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Summary

As the world experiences catastrophic events from climate change, everyone is affected. Cities as the cornerstone of transformation must respond accordingly to guarantee a liveable future for urban dwellers. In looking towards nature-based solutions (NBS), one of the simplest yet most effective ways to adapt to extreme weather events is by integrating Urban Green Space (UGS). As urban areas look towards greening their cities, however, the reintegration of UGS is not always implemented equitably, leaving some people behind in the struggle to mitigate the dangerous effects of climate change and towards healthier urban living.

From the perspective of Environmental Justice (EJ), this research analyses the equity of UGS distribution in Paris using two numerical indicators. The study focuses on the proximity and allocation of UGS to assess the progress of local climate policy, “Plan Climat.”

Statistical and socio-spatial analyses using Geographic Information System (GIS) are employed for a comparative study across Parisian neighbourhoods (arrondissements) by evaluating UGS distribution given varying levels of socioeconomic status (SES) and population density (PD).

The findings reveal that while UGS are generally well distributed around the city, the amount of UGS allocated per capita is not sufficient in any part of the city. Discrepancies of UGS coverage are found between arrondissements, especially when considering other factors of SES and PD. The analysis reveals contrasting results between indicators, in that while those of a lower SES, often in higher PD areas, have observably lower availability of UGS per person, the majority of those areas are within 300m of a UGS. Moreso, higher SES areas, located in lower density areas, have the opposite result with higher allocation per capita but worse-off proximities to UGS.

This research suggests that UGS distribution in Paris has a level of inequity that should be addressed in the remaining progress of its climate policy indicators, to achieve just outcomes in the collective effort against climate change.

Keywords

Urban Green Space, Environmental Justice, socio-spatial analysis, high-density, climate policy

Acknowledgements

Growing up visiting France in the summer, the last few years have been noticeably different. Experiencing extreme heat waves, especially in Paris, I found myself unable to find enough escapes within the city to cool down or even to just enjoy the summer comfortably. While I craved simply sitting down in a park, I felt as though there were not enough options within proximity, or if there were, the size of the park was not what I had hoped. This inspired my interest in the topic, as I felt the lack of green even as a part-time city dweller. Especially acknowledging the increasingly hot summers ahead, the importance of a simple urban green spaces for people is even more desired and necessary. This piqued my interest in understanding what the city is doing to mitigate these effects and create a more liveable city for the future.

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Abbreviations

Abbreviation	Full form
IHS	Institute for Housing and Urban Development Studies
UGS	Urban Green Space
EJ	Environmental Justice
UN	United Nations
WHO	World Health Organization
SDGs	Sustainable Development Goals
HUGSI	Husqvarna Urban Green Space Index
PLU	Local Urbanism Plan
PLUB	Local Bioclimatic Urbanism Plan
CSV	Comma-separated values
GIS	Geographic Information System
APUR	Atelier Parisien d'Urbanisme (Parisian Urban Planning Workshop)
DEVE	Direction des Espaces Verts et de l'Environnement (Directorate of Green Spaces and Environment)
UHI	Urban Heat Island
SES	Socioeconomic Status
PD	Population Density

1. Introduction

1.1 Background Information and Problem Statement

People in all corners of the world are experiencing increasingly catastrophic climate events, namely extreme heat, droughts, floods, and loss of biodiversity. The changing climate is a result of our actions on this planet and are exacerbating due to our inaction in mitigating this crisis.

Cities are affected two-fold by these severe environmental shocks and are among the most susceptible to the effects of climate change. The concentration of populations makes them especially vulnerable as the impacts affect more inhabitants, economic activity, and infrastructure (Hallegatte & Corfee-Morlot, 2010). According to the United Nations (UN) (2018), the percentage of people worldwide living in urban spaces is projected to increase from 55% to 68% by 2050. This is expected to result in an increase in densification of urban centres, calling for an even greater importance of sustainable urban development now and in the future (Haaland & van den Bosch, 2015). Many cities have looked towards the ‘compact city’ model as an attempt to accommodate the growing populations to fit goods and amenities within the existing urban parameters. This archetype includes characteristics such as high-density housing, mixed-use spaces, efficient public transportation and the encouragement of walking and cycling (Burton, 2000). High urbanization offers convenience for people but also carries with it a number of environmental challenges including air pollution and the urban heat island (UHI) effect (Xu & Wang, 2022).

To accommodate a growing population, urban densification and the creation of mixed-use spaces often results in the removal of green space, also known as Urban Green Space (UGS), worsening ecological stresses (Fuller and Gaston, 2009; Brunner and Cozens, 2013 Haaland & van den Bosch, 2015). Urban areas are ill-prepared for this level of disaster because existing cityscapes were not originally designed by a society that prioritised the integration of nature (Pinto et al., 2023). Not only are UGS less readily available, but population growth can also lead to an unequal distribution of these UGS within the city (Kabisch & Haase, 2014). This poses a significant problem in cityscapes as UGS in the city are necessary for human well-being, preservation of the natural environment, climate regulation, and act as social sanctuaries (Buchavyi et al, 2022).

Longer life expectancy, less instances of mental health problems, improved cognitive performance as well as healthier newborns are a few of the health advantages that come with urban greening. (Nieuwenhuijsen et al., 2017). Additionally, it increases CO₂ sequestration,

reduces heat, noise and air pollution, aiding in the fight against the climate crisis (Luo et al., 2022; Swan, 2022). UGS can improve ecosystems and increase biodiversity in cities, particularly through well-designed green infrastructure (Coutts and Hahn, 2015). Studies have shown that UGS lowers rates of premature mortality (Rojas-Rueda et al., 2019). An increase in UGS such as tree coverage of 10% might avert almost 400 preventable deaths per year (Kondo et al., 2020). According to a new study, spending at least 2 hours weekly in natural areas is essential for overall wellness (White et al., 2019).

The Husqvarna Urban Green Space Index (HUGSI), which measures urban greening through satellite data, has found that on a global average, there has been a slight decline in UGS with 0.01% less coverage from one year to the next. However, the majority of the decline is attributed to Central East Asia (HUGSI, 2021b). In Europe and North America, a significant upward trend is observed (HUGSI, 2021b). Europe performs strongly in overall urban greening initiatives, particularly when looking at averages. The average UGS cover per city according to the HUGSI is at 47%, the average green area per capita is 243.5m² and average distribution of UGS is at 45% (HUGSI, 2024). However, when looking to individual cities within Europe, some are severely lacking in UGS coverage. The HUGSI showed that 62% of the European population lives in areas with less UGS than recommended (HUGSI, 2024).

The reintroduction of the natural environment, specifically UGS, is challenging in our modern world because cities have become so densely populated that available space is primarily allocated for services rather than public open areas (Syrbe & Chang, 2018). However, as extreme weather patterns demonstrate the increasing necessity for cities to adapt, there is a paradigm shift in contemporary thought towards reintegrating nature as a focal point (Goode, 1998).

The transition towards sustainable cities has been a global discourse leading to worldwide policies set out by international organizations like the UN and World Health Organization (WHO), who encourage local policies to align with their recommendations. The UN Climate Change Conference that led to the “Paris Agreement” (2015), served as a milestone for countries to work hard towards holding “the global average temperature to well below 2 degrees pre-industrial levels Celsius above pre-industrial levels” and “to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels” (United Nations, 2015). The WHO Regional Office for Europe published “urban green spaces: a brief for action” (2017), which outlines the health benefits that come from UGS interventions and accompanying indicators for cities to follow.

Such policies for sustainable and climate-adaptive cities are meant to increase the health and well-being of its inhabitants and to help them cope with climate change. From analysing more than 1,000 cities, the Barcelona Institute of Global Health discovered that if these urban areas followed WHO's indicators about proximity to UGS, up to 43,000 premature deaths could be prevented annually (Swan, 2022). Municipalities in Europe and surrounding have used indicators outlined in this document to implement in their own cities.

In recent years, France has endured its hottest year ever recorded with rivers drying up, crops shrivelling and a severe water deficit, while also facing extreme rainfall and devastating flooding in a similar timeframe (France 24, 2023). The city of Paris, France is increasingly experiencing dangerous heat events, namely the Urban Heat Island (UHI) effect, caused by its infrastructure that absorbs and re-emits the sun's heat, making the urban zone reach temperatures much higher than relative surrounding areas (Environmental Protection Agency, n.d). In response to these extreme weather events and the progression of climate change, Paris is making strides to make the city more sustainable, climate adaptive and just for everyone. The increasing awareness of the benefits greening the city has led to the city taking affirmative action through climate policies that adopt indicators from the WHO. However, how these numerical targets play out during implementation can have varying effects on different populations and areas within the urban space depending on other factors and characteristics in the city.

1.2 Research Gap and Relevance

1.2.1 Research gap

While researchers have extensively discussed the issue of inequity of UGS distribution and allocation, much of the focus has either completely disregarded the perspective of Environmental Justice (EJ) or has solely focused on its relationship with SES (Rutt & Gulrud, 2016). The topic has been explored within the framework of EJ, however, there has been a lack of acknowledgement in the role of population density (PD) on availability of UGS (Huang et al., 2022). This especially highlights a gap in literature as research has underscored the importance of looking into how the availability of UGS does not necessarily account for the equity.

This leads to the importance of understanding socio-spatial dynamics of individual urban environments for EJ. Researchers have discussed the value of UGS in policy implementation without noting the need for tailoring these greening and climate policies to the unique socio-

spatial characteristics of cities. In this research, addressing the socio-spatial dynamics of Paris PD within the EJ framework is crucial. This approach recognises that in the context of EJ, to achieve equitable UGS allocation and distribution, accounting for the local situation is crucial.

1.2.2 Relevance of research

This research focuses on the city of Paris, France, to monitor and evaluate the progress of locally imposed climate policy, “Plan Climat” (2023), in line with globally recognised greening indicators from the WHO and assess whether there are implications for different populations and areas of the city. As a world-class city known for its grand boulevards and iconic architecture rather than greenery, it is intriguing that Paris takes on the challenge to be one of the greenest cities in Europe by 2030. Paris can leverage its status as a global exemplar to set a benchmark for urban greening for other cities to follow.

In a time where the effects of climate change are felt by everyone, climate policies must leave no one behind to best mitigate this crisis. Understanding where the discrepancies lie helps to eventually achieve EJ especially in urban areas that harbour high population densities, where the disadvantage of one population can in turn harm everyone. Paris has demographically and socioeconomically diverse neighbourhoods, called arrondissements, providing an opportunity to study the equity of UGS distribution across districts. This variety across districts allows for an analysis of how different groups may access and benefit from UGS. In identifying how available UGS are to areas of varying characteristics, an understanding of the level of EJ across the city can be gained.

This study’s use of a socio-spatial analysis helps to pinpoint areas that may not be benefitting from UGS. In monitoring the progress of “Plan Climat,” numerical discrepancies can be located in specific parts of the city as areas to focus on in a quantifiable manner. Not only does this display Paris’ performance in reaching policy indicators but helps to identify and compare how UGS availability might vary across arrondissements with different characteristics. In comparing the arrondissements using different variables, it can help feature the element of EJ. Understanding the correlation between UGS availability and arrondissements dynamics can help identify injustices that may be perpetrated by policies themselves. This can highlight areas and population groups with limited UGS availability that will require more attention in the future. By identifying groups and recognising potential correlations, more research can be done into these relationships and why these imbalances exist. Understanding these inequalities in

Paris can offer insights into broader urban planning and policy issues around EJ, to create more just planning.

1.3 Research Objectives and Research Questions

1.3.1 Objectives

This research seeks to (1) assess the progress of target indicators outlined in policy documents, and (2) using a comparative design, assess the equity of the results on whether greening in Paris has had disproportioned effects in different arrondissements marked by different socioeconomic and population density (PD) variables. By introducing layers of PD and socioeconomic status (SES), the results can demonstrate how the state of the city thus far might disproportionately implement UGS across the city, unveiling environmental injustices within the city. In identifying the relationships between these variables, we can better understand the nature of recent planning methods and help inform policymakers on areas to focus on going forward.

This research will examine the allocation and distribution of UGS within Paris, focusing on the status of numerical indicators set out in Paris' newest climate policy, "Plan Climat." Specifically, the research aims to investigate whether the proximity goals outlined in policy documents align with the actual distribution of UGS. Additionally, the study seeks to assess whether there exists a relationship between socio-spatial dynamics and UGS allocation for inhabitants in different arrondissements. This research hopes to inform policies on areas to pay attention to by providing a socio-spatial analysis of UGS distribution disparities in Paris.

1.3.2 Main research question and sub-questions

Main question: How equitable is the distribution of UGS among inhabitants of Paris?

Sub Questions:

To what extent are benchmarks outlined in "Plan Climat" reflected in the distribution of UGS in Paris? And how does this vary among arrondissements?

How does UGS distribution differ between arrondissements given the varying levels of population density and socioeconomic status?

2. Literature Review and Hypotheses

This literature review explores theories of justice in relation to Urban Green Spaces (UGS).

2.1 Urban Green Spaces

Urban Green Spaces (UGS) can be defined as areas within cities partially or fully covered with vegetation including grass, trees, shrubs and other plants. UGS encompasses parks, community gardens, cemeteries, rooftop/vertical gardens and woodlands (De Haas et al., 2021).

