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Research Paper

# Green justice or just green? Provision of urban green spaces in Berlin, Germany

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## HIGHLIGHTS

- Most areas in Berlin are supplied with more UGS compared to the per capita target value.
- Dissimilarity in UGS provision by demographics, such as immigrant status and age exists.
- The UGS Berlin-Tempelhof can provide more than 180,000 inhabitants with 300 ha UGS in a catchment area of 1500 m.
- An underuse of Tempelhof by immigrants and older age groups was identified.
- Efficient UGS planning requires an increased understanding on preferences of UGS that includes cultural contexts and individual perspectives.

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## ABSTRACT

Urban green spaces (UGS) have been shown to provide a number of environmental and social benefits relevant for a higher quality of life of residents. However, population growth in cities combined with urban planning policies of (re)densification can drive the conversion of UGS into residential land. This development might result in an unequal distribution of UGS in a city. We present an analysis of UGS provisioning in Berlin, Germany in order to identify distributional inequities between UGS and population which are further discussed in light of variations in user preferences associated with demographics and immigrant status. Publicly available land use and sociodemographic data at sub-district level are applied in a GIS, dissimilarity index and cluster analysis approach. Results show that although most areas are supplied with more UGS compared to the per capita target value of 6 $m^2$, there is considerable dissimilarity by immigrant status and age. To address rising concerns about socio-environmental justice in cities and to evaluate the (dis)advantages of applying UGS threshold values for urban planning, visitor profiles and preferences of a site-specific case, the park and former city airport Berlin-Tempelhof are analyzed. Results from questionnaire surveys indicate that the identified dissimilarities on sub-district level are not the same as socio-environmental injustice in Tempelhof, but point to a mismatch of UGS and user preferences. In addition to evaluating UGS distribution, the match between quality of a park and specific cultural and age dependent user needs should be considered for successful green infrastructure planning rather than focusing on target values.



## 1. Introduction

It is now a well-known issue that more than a half of world's population lives in cities and that urban population numbers will continue to increase (United Nations, 2012). The United Nations project nearly 5 billion urban inhabitants by 2030, an increase of 40%. While urban populations continue to increase, global urban land area is expected to grow at a faster rate. Seto, Fragkias, Güneralp, and Reilly (2011) estimated that urban land will increase by 1.5 Mio. $km^2$ by 2030, triple their baseline estimate of 0.7 Mio. $km^2$ (based on MODIS 2001). As urbanization is dominated by both population and urban land area expansion, the need to provide new housing developments for more city residents presents a challenge to urban planning (Haase, Kabisch, & Haase, 2013). This challenge, however, might also present great opportunities for sustainable urban management if development practices incorporate quality of life improvements through equitable provision of urban green spaces (UGS).

### 1.1. Environmental and social benefits of UGS

A number of scientific studies have demonstrated the environmental and social benefits provided by UGS. In these studies,

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UGS were mostly defined as a range of parks, street trees, urban agriculture, residential lawns and roof gardens (Breuste, Haase, & Elmqvist, 2013). Environmental benefits include the process of local climate stabilization via air filtration (Jim & Chen, 2008) or cooling through shade provision (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Gill, Handley, Ennos, & Pauleit, 2007) which is particularly important for mitigation strategies of urban heat island effects. Further, the specific location of street trees and resulting shade was found to reduce overall energy consumption (Simpson, 2002). UGS also reduce noise (Bolund & Hunhammar, 1999), increase carbon storage (Strohbach & Haase, 2012), have positive effects on rainwater infiltration and, thus, lead to water purification (Bolund & Hunhammar, 1999). Social benefits for urban residents include mental and physical health improvements such as stress reduction and relaxation associated with exposure to UGS (see a comprehensive review by Konijnendijk et al., 2013; Kuo, Bacaicoa, & Sullivan, 1998; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006). Particularly during periods of hot weather, UGS reduce local temperatures and can, thus, alleviate the effects of heat on residents (Breuste et al., 2013; Lafortezza, Carrus, Sanesi, & Davies, 2009). Further, UGS may more directly increase the quality of life through the provision of recreational benefits which include active and passive activities. Active exercises are linked to the opportunity to do physical activities such as sports, playing with kids or walk the dog. Passive recreational activities include relaxing, painting, sunbathing, meeting other people, playing with children or simply to experiencing nature (for an overview see Byrne & Wolch, 2009). In addition, UGS provide the potential to increase the perception of safety (Kuo et al., 1998) and act as meeting places for local residents, thereby supporting social interaction (Martin, Warren, & Kinzig, 2004). However, negative effects of UGS on the perception of urban residents have also been observed. For instance, surveys have reported that residents feel insecure and fearful of crime when they are in rather dense, unmanaged wildlife areas with short view distances (Bixler & Floyd, 1997; Schroeder & Anderson, 1983). In a comparative study on social safety in rural and urban areas, Maas et al. (2009) found that in strongly urban areas, notably enclosed UGS are associated with reduced feelings of social safety while the opposite is the case in rather rural areas.

### 1.2. Socio-environmental justice and distribution of UGS

Within a city, UGS are mostly unevenly distributed over space and, are therefore disproportionately available to a subset of the urban population (Ernstson, 2013). Case study research in European and US cities has shown that different immigrant communities have less access to UGS in their vicinity (Germann-Chiari & Seeland, 2004; Pham, Apparicio, Séguin, Landry, & Gagnon, 2012). Comber, Brunsdon, and Green (2008) showed that Hindu and Sikh groups have limited acces to UGS in the city of Leicester. Dai (2011) found that in the city of Atlanta, mainly Afro Americans have significantly lower acces to UGS in their neighborhoods. This disproportionate provision of UGS to specific social groups raises concerns about environmental justice (Davis et al., 2012). Traditionally, environmental justice focuses on the health implications of low-income and minority individuals who reside in neighborhoods with increased concentration of pollutants or unwanted land uses (for a literature review see Downey & Hawkins, 2009). According to a report on Environmental Justice and Race Equity in the EU, environmental justice is described as "...equal access to a clean environment and equal protection from possible environmental harm irrespective of race, income, class or any other differentiating feature of socio-economic status" (Schwarte & Adebowale, 2007). Apart from this report, environmental justice and the importance of health-promoting environmental factors such as UGS in relation to social factors are still a marginal issue on research and policy agendas of the EU (member states, Schwarte & Adebowale, 2007). Some relevant research and policies are discussed in the UK and to some extent in Germany (for UK see e.g. Comber et al., 2008; Walker, Mitchell, Fairburn, & Smith, 2003; for Germany see e.g. UMID: Environment and Human Health – Information Service, 2011). In Germany, the issue of environmental justice is still a new topic, only recently gaining awareness with the 2011 project "Environmental Justice in Berlin" which represents a first step for integrated reporting on environment, health, social issues and urban planning by researchers, urban planners and local stakeholders (Flasbarth, 2011). The report refers to noise, air quality, bio-climatic conditions and UGS provision. The results, however, remain rather descriptive and on a city-wide level.

