Catarina de Sousa Silva

Environmental justice:
Accessibility of urban public green spaces in two European cities

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Orientadores:

Prof. Doutor Thomas Panagopoulos

Faculdade de Ciências e Tecnologia - Universidade do Algarve

Prof. Doutor Simon Bell

Institute of Agricultural and Environmental Sciences - Estonian University of Life Sciences

UAlg FCT
UNIVERSIDADE DO ALGARVE
FACULDADE DE CIÊNCIAS E TECNOLOGIA

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"Declado ser a autora deste trabalho, que é original e inédito. Autores e trabalhos consultados estão devidamente citados no texto e constam da listagem de referência incluída."

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Abstract: Although it is unanimous that urban green infrastructure is essential to increase the population's wellbeing, in many developed countries the availability of green spaces is limited or its distribution around the city is uneven. Also, the availability of public green spaces may be directly related with the geographical location of the city. In Europe, Northern and Central European countries tend to have higher amount of public green spaces compared with the Mediterranean countries. It is also recognized that the distribution of public green spaces is related to the location of social classes. This means that some minorities in society, such as the elderly or ethnic minorities, have less access or are deprived of access to green spaces compared to the rest of the population. In addition, the current planning for urban regeneration and renewal of degraded areas, including slums or ghettos redevelopment, creating new high quality recreational public green spaces, result sometimes in projects that enhance the paradox of green gentrification. Aim of this study is to present evidence about *environmental justice in the distribution of the public green spaces in both Tartu, Estonia and Faro, Portugal*. Quantitative indicators of public green spaces were calculated in each city districts. The accessibility of those spaces was measured using the "walkability" distance and grid methods. The results revealed that there were more availability and accessibility of public green spaces in Tartu than in Faro. Even so, in Tartu there were inequalities between the soviet-era housing block districts, where the majority of Russian inhabitants live, and the rest. Roma communities in Faro were located in districts without access to public green spaces. Availability of public green spaces was varying from 1.22 to 31.44m^2/inhabitant in districts of Faro and 1.04 to 164.07m^2/inhabitant in districts of Tartu. In both cities 45% of the inhabitants had accessible public green spaces within 500m from the residence, meanwhile after the development of the proposed new green infrastructure will be 68% for the city of Faro and 86% for Tartu.

Key words: Accessibility; Green infrastructure (GI), Public green spaces (PGS); Environmental justice; Green gentrification; Soviet-era housing blocks; Tartu; Faro.

Resumo: A infraestrutura verde urbana é uma rede de espaços verdes, que inclui parques, jardins ou avenidas arborizadas, estrategicamente planeada de modo a promover a continuidade dos fluxos ecológicos na cidade e, por isso, proteger a fragmentação dos habitats e promover a biodiversidade (European Commission, 2013). Por outro lado, esta infraestrutura tem associados diversos serviços ecossistémicos que asseguram a qualidade de vida das populações urbanas.

Incluído nos serviços ecossistémicos pode estar a regulação da temperatura do ar e da água e a melhoria da sua qualidade; o fornecimento de recursos de origem vegetal ou animal, por exemplo, alimentos, madeira, algodão ou lã; entre outros. Para além disso, a presença de espaços verdes nas cidades tem contribuído para o aumento da prática de exercício ao ar livre assim como da melhoria da saúde pública e do aumento da socialização entre indivíduos da mesma comunidade (e.g. Maas, Verheij, Groenewegen, Vries, & Spreeuwenberg, 2006; Gill et al., 2008; Hartig et al., 2010; Dai, 2011).

Apesar de ser evidente que a relação entre os espaços verdes e o meio urbano é essencial para o aumento da qualidade de vida das populações (Panagopoulos et al., 2016), observa-se que, ainda em muitos países desenvolvidos, a disponibilidade destes espaços verdes é reduzida ou, por outro lado, a sua distribuição ao longo da cidade é desigual. Alguns autores (Fuller & Gaston, 2009; Kabisch, Strohbach, Haase, & Kronenberg, 2016) afirmam que a disponibilidade de espaços verdes na cidade pode estar diretamente relacionada com a localização geográfica da cidade, por exemplo, no caso da Europa, consideram que os países nórdicos têm tendência a ter maior área de espaços verdes na cidade em comparação com os países localizados ao logo do mediterrâneo. Ou ainda, afirmam que a distribuição dos espaços verdes na cidade está relacionada de acordo com a localização das classes sociais (Park & Kwan, 2017). Isto significa que algumas minorias da sociedade, como por exemplo idosos ou minorias étnicas, têm menor acesso ou são desprovidas de acesso aos espaços verdes em comparação com a restante população (Hoffimann, Barros, & Ribeiro, 2017).

A falta de acessibilidade aos espaços verdes urbanos em algumas zonas da cidade ou por parte de alguns grupos da população é, nos dias de hoje, um problema de justiça ambiental. Por essa razão, têm sido desenvolvidos projetos que visam, por um lado, aumentar o número de espaços verdes na cidade e, por outro lado, reabilitar os bairros degradadas ou *ghettos,* com vista a melhorar a qualidade de vida das populações que habitam nessas áreas. A implantação destes projetos é, usualmente, bem-sucedida quando o projeto é desenhado segundo duas condições:

(1) são tidas em consideração as necessidades dos habitantes destas áreas degradadas e (2) é feita uma integração do projeto na infraestrutura verde existente. Por outro lado, quando uma destas duas condições não é integrada no projeto, as intervenções tornam-se paradoxais e resultam no fenómeno de eco-gentrificação (Wolch, Byrneb, & Newell, 2014). Isto significa que, os novos espaços verdes de alta qualidade, que deveriam colmatar a desigualdade que se fazia sentir nesses bairros degradadas da cidade, tornam-se pontos de atração para as classes sociais com melhores rendimentos e maior poder de compra. A procura por alojamento perto destes novos espaços de recreio potencia a requalificação das habitações originais ou construção de novas e, por isso, num aumento do custo das mesmas, fazendo com que os moradores tenham de ser realojados em áreas mais pobres da cidade onde possam sustentar a renda das casas (Bentley, Baker, & Mason, 2012; Wolch et al., 2014). A eco-gentrificação é, no entanto, um fenómeno difícil de ser estudado, uma vez que apenas é visível a médio ou longo prazo e relaciona-se diretamente com o grau de justiça ambiental que existe numa determinada cidade.
A presente dissertação tem como objetivo responder à seguinte questão: *Existe justiça ambiental na distribuição dos espaços verdes em Tartu (Estónia) e Faro (Portugal)?* Achou-se pertinente estudar estas duas cidades, em primeiro lugar, devido à sua oposição geográfica, uma vez que Tartu localiza-se no Norte da Europa e Faro localiza-se no Sul deste continente, de forma a perceber se a afirmação que Fuller & Gaston (2009) e Kabisch et al. (2016) fazem quanto à influência da posição geográfica na disponibilidade de espaços verdes se verifica neste caso. Apesar desta característica oposta, as duas cidades apresentam algumas semelhanças relativamente à área, ao número de habitantes e às dinâmicas socioculturais.

Para além desta questão fundamental, este estudo tem ainda como objetivo responder a outros três pontos mais específicos: (1) Identificar quais os bairros com menor e maior acesso aos espaços verdes públicos em Tartu e em Faro e estudar a relação entre a distribuição dos diferentes grupos étnicos e o tempo de construção dos edifícios, com este indicador; (2) Analisar temporalmente a disponibilidade e acessibilidade aos espaços verdes públicos em ambas as cidades, ou seja, comparando a infraestrutura verde existente e a futura; (3) Identificar áreas onde possa ocorrer eco-gentrificação.

Para responder a estas questões, em primeiro lugar, as duas cidades foram divididas em bairros e foi estudada a evolução urbana. Em Tartu foi ainda possível identificar a nacionalidade dos residentes em cada bairro da cidade. No caso de Faro, não foi possível ter acesso a estes dados,

no entanto, foram assinalados alguns dos principais locais da cidade onde se localizam minorias étnicas, nomeadamente de etnia cigana.

De seguida foi calculado, um indicador quantitativo, traduzido pela área de espaços verdes urbanos na cidade, por habitante e por bairro da cidade, como sugerido por (Dai, 2011). Posteriormente, foi medida a acessibilidade aos espaços verdes da cidade utilizando o método "walkability distance" que usa "buffers" de 300 metros (cerca de 4 minutos a caminhar) e 500m (cerca de 7 minutos a caminhar) para assinalar as áreas que têm acesso aos espaços verdes públicos. Por fim, foi desenvolvido o método da quadrícula (Kabisch et al., 2016) que relaciona a área acessível aos espaços verdes públicos urbanos com a densidade populacional em cada bairro da cidade. Para isto, a cidade foi intersetada com uma quadrícula de 1 hectare.

Os resultados obtidos sugerem que existe maior acesso aos espaços verdes públicos em Tartu do que em Faro, como seria de prever relativamente à posição geográfica de ambas as cidades. Ainda assim, na cidade de Tartu, é possível observar uma pequena diferença entre o acesso aos espaços verdes públicos nos bairros que foram desenvolvidos durante o regime soviético e onde, ainda se concentram a maioria dos habitantes de nacionalidade russa, em comparação com os outros bairros da cidade que apresentam uma tipologia distinta. No caso de Faro, as minorias étnicas localizam-se em áreas da cidade sem acesso aos espaços verdes públicos. Para além disso, é previsível que ocorra eco-gentrificação numa dessas comunidades, uma vez que está planeado a implementação de um projeto de regeneração urbana de elevadas dimensões para a área.

A presente dissertação inclui ainda uma breve proposta para a cidade de Faro que visa melhorar a qualidade da infraestrutura verde da cidade e, por sua vez, aumentar a área acessível aos espaços verdes públicos da cidade.

Palavras-chave: Acessibilidade; Infraestrutura verde, Espaços verdes públicos; Justiça ambiental; Eco-gentrificação; Habitações soviéticas; Tartu; Faro.

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1. Introduction

Urban green infrastructure, which includes parks, community gardens, forests or corridors along waterways is responsible for important connections between communities and nature. These areas provide numerous ecosystem services and have contributed to increase the physical activities, the improvement of health and socialization of the community residents (e.g. Maas et al., 2006; Gill et al., 2008; Hartig et al., 2010; Dai, 2011).

Although it is unanimous that the relationship between green spaces and urban environment is essential to increase the population's wellbeing (Panagopoulos et al., 2016) , in many developed countries, the availability of these green spaces is limited or its distribution around the city is uneven. Some authors (Fuller & Gaston, 2009; Kabisch et al., 2016) argue that the availability of green spaces in the city may be directly related with the geographical location of the city. In Europe, Northern and Central countries tend to have higher amount of public green spaces area compared with Mediterranean countries. Furthermore, it is also recognized that public green spaces are distributed according to the location of social classes (Park & Kwan, 2017). This means that sections of the society with socioeconomic deprivation, such as the elderly or ethnic minorities, have also less access or are deprived of access of green spaces compared to the rest of the population (Hoffimann et al., 2017).

The low accessibility of urban green spaces in some areas of the city or by some groups of the population is, nowadays, a problem of environmental justice. For this reason, many projects have been developed with two main aims: on the one hand, to increase the number of green spaces in the city; on the other hand, to rehabilitate the degraded neighbourhoods or ghettos, in order to improve the population's wellbeing in those areas. The implementation of those projects is usually successful when the project is designed according two conditions: (1) the needs of the inhabitants are taken into account and (2) the project is integrated into the existing green infrastructure. When one of these two conditions is not integrated into the project, paradoxical interventions lead to the phenomenon of green gentrification. This means that the new high-quality public green spaces, which should mitigate the inequality in those poor neighbourhoods of the city, become attractions for social classes with better incomes and greater purchasing power. The search for accommodation near to these new recreational spaces enhances the requalification of the original dwellings or the construction of new ones and, therefore, their cost increases. The original residents have to be relocated in poorer areas of the

city where they can support the income of the houses. Green gentrification is, however, a difficult phenomenon to study since it is only visible in the medium or long term. In addition, only a few research have studied the same phenomenon in European cities.

Against this background, the aim of this dissertation is to answer the following general research question: *Is there environmental justice in the distribution of public green spaces in both Tartu and Faro?*

Much research about the inequalities of post-soviet union has specifically focused on the quality of buildings dismissively the accessibility of public green spaces. Estonia is an interesting case study to fill this literature lack. Also, there are two reasons why it is relevant to study this country. In the first place, because Estonia is one of the most green countries in Europe, for example, Tallinn has $90m^2$ of public green space per habitant ('Tallinn - Facts and Figures', 2016), and so, would be expected no accessibility problems in the access of public green infrastructure. In the second place, there are obvious differences between green infrastructure in soviet-era housing blocks districts and districts developed before and after that period.

Following the argument that the availability of green spaces is influenced by the geographical location of the city, I found relevant to compare the accessibility of public green spaces between Tartu, a Nordic European city and Faro, a Mediterranean European city. Faro seems to be an interesting case once it is one of the Portuguese cities with less green spaces per inhabitant, about $6m^2$ per habitant. In short, there are two pertinent reasons for comparing the accessibility of public green spaces in Tartu and Faro. On the one hand, both cities are similar in terms of size, population and social and cultural dynamics, on the other hand, they very distinct geographically, climatologically and morphologically.

The results suggest that the availability and accessibility of public green spaces in Tartu is clearly higher than in Faro. Even so, in Tartu there are inequalities between the soviet-era districts, where the majority of Russian inhabitants live, and the rest. In Faro, the ethnic minorities, especially Roma communities, are located in districts generally without access of public green spaces. In addition, it is predicted that the implementation of a high-level urban regeneration project may be responsible for the phenomenon of green gentrification in those communities.

This dissertation is organized in seven chapters each one divided in specific subchapters. The literature review approaches the most important concepts that support this research, including the concept of green infrastructure, environmental justice and green gentrification. The chapter three introduce general and specific objectives of this dissertation. The methods of research includes a description of the study areas and describes the three quantitative methods used in this study. This chapter also refer all the data used and its sources and includes a general urban green infrastructure proposal for Faro. The fifth chapter analyses and interprets all the obtained results using the defined methodology. This chapter also includes a brief reflection on possible occurrence of green gentrification phenomenon. In the discussion, I made a critical analyse between the results obtained in both cities, referring the contributions of this study to the literature and indicating some of its limitations, which identify some possibilities for future research. Finally, a last chapter concludes the dissertation by reflecting on its main findings.

2. **Literature review**

This chapter reviews the concepts of green infrastructure and ecosystem services; the concept of environmental justice and the relation with the accessibility of public urban green spaces; the phenomenon of green gentrification and some solution that have been applied in recent researches and, finally, presents a brief review about the soviet city and new development solutions including the concepts of new urbanism and smart grown.

2.1. Green infrastructure and Ecosystem services

In the late eighteenth century and early nineteenth century, the landscape architect Frederick Law Olmsted stated that all urban green areas, independent of their characteristics, should provide people with benefits from nature. For this reason, the parks should be connected to each other and to surrounding residential areas (Little, 1995). These two ideas were in the origin of greenway movement that, in the end of twenty century, would evolve into the term green infrastructure.

According to Benedict & McMahon (2002), there are two concepts that are in the origin of this new idea: (1) connecting all green spaces for the benefit of citizens, (2) preserving and linking natural areas to counter the fragmentation of habitats and promote the biodiversity.

Nevertheless, these two concepts are very similar to the ideas argued by Olmsted almost two centuries later and implemented in the 1880s in the Emerald Necklace in Boston.

A commonly used definition describes green infrastructure "as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings" (European Commission, 2013, p. 7; see also Costanza et al., 1997; Karhu, 2010; Berte & Panagopoulos, 2014).

There are four classes of ecosystem services defined in Millennium Ecosystem Assessment report (2005): (1) provisioning services; (2) regulating services, (3) cultural services and (4) supporting services. Provisioning services include all the products obtained from ecosystems, for example, food – products derives from plants or animals - wood, cotton, silk and wool (p. 40). Regulating services correspond to all the benefits gained from the regulation of ecosystem processes, for example, air quality regulation, climate regulation, water regulation and erosion regulation (p. 40). Cultural services include all the nonmaterial benefits that people obtain from ecosystems such as "spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences, including: cultural diversity" (p. 40). At the same time, important social benefits, for example, improvement of psychological and mental health (Ulrich, 1984), stress reduction and relaxation (Kuo, Bacaicoa, & Sullivan, 1998; Chiesura, 2004) are considered as cultural ecosystem services. Furthermore, the urban green infrastructure act like meeting places in neighbourhoods (Martin, Warren, & Kinzig, 2004) and positively influence the interactions between different communities (Kim & Kaplan, 2004). Finally, supporting services include soil formation, photosynthesis, nutrient cycling and water cycling. This last class include all the services that are necessary for the production of all other ecosystem services (Millennium Ecosystem Assessment, 2005, p. 40).

2.2. Green Infrastructure components

There are three perspectives on the definition of the green infrastructure components.

The first perspective holds that a green infrastructure is a system of hubs, links (McMahon, 2000; Benedict & McMahon, 2002) and sites (Benedict et al., 2012) (Figure 1). Hubs are considered as the anchor of the green infrastructure network since they provide space for native plants and animal communities, habitat for wildlife and people and are responsible for the ecological processes that move through the system. Hubs appear in the landscape in

different shapes and sizes, for example, large reserves and protected areas; regional parks; community parks and green spaces where natural features and processes are protected and/or restored. In turn, links are the connecter elements that tie the system together, connecting ecosystems and landscapes. These connections are essential to maintain the vital ecological processes and preserve biodiversity. Conservation corridors, such as river and stream floodplains, are an example of links that may also provide opportunities for outdoor recreation (Benedict & McMahon, 2002; Benedict et al., 2012). Finally, sites are smaller areas than hubs and they are not necessary attached to larger regional conservation systems. These elements can, however, provide important social and ecological values (Benedict et al., 2012, pp. 14).

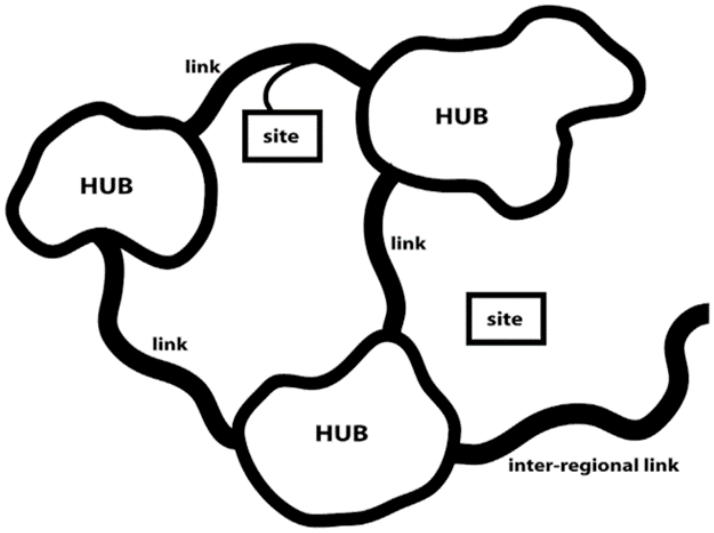


Figure 1 - The components of a GI network. Credit: Benedict et al, 2012

The second perspective assumes that green infrastructure is characterized by a system of hubs, corridors and nodes (Theodore Weber & Wolf, 2000; Ted Weber, Sloan, & Wolf, 2006). In this perspective, hubs are also considered the most ecologically important large natural areas. They are the habitat of many species and sometimes are essential to support particular life stages of several species. Corridors are linear elements, at least 350m wide, which are responsible to link hubs together to allow the flux of animals and plants. Those areas are essential to prevent the extinction of many species (Theodore Weber & Wolf, 2000). Finally, nodes are small conservation areas that serve as “stepping stones” or “rest stops”, allowing the movement between hubs (Ted Weber et al., 2006, p. 100).

Finally, Ahern (2007) admit that the concept of green infrastructure assume the same mosaic model as landscape ecology, which use three major landscape elements: patches, corridors and the matrix. According to Forman (1995), patch is a nonlinear area with homogeneous characteristics, variable size and shape, and which is distinct from the surrounding area. This landscape element serve many functions, for example, habitat for wildlife, sources for species or nutrients or aquifer recharge areas. A corridor is a linear element with a specific land cover type with a different content and from its context (Forman, 1995). Corridors provide several functions within the landscape such as wildlife habitat, pathways or instead barrier, for the fluxes of plants, animals, nutrients and wind. Lastly, the matrix, in terms of area, is the dominant land cover type. For this reason, the matrix is the element with more connectivity and continuity, and is responsible for the major part of the dynamics of the landscape (Forman, 1995).

2.3. Environmental Justice

Although there is agreement about the importance of green infrastructure in the cities and that it should be based on the three pillars of sustainability – ecology, economy, and society - many studies (e.g. Quastel, 2009; Curran & Hamilton, 2012) suggest that the societal variables are mostly not respected or even ignored in the process of project making. The exclusion of a sustainability variable results in unequal distribution of green infrastructure through the cities. In short, the uneven distribution of the green infrastructure in the city, often stratified based on ethno-racial characteristics, including age, gender, disability, education and wealth of the residents, was recognized in the literature as an environmental justice issue (Byrne, Wolch, & Zhang, 2009; Dai, 2011; Gould & Lewis, 2012).

