

Using a Multimethod Approach to Define an Urban Farming Network to Oporto Metropolitan Area

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Abstract: The multi-functionality inherent to the concept of Urban Agriculture (UA) can be associated with a recreational occupation, a method of overcoming financial distress, and a requalification of the landscape. However, urban development and the poor implementation of urban planning policies resulted in the loss of agricultural land and the emergence of residual and interstitial empty spaces within our cities. This article uses a case study of urban agriculture in Oporto City, as a guiding principle to recover and re-establish the continuous productive urban landscape. This paper expands on the currently existing urban planning policies. It establishes new ones, which strive for the protection and the insertion of the continuous productive urban landscape in urban design while regarding the urban/agricultural dichotomy and ensuring the occurrence of its processes, flows, and systems. This article defines urban agriculture as a method for the reliable integration of urban agriculture into urban space planning. The case draws on research in Oporto, focusing on the recovering of the ancient rural ring. This idea is based on recent and historical arguments to support the advantages of retrieving and introducing urban agriculture into open urban space. The paper concludes with a newly defined urban farming network in Oporto, which focuses on connecting these rural areas within the city with the rural areas outside the city.

Key-Words: allotment gardens; sustainable planning; urban agriculture; urban planning; urban ecological structure

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1 Introduction

Urban agriculture always existed. In fact, it was only when organized agriculture began to flourish that cities grew dramatically occupying those agricultural lands. Villas and orchards always punctuated the relation between the urban and the rural space. This harmonious relationship between the city and the countryside allowed the life of the rural landscape since the city acquired the assets that the rural landscape produced [1-5]. Thus, during the long period before the Industrial Era, the urban/rural relationship reflected a functional balance between

these two distinct worlds. However, after the Industrial Revolution, it was assessed an increase in population density in the peri-urban areas, the departure of the rural area, and the sharp increase of the edification in this area [6]. For that matter, the city started to grow into a land surface that until the Revolution Era undertook the specific functions of support the life of the city and, therefore, the economy started to rely on the urban spaces and the rural areas became dependent of those economies. Consequently, the divergence between the rural and the urban world ignited the loss of the

multifunctional landscape and the values and cultural principles. Accordingly, to Magalhães [7], it is essential to eradicate the disruption between these two spaces. Many authors agree [8-12] that the landscape must reflect the quality of both spaces and be planned together as one space. Besides, they all state that the landscape is a reflection of the testimonial land of its past, which means that it is crucial to consider it as one landscape. By reintroducing the rural areas into the urban space, we establish a relation between us and nature in a new reality, which enables the continuity of the rural space with the urban Man and creates the Global Landscape. This landscape aims to connect the passive and living elements, collapsing the segregation between the urban and rural. It also defends that the principles of the biological essence, the buildings, and the soil used should be equally distributed into the land, respecting the ecological aptitude and environmental capacity and always considering the existing landscape [8, 13-15].

Thus, Urban Agriculture and Allotment Gardens establish multifunctional spaces and are, in fact, a feasible option as a new urban function. That new function should be about food production and the valorization of urban components, such as services, green spaces, leisure areas, buildings, economy, and landscape.

To obtain a more significant understanding of the current condition and importance of quality of those areas with agricultural aptitude as agricultural and urban spaces, it is vital to consider an urban farming network that connects those spaces and qualifies their deliberate and suitable use as allotment gardens. Thereby this is a crucial option that allows the city to grow and, simultaneously, to hold its rural nature. Urban Agriculture is critical because it can structure the *Continuum naturale* responsible for ensuring the occurrence of the processes and flows of the several systems that constitute the landscape and connect all the absorbing rural areas of the cities with their inner center [11,16-20].

Drescher [21] points out that Urban Agriculture complements rural agriculture and can reduce pressure to cultivate new rural land, relieve stress on marginal rural lands, and contribute to the generation of income in the rural sector various and multiple interactions between the areas and their inhabitants.

Viljoen and Bohn's [22] states that "(...) urban agriculture could contribute positively to the

creation of sustainable cities, while not compromising the urbanity and sustainable benefits of a compact city". These ideas are precisely the primary purpose of this article: the development of the proposal of a new conceptual and designing approach that arises and results in the creation of a new continuous productive and leisure urban spaces network.

