The Presence of Green Spaces and Its Perceived Effects in Climate Change

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Abstract

The presence of green space refers to the existence and accessibility of vegetated plots like gardens, parks, and landscaped areas in an environment. Green spaces provide several ecological and social services, such as the regulation of temperature, improving air quality, maintaining biodiversity, and providing recreational space for society. Climate change posed a chronic and deepening global issue, affecting the Philippines considerably through increasing temperatures, changed precipitation patterns, and amplified weather events. With several mitigation measures of climate change in place, the contribution of urban green spaces, green roofs, gardens, and parks towards improving environmental quality and constructing climate resilience was widely acknowledged. This study correlated the presence of green spaces and their perceived change in temperature, pollutants, and biodiversity. In studying community perceptions in the context of the Mapúa community, the Intramuros and Makati campuses,through a survey of 300 people, this study aimed to know how urban residents viewed the effectiveness of green spaces in managing climate-related issues. The Spearman's rho correlation analysis results identified positive and significant relationships between the perceived availability of green spaces and their perceived influence in mitigating the effects of climate change across the three dimensions: perceived change in temperature, perceived change in air pollutants, and perceived change in biodiversity. The findings validated that public knowledge and acceptance of green infrastructure directly reflected scientifically derived environmental advantages. We may assume that the occurrence of green space in cities positively influenced climate change reduction through the improvement of biodiversity, air quality, and urban heat reduction.

Keywords: Climate, Temperature, Biodiversity, Air pollutants

1. Introduction

Background of the Study

Climate change had been a long-term problem that continued to worsen in the country. Globally, temperatures had risen by about 1℃ since 1880, with the National Oceanic and Atmospheric Administration (NOAA) indicating that the 20 hottest years had occurred since 2001. Global warming was one of the most evident indicators that climate change continued to shift substantially (Samset et al., 2023). With rising temperatures, shifting rainfall patterns, and increasing weather events, the Philippines continued to experience significant changes. Changes in atmospheric conditions and reduced tropical cyclones were caused by the reduction in average daily rainfall during the mature rainy season from 22 mm per day (1979–1993) to around 15 mm per day (1994–2008) (Olaguerra et al., 2018). Multiple initiatives had been implemented or suggested regarding climate change and environmental preservation in the Philippines. One of which was the Metro Manila Flood Management Project, which focused on improving flood management by setting up upgraded and new pumping stations, solid waste disposal improvements, and housing provisions for displaced communities; additionally, the Bonifacio GlobalCity project in Taguig, Philippines, exemplified successful green urban development, creating cooler microclimates, managing stormwater, and providing social spaces (Grisolia et al., 2019).

Green spaces, specifically green roofs, gardens, and parks overall enhanced the environmental state of society; likewise, green spaces were built for climate resilience as they mitigated urban heat islands, managed stormwater, and reduced flood risks (Sillanpää et al., 2018). To emphasize, green roofs provided different environmental benefits including stormwater management, mitigation of the urban heat island (UHI) effect, and increased building energy efficiency, which reduced energy consumption (Reyes-Riveros et al., 2021; Bevilacqua, 2021; Igugu et al., 2024; Adilkhanova et al., 2024; Santos &Villamor, 2019). Gardens improved air quality as they eliminated air pollution; moreover, gardens provided habitats for animals that helped balance the ecology within the urban setting and helped cool urban areas through evapotranspiration (Tomatis et al., 2023; Wang et al., 2022; Al-Delaimy & Webb, 2017). Parks, along with green roofs and gardens, also had their benefits. Parks contributed to health and well-being by offering spaces for physical activities, social interaction, and stress reduction, while also promoting biodiversity and ecological balance (Douglas et al., 2017; Larson et al., 2016; Prodanovic et al., 2024; Makinde, 2020). Economically, green spaces increased property values and supported local economies by attracting people and businesses, transforming commercial areas into vibrant, interactive spaces (EPA, 2023).

A study by Ramaswami et al. (2017) emphasized the potential of urban areas to achieve significant decarbonization through cross-sectoral strategies, urban-industrial symbiosis, and policies promoting eco-industrial parks and renewable energy credits, despite the complexity of consolidating the strategies into international assessments. According to Hautamäki (2021), Finnish towns integrated modern nature-based solutions, such as green roofs and parks, to improve green infrastructure and mitigate heat stress. Meanwhile, Hsu et al. (2020) examined climate mitigation performance in European cities—identifying government structures, citizen engagement, financial resources, and the integration of climate strategies into urban planning as significant factors in reducing greenhouse gas emissions and achieving climate goals. Additionally, adopting renewable energy technologies in urban infrastructure reduced carbon emissions and fossil fuel use, supporting environmental sustainability (Fawzy et al., 2020).

Understanding how the public viewed urban green areas was crucial to effective urban planning and design, given that cities faced social and environmental difficulties that jeopardized sustainability (Ankita S, 2021; Diogo V, 2021). With this knowledge, planners and legislators could more effectively link the goals of residents with the advantages of public green spaces. The physical attributes of green spaces, such as vegetation, layout, and maintenance, as well as perceptions of greenness, safety, and accessibility, were important components that promoted social cohesiveness (Shah H, 2020). Together, these components strengthened social cohesion and supported environmentally conscious urban growth.

Review of Related Literature

The State of Global Climate

In Asia, climate history during the Cenozoic era was shaped by both tectonic activity and global climatic events. Meijer et al. (2024) examined the Xining Basin, revealing that the proto-Parethys Sea played a key role in influencing moisture patterns, particularly during wetter periods in the Eocene. Over time, the region experienced significant drought due to the retreat of this sea, along with the effects of the Tibetian uplift and global cooling. These findings highlighted that the moisture in Central Asia was modulated by the interplay between westerly winds and monsoons, through long term trends that remained stable. Rugenstein and Chamberlain (2018) further explored asia's hydroclimate through stable-isotope analysis, emphasizing the contribution of monsoonal systems and mid-latitude westerlies in shaping the region's hydroclimate. Additionally, the researchers identified a consistent south-to-north gradient, which pointed to distinct moisture sources-southern Tibet receiving moisture from the south, while Central Asia was influenced by the mid-latitude westerlies.

According to Fyfe (2024), the significant warming of winter cold extremes across North America since 1980 cannot solely be attributed to shifts in average temperature or temperature variance. The researchers revealed that in northern regions, particularly Canada, cold extremes are warming more rapidly than winter averages, while in the southern United States, the warming of cold extremes is linked to alterations in higher temperature distributions. The study indicated that changes in temperature variability, driven by Arctic amplification, are easier to detect than shifts in mean temperatures, challenging previous assumptions about the relationship between cold extremes and arctic warming. The study also confirmed that while cold extremes will still occur, their frequency and intensity are expected to decline due to rising global temperatures.

In the study of Vautard et al. (2023) highlighted a significant discrepancy between climate model simulations and observed trends in extreme heat accross Western Europe, indicating that CMIP6 simulations inadequately captured the rapid warming observed in this region. The study revealed that atmospheric circulation changes contributed significantly to the observed warming, a factor that was underestimated in the 170 climate simulations examined. While thermodynamic trends in average temperatures aligned well with observations, the systematic mismatch in dynamical trends raised concerns about the reliability of these models in predicting future heatwaves.

Globally, the mean temperature has risen by roughly 1o Celsius since 1880, and forecasts suggest that it will climb by another 1.5 degrees Celsius by 2050; likewise, the National Oceanic and Atmospheric Administration (NOAA) points out that the 20 hottest years on record have all happened since 2001. According to Samset et al. (2023), the climate continues to shift significantly with global warming being one of the most evident indicators. The very strong deviation of the 2023 Global Surface Temperature Anomaly (GSTA) from recent global warming trends can be attributed to the warm state of various ocean basins. What made 2023 exceptional was the simultaneous occurrence of warm anomalies across multiple ocean basins, suggesting that the recorded temperature did not signify an acceleration in surface warming but rather resulted from a combination of steady, anthropogenic global warming.

The State and Trend of the Climate in the Philippines

The climate of the Philippines has undergone significant changes over the past decades, characterized by rising temperatures, shifting rainfall patterns, and increased occurrences of weather events. According to Olaguerra et al. (2018), the Philippines established a robust in average daily rainfall during the mature rainy season, with a notable reduction from approximately 22 mm per day 1979-1993 to around 1994-2008. This shift was attributed to changes in large-scale atmospheric conditions, including enhanced low-level moisture flux divergence and reduced tropical cyclone (TC) activity in the region. Specifically, the study pointed out that the frequency of landfalling TC declined, which corresponded with a westward extension of the Western North Pacific Subtropical High (WNPSH), resulting in unfavorable conditions for rainfall.