UGS have been seen as a fundamental feature in urban landscapes since the 19th century as they offer health benefits and recreational qualities (Koprowska, 2020). UGS have been shown to correlate with better health for inhabitants who live among them, namely lessening obesity rates and even reducing the risk of certain diseases and mental health disorders (Jennings et al., 2019; Kato-Huerta et al., 2022). Its mental health impacts have been a topic of more recent research, as a better psychological well-being is associated with more urban green (White et al., 2019). Alongside the countless benefits to humans, UGS help create balance within the environment by regulating urban temperature, purifying air, flood control and overall safeguarding residents from adverse impacts of climate change (Kato-Huerta et al., 2022). As the world inevitably faces the dangers of climate change, UGS are the most sustainable tools within the urban environment to mitigate the crisis (Sustainable Development Commission, 2010; Wu et al., 2020).

There has always existed a strong interrelationship between space and society. Social relations influence the formation and use of space and conversely, these spaces impact social dynamics (Mandelbaum, 2021). UGS enhance the environment (Kabisch et al., 2015) and influence the relationship between communities and the natural world (de Sousa Silva et al., 2018; Mandelbaum, 2021). Even just the presence of UGS contributes positively to how humans view nature (Mandelbaum, 2021). Increasingly, people are recognising the advantages of UGS in fostering a liveable urban environment (Koprowska, 2020). The discourse surrounding UGS shifts within planning prerogatives and recently have emphasised their positive impact on physical activity, mental well-being and urban sustainability within the planning realm (Jennings et al., 2019; Mandelbaum, 2021).

UGS have emerged as a key priority in European environmental policy as ‘nature-based solutions’ (Rutt & Gulsrud, 2016). Planned UGS play a crucial role for sustainable cities, yet

with an exponentially growing population, competition deepens for land use that is also needed in other sectors such as economic, residential, and transportation, making them take less precedence (Das, 2022).

2.2 Urban Densification

Urban densification is a process where the existing built environment endures a process of redevelopment to reach a higher population density (PD) or land use (Verheij, Gerber, & Nahrath, 2023). The prioritisation of dense cities in the last 30 years has been viewed as the path towards sustainable development (Bibri et al., 2020). This is because clustering services and work with residences increases proximities, thereby decreasing transportation distances, which can reduce emissions levels (Ahlfeldt et al., 2018). Densification of services can also promote healthier and more accessible modes of transport, such as walking or cycling. However, in implementing densification, there are trade-offs (Burton, 2000), as land-use competition increases, UGS are often the first to be fragmented (Haaland & van den Bosch, 2015).

Often UGS are included in the compact model to attain city policy goals, while at the same time losing their quality and coherence among the urban area in that process (Jansson & Schneider, 2023). Availability of UGS and densification is often a paradoxical relationship, UGS become an even more important part of sustainable living environments, yet densification often leads to the reduction in UGS (Verheij, Gerber, & Nahrath, 2023). Therefore, ensuring a proportional supply of UGS for the given population is necessary for a sustainable city.

It is often noted that the lower socioeconomic classes are also those that are living in the most densely populated areas (Kato-Huerta et al., 2022). This highlights the even larger importance of implementing UGS in these areas, to allow an escape from a compact living situation (Belikow et al., 2021).

Densification, according to some researchers, is context dependent. The definition of sustainable development has a different connotation depending on the context of the city, meaning that every city should consider its own opportunities and capabilities and challenges given the social, economic and environmental aspects of the urban area (Bibri et al., 2020). PD has a great influence but must be examined based on its urban or non-urban characteristics (Jennings et al., 2012). There is a need for a shift to context-based planning schemes to

accommodate the current paradigm of densification to address how it can be felt by different inhabitants (Jansson & Schneider, 2023; Jansson & Sunding, 2024).

2.3 Environmental Justice

Environmental Justice (EJ) is a concept that exemplifies how different socioeconomic groups experience different exposure to environmental burdens or environmental goods (Schweitzer & Stephenson, 2007; Kronenberg et al., 2020). The concept came to life during the Civil Rights Movement in the United States to protest environmental pollution and its uneven consequences among the population (Huang et al., 2022). Although inequitable access was not at the forefront of the discussion when EJ literature came about, it is now gaining more traction specifically in urban areas (Koprowska, 2020). EJ now embodies a social crusade as well as a scientific field of research (Koprowska, 2020).

The topic of EJ research intertwines aspects of social and ecological justice. It deals with how environmental goods and hazards impact marginalised communities, which broadens the understanding of the environment to spaces other than untouched natural areas, which now encompasses the urban environment (Schweitzer & Stephenson, 2007; Koprowska, 2020). EJ now becomes a growing topic of discussion within urban studies as the topics become more and more linked as environmental inequity can reveal social injustices within urban zones (Koprowska, 2020). The theory can encompass different considerations of EJ, but the most notable deals with equitable distribution and allocation among all social clusters (Kronenberg et al., 2020).

The increasing global urban PD, socioeconomic disparities and climate challenges emphasise the continued relevance of city problems in EJ literature (Koprowska, 2020). EJ research increasingly focuses on UGS accessibility, highlighting the unequal distribution of UGS and its implications for socioenvironmental justice (Luo et al., 2022). The distribution of UGS and balance between supply and demand are imperative to ensure residents' rights to access natural environments, relaxation and recreation (Xie, 2023). Most EJ research primarily addresses pollution exposure, green exposure and access to UGS. Recently, the inequitable distribution of UGS has gained significant attention.

There is a distinction between equality and justice, especially in the context of UGS policy implementation. Environmental equality means residents have fair access to UGS, unaffected by external factors, and conversely, environmental inequality refers to the uneven distribution

of UGS among different resident groups (Luo et al., 2022). Although discourse among planners has recognised the pertinence of planning for equitable UGS, disproportionate availability of UGS remains a problem (Koprowska, 2020). Therefore, urban dwellers are not subject to equal benefits from UGS (Luo et al., 2022). Equality accounts for equal distribution of resources but fails to account for the different needs of disperse groups within a community (Mandelbaum, 2021). This means that although equality is factored into planning, it does not necessarily create just outcomes. Equity, on the other hand, aims to allocate resources based on the required needs and conditions of each group. Justice takes the equity framework one step further by instilling it systematically such as integrating it within policies (Agyeman & Evans, 2003).

As the concept of EJ expands across the world, the framework has been increasingly included in global agendas towards more sustainable and just development goals, which set forth indicators to measure EJ. Internationally recognised documents from organizations like the United Nations (UN) Sustainable Development Goals (SDGs) set forth universal numerical indicators for individual countries and cities worldwide to strive to achieve (Kronenberg et al., 2020).

EJ offers a framework to understand the discrepancy between environmental goods for different social classes but can also offer alternatives to reduce inequalities (Koprowska, 2020). Scholars have divided the understanding of EJ into a few different parameters, which have been employed by researchers at the European level, such as distributive justice and spatial justice (Koprowska, 2020).

2.3.1 Distributive justice

A component of EJ, distributive justice narrows in on the fairness of allocation and access of environmental benefits for different socioeconomic groups (Das, 2022; Koprowska, 2020). Seeing accessibility to amenities and resources a basic right, it is natural to analyse the extent of justice using the distribution of those resources (Harvey 1973; Soja 2010; Mandelbaum, 2021). As seen in cities like Bucharest, conflicting desires for land use such as urban projects can directly impact the arrangement of UGS, which affects distributive justice of that resource in the city (Kronenberg et al., 2020).

Research has demonstrated that high levels of UGS in urban areas is associated with a greater quality of life, while also unravelling various levels of privilege and inequality among those UGS scattered throughout the city (Rutt & Gulsrud, 2016). Studies on EJ from the USA and

other countries have shown that the distribution of UGS is more favourable within wealthier residential areas (Rutt & Gulsrud, 2016). An imbalance of UGS development corresponding to SES has been observed in cities in the Global South (Das, 2022). In South Africa, there was an inverse correlation observed amongst low-income areas and quantity of UGS (Jennings et al., 2012).

According to Kaur et al. (2021) there is an unequal distribution of UGS across various social groups and a need to advocate for the integration of EJ principles in UGS planning (Das, 2022). The uneven dispersion of UGS can determine the marginalisation of certain communities, as it seems to be a pre-condition to distributive injustice. Studies have reported that UGS exposure is dependent on SES, generally highlighting that areas with a higher SES have greater political influence to preserve their UGS, whereas lower SES communities are less able to persuade decisionmakers for the same right (Luo et al., 2020).

UGS research has long targeted increased societal prosperity; yet as numerous European countries are dealing with widening income disparities, its scope might require a new focus into equity and distribution of UGS, specifically among decision makers (Rutt & Gulsrud, 2016).

2.3.2 Spatial justice

A closely related concept, spatial justice incorporates a geographical element to the theory of justice, and various scholars have examined social justice topics using a spatial framework (Harvey, 1973; Soja, 2010). Harvey (1973) asserts that justice and injustice are part of life in the city and can also therefore be attributed a geography (Soja, 2010).

Spaces around the city are experiencing both gentrification and a steady decline in response to the process of spatial restructuring, leading to varied results for different neighbourhoods (Mandelbaum, 2021). Using tools such as Geographic Information Systems (GIS), economic, sociodemographic, environmental and health data can be mapped to reveal and visualise positive and negative spatial patterns, aiding in the pursuit of just planning across cities (Kato-Huerta et al., 2022). Evaluating spatial distribution characteristics in relation to UGS availability can contribute to promoting a fair and effective arrangement of UGS, thereby increasing the quality of life for urban residents (Xu & Wang, 2022). For example, urban dwellers are most likely to journey to a park within 500m of their homes, approximately seven-

minutes walking distance (Boyle, 1983; Xie & Lu, 2020). A distance longer than threshold this could be quantified as injustice.

No matter the quantification, injustice has been observed within the spatial assessment of UGS (Landry & Chakraborty, 2009; Wu et al., 2020). A multitude of studies have explored the socioeconomic factors' impact on UGS access, notably highlighting the distinguishable difference in accessibility for different population groups, thereby declaring UGS accessibility as an EJ indicator (Wu et al., 2020). Research has adopted the spatial dimension of EJ to optimise planning, management and governance surrounding UGS (Kabisch & Haase, 2014; Korpilo et al, 2022). To measure such patterns, popular methods include mapping distances from residences to UGS as well as accessibility of UGS among various marginalised communities (Kabisch & Haase, 2014; Korpilo et al., 2022).

Environmental policies can affect socioeconomic groups differently, leaving those inhabitants feeling deprived of an environmental benefit (Koprowska, 2020). Justice can then be conceptualised as evaluating the level of equity a policy fosters for urban inhabitants (Mandelbaum, 2021). Even policies that are intentionally objectively good for all residents, are either disproportionately implemented, or may have long-term repercussions for some of the population, exacerbating social inequalities (Koprowska, 2020). A level of concern has been raised that UGS public policies lead to environmental discrimination, specifically against low-income residents among Western countries (Lees et al., 2008; Ley and Dobson, 2008; Wu et al., 2020).

EJ requires contextualisation to expressly answer to specific planning outcomes (Kato-Huerta et al., 2022). To have municipal policies which promote EJ within public areas, there must be an acknowledgment of the local situation, considering the preexisting conditions of UGS and the size and characteristics of the population it serves (Mandelbaum, 2021).

2.3.4 Quantifying Environmental Justice

To encourage decision-makers to use data insights from research, it is essential to present the information through comprehensible analytics. Using numerical indicators that people can remember and know to attain, can be more effective in policy evaluation (Moldan et al, 1997). However, indicators specifying minimum distances or levels of UGS per capita often only exist on paper but are not reflected in real life (Kronenberg et al., 2020).

With increasing pressure for cities to reach quantifiable targets, new UGS development will incur different spatial and distributional contexts to analyse (Rutt & Gulrud, 2016). Therefore, developing studies which focus on the evolution of suitable indicators to measure UGS availability are of utmost importance to EJ literature (Van Herzele & Wiedemann, 2003; Comber, Brunsdon & Green, 2008; Raymond et al., 2017; Koprowska et al., 2018; Koprowska, 2020).

UGS in the lens of EJ signifies that inhabitants should have equitable chances to access and benefit from UGS regardless of where they live, demographics or SES. However, as disparities in availability have been observed around the world, it is important to quantify this disparity to understand how conditions of equity can improve for the future (Xie & Lu, 2020). The process can be split into three operations: (i) determining accessibility, (ii) evaluate imbalances, (iii) identify groups with limited UGS accessibility (Xie & Lu, 2020). Similarly, the study of UGS equity has been categorised into three dimensions: quantity equity, spatial equity, and social equity (Huang et al., 2022).

Quantity equity simply refers to the amount of UGS per given population such as a per capita index. It describes the allocation of UGS accessible to everyone, indicated by a population-to-area ratio. Spatial equity encompasses spatial allocation of UGS and the efficiency of use of space. While Wolch et al. (2014) said there is not a general method to determine accessibility to UGS, the most frequently used are quantity and proximity of UGS (Xie & Lu, 2020).

Using economic and other social factors, social equity seeks to understand how such elements influence UGS equity. Frequently used indicators include spatial disparity and population disparity, which can be identified visually using GIS-based mapping (Xie & Lu, 2020). To illustrate disparities in quantity of UGS across various social groups or areas within the urban landscape, mapping factors such as SES could be informative (Huang et al., 2022). This can demonstrate exactly to what extent these minority groups are impacted by injustice (Koprowska, 2020).

