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Perspectives on urban justice: is sustainable Malmö reality or utopia?

A spatial analysis of socio-economic inequalities in availability of urban green spaces in Malmö, Sweden

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Bachelor’s Thesis for Science Programme in Politics and Economics

"Are green spaces needed everywhere? Probably. Perhaps we need green spaces more now than ever before. More and more people choose to move to cities and the city life makes the need for greenery obvious"

- Olsson et al 1998:200, my translation

Abstract

UGS can provide extensive health benefits for city dwellers, especially those with close availability. However, previous research in the US has shown that UGS are not equally distributed within the city. This paper uses an urban justice approach to examine the distribution of UGS in Malmö, Sweden. Following a spatial analysis linking availability of UGS to socio-economic variables using ArcGIS, the variables are correlated using SPSS to demonstrate trends. An observation is conducted to examine qualitative differences. The results show that socio-economically, Malmö is deeply segregated and there are disparities in the availability of UGS, particularly green space per person. Population density and proportion of high incomers were the key explanatory variables, and affluent neighbourhoods with low population density, located further away from the city core enjoyed the best availability. From an urban justice perspective, affluent groups thereby have better access to health. In addition, the analysis demonstrates that Malmö prioritizes its economic and environmental goals ahead of social, which contributes to social, economic and health disparities within the city. Health equality is essential to ensure a sustainable urban development, and this paper concludes that urban injustices exist on multiple scales in the distribution of UGS in Malmö, which can be linked to its social geography. Physical planning can provide better availability of UGS for deficiency groups, thus promoting social sustainability on a structural level.

Key words: Urban Green Spaces, Malmö, Social Sustainability, Social and Environmental Justice, Geographic Information Systems

Word count: 15783

Abbreviations

GIS - Geographic Information Systems (software)

HA – Hectare

MC – Malmö City

MCPO – Malmö City Planning Office

SAMS – Small Area for Market Statistics

SCB – Swedish Central Statistical Bureau

SMD – Swedish Land Cover Data

SPSS – Statistical Package for the Social Sciences (software)

UGS – Urban Green Spaces (in this paper; public urban green spaces)

US – United States

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1 Introduction

Urban green spaces (UGS) provide a range of positive health benefits for individuals and populations, and contribute to the overall quality of life for city dwellers. Research shows that the closer you live to an UGS the more likely you are to use it, thereby deriving positive health benefits. Size, accessibility and quality of the UGS may also influence the usage. Today, more than half of the world's population live in cities. By 2050, this amount is expected to be 75% and UGS are suffering the consequences of city expansions. Densification is one threat, as housing and transport often take priority. Urban sprawl is another, as large land requirements in the suburbs is "stealing" space from the surrounding countryside. Decreasing budgets and population growth makes it an issue of both quality and quantity. Though greenery and population health are becoming increasingly important factors to consider in urban planning while competing with development and higher land use exploitation, the conflict between dense and green is not new. Lefebvre put the conflict into the context of the right to the city versus the right to nature, and greenery versus urbanity is often expressed in the dichotomies urban/rural and nature/culture. Green space was however fundamental already in Ebenezer Howard's garden city and Le Corbusier's high-rise buildings surrounded by green space. Contemporary urban green planning traces back to the public park movement in the 19th century as a reaction to urbanization and industrialisation, which caused decreasing living standards. From being available only to the upper class, parks experienced a social reform aiming to become public commons. However, research has shown that there is still unequal access to green spaces within cities in for example the US (United States) and China, with affluent neighbourhoods generally enjoying better availability and quality.

1.1 Problem

Malmö is one known the fastest growing cities in Sweden. It is since long known as 'the city of parks' and actively promoted as Sweden's most sustainable city. However, according to national statistics Malmö in fact the second least green city in Sweden. It is also a city divided in two, characterized by social, ethnic and economic disparities, which is reflected in public health inequalities across the city, for example life expectancy. Public health can be seen as a necessity for a sustainable city development, and equal access to UGS is therefore vital to ensure urban justice in a social and environmental context and to achieve sustainability goals in Malmö.

1.2 Aim and research questions

This bachelor's thesis aims to examine the distribution of UGS across Malmö to find potential trends and correlations between availability and socio-economic status. The approach is a spatial analysis based on GIS (Geographical Information Systems) and highlights an urban justice perspective for social sustainability in Malmö.

RQ1: Are there geographical differences in the availability of public urban green spaces in Malmö that can be linked to the social geography of the city?

RQ2: How can theoretical perspectives of urban justice interpret the relationship between socio-economic status and availability of green space, and how is the relationship linked to Malmö's sustainability targets?

1.3 Definition of key terms

Urban Green Space

SCB (2010) differs between urban green space and public urban green space, where *urban green space* is *all* public and private greenery that build the *green structure*, which includes parks, grasslands, gardens and green paths. *Public urban green space* is all of the above named green space that is available to the public for use at any time. This excludes all private and semi-private land. *Green areas* refer to publicly available green space with a minimum area of 0.5HA. The terms green structure, urban green space, public urban green space and green areas are overlapping and often used interchangeably, which can cause research issues (Littke 2016). In this paper, UGS refers to ***public urban green spaces*** (including ***green areas***) exceeding 0.5HA. A further discussion on included and excluded land uses follows in the delimitations and methodology sections.

Socio-economic status

The term initially divided people into societal classes. Today, SCB recommends using education level, income level or working class/officials as a measurement (SCB 2017). In this thesis, socio-economic status is defined by income and education. 'Income' measures the total earned income for people living in Sweden the whole year and amount of people in the income-classes ”low”, ”medium-low”, ”medium-high” and ”high”. 'Education' is divided into ”less than high school”, ”high school” ”university < 3 years” and ”university > 3 years” (SCB 2014).

Malmö and Malmö City

The study area 'Malmö' is limited to Malmö Tätort (Malmö urban area) as defined by SCB spatial data (2014e). 'Malmö City' (MC) refers to Malmö City's Administration, including its councils, boards and offices.

1.4 Delimitations

Only UGS as per definition have been considered and therefore a lot of the green structure is excluded. Private spaces and those with a varying degree of publicness, such as gardens, golf courses and allotments are excluded, as they don't provide access for the whole population. Graveyards, though publicly available, are by norms not used for recreation and are also excluded. Green spaces <0.5 HA and green walks are excluded for simplification and accuracy reasons, as data sets did not pick up all smaller UGS. The exclusions could skew the results. For example, areas with mainly villas might have limited availability of public greenery but access to private green spheres. The green area available for residents might therefore be high, but results showing limited access. An area might also have a significant green structure with smaller UGS and green walks which improving the overall greenness but isn't reflected in the results. These areas are also important in the urban environment.

The 'green value' in this study is the "everyday" greenery (such as city parks). Therefore, the 'special occasion greenery' (such as national parks) is excluded. Variables such as use of car to reach UGS, free time for leisure activities and similar are not discussed. Availability, as measured in time and distance, cannot fully explain the use of UGS. There may be several other explanatory factors, such as social and cultural restrictions. However, due to the quantification of data as used in the methods, it was necessary to focus on one factor.

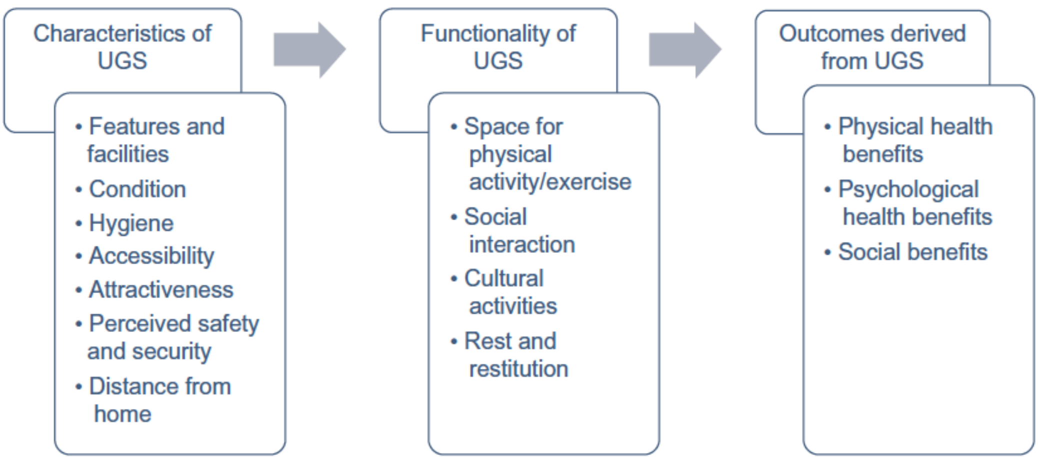
1.5 Outline

This thesis consists of 11 chapters. Chapter 1, the introduction, finishes here. Chapter 2 will provide background information and previous research of urban green spaces and chapter 3 will provide context specific information about greenery in Malmö. Chapter 4 presents the theoretical framework, which is an urban justice approach based on perspectives of social and environmental justice, green gentrification and green city branding. Chapter 5 describes the methodology including chosen research design and methods for spatial analysis. Chapter 6 presents the findings of the study. Chapter 7 interprets the findings and chapter 8 discusses the analysis. Chapter 9 concludes the research. References are found in chapter 10 and appendices in chapter 11. Appendix A contains detailed GIS Methodology; Appendix B SPSS variables and Appendix C additional tables and maps.

2 Urban Green Spaces

2.1 Benefits on health and well-being

Substantial research in recent years exploring UGS value for health has shown that the use of UGS provides a number of important physical, mental and social benefits for individuals and populations (Ives et al. 2017;Little 2016;Grahn 1998;Wolch et at 2014). International federation of parks and recreation administration found a strong support for positive health effects due to facilitation of physical activity which also promoted mental health, based on 201 reviewed studies. Examples included reduced risk for obesity, increased recovery and a strengthened immune system (Söderström 2015). Malmö City Planning Office's (MCPO) (2012:8) findings showed that 30% more were obese in rental property without close access to greenery compared to other accommodation types. The differences remained also after considering factors such as education, age and employment. Wolch's study (2014) showed that respondents with more green space near their homes were less affected by a stressful life than those with less green space, suggesting that green space buffers stress. Greenery also encourages learning and alertness, and physical activity improves cognitive functions such as memory and creativity (Littke 2016:26; Grahn 1998:93). Green neighbourhoods improved social bonding and more social activities were observed where there were trees and vegetation compared to private gardens (Littke 2016:25).



(Lee et al 2015:135)

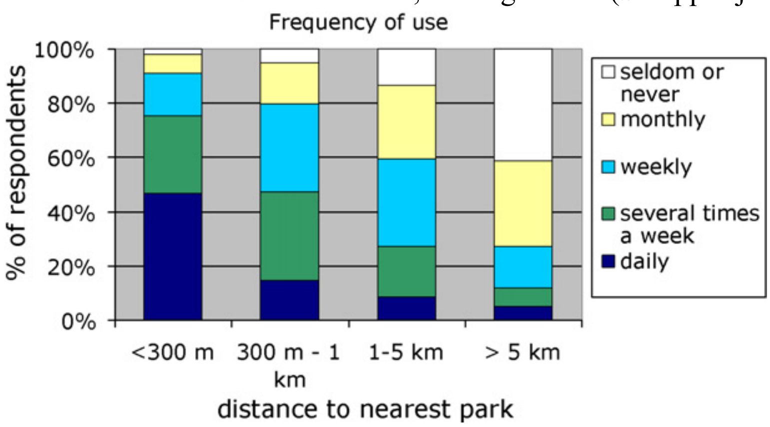
Figure 2:1. Characteristics, functionality and outcomes of UGS

UGS directly contribute to the quality of life in cities and people with better access enjoy better health, see figure 2:1. UGS is also significant for the vitality of city communities (Lee et al 2015;Littke 2016;Grahn 1998;Olsson 1998). In the long run this means that a good availability of UGS can provide economic benefits, such as decreased healthcare costs, less absence from work and higher efficiency (MC Planning Administration 2003:2). According to Söderström (2015) the extensive health benefits make it vital to protect UGS and increase possibilities for physical activity compared to other societal and planning interests.

2.2 Determinants for usage

2.2.1 Availability

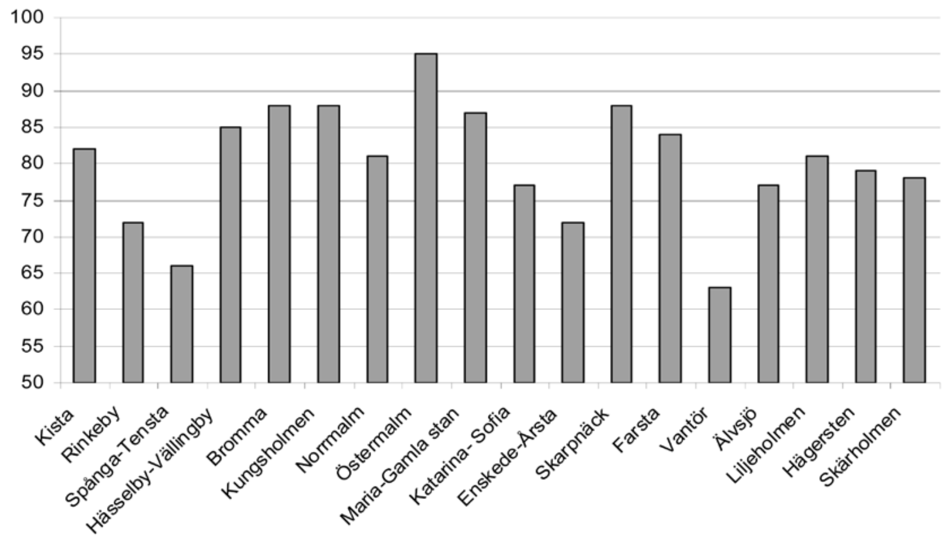
A key determinant for the usage of UGS is availability. A person living in close proximity to green space is more likely to use the area and more frequently so, thereby reaping health benefits from the usage (Littke 2016:27). The ideal distance was determined to be less than 300 meters from home. The greater the distance, the lower the usage frequency (Lee et al. 2015; Littke 2015a; Schipperijn et al 2010a; Grahn 1998:93). Grahn (1986:44) showed that only 11% of those with a distance of less than 300 meters to a green space in Sweden never went there. The results of a national study in Denmark showed that 66.9% of respondents lived within 300 meter of a green space. 43% of those visited the UGS daily and 91.5 % at least once a week. The percentage of daily users decreased significantly when the nearest UGS was more than 300 meters from home, see Figure 2:2 (Schipperijn et al. 2010a).



(Schipperijn et al 2010a:132)

Figure 2:2. Frequency of use of UGS based on proximity to home

Due to Denmark's general proximity to UGS, distance was not a limiting factor for the 66.9% of the population living within 300 meters of an UGS. However, the significant correlation between usage and distance suggested that reducing distance for the remaining 33.1% would likely increase their usage (Schipperijn et al 2010a). Sweden is similarly a very green country, and over 95% of the population have access to at least one UGS within 300 meters from home (SCB 2010). Yet, proximity was perceived differently. MC Planning Administration (2003:16) noted that the experienced distance to UGS appeared less if the way there was green and attractive, suggesting that connecting houses and UGS with green walks could increase usage. Ståhle's study (2010) showed that many inner city districts and dense suburbs experienced less lack of green areas than some low-density green suburbs (see figure 2:3). The differences could be explained by perceptions being affected by the design of the era they were created in, or there could be different demands for different groups of people. Additionally, it raises the question of how the quality of UGS might differ between areas.