In the modern era, Lu et al. (2023) studied the extreme rainfall events in the Philippines during the spring months of February to April. The study noted that the occurrence of Tropical Cyclone Megi served as a critical factor in flooding in early April 2022. Additionally, the analysis revealed that the Enhanced North Oscillation Index remained weak during this period, further amplifying the influence of El Niño-Southern Oscillation on sub-seasonal rainfall extremes. The researcher highlighted the effectiveness of sub-seasonal forecasting models, implying that it improved forecasting capabilities which would enhance disaster preparedness.

Philippine Government Programs and Platforms in Response to Climate Change

The Philippines has made progress in combating climate change and environmental preservation through various programs. One such initiative is the Metro Manila Flood Management Project, a joint effort between the Department of Public Works and Highways (DPWH) and the Metro Manila Development Authority (MMDA). This project aimed to improve flood management by upgrading pumping stations, constructing new ones, and addressing solid waste disposal in waterways. Additionally, the project included housing provisions for displaced communities, enhancing the resilience of Metro Manila against flooding (Dulawan et al., 2024)

In reinforcing the country's commitment to climate action, the Green Samar project was approved in 2024. This initiative targets the restoration of 90,000 hectares of degraded forests within Samar Island Natural Park, aligning with the government’s Enhanced Greening Program (ENGP), which aims to reforest one million hectares by 2028. In Addition to restoring biodiversity, the project promotes economic resilience by developing bamboo-based industries and providing livelihood opportunities to local communities (Sampan, 2024).

Role of Urban Planning in Climate Change Mitigation

The abundance of green spaces has traditionally distinguished Finnish towns; however, contemporary issues, such as climate change, must provide an adjustment of how these places are integrated into urban planning. The shift towards modern nature-based solutions illustrates the need for further studies into their effectiveness in addressing modern climate-related and urban concerns. The study examined how Finnish towns are using these technologies to improve green infrastructure, which benefits both locals and the environment. Using case studies from many different cities, the study pointed out the need of examining urban plans and consulting with city planners to better understand existing implementations and their benefits. The findings indicate that Finnish towns are making progress in implementing nature-based solutions, such as green roofs and parks, which effectively mitigate heat stress (Harms et al., 2024).

Ramaswami et al. (2017) investigated the challenges of achieving significant decarbonization to keep global temperature surges below 1.5 °C. The research emphasized that urban areas, through cross-sectoral strategies, offer unique opportunities for carbon mitigation while also delivering local health benefits. Despite this potential, these strategies have not been adequately integrated into international assessments due to Its complexity which requires advanced urban planning. Additionally, the researcher stressed the importance of urban-industrial symbiosis, advocating for infrastructure that supports mixed-use developments. The study also pointed out that policies in China promotes eco-industrial parks and renewable energy credits for waste heat exemplifying how urban areas and governance can move towards a sustainable future.

In this study, Hsu et al. (2020) investigated the dynamics of climate mitigation performance among European cities, pointing out the critical factors that influence their effectiveness in achieving climate goals. The study assessed how government structures, citizen engagement, and climate action plans impacted cities' greenhouse gas emissions reductions. Moreover, the study indicated that financial resources and the integration of climate strategies into urban planning significantly enhanced each of the cities' abilities in climate action.

Structural Solutions to Climate Change

Various strategies are used for solutions in mitigating climate change. Although, it is well known that green spaces sequester carbon dioxide as it includes diverse plants that eliminates air pollution (Dong et al., 2024). Consequently, Nature-Based solutions that involve green spaces displayed positive impact regarding public health (Castelo et al., 2023). Furthermore, according to Elmqvist et al. (2019), the integration of green infrastructure in urban planning not only enhances biodiversity but also improves urban resilience against climate-related disasters.

Adaptation of renewable energy has been widely known to mitigate climate change. The integration of renewable energy technologies into urban infrastructure can decrease carbon emissions and lessen the use of fossil fuels. Furthermore, transitioning to renewable energy will support environmental sustainability. (Fawzy et al., 2020)

The Nature of Green Spaces (Parks, Gardens, and Green Roofs)

Green spaces are typically utilized to enhance the environment and social interaction by providing space for individuals to interact. (Reyes-Riveros et al., 2021). Specifically, Green roofs offer environmental benefits including, enhancing stormwater management which mitigates the urban heat island effect (UHI) (Bevilacqua, 2021); likewise, it is used for energy conservation as it improves building energy efficiency (Igugu et al., 2024). According to Adilkhanova et al. (2024), green roofs can also substantially reduce energy consumption in buildings.

Gardens significantly improve the state of our environment as it contributes to eliminating air pollution, further improving air quality (Tomatis et al., 2023). Additionally, gardens provide habitat for animals—improving the state of biodiversity (Wang et al., 2022); likewise, gardens mitigate urban heat islands (UHI) by providing shade and cooling through evapotranspiration—the process that helps to lower temperature in urban areas (Al-Delaimy & Webb, 2017).

Essential green spaces such as parks contribute significantly to health and well-being of individuals as it provides space for physical activities, social interaction and restorative experiences in nature (Douglas et al., 2017). Specifically, the presence of parks reduces stress levels and enchance the overall psychological well-being of residents (Larson et al., 2016). Ultimately, parks are crucial for biodiversity conservation as it promotes ecological balance within urban settings (Prodanovic et al., 2024).

Effects of Green Spaces

Green spaces contribute various effects on the environment and society—may it be positive or negative. Environmentally speaking, green spaces contribute positively through releasing oxygen and absorbing pollutants and carbon dioxide (Jabbar et al., 2021). On the contrary, green spaces—if not properly managed or overgrown green spaces—may create habitats for pests and invasive animals that can cause harm to civilians living near the green space (Priya & Senthil, 2024). In addition, green spaces mitigate soil erosion and improve water quality as they filter sediments and pollutant runoff (Kumar et al., 2023); moreover, green spaces significantly impact the urban temperature as they regulate urban temperatures by reducing the heat island effect in cities and providing shade (Ghosh & Das, 2018).

Apart from environmental effects—the factors of social elements such as human interaction are affected by green spaces. Socially, green spaces further improve the health, both physically and mentally of individuals as they create space for physical activities and relaxation (Braubach et al., 2017). However, because low-income communities frequently lack access to well-maintained parks and recreational places, green spaces can negatively contribute to social inequality by worsening already existing gaps (Schüle et al., 2019); furthermore, green spaces provide sites for crime or antisocial behavior that affects the perceived safety and usability of the place (Shepley et al., 2019). According to Rigolon and Németh (2019), in some cases, the enhancement of green spaces can cause gentrification—displacing long-term residents and disrupting established areas. Nevertheless, when properly planned and maintained, green areas continue to be essential to facilitating social interaction within communities and enhancing urban resilience. Green areas may promote social cohesion and improve the wellbeing of individuals by addressing accessibility concerns and assuring inclusive development (Jennings & Bamkole, 2019).

Green Space Implementation in the Philippines

Incorporating green spaces into urban areas can greatly enhance the quality of life for city residents. Makinde (2020) notes that these spaces provide more than just recreation—they also contribute to better mental health and create opportunities for social interaction. Similarly, Sillanpää et al. (2018) emphasize the role of green spaces in building climate resilience by mitigating urban heat islands, managing stormwater, and reducing the risk of flooding, especially in densely populated cities.

In the Philippines, where rapid urbanization threatens environmental sustainability, green infrastructure plays a crucial role in balancing development with ecological preservation. Gonzales et al. (2021) noted that integrating green spaces into cities like Metro Manila, not only helps address environmental concerns but also plays a crucial role in disaster risk reduction, especially when it comes to controlling floods. In addition, urban parks and green corridors support biodiversity by offering habitats for local plants and animals, which is vital for the country's rich but fragile ecosystems. Cities are starting to use more eco-friendly designs in the Philippines, and there’s a trend toward adding technology to green spaces. Things like green roofs, vertical gardens, and permeable pavements are showing up more in new buildings. These additions don’t just make the city look nicer—they also help save energy and cut down on the carbon footprint of buildings (Santos & Villamor, 2019).

Designing Urban Green Spaces for Climate Adaptation

Nature-Based Solutions (NbS) involve using natural processes and ecosystems to tackle challenges like climate change, while also providing environmental, economic, and social benefits. As explained by the International Union for Conservation of Nature (IUCN, 2016), NbS focuses on managing, protecting, and restoring ecosystems to address issues such as urban heat islands, flooding, and biodiversity loss. Unlike conventional solutions, NbS leverages local natural resources—like vegetation, water, and soil—in a way that's sustainable and efficient. An important goal of NbS is to enhance biodiversity, which improves ecosystem health and resilience, helping cities better adapt to climate change (Cohen-Shacham et al., 2019).