Based on the spatial analysis, social groups most affected by the uneven accessibility are identified. Availability serves as the determinant of whether people have equal access to UGS, and it may be observed that inhabitants with a higher SES have better access compared to others, which can be interpreted as environmental injustice (Kronenberg et al., 2020). In pinpointing those impacted by injustice, these existing gaps can demonstrate how local

planning and policies have failed to align with bases of EJ. To mitigate the perpetuation of unequal distribution of the UGS resource, greater focus is needed on reaching residents who are currently underserved by policy goals, as well as realigning strategies to adhere more closely to EJ principles (Kato-Huerta et al., 2022).

2.2 Conceptual Framework

The following conceptual framework outlines the examination of a relationship between UGS proximity and allocation per capita (dependent variables) and SES and PD (independent variables) within the framework of EJ.

The independent variables are both values per arrondissement to create a comparative analysis. The measures of the dependent variables are based on the benchmark values outlined in “Plan Climat” (2023) which are:

Indicator 1: Proximity – every inhabitant to be within 300m of the nearest UGS

Indicator 2: Allocation – every inhabitant to be allocated a minimum of 10m² of UGS

The policy goals used in this research aim to be achieved in the short-term, meaning it is relevant to measure their progress.

This research investigates the relationship between PD, SES and UGS proximity and allocation given the numerical baseline from the indicators set in the Parisian climate policy. This relationship is examined to determine whether different socioeconomic and PD conditions have an effect on levels of UGS allocation and proximity. The levels of the dependent variables are assessed to determine to what extent the policy aims are reflected in the distribution of UGS among inhabitants in Paris and how this varies among arrondissements given the levels of the independent variables. The extent of the policy indicators achieved determines if the policy is advancing to reach its goals and whether there is an influence of the independent variables in different arrondissements. The variables are assessed using the lens of EJ.

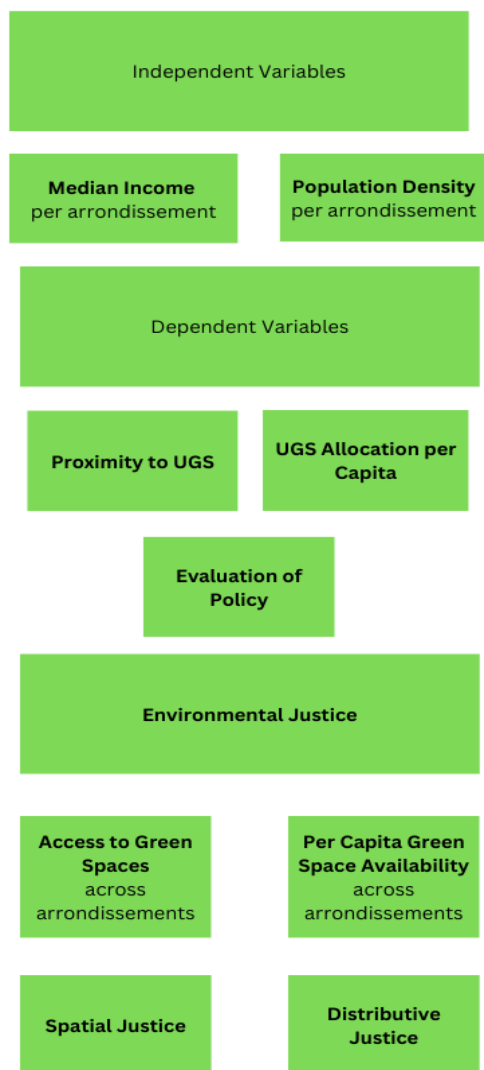


Figure 1: Conceptual framework. Source: Author.

3. Research Design, Methodology

3.1 Research Design

This research employs a combination of a secondary data strategy and a comparative case study analysis to evaluate the progress of Paris’ climate policy “Plan Climat” (2023).

Secondary data strategy:

- Using data from municipal sources (Paris Data, Data.gouv.fr) and national census sources (Insee). Utilizing data directly sourced from governmental sites that would likely be used by policy makers and evaluators ensures precise results.

- Collecting statistical, tabular and spatial data to evaluate quantitative and qualitative outputs in the context of the study area.
- Utilizes a deductive approach to determine if the existing data matches the expected outcomes based on the policy benchmarks as outlined in “Plan Climat” (2023):
 - Indicator 1: Proximity – every inhabitant to be within 300m of the nearest Urban Green Space (UGS)
 - Indicator 2: Allocation – every inhabitant to be allocated a minimum of 10m² of UGS

Comparative case study model:

- Utilizes two separate independent variables to create bivariate analyses to identify trends and disparities among different arrondissements.
- In cross-examining how progress looks between arrondissements with varying attributes can strengthen findings and inform policymakers about the status of the climate policy within the framework of Environmental Justice (EJ).

This research design will attempt to answer the following research question and sub questions:

Main Question: How equitable is the distribution of UGS among inhabitants of Paris?

Sub Questions:

- To what extent are benchmarks outlined in “Plan Climat” reflected in the distribution of UGS in Paris? And how does this vary among arrondissements?
- How does UGS distribution differ between arrondissements given the varying levels of population density and socioeconomic status?

3.2 Research Strategy

The strategies employed in this research are a combination of quantitative and qualitative methods to provide a comprehensive analysis of UGS distribution in the study area.

Quantitative strategy:

- Statistical analysis using numerical values from census data (Insee) and municipal portals (Paris Data, Data.gouv.fr) to evaluate UGS distribution quantitatively.

- Socio-spatial analysis using spatial data in Geographic Information System (GIS) to visually represent the distribution of UGS across the study area and between arrondissements.

Qualitative strategy:

- Analysis of literature and official policy documents to understand the context and numerical objectives of the climate policy.
- Socio-spatial analysis in GIS to interpret the distribution of UGS using demographic and socio-demographic variables to demonstrate the implications on different arrondissements.

The operationalization table in section 3.6 defines key variables and concepts in this research and traces how variables are being measured and with which units. It provides a guide to contextualise the theory as methodology within this study. In providing the framework, it reduces bias and gives the research more reliability.

3.3 Sampling

Given the nature of the indicators involved, the entire city of Paris is considered as the study area. The designated population is the number of inhabitants within the administrative city limits of the city. This allows for a comprehensive approach to ensure all potential UGS and their availability and allocation for the urban population. Therefore, no sampling was needed for the study to evaluate overall policy impact on the entirety of the urban area.

- The entire population within the administrative city limit of Paris as represented statistically and spatially from the data. Total population: 2,228,999 (HUGSI, 2021a).
- For comparative analysis, the population size from each arrondissement is considered.

3.4 Data Collection Methods

- Insee: population, population density (PD), median yearly revenue
- Paris Data, Data.gouv.fr: UGS spatial layout, UGS surface area coverage.

Statistical and demographic data is collected directly from the national census, Insee (2023). Data on Urban Green Space (UGS) in both geospatial and tabular formats come from Parisian open data sources Paris Data (2024) and Data.gouv.fr (2024).

For the purpose of this research, all of the data categorised by the city of Paris as a UGS is considered within the policy “Plan Climat” (2023). The data on UGS in Paris as classified by Data.gouv.fr (2024), categorised UGS as encompassing: open walks, decorative gardens, decorations on public roads, private gardens, sports establishments, cemeteries, educational institutions, childcare establishments, peripheral, woods, ephemeral, horticultural centre, green walls.

The research data gathered on UGS surface area coverage, taken directly from the municipal portal Paris Data (2024) and was described as “actual total surface area coverage” rather than “calculated area” for a more accurate calculation of UGS per inhabitant.

The approach uses a “mixed method” inclusive of both qualitative and quantitative aspects. The qualitative features include literature and official policy documents. The numerical values extracted from those documents served as a basis for the quantitative measurements. The quantitative analysis dealt with secondary data sources such as statistics from census data and spatial data from municipality portals.

3.5 Analysis

3.5.1 Statistical analysis:

Statistical data was primarily used to gather numerical ratios to then be implemented spatially. Census data on the inhabitants in Paris was sourced from Insee to utilize data on population per arrondissement. Using the municipality portal Paris Data (2024), UGS coverage per arrondissement is gathered. With these values, UGS per arrondissement could be calculated. From these values, the amount of UGS per inhabitant per arrondissement in m² was produced using the calculation below.

Equation 1: Area UGS per inhabitant.

$$G_i = \frac{A_i}{P_i}$$

G_i is the UGS allocation per person in the i -th arrondissement

A_i is the total UGS area in the i -th arrondissement

P_i is the population of the i -th arrondissement

3.5.2 Socio-spatial analysis:

The spatial analysis takes from the statistics calculated in the previous section and employs secondary spatial data directly from the municipality to be used in GIS. From Paris Data (2024), spatial datasets in Shapefile format were taken to be analysed in QGIS. These included UGS distribution in the entirety of Paris, and the borders inclusive of area of arrondissements.

To analyse the first indicator (every Parisian within 300m walking distance to a UGS) the buffer method is used. This method is common to measure accessibility (Huang et al, 2022) by calculating the amount of space within or outside of the covered area (Wu et al., 2020). The buffer area spans a radius of 300m around every UGS in Paris which are then dissolved to form a singular continuous shape. This portrays all the zones covered by the buffers that reach the policy benchmarks. This strategy also helps to identify the gaps not covered by buffers as zones not within 300m of a UGS, and not reaching the policy indicator.

The data not available in a Shapefile format, is collected as tabular or statistical data in excel format and converted into comma-separated values (CSV) to upload spatially in QGIS. This method is used for the following data sets:

- PD per arrondissement
- Median yearly revenue per inhabitant per arrondissement
- UGS coverage per arrondissement
- UGS coverage per inhabitant per arrondissement

Once uploaded in QGIS, the CSV file joins with the spatial layers to reflect the socioeconomic, demographic and statistical data in the program.

3.6 Operationalization: variables, indicators

Table 1: Operationalization of key concepts and variables. Source: Author.

Concept/Variable	Definition	Indicators / Units	Source of data
UGS Distribution	Encompassing overall spatial distribution of UGS in the entire study area	Qualitative observation Quantitative assessment using numerical benchmarks	- Municipal databases Paris Data, Data.gouv.fr

UGS Coverage	UGS area per arrondissement	Area in m ²	- Municipal databases Paris Data, Data.gouv.fr
Allocation of UGS	Amount of area of UGS per inhabitant per arrondissement	Ratio of area in m ² to inhabitant	- Municipal database Paris Data - Census data Insee
Proximity to UGS	Areas included in the dissolved buffer area are within a 300m radius to the nearest UGS	Inside 300m radius of buffers surrounding UGS	- Municipal databases Paris Data, Data.gouv.fr - Buffer tool on QGIS
Population Density	Number of inhabitants per km ² per arrondissement	Ratio of inhabitants per km ²	- Census data Insee
SES	Median yearly revenue per arrondissement	Median yearly revenue per arrondissement in euros	- Census data Insee

3.7 Expected Challenges and Limitations

This research can encounter some limitations, especially due to the nature of using secondary data which may not be comprehensive.

The most up-to-date available census data collected from Insee is from years 2020 and 2021 and may not be able to reflect the current state of the population size, PD or median yearly revenue. Given the nature of generalised statistics, the outputs are also a generalisation that cannot accurately represent localised variations and individual experiences.

While assessing proximity to UGS given the buffer areas, it may be difficult to understand how many people are actually represented within the buffer areas, as some areas are more residential and others more commercial. This is why introducing the layer of PD is helpful to have a general understanding how many people live in the area but cannot identify specific clusters of inhabitants within the arrondissements. There could be an oversimplification of the bivariate relationships between socioeconomic and demographic variables and UGS distribution as these relationships may be more complex.

This research encompasses all types of UGS identified by Paris Data, regardless of size, quality, accessibility or functionality, meaning that while inhabitants might be located within proximity to UGS, they may not be sufficient to accommodate their needs.

Finally, this research focuses on a case study of Paris meaning it may be difficult to apply the findings of this research to other cities or regions with different urban dynamics.

3.8 Research Area

Paris is a unique case study as the most densely populated city in Europe (World Population Review, 2024) - its urban area spans 102km² with an urban population of 2,228,999 giving it a PD of 21,901 inhabitants per km² (HUGSI, 2021a). This signifies that Paris critically lacks space for additional UGS. Not only is it a high-density area for inhabitants, but Paris welcomes some 40 million tourists to the city every year (Statista Research Department, 2024), making the necessity to foster a climate adaptive environment even more dire to ensure its city dwellers are safe and healthy.

As historically densely populated city, Paris must now tackle the task of restoring UGS to adapt to the changing climate. The city's urban development patterns present unique challenges and opportunities for integrating UGS. Like many other cities, Paris has made drastic spatial transformations based on contemporary priorities. When the automobile became the centre of planning designs, human and nature-centric areas were removed to make space for cars. As it becomes more evident from extreme weather patterns that the current built environment is not suitable for current needs, we enter a new paradigm shift that brings environmental needs to the forefront. The city of Paris now aims to take the space back from the cars to be restored for humans and nature.

