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The Role of Urban Green Spaces in Enhancing Environmental Health

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Abstract

Urban green spaces and their components of parks, gardens and forests stand essential to environmental health by delivering multiple advantages which support both ecological and social health and public welfare. The review analyzes the major environmental health benefits of urban green spaces which primarily originate from their regulatory functions for air quality, their climate control capabilities and their service capacity to biodiversity preservation. The presence of green spaces in urban areas enhances air quality since they capture pollutants like carbon dioxide together with nitrogen dioxide and particulate matter thus diminishing respiratory disease risks. The green spaces serve as heat island regulators that create cooling effects which become particularly crucial during periods of extensive heat. Ecosystem balance in urban areas benefits from urban green spaces through their provision of habitats for plant and animal species allowing the enhancement of biodiversity. The designed areas enhance climate regulation through their capability to capture carbon while performing effective stormwater management and building urban climates that resist climate change impacts. The review demonstrates why urban planners should prioritize adding green infrastructure because it deals with neighborhood environmental concerns at the same time as solving worldwide problems including climate change and biodiversity reduction. Cities develop sustainable healthier living environments when designers focus on green spaces correctly and set their priorities.

Introduction

An effective network of created environments including parks, gardens, greenways and green belts hence carry a significant health contribution especially in the rapidly growing urban regions. As more than half of the global population is living in urban areas with projection to 68 % by 2050 UN, 2018), therefore urban green spaces are important to offset the negative impacts brought about by urbanization. These are now also valued as parts of urban life infrastructures through playing functions that are conducive to promoting environmental conscientiousness, people's well-being, and general life quality (Rui & Othengrafen, 2023). This introduction discusses the role that urban green spaces have in developing the ability to bring about environmental health and reviews their relevance given the broad trends in urbanization.

According to Zhang et al. (2022), the impact of urbanization relates to environmental health, let's consider the following aspects: air pollution, intensity of heat, and reduce the availability of biological diversity, and inadequate water management. Air pollution contributes to the death of over seven million people every year, and it reveals that people who live in cities breathe more particulate matter and nitrogen dioxide than dwellers in rural areas (Roser, 2024). UHI, a condition associated with enhanced heat island effects in dense concentration structures, which increases the level of heat conductivity in cities during heatwaves, poses health risks to residents (Feng et al., 2021). Losses of natural habitats worsen the diversity and decrease the

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provision of ecosystem services needed for sustaining human life such as pollination and water purification (Ekka et al., 2023). In this case, then, urban green spaces can be identified as a nature-based solution for these problems and the enhancement of environmental conditions.

A rather undeniable advantage of urban plan green areas has been demonstrated in cleaning up the air through decreasing particulate-containing matter in the cities. Tree and plants capture carbon dioxide and other pollutant gases and give out oxygen into the atmosphere (Abduh et al., 2021). Literature analysis, Mandal et al. (2023) has established that urban trees can often filter particles up to 25% in intensive urban areas and thus reduce respiratory and cardiovascular diseases. Moreover, vegetation that grows in green spaces cools the air by evapotranspiration thereby decreasing the incidence of heat island UHI and limit-heat events (Li et al., 2022). These cooling effects are particularly important because rising global temperatures due to climate change cannot be blinked away.

Besides reducing environmental risks, urban green spaces have many positive effects on the health of the population. Green areas improve health, create opportunities for sport and physical activities, and bring a positive effect on the mental health especially in the environments with high population density where there are fewer opportunities to play a sport (Kajosaari & Pasanen, 2021). Previous studies have noted that availability of green areas correlates with the reduced probability of such diseases, as depression, anxiety, or obesity; as well as the enhancement of cardiovascular disorders (Reid et al., 2022). Research conducted in the United States of Amerika revealed that it is even a defy the odds proposition for the people, who are within a of 500-meter from structures of urban parks to get depression as compared to other people with no access to these structures. Globally, these results highlight the need to incorporate greenspace into the physical structure of cities for the health and wellbeing of people.