One specific design under the NbS framework is the implementation of green roofs. Green roofs are vegetated layers installed on rooftops that serve multiple purposes. They help regulate building temperatures, reduce stormwater runoff, and enhance biodiversity by providing habitats for birds and insects. According to Berardi et al. (2014), green roofs can reduce a building's energy consumption by insulating the structure, while also capturing rainwater to mitigate the risk of flooding in densely populated cities. In addition, they contribute to urban cooling by absorbing heat and providing green cover, which helps reduce the urban heat island effect. In cities like Singapore, green roofs are part of larger urban planning efforts aimed at making cities more sustainable. These roofs not only offer environmental benefits but also improve residents' quality of life by providing green spaces in densely populated areas (Hui, 2017).

Importance of Green Space Projects

Urban green space projects are increasingly essential for building sustainable and resilient cities. These spaces provide a range of environmental, social, and economic benefits that enhance both human well-being and environmental health. Parks, green corridors, and community gardens improve air quality, reduce urban heat islands, and boost biodiversity.

For example, urban trees and greenery help absorb pollutants and act as carbon sinks, improving air quality. A study conducted in London found that urban trees can significantly cut down harmful pollutants, reducing the risks of respiratory and heart-related diseases among city residents (Nesbitt et al., 2017). These green spaces also encourage the return of local wildlife by providing habitats for species that might otherwise struggle to survive in urban settings (Cohen et al., 2022). Green spaces go beyond their environmental role; they foster better health and community engagement. Green spaces encourage outdoor activities, which are essential in tackling health issues such as obesity and heart disease (Cheng et al., 2022). After the pandemic, the value of open and accessible public spaces became even more evident, with these areas offering opportunities for relaxation and social interaction, which helps lower levels of anxiety and depression (WHO, 2021).

A great example of green urban development is the Bonifacio Global City (BGC) project in Taguig, Philippines. By incorporating parks, green rooftops, and tree-lined streets, the project creates cooler microclimates, helps manage stormwater runoff, and enhances the area's aesthetic appeal. Beyond the environmental improvements, the green spaces in BGC offer residents social areas to connect and engage in outdoor activities, showcasing how thoughtful urban planning can lead to more livable cities (Grisolia et al., 2019). From an economic perspective, investing in green spaces is a smart move for cities. Thoughtfully designed parks and green areas often raise property values and help boost local economies by making neighborhoods more attractive to people and businesses. According to the EPA, green infrastructure can transform commercial areas into lively, vibrant spaces by drawing more people in and fostering social interactions, which supports local commerce (EPA, 2023).

Public Awareness in Green Space Projects

Nowadays, cities and urban spaces are facing social and environmental challenges that compromise its sustainability. Having a comprehensive awareness of the public perceptions of urban green space held by the intended users can have implications for urban planning and design. To formulate sound design recommendations, it is important to understand more deeply what kind of green space can be developed, who needs to or would use such a space, and at what time the space would be used (Haq et al., 2021). This understanding will help the urban planners and policymakers to maximize the benefits of Urban Green Spaces that are most valued by the public and contribute to the development of cities that match the aspirations of their residents. This understanding will help the urban planners and policymakers to maximize the benefits of Urban green spaces that are most valued by the public and contribute to the development of cities that match the aspirations of their residents (Vidal et al., 2021).

Three aspects were related to promoting social cohesion: physical characteristics, perceptions of greenness, and patterns of use of green spaces. The physical characteristics of green space, presence of vegetation, structure, spacing, layout, size, maintenance and facilities of green spaces help predict social cohesion. Perceptions of landscaping, safety and proximity to green spaces are also strongly associated with social cohesion (Jennings & Bamkole, 2019).

Synthesis and Research Gap

Despite considerable research toward the sustainability benefits of green spaces and their importance in climate change mitigation, key discrepancies existed in the comprehension of their socioeconomic consequences, particularly for underprivileged people. The literature at the time focused on green infrastructure's technical and environmental benefits, such as lowering heat stress, improving air quality, and encouraging biodiversity (Rakhshandehroo, 2017; Taylor & Hochuli, 2017). However, it mainly failed to investigate how accessible these areas were to low-income individuals and how social equality could have been included in urban design. For example, while green roofs and parks were praised for their environmental benefits, there was little debate about their cost and distribution across socioeconomic groups. Studies like those of Santos (2019) revealed that in urban areas of South America, particularly in Argentina, green spaces were often placed in wealthier districts, leaving low-income communities with limited access to these climate adaptation benefits. This suggested that green spaces, though beneficial, were not evenly distributed, and a more inclusive approach was necessary to ensure equitable access.

Moreover, in the context of the Philippines, while initiatives like the National Climate Change Action Plan (NCCAP) and green architecture practices were highlighted (Bautista, 2021; DENR, 2024), research rarely delved into the long-term sustainability and community involvement in these projects. Comprehensive studies assessed how the introduction of green spaces could have been correlated with the socio-economic realities of metropolitan areas, especially those with high population density. On top of that, while policies and initiatives were in effect, little was known as to how they truly influenced vulnerable groups, particularly when it came to how community engagement and public awareness impacted these programs' success. These gaps might have been addressed by examining more deeply the interactions between urban planning, social justice, and public participation in green space projects.

Statement of the Problem

The primary aim of this study is to correlate the presence of green spaces and its perceived effect on climate change. This focuses on understanding community perceptions regarding the effectiveness of green spaces in addressing climate-related challenges, particularly in urban settings.

Specifically, the researchers sought to answer the following questions:

1. What is the perceived impact of the presence of green spaces in climate change in terms of perceived temperature reduction, perceived change in air pollutants, and perceived effect on biodiversity?
2. Is there a significant correlation between the impact of the presence of green spaces and its perceived role in mitigating climate change effects in urban communities in terms of perceived temperature reduction, perceived change in air pollutants, and perceived effect on biodiversity?

Significance of the Study

The study's main purpose was to correlate the presence of green spaces with its perceived effect on climate change. The study benefits environmental policymakers, especially regarding green areas development and protection. This paper aimed at establishing green infrastructure as a key component of climate change interventions and offered a conceptual scheme for urban forests, public parks, and natural reserves. This information can be utilized by policymakers to design programs that promote carbon offsets and other programs that encourage the preservation of biodiversity. Policymakers acquire these benefits by utilizing the research findings to implement regulations and initiatives that prioritized the conservation and expansion of green infrastructure, integrating the data into urban planning strategies that promoted carbon-neutral developments. Ecologists and environmental scientists also found the study informative as it examined the impact of green spaces on carbon storage, species diversities, and differential regional climate. This study is used to develop targeted conservation efforts, justifies ecological interventions, and contribute to policy discussions with data-driven recommendations. Landscape architects also benefit from these findings, applying the insights to create eco-friendly and sustainable urban environments. By incorporating the study's concepts, the researchers aligned their design processes with sustainable practices and helped cities meet climate resilience goals. The paper also outlined how various forms of green spaces managed light and wind, ambient temperature, and affected cities' biota. The information obtained from this research was useful in enhancing carbon absorption and sustainability and helped architects create sustainable environmental spaces. These groups further benefited from cross-disciplinary collaborations and stakeholder engagement to ensure the findings were applied holistically across urban development projects.

Scope and Delimitation

In line with the study's main objective of correlating the presence of green spaces with its perceived role in mitigating climate change effects in urban environments, the focus of this study was to establish the contributions of green infrastructure in mitigating climate change, with a particular focus on how it was used in urban environments. The study explored various types of green spaces, including public parks, urban forests, and natural reserves, serving to lessen the effects of climate change. Specifically, it looked at the ways in which these green spaces promoted biodiversity, improved air quality, and reduced Urban Heat Islands (UHI). Having the primary focus on densely populated metropolitan regions, the study considered the social and ecological advantages of green infrastructure within the framework of sustainable urban development. This paper examined examples of modern green infrastructure initiatives and how they helped cities become more resilient to climate change. The study was conducted within the Mapúan community, specifically focusing on the Intramuros and Makati campuses, with 300 respondents surveyed to provide a comprehensive understanding of the community's perspective on green infrastructure.

Potential student non-responses to the survey presented a challenge that posed significant effects on the representativeness of the results and the entire data-gathering process. Sudden events like natural catastrophes interfered with the research schedule and respondents' accessibility. These factors made it more difficult to gather a complete analysis of community opinions towards green infrastructure. The conclusions consequently only represented a portion of viewpoints and experiences, which limited the manner in which the findings were adopted.