2 Urban agriculture - An Overview

Urban Agriculture (UA) has always existed. The agricultural practices have always been present in the city, not only in an ideological context but also in a functional one. Although the productive component was never lost, the leisure component only started to prevail stem from the Renaissance [23]. Matos and Baptista [24] underpinned that until the 20th century horticultural products were cultivated along the streams and rivers of the city. These former allotment gardens' spaces started to be occupied with highways, residential areas, and other urban infrastructures.

Migratory movements of the population coming from rural areas towards urban areas were accountable for the setting of allotment gardens that inhabit the void and interstitial spaces on the inner and urban fringe. Matos and Baptista [24] appoint that today there are small agriculture explorations in the interstitial spaces or of heavy use in suburban areas in our vast metropolitan areas (Lisbon and Oporto). In this context, Carvalho [25] pointed out that these spaces can undertake several urban functions, such as environmental, educational, touristic, and leisure functions, considering that the agricultural purposes are no longer reasonable to justify its presence.

Current urban models provide fewer interstitial and permeable spaces where urban agriculture could be practiced. Still, according to Gorgoewski et al. [26], it is essential to study alternatives such as rooftops, balconies, courtyards, and terraces as possible places for vegetable production and leisure areas.

Additionally, allotment gardens are increasingly acknowledged for providing essential benefits [27], at different levels:

- (i) Environmental (improves the natural environment, allows the water infiltration, the air renewal and recycles the organic waste);
- (ii) Economic (supplies the vegetable products and increases the family income);

(iii) Social (leisure, stimulates social coexistence and promotes social integration).

These spaces undertake a leading role for the welfare of the citizens, for human alimentation, for environmental awareness and urban ecosystems preservation. Furthermore, allotment gardens might perform pedagogical, cultural, and social purposes, which promote the work and income of the least privileged groups [28].

In Portugal, the first forms of urban agriculture emerged in Lisbon [29], due to the migratory flows in the 60s and 70s [30]. In the past decade, the implementation of urban allotment gardens has increased significantly [29] in cities like Lisbon, Oporto, and Guimarães. The program *Horta à Porta* is one of the most considerable. This program was created by LIPOR in 2013 and is currently formed by 15 allotment gardens in different Portuguese cities (Figures 1, 2, 3, and 4). The program's main goal was to create dynamic and useful green spaces, reinforcing the biodiversity and good agricultural practices through home composting, biological agriculture, contact with nature, life quality, and social responsibility.



Fig. 1: Allotment gardens in Guimarães city



Fig. 2: Allotment gardens in Oporto city



Fig. 3: Allotment gardens in Lisbon city



Fig. 4: Allotment gardens in Maia

In this regard, Pinto [27] indicates it is indispensable to hold and preserve these spaces because apart from allowing the contact with nature, allotment gardens ensure the presence of the natural and rural area in the city, as an instrument of nature's and biodiversity's presence, which has revealing essential to the human being.

3 Materials and Methods

Considering the primary purpose of the present research to develop an urban farming network highlighting the relation between urban and rural areas, aiming to recover and value the agricultural land that remains until today. The used methodology was divided into different but complementary phases. The first phase was based on a bibliographical review of theoretical studies regarding the subjects we intend to develop. Thereby, we studied the persistence of agricultural land in urban space throughout history, the different forms and uses that urban agriculture can take, and also the urban planning policies that exist today and new ones that can be defined to protect and value even more those spaces.

The second phase considered a multi-temporal analysis of the case study, Oporto City. This study encompassed several categories, such as lithology, land use, hydrography, road system, constraints, and agricultural aptitude. These categories provide

progressively detailed information about the city, especially about the agrarian land and existing urban allotments. This analysis led to a substantial characterization of Oporto City and an evaluation of agricultural land throughout the last decades. Thus, we were able to highlight the changes in agricultural land throughout history and to analyze and provide new urban productive spaces, increasing the number of areas used to establish allotment gardens. The third phase considered the conduction of a survey to 100 gardeners, whose primary purpose was to gather a general evaluation of urban agriculture and define the current urban gardener profile. The survey was established in two distinct groups. The first group intended to characterize the gardener (age, professional status, and family household). The second group was about the allotment farmer, crops, and the relation between the gardener and the allotment.