In this paper, we propose an expanded framework of socio-environmental justice combining the presented definition of environmental justice with the social justice concept developed by the anthropologist Low (2013). According to Low's argumentation, three different dimensions need to be discussed to address injustice in the case of public spaces such as urban parks. While *distributive justice* focusses on the fair allocation of public spaces and related resources for all social groups, *procedural justice* relates to fair integration of all affected groups into the planning and decision process of a public space. Finally, *interactional justice* is about the quality of interpersonal relations in a specific place and if people interact safely without, e.g. discriminant behavior. Low emphasized this expanded concept of social justice because major transformations that occurred in the urban society in the U.S. within the last 20 years would necessitate employing a broader framework of justice (Low, 2013). These transformations include increased immigration, greater heterogeneity, more local segregation, economic restructuring and globalization or less public money, e.g. for park maintenance (Low, 2013). Although these changes reflect specific developments in the (U.S.) American context, similar changes have been observed in Western Europe (Low, 1999). Thus, it is reasonable to relate the concept of socio-environmental justice to our case of UGS in Europe.

### 1.3. UGS threshold values and preferences by different social groups

Although distributive aspects of availability and access to UGS as health promoting factors are not yet discussed in a sufficient way, many European cities provide threshold values for per capita UGS or for minimum accessibility for a defined area of UGS. For instance, the city of Berlin, Germany, aims at 6 $m^2$ of UGS per person (Senatsverwaltung für Stadtentwicklung und Umwelt, 2013a), while Leipzig in Eastern Germany aims at 10 $m^2$ per capita (City of Leipzig, 2003). In the UK, it is recommended that city residents should have access to a natural green space of minimum 2 ha within a distance of 300 m from home (Handley et al., 2003).

The pure application of per capita UGS and UGS accessibility threshold values can provide a broad assessment of UGS provision for a total city (Larondelle & Haase, 2013) but does not indicate how UGS are distributed across different groups of the society. Moreover, within a city there exist a range of different demographic and cultural structures, which in turn, implies a diversity of purposes that UGS needs to serve. For instance, a city-wide survey in Berlin showed that older individuals want to relax, get fresh air and enjoy nature while younger and middle aged people also prefer doing sports (Senatsverwaltung für Stadtentwicklung Berlin, 2004). Older individuals, appreciate large trees, a clean and well maintained site and seating while individuals of younger age groups also prefer grassy areas for sitting, sunbathing and playing in rather natural structures. The issue that different age groups have different motives to visit an UGS, participate in different activities and have different preference for specific UGS components was also identified in a study in Amsterdam (Chiesura, 2004).

Only few studies exist on the relationship between UGS use and immigrant status in Europe (for an overview see Gentin, 2011), while there is a long tradition in this research in the North American context (e.g. Dai, 2011; Gobster, 2002; Loukaitou-Sideris, 1995). The European studies have identified, that cultural background affects how UGS are used. For instance, a Dutch study (Peters, Elands, & Buijs, 2010) and also a German study (Jay & Schraml, 2009) found that for Turkish park visitors, group activities such as barbequing and meeting friends and acquaintances play a more important role than for native people. In the Dutch study it was further found that immigrants mainly come in larger groups with their family and friends for social gatherings, eating, relaxing and taking comfort in the shade of trees (Peters et al., 2010).

### 1.4. Objective of this study

In this paper, we discuss possible injustice of UGS provision among different social groups in the city of Berlin. Adding to an upcoming debate on distributive aspects of environmental justice in European cities, we analyze the distributive dimension of the socio-environmental justice concept and relate the results to procedural and interactional aspects in the conclusions of this paper. We used Berlin as a case because the Berlin's Senate Department of Urban Development and the Environment claims that Berlin is one of the greenest cities in Europe with nearly 33% green area (Senatsverwaltung für Stadtentwicklung und Umwelt, 2013b). However, as the city experienced population growth and urban land area expansion over the last decade, local-scale UGS may not be equally distributed and accessible across different social groups.

The overall objectives of this paper are:

- to identify possible socio-environmental injustice in a large city by analyzing the distribution of UGS and associated beneficiaries as well as potential visitor access inequities on a city-wide and site-specific scale,
- to identify and discuss possible differences in visitors' preferences according to immigrant status and demographic structures, and
- to give recommendations on management implications for the development and design of urban parks while referring to the three dimensions of socio-environmental justice – distributive, procedural and interactional justice.

## 2. Materials and methods

We use a multi-method approach and begin with an evaluation of the general distribution and provision of UGS on a city-wide sub-district level using the threshold value of 6 $m^2$ per capita UGS (Senatsverwaltung für Stadtentwicklung und Umwelt, 2013a). We integrate the distribution of different population groups in the analysis to identify whether dissimilarities of UGS provision exist between specific social groups such as immigrants and individuals aged 65 years and over. We specifically focus on these two population groups because immigrants represent a high share of the population in Berlin, reaching up to 30% in some districts while this group of immigrants but also the second group of older individuals (aged ≥65 years) will exponentially increase in Berlin in the next years (Senatsverwaltung für Stadtentwicklung und Umwelt, 2012a). Table 1 shows demographic characteristics for 2011 and for 2030 based on the population prognosis. Older individuals will increase up to 29% until 2030 while immigrants are supposed to show only a slightly lower increase up to 26%.

Next, we turn to a case study of the largest green area in Berlin, the former *city airport Berlin-Tempelhof*. Located in a highly culturally diverse area, we use this second spatial scale to examine whether a large UGS – which meets all area threshold values in this part of the city – also meets the specific needs of potential visitor groups. The spatial access of all residents and the specific visitor groups of immigrants and individuals aged ≥65 years within a catchment area of 1500 m around the entrances is estimated. Results are compared with actual demographic characteristics of visitors of Tempelhof. The obvious benefit of using two scales – city-wide and site-specific – is that we are able to compare city-wide threshold values with the expressed needs of the resident population at a local site.