Conceptual Framework

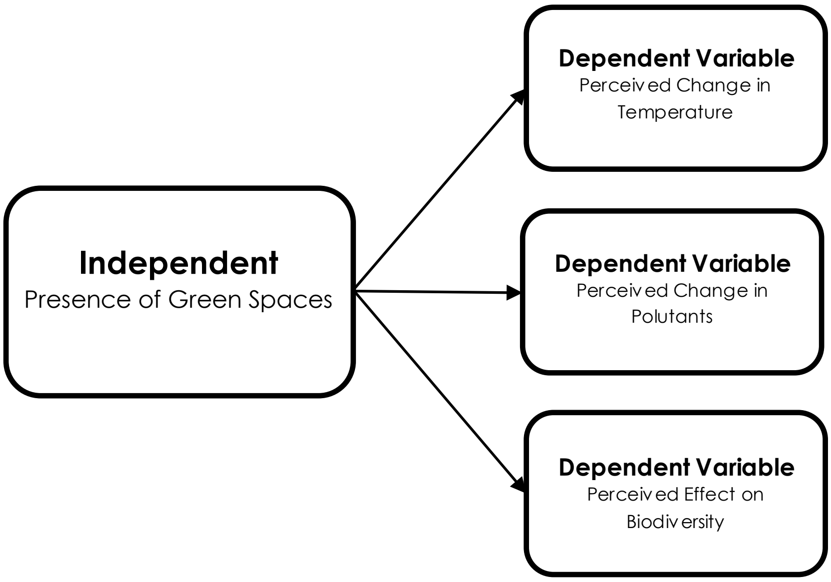

Figure 1.Independent Dependent Variable Framework

The main goal of this study was to correlate the presence of green spaces with its perceived role in mitigating climate change effects in urban communities. This study determined whether there was a significant correlation between the presence of green spaces and its perceived role in mitigating climate change effects in urban communities in terms of perceived temperature reduction, perceived change in air pollutants, and perceived effect on biodiversity. To be able to look deeper into the relationship between the two, the study followed the conceptual framework.

For the independent variable, presence of green spaces referred to areas with natural vegetation, such as parks, community gardens, and tree-lined streets in urban settings. The dependent variables included the perceived change in mental health, where green spaces were associated with improved mental health outcomes by reducing stress and promoting relaxation. The perceived reduction in temperature, as green spaces helped mitigate the urban heat island effect by cooling air temperatures through shade and evapotranspiration. Norton (2015) demonstrated that increased tree canopy coverage in urban areas led to noticeable cooling effects. The perceived change in air pollutants, where green spaces effectively reduced pollutants such as particulate matter (PM2.5), nitrogen dioxide, and carbon dioxide through plant leaves and natural processes. Zhang (2017) found that urban green spaces significantly improved local air quality by filtering harmful particulates. Lastly, the perceived effect on biodiversity referred to how individuals believed green spaces positively impacted their well-being, local climate, air quality, and ecological diversity.

Hypothesis

•Alternative Hypothesis (H_1) – The presence of green spaces significantly influenced the perceived temperature reduction. According to Cohen-Shacham et al. (2019), Nature-Based Solutions (NbS) focused on managing and restoring ecosystems to tackle challenges like urban heat islands, which directly impacted temperature perception in cities. Green spaces, such as parks and trees, provided shade and enhanced evapotranspiration, leading to a cooler microclimate. This, in turn, made urban areas more comfortable and mitigated the effects of rising temperatures.

•Alternative Hypothesis (H_2) – The presence of green spaces significantly influenced the perceived change in air pollutants. Gardens, green roofs, and parks improved air quality by eliminating air pollution and providing habitats for animals that helped balance the urban ecology. Green spaces, such as gardens, contributed to reducing pollutants like carbon dioxide, sulfur dioxide, and nitrogen oxides, leading to a cleaner and healthier environment. By improving air quality, these spaces enhanced the overall well-being of urban residents (Tomatis et al., 2023; Wang et al., 2022; Al-Delaimy & Webb, 2017).

•Alternative Hypothesis (H_3) – The presence of green spaces significantly influenced the perceived effect on biodiversity. Green areas provided essential habitats for various species, thereby supporting ecological diversity and balance in urban environments (Wang et al., 2022; Prodanovic et al., 2024). Moreover, green spaces enhanced the quality of life for residents by offering restorative experiences, which increased awareness and appreciation for local biodiversity (Douglas et al., 2017). The integration of these spaces into urban areas promoted the conservation of native species, leading to the preservation of ecosystems that were vital for maintaining environmental health. Furthermore, by mitigating environmental stressors like pollution and temperature fluctuations, green spaces created more conducive conditions for wildlife, further contributing to biodiversity conservation (Tomatis et al., 2023; Larson et al., 2016).

METHODS

The research sought to correlate the presence of green spaces with its perceived effects on climate change. Using a correlational and cross-sectional research design, data were collected from students of both campuses of Mapúa University—Intramuros and Makati—representing diverse urban populations. A structured questionnaire examined perceptions of green spaces in terms of mental health benefits, temperature reduction, pollution control, and biodiversity enhancement with the use of a 4-point Likert scale for consistency; moreover, the study utilized a Purposive Sampling technique as the study targeted respondents located near green spaces. Additionally, to validate the instrument—the use of Cronbach's alpha tested its reliability. Spearman's rank correlation coefficient, a non-parametric statistical tool ideal for ordinal data, analyzed the strength and direction of relationships between green spaces and their perceived benefits using SPSS software to ensure precision and accuracy. Descriptive statistics such as the mean and standard deviation summarized the findings, and Cronbach's alpha was re-evaluated post-data collection to confirm reliability. The study intended to provide insights into integrating green infrastructure into sustainable urban planning and climate resilience strategies by understanding the views of urban residents.

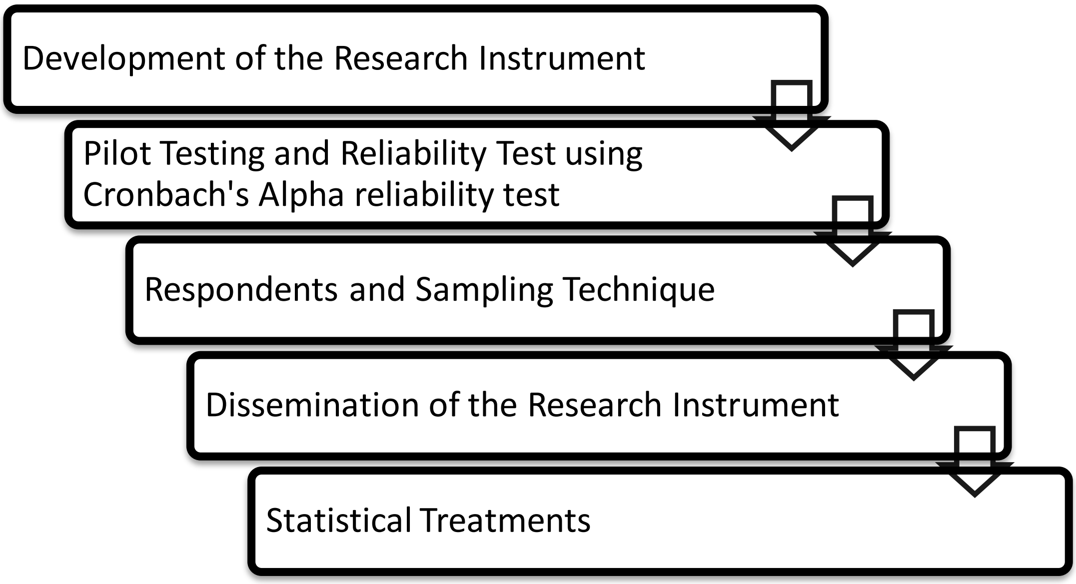

Figure 2. Flow Chart of the Study

Research Design

A correlational research design was used in this study to examine how urban residents perceived the role of green spaces in combating climate change. This design was considered effective because it allowed relationships between factors to be observed as they naturally existed, without requiring any conditions to be manipulated (Williams & Smith, 2019). The relationship between the amount of green space in urban areas and beliefs about its climate benefits was examined to reveal patterns in how environmental impacts were understood within communities.

A cross-sectional approach was applied to collect data from respondents, providing a snapshot of public opinion on green spaces and climate mitigation. This method aided in understanding how different groups within urban populations viewed these areas' potential to reduce climate effects (Johnson & Turner, 2022). Additionally, this approach allowed for a closer examination of how green spaces were valued across diverse urban settings, offering insights that were useful for urban planning and policies focused on sustainability and enhancing quality of life.