These three distinct phases we intended to define an urban farming network, in compliance with general urban sustainability parameters, reflecting the needs of the urban population and describing new typologies and guidelines that these urban productive spaces should follow and enforce.

This qualitative analysis enables a better understanding of the dynamics between the urban and rural spaces. Thus, we considered that urban growth is inevitable and that it is essential to establish sustainable measures to counteract this relation and deploy the urban farming spaces, not only to hold the genius loci and protect those spaces but also to create multifunctional green spaces.

3.1 Continuous Productive Urban Landscape (CPUL's) and the Urban Ecological Structure as a Contribution for the Urban Farming Network

The concept of CPUL's (Continuous Productive Urban Landscape) was previously defined. As mentioned, this concept was introduced by Viljoen in 2005 [31], and it refers to the creation of a network of multifunctional open spaces that include urban agriculture. Oporto's urban farming network was based on the Continuous Productive Urban Landscape. It combines and allows the alliance of a productive landscape with space for leisure and recreational activities, ensuring on a Continuous Green Landscape *Continuum naturale*). To connect these productive landscapes, we defined green routes that allow access to pedestrians and bicycles. Besides, CPUL's is the ultimate solution to connect

the rurality within the city and connect it to its periphery. It also enables the city to keep the rural as its heritage, legacy, and identity, inducting agricultural fields into the contemporary city.

The Ecological Structure is essential to merge the urban space to rural space [32]. Therefore, it is crucial to define an instrument that allows the insertion of Continuity, combining the city with the countryside [6]. Viljoen [31] characterizes this concept as a green, natural and topographical, low, slow and socially active, tactile, seasonal and healthy and, adds that any open urban space, communal or private, inner-city or suburban, small or big would benefit from the introduction and definition of CPUL's. Viljoen and Bohn [22] state that the CPUL's provide strategies capable of giving spatial coherence to the infrastructural and qualitative aspects of urban agriculture. Nevertheless, to translate this concept into practice will require further work; hence Viljoen and Bohn [22] propose now to rethink and to redesign better spaces for urban food systems.

3.2. Urban Agriculture in Urban Planning Policies

Considering that allotment gardens represent a structuring component of the urban area and urban green spaces, these should necessarily be considered when we devise urban planning policies. Hence, the integration of the agricultural regions on the urban planning model composes a new urban space function. In this sense, it is proposed that agriculture be considered a spaces category, with areas and distinct and well-defined occupation and protection rules. Furthermore, it is essential to evaluate the existing functions and values, particularly on soils with high agricultural aptitude [33].

Therefore, urban policies must promote the enforcement of agriculture to promote sustainable development. This measure would allow the introduction of urban agriculture on the urban planning instruments through the following procedures:

- (i) Review of the actual urban zoning and the inclusion of the urban farmers on the zoning plans;
- (ii) The agricultural, urban periphery can and must be included in the city's land-use plan;
- (iii) The central area within the city can and must be reserved;
- (iv) Promotion of urban agriculture as a timeless use of community and private land;

- (v) Development of multifunctional use of the land and encouragement of the community on the management of urban open space;
- (vi) The insertion of space to urban farmers or community gardens in new housing public projects and private systems construction.

It also proposed urban agriculture's addition to education and communal development and the introduction of urban agriculture in urban regeneration projects [34]. Although the spaces intended for urban agriculture's practice will not be sustainable in inadequate spaces. In this context, the municipal policies must define guidelines to ease access to capable land to produce horticultural products [35]. In fact, the protection of agricultural land is already present in countless urban planning instruments. However, it hasn't been possible to avoid the sustained destruction by the arising undertakings.

To counteract this fact, it is suggested that the urban sprawl supports a severe and responsible soil policy, which invalidates the destruction of agricultural land, creating and incorporating the rural area [36]. As an example, figures 5 and 6 shows Oporto's Urban Ecological Structure and Lisbon Green Plan.