### 2.1. Case study

Berlin is situated in the eastern part of the country (Fig. 1) and its administrative boundaries extend over a region of more than 89,000 ha. Berlin's population is estimated to have increased to 3,543,676 inhabitants by 2012 (Amt für Statistik & Berlin-Brandenburg, 2013). More than half a million inhabitants are immigrants (519,517 – November 2012) who are defined as people of exclusively foreign or not known nationality and stateless people. The largest group is represented by Turkish immigrants with more than 101,000 inhabitants. Total population growth in Berlin over the last decade was accompanied by a 16% increase in residential area between 2000 (18,023 ha) and 2011 (21,044 ha) while UGS increased to a lower extent (2000: 9087 ha and 2011: 9677 ha). New population projections suggest a further increase of 254,000 inhabitants until 2030 which will certainly lead to raising densification processes in the inner city areas. At current, public green spaces and forest areas represent more than 30% of the city area. Public green spaces include parks (>10 ha), private yards, allotments, cemeteries, recreational areas, sport grounds and street green. In total, Berlin contains more than 100 parks making an area of around 2000 ha. Berlin's UGS development has been determined by its land use history, as a significant portion of the UGS network is situated where the Berlin Wall was formerly located. The transformation of the former city airport Berlin-Tempelhof is another example where changing land use has created green space. The former city airport was converted into the largest publicly available UGS in Berlin with an area of more than 300 ha (as a reference point, New York City's Central park is 500 ha). Although unique in Berlin, Tempelhof represents the experience of many old industrialized cities where inner city transport areas or large water fronts have been converted to other land uses. Situated 5 km south of Berlin's city center but still accessible by the rapid transit system (Fig. 1), Tempelhof was opened for public use in May 2010 and is visited by more than 10,000 persons on warm summer days (Grün Berlin GmbH, 2012). The area contains huge public green spaces surrounded by sealed surfaces used for cycling, running and skating. Green spaces are mainly lawns and include specific areas for nature conservation, and some smaller areas for barbeque, picnicking or dogs. The outer parts contain trees while the main walking trail areas have no coverage. Infrastructure upgrades are planned for Tempelhof to become a "park for everybody".

### 2.2. Data base and methods

#### 2.2.1. City wide sub-district data

The spatial reference for our city-wide data is based on the spatial hierarchy called "living environment areas" (LEAs). LEAs represent the base for urban planning, prognosis, observation and administration in Berlin since 2006. The spatial hierarchy contains three levels: 60 prognosis areas, 138 district regions and 447 planning areas. In this analysis we refer to the prognosis areas for data and comparability reasons. In the following we call them sub-districts. Land use and demography data are used for these 60

**Table 1**
Demographic characteristics of Berlin for 2011 and 2030. Data are based on the population prognosis for Berlin (Senatsverwaltung für Stadtentwicklung und Umwelt, 2012a).

| Year | Population number | Mean age | Individuals aged ≥65 years | Individuals aged ≥65–80 years | Individuals aged ≥80 years | Immigrants[a] |
|---|---|---|---|---|---|---|
| 2011 | 3,502,000 | 42.3 | 664,200 | 516,200 | 148,000 | 494,000 |
| 2030 | 3,756,000 | 44.2 | 857,800 | 590,300 | 267,500 | 624,000 |
| Change (%) | 7.25 | 4.49 | 29.15 | 14.35 | 80.74 | 26.32 |

[a] People of exclusively foreign or not known nationality and stateless people.

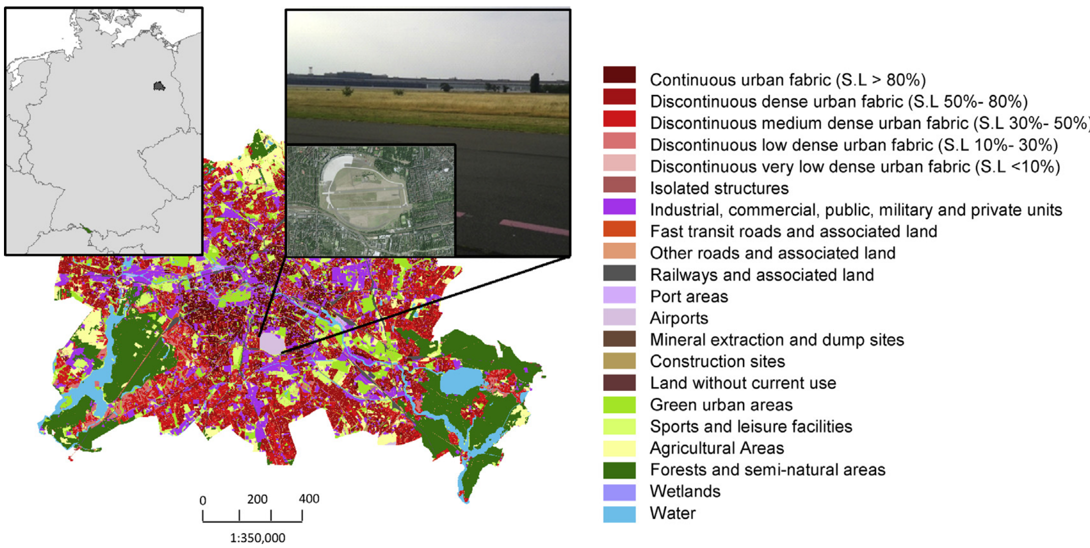



**Fig. 1.** The land cover in the study area based on Urban Atlas (reference year 2006, GMES Urban Atlas provided by Directorate-General for Regional Policy). The location of the study site within Germany is shown in the upper left hand corner and the location of the UGS Tempelhof in the upper right hand corner. The photograph shows a part of the runway and the former airport building. *Note*: as land use data refer to 2006, Tempelhof is classified as "airport" in the land use map.

sub-districts for the reference year 2010. The socio-demographic data include the number of inhabitants, number of immigrants, and number of individuals aged ≥65 years. The land use data include areas of UGS. In this paper, we define UGS as those areas with the following land use: forests, parks, cemeteries, allotment gardens and brownfields with vegetation. Table 2 shows an overview of all data used in the analyses.

We used per capita UGS to establish possible relationships between UGS provision and socio-demographic indicators of population density, immigrant status and age. A hierarchical cluster analysis is conducted to identify clusters of districts with significantly different socio-demographic characteristics and simultaneously differing UGS provision. Significant clusters can highlight concentrations or mismatches between UGS provision and specific user groups in a bundled way. The standardized variables' share of UGS, population density, percentage of immigrants and percentage of individuals aged ≥65 are used. The selection of these variables is based on their importance of indicating possible areas with diverging land uses and demographics. The first two variables – UGS and population density – demonstrate how UGS is distributed with higher shares distant to areas of high population density. The two remaining indicators – percentage of immigrants and percentage of individuals aged ≥65 years – represent specific social groups. A similar analysis was successfully applied to identify reurbanisation sensitive districts in the city of Leipzig. The variables migration balance, mean age, percentage of immigrants and unemployed people were used for this analysis (Kabisch, Haase, & Haase, 2010). The cluster analysis is conducted in SPSS 20, based on WARD-Method with squared Euclidian distance. The final number of clusters is determined by the "elbow criterion" (for explanation see Schwarz, 2010). Maps were produced using ArcGIS 10.