Setting

Both campuses of Mapúa University—Intramuros and Makati were utilized in conducting the study. The location's accessibility state favored the researchers, and it was situated in an urbanized setting which aligned with the study's focus on green spaces and urban climate change mitigation. With the university's diverse population, it provided a representative sample for understanding perceptions of green infrastructure, having a target population that involved students from both campuses. The study, set to take place from 2024 to 2025, emphasized densely populated areas where green spaces contributed to promoting biodiversity, improving air quality, and mitigating urban heat island (UHI) effects.

Research Procedures

Development of the Research Instrument

The research instrument was developed based on the study's objectives to evaluate perceptions of green spaces and their role in climate change mitigation. Relevant literature and existing frameworks were reviewed to ensure the questionnaire aligned with established practices in environmental perception research. Statements were carefully formulated to assess key aspects such as the perceived impact of green spaces on mental health, temperature reduction, pollution control, and biodiversity. A 4-point Likert scale ranging from "strongly disagree" to "strongly agree" was chosen to allow respondents to express their level of agreement with these items, ensuring consistency in measuring perceptions. Moreover, informed consent was provided that included the study's purpose and voluntary nature of participation; additionally, the confidentiality of responses was stated to ensure their understanding and agreement. The respondents confirmed their consent electronically before proceeding with the questionnaire.

Pilot Testing and Reliability Test using Cronbach's Alpha Reliability Test

Firstly, the researchers needed to find the sample size from the population of 300 Mapúan students from both Intramuros and Makati campuses. Using the 10% rule (0.10×300) a sample size of 30 students was determined for the pilot testing. The researchers used Cronbach's alpha to test the reliability of the questionnaire. Cronbach's Alpha is a statistical measure used to assess the internal consistency or reliability of a set of scales or test items; moreover, it evaluated how well the items in a test measured the same underlying construct, ensuring the instrument's reliability (Tavakol & Dennick, 2015).

To start the reliability test, the researchers will tally the data in a spreadsheet. Each respondent's scores will then be summed horizontally in the table to calculate their total score. Next, the variance of the sum of the scores of the responses of each respondent for all statements in the specific parameter will be computed, followed by the total variance of the summed scores. Afterward, the researchers will calculate the variance of each respondent's scores per statement using the formula:

$$\frac{Number\ of\ Statements}{Number\ of\ Statements\ -\ 1}$$

The reliability of the instrument was evaluated using Cronbach's alpha (α), calculated with the formula:

$$\alpha = \frac{x}{x-1}\left(\frac{y-z}{z}\right)$$

where x was the number of statements, y was the variance of the sum of all scores for all parameters in each respondent, and z was the sum of the variances of all scores of all responses for each statement.

With the use of Cronbach's alpha, the researchers determined how well the items in the instrument measured the intended construct. A score of 0.7 indicated strong internal consistency, meaning the instrument reliably captured the data needed for the study.

Respondents and Sampling Technique

For the study's respondents, the researchers utilized both campuses of Mapúa University—Intramuros and Makati to conduct their study. Using Slovin's formula, three hundred (300) Mapúan students served as the researchers' respondents through the use of purposive sampling technique—a non-probability sampling method where respondents were selected for inclusion in the sample according to specific characteristics (Nikolopoulou, 2023). With the use of purposive sampling technique, the researchers were able to gather the appropriate respondents and ensure the reliability of the research study (Lang & Nyimbili, 2024).

Dissemination of the Research Instrument

The questionnaire was distributed through publication materials and promoted primarily via social media platforms. These publication materials were carefully designed to include key details, such as the questionnaire's purpose, target audience, and significance to the study. The design process emphasized creating visually appealing and informative content to attract attention and encourage participation from potential respondents. Social media platforms such as Microsoft Teams were also used to disseminate the questionnaire, with posts including the link along with instructions that were distributed to simplify answering the form.

Statistical Treatments

The nature of the variables in this study included both independent and dependent variables, which were measured at an ordinal level. Ordinal variables represented data that could be ranked or ordered but did not have equal intervals between values. These variables were often used in research where subjective judgments or categorical data were involved, such as survey responses, satisfaction ratings, or performance levels (Hahs-Vaughn & Lomax, 2020; Akoglu, 2018). In this study, the independent variable served as the predictor or factor influencing changes, while the dependent variable represented the measured outcome or response to the independent variable. Because ordinal variables did not assume equal intervals, their analysis required non-parametric statistical methods, which were less restrictive than parametric techniques. This made ordinal-level data particularly useful in studies with smaller sample sizes or when the assumptions of normality were not met, allowing for a more flexible and accurate interpretation of the results. The study compared ordinal variables derived from the responses, whether about green spaces or not.

To analyze the relationship between the independent and dependent variables, Spearman's rank correlation coefficient was used. Spearman's r w appropriate for assessing the strength and direction of monotonic relationships without requiring assumptions of normality or linearity (Sedgwick, 2015; Schober et al., 2018). Specifically, this analysis examined how the presence of green spaces correlated with their perceived role in mitigating climate change effects, including temperature reduction, air quality improvement, and biodiversity preservation. Survey responses were first ranked to align with the assumptions of Spearman's method. Using SPSS (Statistical Package for the Social Sciences), the ranked data were analyzed to compute the Spearman's r coefficient and its corresponding p-value, indicating the strength, direction, and statistical significance of each relationship. The results provided critical insights into how green spaces were perceived to influence climate change mitigation in urban environments, ensuring accurate and robust conclusions. In the same vein, data cleaning was conducted, reducing the number of valid responses from 300 to 278, to ensure accuracy and reliability. Data cleaning is a critical step in data analysis, as it ensures the accuracy and reliability of the dataset by identifying and correcting errors, inconsistencies, and inaccuracies before analysis (Chu et al., 2016). Descriptive statistics such as the mean and standard deviation summarized the survey results.

Data Gathering Tools

This study utilized a structured questionnaire as the primary data-gathering tool. The questionnaire was divided into two sections: impacts of green spaces and their perceived role in climate change mitigation. Perceptions of green spaces were measured using a 4-point Likert scale, ranging from "strongly disagree" to "strongly agree," assessing respondents' views on green spaces' roles in mental health improvement, temperature reduction, pollution control, and biodiversity enhancement. The online questionnaire—distributed via Microsoft Forms—ensured accessibility and ease of participation for respondents, allowing for efficient data collection across a wide geographical range.

Data Analysis

This study utilized **Spearman's rank correlation coefficient** as it is a non-parametric statistical tool used to evaluate the strength and direction of a monotonic relationship between two variables (Akoglu, 2018). Unlike parametric tests, Spearman's r did not require assumptions of normality or linearity, making it ideal for ordinal data or datasets with non-linear associations (Gauthier, 2015). This method ranked the data points, reducing the influence of outliers and providing a robust measure of correlation (Laerd Statistics, 2015). The researchers used Spearman's r when their data consisted of ranks or when traditional correlation techniques were unsuitable due to violations of assumptions. Its versatility allowed it to handle diverse types of relationships, including both positive and negative monotonic trends. By utilizing software like SPSS, the researchers calculated Spearman's r with precision and interpreted the results effectively, supporting data-driven conclusions in various fields of study.

To ensure the reliability of the survey instrument, Cronbach's alpha was utilized. As a widely accepted measure of internal consistency, Cronbach's alpha assessed how effectively a set of items collectively measured a single latent construct (Metsämuuronen, 2022). This was particularly crucial in research focusing on perceptions and attitudes, where consistency across survey items reinforced the validity of the results. The dual application of these statistical tools—Spearman's r for relational insights and Cronbach's alpha for reliability—underscored the study's commitment to rigorous analysis. Together, they enhanced the accuracy and credibility of the findings, contributing to a more robust understanding of the constructions under investigation.

Ethical Considerations

This study strictly followed ethical principles, particularly in compliance with the Data Privacy Act of 2012, to ensure the confidentiality and security of the respondents' personal information. The respondents were fully informed about the research objectives and their right to withdraw at any point without repercussion. A consent form was provided electronically to guarantee their voluntary participation. The questionnaire was carefully designed to avoid sensitive or offensive questions to guarantee comfort among the respondents.

The researchers also accounted for challenges beyond their control, such as natural disasters, non-responsiveness to emails, and technical difficulties that may have hindered data collection. Contingency plans, including the use of alternative communication methods or extended collection periods, were implemented as options to address these issues.

