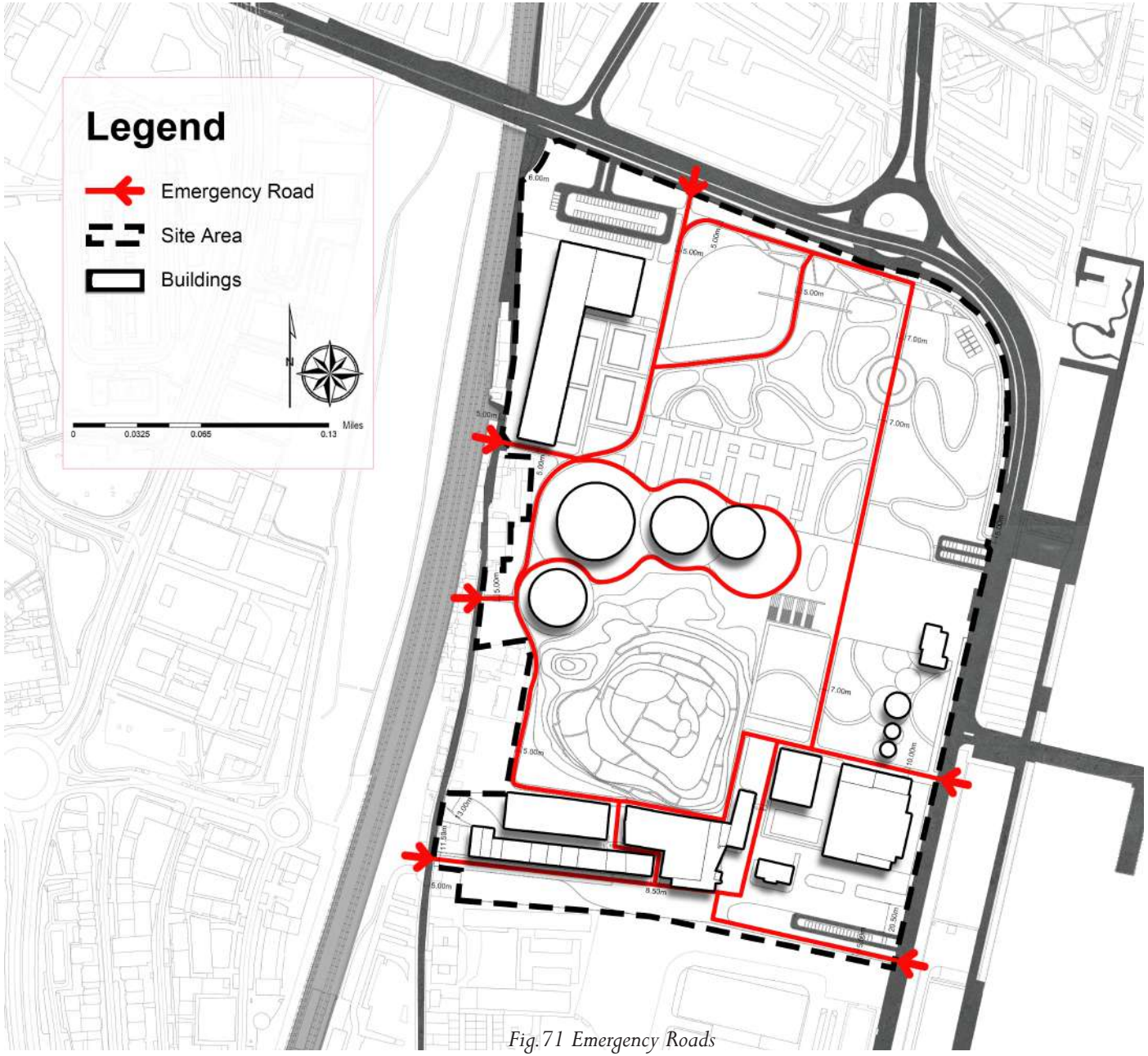


Fig.71 Emergency Roads

8.2.3 Water cycle design

This urban park integrates rainwater management into the landscape system, and uses ecological methods to collect, store, purify and reuse rainwater. The collected rainwater can be used for greening irrigation and landscape water replenishment.

The complete rainwater circulation system first uses the height difference to do natural work, collects the surface runoff of the terraces through the drainage channel and underground pipes into the underground water tank and stores and utilizes it underground.

Then, after being retained by the layers of terraces in 8 plant ponds and purified by aquatic plants, the rainwater is harmless through precipitation, adsorption, oxidation-reduction, and microbial decomposition, becoming nutrients and water sources for promoting plant growth, forming a cascading waterfall landscape, and gathering at the lowest point of the rain garden.

The water accumulated in the wetland is pumped to the canal bridge through a water pump. The existence of the canal makes the space of the park move from a plane to a space, and the tall canal bridge connects the terrains of different height differences together. The 10m high waterfall falls, becoming the focus of the water landscape. The waterfall stirs up a lot of water mist for visitors to walk through the water, so that people and water come into close contact here, and it also oxygenates the fish pond.

The water from the fish pond is then connected to the wet meadow biofilters through underground pipes to nourish and irrigate the wetland landscape. The water is transported to the fountain pool, which aerates the water by spraying it into the air, and becomes the central landscape at the entrance of the park. The aerated water flows into the sedimentation tank and finally into the underground water tank to complete the water cycle.

The water cycle design effectively improves urban water resources conditions by optimizing rainwater management strategies, reducing surface runoff, and improving rainwater quality. At the same time, the project focuses on restoring the biological habitats in the area and improving the ecosystem service functions and ecological diversity value of the site. In addition, the design creates an open public space that integrates ecological functions and environmental education, providing a place for leisure and learning for the public. Through this design, urban residents' awareness and recognition of the sustainable use of rainwater resources are further enhanced, helping to promote green infrastructure construction and the overall improvement of urban ecosystems.

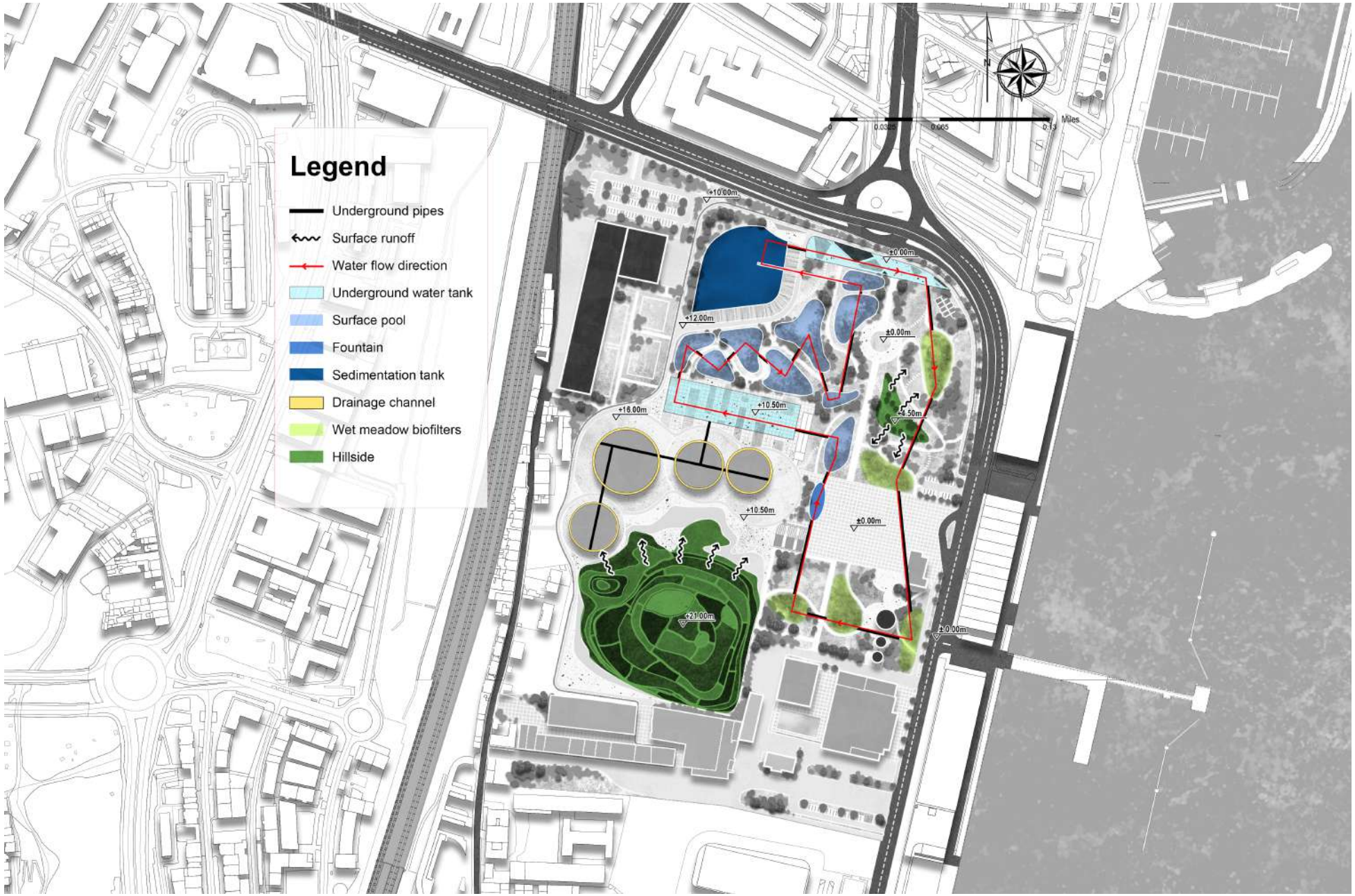


Fig.72 Water Cycle Design

8.2.4 Plant Configuration

- ### Alluvial Soil

In order to counteract heavy metal contamination from the refinery on the site and to improve soil conditions, a range of plants were selected for the alluvial area on the eastern side of the site that are suited to Lisbon's climate and the characteristics of alluvial soils.

Due to the relatively low permeability of alluvial soils, contaminants are usually trapped in the surface or shallower layers of the soil, a characteristic that reduces the potential for deeper contamination but also allows contaminants to accumulate in the surface layer. In particular, heavy metals and some organic pollutants are concentrated in the surface layer through physical adsorption or chemical binding, which may affect the health of plant roots and the water quality of surface water bodies.

Therefore, the plants we screened are not only adapted to the environmental conditions of alluvial soils, but also have the ability to effectively absorb and immobilize heavy metals such as lead, cadmium and copper. Through the joint planting of these plants, the mobility of heavy metals can be reduced and the soil structure can be improved, thus accelerating the ecological restoration process of the site.