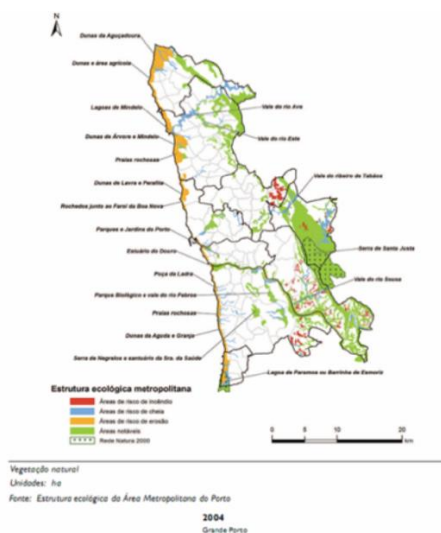


Fig. 5: Oporto's Urban Ecological Structure
 Source: [37].



Fig. 6: Lisbon's Green Plan
 Source: Lisbon's City Hall. Source: [38].

4 The Study Area: Oporto Metropolitan Area

The Oporto City is the central municipality of the Oporto Metropolitan Area. It is located on the north bank of the Douro River and this metropolitan area as approximately 41.2 km² and 237 591 inhabitants (Figure 7).

In the 19th century, Oporto city was a city entirely overpowered by rural life. The agricultural fields and rural areas were scattered across the entire city. In this context, all the current parishes of the urban space comprise full extensions of an agricultural holding, feeding the whole city [39]. Yet, in the same century, the construction of railways and industrial units on those agricultural lands contributed to the urban sprawl. By the end of the 19th century, the city felt the effects of industrialization, such as the presence of industrial units, which allowed easy access to the remote areas of the urban space. As a result, the fierce dynamic that highlighted the city during that period reflected on the green structure, at the expense of the destruction of the agricultural and rural land [40].



Fig. 7: Oporto's municipality location
 Source: [41].

Therefore, the vulnerability of agricultural spaces and the lack of interest of urban planning in the 19th century for its integration or readjust new typologies of urban green space were the leading causes of the destruction of the rural structure of the Oporto municipality. The preservation of these agricultural lands did not constitute a priority in the planning of green spaces. These were progressively destroyed [42].

Thus, the single patch that endured until today is the agricultural lands in Campanhã. Its preservation results from the reflex of the particularities of the eastern side of Oporto, such as its steeped topography and the north-south crossing of the massive railway and highway infrastructures. It is essential to mention the agricultural spaces in the outer ring of the Via de Cintura Interna (VCI). The Oporto's municipality has the most significant number of inhabitants within the Oporto Metropolitan Area, with 6 337,4 inhabitants/km.

The analysis of the population's age structure is crucial to define where to establish allotment gardens devoted to food production and allotment gardens designed for recreational and pedagogical activities. Parishes located on the Eastern side of the city (*Paranhos, Campanhã, Ramalde, Cedofeita, and Bonfim*) present a higher number of elderly and unemployed. Therefore, the allotment gardens for food production must be primarily located on these parishes. These allotments must have bigger

production allotments and little markets where the urban farmers could sell their horticultural products.

The western side of Oporto (*Aldoar, Nevogilde, Foz do Douro, Lordelo do Ouro and Massarelos*) presents a lower rate of elderly and unemployed allotment gardens proposed for this area must be designed for recreational and leisure activities.

Nevertheless, this analysis aims only to define a few guidelines, and it is not restrictive. Hence, these guidelines enable only the creation and definition of these spaces accordingly with the population's needs, but a mix of these allotment gardens typologies that can and should be encouraged.

Concerning lithology, the Oporto city is composed mainly of Cambisol soil, which exhibits a high agricultural aptitude [43]. This soil type is very fertile and is ideal for agricultural use. Therefore, the Oporto metropolitan area, especially the Oporto city, is a territory that could be used more for agrarian purposes, if it wasn't for the strong presence of the urban sprawl [43].

The changes in land use from 2000 until today show a high level of expansion in urban built-up areas. In 2000, the Oporto metropolitan area was occupied by 22% built-up areas, 48% for forest land, and 30% agricultural land use.