**Table 2**
Data used.

| Analysis | Data | Scale | Reference year/period | Source |
|---|---|---|---|---|
| City-wide sub-district level | Population number Population density<br>Number of immigrants<br>Number of individuals aged ≥65 years<br>Area of green spaces | Sub-district level | 2010 | Datenpool des Regionalen Bezugssystems (RBS) des Amtes für Statistik des Landes Berlin-Brandenburg (LOR Data set) |
| Site-specific case: Tempelhof | Population number<br>Number of immigrants<br>Number of individuals aged ≥65 years | Block | 2011 | Amt für Statistik des Landes Berlin-Brandenburg |
| | Visitor survey | Site | 2011 | Grün Berlin GmbH |
| | Residents survey (postal survey and 16 focus groups) | Catchment area (1500 m around entrances) | 2009 | Argus GmbH (on behalf of Senatsverwaltung für Stadtentwicklung Berlin) |

In addition to the spatial analyses, we applied a dissimilarity analysis to detect whether UGS are equally distributed across beneficiaries within the city. Beneficiaries include all inhabitants of Berlin, and again immigrants and individuals aged ≥65. There exist a number of indices which characterize an unequal distribution (or inequality) and are commonly used to measure inequality of income distribution. Among them, we borrow the Gini coefficient as the inequality measure to characterize quantitatively the degree of equality in the distribution of the amount of UGS and the beneficiaries. The Gini coefficient ranges from 0 to 1 where 0 represents perfect equality of potential access to the same amount of UGS and 1 represents perfect inequality. Thus, applying the Gini is a simple way to get an overview of the distribution and relation of two variables to each other. Disadvantages of this coefficient are that it reacts rather sensitively to changes around the median of the distribution and says nothing about the spatial distribution of possible dissimilarities. However, it was already successfully applied as an indicator to assess sustainable urban development (Li et al., 2009) and to measure urban form to differentiate between sprawl and compactness (Tsai, 2005). The Gini is formally represented as (Eq. (1)):

$$GC = \left| \left[ \sum_{i=1}^{k} (B_{i-1} + B_i) a_i \right] - 1 \right| \tag{1}$$

where $a$ is the relative share of the beneficiary group in a sub-district and $B$ is the cumulative share of UGS in the sub-district. Higher Gini coefficients (i.e. close to 1) mean that the share of UGS is extremely high in fewer sub-districts. A Gini coefficient close to 0 means that UGS are rather evenly distributed in the city area.

#### 2.2.2. Site-data of Tempelhof

The analysis of Tempelhof uses a GIS based buffering approach to spatially quantify potential accessibility within a specific distance from park entrances (for a similar GIS approach in cities in Belgium see also Herzele & Wiedemann, 2003 or in Leicester, UK, see Comber et al., 2008). Using a GIS procedure, we calculated the number of people living within a distance of 500 m and 1500 m of the park entrances in 2011. The distance of 500 m was used because the Berlin's Department of Urban Development and the Environment recommends that every resident should have access to UGS of minimum 0.5 ha within a 500 m distance from home. Similarly, a radius of 1500 m is the recommended catchment area for a large UGS of at least 50 ha (Senatsverwaltung für Stadtentwicklung und Umwelt, 2012b). We also calculated the percentage of immigrants and individuals aged ≥65 years within these distances. In addition, results from a visitor survey conducted by a service company of the Federal State Berlin – Grün Berlin GmbH – in 2011 were used and mirrored with the results from the potential analysis. Grün Berlin GmbH (2012) is a private non-profit-making company which is responsible for large open space development projects in Berlin. The visitor survey was conducted between 18th of June and 30th of September of 2011 and included a counting at entrances, semi-standardized face-to-face interviews with a representative sample of 1314 people and a mapping of visitor activities (Grün Berlin GmbH, 2012). To reach representativeness, the interviewed persons were selected based on a simple random procedure (every fifth adult person) when leaving the park at one of the three main entrances. The selection of the total number of interviews at the entrances is based on the percentage shares of visitors resulting from the counting. This means, that the number of interviews done at each entrance was proportionally chosen to the number of visitors at the respective entrance. Further, to include periodicity of visits, interviews were done proportionally to general visits on weekends, weekdays and during four time intervals. Immigrants are slightly but not significantly underrepresented due to language barriers.

In particular, the interviews included questions on demographics (age, immigrant status), means of transport, frequency of park visits, knowledge of park development, and a question about desired/preferred park characteristics and facilities including ecological and man-made park elements. The mapping was meant as a qualitative monitoring of visitor activities at seven different places in the park. The latter include three different places near the barbeque areas, one in between the runways and a further three near the dog areas.

We were also kindly allowed by Grün Berlin GmbH to use results from a postal survey and from 16 focus groups which were conducted in 2009 before the park was opened (Argus GmbH, 2009). The questionnaire was sent to 6000 residents living in the catchment area of 1500 m around park entrances. It aimed to identify main desired preferences on park characteristics which may be developed on the airport area. The return rate was 25%, making around 1346 usable questionnaires. The focus groups were directed to immigrant residents living in the catchment area to integrate them in the survey in an adequate way.

## 3. Results

### 3.1. UGS provision in Berlin

Most sub-districts in Berlin meet the threshold value of 6 $m^2$ UGS per inhabitant (Fig. 2a). However, UGS provision is not equally distributed over the total city area. Notably the outer city districts near the southeastern border of Berlin contain large amounts of UGS of more than 1000 ha and have per capita UGS values of more than 35 $m^2$. By contrast, inner city districts have smaller UGS and per capita UGS. Population density is, accordingly, high in inner city areas, particularly to the south of the city center (Fig. 2b) while per capita UGS is low. In some sub-districts per capita UGS falls below the threshold value of 6 $m^2$ per inhabitant. In these places, population density is upwards of 14,500 inhabitants per $km^2$. Further, Fig. 2c and d shows the population distribution of immigrants and older individuals (aged ≥65 years). Relatively high populations of immigrants are primarily located in the inner parts of the city reaching values of more than 23%. Generally, the percentage of immigrants is higher in the former West German part of the city. Relatively high proportions of older individuals are located in the peripheral parts of the city. In some inner city sub-districts, older individuals represent less than 10% of sub-district population.