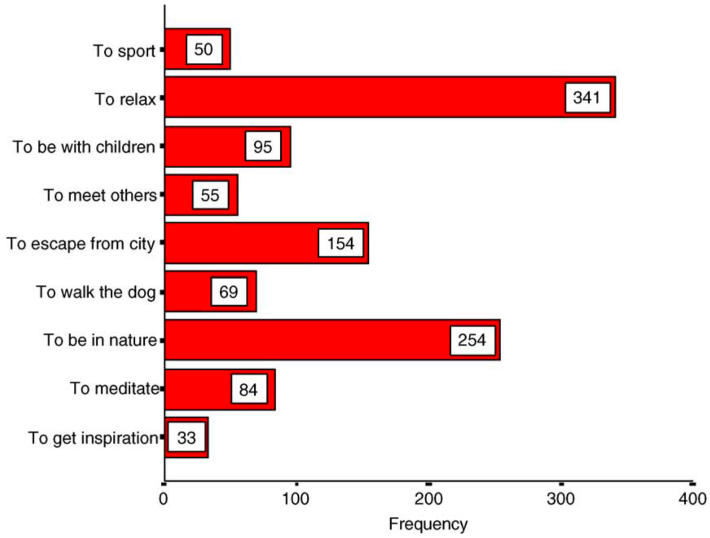
(Ståhle 2010:15)

Figure 2:3. Percentage of people that don't experience a lack of green spaces close to home for city district in Stockholm municipality

2.2.2 Quality

UGS characteristics are important for how they experienced and used. Grahn's study (1986:44) showed that people were more willing to travel further to larger green spaces. Other research showed mixed results: Schipperijn et al's study (2010a) showed a low frequency of visits to large areas further away - even those with good quality, but a local study in Odense, Denmark suggested that small areas within the city limits would be used less (Schipperijn et al 2010b). Schipperijn (2010b) concluded that a neighbourhood needs both smaller and larger green spaces within a reasonable distance to fulfil user needs. Small green areas close to accommodation often have a function for shorter visits where larger areas are more of a recreational purpose and longer visits (SCB 2010; Schipperijn et al 2010b). Though the ideal size is debateable, the results strengthen the evidence that proximity is of key importance.

A study in Victoria, Australia, presented that following improvements of UGS, usage increased significantly. This suggests that maintenance is of high importance (Wolch et at 2014). Cheisura's study of urban parks in Amsterdam (2004) showed that the most important reasons for visiting green spaces were to relax and to be in nature, see figure 2:4. Characteristics such as size, a varied topography, rich vegetation and separate 'rooms' diving the area may also impact the usage (Grahn 1986:63-64)



(Cheisura 2004:132)

Figure 2:4. Reasons for visiting UGS in Amsterdam, Netherlands

Ives et al's study (2017) showed that the values assigned to UGS were varied and reactive to several variables. Not all green spaces were equally significant. This proposes that people have different preferences for certain qualities, which might affect the usage. The more qualities available in an UGS, the more likely they are to be used by a larger crowd (Stockholm City Planning Office 2003; Grahn1998:93; Sandström 2002b:38). Littke (2015a) argues that there are also intangible qualities and values assigned to a green space based on sense of belonging and social interaction, which may explain why parks go unused or underused. For example, to feel welcome, safe and comfortable are fundamental conditions. This could be facilitated by clear public entrances and well maintained areas, and the sense that the space has a purpose. Wolch et al (2014) proposed that another reason could be the sense that the space belongs to another group.

Overall, connotations associated with UGS are positive (Kyttä et al 2013; Ives et al 2017; Littke 2016). The general perception is that greenery brings a certain quality of life. Sandström (2002a) argues that this perception has become stronger in recent years due to a paradigm dominated by health and sustainability trends, which has increased the demand for greenery. His study showed that UGS were of importance for everyday life of urban dwellers, and accessibility and geographical distribution were key factors. Despite this, it is relevant to ask if everyone has the same demand for UGS. Schipperijn et al (2010a; 2010b) argued that gender, age, education, and ethnic background might all have a significant relationship with the use of UGS.

2.3 Pressures: densification and sprawl

Densification, when a city is growing inwards, means to increase the built environment. This normally happens when central land becomes more valuable and increases the pressure on the land use. Ways to densify includes extensions of buildings or demolition and new, more efficient construction. The latter can be linked to regeneration. Common examples are the transformation of older industrial areas (Littke 2016). Densification is happening in many larger cities and can be seen as a reaction to urban sprawl, which started declining in the 1990s. According to MCPO (2010), sprawl has resulted in many negative consequences for the environment, health and land use due to increased distance between accommodation, work and service and a decrease in physical activity, resulting in declining population health. As MCPO have an interest in how land is used in Malmö, this statement should be considered with a little scepticism and contrary, SCB (2002) has shown that previous densification in Sweden has resulted in a decrease in green space. For example, more than 70% of Stockholm's expansion took place on former natural habitats and similar (Sandström 2002b:34). SCB (2002) mean that to counteract the shift, new production needs to happen on previously 'hard ground', which is rarely the case during densification. However, many of the arguments supporting densification suggest that a dense city supports an active life through a reduction in consumption of resources and 'walkability', which reduces pressure on the transport system. When people can walk to services, social capital, safety and trust is supported, all increasing the city's appeal (Littke 2015a).

2.4 City disparities in distribution

Green space is differently distributed within the urban landscape. The reason why varies from city to city, but often includes design philosophy, land development history and social inequalities. A challenge in access measurement is that green spaces differ in terms of size, quality, facilities, purpose, perceptions of safety and more (Wolch et al 2014). Findings in California indicate that areas with higher population density, lower incomes and a greater share of minority residents have inferior access to UGS than white and affluent areas. The green space distribution disproportionally advantaged or disadvantaged people and neighbourhoods based on ethnicity and income. Low-income areas had less green space and also less money to spend on parks and resources, which may lower the quality of existing green spaces (Wolch et al 2014). Findings in Baltimore showed that people of colour generally lived closer to parks but white people had more park space per person. Thus, parks were busier in coloured areas (Wolch et at 2014). Population density may therefore be a key variable.

In the US, people of colour and with low socio-economic status occupy the urban core and/or low-income inner suburbs, where green space is either insufficient or inadequately maintained. Wealthier households often reside on the outer suburbs where the access to quality green space is high (Wolch et at 2014). Wheeler's study (2008) showed an inverted relationship between population density and income equality, suggesting that as urban areas expand, they become increasingly segregated by income. In 1950, 41.5% of urban populations in the US resided in suburban areas, and half a century later 62% did. As a consequence, population density changed; decreasing in the city core and increasing in suburban areas. The study suggests that there is a relationship between and sprawl, which causes an individual's requirement for land to increase when his or her income does, thus motivating a move from the city core to suburban environments. As a result, high-income households shift from the core to the periphery, while poorer residents remain in the core (Wheeler 2008:41-42). Wheelers study thus suggests that income distribution, land requirement and population density are linked. However, Wolch et al (2014) argue that poor people have been a part of the suburbanization too, expressed in an increase in inner-ring suburban poverty, which can be linked to gentrification. This can be exemplified by the High Line in New York City, an urban greening strategy aimed to increase tax revenues and reinvestment (Little 2015b:6). The High Line did increase revenues but also rose property values by 103% between 2003 and 2011, stimulating gentrification in surrounding neighbourhoods and allowing both further new development and an expansion of the neighbourhood (Littke 2015b:11). Analysis of park development in Harlem found that environmental regeneration neutralised the vanishing of low-income groups and the new, improved neighbourhoods instead became centres for upscale development (Wolch et al 2014). Not only is there evidence of social injustice on the basis of income, ethnicity and other differences when it comes to UGS distribution, argues Wolch et al (2014), but also strong evidence of environmental injustice due to its links to health benefits that greenery provides.

The Swedish city development has differed from the American, especially in he post-war era, and socio-economic groups may not be distributed in the same ways. However, political factors largely based on 'the welfare state' have also made social conditions different in Sweden, making income gaps less wide and equality a political priority. The results of American studies cannot be put into a Swedish context directly, but there may be general factors that are transferable and give reason to interpret them in a Swedish setting. This is relevant to understand chapter three which discusses conditions in Malmö.

3 Greenery in Malmö

In 1980 it was concluded that Malmö had half as much green space as the average Swedish City, but it was not until the 90s that Malmö City (MC) put green planning on the agenda. Before the green plan, Malmö's UGS reduced drastically (MCPO 2000:33). The general goal for MC's comprehensive plan today is to maintain and develop Malmö as an 'attractive and sustainable city'. The development will be sustainable economically, socially and environmentally and adapted for a growing population (MCPO 2010; 2014). Green spaces are argued to facilitate such sustainability targets, see figure 3:1, and yearly, 11% of Malmö City's budget (approximately two billion Swedish Krona) goes to environmental maintenance (MC 2016). However, Malmö is characterized by segregation and social disparities. Differences in public health and living standards across city districts are evident. To meet sustainability targets, disparities within Malmö must be reduced. Physical planning, with green planning as a key factor, could contribute to a more socially cohesive city (MCPO 2014).

Summary of Malmö Green Plan Policy and Green Goals
Malmö municipality shall offer a good quality of life with a qualitative and available supply of different kinds of green spaces. A rich and varied natural and cultural environment with high recreative and biological values shall define the city, urban areas and countryside.

General goals
• to increase the total area of green space in Malmö
• to ensure valuable green space so that it is protected from exploitation

Recreative goals
• to create a varied supply of parks, nature and recreation areas that together with certain leisure areas and residential yards meet Malmö's inhabitants "green" needs
• to create a coherent green network with good availability within the whole municipality

Biological goals
• to create a richer and more varied supply of species and biotopes within the municipality
• to strengthen the municipality different landscape types and develop characteristic areas within each landscape type

(Malmö City Planning Administration 2003:II, my translation and adaption)

Figure 3:1. Malmö Green Plan Policy.

3.1 Access and availability

Malmö, known as 'the city of parks', is a relatively small and densely populated urban area. Despite the city's green reputation, the amount of green space in Malmö is limited from a national perspective. The availability of UGS is also below average; despite over 95% have access to greenery within 300 meters from home (MC Planning Administration 2003;SCB 2010). Just over 40% of Malmö's area was considered part of the green structure, which includes a range of land uses such as parks, gardens, graveyards, water, arable and pastoral land, green walks, trees and more. According to SCB (2010), 75% of total green space is considered publicly available, meaning that 30% of total space in Malmö constitute of public urban green spaces. However, MC Planning Administration (2003) suggest that the actual number is only 12% due to different degrees of publicness, and Sandström (2002a) suggests that as little as 4% is fully publicly available. Malmö had the least public green space per person with 93 m^2 per person according to SCB (2010), and 33 m^2 per person according to MC Planning Administration (2003). This is compared to 100 m^2 per person for the 10 largest cities in Sweden. Malmö also had the most people per green space, with over 500 per UGS (SCB 2010). Of Malmö's green areas, approximately 80% were small green areas 0.5-3 ha. 15% were of medium size 3-10 ha and only a few percent were large green spaces >10 ha (SCB 2010).

Malmö Green Plan deficiency analysis, which analysed the availability of different kinds of green spaces, showed that there is a general lack of greenery in Malmö, especially that of public availability (MC Planning Administration 2003). The main deficiency is in the central parts of the city, Tygelsjö, parts of Limhamn and Husie, and Västra Hamnen (MC Planning Administration 2003). SCB (2010) concluded that the areas lacking green spaces were mainly around the harbour area. Distance to a green area does not necessarily mean that green spaces are missing; for example, in the south west of Malmö there is a large section without proximity to a green space, but the city structure is dominated by villas and green structure is therefore mainly linked to private gardens.

3.2 Densification

Malmö City is aiming to become both greener and denser by a mainly inward expansion within the city's outer ring road (MCPO 2014). Examples of previous densification in Malmö include Västra Hamnen and Norra Sorgenfri (MCPO 2010). In the past decade, around half of Malmö's expansion has happened through densification. SCB has measured land use, densification and expansion of the city for selected urban areas with five year intervals, and the results show that the amount of hard ground increased and green spaces decreased for every interval in Malmö and other cities in Sweden (SCB 2002; SCB & Metria 2008; MC Planning Administration 2003). Sandström argues that this is due to densification and a neglect of UGS. MC

Planning Administration (2003) concludes that the small amount of existing green space in Malmö is threatened by exploitation, and it is important to find ways to protect these, and to plan for new areas with green values. In any dense city, it may be hard to create new green spaces and green walks. It is therefore of high important to strengthen and connect current ones (MC Planning Administration 2003).

3.3 'Sustainable Malmö' as a brand

In the early 1990s, Malmö was in a deep economic crisis. Malmö today is known as a 'post-industrial' city and reckoned to be among the world's greenest cities with a global reputation for outstanding progress towards environmental sustainability and sustainable urban planning (Holgersen & Malm 2016:275). Malmö City has also won a range of awards, both internationally (see Figure 3:2) and nationally (such as Sweden's most environmental city). Holgersen & Malm (2016:276) argue that Malmö's so called 'green fix' (derived from Harvey's 'spatial fix' and means to use greenery as a problem solver for urban issues and crisis management) has been used to achieve international recognition, as a business strategy on the housing markets and as a commodity in itself. Malmö's international recognition yearly attracts more than 10.000 professional visitors, such as architects, planners and developers, who come to observe Malmö's sustainable urban development. The visits are 'part of Malmö's branding work' (Holgersen & Malm 2016:281, quote by MC). The 'green fix' as a business strategy, and companies appearing environmentally responsible, is profitable to get tenants and selling apartment blocks. In addition, the whole area increases in value according to local developers (Holgersen & Malm 2016:282). MC Planning Administration (2003:3) argues that parks and green spaces are also used to make city areas attractive to live and work in, and many of the environmentally sustainable buildings are developed for a high-end clientele, unaffordable for the majority of the population (Holgersen & Malm 2016:283).

Västra Hamnen has been in the spotlight for recent years development, due to significant regeneration and branding work. Holgersen & Malm (2016:285) argue that it was built to attract entrepreneurial people to the city. The mean income here was significantly higher than the Malmö average, and nearly three times higher than the sub-districts Törnrosen, Herrgården and Kryddgården (MCPO 2014; Holgersen & Malm 2016:285). Holgersen and Malm (2016:287) argue that better improvements for the city would instead of further work on Västra Hamnen aim to improve disadvantaged neighbourhoods, especially those part of the Swedish Million Programme, which are in desperate need for restoration and could dramatically reduce, for example, energy consumption.

International Awards received by Malmö City 2007-2013

1. Third Greenest city in the world, 2013 (by Mother Nature Network)
2. Finalist for the European Green Capital, 2012 and 2013 Earth Hour Capital, 2011 (by WWF)
3. Third most environmentally friendly city in Europe, 2011 (study by Economist Intelligence Unit commissioned by Siemens)
4. First winner of the Nordic Sustainability Price, 2011 (by Idébanken)
5. Winner of the Intermodes Prize, 2011 (as part of Oresund Region) (by AEBR)
6. Honoured a seat at the Urban Best Practices Area at Expo 2010 in China Recipient of the World Habitat Award, 2010
7. The World Green Building Council's BEX Award, 2009 (for best master plan, with special compliments to the Western Harbour)
8. 'Scroll of Honour 2009' (for its 'innovative and holistic approach to becoming a 21st century eco-city') (by UN-Habitat)
9. Global District Energy Climate Awards, 2009
10. European Fleet of the Year Award from the Green Fleet Award, 2009
11. Honourable Recognition at the Globe Award, 2009
12. Fourth "greenest city in the world", 2007 (by Grist.org)
13. Bo01 used as "Role model" in State of the World report, 2007

(Retrieved from Holgersen & Malm 2016:281, my adaption)

Figure 3:2. International Awards received by Malmö City 2007- 2013.