Paris plans to be among the greenest cities in Europe by 2030 to address challenges posed by climate change. To achieve this aim, Paris' new climate policy, "Plan Climat" aims to make the city "faster, more local and more just" through greening initiatives such as tree planting, a focus

on the local economy and the addition of UGS (Ville de Paris, 2023b). While drafting strategic plans to incorporate more UGS represents progress, the extent to which the city is progressing towards achieving these aims remains uncertain.



Image 1: Overall distribution of UGS in Paris. (Ville de Paris, 2023b).

4. Results, Analysis and Discussion

The following section presents the existing policy context in Paris that led to its current climate policy, “Plan Climat” (2023) and assesses its indicators using socio-spatial dynamics.

4.1 Policy Context

The Paris Agreement established in 2015 put pressure on cities to initiate a more sustainable trajectory in the face of climate change. Since its adoption, the new global paradigm, specifically in Europe, recognises the need for policies that integrate nature in the city. To cope with increasing climate pressures in the face of urbanization and densification, cities have begun to formulate greening plans. Recent EU environmental policy regarding ‘nature-based solutions’ aims to introduce precise environmental policies which are to be used as ‘best practices.’ Research on this matter within Europe has the possibility to progress Environmental Justice (EJ) conceptually and in practice (Rutt & Gulsrud, 2016).

4.1.1 Urban green spaces: a brief for action (2017)

The World Health Organization (WHO) published this urban greening brief based on conclusions from experts on the link between Urban Green Space (UGS) and health. It aims to provide a translated version of key findings from research into implementable goals for policymakers in urban areas. The mentioned objectives have become the baseline for numerical indicators set in strategic documents in cities including Paris. WHO emphasises the need of bringing UGS to where the people are, thereby increasing opportunities for contact with nature in daily life. This internationally recognised policy outlines specific recommendations for municipalities to follow to increase overall UGS for healthier inhabitants of urban areas.

This policy gives the initial introduction of numerical indicators that reappear in the sequential policy documents in this section and that are used for this research. WHO (2017) suggests that for a healthy population, each inhabitant should be allocated at least 10m² of UGS. Image 2 presents the following recommendation for proximity to UGS being within 300m of urban residents.

 Put the green space **close to people**.

- Establish street greenery, urban gardens and green trails in close vicinity to urban residents, and use public open spaces for greenery.
- As a rule of thumb, urban residents should be able to access public green spaces of at least 0.5–1 hectare within 300 metres' linear distance (around 5 minutes' walk) of their homes.
- Ensure access to urban green space of sufficient quality for all population groups and users (universal access).
- Use greening opportunities in other sectors and projects (greening of schools, business areas, shopping areas, housing estates and similar) and promote private green areas.

Image 2: Policy indicators for greening initiatives as outlined by the World Health Organization. (WHO, 2017).

4.1.2 Plan Vert de l'Île-de-France (2017)

This greening policy sought to promote just urban greening initiatives for all inhabitants in Paris and its surrounding region. The same indicators outlined by the WHO are reaffirmed in this document, as the first introduction of these specific greening measurements to be implemented in the region.

The plan refers to the significance of internationally recognised indicators to underline the necessity of allocating 10m² of UGS per person. According to the “Plan Vert” (2017), however, the allocation ratio is not useful if UGS are not accessible, within a 10-to-15-minute walk of one's home. The mention of both measures in this policy highlights the interdependence of the indicators, as achieving both is essential for an effective outcome.

4.1.3 Plan Climat (2018)

The focal point of this climate plan is to make Paris carbon-neutral by 2050 using various strategies and actions to reduce greenhouse gas emissions and adapt to climate change.

The “Plan Climat,” adopted in 2018 by the City of Paris strongly recognises the imminent threat of heat waves in the city: “as a very dense city with many concrete and asphalt surfaces, Paris is particularly subject to the urban heat island (UHI) effect. The city can become a real furnace during heat waves, prompting residents and visitors to seek out cooler areas” (City of Paris, 2018, p. 61)

This policy recognises the need to be within walking distance of a “cool island,” inclusive of UGS, during heat wave instances, to give Parisians the ability to cool down and stay healthy through extreme heat events. The goal set in this 2018 document mentions every Parisian should be within a 7-minute walk of a cool island by 2020.

4.1.4 Plan Local d’Urbanisme Bioclimatique (PLUB) (2023)

The “Local Urbanism Plan” (PLU) is an overarching document that governs the right to land in Paris. It is a strategic document that outlines urban development for the following 15 years, while also regulating the evolution of plots through construction, development and demolition permits and declarations.

A subsection of the “PLU” is dedicated to the “Local Bioclimatic Urbanism Plan” (PLUB), which sets out measures and indicators specifically for urban greening initiatives in Paris with regards to climate adaptation. The “PLUB” is a city project that essentially informs residents on public and private urban planning decisions. It seeks to guide the sustainable urban development of Paris by balancing city growth with environmental considerations in mind, while also maintaining cohesive urban expansion (Ville de Paris, 2023a).

This plan was adopted in June of 2023 and continues to use indicators set by the WHO from their greening brief document in 2017. Table 2 taken from the “PLUB” explicitly mentions the UGS allocation numerical objective at 10m² per inhabitant and demonstrating an accessibility (proximity) indicator. The incorporation of UGS indicators in this policy document suggests that these measures are being considered in urban planning, ensuring that the objectives are being factored into Paris’ development plans.

Table 2: Objectives, variables and indicators outlined in “PLUB.” (Ville de Paris, 2023a). (Translated by author).

Theme	Objective	Measured variable	Indicator	Data source
Improving provision of facilities	Aim for 10 m ² of UGS per inhabitant	Area of UGS open to the public per inhabitant, including in the Parisian woods		Data DEVE
		Accessibility to UGS indicator		APUR, City of Paris

4.1.5 Plan Climat (2023)

This research primarily uses Paris' newest climate policy, "Plan Climat" as the benchmark to monitor and evaluate the progression of its indicators as reflected spatially in Paris.

The strategies outlined in this document are aimed at combating climate change and increasing environmental sustainability. Specific measures related to UGS mention generally expanding the amount of UGS and ensuring all residents have access to natural areas, to improve their quality of life and overall wellbeing while living in an urban environment.

The policy strives to operate within the framework of its slogan, aspiring to be "faster, more local, and more just." The aspect of justice mentions how not all inhabitants feel the effects of climate change in the same way. In particular, the plan emphasises how people living in "working-class" arrondissements are the most vulnerable to the effects of heat waves, pollution and energy poverty. Moreso, it highlights how climate change can even amplify pre-existing inequalities in the city. The plan hopes to reduce poverty to allow all residents to have an increased quality of life in the face of climate change.

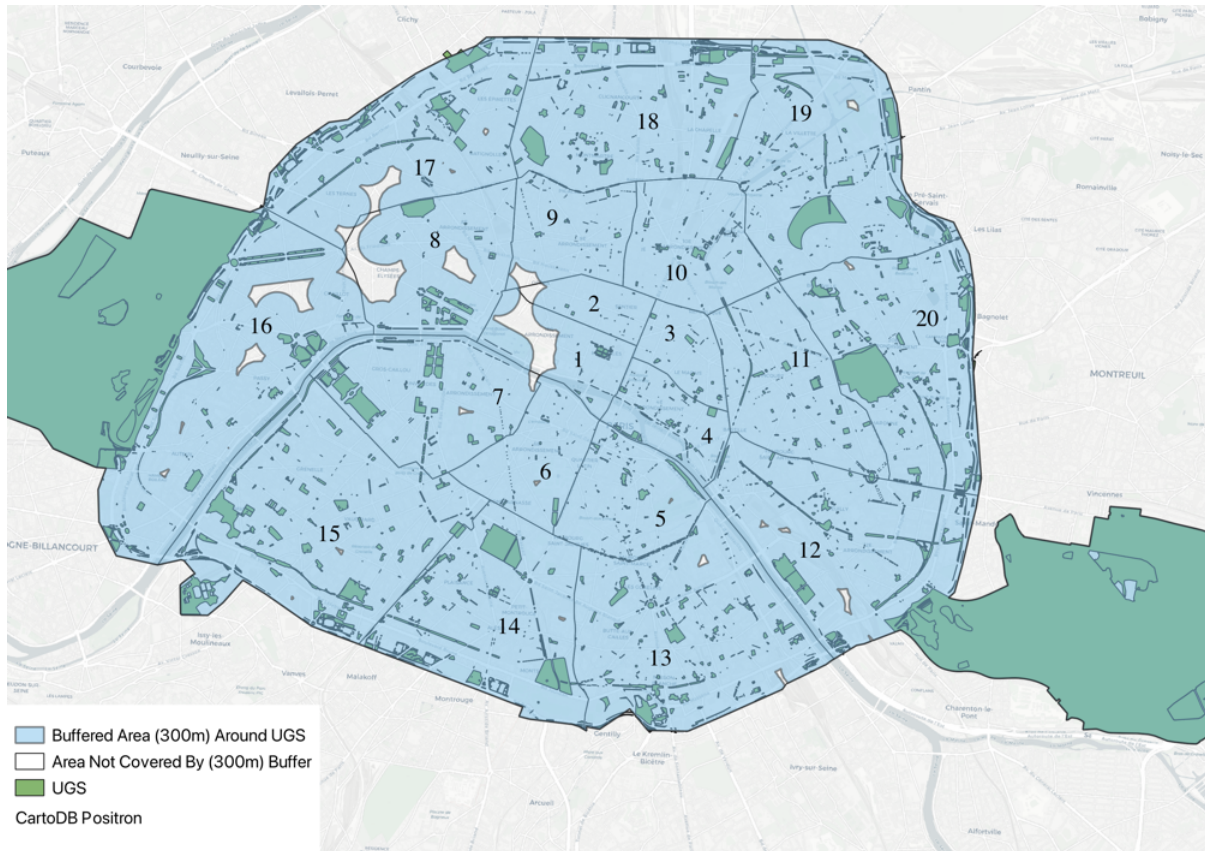
The "Plan Climat" (2023) mentions that 100% of Parisians should be within a 7-minute walking distance of a "cool island," including UGS, by 2030. Moreso, the 10m² per capita allocation of UGS is set to be met by 2040 (Ville de Paris, 2023b). As the newest edition of their climate plan, the UGS indicators for Paris have remained the same since their introduction in 2017.

4.2 Indicators

This next section uses the indicators taken from "Plan Climat" as a basis for the statistical and socio-spatial analyses. WHO indicators are adopted by the preceding Parisian climate policies, and act as the numerical benchmarks for this research. The proximity measurement of 300m is used in the analysis instead of minutes of walking distance, as in line with WHO's recommendations.

4.2.1 Indicator 1: Proximity - every inhabitant to be within 300m of the nearest UGS

4.2.1.1 Socio-spatial analysis



Map 1: UGS distribution surrounded by buffers. Source: Author based on Paris Data using QGIS.

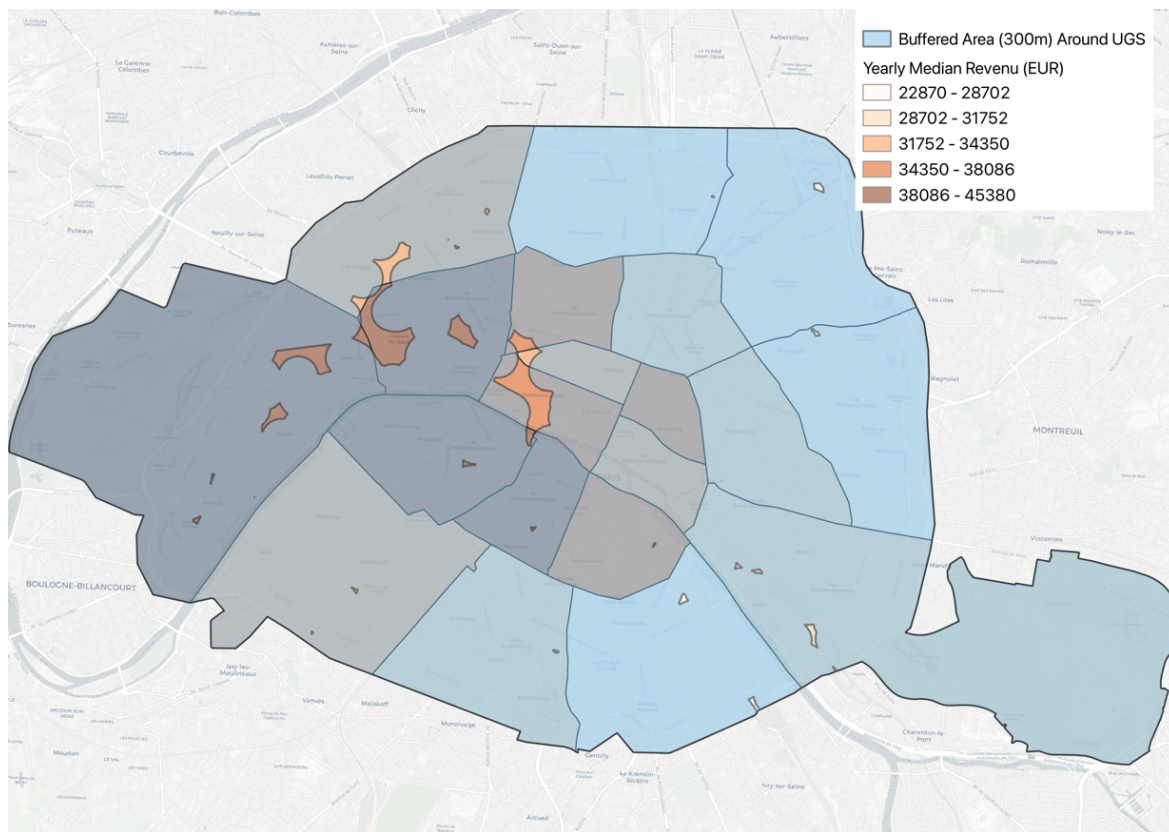
Map 1 demonstrates the buffer areas do not fully cover the Paris metropolitan region at 100%. The buffer area covers 87% of the city's total area. Meaning 87% of the city is within the recommended UGS proximity, within 300m of most inhabitants. From this analysis, it appears as though most Parisians are within the minimum proximity to UGS.