The maps in Fig. 2 highlight a negative relationship between the provision of UGS and population density. This observation was further tested using a cluster analysis. The cluster analysis identifies three significant clusters (Fig. 3). A table below Fig. 3 provides an overview of mean parameter values of the variables forming each cluster and shows a comparison of the mean values to the city average. Cluster 1 comprises 28 districts and therefore appears to have the highest number of sub-districts. In this Cluster, mean values of all variables are below the city average, except for proportion of older individuals (22%). The 9 sub-districts included in Cluster 2 represent a very high share of UGS (>55%) compared to the city average of 24.6%. However, population density and percentage of immigrants are low in Cluster 2. Cluster 3, comprised by 23 sub-districts, has the highest population density (10,889 inh./$km^2$), nearly double the city average (6167.1 inh./$km^2$), but contains only 16.1% of the city's UGS. Percentage of immigrants is significantly high in Cluster 3, with values over 20%, while the percentage of older individuals is the lowest of the three clusters, at 15.1%. Spatial distributions of sub-districts also vary across each cluster. The sub-districts of Cluster 1 are distributed over the whole city area, most of the districts of Cluster 2 are located along the city

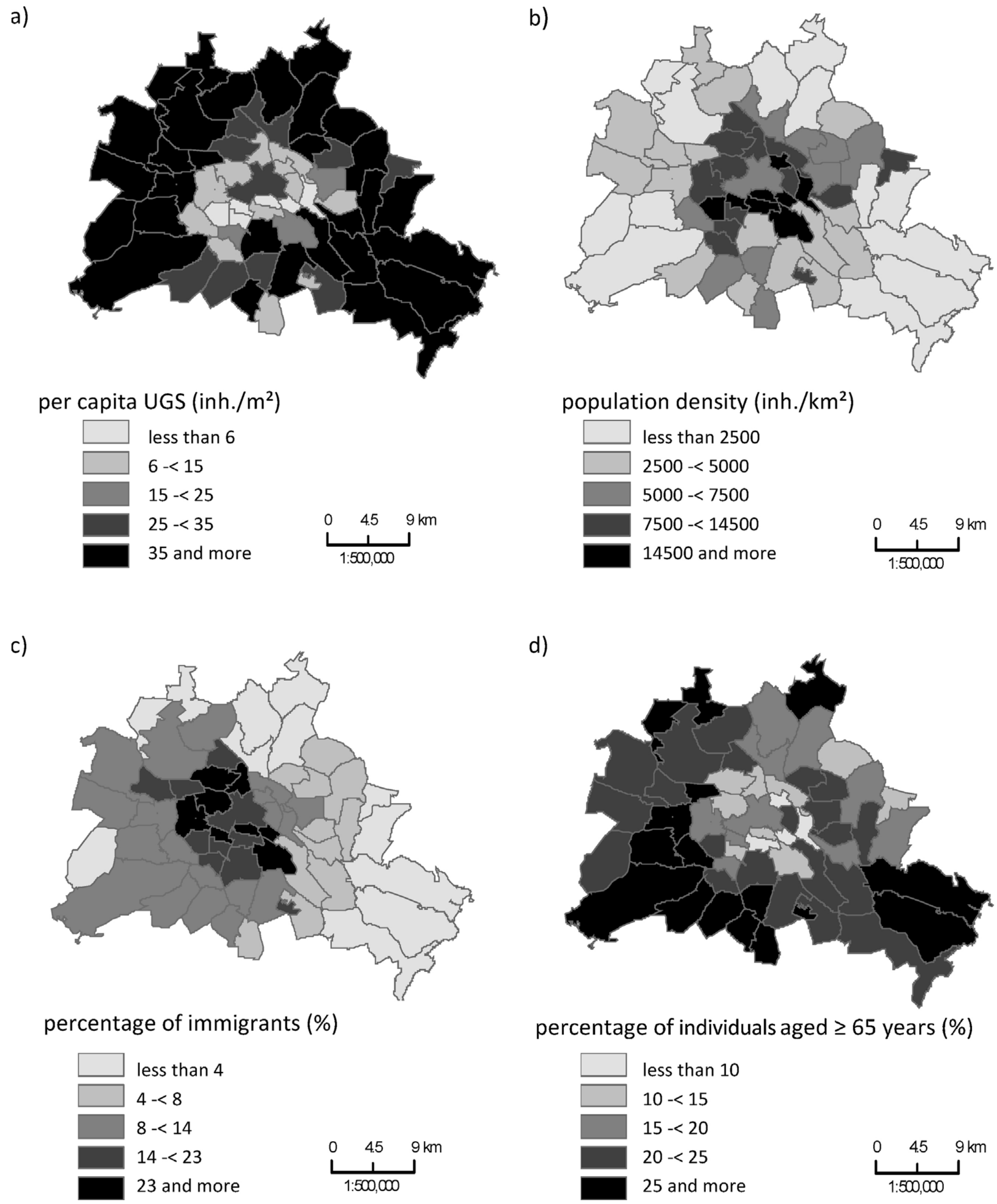



**Fig. 2.** (a) Per capita UGS provision, (b) population density, (c) percentage of immigrants and (d) percentage of individuals aged ≥65 years for Berlins sub-districts 2010.

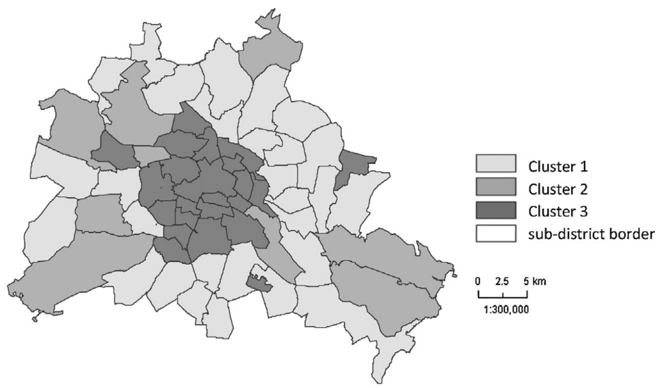
border and sub-districts belonging to Cluster 3 are situated within the inner city.

Overall, the distribution of the clusters and the mean values of the variables confirm that environmental quality varies across the city. In areas where population density is very high, UGS provision is low.