Holgersen & Malm (2016:279) argue that Malmö today could be characterized as an 'entrepreneurial' city, which is connected to the branding work. In MC's comprehensive plan, green growth is listed as vital for the city's development and to encourage economic growth. It is stated that after the 'industrial Malmö comes the knowledge city'. This is part of the agenda to continue the 'development of an attractive city' (MCPO 2014). The city prioritizes environmental issues by economic solutions to make Malmö a good setting for both entrepreneurial people and business, argued to be vital for a sustainable growth. The transformation from industrial to entrepreneurial has also restructured Malmö's commercial life and caused a tourism increase, and the brand Malmö plays a vital role to strengthening Malmö as a destination, for commercial activities and as a place of residents. MCPO (2014) argues that diversity in the commercial sector is important to secure a strong post-industrial economy which ensures an even spread of well-being, and that a city with a well-educated population is the basis for a positive development.

4 Theoretical perspectives on urban justice

4.1 Social and Environmental Justice

Harvey (1973:87) argues that impure public goods, which provide benefits to all individuals, are free but not equally available in terms of quality and/or quantity to the city's inhabitants. A policy issue concerning these goods is to ensure that the good is provided, either by public or private action, in sufficient quantity and quality at the right locations to achieve an equal distribution. Because they can rarely be provided through normal market mechanisms they are more often provided by public action (Harvey 1973:87). However, few criteria have been developed for determining the location and the lack of impure public goods could be due to either market failure, time-lag in achieving equilibrium or social and economic conditions which make operations uneconomic (Harvey 1973:88-89).

It is generally accepted that accessibility and proximity are important features in any urban system. Accessibility can be obtained at a price equal to the cost of overcoming distance, for example time savings (Harvey 1973:56-57). In addition, the connection between value of land and the price of resources is increasing rapidly. Assuming that each person throughout a city system has an identical need for a public good where the price is low if accessible, and high if inaccessible. If there is also a complete inelasticity in the demand, the variation in access price within the city can be seen as a direct effect of income. The quantity of a resource may be altered, price changed or the cost of access changed (Harvey 1973:68-69). Harvey (1973:69) also argues that externality effects must be taken in consideration, such as the well-being and health benefits provided by UGS. Externalities can be viewed as costs or benefits according to whether the producer of the consumer is affected and according to the nature of the effect (Harvey 1973:58).

UGS can be seen as one such public good, and hence the allocation of UGS in the city will also affect the distribution of income, thereby creating clusters of different levels of income within the city. Similarly, UGS must generally be provided by public actions, and because of the economic division within the city, one could argue that provision of UGS is deemed more economic in areas where the income is higher. The division of UGS in the city is therefore both an effect of income levels, but also further creates income disparities within the city. Assuming also that proximity to UGS is directly linked to health benefits derived from usage, a household that is not in proximity could get additional costs derived from the lack of UGS, such as poorer health. From this perspective, public health has a price that is linked to both the distribution of UGS and income. The theoretical approach of social justice therefore suggests that the unequal distribution of resources, such as UGS, within the city system cause social disparities, and because UGS is equally an environmental resource, it can be argued to be a matter of both social and environmental justice.

Social justice and social sustainability are closely linked terms. Social sustainability means to create a society that provides equal opportunities to build a good life for all citizens by securing basic needs such as employment, education, safety and healthcare. Access to UGS could equally be one of those needs as it provides health benefits. Since the key goals on MC's comprehensive plan is sustainable development (MCPO 2014) – including that of social sustainability – the matter of social justice becomes highly relevant in relation to the distribution of UGS.

4.2 Green gentrification

Gentrification is a process where one class is replaced by a class with more buying power, causing changes in the social character of an area (Littke 2016:52). Littke (2016:51) argues that greenery have long been used as a planning tool for economic development by raising property values. More green space in unserved areas often lead to higher property prices. The distribution of new green space therefore favours more affluent communities. This is known as green gentrification, and the effects are displacement and exclusion (Wolch et al 2014). Greening areas with limited access thereby causes paradoxical effects. While the greening in unserved areas often aim to increase health, it also increases the attractiveness of the neighbourhood, causing gentrification. This is known as the 'green space paradox' and can happen even when the primary motive is to tackle environmental injustices. It often damages for the same residents the greenery was meant to benefit by altering housing opportunities. Community members might therefore end up in less desirable suburbs with the same issues (Wolch et at 2014; Littke 2015b:8). This classic pattern ties up with the neoliberalising and competitive city that pursues attractiveness, which includes a green environment (Sandberg 2014:15).

Wolch et al (2014) stresses that complexity of UGS on the one hand being a positive factor for health, and on the other hand leading to green gentrification and environmental injustice. While green neighbourhoods lead to a higher quality of life and thereby contribute to social sustainability, sustainability motives thereby connects to the concept of gentrification (Littke 2016:52). Littke (2016:49) and Sandberg (2014:10) argue that green gentrification can be confirmed when a city is promoting environmental and economic goals, but do not meet social goals. The debate about greenery in cities thereby highlights tensions between different sustainability goals. Wolch et al (2014) suggests strategies that are "just green enough" to protect both social and environmental sustainability. This strategy improves access to UGS to reap health benefits in disadvantaged neighbourhoods while avoiding the green space paradox. For example, small-scale interventions can be promoted instead of large projects, which often regenerates a whole area and thereby sparks rounds of gentrification. This way, access can be increased in a more evenly distributed way rather than one concentrated point of development (Wolch et al 2014).

4.3 Green city branding

Green gentrification is closely connected to entrepreneurial cities, which often includes green city branding (Littke 2016:54). Green city brands and particularly innovative forms of greenery can be seen as an policy tool and marketing strategy for cities, especially post-industrial, to create and strengthen an image as being liveable and sustainable in an era of increased competiveness, to attract capital, residents and companies (Littke 2016:54-57). For the same reason, urban greening projects are often implemented under a political sustainability banner. It can also be seen as a greenwashing strategy for displacing any signs of the poor images that the city previously had (Littke 2015b:9-13). This links gentrification, regeneration, branding, sustainability and green space division.

Holgersen & Malm (2016) argues that the logic of the green fix is to attract capital to the city through the production of a green image. In the green fix, sustainable practices are promoted as features of the city, and the greenery has the function of attracting further capital. Residential areas and office buildings, new infrastructure and transport systems are branded as sustainable and new neighbourhoods, such as Västra Hamnen, are designed to gain a reputation for environmental excellence (Holgersen & Malm 2016:278). The green language and consumption is adapted by many and facilitates on the one hand green space provision and on the other, gentrification and a widening gap of environmental and social justice in the access of the greenery (Wolch et at 2014). The primary goal of planning is now often defined as an attractive and sustainable city. However, environmental challenges are often tackled by economic means such as green technology suggested to provide growing opportunities for Swedish exports (Holgersen & Malm 2016:280), making the sustainability core more business, accumulation of capital and economic growth rather than meeting social and environmental needs. It is also worth noting that in the 'green' context, different sustainability factors such as green environments, green energy, green transport and more branded as one single 'green product'.

5 Methods and material

The research design constitutes of two parts; a quantitative base using GIS (ArcGIS) and SPSS (Statistical Package for the Social Sciences), and one qualitative field observation monitoring the results. GIS was used to map UGS in Malmö and retrieve spatial data for the socio-economic variables income, education and population. Differences across Malmö are visualised by clusters in thematic maps and trends in availability of UGS. Attribute data from was exported to Excel files for use in SPSS, where a bivariate (Pearson's) analysis was conducted, presenting correlations and trends in statistical tables. The field observation resulted in notes and photos of locations of interest (cf. Bryman 2016).

The quantitative basis was used, as it may be hard to find fair indicators on the quality of UGS. Measurements such as green space per person might be more accurate to determine the distribution (Wolch et al 2014). Furthermore, the image of Swedish cities all being very green is not all true and Sandström (2002b:36) claims as little as 4% of UGS in Malmö are actually available to the public, which is why it is of importance to conduct the research with *public* green spaces as compared to all green spaces. SCB and planning authorities generally use the total green infrastructure as the variable. Since, however, both qualitative and quantitative measurements are necessary to determine differences (Stockholm City Planning Office 2003;Bryman 2016), the qualitative observation was added.

5.1 Material

The raw data was in vector format. Ortophoto was used on one occasion to compare and visualise accuracy of the vector data. The following data was collected:

Land cover

- SMD (Swedish Land Cover Data, extracted 2001-2003) (Naturvårdsverket 2014).
- Fastighetskartan, Terrängkartan and Översiktskartan (Lantmäteriet 2014a,b,d) (adding variables not included in SMD).
- Ortophoto (Lantmäteriet 2014b).

Administrative boundaries

- Malmö Tätort boundaries (SCB 2014e).
- City districts and sub-districts (Department of Human Geography 2012).

Statistical data

- Population data. Total population, ethnical background (SCB 2014d)

- Income data ages 25-65. Categories: median income, number of high, medium-high, medium-low, low and total incomers (SCB 2014b).
- Education data for ages 25-65. Categories: Pre-high school, High school, University under years, University exceeding years (SCB 2014a)
- Occupation data ages 25-65 from. People in employment. (SCB 2014c).

5.2 GIS – spatial analysis

GIS was used to map UGS in Malmö and retrieve spatial data for the socio-economic variables income, education and population, with the aim of visualising trends in availability of UGS by thematic mapping (Harrie 2014). The outline of Malmö was used to clip all layers. The first part of the analysis was to create a layer of all UGS in Malmö, see table 5:1, for a specification of included land uses. The vectorized UGS layer was compared with Ortophoto (satellite data) to review accuracy as seen in Figure 5:1. A few areas were manually filled in. UGS <0.5HA were removed to simplify the analysis. The second part of the analysis was thematic mapping of the socio-economic variables seen in table 5:2. Data was adjusted from SAMS (Small Areas for Market Statistics) to describe data on district and sub-district levels. Generally, proportions were used instead of absolute numbers to minimize faults. The third part of the analysis was to create a buffer layer based on the green space to identify areas where green space was missing within 300 meters. Relevant thematic maps were created and attribute-tables were exported to Excel. A complete methodology step-by-step is outlined in Appendix A, and additional maps and tables not presented in the result section are found in Appendix C.

Table 5:1. Land use included and excluded in the green space layer

Included	Not included
Forest (coniferous and deciduous)	Allotments
Urban Green Spaces	Tennis courts
Dams and Lakes	Golf courses
Beaches	Non public recreational spaces
Nature reserves and national parks	Graveyards
Public green recreation areas	Arable and Pastoral Land
	Gardens and other private property

Table 5:2. Socio-economic variables in the GIS-analysis.

Population	Green space	Income	Education
Total	Total		
Ethnic Background	Per person	Median	
Density	Proportion	Proportion (High,Mhigh, Mlow,Low)	Proportion (pre-high school, high school, university)

Figure 5:1 Vectorized data compared to Ortophoto.

5.3 SPSS – bivariate (Pearson's) correlation

SPSS was used to find potential correlation and spatial links between green space distribution and socio-economic variables by conducting a bivariate analysis using Pearson's r. The attribute tables of the spatial data from the GIS analysis were imported to SPSS. All spatial information in separate excel files were combined to one single district file and one sub-district file for simplification, and thereafter correlated using Pearson's R, showing the strength and direction of the relationship. Values <0.3 indicate a weak correlation, 0.3 – 0.6 a medium correlation and values >0.6 a strong correlation. A P-value of 0.05 was determined as the significance level, as generally accepted in the social sciences. P-values under the significance level, <0.05 indicate strong evidence against the null hypothesis, and the null hypothesis was in these circumstances rejected and a correlation was accepted. P-values >0.05 indicate weak evidence against the null hypothesis; therefore any of these cases were interpreted as no correlation (Bryman 2016:346). Any significant correlation is highlighted in red – non-significant correlations are not market in any colour. I also used descriptive statistics to find mean values and rank to find the highest/lowest district and sub-district for the different variables. The output was tables and scatterplots, which highlight spatial links and correlations. The complete list of variables is outlined in Appendix B and tables not included in the result-section can be found in Appendix C.

5.4 Observation – field monitoring

Quantification of space, such as proximity, might not provide a deeper perspective on the usage of UGS (Lindholst et al 2015). In addition, many cities have limited space available, questioning if it is even economically possible to prioritize UGS. It is therefore of importance also to consider qualitative factors and how they might impact the use of UGS. This could potentially give a clue in how to improve quality of life for groups with limited availability. This part of the analysis aims to observe areas of significance with regards to green space and/or socio-economic status, as derived from the quantitative analysis. The observed areas ranked either high or low in any of the following categories: median income, proportion high incomers, proportion low-incomers, education level, green space per person, population density. I visited areas in the south-western part (high amount of green space, high amount of high incomers), central parts (basically non-existing greenery) and the eastern part (high amount of green space, high proportion of low-incomers). Observed areas are ranked below and marked out in figure 5:2.

Southwest:
- Solbacken (Stadion)
- Ärtholmen
- Bellevue
- Nya Bellevue

Central:
- Kronoborg (Pildammsparken)
- Möllevången

East:
- Persborg
- Herrgården
- Rosengård Södra
- Örtagården

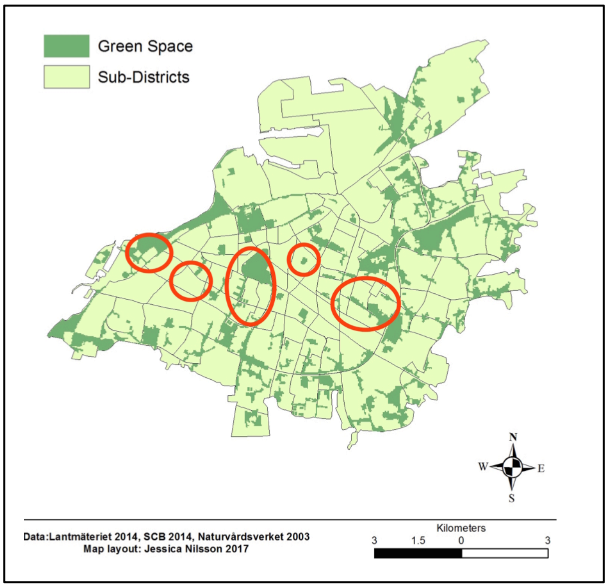


Figure 5:2. Observed areas.

During the observation I took notes and photos. I considered the following:
- What kind of area is it? What does the area look like? Vegetation?
- Is the area well maintained? Are there benches, streetlights, bins? Is it clean?
- Are there people using the area? Does it feel safe?
- Does the area have a purpose? What are people doing in the area?
- What is the perceived accessibility? Are there facilities such as toilets?

5.5 Accuracy and reliability

Maps are models of reality and therefore simplified. This is important to consider in any analysis made where models are used to express reality (Harrie 2014). For example, when matching vectorized data, some green spaces were not adjusted for roads. Though it is possible to adjust obvious faults, there may still be polygons that have not been adjusted, or that are private/public land though stated otherwise. In addition, SMD is 15 years old and is, compared to Ortophoto, missing recent development. I adjusted the green space layer by including more updated data from Fastighetskartan and Terrängkartan, as well as manually creating missing polygons according to Ortophoto. Though adjusted and updated to the best of my abilities, there might still be missing information. This highlights a wider issue with missing land cover data in Sweden.