The Oporto city is located exclusively on urban soil. Therefore, the land-use map is divided into two categories – the urban land and Ecological Urban Structure. As Oporto's city does not present agricultural land, the spaces dedicated to urban agriculture are included on the Ecological Urban Structure, which is divided in:

- (i) Public green areas: include public parks, squares, and green urban parks;
- (ii) Mixed green areas: include agricultural and forest land and woodlands which can enclose collective equipment and infrastructure to support recreational and leisure activities related to nature and national heritage;
- (iii) Private Green areas: include buildings, gardens, patios, and villas, which, despite not being public spaces, are considered relevant to the city's image and promote urban environmental quality;
- (iv) Other green areas: spaces dedicated to serving as physical and visual protection, located alongside the circulation corridor.

The analysis of the built-up areas allows concluding that the planning and development of these spaces do not correspond to the number of families and

enterprises existing in the city. Hence, the space reserved for housing development is superior and exceeds the population's necessities [43]. On the contrary, the agricultural land included in Mixed Green Areas represents only 0,92 km² of the land surface in Oporto city's, which is a little value considering the high population.

The Oporto metropolitan area is constituted by five watersheds: Douro (864,3 km²), Ave (297,2 km²), Leça (278 km²), Vouga (83 km²) and Cávado (52,3 km²). However, the Oporto city only presents two watersheds: Leça and Douro. Both are extremely important for the urban hydrologic system and are undoubtedly the most important rivers within the city [43]. The persistence of agricultural land within urban areas is justified by the ancestral preservation of the riparian edges for agricultural use. Nevertheless, the decrease of the agrarian spaces is related to the urban sprawl, highlighting the territory's shattered and scattered character [40]. Oporto's city presents yet various streams scattered along with all the urban areas, which were essential to establish the urban farming network. However, these spaces are extremely unbundled due to the intense urban sprawl and residential endeavors and educational and clinical equipment.

Nevertheless, the agricultural patches located in Campanhã and Contumil withstand as the rural structure of Oporto's city. In this sense, even though it remained some agricultural land in the city, these present itself as unqualified and, at times, as vacant land. Therefore, it is most likely for these agricultural areas to disappear. This depletion is a natural process for its urban development, and it is increasingly natural for the agriculture lands to occupy the peripheral lands progressively, spreading to the metropolitan area [42].

By contrast, it has become essential for the Oporto municipality to value the green spaces associated with the edification since it enables the existence of courtyards and little allotments, which are an advantage for the Oporto's green infrastructure that is important to uphold and protect. In this regard, the definition and implementation of an urban farming network are fundamental since the planning of these spaces can prevent the consisting destruction of the diverse agricultural patches still existing and their replacement for new urban enterprises.

From the 100 gardeners inquired during the survey, we can accomplish the gardener profile and characterize their respective allotment. The average

age of the gardeners is 62 years old, and most gardeners are retired and have a household of two elements on average. Although everyone profit from these spaces, we can emphasize the elderly and disadvantaged families. Those groups embrace those spaces; hence the allotment gardens allow them to produce healthier and cheaper products while promotes social interaction and leisure activities. We also conclude that the areas dedicated must do UA to be the closest possible to the gardener's residence to increase the number of interested gardeners. When this is not possible, those areas must be close to public transportation lines to allow them access to those spaces. The inquired gardener also appointed the integration of the allotment gardens in green spaces and spaces with particular areas for children. The gardener also named the need to practice biological agriculture and monitor gardeners and proximity relationships.

4.1 Oporto Urban Farming Network

The definition of this network intends to absorb and induct the UA in the community and urban space, retrieving the rural areas that have disappeared due to the urban sprawl. In this sense, we purport that urban allotments revert to comprise a productive grid inserted in the urban space along with the city. To accomplish that purpose, we intend to recover the vacant lands with the agricultural aptitude (Figure 8) and add the allotment gardens in green public spaces, which would uphold its consistency throughout the city.