The dissimilarity analysis reinforces our finding that individuals living in areas of high population density and percentage of immigrants have less access to UGS. Fig. 4 shows the Lorenz curve and the Gini coefficients as the area of concentration between the Lorenz curve and the line of perfect equality. The figure and the values indicate a highly unequal distribution of UGS for specific population groups. The Gini is highest for the distribution of UGS and immigrants, with a value of 0.84. Gini values are lower for all residents (0.69) and even lower for individuals aged ≥65 years (0.65).

### 3.2. *Visitor's potential of the UGS Tempelhof*

The dissimilarity analysis pointed to an uneven distribution of UGS across specific population groups. The largest UGS in Berlin – Tempelhof – is located in a very dense area with high shares of immigrants. It could be assumed that the park being the largest in Berlin matches all threshold values for the population groups in this part of the city. The results of the GIS-buffer analysis show that more than 25,000 inhabitants live within a 500 m distance from the park and more than 180,000 inhabitants live within the catchment area of 1500 m (Table 3). This means that around 5% of the city population would benefit directly from the services Tempelhof provides. In addition, we identified the number and percentage of immigrants and of individuals aged ≥65 years. Nearly 12% of older individuals and 27% of immigrants live in the catchment area of




| | C 1 | C 2 | C 3 | Total city |
|---|---|---|---|---|
| Share of UGS (%) | 21.77 | 55.27 | 16.06 | 24.61 |
| Population density (inh./km²) | 3770.66 | 1554.53 | 10889.23 | 6167.06 |
| Percentage of immigrants (%) | 6.64 | 7.89 | 20.21 | 12.03 |
| Individuals aged ≥ 65 years (%) | 22.43 | 26.23 | 15.07 | 20.18 |
| Nr. of cases | 28 | 9 | 23 | 60 |

**Fig. 3.** Clusters of Berlins sub-districts according to share of UGS, population density, percentage of immigrants and older individuals (≥65 years).

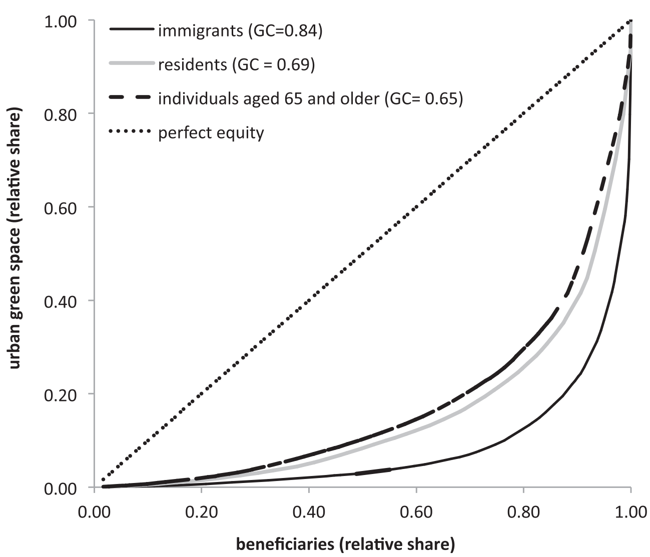



**Fig. 4.** Lorenz curve and values of the Gini coefficient (GC) representing the dissimilarity in UGS distribution and beneficiary groups of all inhabitants, immigrants and individuals aged ≥65 years.

1500 m. Notably the latter is above average as the mean value for the total city was 14.7% in 2011.

Using the visitor survey of 2011, we analyze whether these values are also represented in actual visitors. Visitors participating in the survey were asked for their place of residence. Answers were categorized into five classes: according to the catchment area within a distance from 1500 m from the park area, adjacent districts, other parts of Berlin, other parts of Germany or abroad.

**Table 3**
Potential of visitors in spatial distance to Tempelhof entrances.

| | Distance to park entrances | |
|---|---|---|
| | 500 m | 1500 m |
| Potential of visitors total (inhabitants) | 25.645 | 180.625 |
| Percentage of immigrants (%) | 27.90 | 26.71 |
| Percentage of individuals aged ≥65 years (%) | 10.52 | 11.70 |

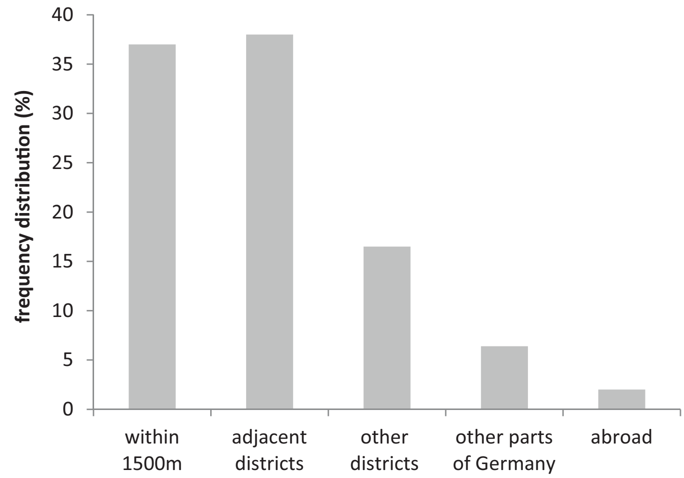



**Fig. 5.** Place of residents of visitors.
Data: Grün Berlin GmbH/Argus GmbH. THF Visitors survey 2011.

Results show that more than one third of the visitors come from a 1500 m distance and one third travels from districts adjacent to Tempelhof (Fig. 5). Thus, dominant visitor groups have relatively easy accessibility to the park. The mean age of visitors was 41.5 while women were slightly younger (40.2) and men older (42.6). Fig. 6 shows general demographic characteristics of visitors. Most visitors are aged 18 to ≤65 years (80.6%), while older individuals visit the area less frequently (6%). This does not match the population of the catchment area. Within the 500 m catchment, 10.5% of the population is aged ≥65 years and within 1500 m, 11.7% of the population is aged ≥65 years. Only 9% of survey participants were immigrant residents, whereas 27% of individuals within the 1500 m catchment were immigrants (again, Table 3). In the catchment area the largest group among immigrants is represented by the Turkish community (28%) followed by Arab immigrants (11%), immigrants from former Yugoslavia (9%) and Poland (8%).