There were some issues with the administrative boundaries of Malmö Urban Area. Lantmäteriet gave two different versions, which were separate from SCB's, though Lantmäteriet stated that both these boundaries were based on SCB definition. At the end, SCB's boundaries were used. The differences were however relatively small, and it appeared as if Lantmäteriet had only simplified SCB's boundaries in shape. They were also adjusted for water boundaries at the harbour, which the SCB boundaries were not. I have, however, adjusted this accordingly, as harbour water otherwise would be included in the green space layer and reflect reality inaccurately.

SCB only provided statistical spatial data for the SAMS. However, several of the SAMS areas were fully or partly missing data from one or more of the variables. For example, the income and education data had a different number of “total people” even though they were both measured in the same age-ranges (25-65). In addition, there was a category of “No Data” where people were counted but not defined as per income or education. There were also areas of recent development, such as Västra Hamnen, for which population data is not accurately updated. For example, in one part it measured only 12 people when in reality, the built up area indicate that the number is significantly higher. In mapping, the result appears skewed when it comes to for example non-Nordic born population indicating the number to be 56-65%, which is comparable to Rosengård. It also indicates an unusual high number of green spaces per person for an area with a very low amount of green space – again dependent on the missing population measurement. Out of 135 sub-districts, data was obtained for 122. Some of these are part of Malmö Municipality and not Malmö urban area, but some were removed due to micro-polygons. In addition, sub-districts were adjusted to only show available data.

6 Results

6.1 Green space availability

The UGS distribution is outlined in figure 6:1a. The total amount of UGS exceeding 0.5HA in Malmö constituted 17.2% of Malmö's total area, with mean numbers of 16.5% on sub-district level and 18% on district-level as presented in table 6:3 and mapped in figure 6:2a. The proportion of green space was lowest in the central parts of the city and around the harbour, and highest in the eastern parts. This number differs significantly from both SCB's 48% (which include all green structure) and other previous research, likely due to different definitions. The absolute UGS area, see figure 6:a1b, is higher the further out from the city core, where the districts are also larger. As seen in figure 6:2b, the vast majority of people have access to green space within 300 meters of home. The main shortage areas are in the northwest area of Västra Hamnen and southwest in Limhamn-Bunkeflo. Looking at figure 6:2c, which includes buildings, the majority of "missing" green space in southwest is covered by private property, probably including gardens. Västra Hamnen on the other hand is an area of recent development where green space is low, but so is number of people residing there. No significant correlation between access to green space within 300 meters and any of the socio-economic variables were found, see appendix C.

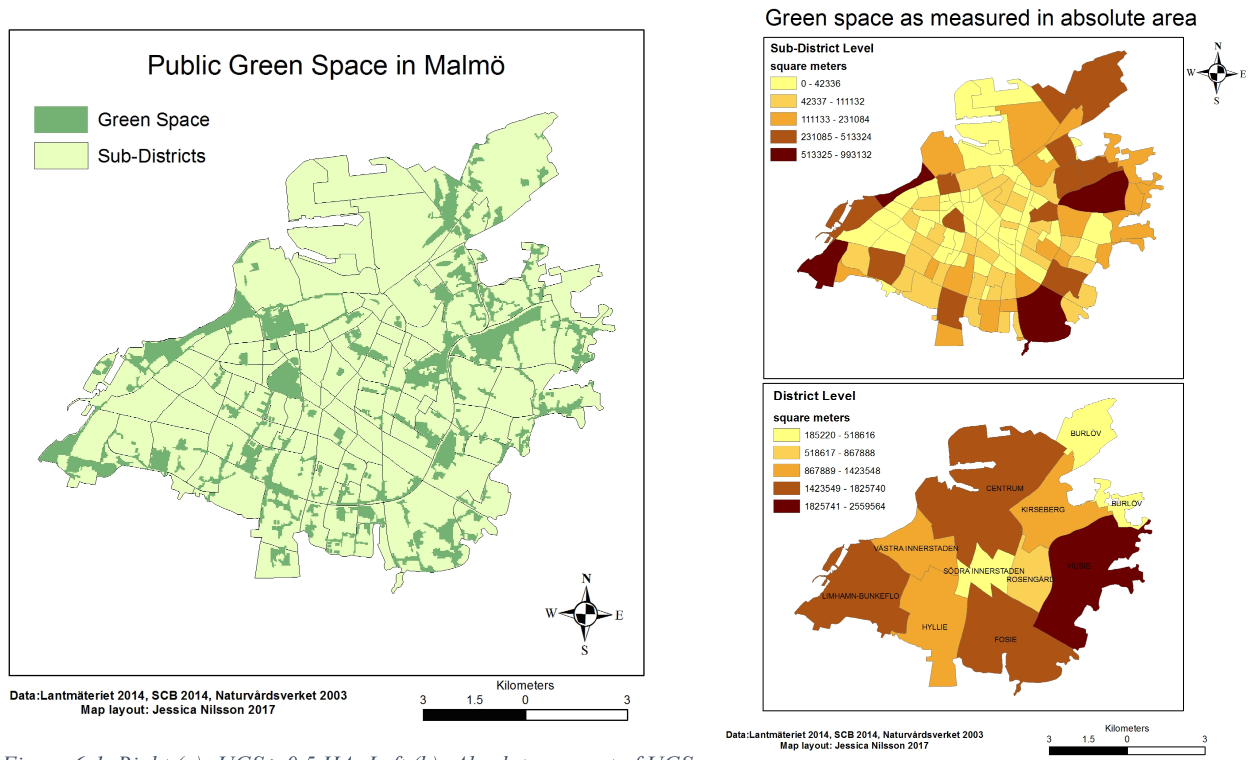


Figure 6:1. Right (a): UGS >0.5 HA; Left (b): Absolute amount of UGS

Table 6:1. UGS average across district and sub-districts.

	Mean (m^2)	Mean (%)	Range (m^2)	Range (%)
Sub-District	111890	16,5%	0 - 993132	0% -91.5%
District	13538700	18%	185220 - 2559564	6.5% - 30.5%

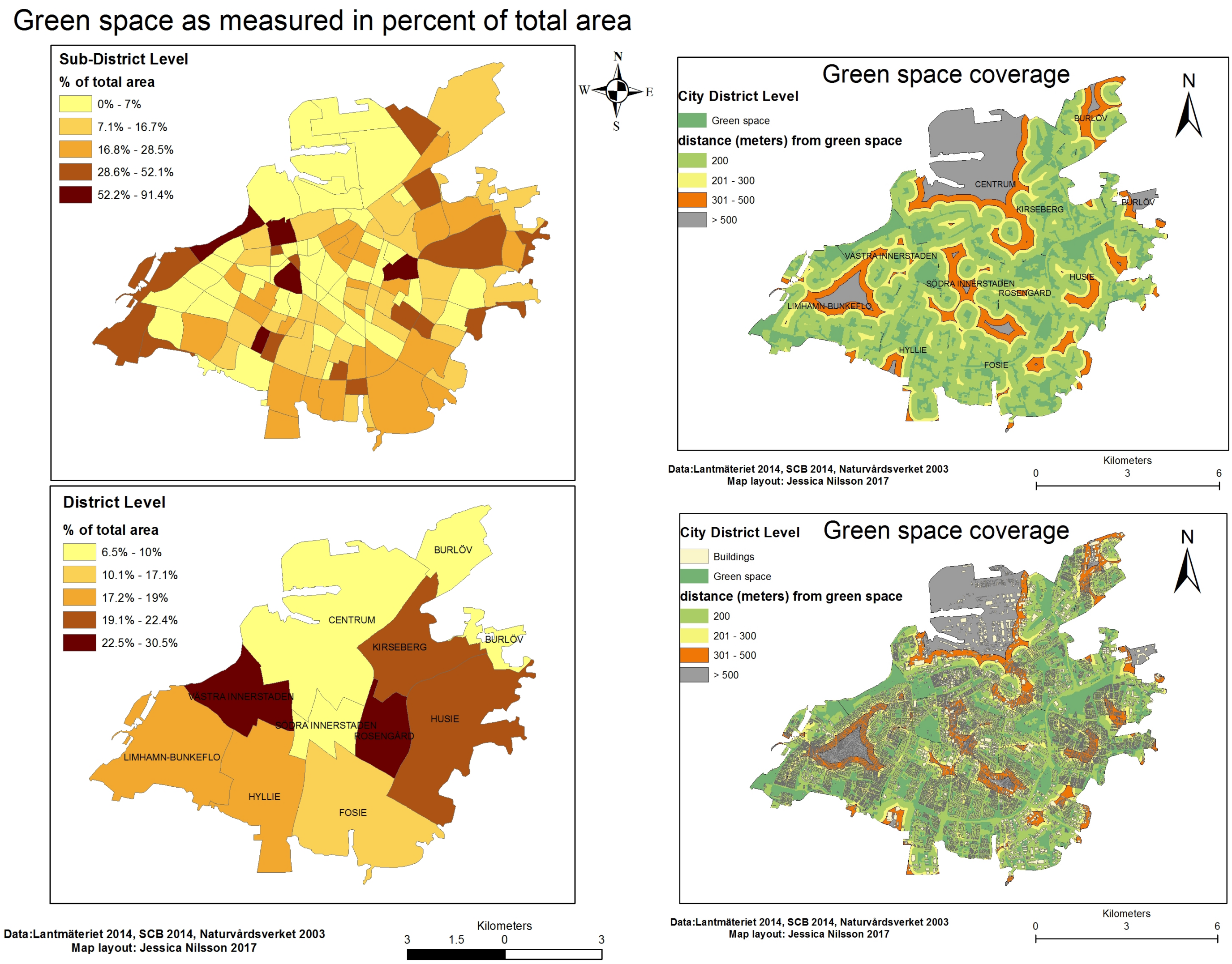


Figure 6:2. Left: (a) Proportion green space across districts and city districts; Right, upper: (b) Green space coverage; Right, lower: (c) Green space coverage including buildings

6.2 Population

Figure 6:3a shows that the population density is highly concentrated to the city's core. The further out, the lower the population density. The highest population density is in Södra Innerstaden, peaking at 10978 people per square kilometre. Population density had strong negative correlation with green space per person on district level (-0.694), meaning the higher the population density, the lower number of green space per person, see table 6:3. The relationship is illustrated in figure 6:3c. There was a weak yet significant correlation on sub-district level as seen in table 6:2. The amount of green space per person, see figure 6:3b, becomes higher the further away from the core and differs significantly from proportion of green space, but with similar trends to absolute amount of green space. The central parts are reaching a maximum of 30 m^2 per person on district level, while the outer eastern part has 114 m^2 per person. Differences are more evident on district than sub-district level. Ethnicity showed no correlations with the green space variables; however, maps are showing a high segregation between Nordic born and non-Nordic born in Malmö. This is not discussed further in the results, but may be of relevance to keep in mind for the analysis section. For further results, see Appendix C.

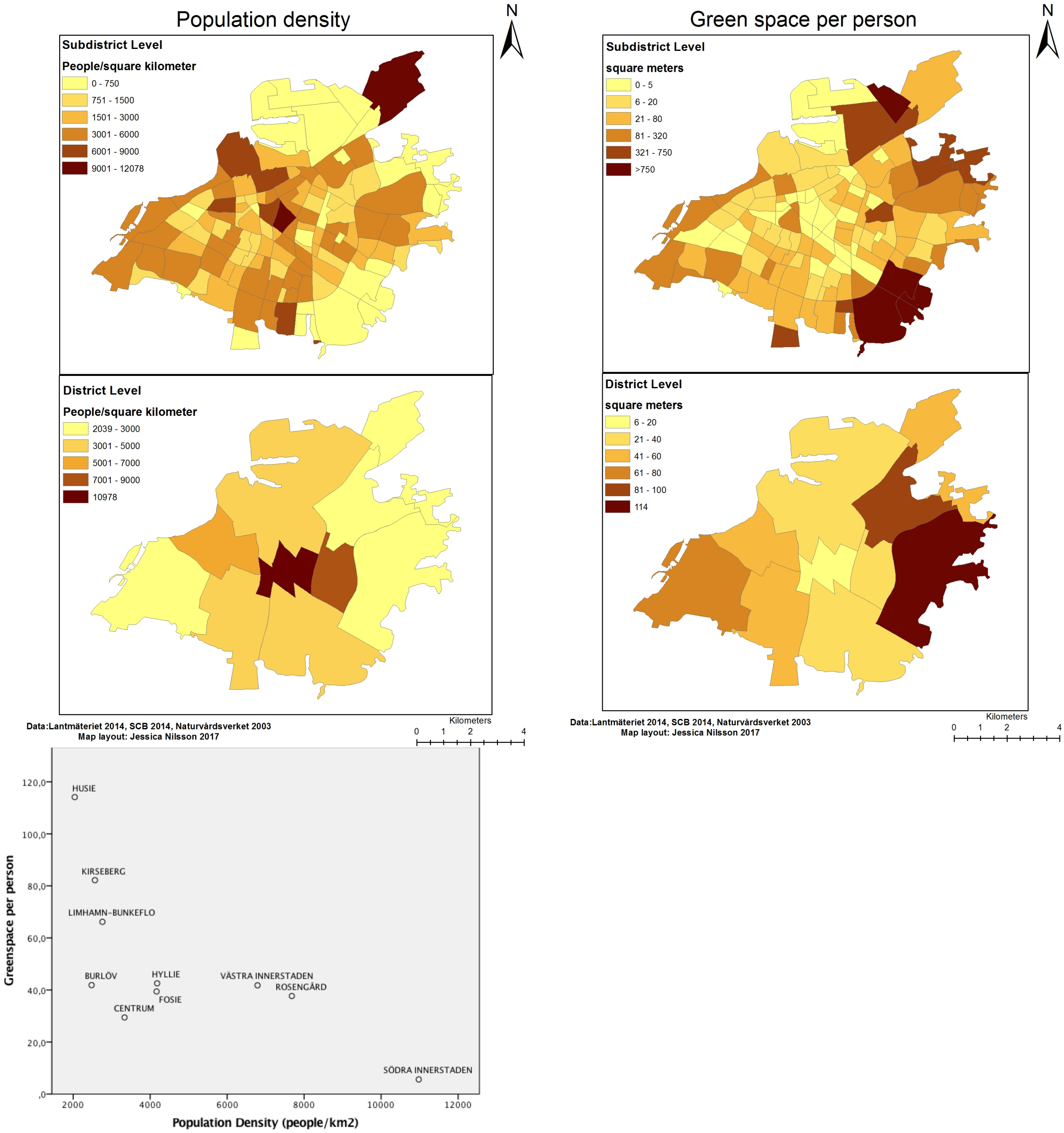


Figure 6:3. Left, upper (a): Population Density; Right (b): Green space per person; Left, lower (c) Relationship population density and green space per person for city districts