Another importance of green space is seen in its contribution toward regulating climate and for conserving of biologic diversities in towns and cities. Through absorption and retarding of local temperature, green spaces play a role in climate adaptation, by lowering emissions of greenhouse gases, and increasing the adaptive capacity of towns and cities. They provide living quarters for countless numbers of plant and animal species making them important for sustaining urban ecosystems. Thus, a diverse biota in urban greenplaces improves not only ecosystem services but also avails educational and recreational amenities to city inhabitants, an improved perception of nature.

Nonetheless, urban green spaces are not equal in spatial and social accessibility across all the regions and classes. Literature reviews have indicated that low-income communities are the least likely to possess quality green spaces to improve the health of the society this has been highlighted as a violation of environmental justice. Many Global South cities have degraded green spaces or have seen these spaces taken over by urbanization preventing their provision of ecosystem services. Eliminating these disparities must be done through the formulation of specific policies and funding for the development of sufficient green areas for clients in these disadvantaged groups.

Nevertheless, the introduction of green spaces into the physical environment of cities poses some difficulties. Green spaces are a scarce resource since due to restricted space for urban expansion, there are other important demands for urban expansion, and there is inadequate capital to finance expanses such as green areas. The potential benefits of green spaces are not all if these areas are not designed and professionally managed. For example, in the case of parks, which are under threat of being lorded over by the private sector, they may not be visited or can bring about deficient environmental improvement, thus cognisance needs to be taken of planning literature and trial methodologies of participatory design and planning.

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Method

The methodology of this study employs a literature review approach, systematically collecting, evaluating, and synthesizing existing research to explore the role of urban green spaces in enhancing environmental health. Literature reviews are particularly suited for identifying trends, thematic patterns, and research gaps across diverse studies. This approach enabled the researcher to provide a comprehensive overview of the relationship between urban green spaces and environmental health outcomes. The following sections outline the steps and strategies undertaken during this review.

This study adopts a narrative literature review design, which focuses on synthesizing qualitative findings from a broad range of studies. Unlike systematic reviews that adhere to rigid protocols, the narrative approach allows for flexibility in selecting and analyzing the literature, thereby facilitating a more nuanced and context-sensitive exploration of diverse perspectives. As Karunarathna et al. (2024) emphasize, narrative reviews are particularly effective for addressing complex and interdisciplinary research topics. This design was ideal for capturing the multifaceted benefits of urban green spaces, from climate regulation and air quality improvement to mental and physical health outcomes.

The data sources for this review include a combination of peer-reviewed journal articles, books, policy reports, and case studies. Scholarly articles were retrieved from academic databases such as Scopus, PubMed, and Web of Science, ensuring access to high-quality and rigorously vetted research. Policy reports from organizations like the World Health Organization (WHO) and United Nations (UN) provided valuable insights into practical applications and global strategies for urban green space development. Grey literature, including government and NGO publications, was also consulted to ensure a comprehensive perspective on real-world challenges and innovations. Case studies enriched the review by highlighting practical examples and context-specific findings.

To maintain relevance and quality, inclusion and exclusion criteria were meticulously defined. Studies published in English between 2003 and 2023 were included, ensuring that the findings reflect contemporary issues and advancements. Only research focusing on urban green spaces and their direct environmental health impacts were considered. Geographically diverse studies were included to provide a global perspective, encompassing varying urban contexts. Exclusion criteria eliminated studies focusing on rural green spaces, articles lacking peer review, and research that did not explicitly address environmental health outcomes. These criteria ensured that the reviewed literature aligned with the study's objectives while maintaining methodological rigor.