A common definition is the one provided by Agyeman (2005) as the right that the entire population has to be protected against environmental pollution and to live in a clean and healthful environment (see also Taylor, Carlos Poston, Jones, & Kraft, 2006). In other words, there is environmental justice when equal distribution of the green infrastructure exists in the city, without discrimination.

Traditionally, the environmental justice movement focuses on pollution issues that affect the health of low-income and minority individuals who lived in closer proximity to polluting sites (Downey & Hawkins, 2008; Kabisch & Haase, 2014; Rigolon, 2017). This movement appeared in the beginning of 1980s, in the United Stated, where low-income racial

communities, including African-Americans and Hispanics, were living in the most polluted neighbourhood comparing with the white communities that, in the opposite, were living in the neighbourhoods with high environmental quality (Boone, Buckley, Grove, & Sister, 2009; Laurent, 2010; Schlosberg, 2004). More recently, environmental justice research has focused on the distribution of the environmental hazards and amenities, including green spaces, through the different society groups (Rigolon, 2017; Shen, Sun, & Che, 2017; Wolch et al., 2014; Wüstemann, Kalisch, & Kolbe, 2017). In this field, Gould & Lewis (2012) refer the importance to analyse "the full spectrum of distribution" (p. 113). It means that the research should consider also who gets access to the environmental amenities, such as parks, water clean-up, and access to public transport, studying all the society groups instead of only the groups that get the environmental burdens of society, such as toxic waste, hazardous facilities, and poor air quality, which has up to now studied in the literature.

Along with a distributive aspect, that represents the way that environmental benefits and costs and public environmental resources are distributed between different groups in the society, Raudsepp, Heidmets, & Kruusvall (2009) defined a second environmental justice aspect - procedural aspect – that refers to the way that the public access and participation used to make environmental decisions (Schlosberg, 2004; Steger, 2007).

One of the most common ways to measure inequality among the population is through Gini index, which is used in economics. This indicator, developed in 1912 by Corrado Gini, provides a measure of income or resource inequality within a population. The Gini coefficient range from 0 to 1. As lower as the index is there is higher equal income distribution, contrariwise, a high Gini index indicates more unequal distribution. For example, in Estonia this measure is around 0.33 and Portugal's Gini index has varied from 0.37 (1995) to 0.34 (2016) ('PORDATA - Gini index (%)', n.d., 'PORDATA - Índice de Gini (%) - Portugal', n.d.). Meanwhile, a single index to measure environmental inequality does not exist yet (Boyce, Zwickl, & Ash, 2016).

To sum up, making cities more resilient, equitable and sustainable is necessary to be aware of environmental justice problems and emphasise the questions related to the access of urban green spaces (Kabisch et al., 2016).

2.4. Public urban green spaces

In this research, the concept of public urban green spaces is defined as "public parks and other green spaces that are accessible to the general public and managed by the local government" (Fan, Xu, Yue, & Chen, 2016, p. 2).

Lindholst et al., (2016) defined three main characteristics to evaluate the quality of urban green spaces according to the Nordic Green Space Award (2015): (1) structure and general aspects such as size, character, location and accessibility; (2) functionality and experience, for example, the recreational and social aspects, the culture and history, nature and biodiversity, landscape and aesthetics and environment and climate and (3) management and organisation, including management, maintenance and communication and information.

2.4.1. Accessibility of public green spaces

As mentioned in chapter 2.3, there are inequalities in the distribution of the green infrastructure throughout the cities. In other words, the different groups of the society have more or less access to the green infrastructure according to their socioeconomic status (SES). To study these inequalities in access to the green infrastructure and to provide solutions, is necessary to measure it. The present subchapter intends to review the aspects and methods used in the literature to measure the accessibility of public urban green spaces.

Most research on accessibility has focused primarily on two aspects: (1) distance to green spaces and (2) area available at that distance, providing threshold values of urban green space per habitant. However, in some cases, accessibility is estimated only using one of these factors (Rojas, Páez, Barbosa, & Carrasco, 2016). For example, The European Environment Agency (EEA) recommends that people should live within 15 min walking distance of their place of residence (Stanners & Bourdeau, 1995), but does not specify the available area available of green space per resident. Also, Boone et al., (2009) (see also Wolch, Wilson, & Fehrenbach, 2005) only defined 400m, a five-minute trip, as the standard distance between a public park and inhabitants' house. In another studies both aspects are combined. Coles & Bussey (2000) considered that green spaces should be 5 to 10 min walk from the residence area and have a minimum of 2 ha. Van Herzele & Wiedemann (2003) suggested a 5 min walk, equivalent to 400 m, until the closest 1 to 10 ha green space. The government agency English Nature provides an Accessible Natural Greenspace Standards (ANGSt) that recommends that should exist at least 2 ha of accessible natural green space per 1000 population with a minimum

distance of 300m from the place of residence (Comber, Brunsdon, & Green, 2008; Handley et al., 2003). Magalhães (1992) considers a minimum distance for children and elderly people of 100 m and also considers 400m^2 as the minimum area for a public green space in Portugal. On the other hand, (World Health Organization, 2010) assume a minimum of 9m^2 green space per person and the ideal area of green space would be 50m^2.

According to the methods review made by Maroko et al., (2009) there are three different methods for measuring accessibility of public urban green spaces: (1) "container approach"; (2) "walkability" distances method and (3) Kernel density estimation, or kernel smoothing.

The "container approach" measures the accessibility using a particular geographic unit of aggregation, such as zip code, neighbourhood or census track, to determinate the location of a park or recreational facility, instead of using a proximity measure. In this method, the number of parks per areal unit can be estimated for the unit of aggregation used and related with specific populations characteristics, for example SES (Maroko et al., 2009). Although this approach is commonly used (Talen & Anselin, 1998; Timperio at al., 2007), in some cases, it cannot describe precisely the access of a green space. For example, if a person lives near to a green space but it is located in another unit of aggregation, the accessibility of that person is not counted. On the other hand, in large areal units could exist a long distance between the population and the park, however it is still consider as part of the same areal unit (Maroko et al., 2009, p. 2).

The "walkability" distances method consider a standard walking distance (5-10 min walk 400m or 300m) for the accessibility to parks as a proxy for access. Though, in this method the actual street network is not considered, only Euclidean distance (Maroko et al., 2009). Meanwhile, the relationship between distance and willingness to walk is a continuous curve without sharp breaks. This has to be said because it should not be created the illusion of sharp breaks, e.g. "people are generally whiling to walk up to 500m to transit".

The Kernel density estimation, although it has been applied in a very few studies (Moore, Diez Roux, Evenson, McGinn, & Brines, 2008) , is considered a more advanced spatial statistical model than the container approach. This approach estimates the accessibility for every point in the study area, instead of giving a binary answer (Maroko et al., 2009, p. 5).

For the evaluation of the access to the public urban green spaces Van Herzele & Wiedemann (2003) suggest to include five variables (1) a citizen based reflecting the quality of a green space where residents live; (2) multiple functional levels including a quantitative

evaluations of the green space from neighbourhood to city level according to their functional scales; (3) preconditions for user, for example, accessibility and safety; (4) quality measure that analyses the variety of quality on green spaces to accommodate different activities; and (5) multiple uses according to the diverse conditions. (Fan et al., 2016, p. 2).

Finally, Dai (2011) argues that a common descriptive method used is the "availability measure calculating the rate of the supplies vs. the demands within a predefined region" (p. 235). This approach, already used in some studies (e.g. Guagliardo, 2004; Potestio et al., 2009) means that accessibility could be calculated as the quantity of green spaces per inhabitant within a district. However, there are two issues associated with the use of these method. On the one hand, it is not predictable that people go to the closest green space. Some studies (e.g. Burgess, 1995; Madge, 1997) show that people choose more distant green spaces because of various reasons, such as its size, fearing dogs, fearing crime and racial attacks. On the other hand, in this method it is not considered that, in the same green space, may be exist population pressure from different neighbourhoods (Dai, 2011).

2.4.2. Availability of green spaces according to the geographic location

Cities are complex socio-ecological systems, and the decisions and processes responsible for the urban green spaces availability today occurred over centuries, for this reason it is hard to study all the responsible factors that affect the quality of the urban green infrastructure. For example, along with the environmental justice issues, the location of a city that is related with morphologic and climatic conditions, such as the water availability, proved to be another strong characteristic that affect the availability of urban green spaces in the city. According to Kabisch et al., (2016) there are some common trends that can distinct the availability of urban green spaces between the countries from the Mediterranean coastline (Southern Europe) and Northern Europe (Figure 2). The Southern Europe cities, located along the Mediterranean coastline, have a lower values for green land cover and a higher degree of impermeable cover and rock surface compared with the Nordic countries. The Northern Europe cities, on the other hand, are characterized by a late urban development, present higher number of green spaces and natural forests in the surrounding landscapes.

Fuller & Gaston (2009) developed a similar study and identified that the higher amount of urban green spaces (20-40%) are located in the Northern and Central European cities while cities of Southern Europe tend to have less than 10%.

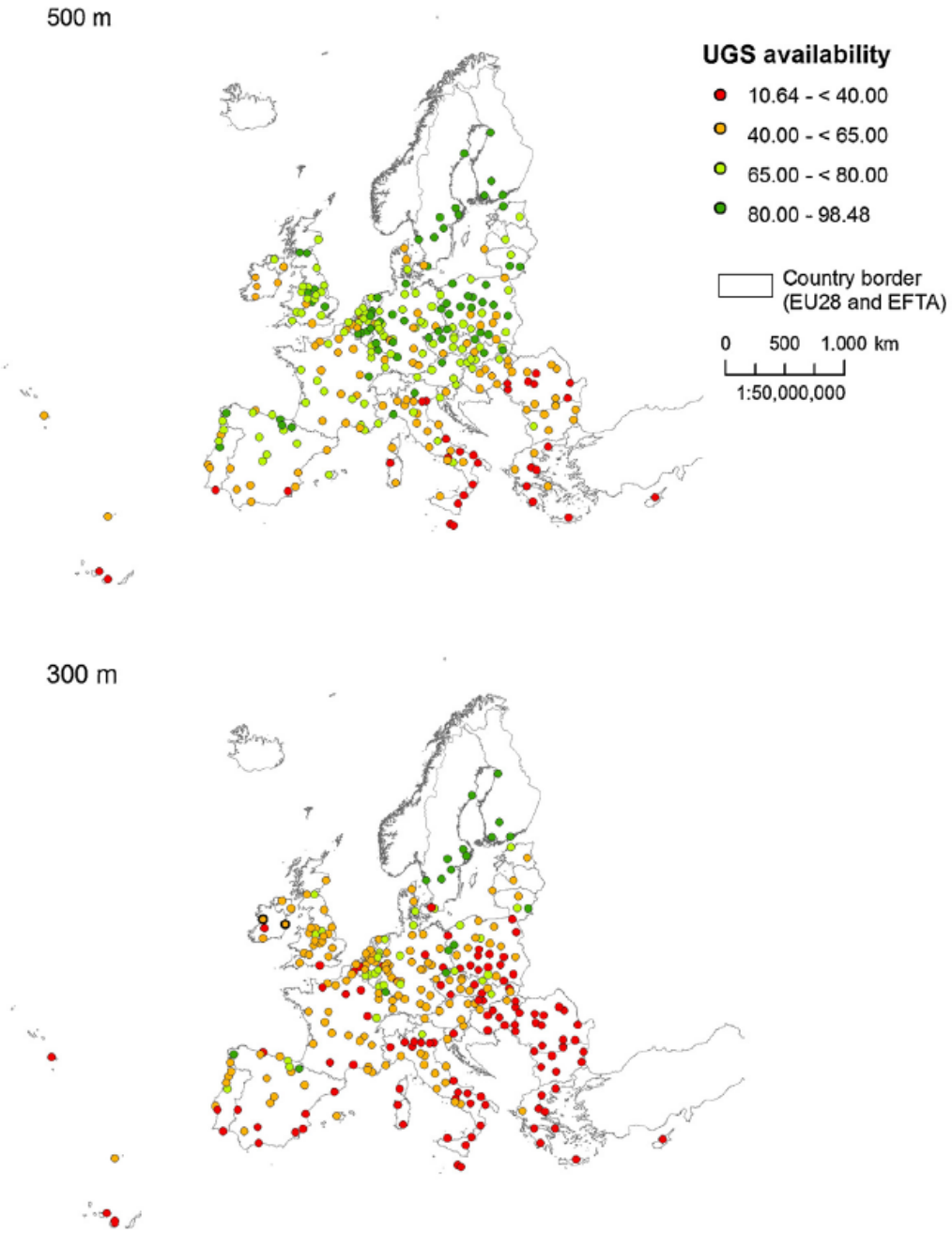


Figure 2 - Share of the population (%) with urban green spaces (≥2 ha) available within 500m and 300m in administrative city boundaries

Source: Kabisch et al. (2016)

2.5. Gentrification and Green Gentrification

The concept of gentrification is defined by N. Smith (1982) as "the process by which working class residential neighbourhoods are rehabilitated by middle class homebuyers, landlords, and professional developers"(p. 139). Moreover, this process emerged as a sporadic and local anomaly in the housing markets of some command-centre cities. Most recently, N. Smith (2002) assume that this process is currently generalized as an urban approach and assumed as a liberal urban policy.

Glass (1964) defines gentrification as a discrete process and gives the example of the working-class quarters in London that were gradually occupied by the middle classes. The modest working-class houses were replaced by expensive residences, which were used in multiple occupation or as lodging houses. Once installed, this process of gentrification changed all the original social character and expanded rapidly to another districts with similar characteristics.

According to Hackworth & Smith (2001) there are, in the context of the Western Europe and USA, three historical waves in the gentrification process. The first wave, with the beginning in the 1950s, represents a sporadic gentrification since the process occurred isolate in small neighbourhoods in the western Europe and north eastern USA (p. 467). A second wave, which the author calls "anchoring phase" represent the increasing of the gentrification process, during the 1970s and 1980s, related with urban and economic restructuring processes (p. 440). The third wave, defined as the recessional pause and subsequent expansion, emerges in the 1990s. N. Smith (2002) look to this wave as gentrification generalized. For example, many neighbourhoods in the city centre continue to gentrify while others, located in the periphery begin to experience the process for the first time.

Against this background, Davidson & Lees (2005) argue that contemporary gentrification has three fundamental characteristics: (1) economic reinvestment in a divested area; (2) forced displacement of low-income populations and their replacement by populations with higher incomes and (3) substantial changes in the urban landscape.

More recently, Gould & Lewis (2012) describe the concept of green gentrification as the urban gentrification processes, displacement or exclusion of the economically most vulnerable classes of society, that are majority enabled by the creation or renovation of an environmental amenity (p. 121) (see also Dooling, 2009).

Currently, urban requalification projects in degraded areas have been promoted to improve the wellbeing of the residents and to control environmental injustice problems. However, these environmental improvements in ethnic communities and/or low income households can create an urban green space paradox (Wolch et al., 2014). The creation of new green spaces with high quality can increase attractiveness making these neighbourhoods more desirable. In contrast, the cost of housing can rise and residents may not be able to support the rent. This results in the exclusion or displacement of the poor neighbourhood's residents, who should benefit from the ecosystem services provided by the new green space. In turn, the residents will return to live in a similar degraded neighbourhood, with low access of green infrastructure (Bentley et al., 2012; Wolch et al., 2014). Such a phenomenon has been variously termed ecological gentrification (Dooling, 2009), eco-gentrification (Quastel, 2009), environmental gentrification (Banzhaf & McCormick, 2007; Checker, 2011; Curran & Hamilton, 2012) or green gentrification, as already mentioned (Gould & Lewis, 2012).

One of the most famous examples of an intervention in an obsolete infrastructure that resulted in a phenomenon of green gentrification is The High Line, in New York, which was designed by James Corner Field Operations ('Field Operations - project details', n.d.). The High Line is a linear park constructed in an abandoned elevated railway that was originally designed to facilitate the access to factories and other businesses. Presently, this project has become one of the most popular parks in New York City, attracting millions of visitors each year. Nevertheless, what appeared to be a successful project resulted in a case of green gentrification. The older and typically low-income industrial houses were rehabilitated, making them more liveable and attractive. This caused the displacement and exclusion of the residents that were not able to pay the rehabilitated properties, which led to the rehousing of them in other degraded neighbourhoods (Wolch et al., 2014).

Another example of green gentrification is the case of Prospect Park, in Brooklyn, designed by Frederick Law Olmsted and Calvert Vaux. The Prospect Park is the biggest public park in Brooklyn. Along the park, there is a clear difference between the ethnicities that occupy the richest neighbourhoods and the poorest ones. Over the years, the greening of the richest neighbourhoods increased the houses' incomes and the opposite affected the degraded neighbourhoods, so "the richest neighbourhoods became richer, the poorest neighbourhoods became poorer"(Gould & Lewis, 2012, p. 139), resulting in an issue of environmental justice. Recently, with the restoration of Prospect Park, the residential construction increased, as did

the rents of all neighbourhoods' houses (Gould & Lewis, 2012). This occasioned the displacement of the poorest residents of the Prospect Park's neighbourhoods, and, consequently, in a phenomenon of green gentrification.

The study of the green gentrification phenomenon can be hampered by two main reasons. First, because this phenomenon could take a long period of time to happen which may not be compatible with the duration of the research, and second, the green gentrification phenomenon is directly related with the social inequalities, for this, it can be difficult to study in cities that avoid to deal with the problem of social equalities (O'Brien et al., 2017).

To control the effects caused by green gentrification, Curran & Hamilton (2012) suggest a "just green enough" strategy, which consists of securing the public health benefits of enhanced access to urban green infrastructure while avoiding the urban green space paradox. One example would be the promotion of new small-scale interventions in scattered sites (Wolch et al., 2014), such as urban allotments, instead big-scale projects that change radically the dynamics of these communities. One specific example of the implementation of this strategy is "just clean enough" based on the removal of the environmental hazard, in Greenpoint, Brooklyn. It was intended "to assure community health while still allowing for industrial uses on the waterfront for the explicit purpose of maintaining the area's working-class population" (Curran & Hamilton, 2012, p. 1039).

Another example are the grassroots movements for urban agriculture that has becoming common in Detroit (Colasanti, Hamm, & Litjens, 2012). These movements replace the declining heavy industry, abandoned buildings and shrinking population. Also, Vancouver, British Columbia, and Michigan, have significant and growing urban agriculture movements that adopt urban agriculture as a sustainability fix (Walker, 2016).

A final proposed solution to control green gentrification regards the involvement of the immigrants in the decision making and planning for green spaces, to include their ethnic and cultural customs and perceptions (Kloek, Buijs, Boersema, & Schouten, 2015).

2.6. The socialist city

In order to contextualize the origin of the soviet-era districts in Tartu and, mainly, to perceive its composition, I considered important to review the concept of socialist city.

A common definition of the socialist city is the one defined by Demko & Regulska in 1987:

"No social or occupational group would have better or more favourably located residential sites so that one would find a randomly distributed housing pattern. Similarly, public services of all kinds, including transportation, should be of equal quality, availability, and accessibility. Commuting to work…would be minimized and no group would be more dependent on or penalized by such travel than others. Such amenities as a high quality physical environment, including recreational environment, would be equally accessible to all. All such urban conditions would be similarly equitably arranged and available" (p. 290).

In short, the socialist city had as main principle an egalitarian society, with equitable distribution and accessibility of the amenities.

It is commonly recognized that there was less social segregation and inequality under capitalism than under socialism. However, the spatial patterns of inequality in both periods have distinct interpretations and, for that reason, it is not appropriated to make strong comparisons (D. M. Smith, 1996).

The Figure 3 represents the general organization of an Eastern European socialist city.

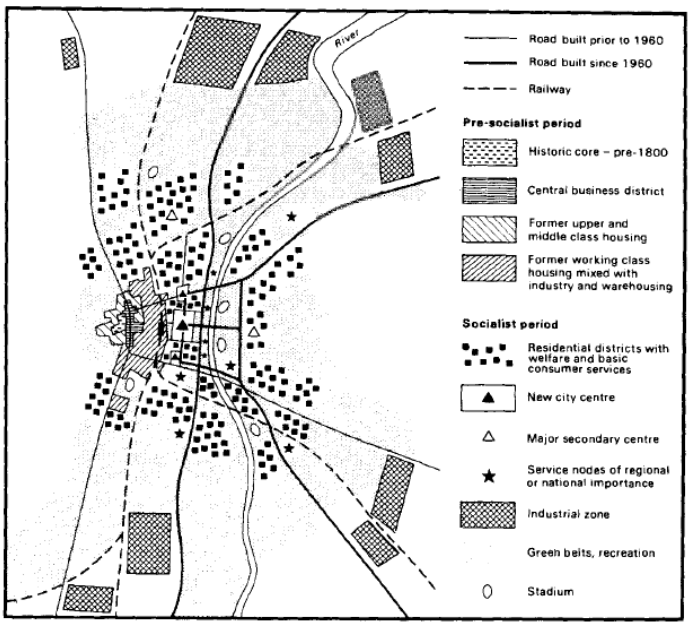


Figure 3 - Model of the growth of an Eastern European socialist city
Source: French and Hamilton (1979: 228, figure 9.3) in Smith (1996)

The residential districts or micro-regions, with basic consumer services, were called *mikroraion* and represented the "basic building block of the soviet city" (D. M. Smith, 1996, p.