“Plan Climat” appears to be in a good position to attain its objective of ensuring 100% of inhabitants are within proximity by 2030. Indicator 1 appears to be evenly spread across the city, apart from a few clustered areas in the west of the city.

Where we see the largest gaps are in the 1st and 8th arrondissements, therefore the proximity to UGS is further than 300m for some residents in those districts. This means that these areas are the least covered by Indicator 1.

Without an understanding of which demographic and socioeconomic status (SES) inhabit the gaps, it appears as though the policy is implemented quite equally across the urban area.

However, equality does not mean equity, and being within proximity UGS does not suggest the policy is just.



Map 2: UGS buffers overlaid onto median yearly revenue. Source: Author based on Insee using QGIS.

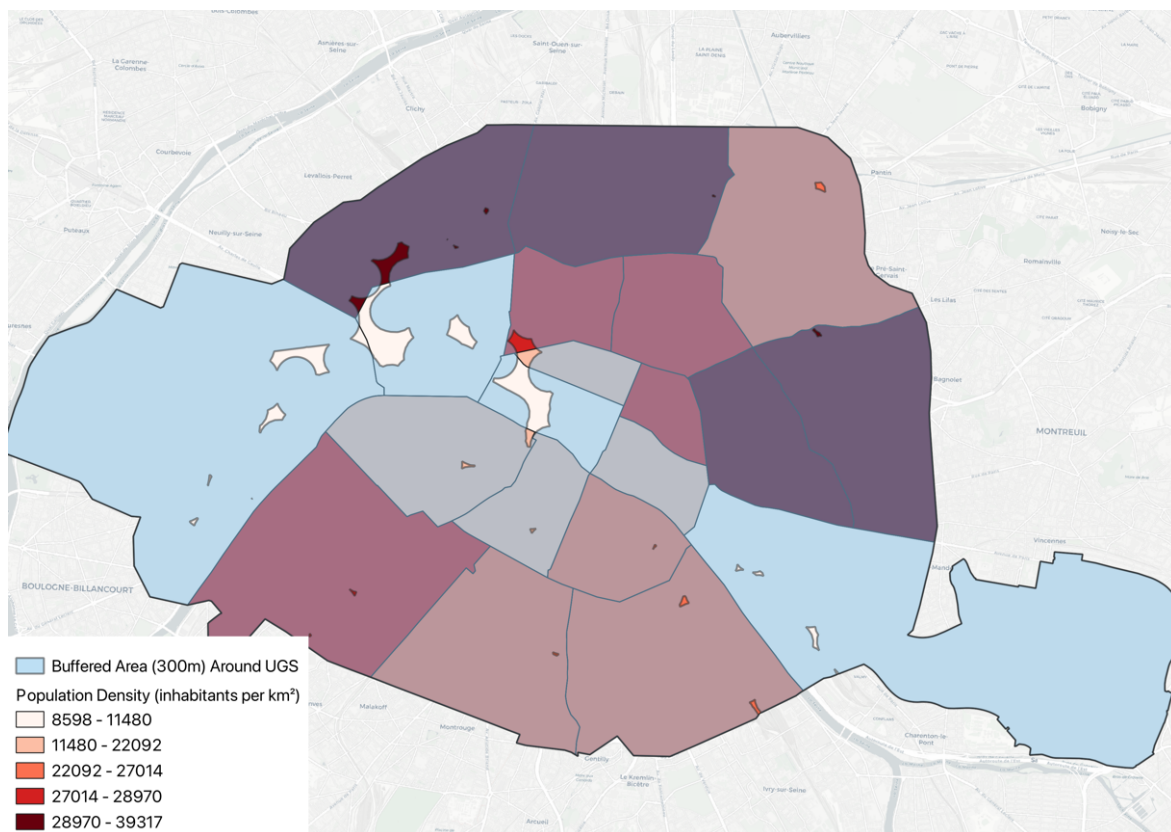
To grasp whether there is an influence of SES on Indicator 1, yearly median revenue is introduced in the context of the buffer zones. According to EJ literature, all inhabitants should have equal access to UGS regardless of demographic background, residential location and SES (Xie & Lu, 2020). In most cases of environmental injustice, it's been shown from countless studies that low-income residents have less access to UGS (Landry & Chakraborty, 2009; Jennings et al., 2012; Wu et al., 2020).

Interestingly, the results for this bivariate analysis demonstrate that the largest gaps in the buffer area are in higher SES arrondissements. The bigger disparities as identified in Map 2 are seen in arrondissements 1 and 8, which are in the top two SES brackets. This means that areas with the least amount of minimum proximity to UGS are found in higher SES arrondissements.

Lower SES arrondissements with a lower median income are mostly covered by the buffers, meaning UGS are within proximity for almost all inhabitants in those areas.

There has been some concern over public policies producing environmental discrimination against those of lower income statuses, while benefiting those with a high income, demonstrating a disparity in UGS access based on income level (Wu et al., 2020). In analysing Indicator 1 in the context of SES, there is the opposite result that “Plan Climat” appears to be mostly benefiting areas of lower SES.

Within the EJ framework that states that all inhabitants should be given the same access regardless of sociodemographic background, the results indicate there is a level of environmental injustice in UGS proximity as residents with a higher SES do not have the same short proximity to UGS as areas with lower SES. However, a grasp of the demographics in those arrondissements is necessary to extrapolate the characteristics of the arrondissements 1 and 8 to discern how many inhabitants are being left out of Indicator 1.



Map 3: UGS buffers overlaid onto population density. Source: Author based on Insee using QGIS.

For a contextualisation of the areas that are lacking the most in the recommended proximity to UGS, it is useful to look at how it relates to the number of inhabitants per area of arrondissement. Based on the overlay of the buffer area on top of population density (PD), it is notable that the areas least covered by the buffers are also the least densely populated. This

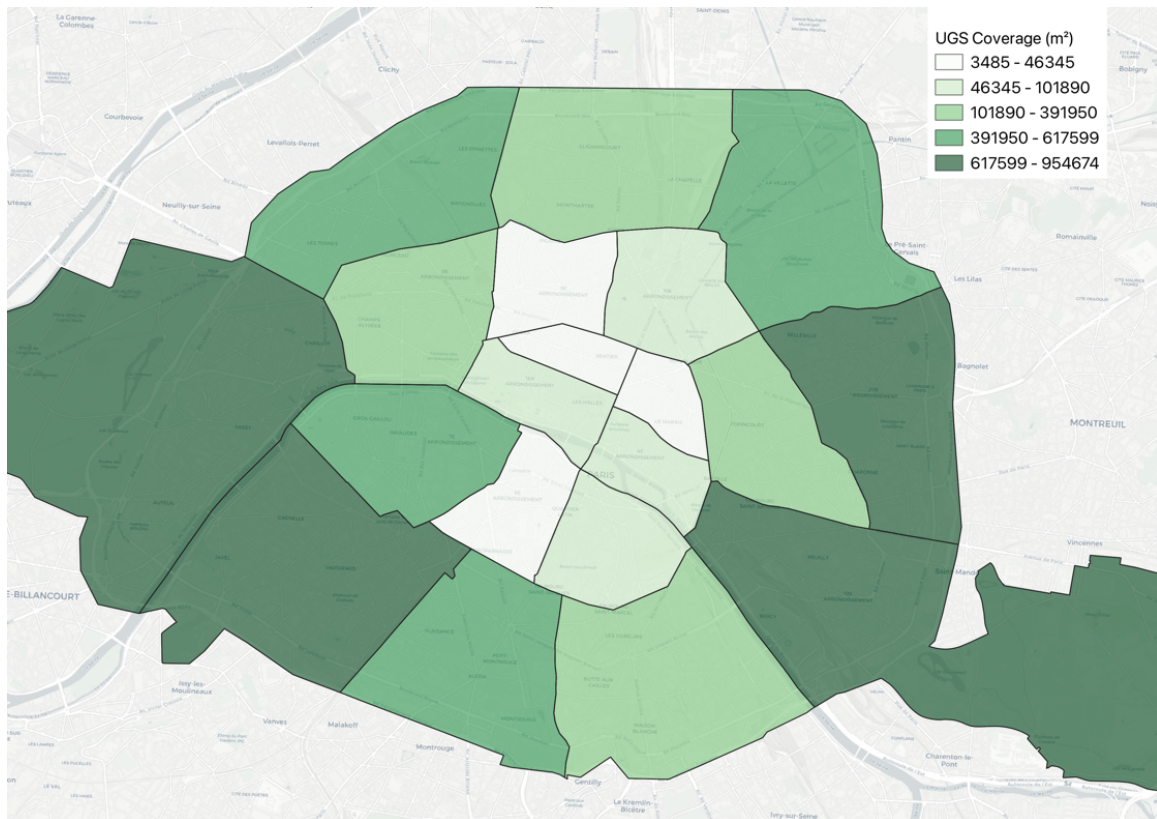
means that although there is less proximity UGS for these arrondissements, they have the least number of residents per area, thereby impacting less people. More densely populated areas are mostly covered by the 300m radius, besides an outlier, a small area within the 17th arrondissement.

According to past studies on EJ, the disadvantaged communities such as those with a lower SES, are in more densely populated areas. It has been shown that these are the communities which benefit the least from UGS (Chakraborty et al., 2020; Kato-Huerta et al., 2022). While lower SES inhabitants demonstrate residing in more densely populated areas of the city, they are not benefitting the least when looking at minimum proximity to UGS.

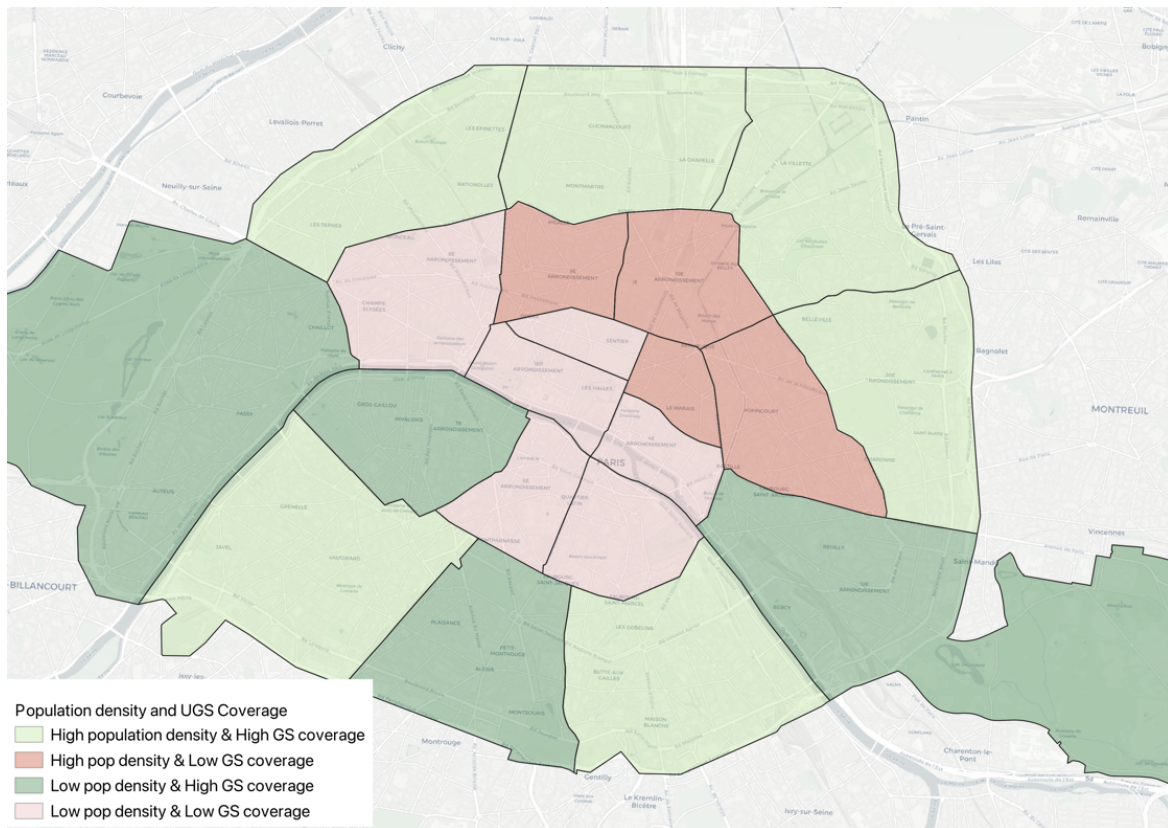
Indicator 1, while not reaching 100% of inhabitants in the city, the areas that are benefitting the least from short UGS proximity are also the least densely populated arrondissements. “Plan Climat” in this sense is progressing by reaching an optimal amount of people through Indicator 1 being almost fully met in the highest density arrondissements, where a lesser proximity to UGS is more crucial.