Salix 1

Poplar trees 2

Phragmites australis 3

Helianthus annuus 4

Chrysopogon zizanioides 5

Canna indica 6

Brassica juncea 7

Lolium multiflorum 8

Festuca arundinacea 9

Fig.73 Plant Configuration of Alluvial Soil

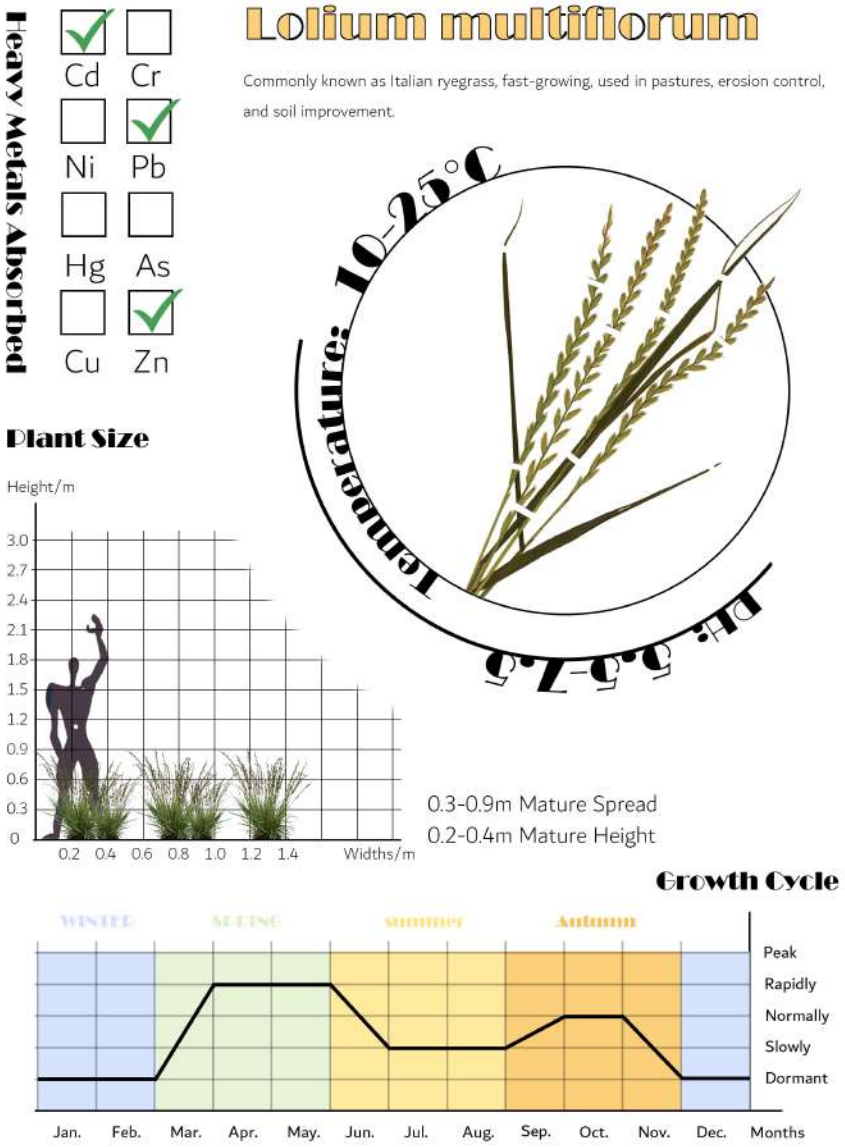


Fig.74 Lolium Multiflorum Analysis

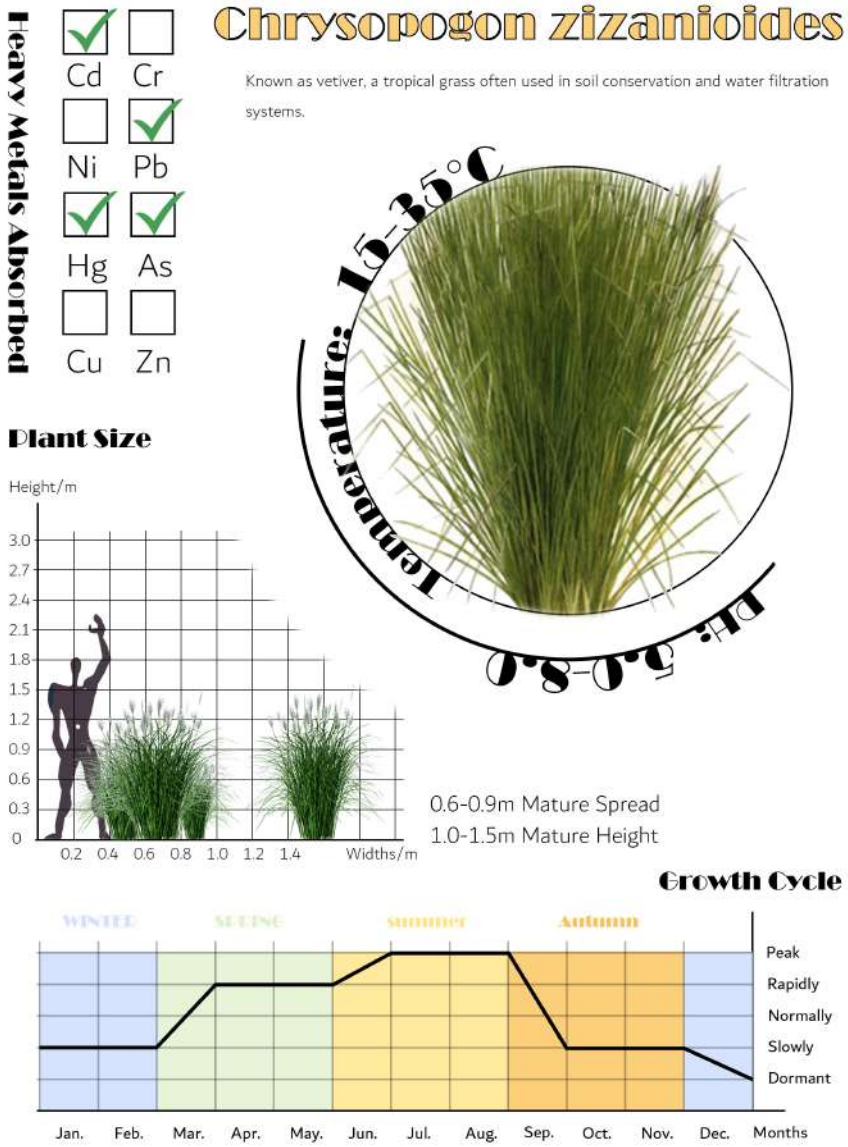


Fig.75 Chrysopogon Zizanioides Analysis

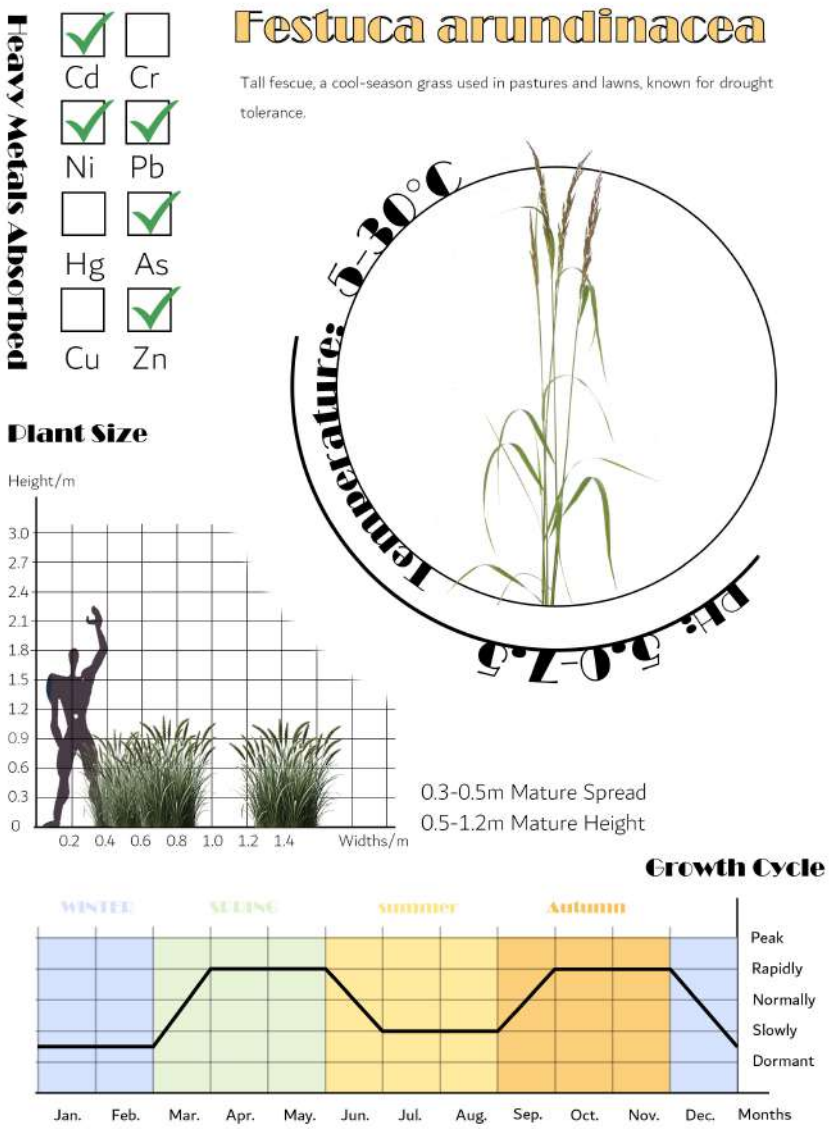


Fig.76 Festuca Arundinacea Analysis

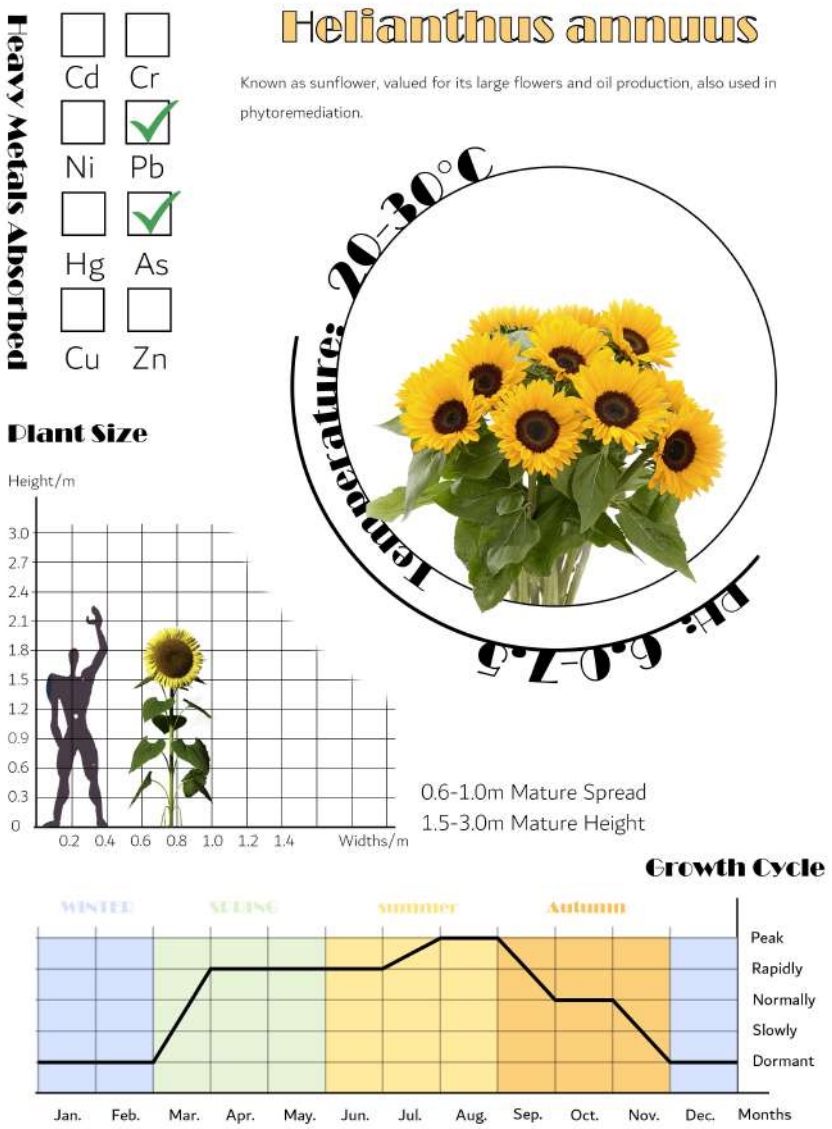


Fig.77 Helianthus Annuus Analysis

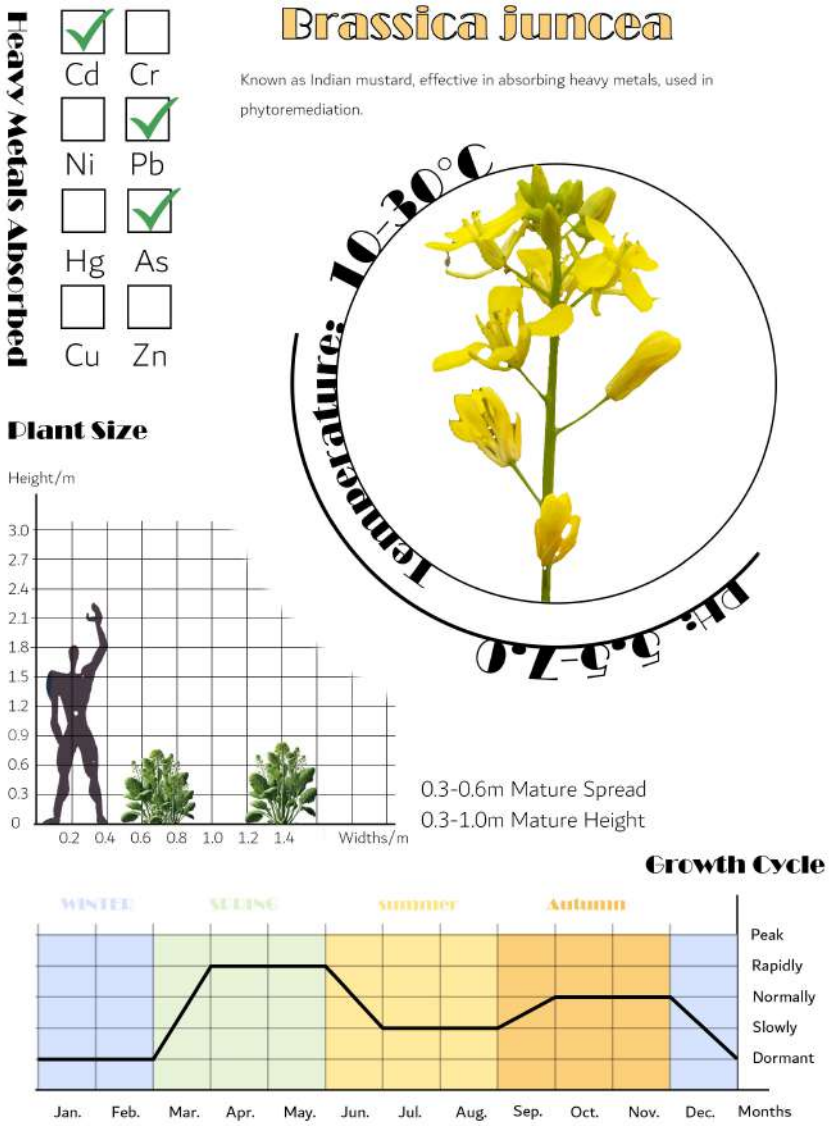


Fig.78 Brassica Juncea Analysis

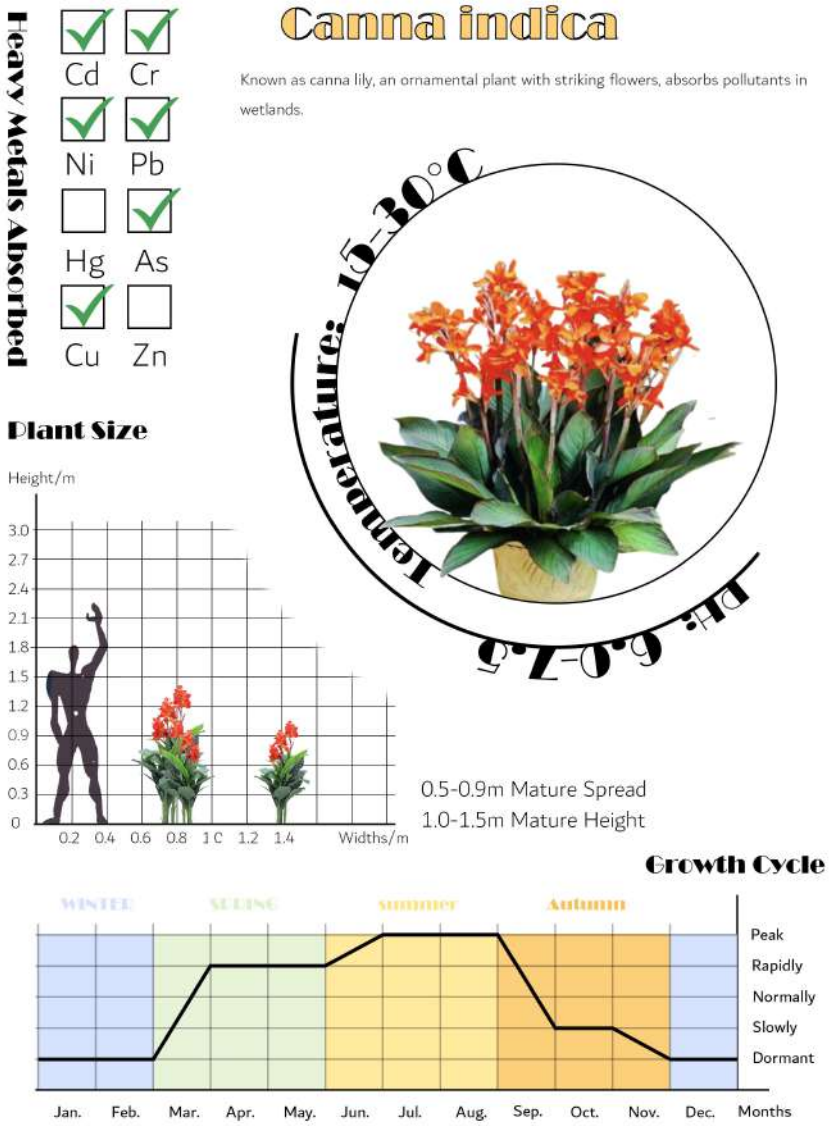


Fig.79 Canna Indica Analysis

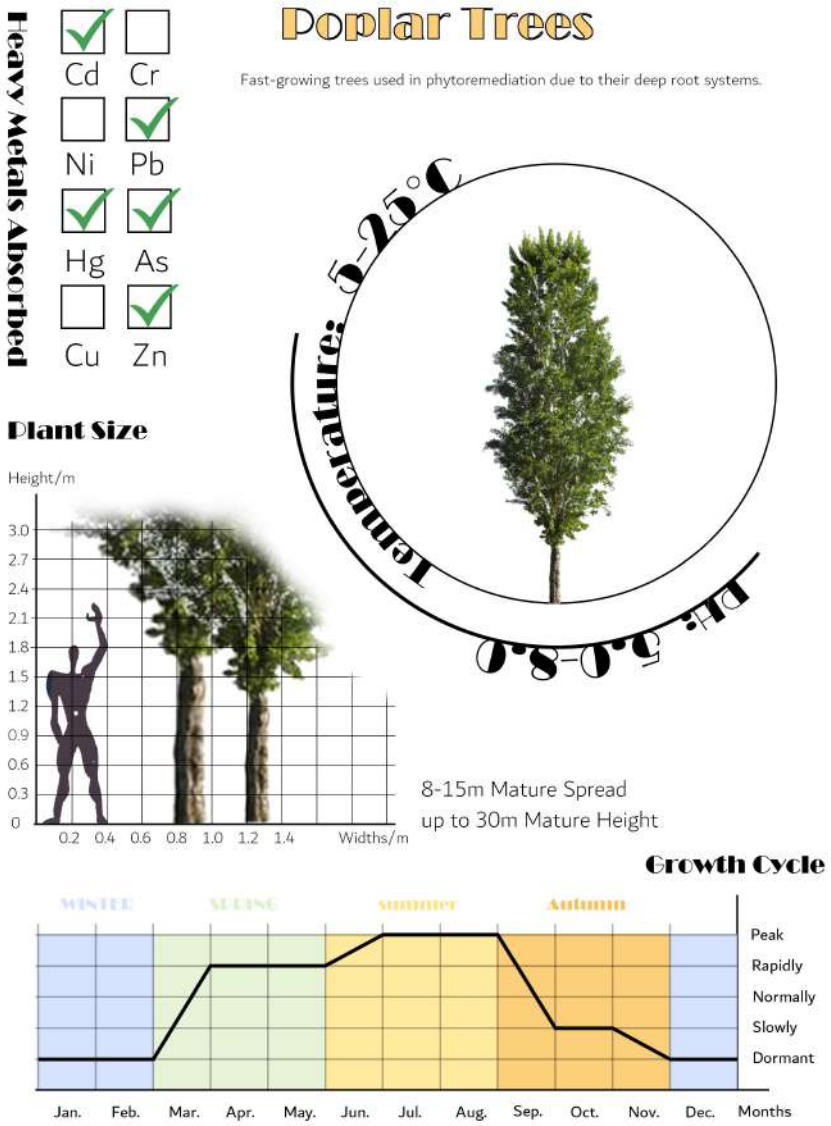


Fig. 80 Poplar Trees Analysis

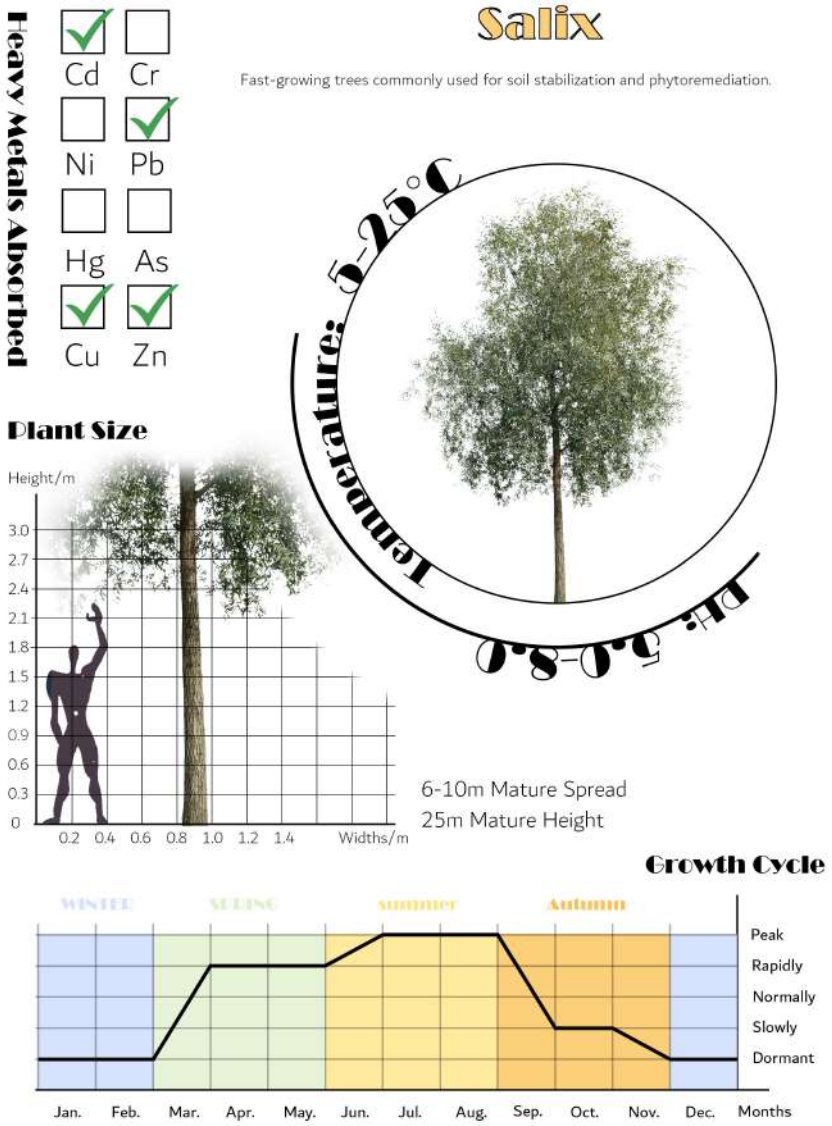


Fig. 81 Salix Analysis

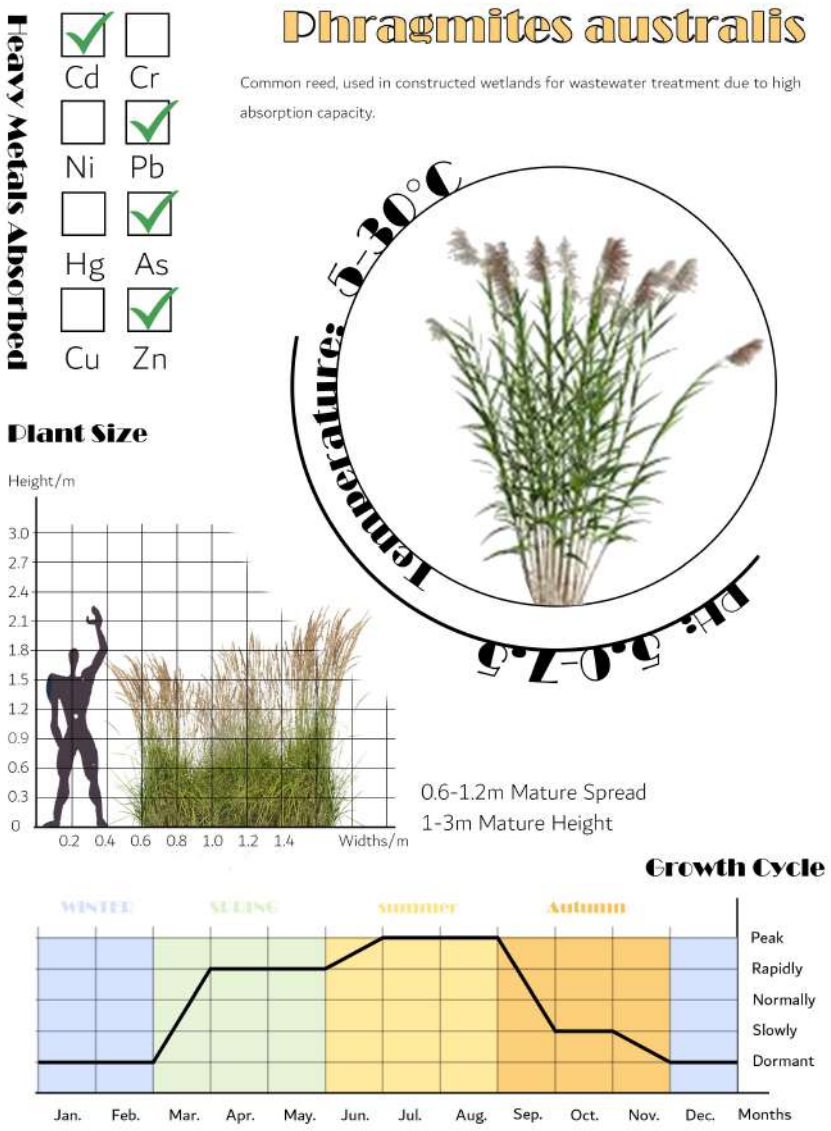


Fig.82 Phragmites Australis Analysis

- **Arenític Soil**

To combat heavy metal contamination from the refinery on the site and to improve soil conditions, a range of plants suited to Lisbon's climate and arenitic soil characteristics were selected for the area of arenitic soils on the western side of the site.

Calcareous sandstone soils are highly permeable, allowing water and contaminants to easily penetrate to greater depths. While this property contributes to surface water drainage, it also increases the risk of contaminants spreading to the subsurface.

Therefore, in this area, we screened a group of plants with deep roots and strong heavy metal enrichment capacity. These plants can effectively absorb and stabilize heavy metals such as Pb, Cd, and Zn, and at the same time slow down the vertical migration of pollutants with the help of deep roots, thus protecting the groundwater quality. Through the joint planting of these plants, we are not only able to reduce the spread of pollutants in the soil, but also improve the soil structure and accelerate the overall ecological restoration of the site.