A systematic search strategy was employed to identify relevant literature. Keywords such as "urban green spaces," "environmental health," "air quality," "biodiversity," "public health," and "climate regulation" were used to query multiple databases. Boolean operators (e.g., AND, OR, NOT) were applied to refine searches and expand the scope of relevant findings. For instance, search strings like ("urban green spaces" AND "environmental health") or ("green infrastructure" OR "urban parks") AND ("air quality" OR "climate adaptation") captured a wide range of articles. Additionally, backward citation tracking of key studies was conducted to ensure no pivotal research was overlooked.

The extracted data were thematically analyzed, enabling a structured synthesis of findings. Key information, such as study objectives, methods, and main results, was categorized under themes including air quality, mental health benefits, climate regulation, and biodiversity conservation. Thematic analysis helped identify both commonalities and gaps across studies, providing a comprehensive understanding of urban green spaces' multifaceted benefits. The analysis

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highlighted challenges, such as maintenance costs, socio-spatial inequalities, and policy implementation gaps, which are crucial for informing future research and policy initiatives.

This methodological approach ensured that the literature review comprehensively captured the benefits and challenges associated with urban green spaces in enhancing environmental health. By integrating insights from diverse sources and perspectives, the study provides a well-rounded understanding of the topic and highlights areas requiring further research and innovation. The narrative review design's flexibility allowed for a deeper contextualization of findings, bridging the gap between theoretical research and practical applications.

Urban Green Spaces and Air Quality

Green spaces in urban environment have a crucial function of relieving pollution of the air through filtering various pollutants and absorbing influence airborne particles. Trees and shrubberies are known to clean the air mechanisms, dust, smoke, and soot stick on the surface of vegetation. Literature has also confirmed a decreased pollutant concentration of particulate matter of up to 40 percent in fully-leafed urban areas (Corada et al., 2021). Trees also remove gaseous pollutants from the air as a through their leaf such as nitrogen dioxide (NO2), sulfur dioxide (SO2), and ozone (O3). These processes are most important in urban regions where mechanical pollution in industries, automobiles and construction is prominent.

In addition to pollutant removal, green spaces mitigate microclimate extremes and hence, have an indirect positive impact on this aspect. Vegetation decreases the thermal bulk of cities and limits the generation of the ground level ozone that arises during heat waves. Lower temperatures mean that energy for cooling requirements is also minimal thus reducing emission from power sector. This implies that our urban parks and green corridors, where we suggested that these should be located within cities, can in fact partly counteract the effects of pollution by acting as barriers in areas of high traffic activity, hence protecting those in close proximity to such areas from the negative impacts of pollution.

Thus, there is weak evidence that the urban green areas provide a positive impact into the quality of air on vegetation type, density and frequency of maintenance. Bryant and Dickinson also found that broader leaved trees like oaks and maples are more capable of trapping particulate matter than the needles bearing trees. On the other hand, many trees may produce volatile organic compounds (VOCs) that can combine with pollutants to generate ozone, thus may have their merits counteracted. Furthermore, intrusive, untidy green features have the potential to collect litter and allergens thus manifesting its inability to act as a pollution sink. Hence, effort has to be made in planning and managing vegetation to ensure the best improvement of air quality in relation to green spaces in urban areas.

Other positive externalities are created by green spaces to increase public awareness regarding air quality. There should be an ability to embrace environmental conservation through interacting with many participants where parks and recreational areas abound, communities ought to be imparted with positive approaches to nature conservation including tree planting, use of environmentally friendly vehicles, and encouragement of green infrastructure. The analysis shows that green spaces, in addition to decreasing the levels of pollutants, facilitate the development of a green conscience in inhabitants (Diener & Mudu, 2021). They also support effuse reductions in emissions due to life style changes that are less friendly to the environment, and therefore the air.