According to the analysis of Indicator 1, the strategy is on track to meet its objective. The areas with the most people and a lower SES, who are most in need of UGS access, are most able to access it given proximity. Arrondissements that have a greater proximity to UGS are inhabitants with a higher SES but living in the least populated zones.

The results from Indicator 1 prompt further investigation into the relationship between UGS coverage and PD.



Map 4: UGS area coverage per arrondissement in Paris. Source: Author based on Paris Data using QGIS.



Map 5: Bivariate UGS coverage and PD. Source: Author based on Paris Data & Insee using QGIS.

The overall coverage of UGS in terms of area is reflected spatially in Map 4, while being overlaid with PD in Map 5. When analysing UGS coverage while factoring in the demographic of PD, it is observable which areas are well positioned for UGS coverage versus which those that are disadvantaged. In Map 5, the darker green areas are the best positioned for UGS coverage relative to their PD. The worst-off arrondissements are those in darker red which have the highest PD and lowest UGS area, found in arrondissements 3, 9, 10 and 11.

This bivariate relationship, coordinating UGS supply with demand - given PD, can often be affected given the state of UGS availability. Meaning that, often when UGS are present, it can increase the attractiveness and development of a neighbourhood, thereby surging living costs. This pushes out those with lower incomes, and leaves space only for those with a higher SES. Inhabitants with a lower SES then cluster together to the spaces unaffected by this sort of market-oriented behaviour, leading them to live in more densely populated areas, with an uneven allocation of UGS to match the demand (Xie, 2023).

In general, the innermost arrondissements have the lowest amount of UGS coverage given PD. Often, the majority of UGS planning is done in newer, more spacious areas of the city, which

creates a situation where there is less UGS in older, denser parts of the city since there is less space (Mandelbaum, 2021). The centre of Paris, which is high-density, also happens to be the oldest part of the city.

4.2.2 Indicator 2: Allocation - every inhabitant to be allocated a minimum of 10m² of UGS

To grasp what the relationship between UGS coverage, demographics and SES mean for individuals, we use Indicator 2. This measure gives an indication into how much UGS people are allocated per their arrondissement. The comparison across arrondissements allows an understanding as to why some arrondissements have more or less UGS per person.

4.2.2.1 Statistical analysis

Given the total population and UGS average across the whole urban area, inhabitants have an average of 3.131m² of UGS allocated to them. Table 3 breaks allocation down based on arrondissement to grasp the variation in allocation.

Table 3: UGS per inhabitant per arrondissement. Source: Author based on Paris Data & Insee.

Arrondissement	UGS per inhabitant (m²)	Arrondissement	UGS per inhabitant (m²)
1	3.095	11	0.779
2	0.164	12	6.758
3	0.842	13	2.173
4	2.381	14	4.273
5	1.468	15	3.226
6	0.786	16	4.777
7	8.042	17	2.561
8	7.012	18	2.014
9	0.326	19	3.180
10	0.766	20	4.133

Table 3 demonstrates that the target of 10m² for Indicator 2 is achieved in 0% of Paris. The result from each arrondissement demonstrates that the allocated UGS is much lower than the minimum value desired. Without assessing other factors such as SES and PD, the minimum recommended allocation by the WHO, recognised within Parisian policy, is not represented anywhere in the city. Therefore, in terms of total UGS area, there is a need for more coverage everywhere in the city, to strive towards that objective of UGS area per person.

Since the target number is not attained anywhere in the city, the analysis continues as a relative comparison between arrondissements using variables of median yearly revenue and PD to visualise where UGS is more available for residents, and whether it is influenced by these variables.

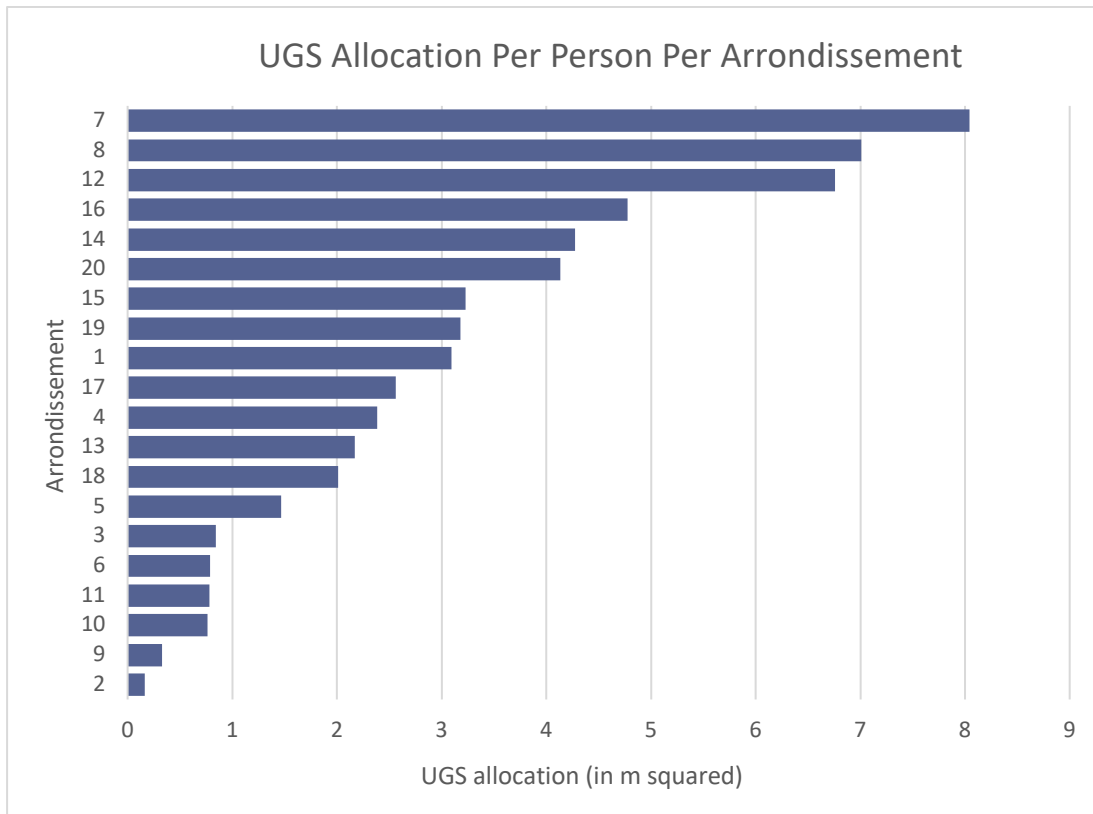
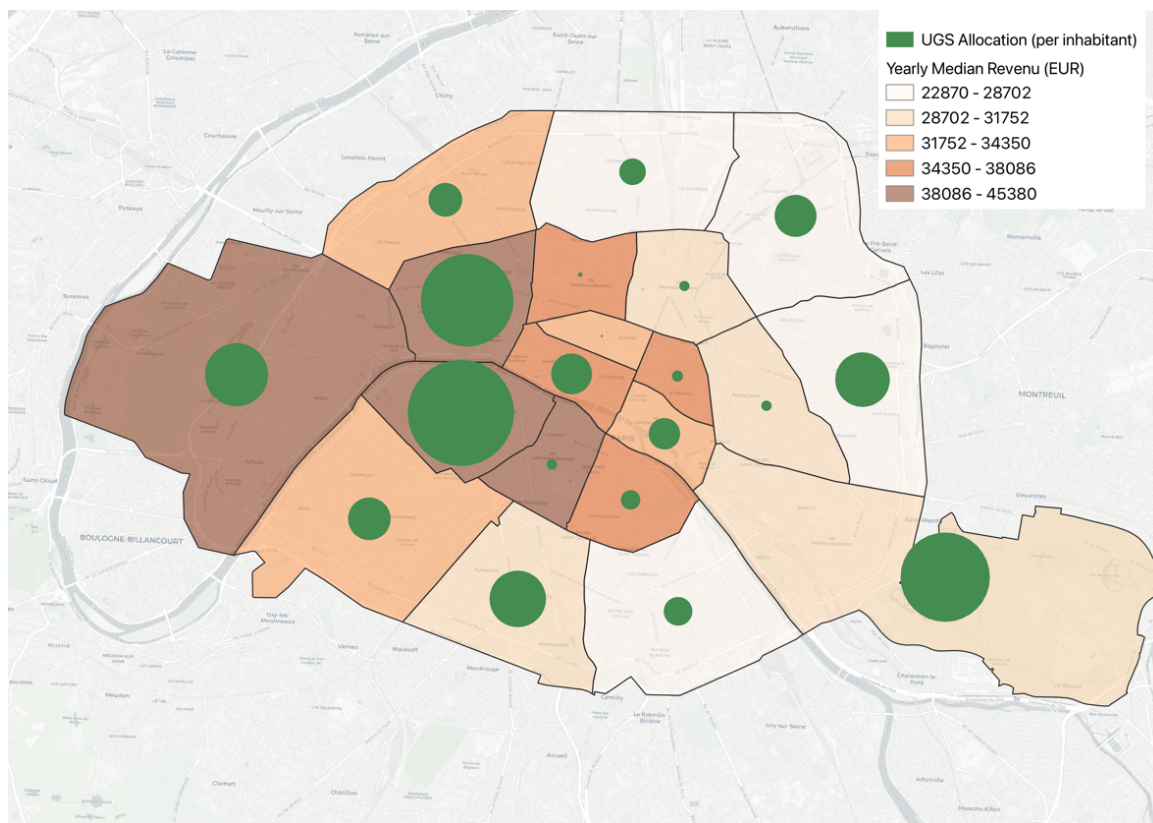


Chart 1: UGS per inhabitant per arrondissement. (Source: Author based on Paris Data & Insee.

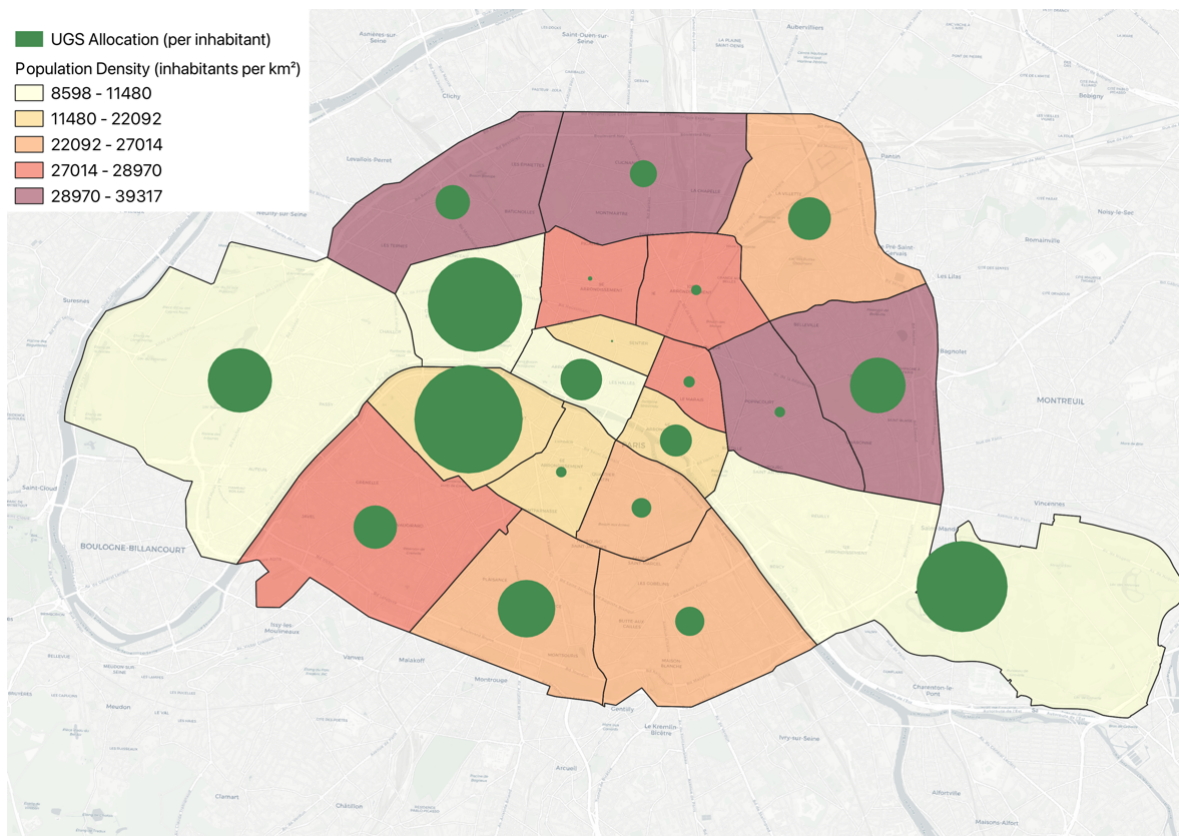
Chart 1 demonstrates how the UGS allocation per person varies drastically among the different arrondissements. More than half of the arrondissements do not even reach 3m² per person. Districts 7, 8, and 12 have almost double the amount of UGS per person as 14 and 20 and roughly triple of 17, 4 and 13. While district 7 has the highest amount of UGS per individual of 8.042 m², districts 3,6,11,10,9 and 2 have less than 1m² allocated per inhabitant.