75). According to Smith (1996) these neighbourhoods were composed of blocks of flats along with associated services to receive 5000 to 15000 people.

These micro-regions (Figure 4) are very common around Estonia. , For example, in Tartu, the second biggest city of Estonia, during the late 1950s, the most of the new housing consisted of five or more storey concrete block dwellings (Andrusz, Harloe, & Szelenyi, 1996).

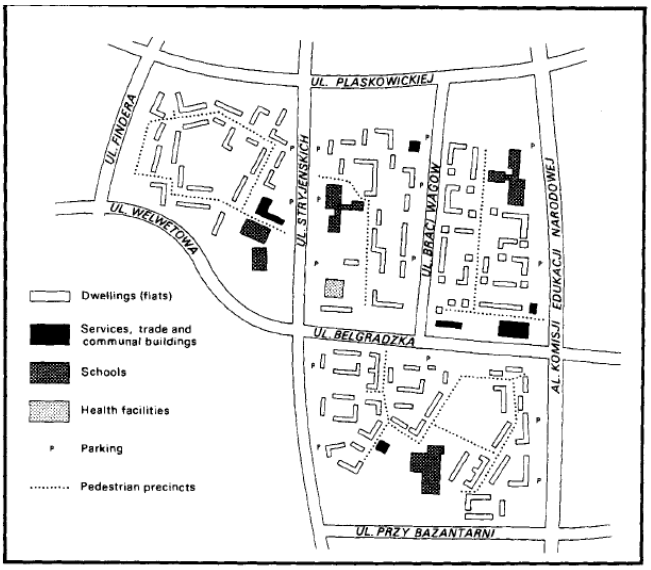


Figure 4 – Layout of housing estate of the late 1970s at Wyzyny in the Ursynow-Natolin district on the southern edge of Warsaw
Source: Smith (1996)

In cities that were under the soviet regime, there are two mainly different types of housing, single family house and the soviet-era housing blocks of flats. According to Vetik & Helemäe (2011), in Estonian cities it is possible to identify a trend in housing occupancy related to the different ethnic groups. In general, Estonians are living in single-family houses while Russians are occupying the high density flats built during the Soviet Union. However, Kulu (2003) posits that, for example, in the late soviet Tartu, in spite of Estonians had more living space than non-Estonians in the case of facilities the situation was the opposite, non-Estonians, including Russians, Ukrainians and Byelorussians, had more facilities, even when the influence of housing ownership was controlled. These differences can be explained by the predominant preferential differences in the housing between ethnic groups and also by the Soviet policy for public housing occupation (Vetik & Helemäe, 2011). Some authors (e.g. French, 1987; Smith,

1996; Szelenyi, 1996) assumed that, according to these evidences, soviet-era housing blocks will become social slums or ghettos. However, further studies admit that these neighbourhoods have still a “strong social mix, and do not reveal clear signs of decline” (Kährik & Tammaru, 2010, p. 215).

2.7. The “Estado Novo”

Portugal was on a dictatorial regime, named “Estado Novo”, from 1933 to 1974. This military regime was characterized by censorship and repression and, in addition, had a strong impact on the growth and morphology of Portuguese cities.

The state philosophy was based on social domination, political control and moral discipline. For this reason, the housing policy defined by “Estado Novo” regime sought not only to respond to the needs of the population increase, but also to consolidate a social base of political and ideological support to the regime while reinforcing the social order, in other words, the hierarchical distribution of the population. Such reorganization may be at the origin of social segregation in Faro, as we shall see later. In Faro, the “Bom João” district (Figure 5 and 6) was built during this regime and inserted in a government's construction programme, called “Economic Neighbourhoods”. The reason that led to the construction of this neighbourhood in Faro is unknown since there were no industrial activities that justifies it has in other Portuguese cities (Pacheco, 2016). According to Baptista (1999), the houses were assigned to "heads of household" - employees, workers, civil servants, military, among others, who were later divided according to the size of the household and their income.

In this context, Rossi, (1982) affirmed that the shape of the city is always an influence of the time of the city, which means that in both Tartu and Faro it is evident that political regimes have directly affected the evolution of the cities and the distribution of social classes.

Figure 5 - 1948, Project for “Bom João” neighbourhood (Pacheco, 2016)

Figure 6 - “Bom João” neighbourhood, 1953. (Pacheco, 2016)

2.8. New Urbanism and Smart Growth

In order to control the environmental justice issues, not only in socialist cities, it is common accepted between the landscape architecture community that “greater focus on the needs of the people who use cities must be a key goal for the future” (Gehl, 2010, p. 6), it means

that new planning and development solutions should be adopted. The New Urbanism and Smart Growth are two of these new approaches, with a sustainability base, that focus on a human-scaled urban design.

The New Urbanism is a planning and development approach based on the principles of "how cities and towns had been built for the last several centuries: walkable blocks and streets, housing and shopping in close proximity, and accessible public spaces"(Congress for the New Urbanism, 2015).

This recent form of design the city pretend to change the typical principles of post-WWII development, which have been negative consequences on the economy, environmental impacts on communities and health (Congress for the New Urbanism, 2015). In other words, New Urbanism intends to reverse the big-scaled planning based on the automobile circulation.

According to Congress for the New Urbanism (2015) the New Urbanism can be applied to diverse scales of development, for example, entire regions, suburban areas, urban neighbourhoods, dense city centres or even a single street. The field of the projects include new development, urban infill and revitalization or preservation design. From the late 1990s, the phrase 'landscape urbanism' start to be used by landscape architects in the United States to refer to the redevelopment of declining post-industrial cities. Landscape urbanism is a theory of urban planning arguing that the best way to organize cities is through the design of the city's landscape, rather than the design of its buildings (Thompson, 2012).

A good example of the application of this concept in the city are the projects implemented by Gehl Architects office ('Gehl — Making Cities for People', n.d.). The main objective of this office is to create human-scale public spaces that allowed the relationships between people and the city, promoting the quality of life.

At the same time, the Smart growth concept is consider as an development approach that "encourages a mix of building types and uses, diverse housing and transportation options, development within existing neighbourhoods, and community engagement"(Karanikola el al., 2018; Sousa Silva et al., 2017).

Emerine, Susman, Shenot, Bailey, & Sobel (2006) define ten principles consider as the support of this approach: (1) Mix land uses; (2) Take advantage of compact design; (3) Create a range of housing opportunities and choices; (4) Create walkable neighbourhoods; (5) Foster distinctive, attractive communities with a strong sense of place; (6) Preserve open space, farmland, natural beauty, and critical environmental areas; (7) Direct development towards

existing communities; (8) Provide a variety of transportation choices (9) Make development decisions predictable, fair, and cost effective and (10) Encourage community and stakeholder collaboration in development decisions.

The most consistent source of a definition of smart city is usually considered the report entitled *Smart cities: ranking of European medium-sized cities* (Giffinger, Fertner, Kramar, Kalasek, & Pichler-Milanović, 2007). This report explains the smart city concept by differentiating six conceptually characteristics (Figure 7): (1) Smart economy; (2) Smart mobility; (3) Smart governance; (4) Smart environment; (5) Smart living and (6) Smart people.

Smart Economy (Competitiveness)	Smart Mobility (Transport and ICT)	Smart Governance (Participation)
•Innovative spirit •Entrepreneurship •Economic image & trademarks •Productivity •Flecibility of labour market •International embeddedness •*Ability to transform*	•Local accessibility •(Inter-)national accessibility •Availiability of ICT - infrastructure •Sustainable, innovative and safe transport systems	•Participation in decision-making •Public and social services •Transparent governance •*Political strategies & perspectives*
Smart Environment (Natural resources)	**Smart Living (Quality of life)**	**Smart People (Social and Human Capital)**
•Attractivity of natural conditions •Pollution •Environmental protection •Sustainable resource management	•Cultural facilities •Health conditions •Individual safety •Housing quality •Education facilities •Touristic attractivity •Social cohesion	•Level of qualification •Affinity to life long learning •Social and ethnic plurality •Flexibility •Creativity •Cosmopolitanism/Open-mindedness •Participation in public life

Figure 7 – Characteristics and factors of a Smart City

Source: Adapted from Giffinger et al. (2007)

3. Objectives – research questions

Following the concepts discussed in the review literature chapter, this study aims at extending our knowledge of accessibility of public green spaces and the influence that some specific factors, for example, the nationality of some population's groups, the time of construction of the buildings, has in the distribution of the public green spaces in the city. To accomplish that, this dissertation pretend to answer the main research question: *Is there environmental justice in the distribution of public green spaces in both Tartu and Faro?*

The general objective can be further divided into three specific points:

(1) To identify the districts with high and low access to public green spaces in Tartu and Faro and verify if there is a relation between the ethnic nationalities and time of construction with those indicators;

(2) To analyse temporarily the availability and accessibility of public green spaces in both cities, by comparing the current and future green infrastructure included in "Tartu Linna Üldplaneering" and in the proposal presented for Faro;

(3) To identify areas where could occur the phenomenon of green gentrification;

4. Methods of research

4.1. Description of the study areas:

4.1.1. Estonia, Tartu

Estonia is a Northern European country located on the eastern coast of the Baltic Sea. Is considered a small country with approximately 45227 km^2 of area and around 1.3 million habitants. One-third of the population lives in Tallinn, the capital, and its suburbs (Raudsepp et al., 2009).

Estonia is one of the most forested countries in Europe Union. Its unique environment is characterized by a high level of biological and landscape diversity, with several rare flora and fauna ('Estonica.org - Encyclopedia about Estonia', n.d.). According to Raudsepp et al. (2009) the forest and wetlands territory represent more than 60 percent of the country.

On 24th of February of 1918 this country was proclaimed as the Republic of Estonia and on 2 February 1920, with the Tartu Peace Treaty the Republic of Estonia was recognized by the Soviet Russia as an independent country. One year later, Estonia became a member of League Nations (Statistics Estonia, 2014, p. 7).

During the soviet period, since 1941 to 1991, the majority of the Estonia's cities, including Tallinn and Tartu, develop according to the principles of the socialist city, as discussed above. The urban planning and construction system during the soviet period favoured the development of large homogeneous areas, composed by soviet-era housing blocks, as showed in Figure 8 (Andrusz et al., 1996).

Figure 8 - Annelinn district, Tartu

Source: Google Earth (2016)

Tartu (Figure 9) is the second biggest city of Estonia with 38.58 km^2 of total area (3858ha urban area). According to 'Statistics Estonia' (2017), Tartu city has about 97600 habitant, including 81.7% of Estonians, 14.7% of Russians and 3.6 % of other nationalities, for example Ukrainians, or Belarusians or Fins. For this reason, Tartu is considered a social mix city (Kährik & Tammaru, 2010).

Tartu is known as a historical university city since the establishment of University of Tartu, the most important and prestigious Estonian university, in 1632 by King Gustavus Adolphus of Sweden. On the other side, the industrial and military investments during the Soviet Union made this city an important migrant destination, especially for Russian comers (Hess, Tammaru, & Leetmaa, 2012).

The city is divided by the Emajõgi River, crossing Tartu for 10 km, and is connected with a Stillwater body the Anne Channel (Figure 10). The urban area is surround by agricultural fields and forest, two of the most typically landscapes in Estonia. In the past years, Tartu has experienced outward growth, mostly in the direction of major highways originating from the town (Kärdi, 2006). The city of Tartu consists "of housing districts of various age and quality" (Kährik, 2000, p. 4) with two essential types of buildings, single-family houses and the high-rise dwellings.

Figure 9 - Location of Tartu City, Estonia

Source: Author

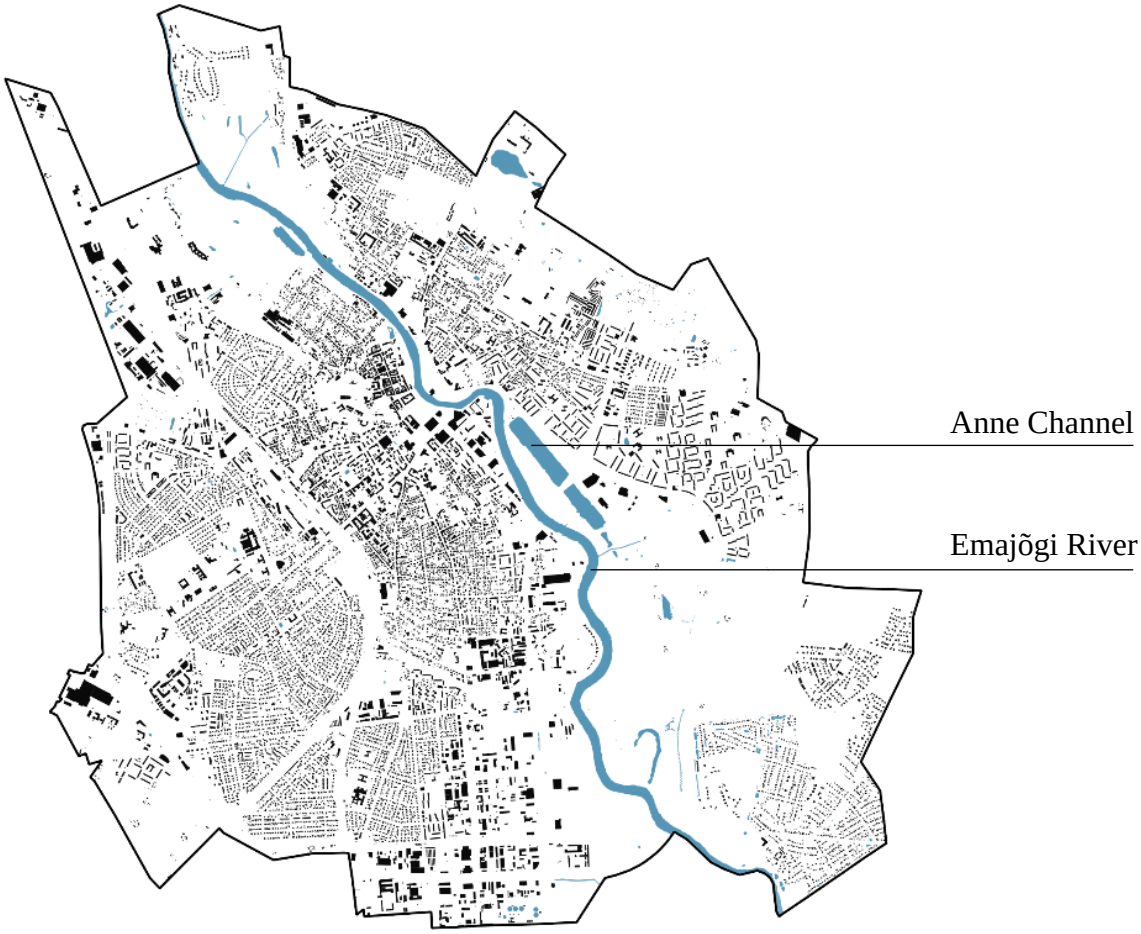


Figure 10 - Tartu city, Estonia

Source: Map elaborated by the author using QGIS 2.16.3, information extracted from Estonian Land Board

4.1.1.1. Delimitation and characterization of Tartu districts

The city of Tartu is organized in 17 districts. Figure 11 shows the location of each district: (1) Annelinn; (2) Ihaste; (3) Jaamamõisa; (4) Karlova; (5) Kesklinn; (6) Maarjamõisa; (7) Raadi-kruusamäe; (8) Ropka Tööstusrajoon (9) Ropka; (10) Ränilinn; (11) Supilinn; (12) Tammelinn; (13) Tähtvere; (14) Vaksali; (15) Variku; (16) Veeriku and (17) Ülejõe.

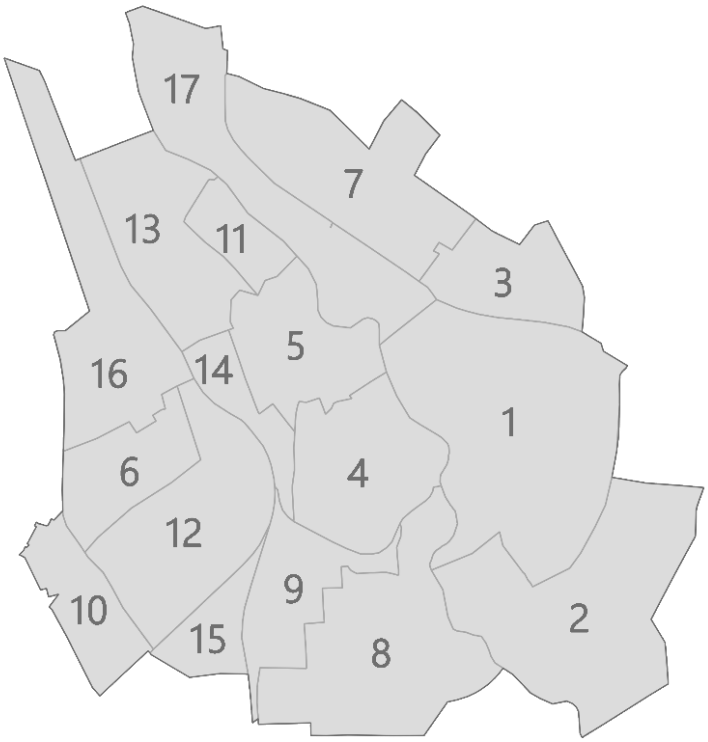


Figure 11 - Location of Tartu districts,
Source: Map elaborated by the author using QGIS 2.16.3, information extracted from 'Statistics Estonia' (2017)

Tamm (2014) divides the districts of Tartu into three groups according to their characteristics: (1) Inner city, that includes the central district of Kesklinn and semi-dominanted regions – Karlova, Tammelinn, Tähtvere, Supilinn and Vaksali, which are also distinct due to their "garden-city" typology; (2) Suburbs which includes Ihaste, Maarjamõisa, Ränilinn, Raadi-kruusamäe, Ropka and Ropka Tööstusrajoon, Variku and Veeriku and (3) Soviet legacy districts, that represents the biggest residential areas in the city Annelinn, Jaamamõisa and Ülejõe.

Kesklin (5) corresponds to the centre of the city which is also the oldest part of Tartu. There are located the majority of service and commercial buildings including Tartu City Government; the main university building, Tartu University museum and Tartu Art Museum, and also modern business and residential buildings. Furthermore, this district, is characterized by high quality public green spaces, for example, Keskpark, Botaanikaaed and Toomemägi, the most emblematic public green space of Tartu (Figure 13).

Karlova (4) was one of the most attractive districts during the 20th century due to its abundant and unique wooden architecture, ornamental decoration and history (Tartu linna kodulehekülg, www.tartu.ee in Tamm, 2014). This district is also considered a rich part of the city where many students, teachers and workers of the University of Tartu live (Tamm, 2014).

Tammelinn (12) was one of the first districts in Estonia planned according to garden city principles (Tartu linna ja maakonna turismiinfo, www.visittartu.com in Tamm, 2014). For this reason, there is a low density of houses, however the small-scale housing has high quality and is also considered an attractive and rich part of the city. During the last decade, several houses have been reconstructed and new buildings have been added (Tamm, 2014).

Tähtvere (13) was also planned according to garden city concept and the houses, built during 1930, follow a functionalist hinterland design (Raam, 1990). A significant part of this district includes the buildings of Estonian University of Life Sciences. Tähtvere also stands out for its public green spaces - Tähtvere Park and Tähtvere dendropark which is the biggest public green space in the city with around 50ha.

Supilinn (11) started to be developed during the 19th century. This district, as well as Karlova, has a unique identity once the owners could build their houses without following any specific pattern (Teedema, 2010 in Tamm, 2014). Kährik (2000) asserts that in Supilinn the housing, mostly single-family houses, is older and usually with low-quality. However, according to Nutt, Hiob, & Kotval (2016), Supilinn is consider one of the most attractive district to invest in the city of Tartu, so many dwellings have been requalified. This is an interesting fact, since that neighbourhood was considered a slum only 30 years ago (Nutt et al., 2016).

Vaksali (14) is a small but high populated district, mainly composed by small apartment buildings that started to be developed only in the beginning of 20th century. According to Kadarik (2012), in that time, Vaksali was one of the most important areas in the city due to the construction of the railway station.

Maarjamõisa (6) was developed also in the beginning of 20th century with the purpose to be a campus with two university hospitals (Marksoo, 2005 in Tamm, 2014). In the middle of the same century the urban growth started to be linear do to the need to build new residents in this part of the city.

Ränilinn (10) was developed with the same reason as Maarjamõisa district. The apartment buildings has five floors and there are also some private houses. The urban structure is regular, creating a grid with internal courtyards which are used mostly for parking. The

landscape of this district is predominantly empty lawns with a few groups of trees (Tamm, 2014).

Raadi-kruusamäe (7) represents one of the smallest part of Tartu suburbs. There are located the Estonian Nacional Museum that was rebuilt in 2016 in place of a former soviet military base.

Ropka (9) was planned in the beginning of 20th century also according to garden city concept. In that period the predominant type of buildings was the family-farm. Beside to this district was developed, in the same period, Ropka Tööstusrajoon (8) that represents the industrial part of the city.

Variku (14) is a small district, connected with Ropka, composed mainly by single-family or two-family houses.