6.3 Income

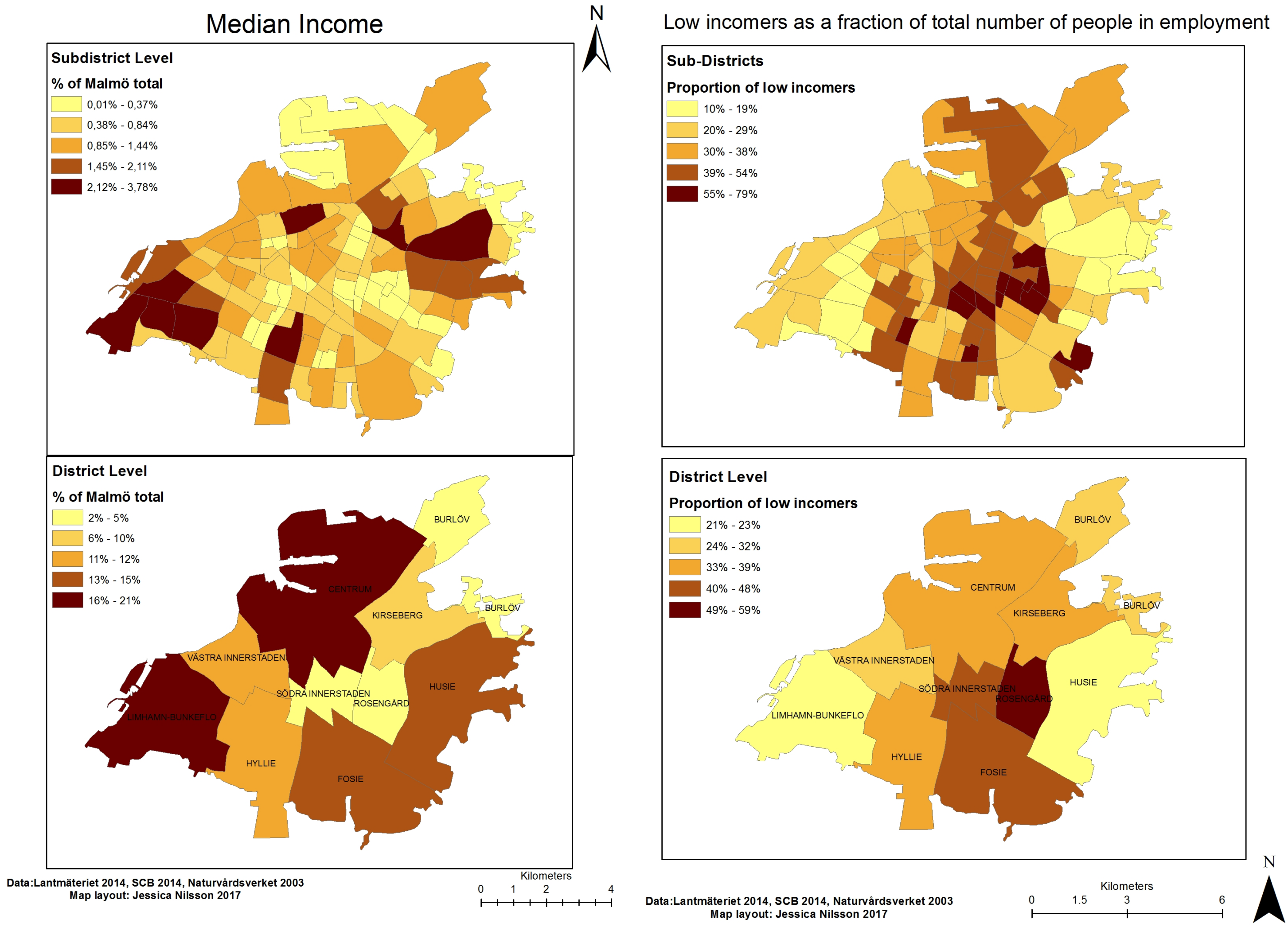
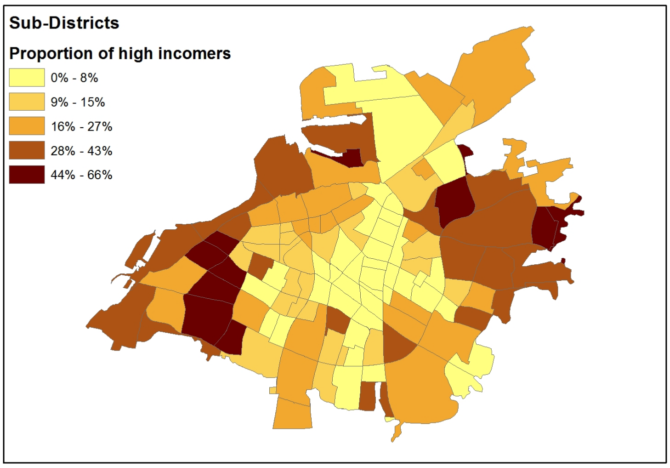
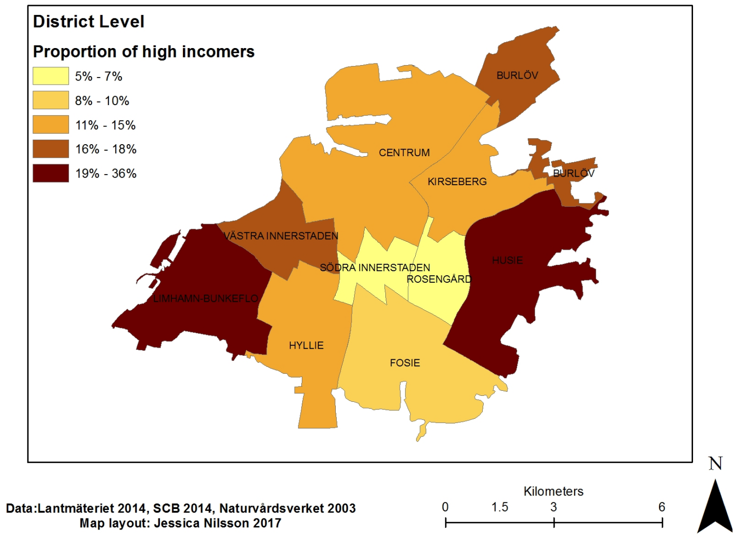


Figure 6:4. Left: (a) Median income as % of Malmö Total; Right: (b) Proportion low incomers

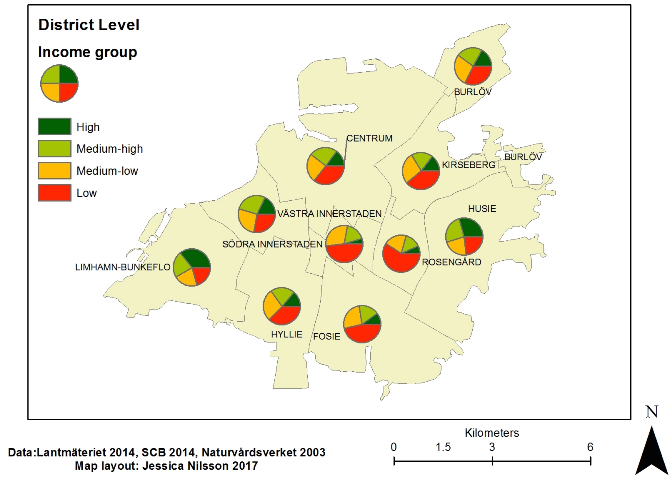
The thematic maps (figure 6:4a-b, 6:5a-b) shows that Malmö is highly segregated income-wise. The lowest incomes and highest amount of low-incomers are found in the inner suburb of Rosengård, and the highest incomes and highest proportion of high-incomers are found in Limhamn-Bunkeflo, a little bit further out. The distribution of income levels seen in figure 6:5b shows that in Rosengård, the proportion of low incomers are significantly higher than any other district, while the proportion of high incomers in Limhamn-Bunkeflo was higher than any other district. High incomers and green space per person on district level were strongly correlated, see table 6:3 and figure 6:5c. For other income levels and on sub-district level, no significant correlations were found for the income variable. Since green space per person also strongly correlated with population density, this suggests that population density and proportion of high incomers are also connected.

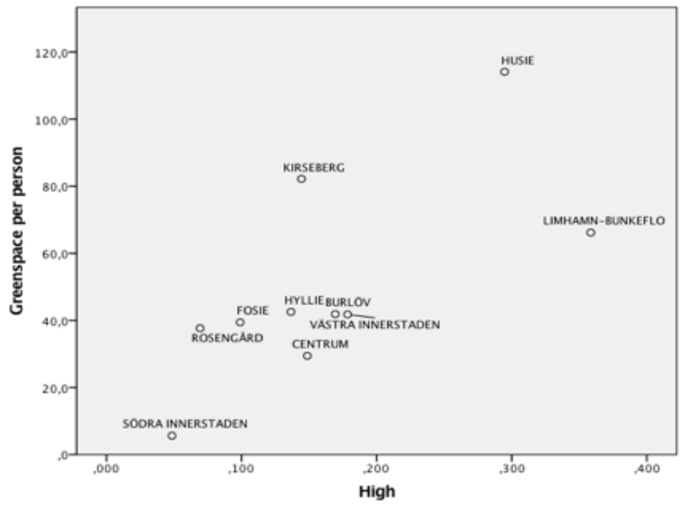
High incomers as a fraction of total number of people in employment





Distribution of income levels





6.4 Education

Highly educated people are highly concentrated to the districts of Limhamn-Bunkeflo, Södra Innerstaden, Västra Innerstaden and Centrum as shown in figure 6:6a-b, essentially dividing Malmö in half. Education did however not show any significant correlation with any of the green space variables on district level; see table 6:3 and appendix C. On sub-district level it was negatively low medium correlated to green space per person (table 6:2). One explanation for the difference between sub-district and district level could be that a lot of highly educated people live in Södra Innerstaden, where amount of green space is significantly lower than the rest of the city.

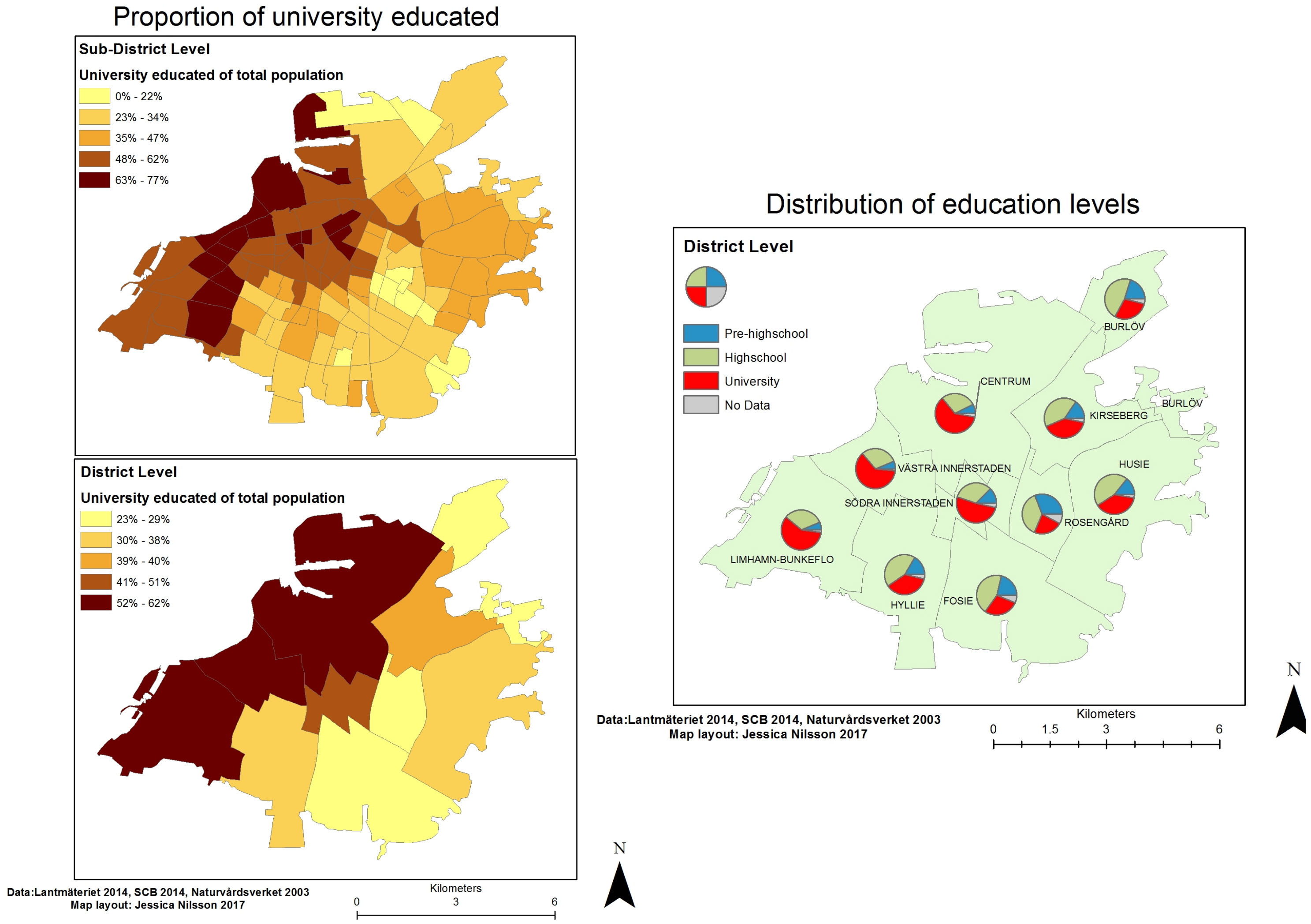


Figure 6:6. Left: (a) Proportion of university educated; Right (b) Distribution of education levels across districts

6.5 Key correlations

Sub-district level

On Sub-district level, as shown in table 6:2, the correlations tended to be weaker than on district level, probably explained by the sub-district being quite small and more varied. There was however a medium positive correlation between population density and median income. This was surprising, as then in the sub-district, this indicates that the higher the median income, the higher the population density. There was a negative but weak correlation between high-incomers and population density, and a similar correlation between population density and green space per person. These results are surprising as median income in turn positively correlated with amount of high-incomers. It appeared that the more high incomers and the higher the median income, the larger the area of the sub-district and consequently, the higher amount of green space within the sub-district.

Table 6:2. Key correlations on sub-district level.

Variables	Correlation	Tot Area UGS (m^2)	Tot Area m^2	Proportion UGS	UGS m^2/per person	Population Density	Median Income	Proportion High Incomers
Tot Area UGS (m^2)	Pearson Correlation	1	0,597*	0,668*	0,176	0,105	0,351*	0,200*
	Sig. (2-tailed)		0	0	0,054	0,25	0	0,028
	N	121	121	121	121	121	121	121
Tot Area m^2	Pearson Correlation	0,597*	1	0,043	0,101	0,217*	0,417*	0,203*
	Sig. (2-tailed)	0		0,642	0,269	0,017	0	0,026
	N	121	121	121	121	121	121	121
Proportion UGS	Pearson Correlation	0,668*	0,043	1	0,099	-0,047	-0,019	-0,016
	Sig. (2-tailed)	0	0,642		0,282	0,609	0,833	0,864
	N	121	121	121	121	121	121	121
UGS m^2/per person	Pearson Correlation	0,176	0,101	0,099	1	-0,192*	-0,069	-0,057
	Sig. (2-tailed)	0,054	0,269	0,282		0,035	0,451	0,531
	N	121	121	121	121	121	121	121
Population Density	Pearson Correlation	0,105	0,217*	-0,047	-0,192*	1	0,408*	-0,211*
	Sig. (2-tailed)	0,25	0,017	0,609	0,035		0	0,02
	N	121	121	121	121	121	121	121
Median Income	Pearson Correlation	0,351*	0,417*	-0,019	-0,069	0,408*	1	0,375*
	Sig. (2-tailed)	0	0	0,833	0,451	0		0
	N	121	121	121	121	121	121	121
Proportion High Incomers	Pearson Correlation	0,200*	0,203*	-0,016	-0,057	-0,211*	0,375*	1
	Sig. (2-tailed)	0,028	0,026	0,864	0,531	0,02	0	
	N	121	121	121	121	121	121	121

* Significant correlations highlighted in red.

