Examination of the Concept of Green City in the Context of the Urban Qualities of Sarajevo

Zahide İnal Karić
Bursa Technical University

Historically recognized as central hubs for population, culture, innovation, and governance, cities face challenges like climate crisis and pollution due to urbanization, necessitating a shift towards sustainability. The "green city" concept emerges to address this, focusing on efficient resource use and reduced pollution. This study examines Sarajevo through green city criteria, delving into its geographical, historical, and cultural dimensions. Pollution types are scrutinized for environmental impact. Findings drive recommendations for Sarajevo's evolution into a sustainable urban hub, emphasizing the broader importance of crafting resilient, environmentally conscious cities that prioritize resident well-being and preserve resources for the future.

Keywords: Green City, Sarajevo, sustainability

INTRODUCTION

Cities have played a significant role in human history, serving as centers for population, culture, innovation, and governance. Throughout history, cities have been hubs where cultures meet, trade flourishes, and knowledge and technology are shared, making them socially, economically, and culturally important for humanity. Technological innovations, social interactions, infrastructure, and connectivity, health, and well-being are some concepts that signify the importance of cities in human life. Consequently, when examining behavioral patterns from the past to the present, it is evident that people have migrated from villages and towns to cities. This behavior indicates a trend where many individuals transition to urban life and will continue to do so.

However, the urban lifestyle, easily adaptable as it is for many, has led to serious environmental issues such as pollution, deforestation, and resource depletion, particularly in the last century. Urbanization contributes to universal problems like climate change, waste generation, and increased energy consumption, exacerbating existing issues. With the awareness of these problems and their escalation, sustainable practices have gained importance.

In 1987, the United Nations defined sustainable development in the Brundtland Report as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The crises induced by urbanization, such as climate change, pollution, and resource depletion, have prompted individuals and governments to create cities that prioritize sustainability. The concept of the "green city" has emerged as a response to these challenges. As the term sustainability suggests, a green city aims to create urban environments that prioritize environmental responsibility and the well-being of residents.

Green cities bring many benefits to the people residing in them. The fundamental driving force behind sustainable cities is the necessity to preserve the natural world and urban populations. Recent events, such as uncontrolled forest fires, have vividly demonstrated the destructive cost of industrialized and urban lifestyles. The latest report from the Intergovernmental Panel on Climate Change emphasizes the alarming trends in global pollution, highlighting the urgent need for global environmental measures. To prevent these outcomes, building and renovating cities to increase renewable energy usage, along with limiting car use, must be crucial barriers against carbon emissions.

Green cities, based on the principle of sustainability, are designed urban areas that aim to reduce environmental impacts, preserve natural resources, and provide a livable environment. Calthorpe, emphasized creating "destinations closer together," stating that a simpler and more elegant solution than collecting acres of solar collectors for a new fleet of electric cars and providing them with power is needed. This design decision is impacted by both environmental and social considerations. The sustainability principles of New Urbanism emphasize the importance of incorporating local retail and accessible public areas to develop neighborhoods that are walkable and diverse in income. The focus on "human-scale" communities promotes movement, social engagement, connectivity, and contributes to the urban environment's distinctive character. Consequently, sustainable cities, beyond their eco-friendliness, evolve into green cities that prioritize human well-being. Currently, many plans around the world are referred to as sustainable or green cities, both implemented and in the project phase. The implementation of these plans is possible through meeting specific criteria.

This study consists of four parts, including the introduction section. In the introduction section, urbanization is discussed, the relationship with the concept of sustainability is emphasized, and the green city concept is defined. The second part, which examines the green city concept from a literature perspective, explores the definition and historical development of the green city concept. This concept is explained comprehensively, and three criteria for a city to be considered a green city are identified as low consumption of resources, low-pollution production, and being healthy. This part also addresses the topics within the scope of the research for meeting these criteria. Additionally, this section provides examples of projects that have been implemented as green cities worldwide. The third part, which focuses on the selected study area, Sarajevo, is geographically and historically examined in terms of cultural, social, and ethnic aspects. The city is evaluated in terms of meeting green city criteria in all aspects. This section first evaluates Sarajevo in terms of the criterion of consuming fewer resources, assessing the consumption criteria of water and energy resources. Then, it analyzes how Sarajevo meets the second criterion of producing less pollution concerning land, air, water, noise, visual, and electromagnetic pollution. Finally, in the third part, the health criterion of the city is examined in terms of physical, psychological, and social health. In the fourth part of the study, which is the conclusion and recommendations section, based on whether the city meets the defined criteria or not, some deductions and analyses are presented, and solutions and methods that can be developed and implemented are explained.