Veeriku (16) was mostly developed in 1980, as an experimental district to test several planning solutions. According to Tamm (2014), for example, some renowned architects were allowed to design new private houses there.

Annelinn (1) is the biggest and most populated district in Tartu. It was planned and developed during the Soviet period, for this reason, it presents a homogeneous urban structure composed by soviet-era housing blocks.

Jaamamõisa (3) was a functional part of military base in Tartu, developed in connection with the military airport. According to Jauhiainen (2003) Jaamamõisa represents a relatively recent residential area also composed by high-rise dwellings from soviet period with poor technical conditions and infrastructures. The same author argues that the military past made the social and economically integration in the city more difficult as well as the feeling of belonging and sense of community by residents.

Ülejöe (17) was greatly destroyed during the World War II, but once it was an agglomeration area (Marksoo, 2005 in Tamm, 2014). Nowadays, new apartments have been built or removed the old ones, however, there are still some degraded houses in this district.

Tamm (2014), explores the concept of neighbourhood reputation and analyses the responsible factors that affects the reputation given to the neighbourhoods. The study concludes that the most preferred districts in Tartu are inner city, Kesklinn, and garden-city areas, Tähtvere, Tammelinn, mostly occupied by single-family houses with big private yards (Tamm, 2014). The least preferred districts are soviet districts located at the periphery of the city, Annelinn, Jaamamõisa and Ropka Tööstusrajoon (Figure 12). According to the same author,

the factors that most influence the preference for a district are the location and the existing services.

Figure 12 – Single-family houses in Supilinn district (in the top) and soviet-era housing blocks in Annelinn district (in the bottom)
Source: Author

In terms of quality of housing, according to Kulu (2003), in the late soviet Tartu, Estonians had more living space than non-Estonians, however, in the case of facilities the situation was the opposite. Non-Estonians had more facilities, even when the influence of housing ownership was controlled. Kulu (2003) also posits that ethnic differences in the housing distribution is still remains even when the influence of other factors, for example, employment sector, educational and age composition, had been controlled.

4.1.1.2.Public green spaces in Tartu

The Figure 14 shows the location of the twenty public green spaces in Tartu with high quality and at least one hectare. The most popular public green spaces in Tartu are Keskpark, Botaanikaaed, with a high variety of exotic species, Holmi park and Kanali park located along the Emajõgi River and Toomemägi (Figure 13).

Toomemägi is located on a small hill that corresponds to the highest point of the city, which gives to this park a privileged view of Tartu. In addition, Toomemägi integrates several University of Tartu buildings including the University of Tartu museum which is located in the former Tartu Cathedral. Thus, this park is mainly frequented by many students, in addition, it has a strong historic value and contain numerous monuments of important personalities.

Table 1 shows the location and area of Tartu public green space and identify the main characteristics of each.

Figure 13 – Toomemägi in spring and winter seasons, respectively

Source: Author

Figure 14 - Location of high quality public green spaces in Tartu with at least 1 ha

Source: Map elaborated by the author using QGIS 2.16.3, based on information from Estonian Land Board; ‘Open data | Tartu linn’ (n.d.) and ‘Tartu Green Map | Open Green Map’ (n.d.)

Table 1- Characterization of the public green spaces in Tartu

Source: Table elaborated by the author, based on data from 'Open data | Tartu linn' (n.d.) and 'Tartu Green Map | Open Green Map' (n.d.)

	Denomination	District	Area (ha)	Characteristics
1	Keskpark	Kesklinn	1.9	Good location, playground, cycling path
2	Botaanikaaed	Kesklinn	3.1	Variety of species, cultural and natural value, water body, good location
3	Vabaduse puestik	Kesklinn	1.6	Good location, cultural and natural value, along the river, cycling path
4	Toomemägi and Pirogov park	Kesklinn	18.7	Good location, panoramic view, cultural and natural value, outdoor gym, playground, cycling path
5	Kassitoome	Kesklinn	2.4	Good location, panoramic view, cultural and natural value, cycling path
6	Vanemuise park	Kesklinn	1.6	Cultural and natural value, water body, cycling path
7	Tähtvere park	Tähtvere	6.8	cycling path
8	Tähtvere dendropark	Tähtvere	47.5	Along the river, urban beach, outdoor gym, playground, cycling path
9	Supilinna spordipark	Supilinna and Tähtvere	17.3	Variety of sport equipment, skate park, outdoor gym, playground
10	Holmi park	Ülejõe	8.9	Along the river, cultural and natural value, cycling path
11	Kanali park	Annelinn	31.9	Along the river, urban beach, outdoor gym, playground, cycling path
12	Tartu Tammik	Annelinn	8.1	Cycling path, dog run
13	Forseliuse park	Karlova	2	Playground
14	Vaksali park	Vaksali	2.1	Playground, close to the train station and a cycling path
15	Mathieseni park	Maarjamõisa	2.7	Historic value
16	Sanatooriumi park	Maarjamõisa	13.8	Playground, cycling path, outdoor gym, dog run
17	Tartu Ülikool Kliinikum park	Maarjamõisa	1.8	Cycling path, close to the university
18	Lembitu park	Tammelinn	1.2	Close to the university
19	Ropka park	Ropka and	10.2	Playground
20	Raadi park	Raadi-kruusamäe	16	Water body, inserted in the museum

"Tartu ja tartlased" is a regular survey that exists in the whole country, aimed to obtain information about the satisfaction of the inhabitants in terms of different areas of urban life. For this reason, this survey also addresses issues related to the green spaces of the city.

In 2013, the survey was conducted to 1500 inhabitants of Tartu city, who live in the various districts of the city, from the age of 16 years and various nationalities. The survey evaluated several topics on a five-level satisfaction scale: (1) Not satisfied at all; (2) Generally not satisfied; (3) Neither satisfied nor dissatisfied; (4) Overall satisfied; (5) Very satisfied; (6) Cannot tell.

Related to the green spaces, in the survey, the following questions were asked to the residents of Tartu: (1) Are you satisfied, in your district, with the following areas? Green areas and parks and (2) Are you satisfied, in your district, with the following areas? Adequacy of green areas and parks. Table 2 and 3 shows the number and percentage of answers to the respective questions.

Table 2 – Tartu resident's satisfaction about Green areas and parks.
Source: Adapted from 'Küsitlusuuring "Tartu ja tartlased 2013"' (2013)

		Number of answers	Percentage
Answer	(1) Not satisfied at all	84	5.5%
	(2) Generally not satisfied	164	10.8%
	(3) Neither satisfied nor dissatisfied	178	11.7%
	(4) Overall satisfied	864	56.7%
	(5) Very satisfied	144	9.5%
	(6) Cannot tell	56	3.7%
Total		1490	97.8%
No answer		33	2.2%
Total		1523	100,00%

Table 3 – Tartu resident's satisfaction about Adequacy of green areas and parks.
Source: Adapted from 'Küsitlusuuring "Tartu ja tartlased 2013"' (2013)

		Number of answers	Percentage
Answer	(1) Not satisfied at all	102	6.7%
	(2) Generally not satisfied	189	12.4%
	(3) Neither satisfied nor dissatisfied	199	13.1%
	(4) Overall satisfied	726	47.7%
	(5) Very satisfied	191	12.5%
	(6) Cannot tell	68	4.5%
Total		1475	96.8%
No answer		48	3.2%
Total		1523	100,00%

According to the report 'Küsitlusuuring "Tartu ja tartlased 2013"'(2013) and the results presented in Figure 15 the quality of the living environment in Tähtvere was better in 2013 in comparison to the years 2003 and 2008. According to the survey's report, compared to the years 2003 and 2008, quality of life was still the worst in Jaamamõisa. On the other hand, Variku and Supilinn, which in previous periods also had lower quality of life indicators, improved their assessments in 2013. Figure 15 shows that the quality of the living environment is worse in Ränilinn, Ropka-Tööstuse and Jaamamõisa. The same report holds that those three districts presented the following issues: situation and adequacy of green areas and parks, street lighting, traffic situation from a pedestrian perspective, leisure and sport opportunities and their adequacy, among others.

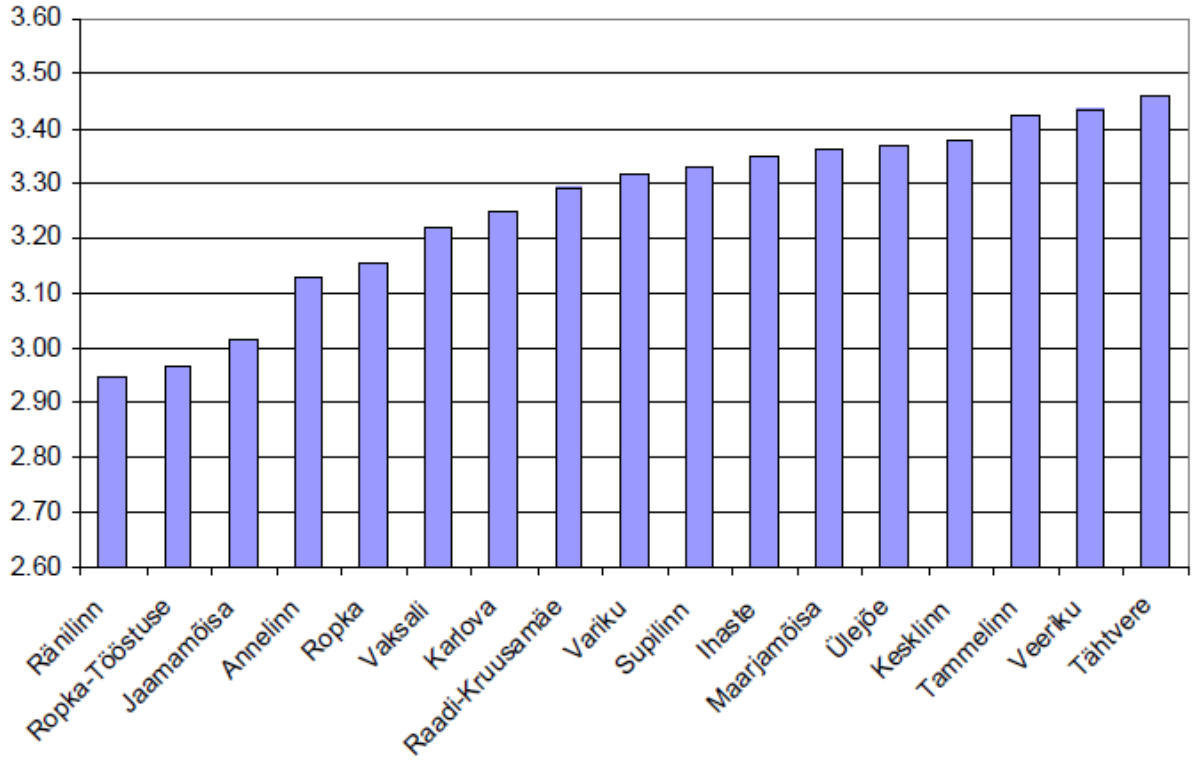


Figure 15 - Quality of the living environment (using five-level satisfaction scale (1) Not satisfied at all and (5) Very satisfied)

Source: 'Küsitlusuuring "Tartu ja tartlased 2013"'(2013)

4.1.2. Portugal, Faro

Faro is a southern Portuguese municipality and the capital of Algarve region (Figure 16), with around 65000 habitats (around 47000 inhabitants live in the city area).

The city has about 711ha and it is located in the limit with "Ria Formosa" Natural Park. This Natural Park, included in Natura 2000 as a special, is composed of a set of barrier islands with a high level of biological diversity, which offers a picturesque landscape to the city. Faro city is compound by parts of the union of two parishes, "Freguesia da Sé e São Pedro".

Figure 16 - Location of Faro City, Portugal
Source: Author

4.1.2.1. Delimitation and characterization of Faro districts

To increase the complexity of the analyses and to compare Faro city with Tartu city, eight districts were defined (Figure 17): (1) Old Town and Historic centre; (2) Urban centre; (3) "Alto Rodes"; (4) "São Luís"; (5) "Bom João" and Industrical area; (6) "Alto de Santo António" and Urban Periphery; (7) "Penha" and (8) "Figuras" and Urban Periphery, based on the morphologic characteristics of the city, the road network ('OpenStreetMap', n.d.), time of construction (Paula & Paula, 1993) and sections and subsections defined by 'Instituto Nacional de Estatística' (2017).

District 1 corresponds to Old Town, still surrounded by walls, and the historic centre that includes historic buildings, the traditional commercial area of the city, and the historic garden "Jardim Manuel Bívar".

District 2 was defined as the urban centre once it represents a strongly densified area of the city. It has associated some structuring buildings, for example, the church of "Carmo", church of "Pé da Cruz" and church of "São Pedro" and one of the most important squares in the city - "Pontinha".

District 3 is characterize, in the centre, by smaller and older buildings with one or two floors and taller and newer buildings near to the main roads. In this district is also included a university polo, a prison, a small abandoned industrial area and the shipyard.

District 4 includes the hospital, the old cemetery, the municipal market, the stadium of “São Luís” and the church of “São Luís”. The residential buildings are manly included in a social housing neighbourhood.

District 5 is characterized by two types of buildings - one or two floor buildings - in the interior part of the district and - taller buildings, maximum of eight floors - in “Bom João” neighbourhood, delimited by the railway line. On the other side of the railway line is located the biggest industrial abandoned area in the city. This area includes a degraded state housing, “Horta da Areia”, where a minority of Roma population lives. On the other side, it has a huge potential once it has a direct visual contact with “Ria Formosa’s” landscape.

District 6 includes the second biggest public green space in the city, “Mata do Liceu” which is connected with the oldest high school in the city. The buildings in this district are mainly single-family houses and new apartments.

District 7 is characterized by a disorderly urbanization mainly represented by residential buildings. This district includes another university polo, the municipal stadium and the municipal pools. In this district is located another state housing in “Avenida Cidade Hayward” which allocates another Roma community. At the same time, there is no public green space in this district.

Finally, district 8 represents the less urbanized part of the city, however, is where are located the most recent residential buildings of Faro. The biggest and newer public green park, “Parque Ribeirinho de Faro” is included in this district and also the smaller park next to the newer cultural and commercial area in the city where “Forum Algarve” and theatre of “Figuras” stands out.

Each district (Figure 17) has associated many sections and subsections previously defined by ‘Instituto Nacional de Estatística’ (2017). Thus, the number of inhabitant (Table 4) in a specific district results in the sum of the number of inhabitants in each sections and subsections included in that district. The districts with higher density of habitants are “São Luís” and “Alto Rodes”. On the other hand, “Bom João” and Industrial area and “Figuras” and Urban Periphery are the districts with less inhabitants per hectare.

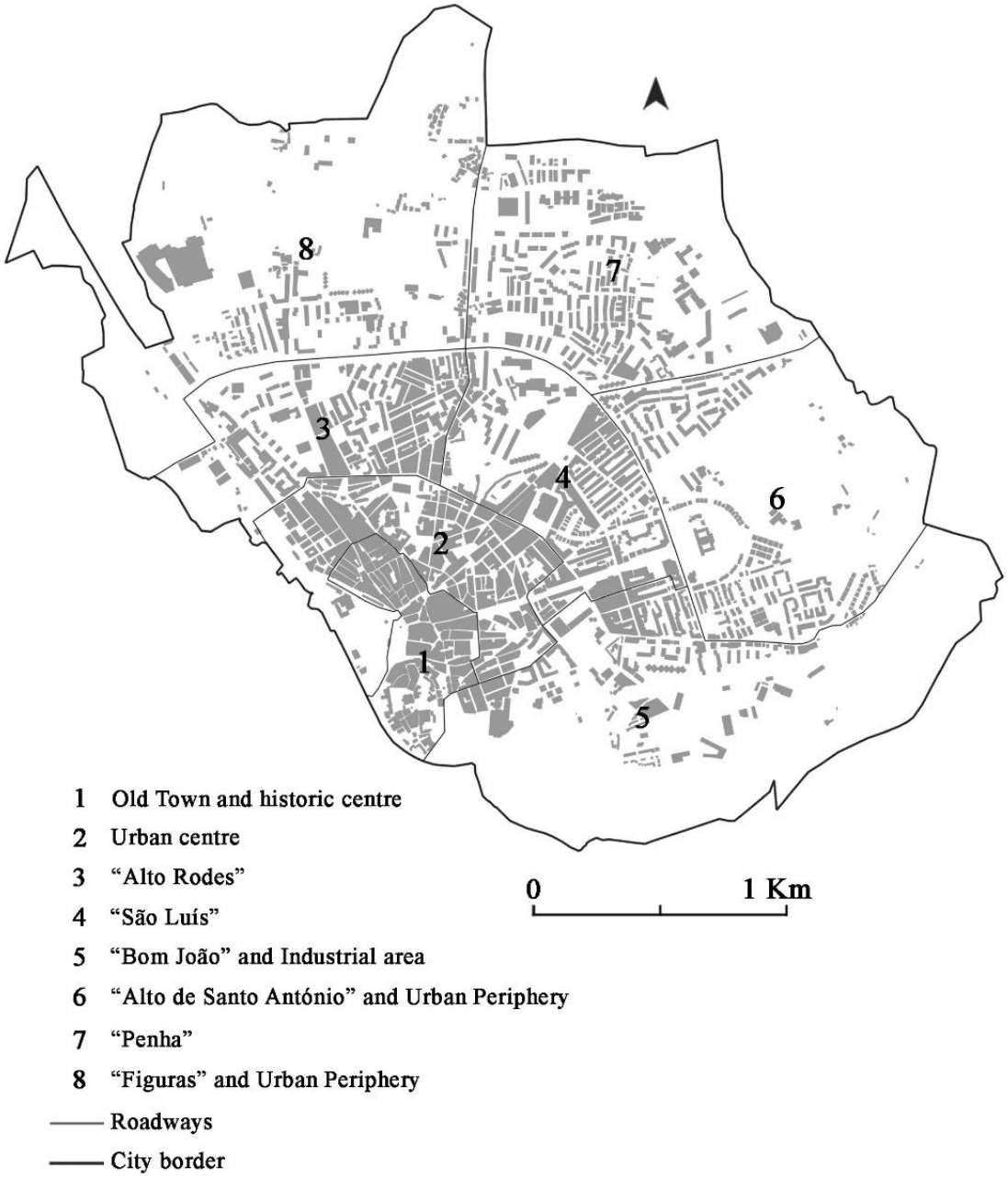


Figure 17 - Faro district

Source: Map elaborated by the author using QGIS 2.16.3, based on information from 'Instituto Nacional de Estatística, (2017) and 'OpenStreetMap' (n.d.)

Table 4 – Characterization of Faro district

Source: Table elaborated by the author, based on information from 'Instituto Nacional de Estatística' (2017)

Districts	Total area (ha)	Total Population	Density (inhab/ha)
Old Town and Historic centre	26	1170	45
Urban centre	52	3535	68
"Alto Rodes"	57	5659	99
"São Luís"	58	7089	122
"Bom João" and Industrical area	146	4141	28
"Alto de Santo António" and Urban Periphery	105	6600	63
"Penha"	100	8170	82
"Figuras" and Urban Periphery	167	4851	29

4.1.2.2. Public green spaces in Faro

There are about four public green spaces in Faro with at least 1ha (Figure 18). The oldest public green spaces in the city are "Jardim da Alameda" (Figure 19). This garden has several leisure equipments including a playground, a miniature golf, sports equipment and a geriatric park (CM-FARO, n.d.) and it is connected with one of the municipal library's entrances. In the last few years this public garden has received some events of the city. "Mata do Liceu", located in district 6, is a public park used mainly for the practice of physical exercise, since it has some sports equipment. The "Parque Ribeirinho de Faro" (Figure 19), built in 2011, is the biggest and newer public green space in the city with about 16ha. This area establishes a visual connection with "Ria Formosa's" landscape and include a wide range of equipments, for example, an amphitheatre, squares, a picnic area, an outdoor gym that are arranged along the park and a cycling path along the "Ria Formosa". In the future, it is expected to extend this park along the "Ria Formosa" and, consequently, the connection of the city with the beach "Ilha de Faro" ('Site Autárquico - Câmara Municipal de Faro Açõe e projetos', n.d.). "Parque Lazer das Figuras" (Figure 19) is a small and flexible green area associated mainly to sports practice and to small events or fairs. Arranged in a minimalistic way with a large (0.85 ha) central open field and the rest of the space is arranged peripherally with places of activity: playground; small,

fenced football field; tennis court; and pocket-sized outdoor gym a small-scale building that hosts a pizzeria. “Parque de Lazer das Figuras” continues to be developed with the help of some recurring local initiatives (Herman et al., 2018).