Fig.83 Plant Configuration of Arenític Soil

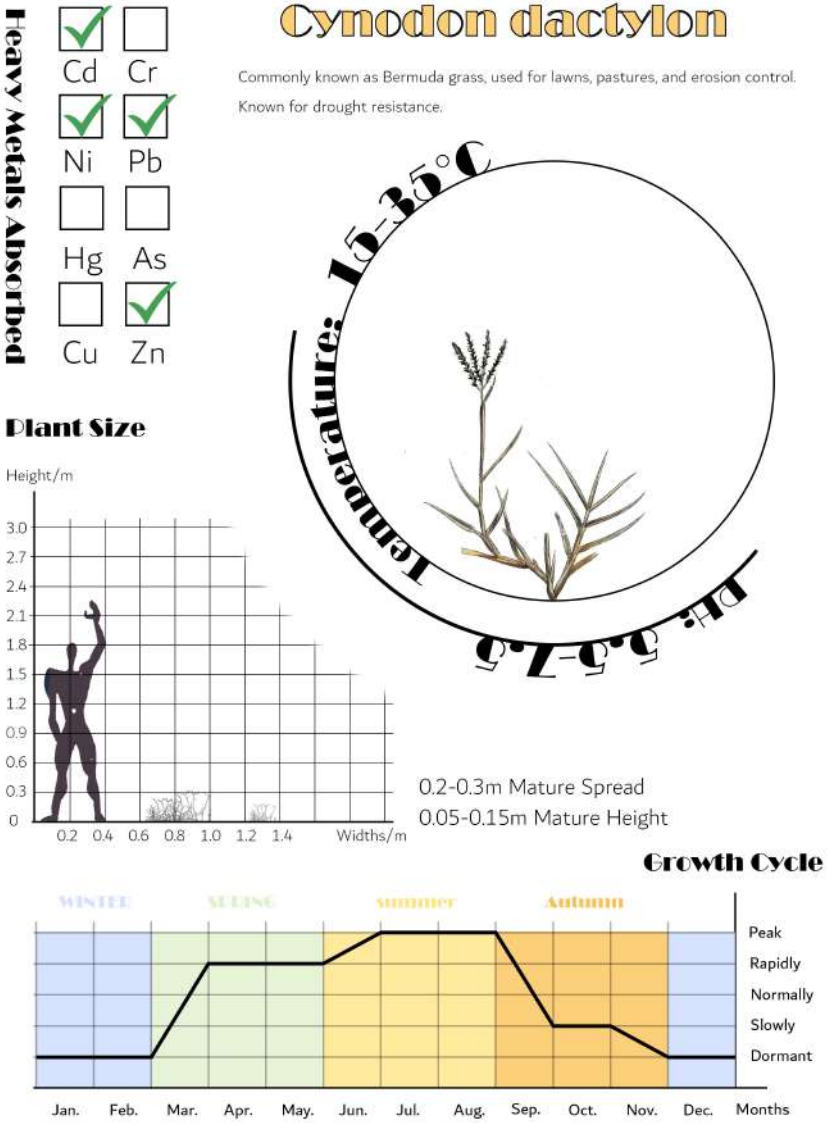


Fig.84 Cynodon Dactylon Analysis

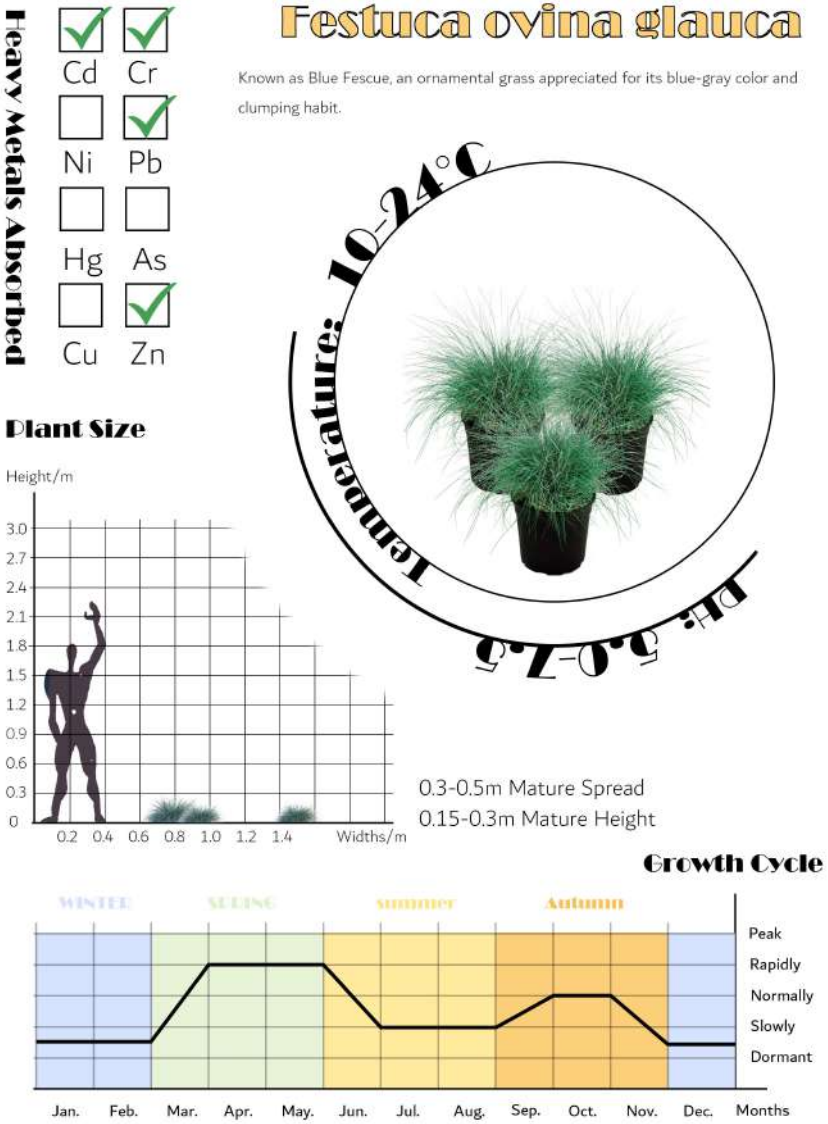


Fig.85 Festuca Ovina Glauca Analysis

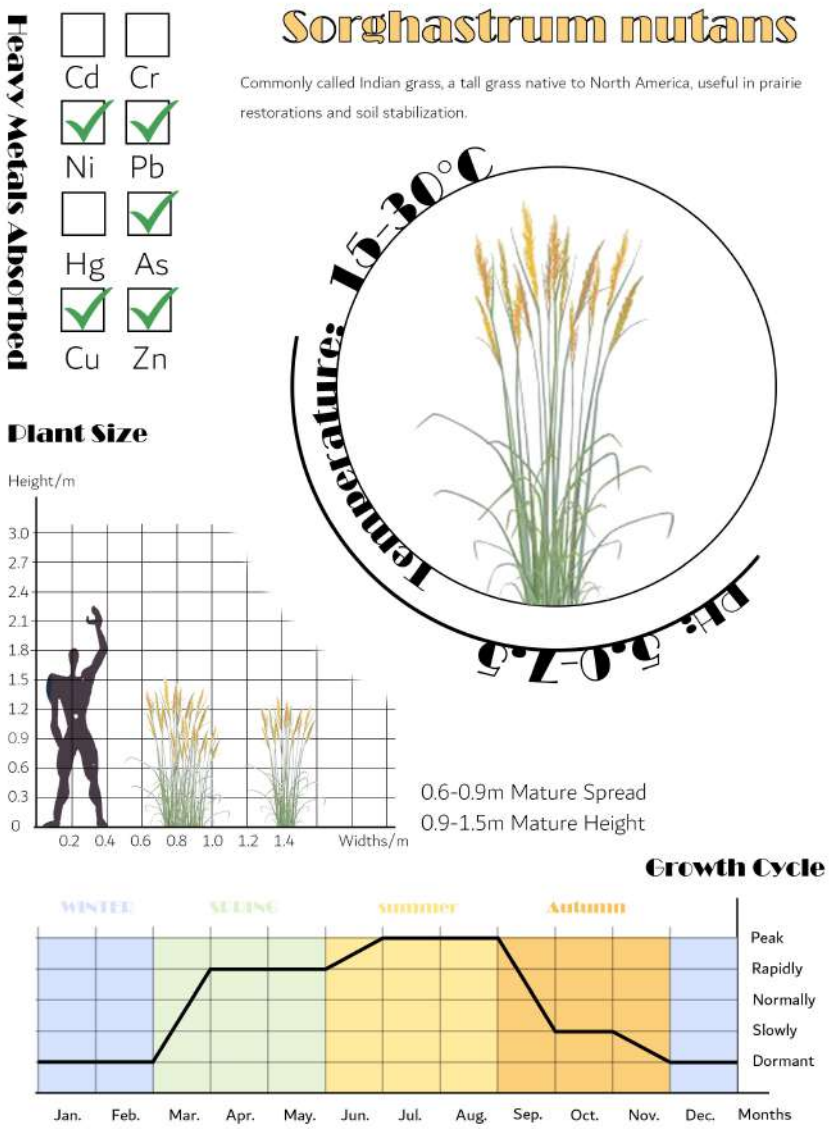


Fig.86 Sorghastrum Nutans Analysis

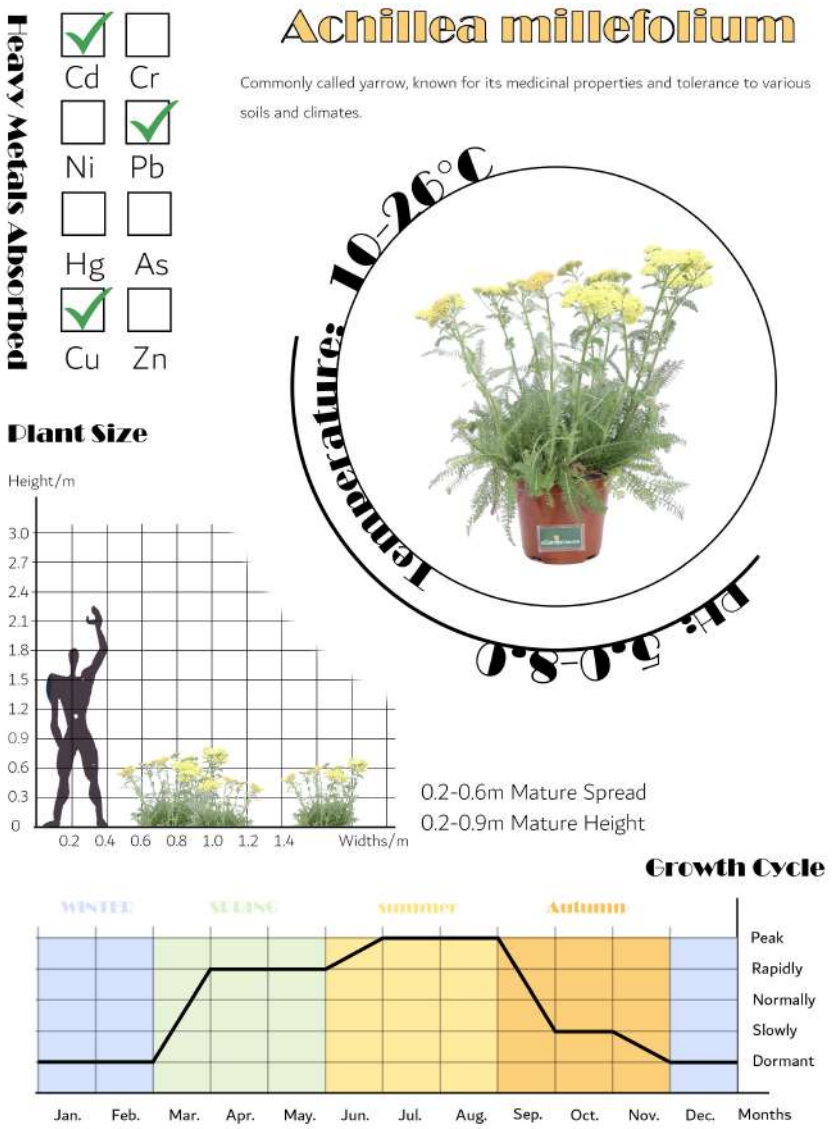


Fig.87 Achillea Millefolium Analysis

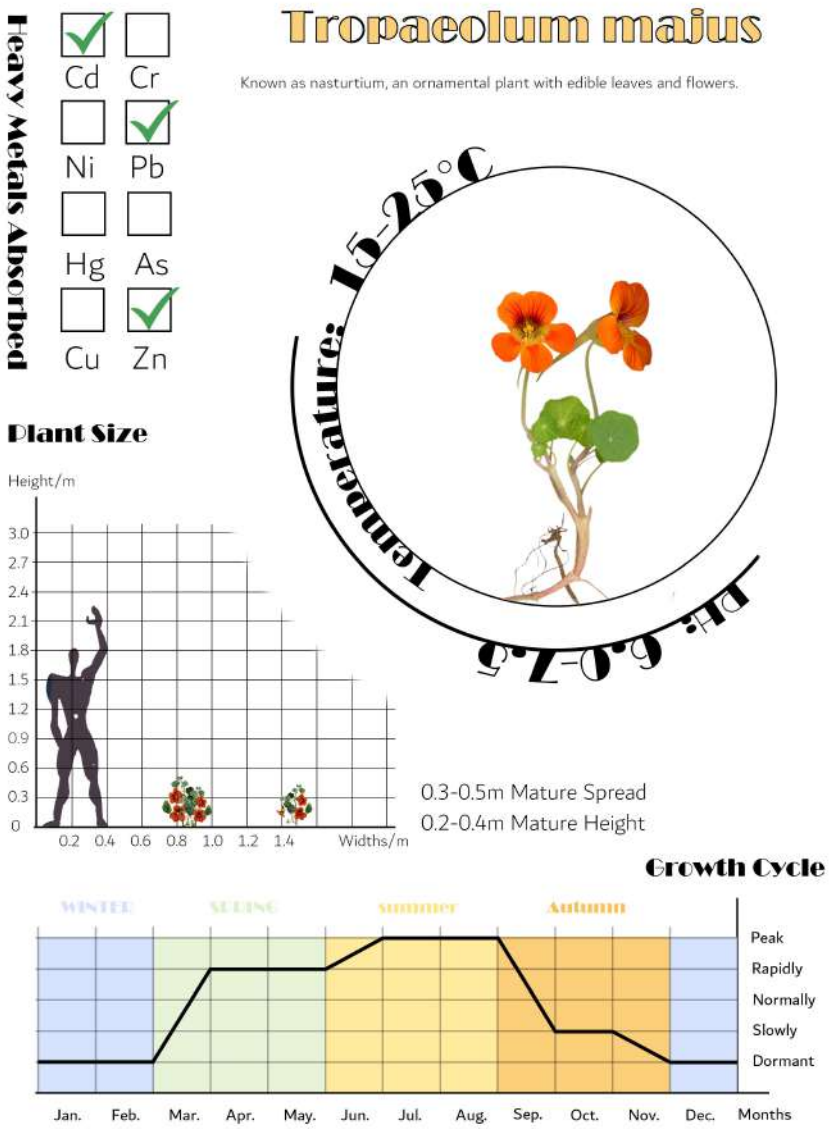


Fig.88 Tropaeolum Majus Analysis

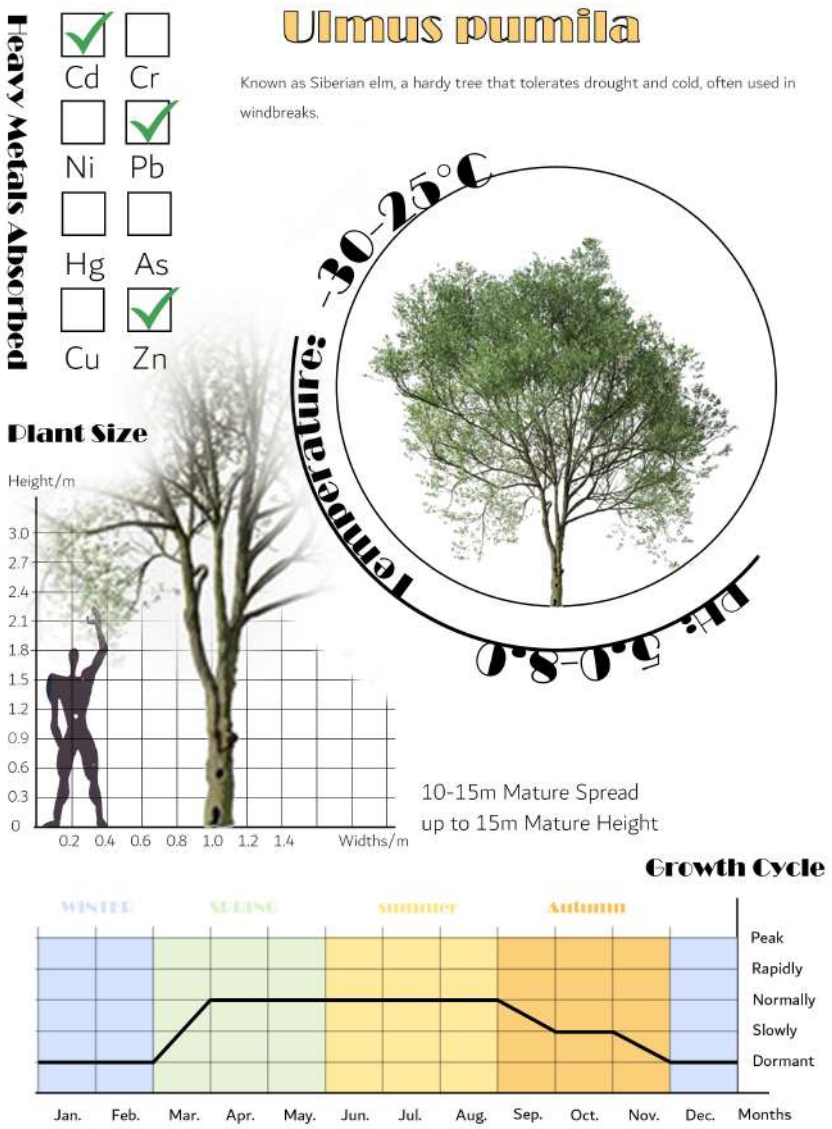


Fig.89 Ulmus Pumila Analysis

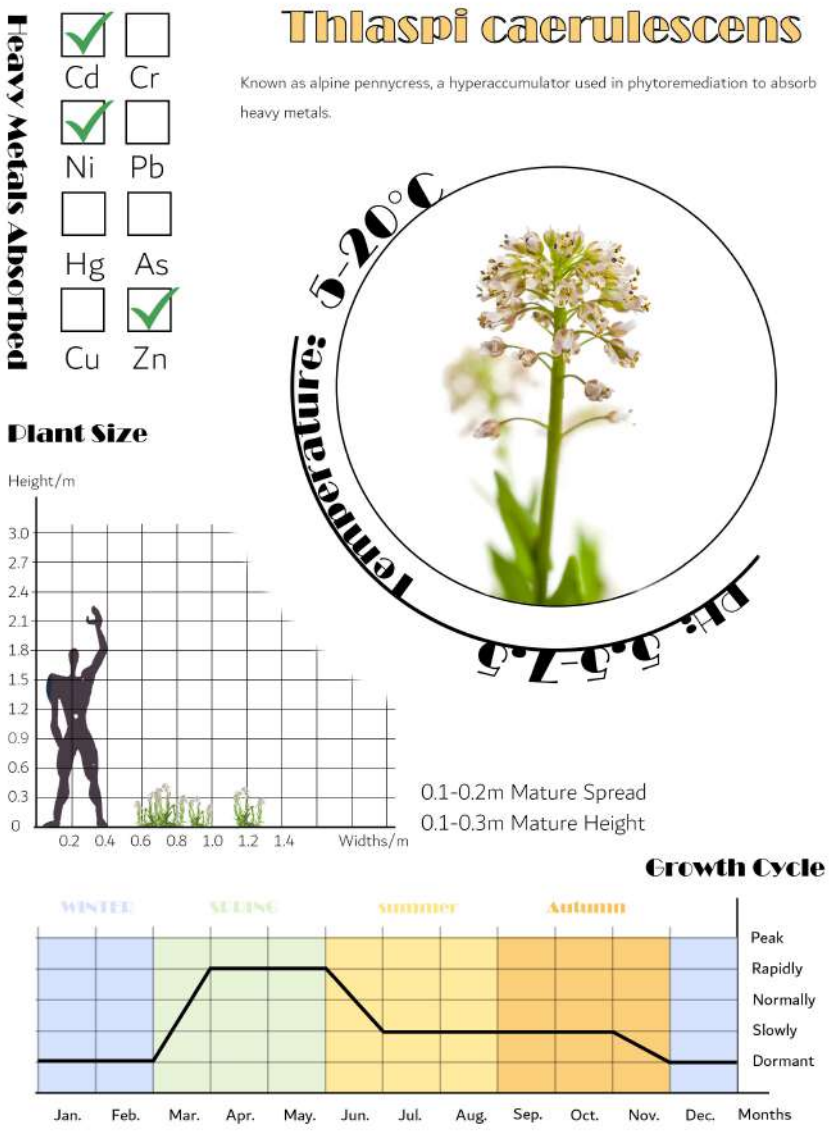


Fig.90 Thlaspi Caerulescens Analysis

• Water Filtration Pool

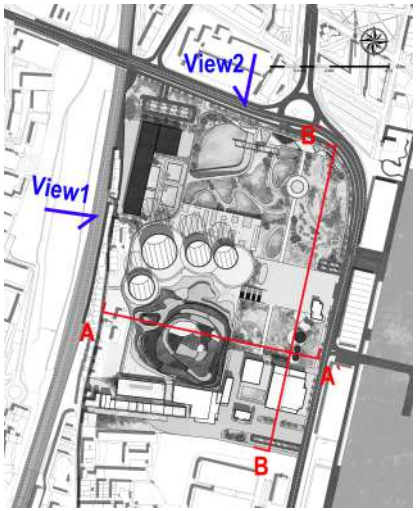
In Lisbon's warm Mediterranean climate, rain gardens can choose a variety of aquatic plants to filter rainwater and absorb heavy metals. Plants such as cattails, cannas, and lilies have well-developed root systems and good heavy metal absorption capabilities, and are suitable for growing in shallow water or humid environments. They can not only effectively filter harmful substances such as lead, cadmium, and copper from water bodies, but also have ornamental value, adding beauty to rain gardens. In addition, plants such as yellow irises, water celery, water plantains, and reeds can not only purify water quality, but also maintain soil stability and improve the ecological balance of rain gardens. By selecting these plants, rain gardens will become sustainable landscapes that combine beauty with environmental protection.

- **Cattail (Typha spp.):** With a well-developed root system and strong adaptability, it can effectively absorb heavy metals such as lead, cadmium, and copper.
- **Canna indica:** Its root system can absorb heavy metals, including lead, cadmium, and chromium.
- **Thalia dealbata:** It is effective in filtering nutrient pollutants such as nitrogen and phosphorus, and can absorb some heavy metals.
- **Water celery (Nasturtium officinale):** Water celery has a

high tolerance and adsorption capacity for heavy metals such as cadmium and lead.

- **Schoenoplectus tabernaemontani:** With a well-developed root system, it can absorb and fix heavy metals and organic pollutants in water.
- **Iris pseudacorus:** Iris pseudacorus can tolerate and absorb heavy metals, especially cadmium and lead.
- **Phragmites australis:** Phragmites australis has an absorption effect on a variety of heavy metals (such as cadmium, copper, and zinc), and has strong resistance.
- **Water dragon (Pontederia cordata):** This plant can effectively remove harmful substances such as phosphorus and nitrogen in water, and also has a certain adsorption effect on heavy metals such as cadmium.
- **Cattail (Sparganium spp.):** The root system of Cattail has a good adsorption capacity for heavy metals in water, especially cadmium and copper.
- **Duckweed (Lemna minor):** Duckweed has a strong adsorption capacity for heavy metals in water, such as cadmium and copper.

8.2.5 Section



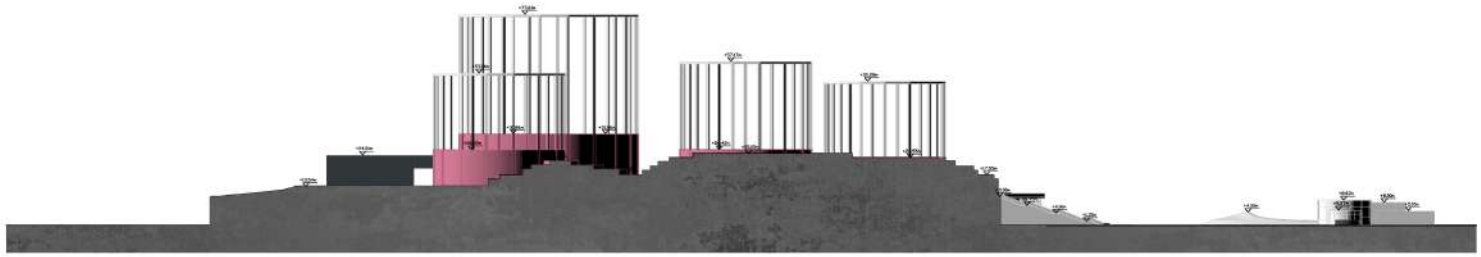


Fig.91 SectionA-A`

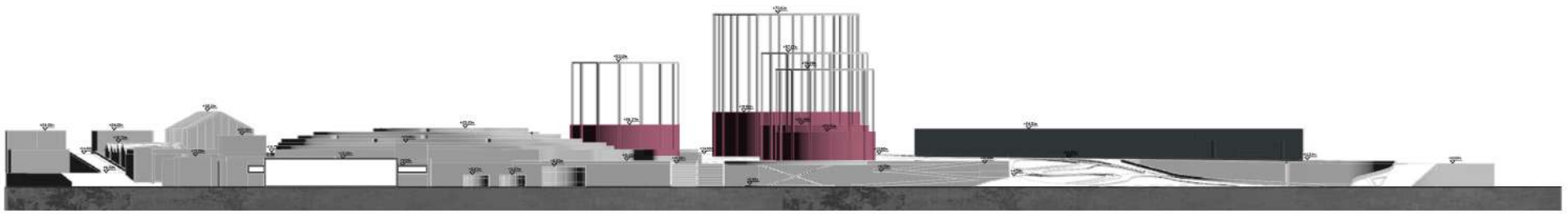
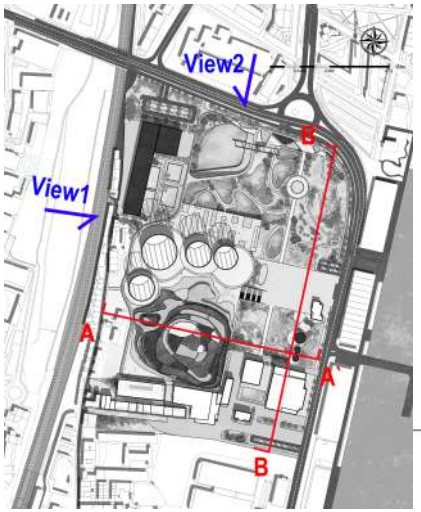


Fig.92 SectionB-B`

8.2.6 Elevation



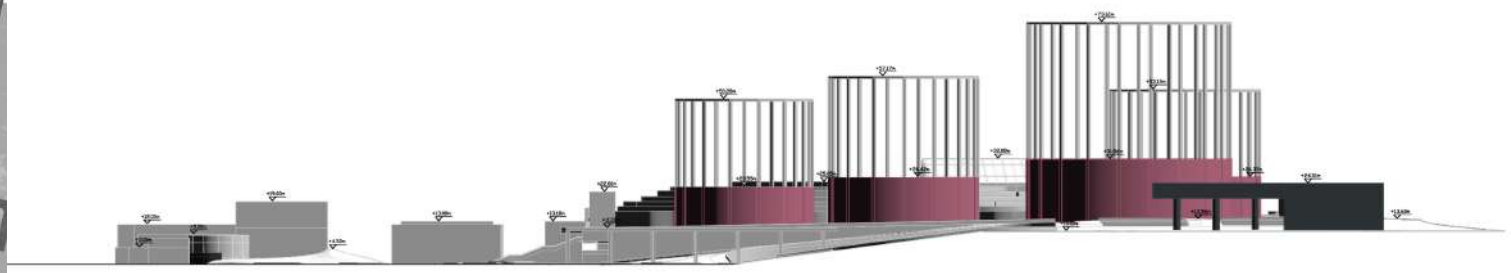


Fig.93 Elevation view2

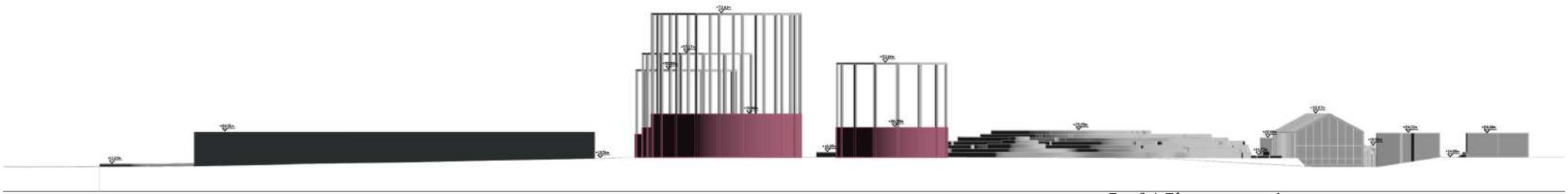


Fig.94 Elevation view1

8.2.7 landscape node

- **Fishpond**