This study aims to analyze Sarajevo, the capital city of Bosnia and Herzegovina, which holds a special place geographically, through the determined green city criteria and to examine how this city can be transformed into a green city by implementing certain steps and procedures based on the results of the analysis.

MATERIALS AND METHODS

A green city refers to urban planning and design that extensively embraces environment-friendly practices, focusing on the principles and goals of sustainability. Such cities encompass various policies and practices aimed at preserving natural resources, increasing green spaces, and promoting environmental sustainability. In this research, a green city is examined based on the main criteria identified as *low consumption of resources, low-pollution production, and being healthy*.

DEFINITION AND HISTORICAL DEVELOPMENT OF THE GREEN CITY CONCEPT

The increasing demand for energy resources and raw materials in the 1970s, along with the rising environmental pollution, gave rise to the concept of sustainability. In 1984, the World Commission on Environment and Development (WCED) convened for the first time and published the Brundtland Report in the spring of 1987. In this document, sustainable development was characterized as "the ongoing effort to fulfill current requirements while ensuring that the capacity of future generations to meet their own needs remains unimpaired."

This definition encompasses two different approaches. The first is a human-centric approach, also known as "anthropocentric," where the focus is on placing humans at the center and addressing the basic needs of humans, today and in the future. The alternative perspective is known as an ecocentric approach, where in the focal point is environmental equilibrium, and the objective is to avoid compromising the natural capacities to fulfill present and future environmental needs by implementing initiatives that address human needs. A sustainable urban area, commonly known as a "green city" or "eco-city," gives precedence to economic, social, and physical health and well-being, along with the conservation of the natural environment, in its planning, development, and functioning. For developing countries, sustainable development involves improving the economic and social environment while preserving the environment and natural resources. In contrast, for industrialized countries, it means maintaining current levels of development and prosperity, enhancing quality of life, promoting environmental values, and protecting the environment. The notion of a green city possesses a multifaceted definition, frequently acknowledged for its impact on economic, social, cultural, ecological, and comparable spheres. The rise in prominence of the dispersed city model during the 20th century not only went against the more condensed cities of the 19th century but also resulted in adverse effects on infrastructure and resources. In response, alternative growth strategies with reduced environmental impact have been investigated.

A review of the literature reveals various structures, often referred to as "Eco-city," "Sustainable city," "Compact city," and similar terms, fundamentally converging as "Green cities." Such cities aim to bring a more environment-friendly and sustainable approach despite sustained urban growth.

In this context, green cities are defined as urban environments that highlight the natural environment, generate less pollution and consumption, actively use renewable energy sources, and, in doing so, create a highly sustainable and quality living environment. These cities adopt economically sensitive production and consumption patterns that protect and enhance the well-being and health of the population. A green city represents an urban planning and design approach that aims to promote ecologically sound practices, conserve natural resources, and provide residents with healthy living conditions. In this study, green city criteria have been established, defining a green city as one that, according to these criteria, consumes fewer resources, generates less pollution, and prioritizes health.

GREEN CITY CRITERIA

Today, the green city approach is a significant urban planning trend that promotes ecofriendly practices in line with the principles and goals of sustainability, aiming to enhance the livability of cities. Environmental factors, mainly pollution such as air, soil, and electromagnetic pollution, generated by industrial activities, have become a driving force for the implementation of green cities and sustainability. Bergmann argued that the principles advocated for solving environmental problems are directly linked to the conceptual framework of green cities and sustainable development, expressing these principles as follows:

- Firstly, the share of renewable energy in renewable resources should always be considered.
- Non-renewable resources such as oil and coal should be strictly preserved and only used in necessary situations due to their adverse effects on the environment.
- Emphasis should be placed on renewable resources in consumption, resorting to the use of non-renewable resources only in cases of depletion or insufficiency of renewable resources.

- Technological capabilities should be utilized to consume resources much less. These capabilities can be applied in many areas, from reducing technological pollution to eliminating it altogether.
- Threshold values in pollution should not be exceeded. In other words, leaving more than nature can bear will lead to the destruction of the future. It is essential to remember that environmental pollution exhibits a cumulative characteristic.
- City residents should be provided with significant opportunities such as green spaces, clean air, sustainable transportation options, and easy access to healthcare services.

For a city to be classified as a "Green City," it is believed to need to meet three criteria: low consumption of resources, low-pollution production, and being healthy.

Less Consumption of Resources

At the forefront of green city criteria is the principle of low consumption of resources. While taking steps to create a green environment, ensuring the best possible transfer of resources from the past to future generations should be one of humanity's primary goals. According to the World Health Organization, consuming less resources is an approach aimed at preserving environmental sustainability and human health by using natural resources and energy efficiently.