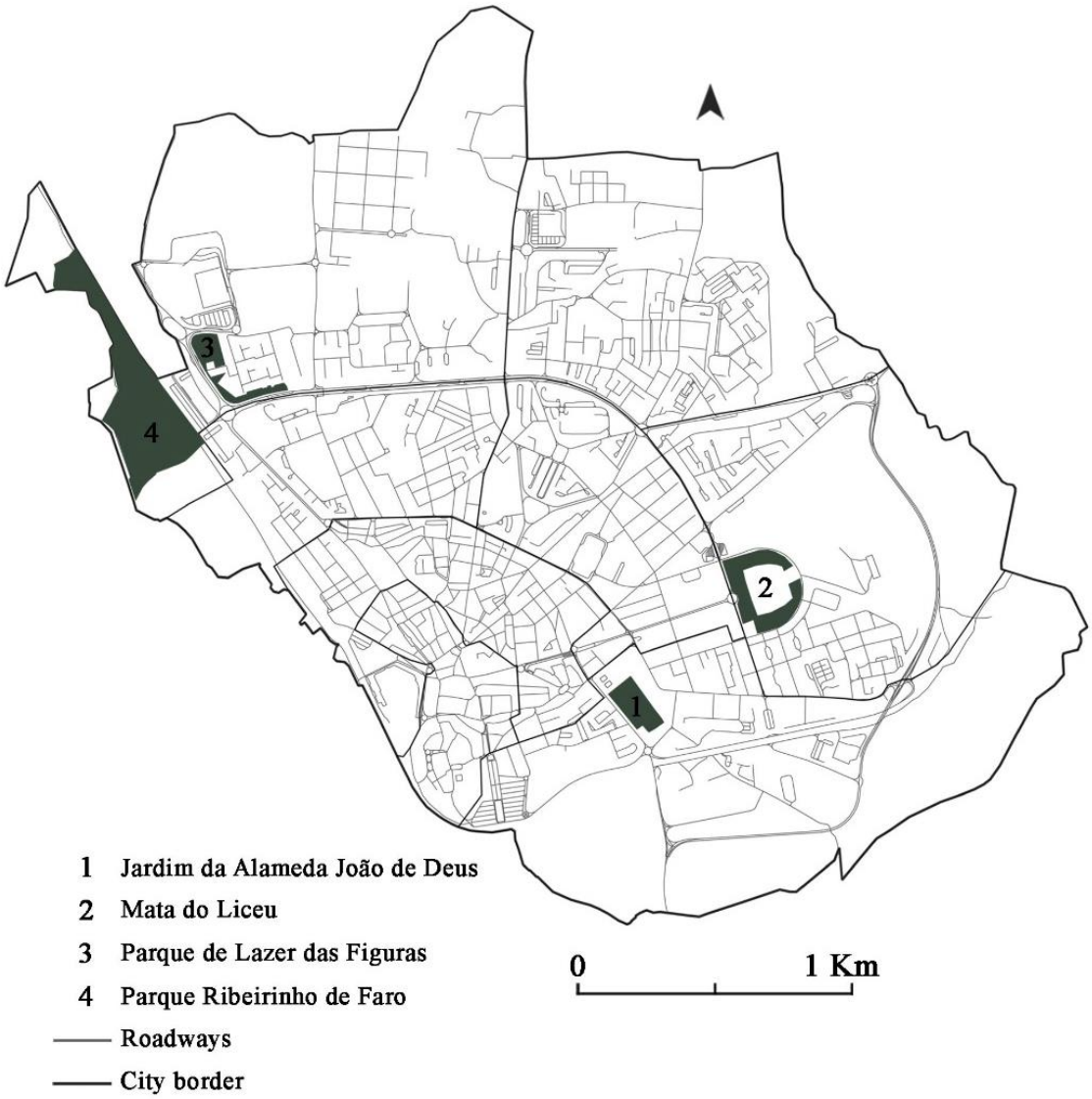


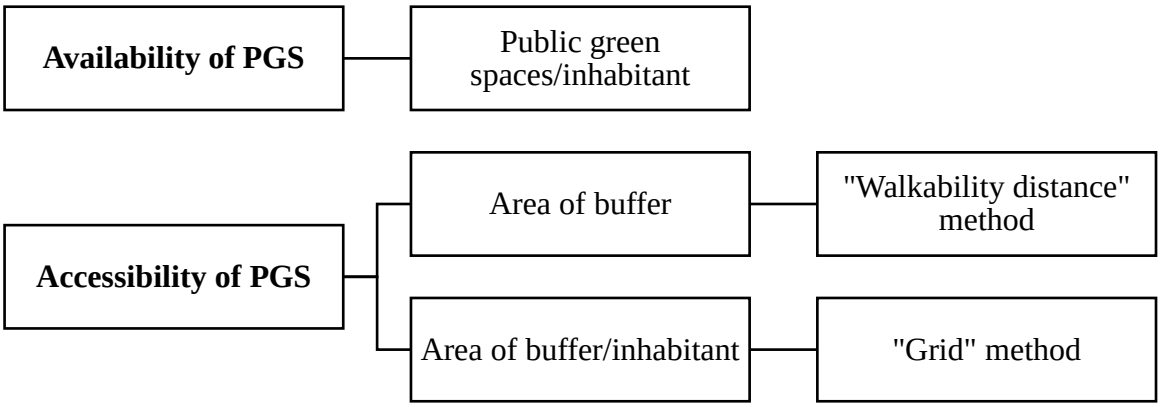
Figure 18 - Location of high quality public green spaces in Faro with at least 1 ha

Source: Map elaborated by the author using QGIS 2.16.3, based on information from Google Earth (2016) and ‘OpenStreetMap’ (n.d.)

Figure 19 - Public green spaces in Faro - "Jardim da Alameda João de Deus", "Parque de Lazer das Figuras" and "Parque Ribeirinho de Faro", respectivel and Mata do Liceu.
Source: 'Site Autárquico - Câmara Municipal de Faro Parques e Jardins' (n.d).

4.2.Quantitative indicators

The following diagram organizes the methodology use in this study.



As a quantitative indicator I considered the *area of public green spaces per district* and the *area of green space per habitant*, assuming the total area of the city and the area per district.

As suggested by Dai (2011), I measured the area of public green spaces per district, using QGIS 2.16.3., in order to compare the results in the distinct districts of Tartu and Faro. For example, in Tartu it was especially pertinent to compare the area of public green spaces in districts developed during the soviet period with the newer ones. The area values can be further related to the number of habitants. This relation resulted in two social sustainability indicators.

The first was the total value of green spaces per habitant, which can be used to do a comparison with the value stipulated as sustainable and with other cities' values. The second was the calculation of the green space per habitant of a specific urban nucleus. The above values are indispensable to classify the degree of environmental justice in the distribution of green infrastructure through the city's habitants.

To calculate the accessibility of public green spaces were adopted two distinct methods – the "walkability" distance method and the gird method (Kabisch et al. (2016)). Although both methods measure urban area that is accessible to public green space the results will be different once the first one estimates the accessible area (ha) using two buffers and grid method incorporates also the population density.

The "walkability" distance method, using buffers around the public green spaces within the administrative boundaries of 300 metres (4 minutes' walk distance) and 500 meters (approximately 7 minutes' walk distance). There are several divergences in the literature about the minimum distance that a public green space should be from the place of residence. For that reason, was considered relevant use two distinct distance buffers. In the first place, because is considered that children and elderly people may have reduced mobility, and so must travel a shorter distance (300m) to reach a public green space, than the rest of the population. In the second place, to compare if there is significant differences in the results using both distance buffers. Although some researches that used the same method consider only public green spaces with 2ha or more (for example Kabisch et al., 2016), in this dissertation was included the public green spaces with at least 1ha in order to compare the results in Tartu and Faro, since the public green spaces in Mediterranean cities tend to have less area than in the Nordic ones and also because Faro has a smaller area than Tartu, that suggests that the same city has smaller public green spaces.

Data from diverse sources was used to select the public green spaces in Tartu. The Estonian Land Board, Green Map System, Tartu linn open data and Google Earth were the source of data to select the current public green spaces with high quality and to select the future public green spaces in Tartu were used data from "Tartu Linna Üldplaneering", a general planning for 2030. Moreover, were only considered the hubs with at least 1ha and classified as green spaces ("HP – haljasala"), forest park ("HM - parkmetsa maa-ala") and recreational sports and cultural facilities ("PV - puhke-, spordi- ja kultuurirajatise maa-ala") which includes, for example, the Tartu Ülikool botanical garden. The public green spaces from Faro city were

defined using a map provided by the municipal authority. For both cities, the individual and total area of public green spaces was measured using QGIS 2.16.3.

To relate the population density and accessibility of public green spaces of Tartu and Faro it was developed a method based on Kabisch et al. (2016). The walkability distance method maps were developed using a buffer of 300m and 500m and then were intersected with a 1ha grid within city borders. In each grid unit it was calculate the area of public green spaces per inhabitant. For each district it was used a different value of population density corresponding to the division between the total number of inhabitants and the total area of each district. Using different population densities allows the results to get closer to the reality of each district. Finally, it was created a five level scale to classify the accessible area for public green spaces, in square meters per inhabitant, using the two different distance buffers.

4.3. Data

4.3.1. Land uses

In order to analyse the evolution of the soil uses in Tartu city (Appendix A - 01) was used statistic data about the evolution of land uses, between 1998 and 2017, collected from Tartu in Figures (‘Statistics | Tartu linn’, n.d.). This information is important for this research for two reasons. In the first place, because it allowed to make a deeper characterization of the city and, in the second place, it shows the evolution of the public parks and green areas in the city that can reflect the importance given to this use.

Table 5 quantifies the area of yards, buildings, trees and grassland per district of Tartu. Is relevant to analyse this information because it characterize each district relatively to the green space and urbanized area. Also, as asserted previously there are two main types of buildings in Tartu city that are directly related with the area of yards. For example, Tammelinn, Ihaste, and Karlova are districts with higher area of yards and the majority of the buildings in these districts are single-family houses as already described.

Table 5 - Area of land use per district of Tartu,

Source: Table elaborated by the author using QGIS 2.16.3 to calculate the areas, information extracted from Estonian Land Board

Districts	District Area	Yards (ha)	Buildings (ha)	Trees (ha)	Grassland (ha)	Other (ha)
Annelinn	542	41,3	31,67	43,6	225,0	113,6
Ihaste	425	129,7	21,90	99,8	118,7	8,7
Jaamamõisa	143	26,1	10,38	8,1	37,1	25,2
Karlova	229	118,8	42,85	0,8	11,3	24,0
Kesklinn	180	45,3	38,31	15,5	5,9	34,1
Maarjamõisa	135	39,5	13,42	13,4	15,9	19,7
RaadiKruusamäe	290	107,8	30,18	42,6	57,3	39,0
Ropka tööstusrajoon	360	122,2	36,92	2,7	115,2	38,5
Ropka	147	71,9	21,77	9,6	11,8	21,6
Ränilinn	122	9,8	9,55	4,2	17,5	13,0
Supilinn	70	30,9	7,27	1,8	19,7	0,5
Tammelinn	289	192,2	42,54	0,8	29,9	18,3
Tähtvere	228	99,0	21,30	18,5	69,2	40,1
Vaksali	77	58,0	14,72	0,0	9,3	3,8
Variku	77	37,5	9,18	0,0	20,9	2,4
Veeriku	280	121,6	35,65	8,9	51,8	31,6
Ülejõe	304	79,2	26,68	53,4	72,1	27,4

4.3.2. Ethnic Nationalities and Minorities

In order to evaluate the access to the pubic green spaces based on the ethnic differences of the society, was collected data from ‘Statistics Estonia’ (2017) about the number of ethnic nationalities per district of Tartu (Table 6). The same data was converted on a bar chart (Figure 20) that includes the measures in percent of the Estonians, Russians and other nationalities per district of Tartu city. This information is relevant to identify the location of the ethnic minorities in the city and posteriorly, compare with the distribution of public green spaces in the city.

Figure 20 shows that the districts with higher number of ethnic minorities, mainly Russians, were Jaamamõisa (39% of Russians and 8% of other nationalities), Annelinn (28% of Russians and 5% of other nationalities) and Ropka Tööstusrajoon (16.4% of Russians and 3.4% of other nationalities). On the other side, the districts with less ethnic minorities were Variku, Tähtvere, Tammelinn and Karlova.

Table 6 - Number of Tartu's district residents per ethnic nationality
Source: Adapted from 'Statistics Estonia' (2017)

District	Total population	Estonians	Russians	Ukrainians	Belarusians	Other nationalities
Annelinn	27042	18164	7560	468	177	676
Ihaste	2690	2326	293	20	8	72
Jaamamõisa	3399	1811	1314	106	47	121
Karlova	9627	8963	462	39	3	161
Kesklinn	6994	6045	584	26	14	336
Maarjamõisa	1454	1289	142	7	5	14
Raadi-Kruusamäe	4578	3783	659	38	20	80
Ropka tööstusrajoon	3247	2601	534	25	15	73
Ropka	5077	4656	333	25	5	65
Ränilinn	1678	1504	136	9	2	29
Supilinn	1925	1784	86	4	2	54
Tammelinn	6694	6356	237	20	6	77
Tähtvere	3434	3238	113	10	3	70
Vaksali	3126	2769	254	12	5	90
Variku	1773	1657	95	2	2	18
Veeriku	5411	4832	453	24	18	86
Ülejõe	9110	7695	1012	56	22	328

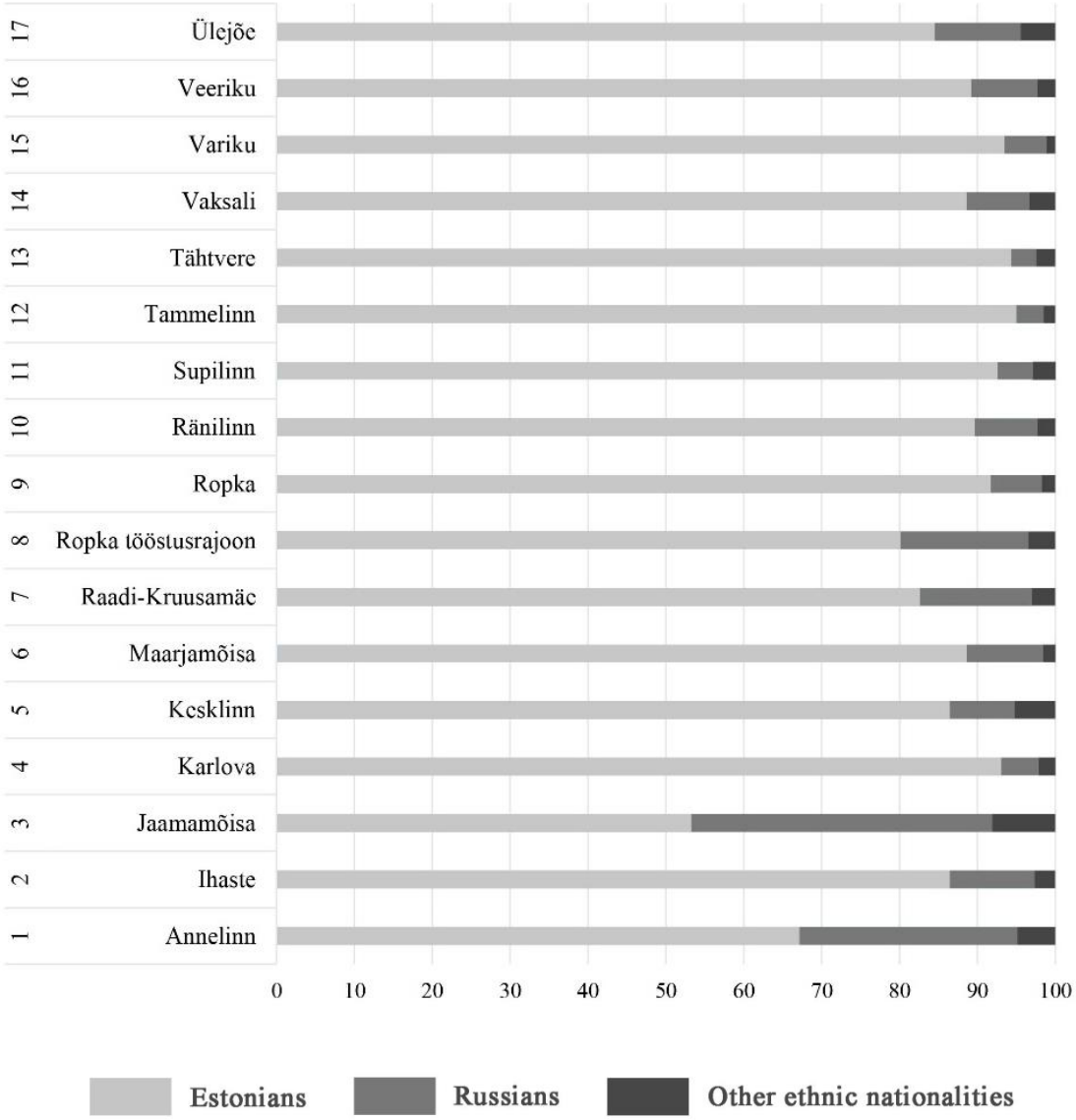


Figure 20 - Ethnics nationalities per district of Tartu (%),

Source: Adapted from 'Statistics Estonia' (2017)

In Faro, the number of immigrants has been decreasing over the years. There were 11.2%, in 2010, and 9.9% in 2016. However, there is no available data relating ethnic nationality with place of residence. Despite this, it is possible to identify a Roma minority in Faro. Roma families occupy three distinct types of habitat: (1) camps in rural areas on the peripheries; (2) poor housing or poor housing conditions located in devalued areas of the city and (3) neighbourhoods of housing estate resulting from rehousing projects (S. R. Santos &

Marques, 2014). The Figure 23 shows the location of four main Roma communities in Faro. This data was based on site visits and brief periods of observation.

"Lejana de Cima" and "Cerro do bruxo" (Figure 22) are two neighbourhoods, located in the periphery, mainly composed by tents and contraries without piped water, sewage or light (S. A. Santos, 2013). "Bairro da Horta da Areia" (Figure 21) and "Bairro da Av. Cidade Hayward" (Figure 22) are housing estate neighbourhoods. These two neighbourhoods were built also in areas far from the city centre, with difficult access to the services, which seems to reinforce the segregation of the communities living there. Furthermore, they have low conditions, for example, the dwellings' area is very small, there is no mobility conditions for people with disabilities or elderly people and there are no common or leisure space (Dias, et al. 2002 and Magano, 2007 in S. A. Santos, 2013). "Bairro da Horta da Areia" was built during the 70's to house temporarily migrants from old former colonies. However, this neighbourhood compose by masonry, prefabricated houses and containers, still housing many families living in miserable conditions.

Figure 21 - "Bairro da Horta da Areia", Faro, 2014
Source: Google Earth (2014)

“Bairro da Av. Cidade Hayward” (Figure 22) was built 20 years ago to house families from “Bairro da Horta da Areia” and another estate housing neighbourhood of the city. The neighbourhood has small entrances and the composition is labyrinth which makes it appear that the neighbourhood is “closed” to the rest of the city.

Figure 22 - "Bairro da Av. Cidade Hayward " and “Bairro Cerro do Bruxo” Faro, 2014, respectively
Source: Google Earth (2014)

There are still other Roma clusters in Faro that live in abandoned old houses or containers that were not identified in the Figure 23 because they have a small dimension.

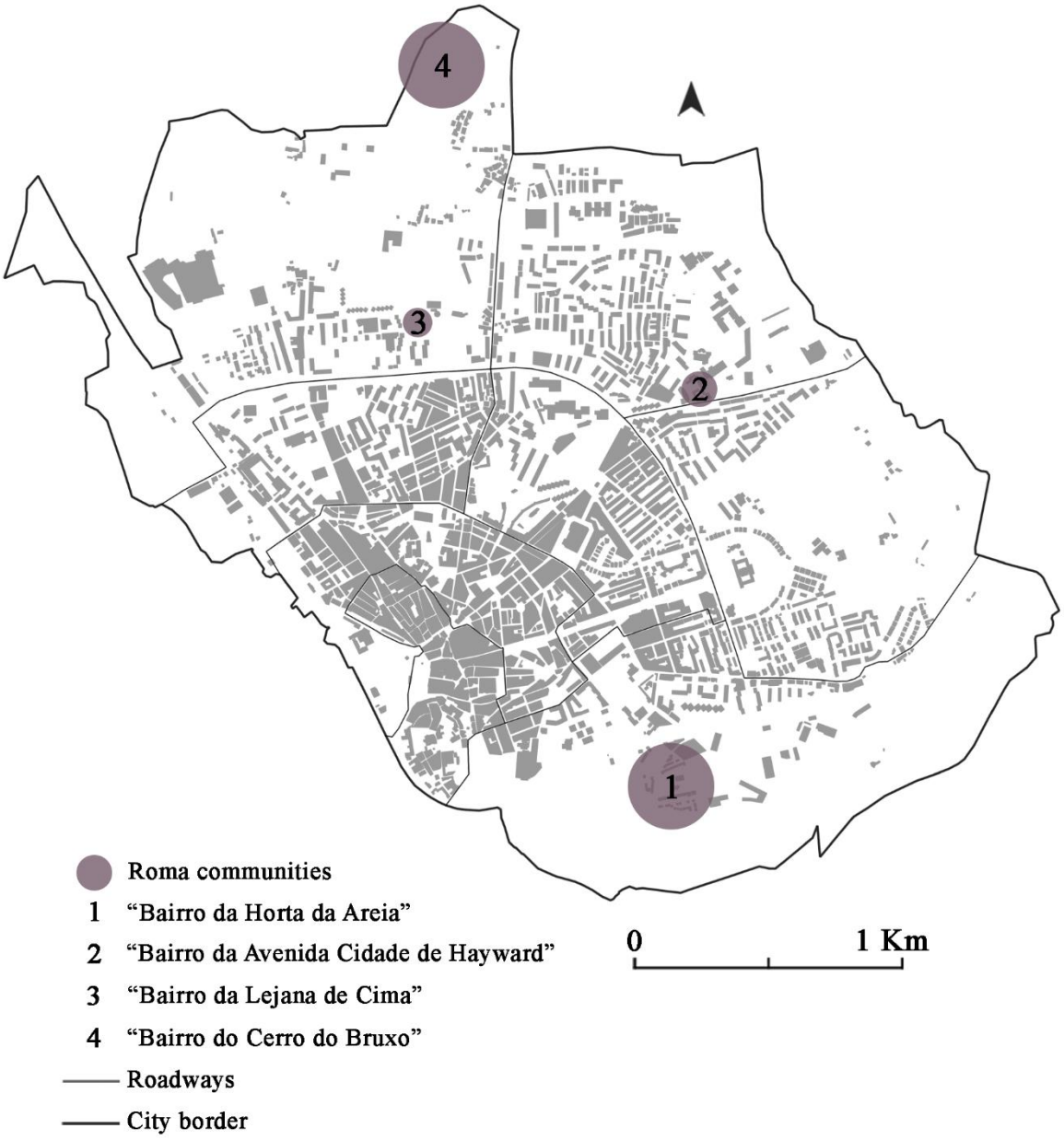


Figure 23 - Location of Roma communities in Faro

Source: Author

4.3.3. Time of construction

The quantitative data about time of construction was collected from two sources in order to understand, in the first place, the exact number of dwellings (apartment buildings, single-family homes, apartments, houses and other small non-residential buildings) built in a certain period of time and, in the second place, the location and distribution of those dwellings around the city. The quantification of conventional dwellings in time (Table 7) and the diagram (Figure 24) which illustrates the data in the table, was gathered from 'Statistics Estonia' (2017). The urban growth map (Figure 25), that represents the year of construction and the buildings' location, was collected from local cartography, belonging to different years – 1935, 1947, 1963, 1977, 1989, 1999 and 2008 - available on 'Estonian Land Board: Geoportal: Historical Map Collection Application' (n.d.). The historic cartography was posteriorly georeferenced in QGis 2.16.3, using Estonian Land Board cartography as base. Thus, it was possible to overlay all the historic cartographies and to identify in which period of time the buildings would have been constructed. This data was fundamental to relate conventional dwellings' period of construction with the availability and accessibility of public green spaces in Tartu.