### 3.3. Preferences of park characteristics

Finally, results from a postal survey and from 16 focus groups done among immigrants in 2009 were analyzed. The aim of the postal survey was to identify desired preferences and expectations people in the catchment area do have on a park before the park was opened for public use. The main result was that

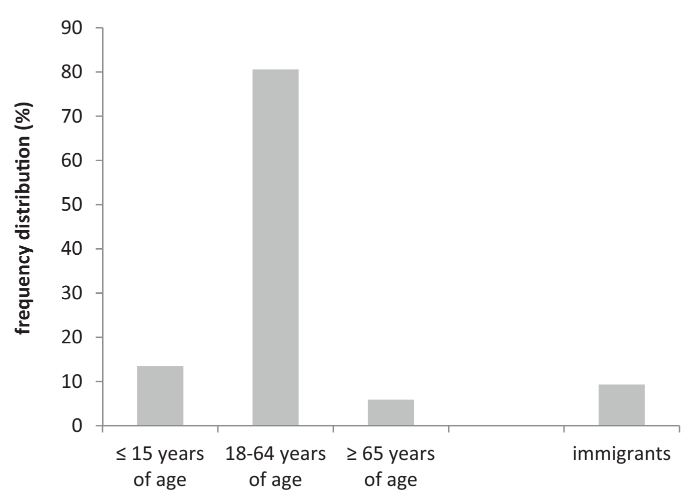



**Fig. 6.** Visitor groups according to age groups and immigrants.
Data: Grün Berlin GmbH/Argus GmbH. THF Visitors survey 2011.

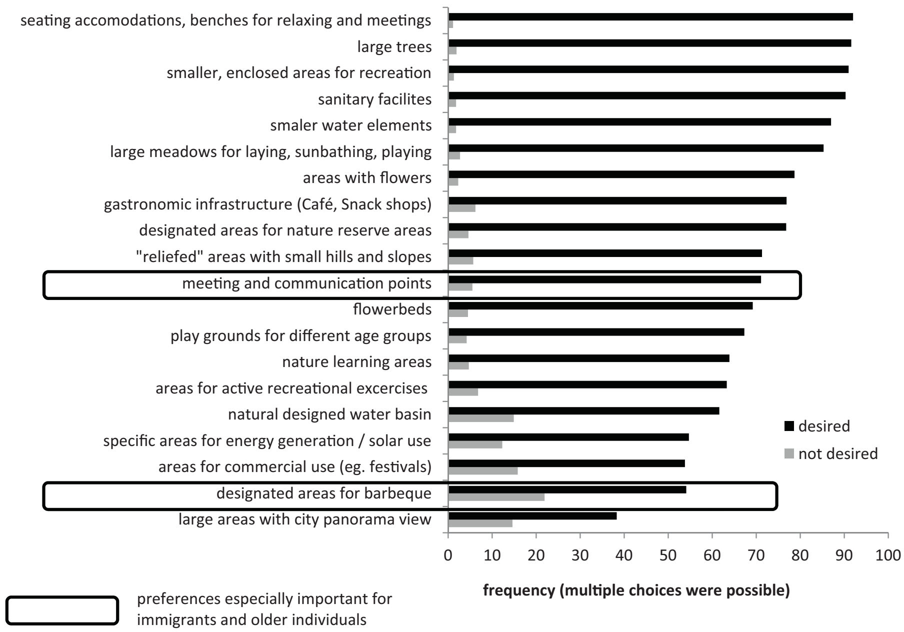



**Fig. 7.** Local residents' expectations in 2009 on a park developed at the former Tempelhof airport. 20 most desired and not desired characteristics. Data: Argus GmbH, residents survey 2009.

people mostly desire areas with large trees, benches, smaller closed areas for recreation and well-maintained sanitary facilities (Fig. 7; Argus GmbH, 2009). Divided by socio-demographic criteria, it was discovered that native German families prefer grassy areas for sunbathing and playing, playgrounds for different age groups and sites for specific sport activities (Argus GmbH, 2009). Older individuals and immigrant families rather prefer barbeque areas and communication zones for picnicking.

## 4. Discussion

The analysis of UGS provision in Berlin indicated that in most of Berlins' sub-districts the inhabitants are provided with more than 6 $m^2$ UGS per inhabitant. Thus, the general provision of UGS seems to be sufficient for most of the inhabitants. However, it is not enough to only examine per capita values as evidence of distributive injustice was identified at the sub-district level. Here, a cluster analysis identified that some high density areas in Berlin have disproportionately less UGS. In those areas, immigrants are over-represented and may derive less benefit from local UGS. Here, a scale perspective might uncover a notion of socio-environmental injustice. Although a number of environmental benefits of UGS, such as mitigation of heat island effects or $CO_2$ storage by urban vegetation (Strohbach & Haase, 2012), are effective at a city-wide scale (Bolund & Hunhammar, 1999); some biophysical or ecological processes that occur in UGS produce benefits to residents only at the local scale and might be less distributed in the sub-districts of the undersupplied Cluster 3, where UGS are below city average. These local effects of UGS include, e.g. reduction of noise (Bolund & Hunhammar, 1999), or direct impacts on physical and psychological health (Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003). Although it is not always easy to define the scale at which biophysical processes operate, this perspective highlights that those beneficiaries of environmental benefits are often those who live in a vicinity of UGS while other benefits affect the total population of a city. The inequality in the amount of UGS for immigrants in Berlin was also expressed in an enormously high Gini index of more than 0.8. In other studies immigrant groups were also found to suffer from low distribution and access to UGS, e.g. in US (Dai, 2011) or in British cities (Comber et al., 2008), and even to have higher levels of health inequality (Mitchell & Popham, 2008).

Although our expectations where somehow different, in our analysis of potential beneficiaries of Tempelhof, only 9% of surveyed visitors were immigrants. This result was surprising because the districts in the adjacent areas are characterized by a high cultural diversity and have a percentage of more than 27% immigrants. We assumed that the percentage of immigrants of the districts must be reflected by a similar percentage in the survey as also other research identified that people mostly prefer short distances to come to an UGS (Ravenscroft & Markwell, 2000). The identified unbalance might be due to the fact that a certain bias in the survey appeared in a way that immigrants who are not able to speak German were not interviewed. On the other hand, immigrants may prefer to visit other parks with other design or other park components than currently being represented at Tempelhof. Cultural constraints may also limit immigrant groups' use of nearby parks for certain recreational activities. For instance, Muslim women may not use the park because there is no adequate space for them, that is semi-secluded areas where they can stay with their children away from men (Low, 2013). The resident's postal survey on desired park characteristics conducted in 2009 found that immigrant people prefer barbeque areas and communication zones for picnicking while native Germans rather prefer sites for active sport and play. As most of the immigrant visitors of Tempelhof and most of the local residents belong to the Turkish or Arab community (indicated also by the mapping results of the 2011 visitor survey) these preferences may reflect their cultural background. Although also young (Turkish) immigrant visitors do sports (e.g. cycling or walking), going to urban parks in larger groups with families and friends to spend a few hours of relaxing, eating and communicating (i.e. following rather passive recreational activities) are more a part of Turkish cultural identity than for Germans (Peters et al., 2010). According to a recent review by Byrne and Wolch (2009), many of active and passive activities may be differentiated by cultural background and ethnicity. For the American background they concluded that Latinos rather engage in passive sedentary and informal social activities such as picnicking while African-Americans are more in favor of active exercises such as basketball or walking. Whites tend to prefer cycling, swimming, dog-walking and other activities. For the Western European background, similarly, Seeland, Dübendorfer, and Hansmann (2009) found in a survey in Zurich, that sports activities seemed to play a somewhat larger role for the Swiss than for immigrants. Tempelhof provides an optimal environment for such sport activities, whereas seating, shaded areas, accommodations and semi-secured spaces reserved for relaxation, socializing or other more passive activities are not yet developed in a sufficient manner (see also the photograph in Fig. 1). There exist at least three areas designated for barbequing at Tempelhof but they are rather small and do not contain seating or even trees which could provide shade. Notably, the latter is indispensable during hot weather as non-shaded spaces heat-up very quickly with direct insolation. In conclusion, if an UGS such as Tempelhof might not meet the specific culturally framed needs and expectations of potential local visitor groups due to a lack of appropriate infrastructure, it may be less effective as a recreation area.