Less Consumption of Water Resources

Water holds a crucial place in everyday life, necessitating a constant emphasis on improving and preserving its quality. The rapidly increasing population density worldwide draws attention to the indispensability of water, a paramount element for human existence, resulting in a significant global freshwater scarcity. Consequently, wastewater treatment and water reuse have become critical topics, prompting scientists to seek cost-effective and suitable technologies. The concept of minimizing water consumption involves the efficient utilization of water and prevention of wastage. In the context of designing a green city, this entails strategies and practices aimed at reducing water consumption. Such methods require the adoption of a multifaceted approach encompassing technological advancements, policy interventions, and public participation, with the goal of sustaining water management while preserving the quality of urban life. The UN plays a pivotal global leadership role in the prudent use and sustainable management of water resources. In pursuit of safeguarding the universal right to clean drinking water, the UN encourages the conscious management and non-wasteful utilization of water resources. Additionally, the UN underscores the role of water resources in combating climate change, as alterations in the water cycle can lead to reductions or alterations in water resources. Consequently, the UN executes various programs to align and protect water resources with climate change. Water treatment technologies, employed for purposes such as reducing water consumption, wastewater treatment, and recycling, hold paramount importance and play a significant role in the methods employed when designing a green city. When planning a green city with minimized water consumption, the following steps can be taken:

Water-Efficient Infrastructure. Prioritizing the development of infrastructure that aims to use water efficiently is essential for green cities. This involves the integration of low-flow fixtures, dual-flush toilets, sensor-based irrigation systems, and similar technologies that minimize water wastage without compromising functionality.

Graywater and Rainwater Harvesting. The use of graywater and rainwater collection systems is crucial for a green city. Graywater, derived from lightly polluted water sources like showers and sinks, can be treated for reuse in non-potable purposes such as garden irrigation or toilet flushing. Similarly, rainwater can be collected, stored, and utilized for various non-potable purposes, reducing pressure on freshwater sources. Rainwater harvesting systems typically involve collecting rainwater from impermeable surfaces like a building's roof, directing it through gutters and drainage pipes to storage tanks or reservoirs. Filtration systems improve the quality of the transported water, removing residues, leaves, and other particles, preventing clogging of the storage system. The stored rainwater is then distributed to users for intended applications.

Water Pricing and Incentives. An appropriate pricing structure and incentives can significantly influence water consumption habits. Green cities may implement tiered pricing, where the cost per unit of water increases as consumption rises. Additionally, offering incentives for water-efficient devices or rainwater harvesting systems can motivate residents and businesses to adopt water-saving measures.

Efficient Landscape and Urban Design. Urban planning in green cities should prioritize water-sensitive landscape and design principles. This includes the use of native or drought-resistant plants, implementation of efficient irrigation techniques like drip irrigation, and the use of permeable surfaces that prevent water runoff.

Water Conservation Education. Public awareness and education play a crucial role in reducing water consumption. Green cities should develop comprehensive educational campaigns to encourage the adoption of water-saving practices among residents, businesses, and institutions. These campaigns can highlight the importance of water conservation, provide practical tips for reducing water usage, and increase awareness of the value of water.

Smart Water Management. Technologies like smart water management systems can ensure efficient water management in a green city. These systems provide real-time data on water consumption, enabling early detection of leaks, optimization of water usage, and informed decision-making for water resource planning.

Less Consumption of Energy Resources

Energy sources are classified into two main categories: non-renewable (fossil) energy sources and renewable energy sources. Non-renewable energy sources are finite and depletable sources, often known as fossil fuels, and can be problematic for sustainability due to their environmental impacts and greenhouse gas emissions.

Examples include:

- Petroleum: Widely used for transportation, industry, and energy production.
- Natural Gas: Used for heating and energy production in homes.
- Coal: A fuel used for electricity generation in thermal power plants.

These energy sources are utilized to varying extents globally to meet energy needs. However, the overconsumption of resources and increasing demand have led to a push for efficient energy use and the acceleration of renewable energy-based initiatives. Moreover, due to the lesser environmental impact of renewable energy, it holds the potential to provide a sustainable energy future. Therefore, in a green city, the use of renewable energy is more appropriate than non-renewable energy sources. Renewable energy sources refer to energy produced using continuously replenished natural processes, making them inexhaustible. Solar, wind, hydropower, biomass, and geothermal energy are among the renewable energy sources. The concept of minimizing energy consumption involves the efficient and effective use of energy, as well as preventing energy waste. This concept aims to manage energy resources sustainably, increase energy efficiency, and reduce energy demand. In green city planning, minimizing energy consumption is of great importance, and for this purpose, energy-saving measures should be taken, energy awareness should be increased, the use of energy-efficient technologies should be promoted, and emphasis should be placed on renewable energy sources in energy production. Below are some commonly used renewable energy sources that can be utilized when planning a green city:

Solar Energy. Utilizing solar energy involves harnessing the light and heat energy from the sun for various purposes, such as electricity generation or water heating. Harnessing solar energy helps reduce energy costs, decrease energy dependence, minimize environmental impacts, and contribute to energy sustainability.