To elaborate the diagram (Figure 24) I considered the subdivisions of the districts proposed by 'Statistics Estonia' (2017) (Appendix B - 02).

According to Figure 24 the districts with highest urban development, more than 1500 dwellings (identified with black colour), over the years, were the Ees-Karlova, before 1944, and Anne II since 1971 until 1989. On the other side, the district with lowest urban growth (less than 100 dwellings), over the considered period of time, was Veeriku tööstusrajoon.

Table 7 - Time of construction in conventional dwellings (apartment buildings, single-family homes, apartments, houses and other small non-residential buildings)
Source: Adapted from ‘Statistics Estonia’ (2017)

District	Before 1919	1919 to 1944	1946 to 1959	1961 to 1969	1971 to 1979	1981 to 1999	2001 to 2004	2006 or later
Annelinn	11	44	60	1157	4816	5642	198	191
Ihaste	2	1	2	45	140	65	136	142
Jaamamõisa	13	0	6	56	717	478	25	391
Karlova	907	1477	330	245	64	947	228	322
Kesklinn	714	157	472	1196	88	0	108	72
Maarjamõisa	13	4	151	71	7	2	34	46
Raadi-Kruusamäe	142	223	293	156	438	397	26	46
Ropka tööstusrajoon	6	0	22	288	452	356	0	12
Ropka	2	71	342	230	1079	218	66	21
Ränilinn	0	9	7	3	523	240	1	0
Supilinn	425	173	37	24	1	0	26	101
Tammelinn	17	529	350	308	547	217	55	88
Tähtvere	97	371	224	148	346	39	20	5
Vaksali	470	453	41	145	99	63	119	133
Variku	1	17	58	79	156	159	17	16
Veeriku	34	73	196	337	389	982	29	284
Ülejõe	515	409	303	1456	197	256	256	432

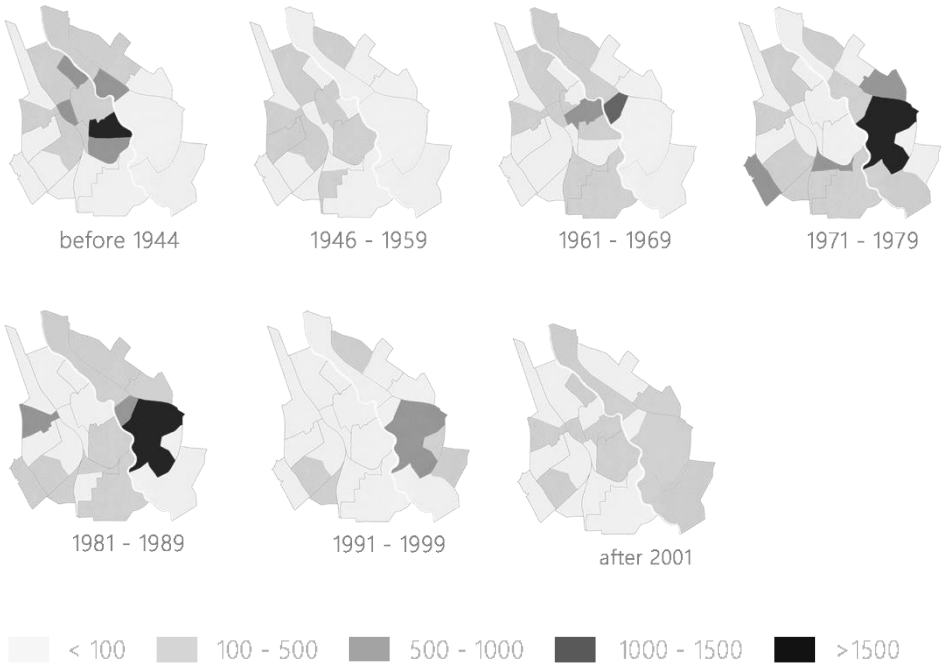


Figure 24 – Number of conventional dwellings (apartment buildings, single-family homes, apartments, houses and other small non-residential buildings)

Source: Adapted from Table 7.

Figure 25 shows the urban growth process, per district, in Tartu city. The older buildings (before 1935) are located in Kesklinn, Supilinn and Ülejöe. During the soviet regime (since 1941 to 1991) the urban grown was stronger in Annelinn, Ihaste, Jaamamõisa, and Ropka. During the last few years the development of new buildings were not so intense, however it is possible to observe new buildings in the north part of Ülejöe district and along the banks of the Emajõgi river. Additionally, the map shows a clearly difference between the shapes of the single-family houses and the soviet-era housing blocks (Figure 12), mainly in Annelinn district.

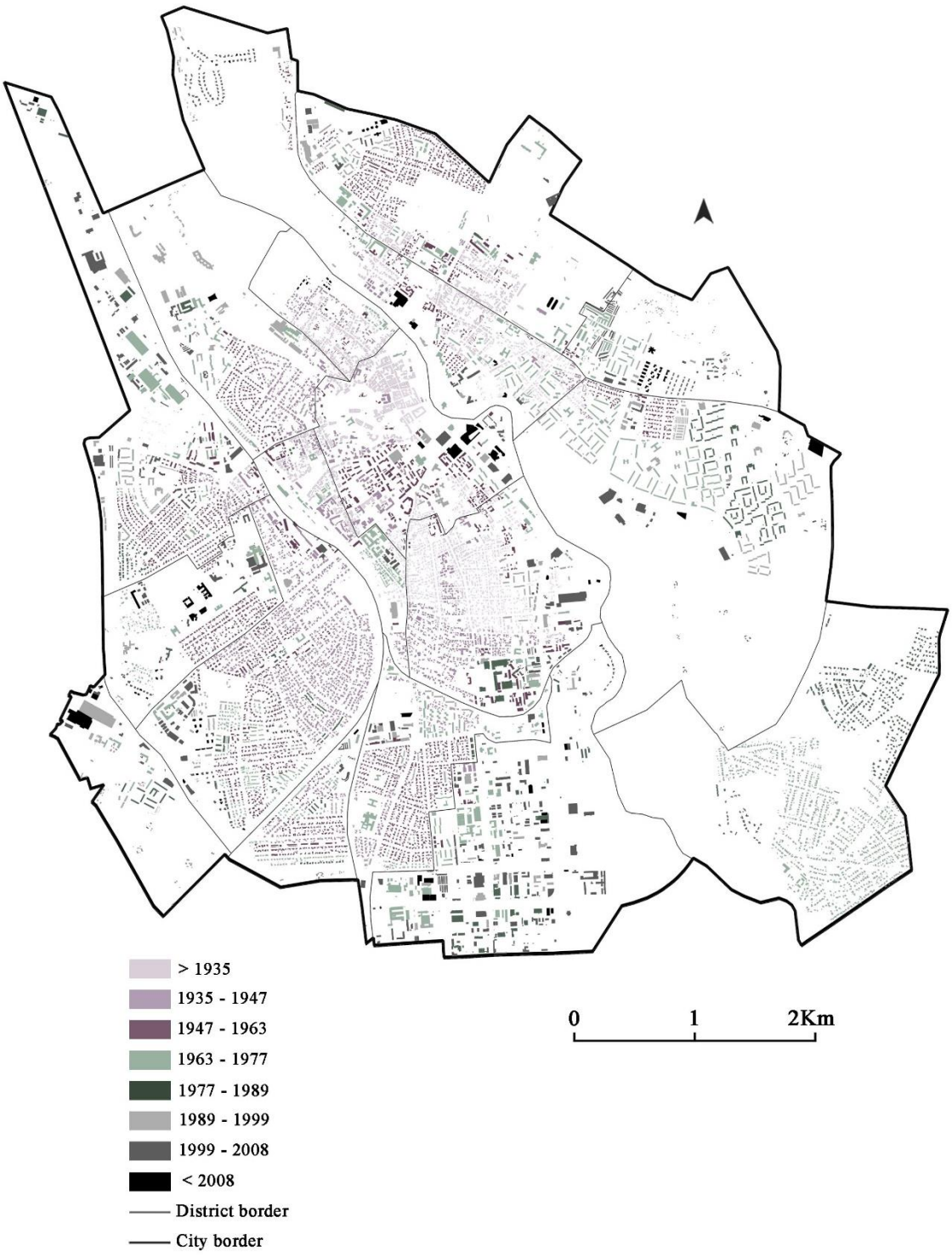


Figure 25 - Urban growth in Tartu,

Source: Map elaborated by the author using QGIS 2.16.3, information extracted from Estonian Land Board Geoportal

The urban growth in Faro (Figure 26) is characterized by six main periods.

As described by Paula & Paula (1993), before the 13th century there was the structuring of old town, also called "Vila-a-dentro" and the expansion of two extramural nuclei that were densifying at the end of this period. During the next few centuries, until 15th century, new areas outside the old town were created and integrated into the global organic structure of the city. In the beginning of the next period (15th to 19th century) there was an intense urban growth and the construction of the 2nd "cerca" that would delimit the urban perimeter at that time. The end of the same period was characterized by urban containment and the end of the organic growth of the city. The 19th and 20th centuries were characterized by a rational growth of the city and the destruction of the 2nd "cerca". The same period was characterized by an industrialization and were installed new industries, the railway line as well as the most important avenues of the city. Finally, urban expansion in 21st century follows the same pattern as in previous centuries. In this period stands out the urbanization of urban gardens the installation of equipment of regional dimension (Paula & Paula, 1993).

Figure 26 - Urban growth in Faro,

Source: Map elaborated by the author, information extracted from Paula & Paula (1993)

4.3.4. Tartu Linna Üldplaneering

"Tartu Linna Üldplaneering" is the most important document of the spatial development of the city, which determines the general conditions for construction and land uses. This plan, that considers the city planning for 2030, was adopted and publicized in March 2017.

The Master Plan highlights Tartu as an open international University campus, which has, together with its neighbourhoods, become a coherent city area. The general plan also emphasizes the development of the centre of the city, the development of the Maarjamõisa and the Raadi-kruusamäe district, the closer integration of business with the existing housing environment of the city, and the preference of apartment buildings for private houses not yet built up ('Open data | Tartu linn', n.d.).

Figure 27, shows the master plan for the proposal of Green Network and Recreational Areas.

Figure 27 – Green Network and Recreational Areas of Tartu Linna Üldplaneering

4.3.5. Proposal for Faro

In order to compare both cities with regard to the availability and accessibility of future public green spaces, it was necessary to develop a proposal for Faro, which would meet the proposal already developed for the city of Tartu, presented in the previous chapter.

This proposal was developed with the aim of increasing the number of green spaces and, consequently, to promote the equal distribution of these areas in Faro.

The following map (Figure 28) identify the location of the main problematic areas in the city and the respective proposed solutions for these issues.

It is suggested the development of "Penha" Urban Park (A) and the redevelopment of the industrial area (B) promoting the connection between inhabitants and "Ria Formosa". For the most urbanized area and so the area without space to developed new green areas, that includes the districts 1, 2 and 3, it is proposed the construction of green roofs in the top of the buildings and plantation of trees along the streets to promote the connection of the existent green areas and the continuity of ecological flows. In the Old Town area, included in district 1, it is proposed the rehabilitation of private abandoned yards as urban agriculture allotments, establishing a connection between these areas with the existing public green areas and enhancing city resilience (Panagopoulos et al., 2018). Those abandoned private yard, for being located in a historic district and for being close to the "Ria Formosa", have a high ecological and recreational potential in the city, especially for the inhabitants of the old city that are mostly elderly people. It is also important to highlight that those proposals must integrate the ideas, expectations and suggestions of the inhabitants (Karanikola et al., 2016) and visitors (Karanikola et al., 2017).

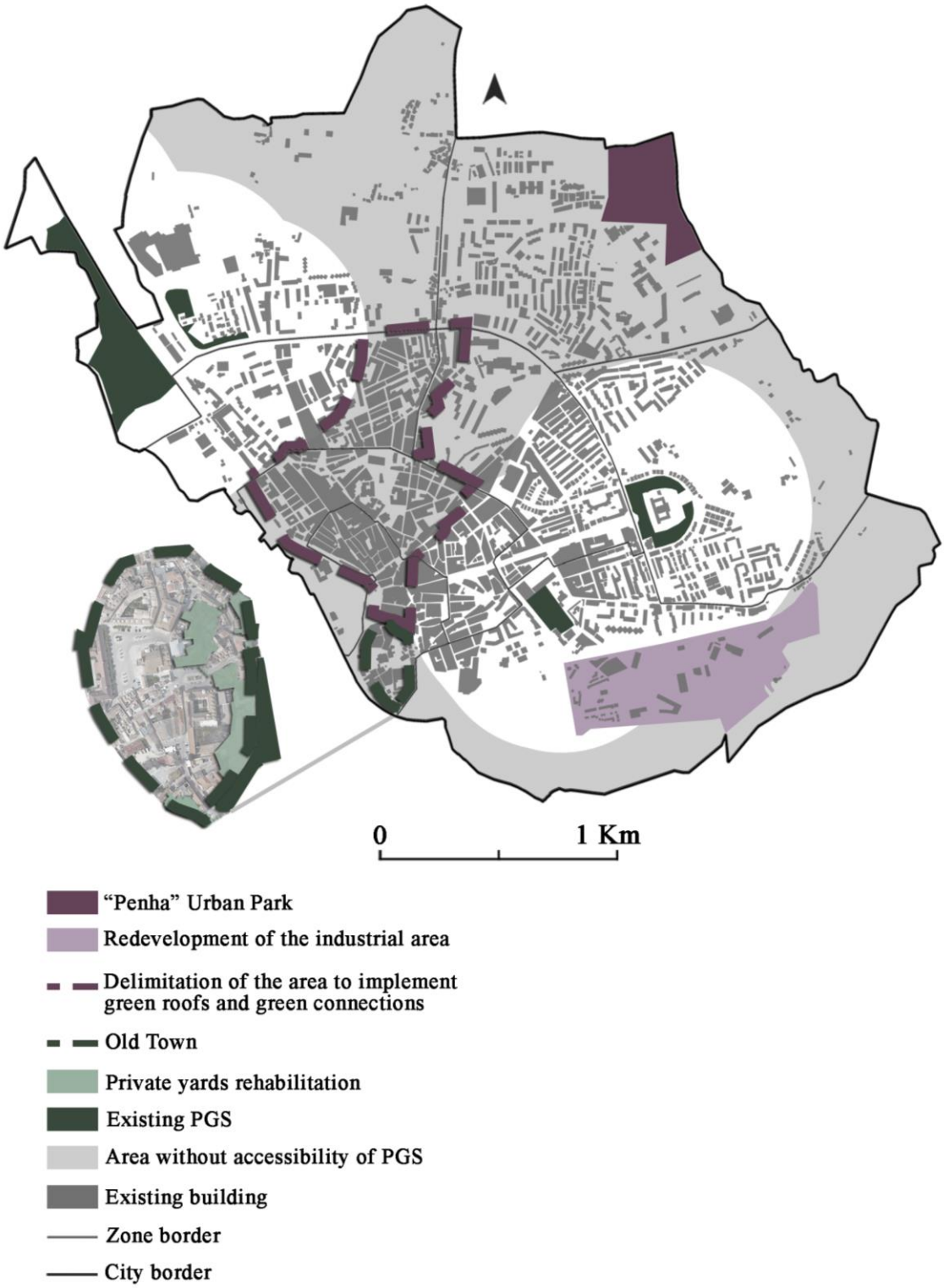


Figure 28 - Proposal for Faro

4.3.6. Green gentrification

Following the discussion above, I considered pertinent to approach the concept of green gentrification and, at the same time, the hypothesis of this phenomenon occurs in Faro. In order to discuss the subject later, it is also made a brief comparison with popular projects that have resulted in gentrification.

The green gentrification is a phenomenon that happens when the implementation of a new public green space, with high quality, changes the dynamics of an abandoned and degraded area by expelling residents once they cannot afford the rent of the dwellings or because the new project does not integrate the community in the area. Taking this in account, and comparing it with Tartu and Faro cases, in my view, this phenomenon is more likely to occur in Faro than in Tartu since there is more available area with capacity to develop new green spaces in Tartu than in Faro. In addition, Tartu presents, in general, a typology of buildings that allow the existence of private gardens, which are an alternative to the access of public green spaces by the residents of these single-family houses.

In Faro, the industrial abandoned area, included in district 5, is a privileged area of the city once it has a direct contact with the "Ria Formosa's" landscape, a proximity to the city centre and the Faro's airport and an extensive area. Some local news (Claro, 2016a, 2016b) referred that in the place of this former industrial area will be implemented a project of a tourist-residential and a marina (Figure 29), that will occupy 29 hectares of that area. The municipal authority argues that the urban redevelopment project will not compromise the operation of the current commercial port and the high environmental quality that characterizes that landscape. On the other hand, it is affirmed that this area has a total potential value of 300 million euros for the city (Claro, 2016a).

As previously mentioned, there is a state housing located in this district called "Horta da Areia". The residents, mostly of Roma ethnicity, live in this old industrial area since 1970. A few authors have characterized this community as an example of social exclusion in the city of Faro and shown concern due to the problems of poverty, crime and security (Martins & Lucio-Villegas, 2014). Having said that, it is possible to argue that the implementation of a high dimension urban regeneration project located in the same area of "Horta da Areia", will affect directly the life of the residents, since, it is predictable that they will have to be relocated in another part of the city. The same local news, referred that the rehousing of this community

should be done, if possible, in a dispersed way throughout the county of Faro. Thus, this area is assumed with a potential occurrence of gentrification and green gentrification.

Figure 29 – Representation of the urban regeneration project for the Faro industrial area.

Source: Claro (2016a, 2016b)

Although the implementation of this urban regeneration project might be a reality for Faro, another big-scale projects, with a higher environmental impact, can occupy this abandoned industrial area and result in green gentrification.

The EXPO98, in Lisbon, is a good example of an urban regeneration project that resulted in gentrification (Pereira, 2017). It is pertinent to mention this project once it has similar characteristics to the industrial area of Faro. Before the intervention, this site had high levels of contamination and degradation. Despite this, in this area there were a Roma community living in a neighbourhood of housing estate with precarious conditions.

Although the Expo 98 project was an international success due to the application of innovative decontamination techniques (Velez, 2008) and re-establish the relation between the city and Tagus River, it did not integrate the needs of the inhabitants of the area. For this reason, the inhabitants of this neighbourhood had to be relocated in another neighbourhood of housing estate with similar conditions (Dias, 2004). Nowadays this area, represents one of the most expensive and attractive areas in Lisbon. However, it should be note that the success of a project

should not only depend on its economic and ecological benefits but also on social benefits. It is the only way to achieve sustainability.

More recently, in Tallinn, the urban renewal project in the former soviet-era industrial area "Rotermanni Kvartal" is another example of gentrification. This new commercial and residential area, designed by renowned Estonian architects, is strongly changing the dynamic of the city centre. Since housing prices have risen exponentially, only a small part of the population of Tallinn is able to live in this area, enhancing social fragmentation.