Fig. 8: Soils with agricultural and forest aptitude in Oporto

It is possible to notice that the areas with agriculture aptitude prevail above the VCI, with occasional spaces within. These spaces are centered in Campanhã Valley and west of Oporto's city. This agricultural land used to embed and comprise the former rural ring of the city. Currently and, regardless of its agricultural aptitude, those spaces are susceptible to fierce speculative processes.

On the other hand, the spaces located in Contumil are featured by its heightened disqualification. This is an abandoned rural area, waiting to be embraced and deployed by the urban tissue. In fact, it has become increasingly essential to structure and articulate an urban farming network that qualifies the scarce spaces which protect its agricultural value, enforcing a green agrarian system in the city.

Besides, it is suggested that this urban farming network coordinates with different local markets. This measure enables to assist of the unemployed and retiree's economies. In this context, the urban farmers produce their own food, selling it in local markets and supplying it to a restaurant and hotel chain. It can be build up as well as several sale points and markets in the allotment gardens to sell the produced seasonal products.

The definition of an urban farming network allowed establishing a connection between this and the different accessibility lines imposed by public transportation. This measurement was considered essential since a large number of people with advanced age draw on these spaces and the public transportation network provided by the Oporto city to dislocate within the city. In the survey, some inquired enhanced the importance of the new UA spaces being implemented in the proximity of bus stop stations. Nevertheless, it was considered essential to offer other options for the urban farmers and users of those places. It is proposed the definition of bicycle paths and pedestrian routes that interconnect the different allotment gardens.

It is also vital to establish a continuity of UA spaces within Oporto city and the remaining municipalities of the Oporto metropolitan area. This measure must be supported and administered by the several municipal councils and by the entities responsible for the management and maintenance of allotment gardens.

The proposed urban farming network promotes the rehabilitation and recovery of void spaces with high agricultural aptitude. This is an essential measure since It uses the natural resources of those spaces, increases the total of green areas in the city, and improves the ecological footprint by depressing the transportation costs inherent to the agricultural production corroborated with the ideas presented by Gomes [44]. Besides, the application of this measure reduces noise, increases the infiltration of water in the soil and improves the image of the city and the

contact with nature, enhancing the biodiversity in the urban space [45].

To counteract the high density of buildings that exists in the urban center, it is suggested the deployment of allotment gardens on the top of buildings. This initiative consists of a cultivable bed with an incorporated irrigation system with little maintenance, which allows planting a variety of vegetables, fruits, and aromatic herbs. This initiative aims to contribute to a socially aware and self-contained, providing the necessary tools to act reordering the urban landscape, the relationship with food, and life in a community. This measure would be enforced on rooftops of municipal buildings, such as Trindade's subway and the buildings in the Oporto Business Area.

Figure 9 represents a diagram where the proposed urban farming network is combined with a few allotment gardens already existent, establishing connections between both networks. Due to the high demand of this green spaces typology it is essential the increase them and to promote an equitable distribution within all the urban space.



Fig. 9: Representative diagram of different typologies of allotment gardens

By overlapping the urban farming network (Figure 10) with the constraints plant, it was possible to notice that various spaces with agricultural aptitude are located in the vast areas of UOPG's. Therefore, some might be adapted and used for the enforcement of the urban farming network.



Fig. 10: Urban farming in Oporto

The definition of this urban farming network represents a fundamental strategy for the deployment of an articulated system of green agricultural areas, connecting the countless patches of rustic spaces, owned to the former rural ring and dispersed along with the city, enhancing and characterizing the public urban space. It is essential to mention that through this intervening methodology, we can merge the dichotomy between the rural and urban areas, recovering the countryside that gave rise to the city. Thus, the landscape can be seen as a global system.

5 Conclusions

The conversion of the agricultural landscape into the urban landscape had a few repercussions in the territorial planning and the management of the available natural resources and, therefore, ignited significant changes and restrained the environmental qualification and nature's reintegration in the urban environment [46]. Hence, the rural ring that overcame the urban periphery of Oporto's city in 1982 is currently narrower due to the extension of buildings and the disclosure of urbanization on the main axial development paths of the city [40]. Contextually, the disposal of the municipality's rural structure was the result of the planning processes, which did not include any clause regarding the agricultural lands in its spaces. Thus, land with agricultural aptitude had to be eliminated because it was planned for countless urban interventions, which do not include the definition and structure of green areas. However, numerous spaces with agricultural aptitude are located in areas called planning units. It is foreseen the definition of green spaces, due to its location in spaces with agricultural aptitude planning strategies and urban development.