4.3.2.2 Socio-spatial analysis



Map 6: UGS allocation per inhabitant per arrondissement overlaid onto median yearly revenue. Source: Author based on Paris Data & Insee using QGIS.

When overlaid with yearly median revenue, areas with a higher SES are not consistently correlated with the larger green circles that indicate a higher amount of UGS per individual. The high-income areas have a mix of bigger and smaller circles, as well as areas of lower median revenue do not have a consistent amount of UGS allocation per person. This suggests that SES does not have an influence on the amount of UGS per inhabitant.



Map 7: UGS allocation per inhabitant per arrondissement overlaid with PD. Source: Author based on Paris Data & Insee using QGIS.

The bivariate relationship between PD and UGS allocation per capita in Map 7 demonstrate an inverse relationship. As PD increases, UGS allocation shows a steady decline. Arrondissements with higher PD mostly demonstrate smaller circles, indicating less UGS allocated per resident, while lower density areas generally have larger circles. Lack of availability of UGS area prevents all ecosystem services, making it more dire than a lack of proximity, which only prevents some services (Kronenberg et al., 2020).

It is interesting to note the difference in results from Indicator 1 versus Indicator 2 in the same arrondissement. The results from Indicator 1 showed that arrondissement 8 ranks as one of the least covered by the minimum proximity measure. While when assessed using Indicator 2, it has the second highest UGS allocation per inhabitant according to Chart 1. This demonstrates that looking at a singular measurement is not sufficient to examine the progress of a city holistically, without using context. In this case, factoring in PD allows for a better indication of UGS distribution.

5. Conclusions, Limitations and Recommendations

5.1 Summary of Outcomes

While the presence of UGS alone is good for climate purposes such as cooling the air, water absorption and air quality, to ensure the sustainability of cities, their positive effects on mental health, stress reduction and thermal comfort is critical for city dwellers. This cannot be achieved if not all residents have the same access to or availability of UGS.

However, without context of the city where the indicators are being imposed on, it is difficult to understand what progress means in the city's context. Specifically, understanding that it is not just about the space where greening should occur, but it should align with the population which lives there. Because higher population density (PD) can be correlated with lower socioeconomic status (SES), it is important to focus on areas where more people live. Visualising PD and understanding how it relates to methods of greening is helpful to avoid environmental injustices.

In looking at the results from the lens of Environmental Justice (EJ), the gaps in UGS distribution are generally areas that are at the highest risk of reinforcing discrepancies and inequalities (Kato-Huerta et al., 2022). By identifying these areas spatially, policies can adapt and refocus initiatives in these areas, for more equitable reflection of policy objectives.

Although the first indicator is nearly reached in all parts of the city, the second indicator not being reached in any part of the city demonstrates the disparity in UGS acreage not being sufficient for such a densely populated city. While UGS are close to most residents, the size of those UGS may not be sufficient for the populations around them.

Based on the results from this research, the correlation between high density and low UGS allocation demonstrates the necessity of policies to prioritise areas with these characteristics to balance current disparities. In the context of this case study, it is important to look at the PD of the city, to understand how much and where UGS is needed to create a proportional ratio for its inhabitants.

This policy evaluation highlights the conflict between equality and justice in illustrating how equally distributing resources spatially differs from distributing them equitably based on population.

5.2 Answers to Research Questions

This research aimed to monitor the status of indicators outlined in Paris' climate policy "Plan Climat," while seeking to grasp whether its progress is equitably distributed to all inhabitants.

The questions to be answered by the results of this research are as follows:

Main Question: How equitable is the distribution of Urban Green Spaces (UGS) among inhabitants of Paris?

Sub Questions:

- To what extent are benchmarks outlined in "Plan Climat" reflected in the distribution of UGS in Paris? And how does this vary among arrondissements?
- How does UGS distribution differ between arrondissements given the varying levels of population density and socioeconomic status?

To answer the main research question, the distribution of UGS in Paris shows a degree of inequity, particularly when SES and PD are considered. Although the majority of Parisians live 300m or less from a UGS (Indicator 1), the distribution of UGS per resident (Indicator 2) is inadequate in all arrondissements, with notable variations. While arrondissements of higher SES have better distribution of UGS per resident, lower SES areas are typically closer to UGS. The mixed result indicates that while proximity to UGS is relatively equitable across inhabitants, the actual area of UGS available per person is not, especially in high-density and low SES areas.

The current distribution of UGS according to benchmarks from "Plan Climat" (2023) which include every Parisian being within 300m of a UGS (Indicator 1) and having at least 10m² per person (Indicator 2), are partially reflected. Despite being categorically well distributed according to policy Indicator 1, the proportion of available UGS per person is not sufficient in accordance with the benchmark set in Indicator 2. Given that 87% of Paris is within 300m or less from a UGS, the proximity goal is almost reached. However, the 1st and 8th arrondissements have significant gaps when compared to other areas. The allocation goal is attained in 0% of arrondissements, with a general allocation of 3.131m² of UGS per inhabitant. When looking into the difference in arrondissements, significant disparities are observed. While the 3rd, 6th, 11th, 10th, 9th, and 2nd arrondissements have less than 1m² per capita, the 7th, 8th and 12th arrondissements are reaching upwards of 6.758m² per person. The same arrondissements that score well for Indicator 1, are not the same ones that are close to reaching Indicator 2, namely

the 1st and 8th arrondissements. While being the worst off in terms of proximity, the 8th arrondissement has the second most UGS allocation per capita at 7.012m², while the 1st has a higher allocation than 11 other arrondissements at 3.095m².

UGS distribution varies considerably between arrondissements when SES and PD are taken into account. Arrondissements with a higher SES have less proximity coverage but higher UGS per resident. The 1st and 8th arrondissements, among the highest in SES, demonstrate the most significant gaps in UGS proximity. Lower SES areas have less UGS area per person but are better served in terms of proximity. Higher PD areas that fall into the two largest density brackets, have significantly lower UGS per capita. The 3rd, 9th, 10th and 11th arrondissements have less than 1m² per inhabitant, signifying an inverse relationship between PD and UGS allocation. The lowest density areas are those with the most UGS allocation, namely the 8th with 7.012m², the 12th with 6.758m², the 7th with 8.042m² and the 16th with 4.777m². These arrondissements also happen to be in the highest SES category, with the exception of the 12th arrondissement that is in the second-lowest SES bracket.

5.2.1 Main findings

- Proximity: 87% of Paris areas are within 300m of a UGS. The largest gaps are found in higher SES arrondissements (1st and 8th).
- Allocation: No arrondissement achieves the 10m² per inhabitant target. Higher SES areas have a higher UGS allocation per capita. PD inversely correlates with UGS per inhabitant.
- SES and PD influence: Lower SES and densely populated areas have better proximity but less UGS allocation. Higher SES and less densely populated areas have worse proximity but better UGS allocation. The mixed results demonstrate that multiple indicators and variables are necessary to understand UGS distribution equity.

5.3 Contributions

The study has added to the existing knowledge on this topic by highlighting the importance of evaluating proximity and allocation when assessing UGS equity. It proves that determining the actual distribution of UGS requires a comparison of indicators. Moreover, it shows how crucial it is to consider local socioeconomic and demographic attributes when evaluating equitability versus equality.

Through the integration of socioeconomic and demographic characteristics with UGS data using a socio-spatial approach, this research offers a more nuanced perspective of the

distribution of UGS, exposing areas with significant accessibility and allocative injustices. By demonstrating the gaps spatially, these areas could be strategically targeted for further interventions, to create more just cities. By displaying policy impact through socio-spatial means, it gives a simple way to digest how well the policy is distributed across the city. Using indicators is easy to communicate to both citizens and policymakers.

5.4 Limitations

While the World Health Organization (WHO) recommends a linear distance of 300m, this study's measure of distance may not be as accurate using a radius that may not be representative of the actual path to specific UGS. By not considering potential physical barriers such as fencing could add more distance between UGS and residences.

The socioeconomic and demographic data gathered is from years 2020 and 2021 meaning that they may not currently reflect the characteristics in the city. This may lead to a mismatch in how these variables influence UGS distributions presently.

5.5 Recommendations

Embedding principles of EJ into urban policies is crucial to ensure equitable outcomes in the specific context of a given city. Universal indicators are helpful to create a broad framework, yet often flounder to address the spatial contexts of the cities in which they are being implemented. Equity without justice is incomplete, achieving justice comes from acknowledging the local context (Koprowska, 2020; Kronenberg et al., 2020). The mismatch between the attainment of indicators from the WHO in the case of Paris emphasises the need for a more comprehensive approach that considers several factors influencing distribution equity of UGS.

A greater consideration for PD to address a proportional number of UGS resources for the given population is needed. The observed correlation between high-density areas and lack of UGS allocation in this research underscores an imbalance that must be addressed to serve both the current and growing population.

Disparities in policy implementation can be effectively addressed by integrating socio-spatial analysis into policy monitoring. This approach facilitates the identification of unique needs and challenges of different municipal neighbourhoods, thereby assessing gaps and ensuring equitable policy implementation across the entire urban area.

Further research could investigate additional characteristics of UGS, such as their individual sizes and qualitative aspects. Examining how local stakeholders view the quality of UGS from

an EJ standpoint can yield insightful information. Additionally, analysing other variables such as health indicators in connection to UGS distribution may uncover significant correlations.

Bibliography

- Agyeman, J., & Evans, T. (2003). *Towards Just Sustainability in Urban Communities: Building Equity Rights with Sustainable Solutions*. Sage Pub. Retrieved from <https://journals.sagepub.com/doi/abs/10.1177/0002716203256565>
- Ahlfeldt, G., et al. (2018). *The Economic Effects of Density: A Synthesis*. CEPR. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3315371
- Belikow, A., DeWeese, J., Ravensbergen, L., Kestens, Y., & El-Geneidy, A. (2021). Are we happy in densely populated environments? assessing the impacts of density on subjective well-being, quality of life, and perceived health in Montreal, Canada.: Published in findings. Retrieved from <https://findingspress.org/article/23718-are-we-happy-in-densely-populated-environments-assessing-the-impacts-of-density-on-subjective-well-being-quality-of-life-and-perceived-health-in-mo>
- Bibri, S., et al. (2020). *Compact city planning and development: emerging practices and strategies for achieving the goals of sustainability*. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/pii/S266616592030017X>
- Boyle, R. (1983). *A survey of the use of small parks*. Research Gate. Retrieved from https://www.researchgate.net/publication/291524346_A_survey_of_the_use_of_small_parks
- Buchavyi, Y., Lovynska, V., Samarska, A. (2022). *A GIS Assessment of the Green Space Percentage in a Big Industrial City (DNIPRO, UKRAINE)*. Research Gate.
- Burton, E. (2000). *The Compact City: just or just compact? A Preliminary Analysis*. SagePub. <https://journals.sagepub.com/doi/epdf/10.1080/00420980050162184>
- Chakraborty, N., et al. (2020). *The COVID-19 pandemic and its impact on mental health*. Retrieved from <https://wchh.onlinelibrary.wiley.com/doi/full/10.1002/pnp.666>
- Chen, Y., Men, H., & Ke, X. (2023). *Optimizing urban green space patterns to improve spatial equity using location-allocation model: A case study in Wuhan*. Science Direct. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1618866723000936>

- City of Paris. (2018). *Paris climate action plan: towards a carbon neutral city and 100% renewable energies*. CDN Paris.
<https://cdn.paris.fr/paris/2019/07/24/1a706797eac9982aec6b767c56449240.pdf#:~:text=URL%3A%20https%3A%2F%2Fcdn.paris.fr%2Fparis%2F2019%2F07%2F24%2F1a706797eac9982aec6b767c56449240.pdf%0AVisible%3A%20%25%20>
- Comber, A., Brunson, C., & Green, E. (2008). Using a GIS-based network analysis to determine urban greenspace accessibility for different ethnic and religious groups. ScienceDirect. Retrieved from
<https://www.sciencedirect.com/science/article/abs/pii/S0169204608000066>
- Coutts, C., & Hahn, M., (2015). Green Infrastructure, Ecosystem Services, and Human Health. ResearchGate. Retrieved from
https://www.researchgate.net/publication/281812423_Green_Infrastructure_Ecosystem_Services_and_Human_Health
- Cozens, P., & Brunner, J. (2013). “where have all the trees gone?” urban consolidation and the demise of urban vegetation: A case study from Western Australia. Retrieved from
<https://ideas.repec.org/a/taf/cpprxx/v28y2014i2p231-255.html>
- Das, D. K. (2022, May 31). *Factors and strategies for environmental justice in Organized Urban Green Space Development: Article*. Cogitatito.
<https://www.cogitatiopress.com/urbanplanning/article/view/5010>
- Data.gouv.fr. (2024). Espaces verts et assimilés. Retrieved from
<https://www.data.gouv.fr/fr/datasets/espaces-verts-et-assimiles/>
- De Haas, W., Hassink, J., & Stuver, M. (2021). The role of urban green space in promoting inclusion: Experiences from the Netherlands. Retrieved from
<https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2021.618198/full>
- Environmental Protection Agency (EPA). (n.d.). Learn About Heat Islands. Retrieved from
<https://www.epa.gov/heatislands/learn-about-heat-islands>