In the case of the city of Tartu, in my opinion, and supporting the results obtained, the neighbourhoods built during the Soviet period are where the phenomenon of eco-gentrification may exist since, as stated in the literature, they present poorer conditions than others. However, the fact that there is a wide variety of areas suitable for the construction of new public green spaces and, on the other hand, the fact that Tartu is considered a socially balanced city, reduces the likelihood of this phenomenon to occur.

5. Results

This chapter presents the results using three different methods, described in chapter 4, to calculate the *Availability and Accessibility of pubic green spaces* in Tartu and Faro.

Each sub chapter is organized in three parts, firstly are presented the results for Tartu city, secondly the results for Faro city and, finally, the comparative results.

5.1.Availability of public green spaces

As suggested by Dai (2011), using the *number of inhabitants* and *area of public green spaces* it is possible to calculate the availability of public green spaces.

Table 8, for Tartu, and Table 9, for Faro, show the results considering the public green spaces with at least 1ha and the number of inhabitants in each district.

In Tartu (Table 8), Tähtvere is the district with more availability of public green spaces, around 146 m^2 per habitant. In Maarjamõisa and Supilinn districts there are also a significant area of public green per inhabitant, 126 m^2/inhab and 79 m^2/inhab, respectively. At the other side, Karlova is the district with less availability of public green spaces, about 1 m^2/inhab. Also, in Ihaste, Jaamamõisa, Ropka, Ränilinn, Tammelinn Vaksali, Variku and Veeriku there are less than 10 m^2 of PGS per inhabitant.

Table 8 – Area of public green spaces per inhabitant per district of Tartu city

Districts	Number of inhabitants	Public green spaces (m^2)	Public green space per inhabitant (m^2/inhab)
Annelinn	27042	398900	14.75
Ihaste	2690	>10000	3.72
Jaamamõisa	3399	>10000	2.94
Karlova	9627	>10000	1.04
Kesklinn	6994	292100	41.76
Maarjamõisa	1454	183400	126.13
RaadiKruusamäe	4578	160500	35.06
Ropka tööstusrajoon	3247	72600	22.36
Ropka	5077	29700	5.85
Ränilinn	1678	>10000	5.96
Supilinn	1925	151700	78.81

Tammelinn	6694	11650	1.75
Tähtvere	3434	563400	164.07
Vaksali	3126	>10000	3.20
Variku	1773	>10000	5.64
Veeriku	5411	>10000	1.85
Ülejõe	9110	89000	9.77

In Faro (Table 9), there is low availability of public green spaces in the majority of the districts, less than 10 m^2 per inhabitant. Exceptionally, in district 8, "Figuras" and Urban Periphery, there is about 31 m^2 of public green space per inhabitant.

Table 9 - Area of public green spaces per inhabitant per district of Faro city

Districts	Number of inhabitants	Public green spaces (m^2)	Public green space per inhabitant (m^2/inhab)
Old Town and Historic centre	1170	<10000	<8.55
Urban centre	3535	<10000	<2.83
"Alto Rodes"	5659	<10000	<1.77
"São Luís"	7089	<10000	<1.41
"Bom João" and Industrial area	4141	19700	4.76
"Alto de Santo António" and Urban Periphery	6600	35900	5.44
"Penha"	8170	<10000	<1.22
"Figuras" and Urban Periphery	4851	152500	31.44

The World Health Organization (2010) recommends that should exist at least 9m^2 of green space per person and the ideal area would be 50m^2. Comparing these reference values with the results in Table 8, referent to Tartu, it is possible to assert that the districts of Ihaste, Jaamamõisa, Karlova, Ropka, Ränilinn, Tammelinn, Vaksali and Veeriku have less area of public green space per inhabitant than the suggested by The World Health Organization.

Comparing with the same source, only Maarjamõisa, Supilinn and Tähtvere have over the ideal value for the area of public green spaces per habitant. However, in this analysis is important to note that most of the districts with the lowest value of public green space per inhabitant in Tartu have a high area of private yards, as shown in Table 5.

In Faro (Table 9) the majority of the districts have less than the recommended value by the World Health Organization (2010). Even though, "Figuras" and Urban Periphery has 31.44 m^2 per habitant is still less than the ideal area of 50m^2 assumed by the same organization.

Availability of public green spaces was varying from 1.22 to 31.44m^2/inhabitant in districts of Faro and 1.04 to 164.07m^2/inhabitant in districts of Tartu, which clearly means that there is more availability of public green spaces in Tartu than in Faro. However, "Figuras" and Urban Periphery district, in Faro, has more PGS per inhabitant than the majority of Tartu districts.

5.2. Accessibility of pubic green spaces

This subchapter presents the results of "walkability" distance method and grid method for both cities, Tartu and Faro, in the first place, considering the existing public green spaces and, in the second place, the future public green spaces included in"Tartu Linna Üldplaneering" and in the proposal for Faro, presented in chapter 4.

Figure 30 and Figure 31 show the results of the "walkability" distance method for Tartu city, using a distance buffer of 300m and 500m and two different sources of data described already in subchapter 4.2. Each one of the maps have associate a table (Table 10 and Table 11) that shows the quantitative results of this method, in order to compare the accessible area (ha) in each district. These tables also present the percentage of accessible area in each district.

Table 10 shows that the districts with higher percentage of accessible area are Supilinn where the accessible area covers the total district's area, for both distance buffers; Kesklinn (83%, using a buffer of 300m and 96% using a buffer of 500m); Maarjamõisa (78% and 99%, respectively) and Tähtvere (72% and 93%, respectively). Conversely, the districts with less percent of accessible area of public green spaces are Jaamamõisa and Variku without accessible area in all district, Ränilinn with only 2% considering a buffer of 300m and 16% considering a buffer of 500m, Veeriku with 6% and 16%, respectively, and Ihaste with 4% and 11% considering a distance buffer of 300m and 500m, respectively. It is important to look to the percentage of each district instead of consider only the total accessible are of public green spaces because it considers the total area of each district. The Figure 30 shows the exact area covered by the buffer, that is why is important to look to these two sources together.

Figure 30 - Accessibility of pubic green spaces in Tartu, using the "walkability" distance method (300 and 500 meters buffer)

Source: Author, using QGIS 2.16.3

Table 10 - Quantification of the accessible area to the public green spaces in Tartu defined in Figure 30

Districts	District Area (ha)	Public green spaces (ha)	Accessible area (ha) using 300m buffer	Percent (%)	Accessible area (ha) using 500m buffer	Percent (%)
Annelinn	542	39.89	176	32	280	52
Ihaste	425	<1	16	4	46	11
Jaamamõisa	143	<1	0	0	0	0
Karlova	229	<1	73	32	134	59
Kesklinn	180	29.21	150	83	173	96
Maarjamõisa	135	18.34	105	78	133	99
RaadiKruusamäe	290	16.05	72	25	117	40
Ropka tööstusrajoon	360	7.26	53	15	95	26
Ropka	147	2.97	28	19	49	33
Ränilinn	122	<1	2	2	19	16
Supilinn	70	15.17	70	100	70	100
Tammelinn	289	1,17	68	24	124	43
Tähtvere	228	56.34	164	72	213	93
Vaksali	77	<1	39	51	53	69
Variku	77	<1	0	0	0	0
Veeriku	280	<1	17	6	47	17
Ülejõe	304	8.90	120	39	194	64

In Figure 31 was used the same method, however was considered the Green Network and Recreational Areas data available in “Tartu Linna Üldplaneering”, a general planning for 2030. Moreover, were only considered the hubs with at least 1ha and classified as green spaces (“HP – haljasala”), forest park (“HM - parkmetsa maa-ala”) and recreational sports and cultural facilities (“PV - puhke-, spordi- ja kultuurirajatise maa-ala”) which includes, for example, the Botaanikaaed. Thus, in this case, the districts with high percent of accessible area to the public green spaces (Table 11) are Supilinn, Jaamamõisa, Kesklinn and Ränilinn while the districts with less percent of accessible area of public green spaces are Tammelinn, Veeriku and Ropka tööstusrajoon, for both distance buffers. There are different results comparing the Figure 30 and Figure 31 that will be analysed later, besides the fact that was used a different source in both maps.

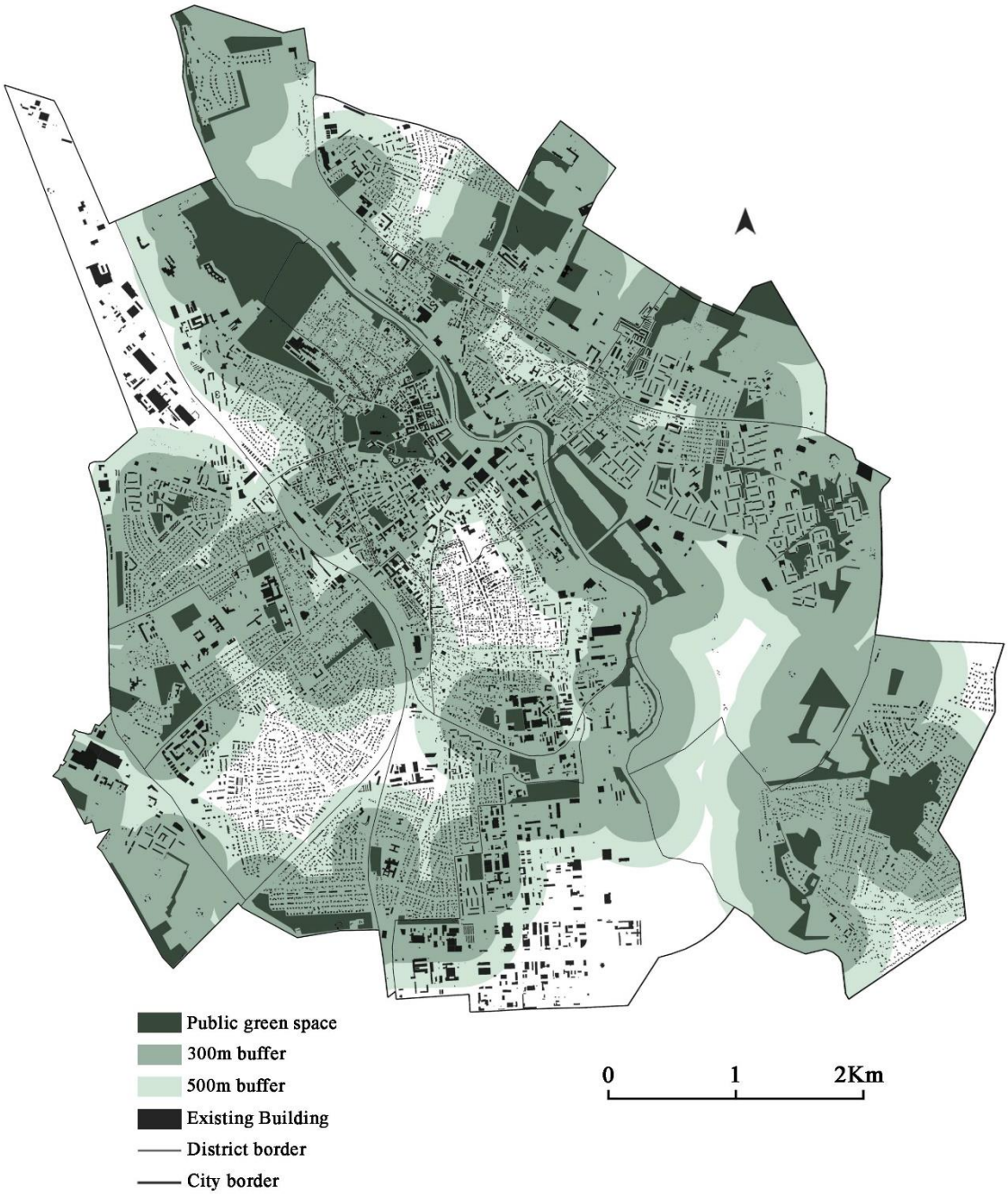


Figure 31 - Accessibility of pubic green spaces in Tartu, using the “walkability” distance method and data from “Tartu Linna Üldplaneering” (300 and 500 meters buffer)

Table 11 - Quantification of the accessible area to the public green spaces in Tartu defined in Figure 31

Districts	District Area (ha)	Public green spaces (ha)	Accessible area (ha) using 300m buffer	Percent (%)	Accessible area (ha) using 500m buffer	Percent (%)
Annelinn	542	66.70	452	83	523	97
Ihaste	425	46.88	290	68	391	92
Jaamamõisa	143	26.37	127	89	142	100
Karlova	229	5.82	109	48	177	77
Kesklinn	180	23.37	149	83	173	96
Maarjamõisa	135	9.85	126	94	132	98
RaadiKruusamäe	290	20.98	213	74	268	93
Ropka tööstusrajoon	360	15.61	147	41	205	57
Ropka	147	4.38	90	61	129	87
Ränilinn	122	5.02	101	83	121	99
Supilinn	70	22.64	70	100	70	100
Tammelinn	289	8.04	124	43	204	71
Tähtvere	228	58.50	158	69	211	93
Vaksali	77	1.50	61	80	73	95
Variku	77	10.48	55	71	73	95
Veeriku	280	5.34	111	40	152	54
Ülejõe	304	23.75	252	83	302	99

Regarding the accessibility of public green areas in Tartu, the results suggested that the districts with less accessible area to the PGS were Jaamamõisa, Variku, Ränilinn, Ihaste and Veeriku. However, it would be expected that Annelinn and Ropka tööstusrajoon would be also included in the districts with less accessibility of public green spaces since, according to the survey 'Küsitlusuuring "Tartu ja tartlased 2013"'(2013), the inhabitants consider as the districts with less quality of living environment, as well as Jaamamõisa and Ränilinn. In addition, according to Tamm (2014), Annelinn, Jaamamõisa and Ropka tööstusrajoon are the three districts with the worst reputation among the inhabitants. Still, critically observing Figure 30, it was verified that in Annelinn there was a significant area of housing that is outside the

buffered area, which means that although there was a significate percentage of accessible area to the PGS in this district (52% considering a 500m buffer), the majority of this area coincides with spaces without or only with a few dwellings.

According to Table 14, that summarizes the results presented in Table 10 and Table 11, I found a significant increase in the area of public green spaces, around 160 ha, using the data from "Tartu Linna Üldplaneering". Consequently, there is also an increase in the accessible area to these spaces. This plan predicts that the total accessible area in Tartu will increase from 30% to 68% and from 45% to 86%, using a 300m and 500m distance buffer, respectively.

Table 12 – Comparison between the current accessibility of PGS in Tartu (Figure 30) and using "Tartu Linna Üldplaneering" (Figure 31)

Source	PGS		Accessible area				Non-accessible area			
			300m		500m		300m		500m	
	ha	%	ha	%	ha	%	ha	%	ha	%
Tartu	195	5.0	1153	30	1747	45	2744	70	2150	55
"Tartu Linna Üldplaneering"	355	9.1	2635	68	3346	86	1262	32	551	14

Nevertheless, considering the data, per district, represented in Tables 10 and 11, and looking to these results in a critical way, it is possible to argue that this increase in the public green spaces, and consequently in the percent of accessible area, are the result of two transformations in the landscape of the city: (1) an empty area, without any function, can be transformed in a public green space with high quality or (2) an existing public green space with low quality can be transformed in a new public green space with high quality. Variku and Ihaste (Figure 32) represent an example of these transformations. For example, in Ihaste the area of PGS will increase 46ha, however, this area represents existing green spaces with low quality or low mobility conditions. In turn, Variku will increase the area of PGS in 10ha, which will be substituted by a new public green space, once that area does not have any function currently. According to "Tartu Linna Üldplaneering" in this new public space will be included a dog walking area and recreation, sports and cultural facilities.

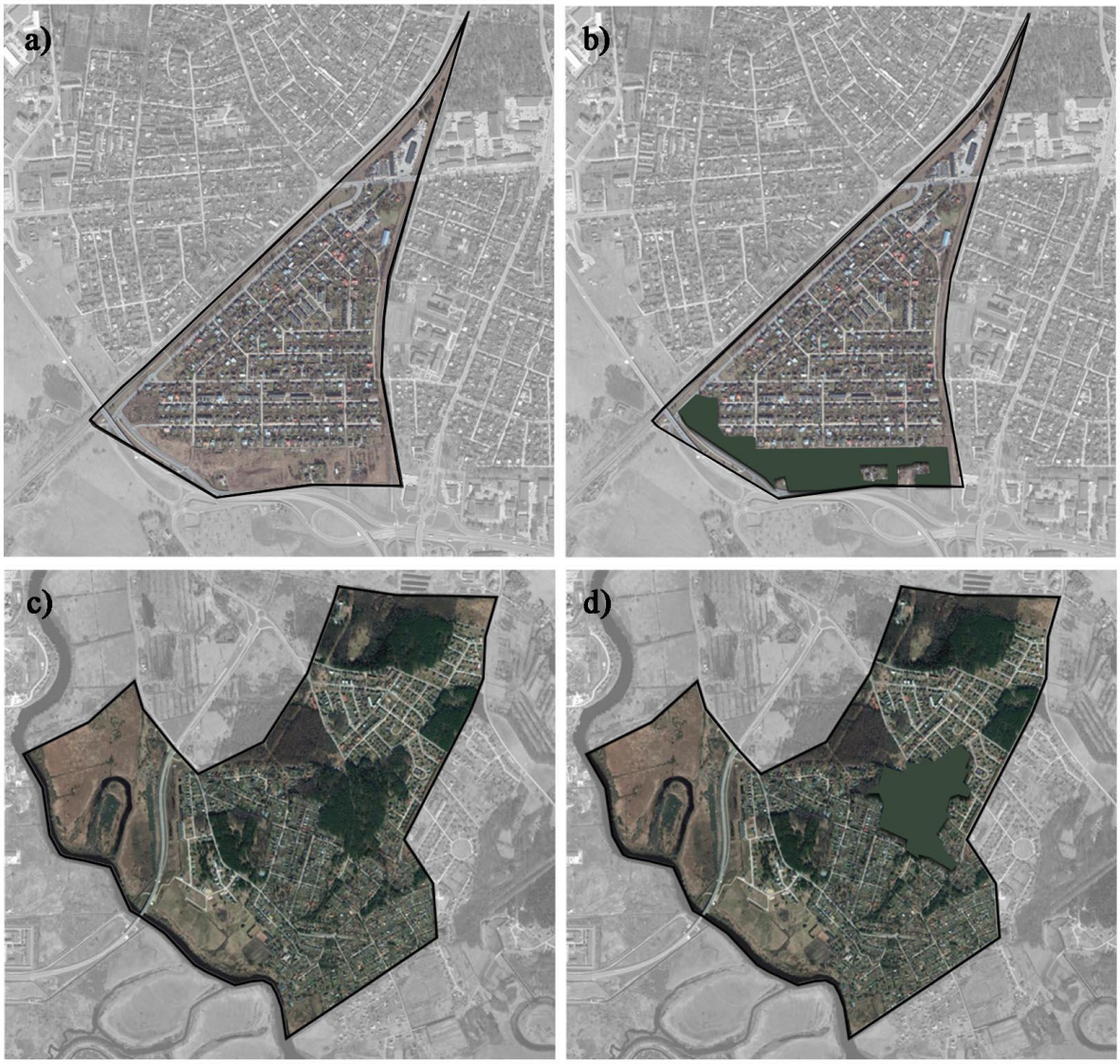


Figure 32 – a) Variku before “Tartu Linna Üldplaneering”; b) Variku after Tartu Linna Üldplaneering; c) Ihaste before “Tartu Linna Üldplaneering”; d) Ihaste after Tartu Linna Üldplaneering

Source*:* Satellite images from Google Earth (2016)

In short, the implementation of “Tartu Linna Üldplaneering” will be beneficial to Tartu, since the availability and accessibility of public green spaces will increase as shown by the results.

In Faro, according to the "walkability" distance method (Figure 33) and quantified in Table 12, the districts with higher percent of accessible public green spaces are district 6 ("Alto de Santo António" and district Urban Periphery) with 39%, using a buffer of 300m, and 70%, using a buffer of 500m, and district 8 ("Figuras" and Urban Periphery) with 35% and 51%, respectively, of the total district's area. On the other hand, the districts with less percentage of accessible area are district 1 (Old Town and Historic centre) with only 23%, considering a distance buffer of 500m, and district 7 ("Penha") without accessible area to the public green spaces.

Figure 33 - Accessibility of pubic green spaces in Faro, using the "walkability" distance method (300 and 500 meters buffer)

Table 13 - Quantification of the accessible area to the public green spaces in Faro defined in Figure 33

Districts	District Area (ha)	Public green spaces (ha)	Accessible area (ha) using 300m buffer	Percent (%)	Accessible area (ha) using 500m buffer	Percent (%)
Old Town and Historic centre	26	<1	0	0	6	23
Urban centre	52	<1	8	15	17	33
"Alto Rodes"	57	<1	19	33	39	68
"São Luís"	58	<1	19	33	31	53
"Bom João" and industrial area	146	1.97	37	25	70	48
"Alto de Santo António" and Urban Periphery	105	3.59	41	39	74	70
"Penha"	100	<1	0	0	0	0
"Figuras" and Urban Periphery	167	15.25	59	35	85	51

Figure 34 shows the results of “walkability” distance method using the public green spaces included in the proposal (Figure 28).