However, the incorporation of green areas as the part of the territorial design has certain difficulties. As the population density increases, space for green infrastructure is scarce, and it is often replaced by funded commercial or residential infrastructure. Socio-economic injustice work on the degree and type of green space, and people with low socio-economic level tend to

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have less access to good quality vegetation (Csomós et al., 2021). To eliminate these inequalities, there is a need for pro-equity polices within urban planning hence enhancing the distribution of airs quality within green spaces to all people. Overall, as such green spaces as parks, squares, gardens when planned and equipped properly can become the basis for building healthier and more sustainable cities.

Green Spaces and Public Health

The existence of green areas in cities heralds important consequences for the quality of life at the physical and even at the mental level. Urban green spaces also contribute to health in that; when properly designed, green areas offer areas for physical activations. Here, it is important to note that while physical activity or exercise may refer to systematic exercise, games, and other forms of exercise that are approached systematically, physical activity may also refer to daily movement in a more general terms as shall be seen later in this text. Recreation grounds, parks and; walking paths, and other places whereby some people go for jogging, walking, bicycling, and other sporting activities help in exercising thus promoting the health of the people. Historical evidence has it that people who are nearby these green areas are most likely to exercise and have minimal risks to obesity related disease, cardiovascular complications and diabetes (Nardone et al., 2021). Quantitative research has shown that by inclusion of green spaces in the physical entities of urban planning, the citizens of these cities will be able to access the necessary facilities for an active lifestyle.

Apart from physical activities, accessibility of green spaces is essential for explicit mental health benefits. Introducing children to natural environments has been argued to reduce stress, anxiety, and even depression levels. According to Jones et al. (2021), it was evident that time spent in parks and other green thought processes could consequently decrease levels of cortisol a stress hormone – increase mood while enhancing cognitive functioning. This has been cited as the restorative value of nature which offers those immersed in such an environment an opportunity to come to terms with reductionist and stress information procurement environment of urban life. It was also found that short periods spent in or around green settings, by sitting on a park bench or strolling down a tree-lined street, produce the same benefits to mental health and ward off negative emotions.

Such spaces include green areas as they are socially recharge points that facilitate the formation of communities and their sustainably. In creating greenspace for our fast-growing cities, urban parks are unique places that call people of all backgrounds and ages together in a shared environment give a feeling of ownership. Callaghan et al. (2021) also notes that one other implication of this social aspect of green spaces is the improvement of mental health as social connectedness is long established as an important antidote for depression and loneliness. Beside beautifying and integration to inter cette social relationships, community gardens and shared green space involved in food needs program offer area for food production. Such a multiple function indicates that green spaces as environment-related infrastructures are crucial for people's health and general welfare.

In addition, green spaces have such health breakout as environmental impact, which contributes to the improvement of public health in an indirect manner. Green spaces enhance the quality of fresh air, efficient lighting and reducing noise level therefore enhanced quality environment in our towns. For instance, trees and plants eliminate air pollutants, and minimize the urban heat island impacts, which cause heat-related diseases. In high population density areas like urban environments where heat waves and poor air quality act as a public health risk, an emphasis on greenery acts as a natural shield for people against other harms from the environment (Piracha & Chaudhary, 2022). This aspect of green spaces is most appreciated in modern cities where

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climate change impacts are felt every now and then as green surfaces provide a cost-effective natural remedy towards disruptions of the natural environment leading to poor health.

Opportunities of quality green spaces are distributed inequitably in urban environments; meanwhile, excluded populations have restricted chances to access quality green infrastructure. Studies have established that low income and minority areas are denied access to aesthetically attractive and functional green spaces (Haque & Sharifi, 2024). This inequality not only worsens health differences but also hampers the possibility of some groups of people to take advantage of the physical and mental health promotional effects of green spaces. Redressing these anomalies require policy interventions that aim at closing the geographic access to green spaces with an intention of extending the public health returns on exposure to nature to all citizens in the city.