District Level

On District-level, see table 6:3, one of the key correlations was population density and availability of green space, including green space per person and absolute amount of green space in the district. The correlation was negative, meaning the higher the population density, the lower availability of UGS and vice-versa. Population density was also strongly correlated to the amount of high-incomers in the district, also a negative correlation meaning that the more high-incomers in a sub-district, the lower the population density. Proportion of high incomers was also strongly (positively) correlated to green space per person and to median income - the more high incomers and the higher the median income, the more available green space per person. The total area of the district was also relevant, as it strongly correlated to the amount of green space, but also to median income. Looking at the outline of the city districts, it is clear that the smaller districts are located more central, and the larger ones are in the outskirts of the city, where population density is lower and amount of green space is higher. Larger districts have more green space in absolute numbers. This is also where the high-incomers tend to live, see figure 6:6a-b. It is important to note that no correlation was found with proportion of green space. The relationship between the different green space variables and income has been illustrated with scatterplot, see figure 6:7a-d.

Table 6:3. Key correlations on district-level.

Variables	Correlation	Proportion High Incomers	Median Income	Tot Area m^2	Population Density	UGS m^2/per person	Tot Area UGS (m^2)	Proportion UGS
Proportion High Incomers	Pearson Correlation	1	0,714*	0,381	-0,640*	0,696*	0,657*	0,244
	Sig. (2-tailed)		0,02	0,277	0,046	0,025	0,039	0,497
	N	10	10	10	10	10	10	10
Median Income	Pearson Correlation	0,714*	1	0,699*	-0,447	0,373	0,792*	0,178
	Sig. (2-tailed)	0,02		0,025	0,195	0,288	0,006	0,622
	N	10	10	10	10	10	10	10
Tot Area m^2	Pearson Correlation	0,381	0,699*	1	-0,597	0,251	0,708*	-0,219
	Sig. (2-tailed)	0,277	0,025		0,069	0,485	0,022	0,543
	N	10	10	10	10	10	10	10
Population Density	Pearson Correlation	-0,640*	-0,447	-0,597	1	-0,694*	-0,635*	-0,06
	Sig. (2-tailed)	0,046	0,195	0,069		0,026	0,048	0,869
	N	10	10	10	10	10	10	10
UGS m^2/per person	Pearson Correlation	0,696*	0,373	0,251	-0,694*	1	0,714*	0,456
	Sig. (2-tailed)	0,025	0,288	0,485	0,026		0,02	0,185
	N	10	10	10	10	10	10	10
Tot Area UGS (m^2)	Pearson Correlation	0,657*	0,792*	0,708*	-0,635*	0,714*	1	0,412
	Sig. (2-tailed)	0,039	0,006	0,022	0,048	0,02		0,236
	N	10	10	10	10	10	10	10
Proportion UGS	Pearson Correlation	0,244	0,178	-0,219	-0,06	0,456	0,412	1
	Sig. (2-tailed)	0,497	0,622	0,543	0,869	0,185	0,236	
	N	10	10	10	10	10	10	10

*Significant correlations highlighted in red.

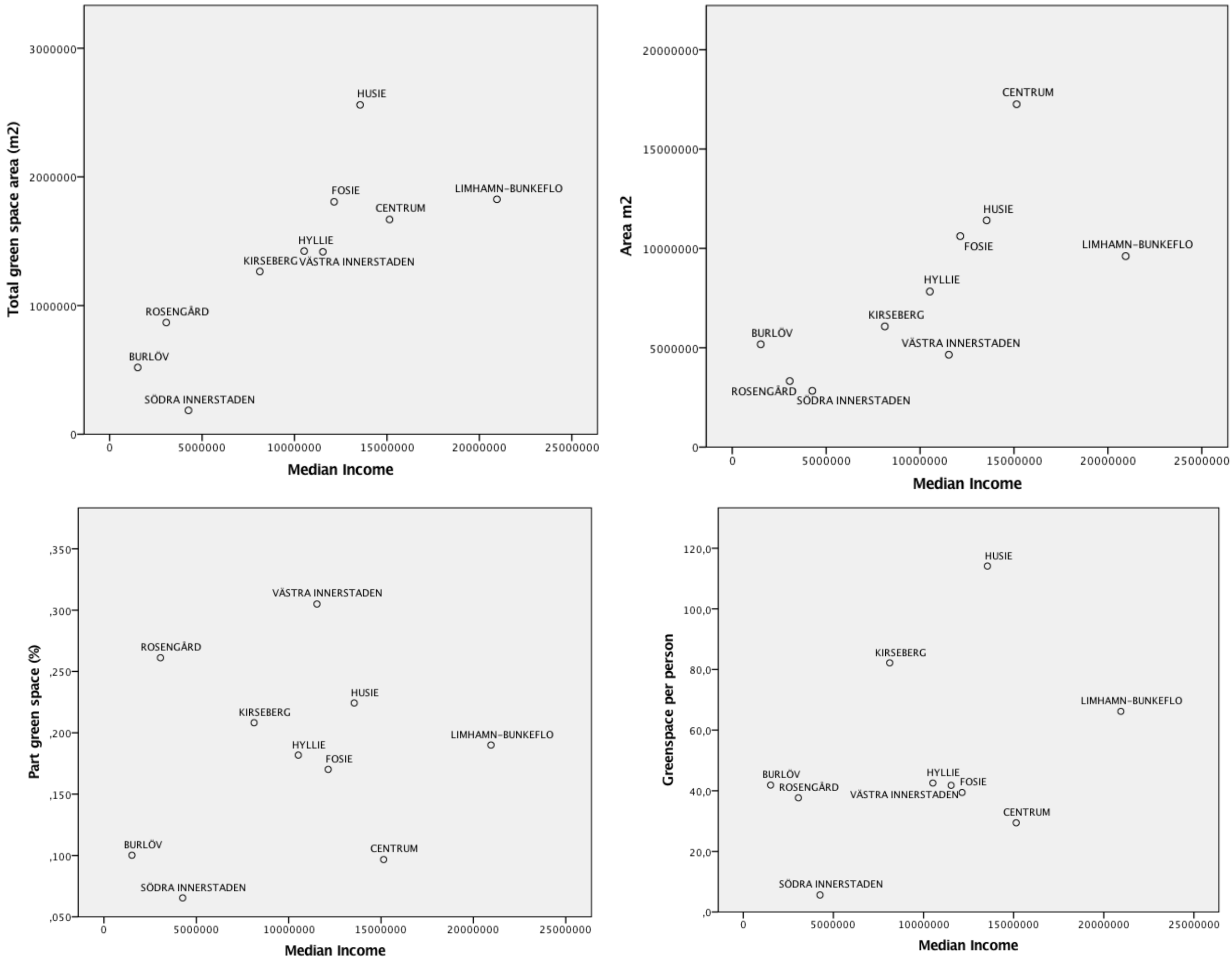


Figure 6:7. City districts. Left, upper: (a) Strong positive correlation green space area and median income; Right, upper: (b) Strong positive correlation total area and median income; Left, lower: (c) No evident correlation proportion green space and median income; Right, lower: (d) Weak-medium correlation green space per person and median income

6.6 Observation

The observation was conducted a Sunday in December, 11.30 am – 2pm. Weather conditions were cold, sunny and clear, see full details of the observation in table 6:4. Note that not all areas visited had parks or larger green spaces – some included green walks, and others contained no green space. Quality-wise, nearly all areas were well maintained except Persborg and Örtagården. There was sufficient lighting, bins and benches with no visible differences. One big difference was that the green spaces in the central and south-western parts were a lot busier, with activities such as dog walking, running and playing with children. In the eastern part, there were hardly any people using the UGS, which made it feel unsafe in certain parts. This remark is important as it might either suggest that people use the green spaces differently, but it could also suggest that the inhabitants in the eastern part feel unsafe using the green space. Another main difference was that in the south-western part, especially around Bellevue, there was an extensive green structure connecting parks, greenery and house, which was clean, well maintained and well used, see figure 6:8a. Here, villas dominated the accommodation structure, the majority of them with attached gardens and some with neighbourhood allotments. Flats dominated the majority of other areas visited. Around apartment areas in the south-western part there were main green squares in the inner circle. This was not visible in the eastern part. If these private green spaces had been measured in my analysis, it is likely that the total amount of green space had increased significantly in the south-western part, but stayed approximately the same in the eastern and central parts. Many of the walks in the eastern part, even if they had trees and greenery around, were not clean with trash lying around, making the overall feeling less nice. Some of the locations had trees obscuring the walking paths, making the area look dark as seen in figure 6:8b. Even if the walks are just connecting people to places, they make an impact and can make the surroundings feel safe or unsafe.

Table 6:4. Area qualities based on observation.

Area	Kronoborg	Solbacken	Ärtholmen	Bellevue	Nya Bellevue	Möllevången	Persborg	Herrgården	Rosengård Södra	Örtagården
Type	City park	Open green	Green walk	Green/Allotments	Green walk	N/A	N/A	Park	Park	N/A
Green	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
Maintained	Yes	Yes	Yes	Yes	Yes	N/A	No	Yes	Yes	No
Street Lights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facilities	Yes	No	No	No	No	No	No	No	No	No
House Structure	N/A	Flats	Flats/Villas	Villas	Villas	Flats	Flats/Villas	Flats	Flats	Flats
Clean	Yes	Yes	Yes	Yes	Yes	N/A	No	Yes	Yes	No
People	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes/No	No
Activity	Recreation	Recreation	Recreation	Recreation	Recreation	Services	Varied	N/A	Services/N/A	N/A
Purpose	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Safety	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Accessibility	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Location	Central	Southwest	Southwest	Southwest	Southwest	Central	East	East	East	East

* Facilities = Benches, Bins, Toilets

Figure 6:8. Left: (a) Green walk linking a larger green area with apartments in Bellevue; Right: (b) Green walk linking Rosengårdsfältet with Rosengård Centrum.

7 How greenery and urban justice are linked to Malmö's sustainability goals

The findings show that Malmö is highly socio-economically segregated, visible by clustering of for example highly educated and high incomers in the thematic maps, when it comes to income, education and ethnical background. The main correlations between availability of green space (green space per person, absolute amount of green space) is that of a) proportion of high incomers in a city district and b) population density in both city and sub-districts. High incomers tended to have better availability and more green space was available in areas with lower population density. As expected, there was a strong correlation between the size of a city district and absolute amount of green space, and these variables were also strongly correlated with income levels. Median income also correlated with green space per person, but not with proportion of green space. The correlations tended to be stronger on district level, as sub-districts may have high variations. Therefore, the analysis will mainly focus on the results on district-level. With economic, social and environmental sustainability as the key objective for Malmö's development, it is clear that not all districts are integrated in the green space context. For example, this is visible in the unequal conditions to recreation by differences in available green space per person. According to MCPO (2012:10), segregated districts where education and income levels are low tend to be segregated also when it comes to access to resources and facilities, which appeared to be the case for Malmö.

The results suggest that the higher the income, the further you live from the city's core. This was particularly concentrated in the district Limhamn-Bunkeflo. The districts further out tended to have a larger absolute size than those in the city core, which is why a correlation with total amount of green space but not proportion of green space can be noticed. Additionally, there may be a higher amount of private and semi-private green spaces as described in the observation. Freestanding houses, which dominate the accommodation structure here, are space consuming and there is an increase in UGS per person due to the lower population density. This tends to increase the attraction of the suburb and thereby housing prices. Economic resources thereby determine where people live, causing clustering of people of different income levels, which is reflected on public health variables. For example, the mean life expectancy is higher in Limhamn than elsewhere in Malmö (MCPO 2012:12).

7.1 Social sustainability

UGS are not equally available in terms of quality or quantity in Malmö (cf. Harvey 1973:87). There are quite large differences in green space per person, which related to population density, which was in turn highly linked to income. This suggests that the higher the income, the more green space is available for an individual. Because accessibility can be obtained at a price (cf. Harvey 1973:56), the income also determines the distance to the green space, and with a close distance an individual is more likely to use the green space available at his or her disposal. This argument is confirmed by the fact that the higher amount of high-incomers in a city district, the more green space is available, both in absolute numbers and square meters per person. While greenery in Malmö has suffered reductions in favour for an increasing share of buildings and hard ground due to urbanisation and densification, the value of green space in Malmö is going up due to the links between value of land and price of resources (cf. Harvey 1973:88-89). The unequal distribution of UGS in Malmö can be seen as an effect of income and population density (cf. Harvey 1973:69). One could also argue that the difference in the lack of UGS in more densely populated areas and areas with a higher number of low-incomers could be due to the socio-economic conditions making the operation uneconomic in more segregated areas, thereby further increasing differences (cf. Harvey 1973:88-89). This could be illustrated in the perceived feeling of the disadvantaged areas feeling less safe, and more people using the green spaces in more affluent areas.

Less green space per person in low-income areas and existing green space perceived as less safe creates an argument for externality effects as a result of the usage of UGS. This is for both advantaged and disadvantaged neighbourhoods. The group residing in generally wealthier suburbs such as Limhamn will, due to the good supply of quality green space, derive positive health benefits. The opposite can be seen in disadvantaged areas such as Rosengård, where one could assume the opposite effects, such as a lack of activity. This could be one factor in explaining why public health is generally poorer in disadvantaged areas, but would require a more extensive, qualitative study of *how* and *why* people use certain green spaces and not others.

In accordance with the findings from California, the results in this study showed that the same variables were related to availability of UGS: population density and income-levels. As ethnic background strongly correlated with income-levels and population density, there are similarities for the minority residents' variable too, but it was not a limiting factor on its own (cf. Wolch et al 2014). If socio-economic variables also determined the amount of money each group have to spend on non-profit resources (cf. Wolch et al (2014), this could help explain why the UGS in more affluent areas were generally perceived as more safe. Also MCPO (2012:10) argued that many segregated areas have UGS of lower standard.

Considering the distribution of UGS, one has to also consider the history of land development and social inequalities (cf. Wolch et al 2014). Rosengård, on one hand, was part of the Swedish Million Project to fight the lack of accommodation with high-rise buildings in modernistic design. Limhamn used to be a village, later integrated with Malmö as part of urban sprawl in Malmö. This helps explain why

Södra Innerstaden had the least amount of green space, as pressure to exploit in the city's core is higher. Greenery increases the further away you move from the city's core, as seen in figure 6:1. Södra Innerstaden displayed other interesting features. For example, incomes were low and population density was high. At the same time, the education was high. Lack of access to green spaces for this particular area may therefore be explained by other variables than those studied in this thesis. In addition, this area had a younger crowd as residents. Therefore, socio-economic variables might largely overlap with age and possibly generation. This district differed from the general trends in Malmö and should not be seen as representative for the city.

Many of those who are already disadvantaged are affected the most negatively by further detoriation in the physical environment according to MCPO (2012:10). The more segregated the area is, the more important it therefore becomes to provide quality UGS, especially in areas with high population density, where the green space can provide an option to being at home. As seen in the observation, green walks also play a vital role in the feeling of safety and perceived attractiveness of an area, which according to MCPO (2012:16) can be promoted by public spheres being peopled at all times of the day. Green walks could therefore also be one way to increase social cohesion and despite not being part of the results for this paper, is a very important part of the city's green structure.

MCPO (2010) state that to achieve social sustainability, there needs to be a daily meeting of people with different life conditions. This highlights the importance of discussing public green spaces as compared to any green infrastructure, as access is vital for meetings to happen. Public green spaces therefore support social sustainability and a more equal access across city spheres. UGS should therefore be distributed in proportion based on needs of certain areas to ensure social and environmental justice, helping to promote health and well-being. One such distribution would be to consider population density in green space planning. These kinds of investment have the possibility to expenses in a long-term perspective, as quality of life and public health may increase. Social justice is also a question of economic character, something that is not always considered in green space planning.