The quantification of the accessible area of public green spaces in Faro, considering a buffer of 300m (Table 13), shows that “Bom João” and industrial area, “Alto de Santo António” and Urban Periphery, “Penha” and “Figuras” and Urban Periphery are the districts with more accessibility of PGS. On the other hand, considering a distance buffer of 500m, the results show that all the districts have access of public green spaces, specially “Bom João” and industrial area with 97% of accessible area. Also, Old Town and Historic centre increased its accessible area by 23% comparing with the results using a buffer of 300m.

The first four districts correspond to the most urbanized areas and for that reason the small interventions suggested in the proposal cannot be represented in Figure 34, once it only includes the public green spaces with at least one hectare. Despite this, I consider small

interventions in largest urbanized areas to be essential in increasing green spaces and allowing the access of PGS by all the inhabitants of Faro.

Figure 34 - Accessibility of pubic green spaces in Faro, using the "walkability" distance method (300 and 500 meters buffer) including the PGS from the proposal

Table 14 - Quantification of the accessible area to the public green spaces in Faro defined in Figure 34

Districts	District Area (ha)	Public green spaces (ha)	Accessible area (ha) using 300m buffer	Percent (%)	Accessible area (ha) using 500m buffer	Percent (%)
	26	<1	0	0	6	23

Old Town and Historic centre						
Urban centre	52	<1	8	15	17	33
"Alto Rodes"	57	<1	19	33	39	68
"São Luís"	58	<1	19	33	31	53
"Bom João" and industrial area	146	35.8	120	82	141	97
"Alto de Santo António" and Urban Periphery	105	3.59	52	50	87	83
"Penha"	100	12.4	50	50	78	78
"Figuras" and Urban Periphery	167	15.25	59	35	85	51

Table 15 shows the comparison of the general quantitative results between the current accessibility of public green spaces in Faro (Figure 33) and using the data from de proposal (Figure 28 and Figure 34). In a scenario where this proposal would be implemented (Faro planned) the area of PGS in the city would increase 46ha and the accessible area of those public spaces would cover more than half of the city, considering a buffer of 500m.

Table 15 - Comparison between the current accessibility of PGS in Faro (Figure 33) and Faro planned (Figure 34)

Source	PGS		Accessible area				Non-accessible area			
			300m		500m		300m		500m	
	ha	%	ha	%	ha	%	ha	%	ha	%
Faro	21	3	183	26	321	45	528	74	390	55
Faro planned	67	8.6	329	46	483	68	382	54	228	32

Finally, a comparison between the results of "walkability" distance method in these two cities (Table 16), suggest that Tartu has more area of public green spaces than Faro.

The percentage of accessible area to the PGS are very similar in both cities. However, considering a distance buffer of 300m, Tartu has better access to these spaces than Faro and the results of grid method show that, in general, the accessible area per habitant is higher and more uniform in Tartu than in Faro. Furthermore, the comparison of both cities regarding the number of inhabitants per hectare of PGS (Table 14) shows clearly that the availability of public green spaces in Tartu (499 inhab. per hectare of PGS) is higher than in Faro (1963 inhab. per hectare of PGS). Moreover, according to the government agency English Nature should exist at least 2 ha of accessible public green spaces per 1000 inhabitants (Comber et al., 2008; Handley et al., 2003), which means that only Tartu complies with this reference value.

Table 16 – Quantification of the availability and accessibility of PGS in Tartu and Faro

City	Area (ha)	Population (inhab.)	PGS		Accessible area				Non-accessible area				Inhab./ ha of PGS
					300m		500m		300m		500m		
			ha	%	ha	%	ha	%	ha	%	ha	%	
Tartu	3897	97259	195	5	1153	30	1747	45	2744	70	2150	55	499
Faro	711	41215	21	3	183	26	321	45	528	74	390	55	1963

The greater accessibility in Tartu, in comparison with Faro, can be justified by two main factors: (1) the geographic location and the (2) cultural differences. As already referred by many studies (Fuller & Gaston, 2009; Kabisch et al., 2016), there is a tendency for northern European countries to have greater availability of green spaces, once the climate is more favourable to develop this spaces comparing with Mediterranean countries. Nonetheless, the culture also influence the use of public spaces. For example, some studies (Corraliza, 2000; Thompson, 2002) refer that in Mediterranean countries there is a long tradition of strolling in the street. Meanwhile, in Nordic countries the urban park is the main element in the public space and it plays an important role in social relations. The importance and the use given to the public green

spaces can influence the availability of those spaces in the city. However, even if in Mediterranean countries the public green spaces are less widely used than in the Nordic countries, it is still important to note that the presence of such spaces in the city, and associated ecosystem services, are essential to secure the high level of quality in urban living.

Figure 35 and Figure 36 show the results of grid method using the 300 meters and 500 meters buffer for Tartu and Faro city, respectively.

In Tartu (Figure 35), the districts of Annelinn and Karlova have between 101 and 250m^2 of accessible public green area per inhabitant. In the remaining districts the accessible public green area per inhabitant is over 251 m^2. Both distance buffers do not cover Variku and Jaamamõisa.

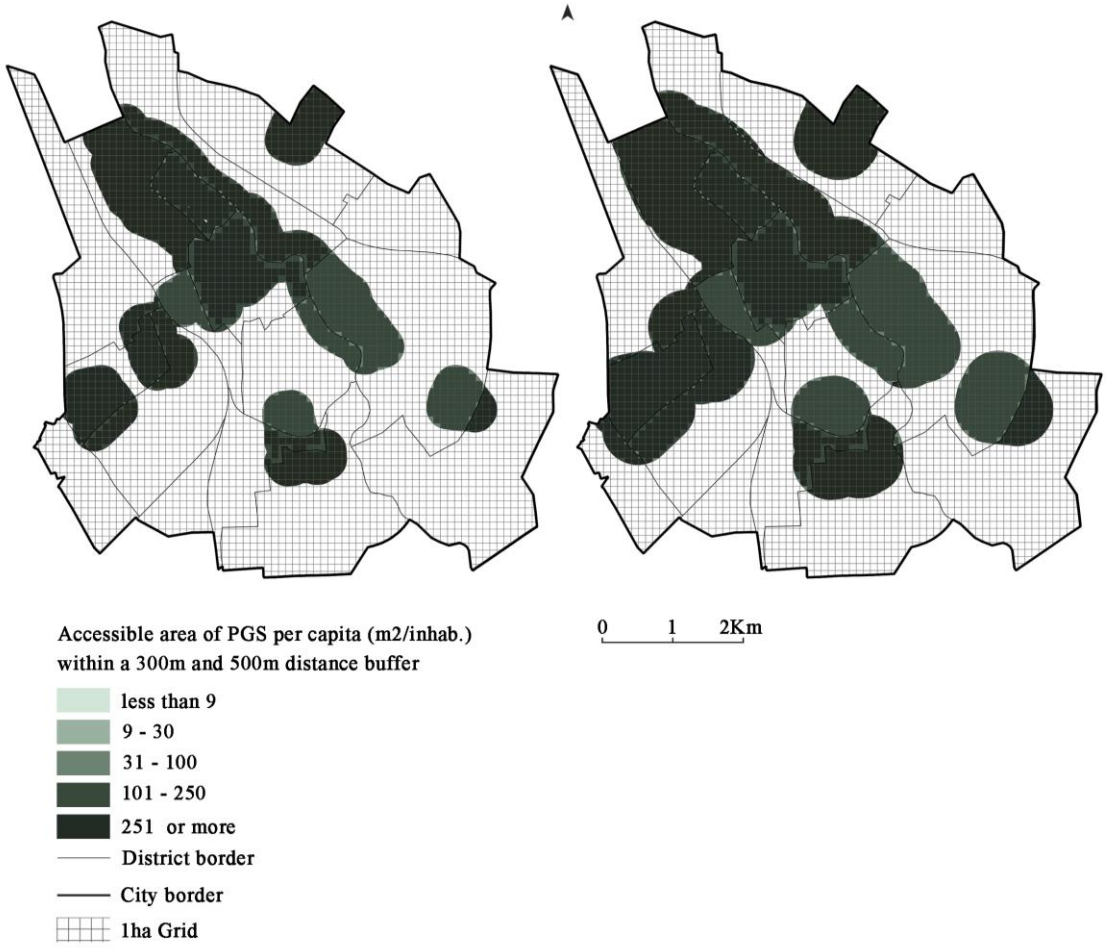


Figure 35 - Grid method for Tartu using a 300m and 500m buffer, respectively

The same grid method was developed for Faro city (Figure 36). The results, using the area calculated in Table 12 for a distance buffer of 300 meters, show that district 5 and district 8 are the two districts in the city with more accessible area to public green spaces per inhabitant (more than 251m^2). District 2 and district 6 have between 101 and 250 m^2 per inhabitant and the districts 3 and 4 have, in general, between 31 and 100m^2 per inhabitant. Finally, in Old Town and Historic centre (district 1) and "Penha" (district 7) there is no accessible area to public green spaces. The results are similar using, instead, a distance buffer of 500 meters, only increasing, in general, the accessible area to the public green spaces in each district. Despite this, a part of district 1 has between 101 to 250 m^2 per inhabitant of accessible area. In this case, "Penha" (district 7) is the only district without accessible area to public green spaces.

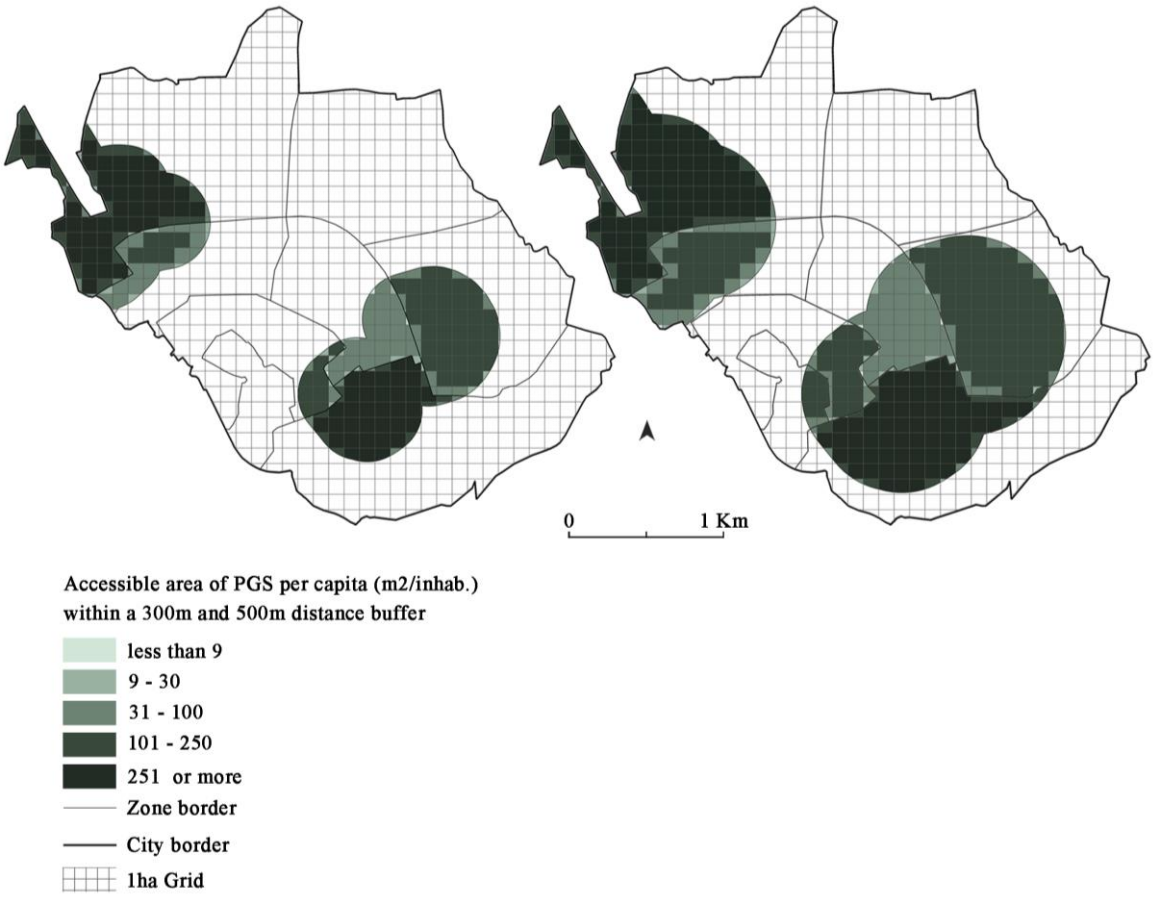


Figure 36 - Grid method for Faro using a 300m and 500m buffer, respectively

6. Discussion

As mentioned in the literature review, both Tartu and Faro, crossed political periods that had a strong influence on the way the city was developed, which directly influenced the location of public green areas in the city. The results presented in this study pay support to this literature evidence, since the soviet districts of Tartu present lower quality and availability of public green spaces and, in "Bom João" district that, as mentioned before, was built during the Portuguese dictatorship, there are less than $5m^2$ of public green spaces per inhabitant. In addition, these regimes, not only had effect on the unequal "shape of the city" but also on the distribution of the population through the city. It means that, if the poorer social groups live in the most deprived areas of the city then, of course, those groups will have less access to the public green areas. Again, the results presented in this study are in line with the literature. In Tartu, the majority of ethnic minorites, mainly Russians, live in Jaamamõisa and Annelinn, which are two of the districts with less availability of public green spaces. In Faro, Roma communities are also one of the most affected groups. I consider that there is still another problem arising from this finding. The segregation of certain social groups sometimes means that although there are public green spaces in the city, the lack of relationship between different ethnic groups or the lack of knowledge of those ethnic groups by landscape architects, makes that, sometimes, public green spaces cannot satisfy the needs of those users. In this context, the study of public life and the implications that this has for city planning and green spaces design is a current topic that should be included in future research. The accessibility of public green areas, that support a range of ecosystem services, should be a priority in the planning of today's cities and one of the key variables for environmental justice. Although this study focused only on public green spaces, these areas have an important role for cohesion and resilience of green infrastructure.

According to Barreira et al. (2018) some of the reasons behind residential satisfaction and city attractiveness are the availability of green areas and opportunities for leisure activities in open air public space. Moreover, green infrastructure may enhance city resilience to climate change by means of ecosystem services improvement (Berte and Panagopoulos, 2014) and assist in climate change adaptation, which is one of the factors for future city growth (Barreira et al., 2017). According to Panagopoulos (2017) city climate change adaptation is a major issue in environmental justice for the vulnerable urban populations like the elderly, minorities and the poor families.

This dissertation contributes to the literature on environmental justice in four ways. In the first place, it identify a pattern of environmental injustice that can be comparable in other cities with similar characteristics, based on the studying of three issues simultaneously – availability and accessibility of public green spaces; location of ethnic minorities and urban growth. Secondly, it considers two distance buffers, 300 and 500m, to measure the accessibility of PGS, allowing the inclusion of people with reduced mobility, even though it has not been possible to characterize this group. In the third place, it compares the current situation in Tartu city with the future scenario of "Tartu Linna Üldplaneering". Finally, it addresses the concept of green gentrification in two European cities and, against this background, it identify a future scenario of gentrification and green gentrification in Faro.

Despite this contributions, this dissertation does have some limitation that should be integrated in future research. First, although two distance buffers were used to measure the accessibility of public green spaces and there are clear differences is the application of both that give us important contributions, would have been interesting the use of a 100 meters distance buffer once, as suggested by Magalhães (1992) should be the minimum distance walk for children and elderly people. However, there is no available data about the ages of inhabitants per district, both in Tartu and Faro. In this context, the same author suggests that, in Portugal, should be consider all the public green spaces with at least 400m^2. On the other side, many studies suggest that for a Northern country, such as Estonia, should be consider only the public green spaces with at least 2ha. In order to compare Tartu and Faro, I considered in both cities all the public green spaces with at least 1ha. Further research should adopt 2ha as a reference when comparing Northern cities and 400m^2 when comparing Mediterranean cities, with similar characteristics to Portugal.

Moreover, it was not possible to evaluate the green gentrification in the city of Tartu. On the one hand, because it is a process that takes time to occur; on the other hand, "Tartu Linna Üldplaneering" was not fully implemented yet. Also, in Faro, although was identified an area with risk of gentrification, it was not possible to develop any method to calculate this phenomenon. For future research to evaluate the green gentrification phenomenon, it is suggest the use of Markov Model of Urban Change used by Royall & Wortmann (2015), which represents the urban change in time and space using additional socio-economic data.

Finally, the development of sustainable urban planning proposals by landscape architects should include a study on availability and accessibility of existing public green areas,

and an identification of the most problematic areas of the city (Bell & Morse, 2003). In addition, future actions should be conducted with aim at environmental education and awareness of the population, to inform about the importance of public green spaces in the cities and to monitor the ecosystem services provided by those spaces.

7. Conclusions

The public green spaces accomplish important functions in the cities that affect directly the quality of life and wellbeing of the inhabitants. For this reason, those public spaces should be homogeneously distributed throughout the city, in order to provide ecosystem services to the entire population. However, in many cases, instead of this condition, there is an unequal distribution of public green spaces that is often related to the distribution of social classes. For example, the newest and richest neighbourhoods tend to be closer to the higher quality public green spaces comparing to the oldest and poorer neighbourhoods that tend to be close to areas of high environmental pollution.

This dissertation has used Tartu and Faro as a study case to measure the availability and accessibility of public green spaces using three different methods.

The results revealed that there were more availability and accessibility of public green spaces in Tartu than in Faro. Even so, in Tartu there were inequalities between the soviet-era housing block districts, where the majority of Russian inhabitants live, and the rest. Roma communities in Faro were located in districts without access to public green spaces. Furthermore, those neighbourhoods may suffer gentrification and green gentrification processes in the future due to the implementation of large-scale urban regeneration projects that aim to satisfy the tourist needs of the region. Availability of public green spaces was varying from 1.22 to 31.44m2/inhabitant in districts of Faro and 1.04 to 164.07m2/inhabitant in districts of Tartu. In both cities 45% of the inhabitants had accessible public green spaces within 500m from the residence, meanwhile after the development of the proposed new green infrastructure will be 68% for the city of Faro and 86% for Tartu.

In addition, these results meet the argument that geographical location has influence in the availability and accessibility of PGS in urban context, as many studies posit.

Being Faro one of the Portuguese cities with less green spaces per inhabitant (Revez, n.d.), it is urgent to focus on planning the green infrastructure, on integrating the needs and opinions of residents into the future proposals, in order to increase the accessibility of public green spaces and secure the environmental justice in the city.

Finally, this study showed that there is a direct relationship between the distribution of urban green infrastructure, which is responsible for environmental justice in the city, and the type of urbanization or location of ethnic minorities.

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Appendices

Appendix A

Evolution of the land use and occupation in Tartu city

Appendix B - Maps

01 - Location of Tartu city and delimitation of districts

02 - Subdivisions of Tartu districts

03 - Location of Faro city and delimitation of districts

04 - Public green spaces of Tartu with high quality and at least 1ha

05 - Public green spaces of Faro with high quality and at least 1ha

06 - Urban growth in Tartu

07 - Urban growth in Faro

08 - Accessibility of PGS in Tartu using the “walkability” distance method

09 - Accessibility of PGS in Tartu using the “walkability” distance method and data from “Tartu Linna Üldplaneering”

10 - Accessibility of PGS in Faro using the “walkability” distance method

11 - Accessible area of PGS per inhabitant within a 300m and 500m distance buffer using the grid method for Tartu

12 - Accessible area of PGS per inhabitant within a 300m and 500m distance buffer using the grid method for Faro

13 - Proposal for Faro

14 - Accessibility of PGS in Faro using the “walkability” distance method including the PGS from the proposal

Evolution of the land use and occupation in Tartu city *(ha)*

Source: Adapted from Tartu in Figures (‘Statistics | Tartu linn’, n.d.).

Land use and occupation	Year										
	1998	**2000**	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**	**2014**	**2016**	**2017**
City's reserve land	456,9	357,5	328,7	448,7	417	398,3	365,7	201	207,3	170,4	164,2
Agricultural land	100,9	84,2	48,4	45,2	39,9	38,2	43,5	43,5	42,7	42,7	42,5
Marshland and shrubs	660,7	640,1	627,6	600,6	553,3	520,1	512,6	497,9	490,8	436,3	424,4
Public parks, green areas	189,6	327,8	372,1	353,3	367,8	386,6	394,8	383,4	375,8	400,7	389
Water bodies	131,9	131,9	131,9	131,9	131,9	131,9	92,4	92,4	92,8	92,8	92,8
Streets, roads	364,7	368,9	375,6	381,2	402,5	422,3	510,8	591,1	616,1	634,9	641,1
Railway	84,7	81,6	78,9	70,6	70,6	70,1	62,6	53,4	53,4	53,4	53,4
Land under churches and graveyards	43,3	49,3	49,5	49,6	49,2	49,2	49,5	49,5	49,5	49,5	48,9
Land under social and government institutions	577,5	534,1	554,1	489,5	478,6	503,6	463,9	296,8	304,6	302,7	310
Land under enterprises	316,9	311,3	315,9	295,3	293,6	282,5	303,2	590,8	565,9	598,2	609,2
Land under residential buildings	952,9	993,3	997,3	1014,1	1075,6	1077,2	1083	1087	1098	1115,3	1121,4