For this reason, the remaining spaces with agricultural aptitude that exist today are disqualified, abandoned, and might disappear if we do not create measures and requalification strategies in the urban planning which strive for its preservation. The presence of agriculture in the urban environment, associated with elements and natural values in the city, is already recognized as an essential condition for the restoration of the balance that had been lost with the urban development in the Industrial Era and the environmental qualification of the territory.

In a few situations, the introduction and reinforcement of the agricultural spaces reveal fundamental since it enables the reintroduction of the rural area in the urban space. Agriculture as an

activity emerges as an interaction between the rural culture and the improvement of public services in terms of better living conditions in Oporto's city [46].

Through the UA is embraced and introduced the *continuum naturale* in urban space. This would be formed by the space surrounding housing blocks and the ensemble agricultural and forest spaces. Thus, urban areas' planning may be the instrument and key to the reintegration of the natural space into the urban space.

The main purpose of this article was to define an urban farming network and, to accomplish that it was identified the favorable spaces for the development of this activity, based on its agricultural aptitude, natural values, and land-use. In this sense, it was intended to gather those spaces in a continuous network, including the dense urban center, which proposed the definition of allotment gardens on rooftops. It was verified a higher concentration of agricultural spaces in the eastern part of the city (Campanhã), mainly due to its steep topography and to the north-south crossing of heavy highway and railway infrastructures.

It was intended to enforce a continuous productive network and Oporto's municipality but simultaneously contribute to food security, the reduction of ecological footprint, and environmental education. To fulfill these purposes, it is suggested that the urban space design inducts the UA in the existing and proposed green areas. However, due to the lack of legislation and measures that protect the agricultural soil and encloses the agricultural activity in the urban tissue, it is suggested that the current law be questioned and be defined as a new space class, integrated into the Urban Ecological Structure. The inclusion of UA in urban policies allows the urban farmers to have more excellent safety, comparatively to their lands, and the improvement of UA spaces' characteristics and to the placement of a more significant number of allotments. By contrast, the introduction of UA in urban planning policies is not enough to preserve the soils with agricultural value in the urban space. Hence, it is suggested that those regulations acknowledge the allotment's gardens value as a multifunctional space.

It is expected with the definition of this urban farming network warns to its natural purpose and contributes to the management of voids spaces and the increase and strengthening of the Urban

Ecological Structure. It is also suggested that the CPUL's concept be enforced, through the promotion of green corridors, bicycle paths, and pedestrian paths, connecting the diverse UA spaces along the city.

As a suggestion of future developments, it is proposed the revalorization of the existing allotment gardens and the establishment of mechanisms which prevent the systematic disposal of the agricultural spaces (Figure 11).

This urban farming network represents an essential step for the valorization of the existing allotment gardens. It enables the urban population to have access to those areas according to their needs, implanting the rural world where it is increasingly scarce.



Fig. 11: Representative sketches of urban allotment gardens inserted in the urban farming network

6 Study Limitations and Further Research Lines

Even if this study expands our knowledge on the urban agriculture, productive urban landscapes, and specificities of land-use changes in the urban territories, as is the specific case of the Oporto metropolitan area, essential prospects for future research remains.

It is a fact that urban policies (including the land-use policies) are often changing in the territories [47-50], pointing the need for close monitoring and also new investigations over the trends and dynamics of the land-use changes, along with the management of these sustainable urban development approaches.

Yet, the conducted study provided us essential aspects of the land-use changes, urban agriculture, and productive urban landscapes, in the specific case of Oporto city, if more surveys and variables were conducted and selected, it would produce us more, comprehensive conclusions. In this sense, if advanced statistics – i.e., Chi-Square or t-test – were used, the results could be even more reliable. Moreover, the authors' opinions this type of research should be performed and extrapolated to other case studies.

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