- France 24. (2023). France unveils plan to cut greenhouse gas emissions by 50 percent by 2030. Retrieved from <https://www.france24.com/en/france/20230522-france-reveals-plan-to-cut-greenhouse-gas-emissions-by-50-percent-by-2030>
- Fuller, R. A., & Gaston, K. J. (2009). The scaling of green space coverage in European cities. Retrieved from <https://research.monash.edu/en/publications/the-scaling-of-green-space-coverage-in-european-cities>
- Haaland, C., & van den Bosch, C. (2015). Challenges and strategies for urban green-space planning in cities undergoing densification: A review. ScienceDirect. <https://hugsi.green/ranking?region=Europe>)
- Goode, D. (1998). Integration of Nature in Urban Development. Scispace. Retrieved from <https://typeset.io/papers/integration-of-nature-in-urban-development-4x75ddb727>
- Hallegette, S., & Corfee-Morlot, J. (2010). Understanding climate change impacts, vulnerability and adaptation at City Scale: An Introduction - Climatic Change. Retrieved from <https://link.springer.com/article/10.1007/s10584-010-9981-8>
- Harvey, D. (1973). Social justice and the city. JSTOR. Retrieved from <https://www.jstor.org/stable/j.ctt46nm9v>
- Huang, S., Wang, C., Deng, M., & Chen, Y. (2022, December 27). Coupling coordination between Park Green Space (PGS) and socioeconomic deprivation (SED) in high-density city based on multi-scale: From environmental justice perspective. MDPI. <https://www.mdpi.com/2073-445X/12/1/82>
- HUGSI. (2021a). How green in Paris? HUGSI. Retrieved from <https://hugsi.green/cities/Paris>
- HUGSI. (2021b). Quantifying the Greenness of Global Cities. HUGSI. Retrieved from <https://hugsi.green/>
- HUGSI. (2024). How green are cities? Retrieved from <https://hugsi.green/ranking?region=Europe>

- Insee. (2023a). Évolution et structure de la population en 2020 – France.
https://www.insee.fr/fr/statistiques/7633058?geo=METRO-1#tableau-POP_G2
- Insee. (2023b). Dossier complet France – Revenus et pauvreté des ménages en 2021.
<https://www.insee.fr/fr/statistiques/2011101?geo=FRANCE-1#chiffre-cle-8>
- Jansson, M. & Schneider, J. (2023). The Welfare Landscape and Densification – Residents’ Relations to Local Outdoor Environments Affected by Infill Development. DOAJ.
Retrieved from <https://doaj.org/article/65f357a5fc6f496f9f8c321f6de3a859>
- Jansson, M. & Sunding, A. (2024). Children’s everyday recreational mobilities – growing up in a densifying Swedish small town. Retrieved from
<https://pub.epsilon.slu.se/34586/1/jansson-m-et-al-20240507.pdf>
- Jennings, V., et al. (2012). Promoting Environmental Justice Through Urban Green Space Access: A Synopsis. Retrieved from
https://www.srs.fs.usda.gov/pubs/ja/2012/ja_2012_jennings_001.pdf
- Jennings, V., et al. (2019). The Relationship between Social Cohesion and Urban Green Space: An Avenue for Health Promotion. Pubmed. Retrieved from
<https://pubmed.ncbi.nlm.nih.gov/30720732/>
- Kabisch, N., & Haase, D. (2014). Green justice or just green? Provision of urban green spaces in Berlin, Germany. *Landscape and Urban Planning*, 122, 129-139.
- Kabisch, N., et al. (2015). Human-environment interactions in urban green spaces – A systemic review of contemporary issues and prospects for future research. ResearchGate.
Retrieved from https://www.researchgate.net/publication/265057791_Human-environment_interactions_in_urban_green_spaces_-_A_systematic_review_of_contemporary_issues_and_prospects_for_future_research

- Kato-Huerta, J., & Geneletti, D. (2022). (PDF) a distributive environmental justice index to support Green Space Planning in cities. ResearchGate. Retrieved from https://www.researchgate.net/publication/364198214_A_distributive_environmental_justice_index_to_support_green_space_planning_in_cities
- Kaur, M., et al. (2021). Geospatial analysis of the distribution of urban green spaces: a study of four Indian cities. ResearchGate. Retrieved from https://www.researchgate.net/publication/353494958_Geospatial_analysis_of_the_distribution_of_urban_green_spaces_a_study_of_four_Indian_cities
- Kondo et al. (2020). Health impact assessment of Philadelphia's 2025 tree canopy cover goals. ResearchGate. Retrieved from https://www.researchgate.net/publication/340954264_Health_impact_assessment_of_Philadelphia's_2025_tree_canopy_cover_goals
- Koprowska, K., et al. (2018). Subjective perception of noise exposure in relation to urban green space availability. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1618866717304119>
- Koprowska, K. (2020, July 7). Environmental justice in the context of urban green space availability, accessibility, and attractiveness in Postsocialist Cities. ScienceDirect. <https://www.sciencedirect.com/science/article/pii/S0264275120312105>
- Korpilo, S., Kaaronen, R. O., & Raymond, C. M. (2022, October 13). Public participation GIS can help assess multiple dimensions of environmental justice in Urban Green and blue space planning. Science Direct. <https://www.sciencedirect.com/science/article/pii/S0143622822001655>
- Kronenberg, J., Haase, A., Laszkiewicz, E., Antal, A., Baravikova, A., Bienacka, M., Dushkova, D., Filcak, R., Haase, D., Ignatieva, M., Khmara, Y., Nita, M. R., & Onose, D. A. (2020, July 7). Environmental justice in the context of urban green space availability, accessibility, and attractiveness in Postsocialist Cities. ScienceDirect. <https://www.sciencedirect.com/science/article/pii/S0264275120312105>

- Landry, S., & Chakraborty, J. (2009). Street Trees and Equity: Evaluating the Spatial Distribution of an Urban Amenity. Sage Journals. Retrieved from <https://journals.sagepub.com/doi/10.1068/a41236>
- Lees, L., et al. (2008). Gentrification and Social Mixing: Towards an Inclusive Urban Renaissance? Sage Pub. Retrieved from <https://journals.sagepub.com/doi/abs/10.1177/0042098008097099>
- Ley, D., & Dobson, C. (2008). Are there limits to gentrification? The contexts of impeded gentrification in Vancouver. JSTOR. Retrieved from <https://www.jstor.org/stable/43197722>
- Luo, J., Zhai, S.; Song, G.; He, X.; Song, H.; Chen, J.; Liu, H.; Feng, Y. (2022). Assessing Inequity in Green Space Exposure toward a “15-Minute City” in Zhengzhou, China: Using Deep Learning and Urban Big Data. *Int. J. Environ. Res.* <https://doi.org/10.3390/ijerph19105798>
- Mandelbaum, R. (2021). Size Does Matter: Justice versus Equality in Urban Green Space Policy in Beersheba, Israel, *The Professional Geographer*, 73:3, 434-446, DOI: 10.1080/00330124.2021.1895848
- Moldan et al. (1997). Sustainability Indicators: a report on the project on sustainability indicators of sustainable development. [https://doi.10.1002/\(SICI\)1099-1719\(199808\)6:2<99::AID-SD85>3.0.CO;2-A](https://doi.10.1002/(SICI)1099-1719(199808)6:2<99::AID-SD85>3.0.CO;2-A)
- Nieuwenhuijsen et al. (2017). Exploring pathways linking greenspace to health: Theoretical and methodological guidance. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0013935117303067>
- Paris Data. (2024). Espaces verts et assimilés. Retrieved from https://opendata.paris.fr/explore/dataset/espaces_verts/map/?disjunctive.type_ev&disjunctive.categorie&disjunctive.adresse_codepostal&disjunctive.presence_cloture&refine.adresse_codepostal=75011&refine.type_ev=Jardinet%20d%C3%A9coratifs&basemap=jawg.dark&location=12%2C48.83806%2C2.32841

- Pinto, L. V., Inacio, M., & Pereira, P. (2023). Green and blue infrastructure (GBI) and urban nature-based solutions (NBS) contribution to human and ecological well-being and health. Retrieved from <https://academic.oup.com/ooih/article/doi/10.1093/ooih/ouad004/7322050>
- Raymond, C., et al. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/pii/S1462901117306317>
- Région Île-de-France. (2017). Plan vert de L'ÎLE-DE-FRANCE : La Nature pour tous et partout ... Région Île-de-France. https://www.iledefrance.fr/espace-media/applis_js/rapports_cp-cr/2017-03-09/rapportsPDF/CR2017-50.pdf
- Rojas-Rueda, D., et al. (2019). Green spaces and mortality: a systemic review and meta-analysis of cohort studies. DOAJ. Retrieved from <https://doaj.org/article/5a1fae44c1054aa6accb27b1bb9729bf>
- Rutt, R. L., & Gulsrud, N. M. (2016, July 9). Green justice in the city: A new agenda for urban green space research in Europe. ScienceDirect. <https://www.sciencedirect.com/science/article/pii/S1618866716301753>
- Schweitzer, L. & Stephenson, M. (2007). Right Answers, Wrong Questions: Environmental Justice as Urban Research. Sage Journals. Retrieved from <https://journals.sagepub.com/doi/10.1080/00420980601074961?icid=int.sj-abstract.similar-articles.1>
- Soja, E. (2010). Seeking spatial justice. JSTOR. Retrieved from <https://www.jstor.org/stable/24396736>
- Statista Research Department. (2024). Tourism in Paris – statistics and facts. Statista. Retrieved from <https://www.statista.com/topics/6314/tourism-in-paris/>
- Sustainable Development Commission. (2010). Commission on Sustainable Development: report on the 18th session. UN. Retrieved from <https://digitallibrary.un.org/record/685994>

- Swan, E. (2022). Why do cities need more green spaces than ever? HUGSI. Retrieved from <https://hugsi.green/stories/why-cities-need-more-green-spaces-than-ever/>
- Syrbe, R.U., Chang, J. (2018). Options and Challenges for Implementing Green Spaces in Urban Development. In: Grunewald, K., Li, J., Xie, G., Kümper-Schlake, L. (eds) Towards Green Cities. Cities and Nature. Springer, Cham. https://doi.org/10.1007/978-3-319-58223-8_4
- United Nations. (2015). Paris Agreement. <https://unfccc.int/process-and-meetings/the-paris-agreement>
- United Nations. (2018). 68% of the world population projected to live in urban areas by 2050, says un | UN Desa Department of Economic and Social Affairs. United Nations. <https://un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>
- Van Herzele, A., & Wiedemann, T. (2003). A monitoring tool for the provision of accessible and attractive urban green spaces. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0169204602001925>
- Verheij, J., Gerber, J. D., Nahrath, S. (2023). Ensuring Public Access to Green Spaces in Urban Densification : The Role of Planning and Property Rights. T&D. Retrieved from <https://www.tandfonline.com/doi/pdf/10.1080/14649357.2023.2239215?role=button>
- Ville de Paris. (2023a). Plan local d'urbanisme bioclimatique. PLU version 55. http://pluenligne.paris.fr/plu/sites-plu/site_statique_55/index_plu.html
- Ville de Paris. (2023b). Projet de plan climat air énergie de Paris 2024-2030. Paris.fr. Retrieved from https://cdn.paris.fr/paris/2024/02/09/projetplanclimatparis2024-2030_adopte-07VX.pdf
- Wang, C., Wang, S., Cao, Y., Yan, H., & Li, Y. (2023, September 18). *The social equity of urban parks in high-density urban areas: A case study in the core area of Beijing*. MDPI. <https://www.mdpi.com/2071-1050/15/18/13849>

- White, M., et al. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. PubMed. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/31197192/>
- Wolch, J., et al. (2014). Urban green space, public health, and environmental justice: The challenge of making cities ‘just green enough.’ Science Direct. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0169204614000310>
- World Population Review. (2024). Population Density by City 2024. Retrieved from <https://worldpopulationreview.com/world-city-rankings/population-density-by-city>
- Wu, J. et al. (2020). Dismantling the fence for social justice? Evidence based on the inequity of urban green space accessibility in the central urban area of Beijing. SagePub. <https://journals.sagepub.com/doi/full/10.1177/2399808318793139>
- Xie, Q., & Lu, M. (2020, January 1). Measures of spatial and demographic disparities in access to urban green space in Harbin, China. ACM Digital Library. <https://dl.acm.org/doi/10.1155/2020/8832343>
- Xie, P. (2023, January 1). Study on spatial layout and environmental equity of urban green space in Nanning city based on GIS – Doaj. DOAJ. <https://doaj.org/article/1c36d849f73f4eb5a9123fad967a874c>
- Xu, S., & Wang, Y. (2022, December 19). Influence of spatial scale on the study of Access Fairness of Urban Park Green Space. Frontiers. <https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2022.1030796/full>

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