In the urban agriculture park, the fish pond next to the rain garden is a characteristic landscape node that integrates ecological functions, landscape values and interactive experiences. By connecting with the recycling system of the rain garden, a comprehensive water ecological unit is formed. A wooden viewing platform is provided beside the fish pond to provide visitors with a space for close observation and rest. At the same time, a water diversion device is designed above the fish pond to channel purified rainwater into the fish pond, and the sound of the waterfall adds natural sound effects to the surrounding environment, while serving to replenish and oxygenate water, maintain the ecological balance of the water body, and create a visually and aurally dynamic landscape. As a vehicle for science education, the fish pond demonstrates the principles of rainwater recycling and water ecosystem functioning, incorporates the theme of urban agriculture, and demonstrates the process of aquaculture, providing visitors with opportunities for environmental education, and is particularly suitable for children to participate in. As the downstream node of the rain garden, the fish pond not only reflects the efficient use of water resources, but also forms a holistic landscape effect with the rain garden through naturalized design techniques.

Fig. 95 Fishpond

- **Market**

The market of the Urban Agricultural Park is the central architectural node of the entire park and a key site for the promotion of sustainable agriculture and community interaction within the Mavila Region. The building was originally in a state of disrepair, with some of the walls remaining. In order to preserve its historic appearance and to practice architectural reuse, the original walls were used to re-enclosed the space with steel and glass to create a new market building with modern functionality. It continues the historical memory of the site and gives it a new vitality, making it another landmark area of the urban agricultural park.

The most prominent part of the market is a two-storey, pitched-roofed, glazed building, which still retains the walls of the original building on the outside, while on the inside the new part of the building has a simple design that blends in with the architecture of the original industrial site. The first floor is a market area dedicated to agricultural trade, ideal for tourists and local residents to purchase fresh produce, much of which is sourced from the park's agricultural production. At the same time, the market area is also designed with a food processing plant, where consumers can process their purchased agricultural products into finished products on-site according to their needs, adding a sense of convenience and interactive experience to the market. The second floor is a vertical planting area that utilizes modern agricultural technology, not only providing the market with a greater supply of agricultural products, but also serving as a window to showcase urban agricultural technology, enhancing the market's educational function and sense of technology.

The spatial layout of the building further strengthens the connection within the park. The market building is connected to the building on the other side by an aerial platform constructed of steel structure, forming a walkable corridor-bridge-like passageway that facilitates the free flow of visitors and staff between the buildings. This design not only optimizes the functional layout, but also increases the openness and accessibility of the space, giving more flexibility and interactivity to the overall park.

The role of the market is not only limited to the interior of the park, it also serves as a linking hub for the entire region through the linkage of the four neighboring agricultural parks. The market can be used as a platform to unite with the neighboring agro-parks to organize regular agricultural themed events, such as agricultural product fairs, planting training courses, etc., to further promote public participation and enhance the dissemination of

knowledge and demonstration of innovations in the field of agriculture.

The market building not only functionally realizes the multiple integration of agricultural products trading, agricultural exhibition and community interaction, but also demonstrates the harmonious unity of modern design and historical preservation through the reuse and renewal of the old building.