Similarly, people belonging to the age group of ≥65 years were less present in the park compared to the shares in the catchment areas. The reason for this "underuse" by older individuals may also be found in the current infrastructure of the park: again, Tempelhof contains large areas of lawns but nearly no trees, which would provide shade. In addition, the supply of seating and eating areas is lacking. Such "passive use areas" (Gobster, 1998, p. 51) are found to be especially important for older individuals (World Health Organization, 2007). Sports activities, the main exercises available at Tempelhof, are less important for them (Grün Berlin GmbH, 2012).

Concerning the issue of socio-environmental justice, we conclude that the identified dissimilarities in the Tempelhof area are not the same as distributive injustice which was identified in the city-wide study. On the sub-district level, however, we showed that dissimilarities exist between residential groups and UGS provision. On the local scale, additionally the question of a fair treatment of all people remains when considering how to handle a possible undersupply of UGS in very dense urban areas.

## 5. Conclusions and recommendations

In our analysis of UGS provisioning in Berlin, we found that in most of the sub-districts, residents have access to sufficient UGS in their vicinity using the threshold value of 6 $m^2$ per person. However, at least some of the inner city sub-districts with relatively high percentages of immigrants and high population density have disproportionate less access to UGS. A dissimilarity analysis further confirmed the finding of distributive injustice of UGS among resident groups. Socio-environmental justice was further explored using the UGS of the former city airport – Tempelhof. Although a high percentage of residents in the Tempelhof area are immigrants, we found that the park is mostly frequented by Germans. The reason for underuse of the park by immigrants considers how cultural background relates to recreational needs.

Further, residents of individuals aged ≥65 years do not frequently visit Tempelhof. This can be partially attributed to the poor developed infrastructure and the homogenous structure of wide green areas without tree coverage.

Based on this study and referring to the initially proposed framework of socio-environmental justice, we highlight some design and management recommendations for Tempelhof but also for other UGS:

(a) From a *distributive perspective*, planners should consider who is using the UGS including who lives in walking distance not only to the park but to park entrances and is, therefore more likely to use it; and to think if the resources of the park are fairly allocated among all possible user groups. Although Tempelhof provides access to an UGS for a large number of residents, there is not equal space for everyone at the moment. The current park design gives priority to large open spaces for active sport exercises while little adequate space is reserved for barbequing, resting or play. Such spaces are preferred by specific social groups that prefer to come as larger groups of friends and families. The concluding general recommendation is to offer additional areas or niches that provide enough (semi-secured) space for barbequing or picnicking being equipped with shade, tables, seating, and nearby playgrounds where children could play and be supervised.

(b) Local residents, regardless of age, cultural background, sex or social status need to be consulted and integrated into the UGS planning and decision process to give them a fair chance to articulate their needs and requirements. This recommendation points to Low's (2013) understanding of *procedural justice* and acknowledges the planning process in Tempelhof where local residents of divers social groups gained a voice and could – even in their mother tongue – express their needs and expectations through focus groups, workshops and surveys. The Green City project (Roo, 2011) similarly recommends public participation but additionally recommends the participation of visitors in the maintenance of the green space. At Tempelhof some pioneer areas were installed on a one-year contract base with local residents. They include spaces for urban gardening and environmental education which successfully foster public participation and should be installed on a long-term perspective.

(c) In the case of Tempelhof, planners envision "a park for everybody", which would mean that the specific needs of different visitor groups have to be equally met. Of course, this is challenging, as contradictory requirements exist such as quiet versus lively areas, areas for (individual) sport activities versus family oriented spaces or areas for nature observation versus human activities. From the perspective of *interactional justice*, UGS should allow for all visitor groups – regardless of age and cultural background – to interact freely and safely (Low, 2013). For Tempelhof, this could be supported by a clear designation of spaces for sport activities, for barbequing or for quiet relaxation and even for dog-walkers.

(d) Finally, when thinking of the increasing number of older individuals, their recreational and social needs should be considered in an aging society. Their needs include basic amenities such as clean restrooms and seating in a sufficient number. Seating and other infrastructural elements which foster communication zones have to be easily accessible and near park entrances. Similar guidelines were also presented by the WHO according to an age-friendly environment (World Health Organization, 2007). Another point advocated by the WHO is a general clean and beautiful environment with limited noise and air pollution levels.

Finally, some methodological limitations and possible improvements in future research are highlighted. The use of secondary data clearly limited the opportunities of statistical analysis in this study. Bringing together a city wide analysis with a site specific case and using a multi-method approach may require complex consideration but we believe that our results confirm the usefulness of this combination. Further, methodological improvements may result from using additional qualitative and quantitative methods settled in environmental and social sciences. Quantitative environmental science methods may include the measurement of temperature noise levels to assess the "real" reduction potential of shaded park areas by trees. Quantitative social science methods could include the use of conjoint analysis and segmentation methods to disentangle different cultural groups in their preferences.

Qualitative analyses may include structured methodologies from rapid ethnographic assessment procedure (REAP, Low, 2013) that are individual interviews and focus groups in different languages, expert interviews and behavior mapping to give more priority to the analysis of procedural and interactional justice.

Overall, this paper articulated the socio-environmental justice concerns in UGS research and planning. It hopefully helps to raise awareness on the issue and assessment opportunities of socio-environmental justice and to define good practice recommendations to develop greener neighborhoods for everyone.

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