7.2 Environmental sustainability

Green gentrification may be hard to measure, as it is a process that happens over time. There may be also uncertainties as to what differentiates green gentrification from general gentrification. It is particularly problematic as greenery keeps disappearing in Malmö. However, since greenery is used as a planning tool for economic development by raising property values, especially high end residential development (Littke 2016:51), there may be examples in Malmö showing spatial link between green gentrification and urban justice. With policy makers favouring economic and environmental goals to social goals, greenery highlights the tensions between the environmental, economic and social aspects of sustainability and connects sustainability motives to the concept of green gentrification (Wolch et al 2014; Sandberg 2014). While UGS is a positive factor for health and well-being, and needed for a socially sustainable development, it is also important to avoid the green space paradox leading to green gentrification. Environmental injustice structures exist in Malmö on the same ground as social injustice structures, by green space being unequally distributed within the city and favouring more affluent areas as discussed in previous chapter (cf. Wolch et al 2014).

One such example is Limhamn, a highly homogeneous social environment (Sandberg 2014:6), as also seen in the thematic maps and confirmed by its links between green space per person and population density. Here, access to the quarry is not fully public, signalling exclusivity. Sandberg (2014) argues that this area follows the patterns of environmental gentrification by its ties to neoliberalism and the entrepreneurial city, by marketing forces determining where people live (cf. Harvey 1973). This is illustrated by, for example, the green environment in the suburbs surrounding the quarry. Another example is Västra Hamnen, previously an industrial area and now an area, which is profiled for its environmental solutions, regenerated to attract high-end clientele (Holgersen & Malm 2016:9). The city uses greenery to create attractiveness and reshape the characteristics of the area. However, Västra Hamnen is also one of few areas in Malmö having a deficiency of UGS. Greenery here is instead shaped by innovative solutions and private property, which highlights one of the key issues with this paper – private green spaces are excluded, and innovative green values such as green roofs and similar displayed in Västra Hamnen are hard, if not impossible, to map with current data. MCPO (2010) has argued that densification stimulates innovative solutions and thereby creates an environmentally friendly, attractive and sustainable city. Those innovative solutions, such as in Västra Hamnen, may be environmentally friendly but they also spur property prices as also confirmed by developers in Malmö using the 'green fix' to increase property values, and thereby only benefit high-incomers (cf. Holgersen & Malm 2016). For example, mean income was nearly three times higher than the lowest income sub-districts (MCPO 2014; Holgersen & Malm 2016:285).

Though the recent decade has seen a high population increase in Västra Hamnen, much of the area is still "no data" as much of it is still being or having just been built. This can help explain why results in Västra Hamnen in some of the categories were disproportionate. However, much of the other data suggests linkages to green gentrification. Densification, which is probably the best word of describing the current situation in Västra Hamnen, has in this case close ties to both regeneration and green gentrification. For example, MCPO (2010) argues that low status areas can be revitalized through new functions or alternatives that increases the attractiveness of the area, thus achieving a decreased segregation by densification. The opposite appears be happening. MC's goal of a denser and greener city (MCPO 2012:18) thereby spurs on green gentrification and is of importance for social and environmental justice in Malmö. In addition, densification causes an increased population density and means that more people will be using the same UGS. Where green space is already a shortage, the competiveness of the existing green space will increase. However, market driven mechanisms means that the will to pay for different areas usually determine where densification may be relevant. According to MCPO (2010), the central and western parts of Malmö are of high interest for densification, and the south-eastern part are of low interest. By further densification in the western part, attractiveness of the area could increase further and thereby cause a greater divide between Malmö's 'two cities'. MC therefore has to be careful as to how green values are used in the city, where new greenery in located and how existing greenery is improved. The green space paradox and green gentrification are very much realities for both city halves.

7.3 Economic sustainability

Green gentrification is closely linked to green city branding. Green city branding can, in addition to official promotion and council documents, be seen in SCB's statistics. Numbers related to the amount of green spaces were significantly higher than the numbers in this research. For example, SCB (2008) suggested that the average Malmö citizen had over 100 square meter green space per person. It also suggested that 30% of the city area was publicly available land, whereas my statistics showed only 16.5% across sub-districts and 18% across district. By including private and/or semi-private land in many of the official statistics, it gives an inaccurate picture of Malmö being greener than it is. As official statistics are used for official documents, such as Malmö Green Plan, but also for marketing purposes, it becomes problematic. There is also a neglect to discuss differences in greenery within Malmö, which is in line with using green branding as a policy tool to strengthen the picture of Malmö as liveable and sustainable (cf. Littke 2016:54-57). Sandberg (2014) argues that the disparity between the 'two cities' is rarely problematized as a collective problem for Malmö, but portrayed as an issue for "problem areas" such as Rosengård. Contrary, lack of diversity in areas such as Limhamn remains unexamined.

Västra Hamnen can in addition to green gentrification also be discussed from a marketing point of view. The area has little physical green space but there are many innovative forms of greenery (cf. Littke 2016:55-57), which may be used for marketing purposes and to attracti visitors, residents and companies. In 'post-industrial' Malmö, one could also argue that the city's branding of Malmö as green and sustainable is a form of green washing to shake of the poor images of Malmö which links back to industrial Malmö the economic crisis 20 years ago. The sustainability image has had a big part in removing this label, as seen in many of the awards won. The greening projects are exercised under a political flag which appears politically impartial but serves the high-end developments, such as Västra Hamnen, which are design to gain an environmental excellence reputation (cf. Littke 2015b:9;Holgersen & Malm 2016:278). Economic interests in attracting capital does, one the one hand, facilitate green space provision. However, the uneven marketing concentrated to a few points of recent, green development, may cause further clustering of high-incomers to certain parts of the city, which contributes to an increasing urban injustice. It also helps explaining the high concentration of high-incomers in entirely new or rebranded neighbourhoods such as Västra Hamnen and Norra Sorgenfri. As previously argued, the city would gain a number of advantages in sustainability by, for example, investing in renovations for the Million Projects such as Rosengård, causing remarkable energy savings (Holgersen & Malm 2016). However, these renovations are not equally economically beneficial for the city as further work on the new city areas.

Branding of Malmö as "the most climate conscious city in Sweden" and goals to become a "living knowledge and development centre for sustainable urban development" by 2020 (Malmö City Environmental Council 2017) is problematic. With key goals to become an "attractive and sustainable" city, it is stated as facts in official documents that Malmö is a motor for sustainability in urban environments and has successfully completed the transition from industrial to a knowledge centre. Official documents also state that the densification will add lots more greenery, such as grass roofs and other innovative solutions (cf. MC Environmental Council 2009:5). The focus on environmental solutions and innovation ignores social disparities, by arguing that the building of environmentally sustainable cities is a 'global survival question', thereby important for Malmö to intensify investments in certain areas (MC Environmental Council 2009:5). Hence, the driving forces for 'sustainable Malmö' are economical and the key method is branding. Economic resources are invested in showing sustainable solutions, such as those in Västra Hamnen, while other areas are not shown at all. The problem therefore appears to be that the investment is only going to a couple of different parts of Malmö, which are the same ones as those promoted as the brand Malmö. For example, the quarry is often seen in tourism advertisement. However, the area itself is not fully publicly accessible, and is part of the city district with the highest incomes, lowest percentage of people with foreign background etc. (cs. Sandberg 2014:7).

Another important issue with the marketing of sustainability is that all kinds of greenery, specifically in Malmö's public documents, discuss different kinds of green values as if they were the same; green technology, green areas, green infrastructure and more. This, together with using the word sustainability, also help creating a certain image of Malmö being green and sustainable on all levels.

8 Discussion

The analysis shows that there is a degree of social and environmental injustice in terms of availability of UGS sin Malmö. However, a significant amount of Malmö's green structure is private or semi-private. It would therefore have been relevant to compare public urban green spaces with the complete green infrastructure, as much of the "everyday greenery" has been excluded. Most likely, to consider the full green infrastructure would have increased socio-economic differences, as affluent areas also tend to have access to a greater amount of private green spheres, but all of the green infrastructure contribute to health benefits and an active lifestyle, and can improve quality of life. The reason for selecting only publicly available spheres can be justified by the point of equal access, as not everyone have access to the private green spaces. Without including the full green infrastructure, one could also have considered certain semi-public spaces such as allotments. Though semi-public spaces may be of great importance for greenery in the city and for people's quality of life, different people have different access to them, which makes it a difficult subject of analysis. Graveyards, which in theory could be used for recreational purposes and have full public access, could have been considered for the analysis, it is however unlikely that graveyards contribute to health and well-being in the sense discussed in this analysis. The most important exclusion for this paper is green walks and small green spaces <0.5HA that both contribute significantly to health and well-being and are publicly available. They were excluded for analytical and simplifications purposes but are significant parts of the green structure and quality of life in the city, and should this kind of research be repeated they should be included. Since they cover small areas, however, it is unlikely that they would have made a difference to the results. As discussed in the analysis, innovative forms of greenery are increasingly shaping Malmö, especially in areas with new development. It might also have been of relevance to consider this type of greenery, but a key issue is that data is missing and therefore makes it impossible. One could, in relation to innovative forms of greenery, argue that also other kinds of green values should be considered as a substitute to green spaces. This topic, in similarity to innovative forms of greenery, is likely to increase within the near future and should require further research.

Qualitative differences could have been considered in the research by a more extensive observation and for example interviews. While my observation saw more recreational activities going on in wealthier suburbs, there are indications that there are either qualitative differences and/or differences in how different groups use green spaces. This could be affected by, for example, ethnical background, income or gender. There may be restrictions even if the green space is available, such as social or cultural restrictions, reflected in the usage. Though this is not reflected in availability but rather the usage of, it is of great importance to determine what kind of UGS fit into a neighbourhood and how to increase an active and healthy lifestyle for everyone. This is an area where further research is much needed. This also raises the question if socio-economic variables are enough to analyse availability. For example, there is an overlap of income and age, which can be misleading in terms of what is socio-economic status and what is generation, as younger people tend to have lower incomes. However, despite other important factors, it was necessary to limit myself to only one variable due to quantification of data, and availability and distance is of high importance for the usage. The argument is the same for the socio-economic variables. I therefore want to argue that the results are still reliable based on their premises.

On a last note, one also has to consider that Sweden is one of the greenest countries in the world, and also one of the most equal. It may therefore not be the typical case when speaking of availability to UGS. Therefore, basing previous research on the same kind of studies in the US might not have had any relevance in Sweden. That Sweden and US share similarities in how availability of UGS differ however, and differences do exist in Sweden, it is highly likely that there are differences in many more places in the world and should be subject of further research.

9 Conclusions

There are geographical differences in the availability of UGS in Malmö, especially in terms of green space per person and the absolute area of UGS across districts and city districts. The differences can be linked to the social geography of Malmö. High-incomers tend to live in areas with lower population density, where additionally, the absolute amount of green space tends to be higher. These areas are generally further away from the city core. High-income suburbs additionally tend to have higher private spheres of greenery, such as gardens, which can be linked to the villa-dominated structure in these areas. The geographical differences in distribution of UGS can be interpreted through an urban justice perspective. Both sprawl, such as in Limhamn, and densification processes, such as in Västra Hamnen, with its close ties to green gentrification and green marketing adds to social disparities in Malmö. In Västra Hamnen, greenery is scarce, but green values are instead reflected in innovative ways of meeting the demand for greenery, and marketed accordingly. While this indeed might contribute to environmental benefits, only a small share of the city can derive positive effects from the development, which contributes to widened gaps between Malmö's 'two cities'. Socio-economically segregated areas such as Rosengård generally had the same proportion of green space as any other district, but due to a high population density there is little green space per person. In addition, green space here appear to be used less and perceived as less safe. The green infrastructure in the eastern part of the city has not been developed and maintained in the same way as the south-western part, which makes the area seem less green. The distribution of UGS thus show evidence of social injustice in terms of unequal access, and environmental injustice in terms of the externalities derived from the social geography. Unequal premises are reflected in unequal health and social spheres. It can also be concluded that urban justice appears to exist on multiple scales (see figure 9:1). Starting with public policy and the green plan, which determines how, which and where green values will shape Malmö, then reflected in the more structural level of physical planning, which forms people's everyday landscape and creates both possibilities and restrictions as to how people use green spaces. Finally, the shape of the urban landscape and distribution of UGS are reflected in public health variables.

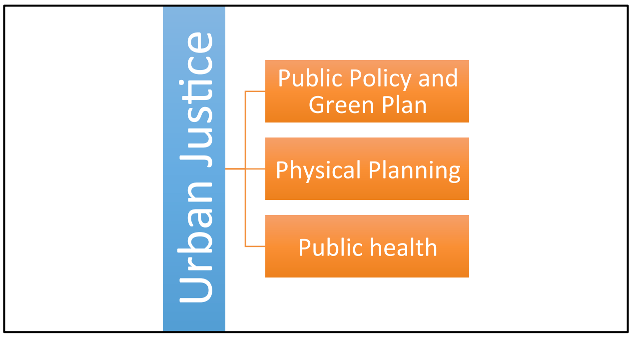


Figure 9:1. Scale of urban justice

Malmö's sustainability fix appears to be more about achieving economic and environmental goals than meeting the city's social needs. One such example is the marketing of an 'attractive and sustainable city' aiming to attract capital and entrepreneurial people by using green values. Social justice, with its close ties social sustainability, is of key importance to achieve Malmö's sustainability targets. Physical planning can promote urban justice by considering disparities within the city, and UGS can thereby play a big role in meeting those targets, but may be restricted by public policy and economic goals prioritizing other societal interests. For example, money must be invested in increasing green values in unserved neighbourhoods. By making existing UGS more appealing and increasing the usage, safety, social bonding and physical activity can be promoted, all contributing to a more socially inclusive city while avoiding the 'green space paradox'. Public health must be seen as a precondition to achieve sustainability targets, and an equal availability of UGS could help reducing differences and positively benefit the well-being of disadvantaged neighbourhoods by creating opportunities for equal living conditions and healthy lifestyles. These opportunities start on policy level and have the opportunity to change livelihoods by physical planning.

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11 Appendices

11.1 Appendix A – Detailed GIS methodology

Retrieve, project and clip relevant data
First step in the analysis was to download raw data. Non-projected data was projected to the chosen coordinate system SWEREF99_TM (geographic coordinate system GCS_SWEREF99). The chosen projection was Transverse Mercator.

Creation of relevant data layers
I aimed to create a polygon layer containing all UGS in Malmö. Blue spaces in city parks were integrated with the park space. The base for this layer was SMD data, selecting the following in the attribute data with SQL (Structured Query Language): Urban Green Space, Lakes, Beaches (to pick up also Ribbersborg).
I exported these variables to a separate layer. The SMD contained other kinds of recreation areas, containing everything from graveyards to golf courses, to public football courts and sports areas. Not all of those were, per my definition, UGS, however some were. As I was unable to differentiate between them in SMD, I used Lantmäteriet Fastighetskartan, which included the same recreation areas and green spaces, outlined in more detail. I was then able to differentiate public from private green spaces and was able to pick out public spheres missing in the SMD layer, such as some recreation areas. I could also exclude public spheres I had decided not to use, such as graveyards. I then created a separate layer for the chosen variables. To create a complete layer with all UGS within the chosen administrative boundaries, I used the overlay function "merge" to which I added the layer of green spaces based on SMD data and the additional public recreational spaces based on Lantmäteriet. In addition to the created polygon layer function as the basis for my analysis, I extracted additional layers (polygon, line, point) useful for map visualisation. Such included:

- A polygon layer of buildings and property boundaries
- A polygon layer of open space (which includes public space such as squares and plazas)
- Line layers of roads: one containing railways, one for roads and one for biking/walking paths.