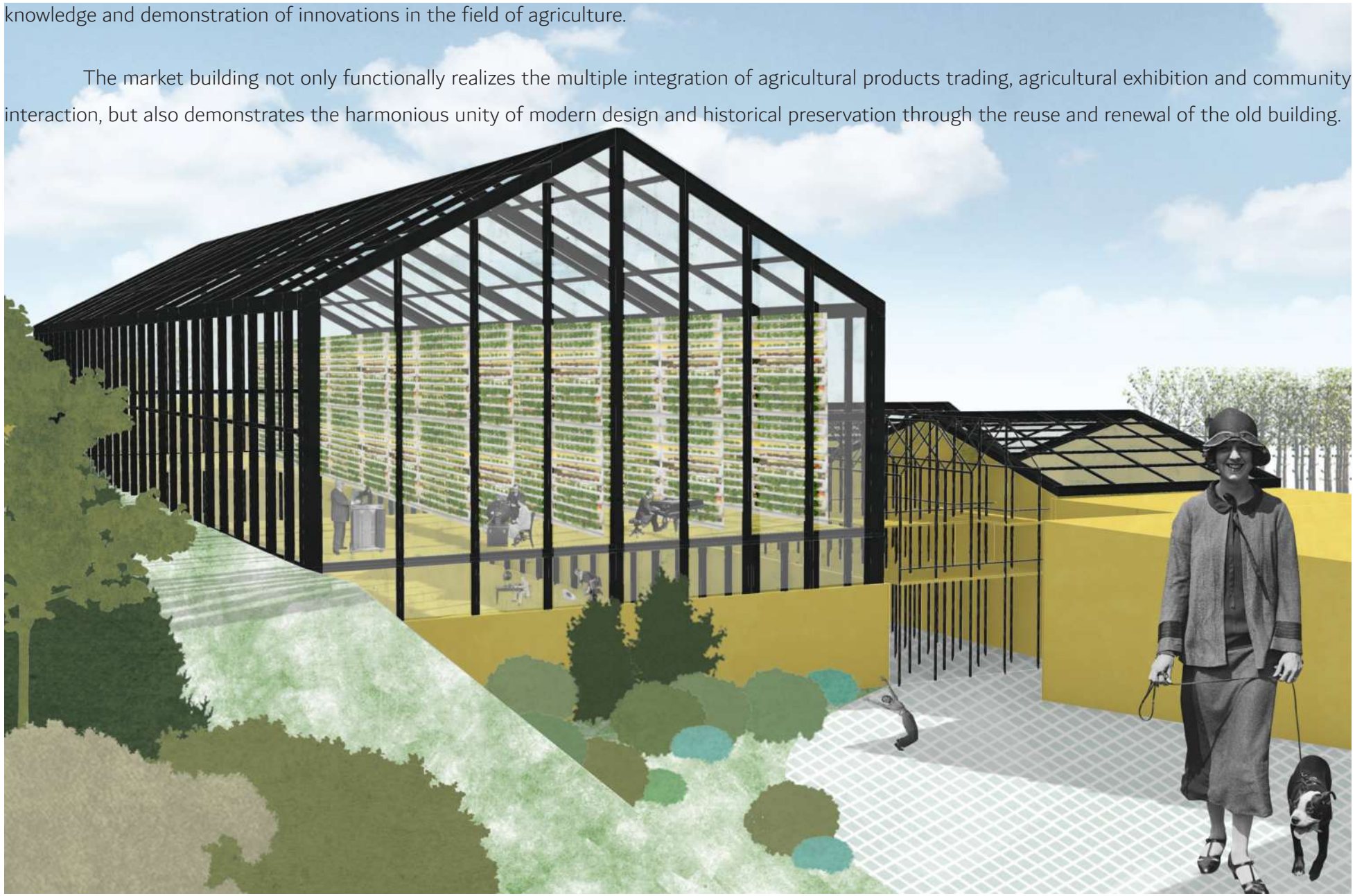


Fig.96 Market

- **Wetland**

The rain garden area utilizes terrain elevation differences and natural water circulation systems to collect, purify and store rainwater, creating an ecologically beneficial landscape node.

This design aims to achieve the combined goals of rainwater management, water utilization and ecological restoration, while providing an aesthetically pleasing, interactive experience area for visitors.

Rain gardens channel rainwater from hard-paved areas or agricultural areas through elevation differences into the garden, where it is filtered and purified through layers of plants, soil, and gravel beds, and the purified water infiltrates into the groundwater recycling system, where it is used for irrigation or ecological recharge in the park. In terms of landscape function, rain gardens play an educational role in parks by planting plants adapted to the humid environment, and at the same time setting up popularization boards or interactive installations to display knowledge of rainwater management and water cycle as. The ecological restoration function is reflected in the restoration of the damaged hydrological system in the city, improving the local microclimate and providing habitats for organisms.

The use of elevation differences and flow paths is key to the design, with natural terraced layouts forming small waterfalls, streams, or sedimentation basins, and clear paths for rainwater inflows and outflows to meander and enhance aesthetics. The installation of walkways and activity spaces enhances the visitor experience and allows visitors to experience nature up close. The water recycling system contains primary treatment areas, purification areas, water storage areas and overflow drainage channels, forming a complete rainwater management chain. In addition, the rain garden will provide water for the grass area in phase 3 and the farmland area in phase 4, and demonstrate the cyclic process of “rainwater-plant-farmland”, as well as serve as an educational function for the neighboring residents and visitors. At the same time, the landscape nodes of the rain garden also serve as a linking hub to connect two different functional areas with height difference, visually combining different landscape nodes to form a system. Through the rational design of rain gardens can not only its own role, but also for urban agricultural parks to add ecological, educational and recreational combination of multi-functional space.

Fig.97 Wetland

- **Terraced Fields**

The terraced landscape node in the Urban Agriculture Park is located in the southern part of the Refinery Barrel building and is a landmark landscape that combines natural ecology with humanistic design. The terraces are composed of several levels, each with different types of plants, providing a beautiful natural landscape for visitors. The terraces and the oil refinery barrel building are separated by a square for transition, forming a clever mix of landscape node-public space-architecture.

Visitors can walk to the top of the terraces through a curved ramp on one side, enjoying the layered beauty and meticulous design of the planting along the way. At the top of the terraces, there is a viewing platform, which, with the advantage of the difference in elevation of the terrain, allows people to look down on the entire urban agricultural park and enjoy the rich landscape of the park, including the oil refinery barrel building, the market area, and other attractions, making it one of the best viewpoints in the park. On the other side of the ramp, visitors can descend from the top of the terraces to the market area of the park, creating a fluid pathway that seamlessly connects the nature experience with the market interaction. This landscape node not only enhances the sustainability of the urban agricultural park with its ecological design, but also creates a multi-layered experience for visitors through the design of the ramp and observation deck.

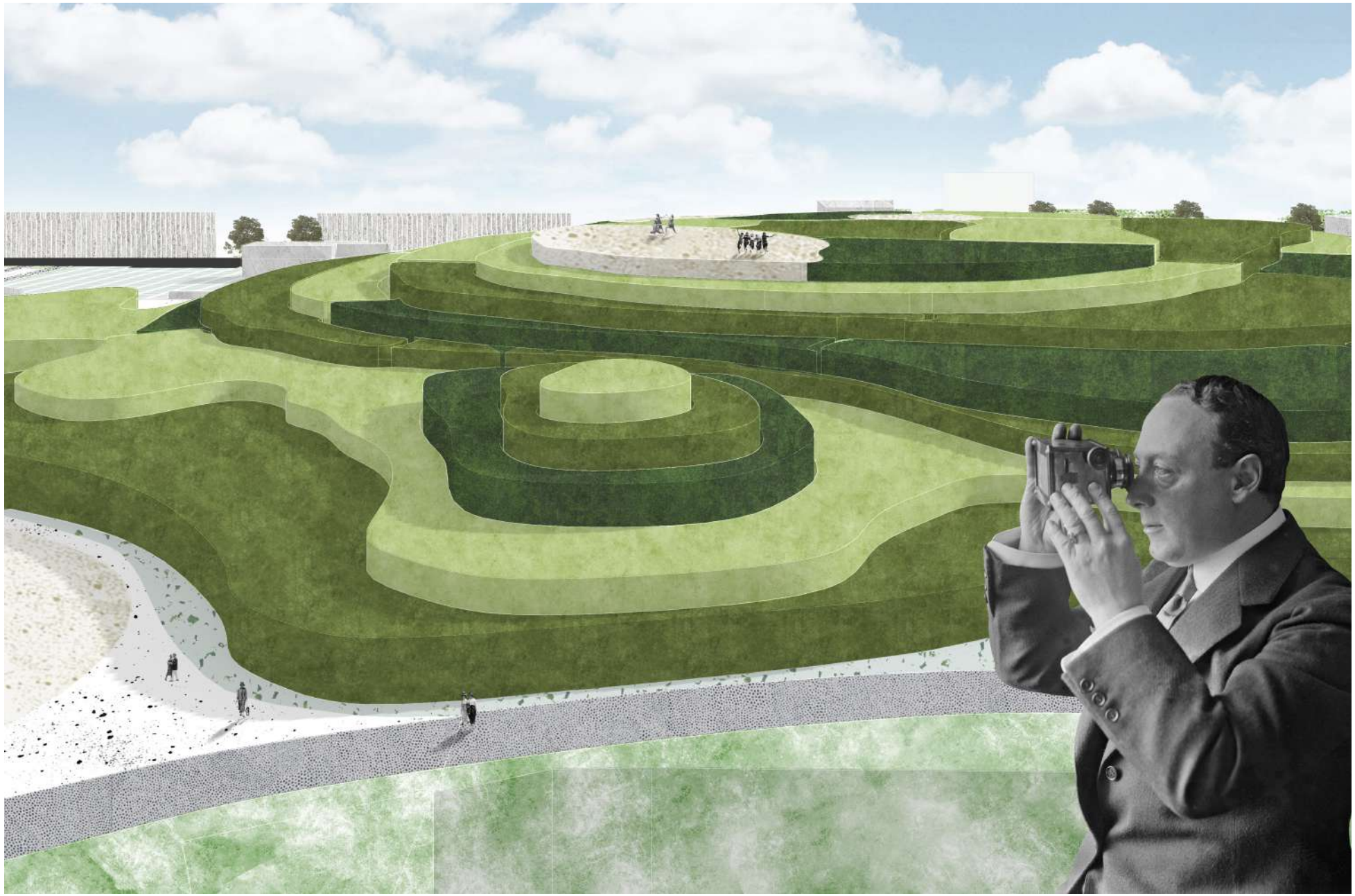


Fig.98 Terraced Fields

- **Social event venue**

The plaza to the north of the barrel building is an important architectural landscape node in the urban agricultural park, designed to combine openness, versatility and flexibility. The barrels have been transformed into a restaurant, museum and conference room based on their unique industrial context, and the location of the plaza adjacent to them gives it a central function of culture and communication.

The plaza serves as an open space for the public to move about, relax or hold small gatherings, and is accessible and inclusive, making it an important place for the community to live and for visitors to experience. In particular, the plaza is designed with a flexible and movable modular system that can be quickly deployed and adjusted according to the needs of different activities. For example, building temporary exhibition halls for art display and education programs, or setting up temporary screening areas for outdoor movies, or building temporary dining areas as a place to carry out dinner parties for some large-scale events. The modular design not only improves space utilization, but also reduces the need for long-term changes to the ground infrastructure, in line with the concept of sustainable development. As an extension of the restaurant, museum and conference room, the plaza can host large-scale outdoor events such as bazaars, concerts, cultural festivals, food festivals, etc., becoming an important node for interaction between people and the environment. This flexible function enhances the attractiveness of the area while injecting more dynamism and vitality into the overall function of the agricultural park.

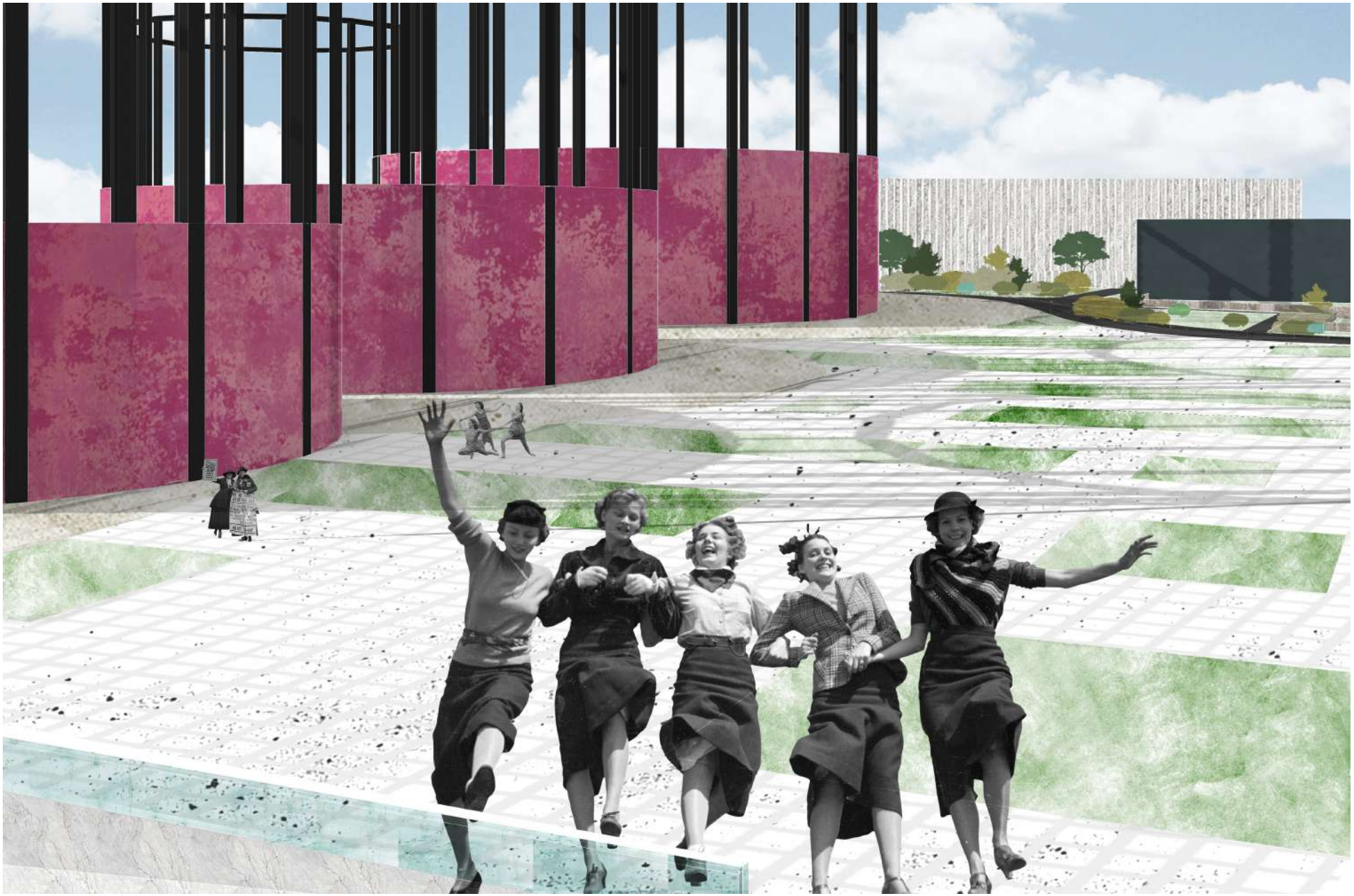


Fig.99 Social event venue

8.3 Urban Agriculture Park (phase 4)

8.3.1 Master Plan

After 5-10 years of deep purification of land contamination, this land will be fully suitable for crop production, i.e., the site will eventually be converted into an urban agricultural park. Since alluvial soil is the most suitable soil for growing crops, only the plants that were originally used to purify the soil need to be replaced with crops. At this point in time, according to the plan, this urban agriculture park will become the core hub of urban agriculture in this area Core hub, a multi-functional central area that combines the functions of production, education, community interaction, and resource management to support agricultural activities. It will not only provide services for agricultural production, but also become a center for knowledge sharing, community activities and resource recycling.