Green Spaces and Climate Regulation

Green spaces in cities are valuable in controlling climate conditions in the urban areas, including UHI and improving climate control. This is because cities with large and dense constructions and few vegetation take a long time to release heat compared to a rural area where surfaces that can heat and cool themselves include; asphalt, concrete, wood, steel and water. Open spaces on the other hand act as heat sinks that reduce the intensity of direct sunlight besides promoting the process of evapotranspiration whereby plants emit water vapor into the surrounding air thus lowering the temperatures of the surrounding air. Research has indicated that well covered areas by trees and other vegetation sources can lower temperatures in urban areas by several degrees thus improving thermal comfort particularly at times of high heat (McDonald et al., 2021). In addition to helping make cities more habitable this cooling effect also reduces the risk of heat associated health problems that are particularly more serious for populations that are most vulnerable including elderly and sick persons.

Other than cooling, green spaces also serve to filter the air as which is very crucial in managing local climate. Plants eliminate carbon dioxide, a known agent of greenhouse effect and global warming. During photosynthesis trees and plants can, and do, absorb the CO2 from the atmosphere, thus reducing the concentration of the greenhouse gas. This carbon sequestration job of green spaces becomes even more crucial in cities than in the countryside as carbon emissions are usually high because of different industries, vehicles, and power usage. A study has revealed that trees in urban environments city green spaces such as forests and parks help sequester carbon and thus play an important role as carbon reservoir in the face of climate change (Halecki et al., 2023). Therefore, through the provision of more urban green spaces, cities can improve their ability to look for carbon dioxide and in the process be part of the world's initiatives to mitigate greenhouse gases.

Besides, areas of greenery work to the advantage of combating with effects such as climate change since they come with natural solutions to stormwater management. Trees, green roofs and other vegetation surfaces play an important role in intercepting rain water and delaying runoff hence checking on flooding. This is particularly so in urban centres where runoff water is likely to cause flash floods due to poor water management infrastructure such as pavements, roofs and building structures of engineered surfaces. Land scape features like parks, wetlands, and rain gardens help in storing excessive water hence less demand on drainage facilities and therefore reduces possibility of floods (Sharma & Malaviya, 2021). Aside from preserving facilities from storms, these natural systems of stormwater control also eliminate most of the consequences in terms of both the costs of storms due to climate change.

Local biological diversity is another area where green space features can affect climate regulation in a given region. Turf and tree plant densities found in urban centers serve as homes

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to many plant and animal species thus promoting the conservation of species variety within cities. Heredity, urban ecosystems increase resilience by supporting diverse species that help cities cope better with climatic shocks. For example, the variations in plants in the green areas enhance the soil status, water holding capacity, and food to the pollinators, which enhances the general stability of the urban environment. Public green spaces are therefore important in ensuring conservation of the biophilltera in the event of increasing urbanization and climatic change (Semeraro et al., 2021).

From the climate regulation perspective, green spaces have great potential; however, planning constraints, spatial limitations and competing land use demands limit their achievement of their potential. Most of the time, green spaces are few and are patchy and unable to deliver all the benefits related to climate regulation. If green infrastructure is to prove effective in making our cities more climatically durable, the planners need to consider where the greenery is and where it is not in relation to these functions: to provide amenity areas to enhance temperature regulation, stormwater management, and carbon sequestration. Regular awards for architecture and design of green landscapes also prove that the expansion of green zones benefit citizens and help cities adapt to climate change consequences.

Biodiversity and Ecosystem Services

Biological habitats in urban development refer to avian habitants, mammals, plants, and other species that dominate the existing plants in cities and also benefit a lot from green spaces. Parks, gardens, forests, wetlands etc. are the green belt where plants and animals find shelter, food and breeding places in the middle of concrete jungle. Due to the increasing and development of urban areas and extension of urban centrality, the conservation of green areas plays an essential role in the preservation of bio-diversity. City ecosystems are the foundation of ecosystems resilience and assist cities to cope with environmental dilemmas for instance climate change, pollution and other environmental issues. Scholars have also found that creating good quality green spaces plays a key role in supporting the local bio-diversity ranging from plants, insects, birds and rodents in urban ecosystems (Jabbar et al., 2022). This serves not only as a protection of these habitats as conservation areas, but also as the provision of people with opportunities for free time together with nature.