Modifications and accuracy of green cover layer
To match the SCB definition of UGS and to prepare for the analysis, I added the fields "area m^2" and "area ha" to the complete UGS layer and calculated the area of the different layers. I then used SQL to only include layers >0.5 ha. Areas <0.5 ha were, consequently, removed. To review the accuracy of the data layer created, I matched the selected green space layer with Ortophoto. My layer appeared to have picked up the majority of UGS that were public and above the size requirements. Either SMD or Lantmäteriet did not pick up a few larger UGS. There were also certain larger green spaces, which were private, or semi-private that was included. Some of the harbour water was included showing as green space and finally. Consequently, based on the Ortophoto analysis, the following was adjusted:

- Harbour water was removed
- Non-public green space was removed.
- Manually added missing green spaces using checklist of parks in Malmö and Ortophoto.

Some green spaces had not been adjusted for roads and therefore showed as coherent. It was however not adjusted due to the lengthy process and limited green space affected.

Adjusting administrative boundaries and joining attribute tables
I created a layer including all districts and sub-districts, which were used for a spatial join with the statistical variables in order to use the dissolve function of the SAMS areas obtained in the war data from SCB. Malmö administrative boundaries (with included SAMS-areas) were combined using the overlay function union with data from the Department of Human Geography to create the outline layer of Malmö divided into districts and

sub-districts. It is important to note that part of Malmö Tätort also include a part of Burlöv Municipality at the north. Information for this polygon was manually added when combined with the outline layer. The part of Burlöv included in Malmö Tätort is on the SAMS-map initially divided into three SAMS-areas, but was named Burlöv in the outline layer. After the union, many micro polygons were created, which I eliminated using "data management: elimination of slivers". The limit was set to <0.5 ha. All polygons smaller than this were merged with neighbouring polygons. With the SAMS-polygon still in the background, there were some shape-differences when joining the two layers, I used "multipart to singlepart" and exploded the large background polygons in order to "clip" the layer to its correct shape. Again, this caused slivers, for which data management: elimination of slivers was used again. The final layer was used as clip for all statistical layers in the spatial analysis. To merge the new layer's attribute table with for example the income layer I used the analysis function spatial join to transfer attributes of one layer to another. This was useful in a later stage, when using the dissolve function to create both district and sub-district layers.

Green space area:
I began by calculating en green space area for city district and sub-district. Since I had a layer of all selected UGS and a layer with all districts and sub-districts, I went to the zonal functions and used tabulate area, selecting Malmö City district as the zone area and the green space as the feature layer. This calculated the amount of green space in each city district and sub-district (respectively). To visualise, I joined the table with the zone area, also adding a field with the amount of green space in each area as a part of the whole area (%). I was then able to visualise both absolute and relative amount of green space. To make the layer permanent, I exported the layer. As Burlöv was manually added but split into two separate polygons with the same name, it showed the same amount of green space but not in relation to the area. I solved this problem by editing the names to Burlöv1 and Burlöv2, keeping the same city district names. The final layers on district and sub-district level were exported to excel files to be used for the SPSS analysis, and was also functioned as malls for the upcoming variables.

Income:
Income (as well as population and education) came in a polygon layer divided into SAMS-areas. To process the analysis I had to change the SAMS to city district and sub-district level. Firstly, I clipped the SAMS-area according to the green space malls named "District Level" and "Sub-district Level". To then dissolve the SAMS-areas proportionally, as the administrative boundaries are completely different, I added a field to the income-layer and calculated the area. I then went to geoprocessing and intersected the income layer (join all attributes) with the Sub-district layer. I then calculated the area to the new layer named income_proportioned. The area was less than the income area for those crossing SAMS-boundaries. I added a field to proportioned_income and calculated the "proportion" variable (proportioned_income_area / income_area) to get the adjusted amount in proportion for that district. I then added fields for all income fields (median income, high incomers, high-medium incomers, low-medium incomers, low incomers, total incomers) and multiplied the original fields with the proportion variable. I then dissolved on Sub-district and City district level (separately), selecting sum on all variables. With median income, this showed the sum of all median incomes (in proportion) for all polygons created in the intersection, thereby summarizing the median income of all pieces that fall within the boundaries of a city/sub-district. This was the most accurate way to calculate median income. The result does NOT reflect the actual median income in the district (in correct numbers); it does however accurately reflect the correct division and proportion of median income, which is of importance for the SPSS-analysis. The attribute tables were exported to excel. The result also showed, the amount of people in all income-levels on district and sub-district level.

Population, education:
I repeated the above procedure for population and education variables (including clipped and intersected the layers according to the District Level and Sub-District Level produced in the first stage of the green space analysis). To calculate amount of green space per person I used the tabulated area tables created when calculating amount of green space in each city and sub-district, and joined this with the population layer, adding a field calculating available green space per person (square meters green space / population), then exporting the data to a separate layer. These tables were exported to excel. Green space statistics was calculated on district, sub district and city Level. The education variable came in four categories – pre-high school, high school, university (less than 3 years) and university (more than three years). I group the university categories together, so that only three categories remained.

Proximity analysis:
This part of the analysis aimed to calculate the coverage of green spaces within the city and sub-districts. To visualise, I created a multi-buffer set on 200, 300 and 500 meters from green spaces, illustrating the coverage. I chose the 300-meter buffer to include in the analysis, as this is the suggested limit, and create a single-buffer layer. I then used the tabulate area function, with the city districts and sub-districts as set zones, and the buffer layer as cover layer, then joining the tables (respectively) with the zone layers. This was exported as a separate layer and attribute table exported to excel. This is the green space coverage, which can be calculated as green space coverage/total area, showing the percentage of districts and sub-districts that have access to green space within 300 meters. The coverage was calculated in a new field as per following:

- Total area – green coverage area in each city district = area without coverage
- Area without coverage * population = people without coverage

11.2 Appendix B – SPSS Variables

The following variables were used as a base (to which the socio-economic variables were correlated to:

- Green space per person as measured in square meters (named UGS m^2/pp)
- Area UGS as measured in square meters (named AreaUGS m^2)
- Total area as measured in square meters (named Tot Area)
- Proportion of green spaces (area square meters/total area – named proportion UGS)
- Proportion without access to green space within 300 meters (named w/o UGS <300 m)

The following socio-economic variables were correlated to the base layers to find out potential correlations between socio-economic status and green space:

- Income: Median income (named median)
- Income: Proportion high incomers (named high)
- Income: Proportion medium-high incomers (named Mhigh)
- Income: Proportion medium-low incomers (named MLow)
- Income: Proportion low incomers (named Low)
- Population: Population density as measured in people/square km (named Pop Dens)
- Education: Proportion of people with maximum education pre-high school (named pre-high school)
- Education: Proportion of people with maximum education high school (named high school)
- Proportion of people with maximum education University, less than three years (named Uni < 3 yr)
- Proportion of people with maximum education University, more than three years (named Uni > 3 yr)
- Proportion of people with maximum education University, any level (named Tot Uni)
- Additional variables: Proportion unemployment (only measured on district-level) (named: unemployment)
- Additional variables: Proportion employment (only measured on district-level) (named: employment)
- Additional variable: Proportion country of birth within the Nordics (named Nordic)
- Additional variable: proportion country of birth outside the Nordics (named Non-Nordic)

11.3 Appendix C – Correlations

Red highlights significant correlations.

Table 11:1. Correlations population density and green spaces

Variables	Correlation	District PopDens	Sub-District PopDens
UGS m^2/pp	Pearson Correlation	-,694*	-,192*
	Sig. (2-tailed)	0,026	0,035
	N	10	121
Area UGS (m^2)	Pearson Correlation	-,635*	0,105
	Sig. (2-tailed)	0,048	0,25
	N	10	121
Proportion UGS	Pearson Correlation	-0,06	-0,047
	Sig. (2-tailed)	0,869	0,609
	N	10	121
w/o UGS <300 m	Pearson Correlation	-0,28	-0,094
	Sig. (2-tailed)	0,433	0,307
	N	10	121

Table 11:2. Correlations income and green spaces on sub-district level.

Variables	Correlation	High	Mhigh	Mlow	Low	Median
UGS m^2/pp	Pearson Correlation	-0,057	-0,096	0,067	0,067	-0,069
	Sig. (2-tailed)	0,531	0,295	0,462	0,464	0,451
	N	121	121	121	121	121
Area UGS (m^2)	Pearson Correlation	,200*	,186*	-0,164	-,208*	,351*
	Sig. (2-tailed)	0,028	0,041	0,073	0,022	0
	N	121	121	121	121	121
Proportion UGS	Pearson Correlation	-0,016	0,092	-0,044	0	-0,019
	Sig. (2-tailed)	0,864	0,317	0,63	0,998	0,833
	N	121	121	121	121	121
w/o UGS <300m	Pearson Correlation	,195*	-,226*	-0,114	-0,062	0,032
	Sig. (2-tailed)	0,032	0,013	0,214	0,5	0,725
	N	121	121	121	121	121

Table 11:3. Correlations income and green space on district-level.

Variables	Correlation	Low	Mlow	Mhigh	High	Median
UGS m^2/pp	Pearson Correlation	-0,56	-0,428	0,343	,696*	0,373
	Sig. (2-tailed)	0,092	0,217	0,332	0,025	0,288
	N	10	10	10	10	10
Area UGS (m^2)	Pearson Correlation	-0,559	-0,494	0,48	,657*	,792*
	Sig. (2-tailed)	0,093	0,147	0,16	0,039	0,006
	N	10	10	10	10	10
Proportion UGS	Pearson Correlation	-0,124	-0,438	0,139	0,244	0,178
	Sig. (2-tailed)	0,734	0,206	0,701	0,497	0,622
	N	10	10	10	10	10
w/o UGS <300 m	Pearson Correlation	-0,233	0,07	0,318	0,127	0,193
	Sig. (2-tailed)	0,518	0,847	0,37	0,727	0,593
	N	10	10	10	10	10

Table 11:4. Correlations education and green spaces on sub-district level.

Variables	Correlation	Pre-High school	High school	Uni<3yr	Uni>3yr	Uni Tot
UGS $m^{2/}$pp	Pearson Correlation	0,068	,316*	-,465*	-0,154	-,237*
	Sig. (2-tailed)	0,459	0	0	0,091	0,009
	N	121	121	121	121	121
Area UGS (m^2)	Pearson Correlation	-0,035	,193*	-0,068	-0,087	-0,089
	Sig. (2-tailed)	0,704	0,034	0,459	0,341	0,334
	N	121	121	121	121	121
Proportion UGS	Pearson Correlation	0,046	0,16	-0,051	-0,14	-0,128
	Sig. (2-tailed)	0,614	0,08	0,58	0,126	0,161
	N	121	121	121	121	121
w/o UGS <300m	Pearson Correlation	0,049	-,371*	-0,046	,233*	,183*
	Sig. (2-tailed)	0,592	0	0,615	0,01	0,044
	N	121	121	121	121	121

Table 11:5. Correlations education and green spaces on district level.

Variables	Correlation	Pre- High school	High School	Uni < 3yr	Uni > 3yr	Tot Uni
UGS m^2/pp	Pearson Correlation	-0,085	0,381	-0,102	-0,148	-0,141
	Sig. (2-tailed)	0,816	0,277	0,78	0,682	0,697
	N	10	10	10	10	10
Area UGS (m^2)	Pearson Correlation	-0,298	0,066	0,124	0,147	0,144
	Sig. (2-tailed)	0,403	0,857	0,734	0,685	0,691
	N	10	10	10	10	10
Proportion UGS	Pearson Correlation	0,107	0,003	-0,123	-0,051	-0,065
	Sig. (2-tailed)	0,769	0,994	0,735	0,889	0,859
	N	10	10	10	10	10
w/o UGS <300 m	Pearson Correlation	-0,39	-0,327	0,272	0,42	0,397

Table 11:6. Correlations ethnic background and green spaces on sub-district level.

Variables	Correlation	Nordic	Non-Nordic
UGS m^2/pp	Pearson Correlation	-0,142	0,062
	Sig. (2-tailed)	0,121	0,5
	N	121	121
Area UGS (m^2)	Pearson Correlation	0,147	-0,148
	Sig. (2-tailed)	0,108	0,105
	N	121	121
Proportion UGS	Pearson Correlation	0,03	-0,015
	Sig. (2-tailed)	0,743	0,874
	N	121	121
w/o UGS <300m	Pearson Correlation	-0,035	-0,047
	Sig. (2-tailed)	0,702	0,607
	N	121	121

Table 11:7. Correlations employment, ethnic background and green spaces on district-level

Variables	Correlation	Unemployed	Employed	Nordic	Non-Nordic
UGS m^2/pp	Pearson Correlation	-0,385	0,385	0,324	-0,324
	Sig. (2-tailed)	0,272	0,272	0,361	0,362
	N	10	10	10	10
Area UGS (m^2)	Pearson Correlation	-0,399	0,4	0,382	-0,382
	Sig. (2-tailed)	0,253	0,253	0,277	0,277
	N	10	10	10	10
Proportion UGS	Pearson Correlation	-0,004	0,004	0,078	-0,078
	Sig. (2-tailed)	0,99	0,991	0,831	0,831
	N	10	10	10	10
w/o UGS <300 m	Pearson Correlation	-0,34	0,34	0,289	-0,289
	Sig. (2-tailed)	0,336	0,336	0,418	0,417

	N	10	10	10	10

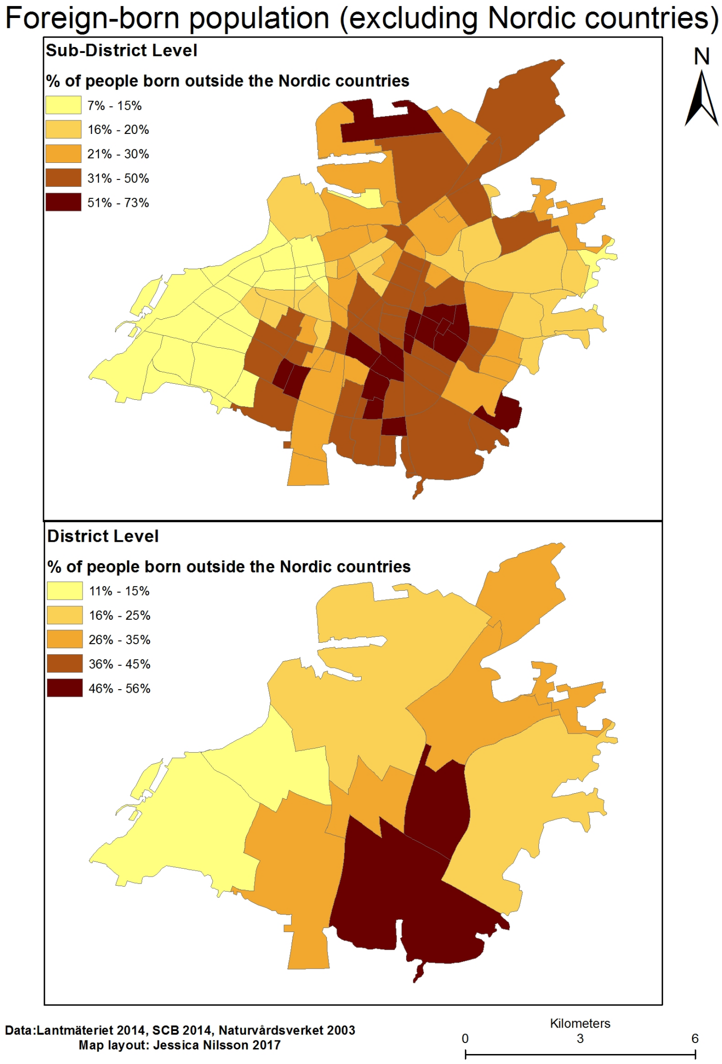

Figure 11:1. Non-Nordic born population on district and sub-district level.