RESULTS and DISCUSSIONS

The study aimed to determine the correlation between the presence of green spaces and their perceived impact on climate change mitigation efforts, focusing on temperature reduction, pollution control, and biodiversity. Descriptive and inferential statistical analyses were performed using purposively selected respondents from both Mapúa University campuses, Intramuros and Makati, who are near or frequently exposed to green spaces. The complete questionnaires were subjected to descriptive statistics, including mean and standard deviation, to determine central tendency and perception variability. Additionally, Spearman's rank correlation coefficient was utilized to assess the direction and magnitude of the relationship between green space exposure and perceived environmental benefits.

The results were interpreted in light of available literature to present a contextual, evidence-based discussion that either supports or refutes the observed trends. Variations in perception were identified and socio-environmental factors influencing public perception of green space roles in urban climate resilience were examined.

Results and Findings Concerning (Research Problem 1)

1. What is the perceived impact of the presence of green spaces in climate change in terms of perceived temperature reduction, perceived change in air pollutants, and perceived effect on biodiversity?

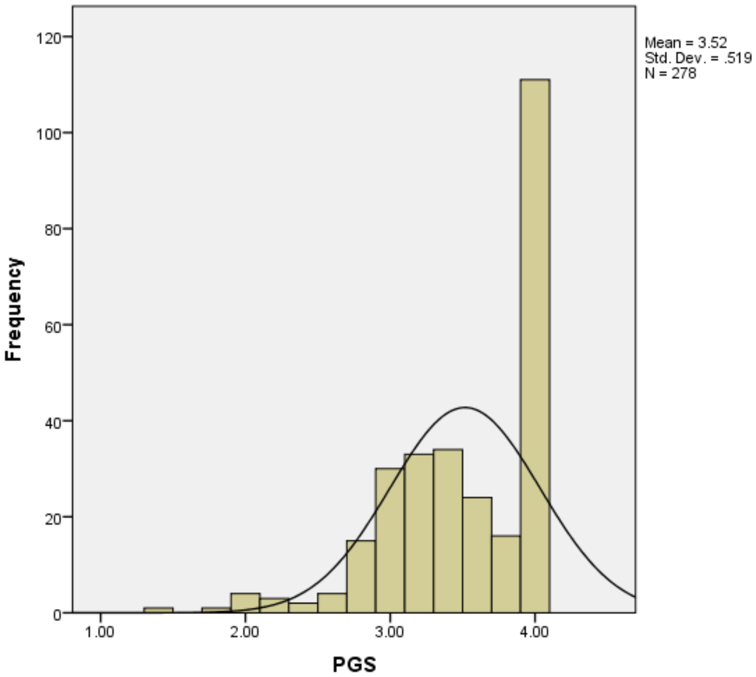

Figure 3.Frequency of the Distribution of the Respondents' Perception of the Presence of Green Space

Figure 3 indicated the distribution of responses for perceived availability of green spaces among 278 participants. The data reflect a right-skewed distribution wherein responses are crowded near the largest value on the Likert scale, with mean = 3.52, and standard deviation = 0.519. This implied that a majority of respondents view their environments—be these campus-based, resident-based, or city-based—dotted with green infrastructure in the form of parks, streets with trees, gardens, and open landscaped areas.

Such a vision may have resulted from constant sight or bodily presence in green places, especially along or in close proximity to the university's Makati and Intramuros campuses, situated as these are within relatively planned city areas.

In contrast, a few respondents' answers between 1.5 and 2.5 indicate that all the respondents are exposed to or available for green spaces at the same intensity. The disparity may be due to residential differences, differing urban development quality, or socioeconomic disparities in urban design. In less greened-up neighborhoods or intensely developed areas, green infrastructure could be low in number, underdeveloped, or neglected, thereby affecting the perceptions of the residents.

These results are consistent with Kabisch et al. (2016), whose studies revealed that accessibility to urban green spaces tends to be unequally distributed, with marginalized communities suffering from restricted accessibility; likewise, Santos (2019) recognized by observing that green infrastructure tends to be concentrated around affluent neighborhoods to the detriment of other communities having fewer opportunities to enjoy such amenities. According to Schüle et al. (2019), exposure of residents to green spaces is largely dependent on geographical and socioeconomic variation, which in turn influences their environmental attitudes and awareness. In contrast, the low percentage of lower responses indicates prevailing urban inequalities in access to green infrastructure, and the high percentage of perception of availability of green space in this population may be an indicator that it is likely to be accessible to campus-related categories. This initial inspection of the perceived presence of green spaces is used as a baseline in determining if these perceptions are correlated with how individuals rate the impact of greenery on pollution control, biodiversity improvement, and lowering temperatures, as discussed in the following figures

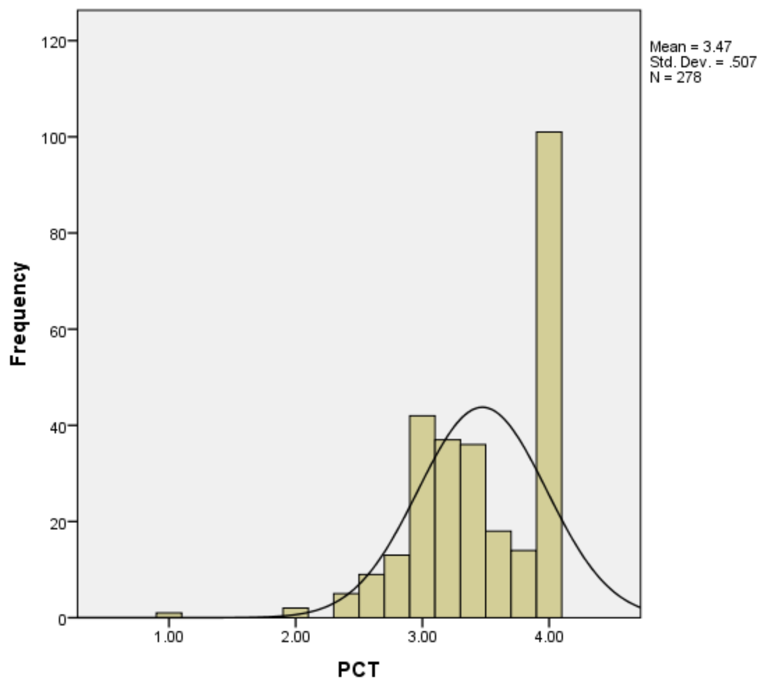

Figure 4.Frequency of the Distribution of the Respondents' Perception of Temperature in the Presence of Green Space

The cooling presence of green spaces has been long recognized in contemporary literature, especially for their ability to counter the urban heat island effect. During the current study, the respondents were surveyed to evaluate their thermal perceptions as they moved from non-green to green spaces, and dominant trends in terms of perceived cooling emerged. As indicated in Figure 4, the response distribution for "Perceived Change in Temperature" was skewed toward higher values, with the mean score of 3.47 reflecting a significant perceived reduction in heat levels. The figure also displayed a slightly left-skewed distribution, which implies that more respondents strongly agreed with the statements, emphasizing the consistency of perceived cooling effects. The majority of the respondents all concurred that green areas tended to feel windier, sweated more rapidly, and removed the feeling of heat emanating from nearby surfaces like pavement or concrete. All these physiological phenomena are typical of physical changes for cooler microclimates, the well-documented advantages of green cover through the provision of shade, enhanced transpiration, and enhanced airflow. As per Liu et al. (2022), green spaces of Beijing lowered the average land surface temperature by 1.32°C, particularly in middle urban areas, and area as well as complexity of shape proved to be determinant factors in terms of defining cooling effects.

Furthermore, the sense of relaxation, comfort, and enhanced energy levels expressed by participants validates that thermal comfort was not just physical but also psychological. When green spaces create a fresher and more ventilated environment, people tend to feel less tired and stressed, thereby also improving their appraisal of the environment. The findings indicated that people's assumptions are based on facts, including in addition to being aesthetically beautiful, green spaces are functioning ecological systems, reducing city pollution, and cleansing the atmosphere. Rated from 1.0 up to 2.5, the smaller sample indicates that it was not meant for all. According to Liu et al. (2022), targeted enhancements to existing green infrastructure would further amplify such effects, particularly in highly populated or poorly ventilated urban areas. They determined green spaces with unrealized potential that, when enhanced, can accommodate future residential growth while fostering thermal comfort. This supports the importance of evidence-based planning and design of urban green spaces such that spatial layout, coverage, and location are optimized for maximal cooling impacts; consequently, the availability of green space strongly relates to climatic mitigation perceptions, especially urban thermal comfort, and show how perceptual observations are in accordance with empirical environmental research.