Besides conserving species, cities also benefit from other ecosystem services that GU directly offers to human well-being. Ecosystem services refer to the value received by human beings from natural systems and green spaces have some benefits that enhance urban settings. There is nothing more significant as a service that Agua offers, and these are air purification services. Changes in plant foliage and litter reduce available air space for the accumulation of disease vectors, while also removing air pollutants including CO2, NO2 and particulate matter, thus reducing diseases associated with polluted air such as respiratory diseases (Mandal et al., 2023). Vegetation within the urban context a very important function of minimizing the impacts of air pollution that is a major threat to the health of people in many cities across the globe. Through enhancing better air quality, urban green places offer benefits in cut down effects of sicknesses including asthma besides other cardiovascular sicknesses primarily in densely populated areas.

Another essential ecosystem service related to urban green space is water regulation. Vegetation decreases stormwater by minimising surface runoff and increasing water infiltrated and water storage in the ground. Permeable pavement, green roofs, and bioswales rehearse forces of hydrology by letting the rainwater to be filtered by soil rather than draining quickly into streets, sewers, and storm drains, which results in floods and water contamination (Sanyal, 2022). The properties of minimizing and controlling storm water runoff make green spaces even more essential for urban areas that undergo common scenarios of floods and water

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shortage. This way, more green infrastructure implementation will alleviate the demand on the stormwater management systems in the cities.

The last ecosystem service that should be discussed regarding the urban green spaces is climate regulation. Urban green areas are vital within the context of alleviating the UHI or urban heat island it was discussed earlier. Plants play an important role in evapotranspiration, in which they release moisture to humidify the air around them; this greatly beneficial during heat waves as it makes city warmer and can decrease the health risks of temperatures (Ebi et al., 2021). Green areas keep carbon and fight climate change by holding carbon dioxide through photosynthesis. This shows how green spaces can provide a form of relief through cooling during the summer as well as work towards easing global problems of carbon day captured in these surfaces. This research has also shown that improving the biological diversity within green urban spaces can help to support ecological equilibrium as well as fight climate change.

The involvement of biological diversity in the design of urban areas also have social and educative gains. Public green spaces provide residents with ways of interacting with the natural environment thus promoting an appreciation of nature conservation. Urban green spaces must thus be made to act as facilities that enable the population, especially the young one, to engage in environmental studies, including those on plants and animals, as well as the dynamics of ecosystems, and others. Health promotion activities in green settings may enhance people's understanding of the value of protecting species and other ecological benefits that nature offers thus changing people's behavior and influencing local policies. Green areas that support diverse plant and animal species help increase the visual and cultural utility of urban environments and are more than simple areas of ecological significance.

On balance, the prospects for the right utilization of the services of green intramural land in the context of extant and emerging ecological, social, and economic conditions are crucial to the welfare of cities. As result of the increasing urbanization, there is need to make sure that as much green areas as possible are protected or further developed in order to ensure that there is room for the development of human civilization as well as for the natural environment. Therefore, focusing on biodiversity and ecosystem benefits in planning the urban development, cities can shape healthier, even more resilient, and more sustainable current and future environments.

Conclusion

This paper aims to review the significance of urban green spaces in relation to environmental health in order to determine just how important it is that more green spaces are constructed in our cities. Besides, the effect of heat, pollution, and climate change is reduced through these spaces apart from contributing to psychological and social health of the citizens, making urban life better. With the ever-increasing pace of urbanization, the need to maintain and develop green areas is the key to our sustainable future. What the green infrastructures aim at is when incorporated within the cities, they offer solutions to some of the critical environmental issues apart from enhancing urban resilience and the welfare of the people.

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