For the crops planted in the agricultural experience park, we choose crops that are suitable for local climate and soil conditions, local food culture and interactive and rich in tourists' participation:

- **Grapes:** Portugal is famous for its high-quality wines. Planting grapes is not only in line with local traditions, but also provides tourists with picking and winemaking.
- **Olives:** Olive trees adapt to the Mediterranean climate. Planting olives can produce olive oil and allow tourists to participate in the picking and pressing process.
- **Citrus fruits:** Such as oranges, lemons and tangerines, these fruits grow well locally and are deeply loved by tourists.
- **Vegetables:** such as tomatoes, cucumbers, carrots and cauliflower, planting these vegetables can provide visitors with farming experiences such as sowing, harvesting and cooking.
- **Aromatic plants:** such as lavender, orange blossom, tarragon, these plants can be used to make essential oils and sachets, increasing the diversity of the experience garden.
- **Spices:** rosemary and thyme, mint, laurel, etc., these plants can be used to make herbal tea experiences and herbal bags.

Fig.100 Master plan of Urban Agriculture park

8.4 Design feasibility analysis

Architect and sustainability expert Carl Elefante famously said, “The greenest building is the one that's already built.” The reason is not hard to understand: adaptive reuse projects are often built faster, more economically, and more sustainably than new construction.

Directly retrofitting an abandoned refinery, planning and allocating the amount of earthwork to design the site, and using local materials wherever possible can save on the cost of transporting materials and constructing the building itself. It also helps to increase the value of the land and attracts investors to invest more in the area, thereby boosting the economy of the surrounding region.

Industrial waste sites often require high management and safety maintenance costs (e.g. cleaning up pollution, monitoring illegal encroachment). These costs can be greatly reduced by converting them into parks, which can be permanently converted to productive use after cleaning up the pollution and restoring the soil.

In terms of remediation costs, ecological restoration can be achieved through agricultural activities (e.g., planting soil remediation plants, rainwater management systems, etc.) to gradually improve the quality of the environment, and such long-term natural measures are effective in reducing the remediation costs to a certain extent.

Urban agriculture often involves community participation in the form of volunteers and cooperatives to share some of the daily maintenance work, thus reducing the single management cost of municipalities.

From the perspective of policing costs, abandoned sites can easily become a breeding ground for illegal activities; transforming them into public spaces improves security and reduces policing costs by increasing foot traffic and activity.

By applying modern technologies such as vertical farming, smart irrigation, sustainable water recycling and other modern techniques, maintenance of agricultural parks can be efficient, economical and environmentally friendly.

Part of the maintenance cost expenses of the agricultural park can be covered by agricultural labor (e.g., crops produced, ticket sales, agricultural education activities, etc.) to make it somewhat self-sufficient.

The operational pressure on urban agro-parks can also be further reduced through funding from international organizations or strategic EU acts, such as the European Commission's creation of the European Innovation Council (EIC), a new funding agency aimed at facilitating the process of transforming inventions and research results into goods and services. As well as other EU programs such as the Common Agricultural Policy (CAP), which regulates agricultural subsidies, and the European Horizon 2021-27, which seeks to restore Europe's ecosystems and biodiversity and to sustainably manage natural resources in order to ensure food security and a clean and healthy environment, there are also a number of other initiatives that can help reduce the pressure on the operation of urban agri-parks, such as the European Commission's European Innovation Council (EIC), a new funding agency that aims to promote the translation of inventions and research into goods and services. “These can be the driving force behind the construction and operation of urban agro-parks.

Chapter 9

Conclusion

9. Conclusion

Outcome of the study

The research demonstrated the potential of transforming the site of the abandoned oil refinery Antiga GALP in Lisbon into a sustainable urban agro-park, addressing key urban issues such as food security, environmental degradation and reuse of abandoned buildings. This thesis provides a multidisciplinary framework that combines urban agriculture, environmental restoration and community engagement. It also highlights Lisbon's strategic advantages due to its favorable climate, policy support and community readiness.

Advantages of the proposed design

Economic Increased land value, production of local food creates economic value, increased employment opportunities for local residents. Environmental restoration achieves soil remediation, improves air quality, optimizes the water cycle, and promotes sustainable ecology.

Social benefits promote social inclusion and community cohesion, and increase educational.opportunities in the neighborhood through vertical farming, soilless cultivation and other techniques.The policy integration is in line with Lisbon's urban planning and sustainable development goals, and serves as a model for other cities with urban agriculture needs, contributing to global environmental goals.

Key issues to be addressed

In terms of environmental pollution, although the problem of soil contamination has been largely solved, there is no standardized criterion for whether or not the contamination is removed cleanly at a deeper level. Secondly, the cost of treating plant products used for soil decontamination is relatively high, and the technical means to fully utilize these crops at a low cost are still being explored.

Economically, how to secure long term funding to ensure financial and profitability sustainability through phased development and sound planning needs to be rigorously developed.

At the social level, there is a need to maintain the active and inclusive participation of different communitygroups and mobilize the interest of the surrounding population in urban agriculture for its healthy development.Policy and management need to pay more attention to coordination between stakeholders, creating efficient models of cooperation and work, and aligning with broader urban agriculture policies.

Vision for future plans for Lisbon

In the context of the large number of abandoned industrial buildings as well as brownfield sites left behind after Lisbon's industrial transformation, the transformation of the Antiga GALP into an urban agricultural park can serve as a scalable model for urban regeneration in Lisbon and beyond. It lays the groundwork for future projects in Lisbon that integrate agriculture into the urban landscape, emphasizing resilience, sustainability and inclusiveness. Lisbon's vision of a 'green city' can be realized by expanding green corridors, enhancing urban biodiversity, and creating solutions based on innovative agriculture in the context of food security and climate change challenges.

The thesis offers a forward-looking approach that makes Lisbon a pioneer in the sustainable use of resources and a good example for future trends in global sustainable urban transformation.

Bibliography

1 Mougeot, Luc J. A. *Agropolis: The Social, Political, and Environmental Dimensions of Urban Agriculture.* Earthscan and the International Development Research Centre, 2005..

2 Smit, Jac, Joe Nasr, and Annu Ratta. *Urban Agriculture: Food, Jobs and Sustainable Cities.* United Nations Development Programme (UNDP), 2001.

3 United States Department of Agriculture (USDA). "Urban Agriculture." 2020.

4 RUAF. "Urban agriculture: what and why?", RUAF, 2006, *www.ruaf.org*.

5 Resource Centres on Urban Agriculture and Food Security (RUAF). "What is Urban Agriculture?" 2015.

6 Food and Agriculture Organization of the United Nations (FAO). "Urban and peri-urban agriculture" *Food and Agriculture Organization of the United Nations UPA*, www.fao.org/urban-peri-urban-agriculture/about/.

7 Food and Agriculture Organization of the United Nations (FAO). "Urban Agriculture." 2020.

8 Lovell, Sarah Taylor. "Multifunctional Urban Agriculture for Sustainable Land Use Planning." *Sustainability,* vol. 2, no. 8, 2010, pp. 2499-2522.

9 Growing Power. "What We Do." 2018.

10 Lawson, Laura J. "Agriculture: Sowing the City." *Nature*, vol. 540, 2016, pp. 522-523..

11 Janick, Jules. "Ancient Egyptian Agriculture and the Origins of Horticulture." *Acta Hort*., vol. 582, 2010, pp. 23-39.

12 Smith, Andrew F. *The Oxford Companion to American Food and Drink*. Oxford University Press, 2007.

13 Gies, Joseph, and Frances Gies. *Life in a Medieval City*. Harper & Row, 1969.

14 Rostami, Rasoul, et al. "Successful Public Places: A Case Study of Historical Persian Gardens." *Urban Forestry and Urban Greening*, vol. 15, 2015, pp. 211-224.

15 ZAAR, M. H. "Agricultura urbana: algunas reflexiones sobre su origen e importancia actual." *Biblio 3w*, v. 16, 2011, p. 944.

16 Lawson, Laura J. *City Bountiful: A Century of Community Gardening in America*. University of California Press, 2005.

17 Glowa, Michelle K. "Urban Farming: History of Urban Agriculture and Urban Farming Policies." *AU Online*, 2019.

18 Appolloni, Elisa, et al. "The Global Rise of Urban Rooftop Agriculture: A Review of Worldwide Cases." 2021.

19 Al-Kodmany, Kheir. *The Vertical Farm: A Review of Developments and Implications for the Vertical City,* 2018.

20 "What is a community garden?". *American Community Garden Association,* 2007.

21 Taylor JR, Lovell ST. "Urban home gardens in the Global North: A mixed methods study of ethnic and migrant home gardens in Chicago, IL." *Renewable Agriculture and Food Systems.* vol. 30, no. 1, 2015, pp. 22-32.

22 Van Veenhuizen, R. *Cities Farming for the Future: Urban Agriculture for Green and Productive Cities*; IIRR: Ottawa, ON, Canada; RUAF: Leusdan, The Netherlands; IDRC: Cavite, Philippines, 2006.

23 Filippini, R., et al. "The Contribution of Urban Food Policies toward Food Security in Developing and Developed Countries: A Network Analysis Approach." *Sustainable Cities and Society*, vol. 47, 2019, article no. 101506.

24 Mok, Hoi-Fei, et al. "Urban Agriculture in Developed Countries: A Review of the Benefits and Challenges." *Renewable Agriculture and Food Systems*, vol. 29, no. 2, 2014, pp. 79-92.

25 Kaufman, Jerry, and Martin Bailkey. "Farming Inside Cities: Entrepreneurial Urban Agriculture in the United States." *Lincoln Institute of Land Policy Working Paper*, 2000.

26 Wortman, Sarah E., and Sarah T. Lovell. "Environmental Challenges Threatening the Growth of Urban Agriculture in the United States." *Journal of Environmental Quality*, vol. 42, no. 5, 2013, pp. 1283-1294.

27 Tornaghi, Chiara. "Critical Geography of Urban Agriculture." *Progress in Human Geography,* vol. 38, no. 4, 2014, pp. 551-567.

28 Bailkey, Martin, and Joe Nasr. "From Brownfields to Greenfields: Producing Food in North American Cities." *Community Food Security News*, vol. 1, no. 1, 2000, pp. 6-7.

29 Greensgrow. "Greensgrow Farms: A Hub for Urban Agriculture and Community Engagement." *Greensgrow Farms*, 2020, www.greensgrow.org.

30 Omar, Dina, et al. "Social and Behavioural Sciences." *Soc. Behav. Sci.*, vol. 201, 2015, pp. 352-359.

31 Glover, Troy D. "Social Capital in the Lived Experiences of Community Gardeners." *Leisure Sciences*, vol. 26, no. 2, 2004, pp. 143-162.

32 Poulsen, Melissa N., et al. "Exploring the Multifunctionality of Urban Agriculture in Baltimore, MD." *Sustainability,* vol. 7, no. 4, 2015, pp. 4789-4806.

33 McCormack, Lacey Arneson, et al. "Review of the Nutritional Implications of Farmers' Markets and Community Gardens: A Call for Evaluation and Research Efforts." *Journal of the American Dietetic Association*, vol. 110, no. 3, 2010, pp. 399-408.

34 Algert, Susan J., et al. "Disparities in Access to Fresh Produce in Low-Income Neighborhoods in Los Angeles." *American Journal of Preventive Medicine,* vol. 30, no. 5, 2006, pp. 365-370.

35 Blair, Dorothy. "The Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *Journal of Environmental Education*, vol. 40, no. 2, 2009, pp. 15-38.

36 Langemeyer, J.; Camps-Calvet, M.; Calvet-Mir, L.; Barthel, S.; Gómez-Baggethun, E. "Stewardship of urban ecosystem services: Understanding the value(s) of urban gardens in Barcelona." Landscape and Urban Planning, vol. 170, 2018, pp. 79-89.

37 Langemeyer, J.; Madrid-Lopez, C.; Beltran, A.M.; Mendez, G.V. "Urban agriculture—A necessary pathway towards urban resilience and global sustainability?" *Landscape and Urban Planning*, vol. 210, 2021, article no. 104055.

38 De Kimpe, C. R., and J. L. Morel. "Urban Soil Management: A Growing Concern." *Soil Science*, vol. 165, no. 1, 2000, pp. 31-40.

39 Pataki, Diane E., et al. "Urban Ecosystems and the North American Carbon Cycle." *Global Change Biology*, vol. 17, no. 2, 2011, pp. 775-790.

40 Hassan, D.K.; Hewidy, M.; El Fayoumi, M.A. "Productive urban landscape: Exploring urban agriculture multi-functionality practices to approach genuine quality of life in gated communities in Greater Cairo Region." *Ain Shams Engineering Journal*, vol. 13, 2022, article no. 101607.

41 Aubry, Christine, and Lahcen Kebir. "Shortening Food Supply Chains: A Means for Maintaining Agriculture Close to Urban Areas? The Case of the French Metropolitan Area of Paris." *Food Policy*, vol. 41, 2013, pp. 85-93.

42 Smit, Jac, and Joe Nasr. "Urban Agriculture for Sustainable Cities: Using Wastes and Idle Land and Water Bodies as Resources." *Environment and Urbanization*, vol. 4, no. 2, 1992, pp. 141-152.

43 Soga, Masashi, et al. "Health Benefits of Urban Allotment Gardening: Improved Physical and Psychological Well-Being and Social Integration." *International Journal of Environmental Research and Public Health*, vol. 14, no. 71, 2017.

44 Castel-Branco, C. "O terreno da Expo'98 em 1993." *O Livro Verde = The Green Book*, edited by Comissiariado da Exposição Mundial de Lisboa, ParqueExpo'98, 1999, pp. 15-29.