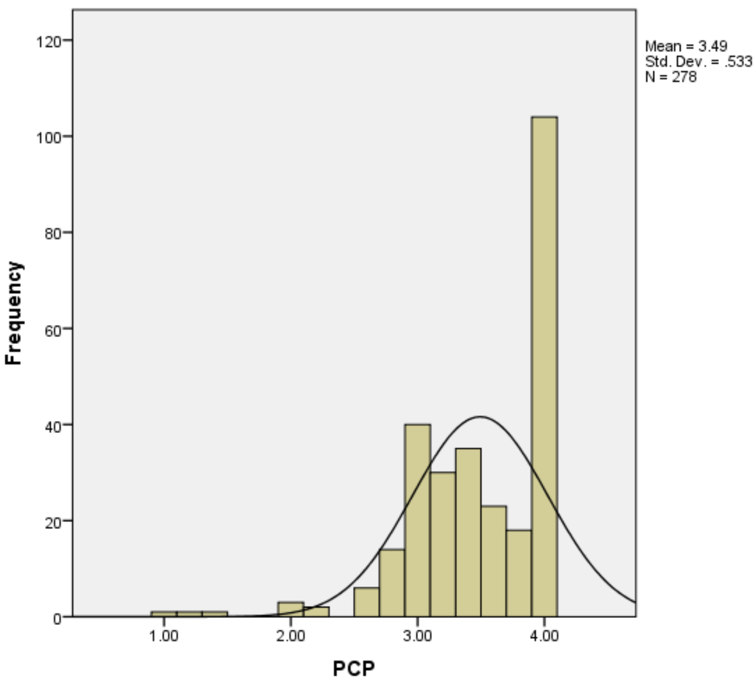

Figure 5.Frequency of the Distribution of the Respondents' Perception of Pollutants in the Presence of Green Space

Figure 5 showed a high skew towards the upper end of the scale, indicating that respondents strongly perceive green spaces as having a significant positive impact on pollution reduction. The mean of 3.49 and standard deviation of 0.533 validated this trend, displaying that the majority of the responses trend is heavily in the direction of the opinion that green areas assist in cleaning the air, with minimal variation of opinion among respondents. In comparison to less vegetated areas, this finding can be the outcome of observable signs in urban green spaces, like reduced dust, improved air quality, or a generally fresher environment; moreover, individuals also find greener areas to be associated with improved overall air conditions because they contain less smog and fewer emissions from cars. These perceptions are further supported by the physical experience of inhaling "cleaner" air in such areas. This implies that even in the absence of scientific readings, individuals form accurate assumptions based on their surroundings. In addition, the consistency of the responses suggests a common appreciation of green areas as efficient natural air purifiers in urban environments; however, the smaller group of responses ranging from 1.0 to 2.5 illustrates that not all individuals share this perception. These outliers can be due to regional variations, different sensitivities to pollution, or no exposure at all to where pollution was demonstrably severe. Generally, the distribution observes a common awareness of shifting pollution levels, while also recognizing that perception will differ according to the different conditions and experiences of living.

The social impression evident in this information concurs with empirical evidence in environmental science. According to Dong et al. (2024), urban green spaces are instrumental in carbon sequestration by trapping and holding atmospheric carbon dioxide, thus reducing overall pollution; moreover, the U.S. The Environmental Protection Agency (2023) stated that green corridors and vegetated infrastructure efficiently improve the quality of local air by filtering airborne pollutants like nitrogen dioxide and PM2.5. The incorporation of green roofs ensures pollutant removal and thermal management in buildings (Bevilacqua 2021). The results reveal that individuals' assumptions are upheld by evidence: green areas act as efficient ecological systems that alleviate urban pollution and clean the air, besides being visually pleasing. It was not for all, however, as indicated by the smaller sample size, with ratings from 1.0 to 2.5. According to Santos (2019), low-income individuals are less likely to appreciate urban green spaces as they tend to be situated in high-income neighborhoods. Regional disparities and irregular exposure to visibly dirty or green space could be the cause of the difference.

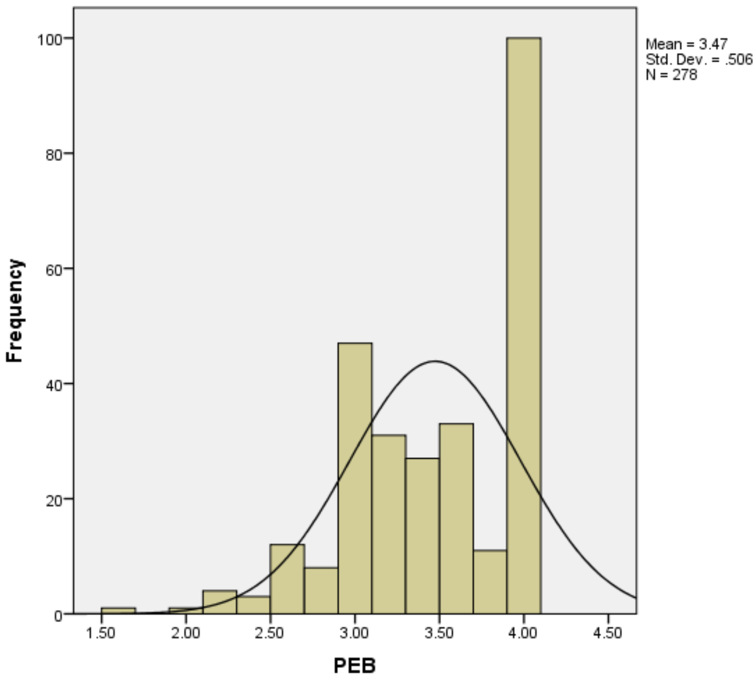

Figure 6.Frequency of the Distribution of the Respondents' Perception of Biodiversity in the Presence of Green Space

Figure 6 illustrated a highly skewed distribution to the right, reflecting the respondents' immense belief that green space has a strong impact on biodiversity. The standard deviation of 0.506 and the mean score of 3.47 confirm this trend of belief, reflecting a uniform view that green space contributes to the survival and existence of various species in the city. This can be caused by people having contact with birds, flies, and small rodents in parks, gardens, and other green areas, particularly compared to dirty, concrete-filled cities; moreover, frequent contact with flowering plants, trees, and natural landscaping in greener areas provides an added visual display to the view that such areas promote ecological activity. These unusual observations can cause the perception that urban biodiversity was enhanced wherever vegetation was part of city design.

The similarity of the scores further showed that people across backgrounds and locations care about the contribution that green space makes to urban wildlife. This is in support of growing concern for the environment and environmental conservation. Although the majority of the individuals agree, a minority provided ratings between 1.0 and 2.5, an indication that others do not necessarily see or appreciate the benefits of biodiversity from green infrastructure closely. Such variation may be attributed to residing in those neighborhoods with less maintained or less accessible green spaces, or locations where biodiversity was not as prominent. Limited environmental education or unfamiliarity with biodiversity may also impact their answers.

The public perception depicted to the figure corresponds to scientific facts. According to Wang et al. (2022), green spaces are crucial habitats for both widespread and endangered urban species, promoting biodiversity even in dense cityscapes. Similarly, Elmqvist et al. (2019) emphasize that properly planned green infrastructure, such as parks, urban forests, and community gardens, enhances ecosystem resilience and species richness; likewise, Prodanovic et al. (2024) claimed that nature-based solutions in urban planning not only enhance biodiversity but also enhance environmental and human well-being.

The strong sentiment among the respondents complements these findings, and the community recognizes green spaces as not merely recreational areas, but as living systems that foster ecological diversity. The lower-scoring group indicates, however, that such advantages are not necessarily evident. Exposure to green spaces for residents was influenced by socioeconomic and geographical differences in city development, also influencing access and perceived biodiversity (Schüle et al. 2019; Santos, 2019). In neighborhoods that have little or no green spaces or environmental learning, people will not see or appreciate the ecological function of such areas, thereby creating a gap in perception.

Generally, the evidence indicated that respondents share a common understanding about the environmental function of green spaces in maintaining biodiversity, but such an understanding can differ based on where one has lived or seen in their lifetime and was exposed to successful green spaces.

Collectively, the information strengthens that the public understanding of green space is generally in accordance with scientific facts concerning their resilience against climate; however, variation in experience supports that equitable data-driven urban planning is crucial for considering accessibility, visibility, and quality of green infrastructure. To remedy these inequalities, not only will more people enjoy green space physically and psychologically, but a more educated and participatory citizenship is fostered when responding to climate adversity.

Results and Findings Concerning (Research Problem 2)

2. Is there a significant correlation between the impact of green spaces and its perceived role in mitigating climate change effects in urban communities in terms of perceived temperature reduction, perceived change in air pollutants, and perceived effect on biodiversity?