45 Vaz, J. "O Plano de Urbanização da Zona Envolvente da Expo'98." In *A Brand New Fragment in the City of Lisbon: The Expo'98 Case Study*, edited by C. Cavaco, FAUTL, 43rd International Conference MCL, Venice, 24-25 June, 2005.

Appendix

WORLD FOOD SECURITY INDEX

Country	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	Strategy	HICs
Algeria	58.9	62.5	56.7	58.1	58.5	58.3	57.9	54.9	52.7	47.8	50.5	1	0
Angola	43.7	45.5	43.8	42.4	40.6	39.2	42.4	43.3	41.9	41.9	42.9	0	0
Argentina	64.8	64.7	64.1	62.3	64.5	64	64.4	60	63.6	63.4	63.5	1	0
Australia	75.4	70.7	77	75.7	77.1	76.1	75.6	74.8	76.1	73.8	70.8	0	1
Austria	78.1	77.7	77.3	78.2	77.5	78	77.4	77.6	76	74	74.4	0	1
Azerbaijan	59.8	60.8	56.3	62.4	58.2	59	62.8	65.4	63.8	61.6	56.9	1	0
Bahrain	70.3	69.3	72	69.4	69.5	66.1	65.5	65.2	65.9	64.5	64.7	0	1
Bangladesh	54	53.6	53.8	54.8	56.5	57.1	54.2	52.9	53	51.9	47.1	1	0
Belarus	64.5	69.1	59.6	71.6	69.7	65.1	65.6	61.1	63.9	60.5	60.2	1	0
Belgium	77.5	74.5	78.5	75.8	77.2	77	75.5	76.2	74.6	73.9	73.6	0	1
Benin	48.1	46.6	47.6	46.4	46.4	46.7	45.5	44.7	41.3	39.8	39.2	1	0
Bolivia	65	64.7	65.2	65.6	65.4	65.4	64	62.5	59.7	59.1	52.8	1	0
Botswana	51.1	54.7	45.4	56.4	54.7	53	52.2	51.2	50.5	50.1	50.2	0	0
Brazil	65.1	66.2	62.1	71.8	73.6	69.9	70.2	68.5	66.9	66.5	63.8	0	0
Bulgaria	73	72.2	77.3	68.2	66.4	68.3	68.1	67.3	65.1	64.5	63.5	1	0
Burkina Faso	49.6	51.8	48.4	51.1	50.6	50	48.3	45.1	44.1	42.4	38.9	1	0
Burundi	40.6	39.3	39.3	39.4	32.8	42.4	41.9	43	41.9	41.1	42	1	0
Cambodia	55.7	55	58.7	56.2	58.9	56.1	55.1	54.2	51.4	47.1	44.3	1	0
Cameroon	46.4	48.4	45.4	47.4	48.1	46	46.3	47	43	42.1	43.6	0	0
Canada	79.1	79.5	80.6	77.8	76.1	74	72.6	71.1	72.5	72.8	72.1	1	1
Chad	43.2	42.4	43.7	43.9	42.3	42.4	41.6	41.1	38.6	33.2	35.5	1	0
Chile	74.2	74.4	74.3	75.7	75.4	73.6	69.6	69.5	71.6	69.6	68.3	1	1
China	74.2	70.6	78.1	73.4	71.6	70.4	70.7	69.8	67.9	66	60.5	1	0
Colombia	60.1	63	55.3	71	72	67.4	67	67.9	66.1	61.7	62.3	0	0
Congo (Dem. Rep.)	43	44.5	41.5	44.6	41.5	44.1	39.9	40.1	39.9	37.2	33.7	1	0
Costa Rica	77.4	77.7	78.5	74.9	76.7	74.5	74.7	74.2	74.4	74.5	71.7	1	0
Côte d'Ivoire	46.5	48.4	41.6	50.4	50.8	48.7	47.8	49.7	46.9	47.2	45	0	0
Czech Republic	77.7	76.6	77.6	79	77.4	79.4	78.9	74.5	73.5	71.3	72.3	1	1
Denmark	77.8	77.3	79.5	76.6	77.7	78.7	77.7	78.2	77.4	74.2	73.4	0	1
Dominican Rep.	65	64.8	64.6	65	65.6	64.3	64.7	62.1	60	58.8	59.5	1	0
Ecuador	65.6	64.9	65.9	66.2	66.4	64.1	62	61.2	61.8	59.4	59.4	1	0
Egypt	56	58.5	56.5	54.8	50.9	53.2	55.3	56.9	55.3	54.8	53.8	0	0
El Salvador	64.2	62.3	67.6	62.8	62.9	60.8	59.4	63.6	61.1	61.7	58.8	1	0
Ethiopia	44.5	42.7	47.3	45.8	46.5	48	43.9	44.5	46.1	41	38.7	0	0

Finland	83.7	82.7	83.1	83.6	83.8	84	83	80.7	78.3	78.2	78.4	1	1
France	80.2	78.3	82.4	77.9	78.4	78.6	76.9	77.5	77.2	76.3	76.8	1	1
Germany	77	77.3	75.7	78.5	78.2	79.1	78.5	77	76.2	74.8	73.4	0	1
Ghana	52.6	54.2	48.6	55.4	56.5	54	54.3	53.8	52.7	53.1	50.5	1	0
Greece	72.2	72.5	68.8	75.7	76.4	76.4	75.3	75.5	72.7	70.9	67.5	0	1
Guatemala	62.8	59.1	64.3	59.7	62	62.5	62.9	61	59.8	58.5	56.2	1	0
Guinea	45.1	46.4	44.8	44.5	44.1	43.7	42.7	45.3	43.7	38.6	35.8	1	0
Haiti	38.5	38.5	40.8	37.9	41.7	42.4	45.4	48.5	46.5	46	43.9	0	0
Honduras	61.5	62.3	61.3	62.1	61.8	59.8	58.8	58.4	56.9	56.9	54.1	1	0
Hungary	71.4	68.5	71.7	71	71.1	72.7	72.6	71.4	68.5	66.1	66.1	0	1
India	58.9	58.4	57.7	61.1	61.8	60.8	59.3	56.3	53.4	54	53.8	1	0
Indonesia	60.2	59.8	58.8	61.5	63.6	60	58.5	57.9	56.9	57.6	55.4	0	0
Ireland	81.7	81.6	81	82.7	82.4	81.6	80.7	78.5	78.2	78	76.9	1	1
Israel	74.8	73.1	76.7	73.5	74.1	71.9	71.6	71	68.6	68.1	67	0	1
Italy	74	74.1	72.9	74.6	74.2	74.8	74.2	74.5	74.2	70.3	71.5	0	1
Japan	79.5	79.5	78.9	79.7	79.8	78.5	77.8	77.2	77.3	77.6	75.4	1	1
Jordan	66.2	65.6	67.1	64.1	65.3	65.9	65.8	66.5	60.3	63.7	63.3	1	0
Kazakhstan	72.1	70.7	72.6	71.2	68.2	66	66.1	64.2	64.4	61.7	62.7	1	0
Kenya	53	52.6	54.1	53.4	50.7	51.2	49.1	49.7	49.6	47.6	43	1	0
Kuwait	65.2	68	62	68.7	68	64.7	63.1	64.5	67.2	66.7	65.7	1	1
Laos	53.1	49	53	52.3	54.4	53.5	51.8	51.4	47.2	47.8	44.1	1	0
Madagascar	40.6	43.3	39.4	37.6	38.4	39.1	39.5	40.2	40	40.4	39.4	0	0
Malawi	48.1	45.3	50	46.6	44.7	39.7	40.3	41.4	39.4	39.6	45.5	1	0
Malaysia	69.9	71.5	71.9	68.6	67.2	66.8	66.3	68.1	67	65.2	64.2	1	0
Mali	51.9	52	53	50.1	49.7	47.9	45.2	48.2	47.5	45.6	44.5	1	0
Mexico	69.1	70.9	67.8	68.8	65.6	68.2	65.4	63.4	64.6	61.4	61.8	1	0
Morocco	63	64.3	61.1	61.4	63.5	57.9	58.2	59.2	56	54.8	53.9	0	0
Mozambique	47.3	45.3	46.6	49.9	44.3	42	46.5	49.2	48.4	48.7	43.8	0	0
Myanmar	57.6	58.3	60.5	56.2	57.2	54	53	51.8	52.7	50.3	49.4	1	0
Nepal	56.9	55.1	57.8	56.5	56.8	54.1	52.4	51.5	50.3	47.9	45.8	1	0
Netherlands	80.1	79.9	80.7	80.9	80.7	76.6	76.2	76	76.2	76.7	73.4	1	1
New Zealand	77.8	77.4	77.7	77.6	77	78	77.2	75.7	76.2	74.2	72.6	0	1
Nicaragua	56.6	57.6	55.6	55.7	56.8	56.3	54.4	53.9	52.8	52.6	50.3	1	0
Niger	46.3	49.7	41.3	51.3	50.8	50.5	50.6	48	43.6	43.7	42.1	0	0
Nigeria	42	46.8	38.2	47.4	44.7	46.7	47.7	45.4	44.7	44.1	42.9	0	0
Norway	80.5	78.4	80.1	81.7	82.3	81.6	81.2	82	81.9	81.5	80.9	0	1
Oman	71.2	72.3	70.4	72.2	73.3	71.3	70.1	64.4	64.6	59.4	57.4	1	1
Pakistan	52.2	50	53	54.1	53.4	52.1	51.5	48.6	45.9	45.3	43.5	1	0
Panama	70	74.2	65.1	74.5	71.5	70.4	65.1	65.1	64.8	63.6	61.2	0	1
Paraguay	58.6	64.6	51.3	62	60.6	59.7	59.2	55.7	57.9	58.5	54	1	0

Peru	70.8	73.1	68.6	74.7	71.9	72.2	71.2	71.3	68.6	67	63.1	1	0
Philippines	59.3	59.6	58	59.7	59.3	57.5	57	55.5	54.4	53	52.1	0	0
Poland	75.5	75	76	75.5	73	73.2	72.9	71.5	72.3	71.3	68.5	0	1
Portugal	78.7	77	77.7	78.8	79.2	78.1	77.3	76.7	73.6	74.4	74.8	1	1
Qatar	72.4	74.6	70.8	73.8	73	73	72	72	72.8	70.1	69.9	1	1
Romania	68.8	69.3	65.9	70.5	69.2	70.9	68.7	67.7	66.6	64.5	63	0	1
Russia	69.1	71.7	67	70.9	70.9	67.8	61.1	63.8	63.7	64.6	63	1	0
Rwanda	50.6	44.6	52.7	47	42.4	41	44	46.9	44.9	42.1	45.9	1	0
Saudi Arabia	69.9	68.2	70.7	65	67.3	66.1	64.5	65.3	62.9	61	58.1	1	1
Senegal	51.2	50.8	51.5	50.4	50	47.3	48.6	49.7	46.6	44.4	42.5	1	0
Serbia	61.4	62	61.6	60.9	60.2	61.3	58.7	60.8	57.8	56.6	53.4	0	0
Sierra Leone	40.5	42.9	35.3	42.4	40.1	44.5	46.6	48	46.7	42.6	41.5	0	0
Singapore	73.1	72.8	71.5	74.7	72.4	70.2	70.8	72.1	72.3	70.1	68.4	1	1
Slovakia	71.1	71	72.4	70.3	69.9	74.7	74.2	73.6	68.7	66	64.2	0	1
South Africa	61.7	64.9	58.9	66.1	65.8	64.3	66.4	61.4	61.5	60.8	57.1	1	0
South Korea	70.2	68.9	70.3	69.2	68.4	68.1	68	66.4	66.4	65.1	63.1	0	1
Spain	75.7	76.6	74	77.2	78	77.1	77.4	76.8	74.4	75.1	74.9	0	1
Sri Lanka	55.2	55.5	53.1	59.7	57.4	60.1	58.4	55.2	54.2	55.5	52.9	1	0
Sudan	42.8	38.8	46.5	40.9	40.1	40.5	39.1	36.9	36.8	34.8	35.5	0	0
Sweden	79.1	77.7	78.9	80.4	80.9	80.4	78.7	77.5	75.2	75.8	75.7	1	1
Switzerland	78.2	78	78	77.8	78.5	74.8	74.2	73.4	74.3	72.8	73.2	1	1
Syria	36.3	36.2	34.1	45	39.9	38.3	40	41.7	42	42.4	46.8	0	0
Tajikistan	56.7	54.4	58.4	56	52.3	53	51.3	49.5	51.5	52	47.1	1	0
Tanzania	49.1	48.2	49.6	46.9	45.2	46.9	46.9	42.8	43.5	39.6	38.9	1	0
Thailand	60.1	62.1	58.8	62.4	61.7	60.7	59	57	57.9	57.4	55.5	0	0
Togo	46.2	48.5	43.3	48.2	47.8	47.3	42.7	47.1	46.2	43.3	42.7	1	0
Tunisia	60.3	60.4	61.3	59.2	59.1	60.4	57.2	56.3	55.6	54.9	56	0	0
Turkey	65.3	65.6	69.1	64.4	65.2	67.3	65	63.2	64.2	61.8	62.4	1	0
Uganda	47.7	47	47.7	48	44.7	47.8	47.8	49	47.5	43.1	41	0	0
Ukraine	57.9	60.6	58	55.5	52.4	54.5	49.5	53.1	56.8	54.3	55.8	0	0
United Arab Emirates	75.2	73.6	76.7	72.9	71.6	63.9	60.3	61.5	62.1	61.4	63.2	1	1
United Kingdom	78.8	79.3	78.8	78.4	76.9	77.7	77	76.5	73.9	74.9	71.6	1	1
United States	78	78.7	76.9	78.7	78.9	79.3	78.9	76.5	78.1	77.3	76.7	0	1
Uruguay	71.8	69.2	69.5	74.2	75.3	70.5	69.8	68.6	67	66.9	60.9	1	1
Uzbekistan	57.5	54.5	61.9	51.4	52.1	57.7	55	52.3	49.9	51.4	50.4	1	0
Venezuela	42.6	44	39.9	45.4	47.5	48.2	50.7	47.7	47.3	48.4	47.5	0	0
Vietnam	67.9	62.7	70.3	65.6	67.3	64	66.2	64.7	64.6	60.8	54.5	1	0
Yemen	40.1	39.8	40.3	38.1	38.9	39.4	43.3	46.2	41.2	42.5	40	0	0
Zambia	43.5	44.7	40.4	45.5	45.5	41.5	47.3	45.6	46	46.5	45.3	1	0

* "Strategy" refers to if the country has a food security strategy. 1 means yes, 0 means no.

* "HICs" refers to if the country is a high-income country. 1 means yes, 0 means no.