Table 1. Spearman's Correlation Between Green Space Presence and Perceived Environmental Benefits

		Perceived Change in Temperature	Perceived Change in Pollutants	Perceived Change in Biodiversity
Presence of Green Spaces	Correlation Coefficient	0.505	0.600	0.621
	Sig. (2-tailed)	0.000	0.000	0.000
	N	278	278	278
	Interpretations	Moderate Correlation	High Correlation	High Correlation

Note: The Interpretation was Adapted from Papageorgiou, S. N. (2022). "On correlation coefficients and their interpretation.

Table 1 displayed Spearman's rho correlation between the Presence of Green Spaces and three environmental outcomes: Perceived Change in Temperature, Perceived Change in Pollutants, and Perceived Effects on Biodiversity. All correlations are significant at the 0.01 level (2-tailed), with a 99% confidence level. Green spaces are perceived to play a crucial role in shaping urban environmental conditions, as seen by the respondents in this study.

The presence of Green Spaces and Perceived Change in Biodiversity showed the strongest correlation among the three indicators ($\rho = .621$, $p < .01$). This suggests that respondents most strongly associated green spaces with improvements in biodiversity. Green areas such as parks, gardens, and tree-lined streets often provide essential habitats for a variety of plant and animal species, which may increase community exposure to wildlife and natural ecosystems. The high correlation implied that many individuals recognize these ecological benefits, either through direct observation or general environmental awareness. This perception may also reflect the public's growing concern about the loss of native species and habitats in urban areas, reinforcing the value of green infrastructure as a visible and meaningful component of biodiversity conservation. Prodanovic et al. (2024) stated that even small urban green spaces can act as biodiversity hotspots, providing habitat for birds, insects, and small mammals. Likewise, Douglas et al. (2017) contend that green spaces help greatly in the conservation of urban flora and fauna, promoting ecological consciousness among residents. The high correlation supports the idea that biodiversity benefits are the most visible and widely recognized environmental contribution of urban green spaces among the public.

The presence of Green Spaces and Perceived Change in Pollutants also had a high correlation ($\rho = .600$, $p < .01$). This supports the perception that green areas help reduce environmental pollutants, especially air pollution. Vegetation in urban green spaces has the proven capacity to absorb pollutants such as nitrogen dioxide and particulate matter, resulting in a measurable improvement in air quality. The high correlation can imply that respondents are conscious of or have felt this green benefit to the environment and potentially add to feelings of well-being in greener communities. Tomatis et al. (2023) explained that urban shrubs and trees substantially lower airborne particulate matter and gas levels such as nitrogen dioxide (NO2). Likewise, Al-Delaimy and Webb (2017) noted the capacity of vegetation to sequester carbon and improve urban air quality. The strength of this perception among respondents showcases how local experiences with cleaner surroundings in green areas translate into broader awareness of air quality benefits, thereby supporting advocacy for more expansive and accessible green infrastructure.

A moderate correlation exists between green space presence and perceived temperature change ($\rho = .505$, $p < .01$). This link was somewhat less strong compared to the two other relationships observed. This finding matched research on green spaces and their role in lessening the urban heat island effect. Vegetation cools the air through shading and water evaporation. Though the correlation was strong, its weaker value most likely comes from different ways people experience temperature change. Factors such as outdoor time, closeness to streets or buildings, and time of year can affect these perceptions. Bevilacqua (2021) mentioned that urban vegetation can reduce the urban heat island effect by affecting localized microclimates Likewise, Reyes-Riveros et al. (2021) highlighted that green infrastructure in cities not only moderates heat but also enhances thermal comfort for inhabitants. This correlation reinforces the broader understanding that urban green development was not only aesthetically valuable but also plays a practical role in addressing climate-related heat issues, especially in densely built-up communities.

In interpreting the findings of the correlation table, Spearman correlation coefficient (ρ) was employed to gauge the strength and direction of the relationship between the presence of green space and measures of perceived environmental change. According to Schober, Boer, and Schwarte (2018), correlation coefficients are suitable for determining monotonic relationships in ordinal data, including Likert scale answers. The values of the coefficients varied between 0.505 and 0.621, which, by usual standards, are moderate to high correlations. These provide indications that as there was greater presence or awareness of green space, so too the belief in their advantages. It should be noted, however, to interpret these coefficients as association, not causation. That was while the results indicate a relationship between variables, they do not imply that green spaces directly cause changes in temperature, pollution, or

biodiversity—only that these changes are perceived more strongly where green spaces are more prominent.
The results showed that perceived impact of green spaces have a significant and positive relationship with how people evaluate their contribution to the reduction of climate change effects, especially in the reduction of temperature, improvement of air quality, and support of biodiversity. The people perceive green spaces as functional environmental system, as evident from the persistent upward trend of all four measures. These intuitions, which are deeply rooted in practical knowledge—feeling cooler temperatures in shaded areas, sensing cleaner air, or seeing visible wildlife—are supported by empirical evidence from such research as Dong et al. (2024), the EPA (2023) regarding decreasing pollution, Wang et al. (2022) and Elmqvist et al. (2019) regarding increasing urban biodiversity, and Liu et al. (2022) regarding cooling.
Although the fact that there were lower ratings (1.0–2.5) across each distribution would indicate a gap in perception triggered by an imbalanced level of exposure to good-quality green spaces. People living in less green or deprived areas are less probable to see and become exposed to the environmental benefits of green areas, as noted by Kabisch et al., Kabisch et al. (2016), Santos (2019), and Schüle et al. (2019). These findings suggest that socio-spatial difference in urban design affects exposure to green infrastructure. These differences may also express themselves in awareness, environmental attitude, and how much green infrastructure is appreciated among different populations.
The results of the correlation analysis provide a compelling picture of how urban residents perceive the environmental contributions of green spaces. Among the three indicators, the perception of biodiversity enhancement showed the strongest association with green space presence. This means that this benefit is the most visible or valued among the respondents. These findings imply that urban green infrastructure was not only noticed by communities but was also perceived as an active agent in addressing climate-related environmental changes.

CONCLUSION

This study looked into how people see the role of green spaces in addressing climate change, particularly in terms of lowering temperatures, reducing pollution, and supporting biodiversity. Using Spearman's rank correlation, the results showed clear positive relationships in all three areas: pollution control (ρ = 0.600), biodiversity enhancement (ρ = 0.621), and temperature reduction (ρ = 0.505), all of which were statistically significant at the $p < 0.01$ level. The findings showed that a greater reported presence of green spaces was associated with stronger public belief in their role in mitigating climate change impacts, with biodiversity enhancement having the highest correlation. This indicated that respondents tended to perceive green spaces not only as recreational areas, but also as important environmental assets linked to climate resilience.
The results showed a clear link between green spaces and how people view their environmental benefits. A strong connection with biodiversity enhancement pointed to the value of these areas as habitats for various species. Likewise, the significant ties to pollution control and temperature reduction showed how green spaces help improve air quality and cool down cities. Overall, the findings support the idea that green spaces play a role in fighting climate change and are widely seen as helpful in tackling urban environmental problems. They also highlight the importance of investing more in green infrastructure to make the most of its benefits.

RECOMMENDATIONS

Based on findings from this study, several suggestions were provided for future research as well as application in the field. Given the statistically significant positive relations among the availability of green spaces and the public perception of how these spaces can help counter climate change through pollution control, the promotion of biodiversity, and temperature regulation, it is vital to explore further and apply measures that are grounded on these findings.

Recommendation for Future Research

For future research, researchers are encouraged to compare the relative performances of different forms of green space—urban parks, green roofs, community gardens—and contrast them with their relative contributions of specific environmental benefits. Understanding which forms of green infrastructure are most effective to increase biodiversity or reduce the urban heat can inform more specific urban planning. Comparative urban-rural research can also reveal differences in green space valuation and offer broader environmental planning implications across different settings.

Recommendation for Practice

In terms of practical application, local governments and urban planners must recognize green spaces as an essential component of climate resilience strategies. Giving priority to the development and maintenance of these areas, particularly in dense urban environments, can significantly enhance a city's resilience to pollution, support biodiversity, and regulate heat. Educational institutions and advocacy groups should implement awareness programs that emphasize the critical role of green spaces in environmental health. These campaigns will create more public interest in protecting and developing green areas. Moreover, policymakers must include green infrastructure in urban long-term development plans and climate action plans that are institutionally and financially sustainable. Lastly, involving members of society in the planning and management of green spaces is likely to make them accomplish more and gain more appreciation in society, which will increase the sense of collective responsibility towards mitigating climate change.

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