Wind Energy. Harnessing wind energy when designing a green city contributes to a sustainable energy future and ensures energy security. Wind turbines are used to convert wind energy into mechanical or electrical energy. These turbines capture the kinetic energy obtained from the force of the wind, directing it to generators to produce electricity, which is then distributed to residents of the green city.

Hydropower Energy. The potential energy in water sources can be converted into electricity through hydroelectric power plants. The water in hydroelectric power plants carries a large amount of energy due

to its flow from a height, and this energy is converted into electricity through turbines and generators. At the end of the process, this electrical energy is delivered to the residents of the green city.

Biomass Energy. Energy obtained by burning or fermenting organic matter (trees, plants, waste, etc.) is called biomass energy. This energy, also referred to as organic carbon, can contain energy residues even when in waste form because these organic wastes, having previously trapped solar energy through photosynthesis, retain the energy remnants within them. Therefore, when these organic wastes are burned, trapped energy is released. Biomass energy encourages the use of sustainable energy sources in green city design, offering the potential to provide environmentally friendly energy. In the process of biomass energy production, equipment such as boilers for fuel breakdown and loading, firing, water supply, conditioning and filtration systems, steam boilers, turbines, and energy fuel systems are used. Various types of fuels are produced using these technologies, and due to the renewable nature of these fuel types, a more sustainable energy source is obtained.

Geothermal Energy. Geothermal energy is heat from the earth. It is possible to heat buildings or generate electricity using steam and hot water produced underground. Geothermal energy is a renewable energy source because it relies on the continuous production of steam and heat inside the earth, where the heat source is constantly replenished by rainfall. The use of geothermal energy is of great importance in green city planning. The natural replenishment of heat on the Earth's surface and the extraction of thermal energy stored underground make geothermal energy a continuous source, reducing dependence on external energy supplies. Additionally, as it does not emit harmful emissions into the atmosphere, this energy method enhances energy security and contributes to a more stable energy supply in green cities. Geothermal power plants rotate turbines attached to generators using high-temperature water, steam, or gas obtained from underground, functioning as systems that produce electricity. The energy produced through this method is delivered to city residents in a cleaner, more sustainable, and cost-effective way for the atmosphere.

In conclusion, a green city designed with the principle of minimizing energy consumption will rely more on renewable energy sources. This not only provides a more beneficial design option for the atmosphere and the Earth but also reduces energy costs for green city residents, decreases energy dependence, minimizes environmental impacts, helps ensure energy sustainability, and offers a more reliable energy source.

Producing Less Pollution

The term "low-pollution production" refers to the reduction or prevention of harmful waste, emissions, and pollution to the environment through production processes, activities, or technologies, aiming to minimize environmental impacts and negative consequences. This term represents an approach that aims to achieve environmental protection and sustainability goals, making it one of the key processes that should be utilized in green city design. Pollution reduction can be applied in various areas, from energy production to industrial manufacturing processes, waste management to transportation systems. The use of clean technologies, recycling and waste reduction measures, and methods such as controlling air and water pollution support pollution reduction efforts in these processes. The goal of these measures is to ensure environmental sustainability and protect human health. The design of a green city plays a significant role in pollution reduction and environmental sustainability. Therefore, a green city must have the criterion of low-pollution production. A well-planned green city design can take a series of measures into account and include them in the design process to reduce pollution. These measures may include waste management, water treatment, improving air quality, preserving, and expanding green infrastructure, noise control, and sustainable transportation. Soil, water, air, noise, and light are just a few of the main sources of pollution in a city, and the various types of pollution are explained below. Additionally, ways to minimize these pollutants are discussed, and measures that can be taken in this regard are highlighted.

Soil Pollution

Soil pollution refers to the condition where harmful substances accumulate in the soil or the properties of the soil are disrupted, resulting in the impairment of its natural functions. Pollutants causing soil pollution

can come from various sources such as heavy metals, chemical pollutants, agricultural pesticides, industrial wastes, and petroleum products. Soil pollution can have adverse effects on vegetation and agricultural productivity, as well as harm groundwater sources and ecosystems. Therefore, preventing, controlling, and remedying soil pollution are considered important goals for environmental sustainability, and it is an aspect that should be taken into account in the process of green city design. Soil pollution in urban areas arises from both natural and artificial factors. Among natural factors are erosion, soil particles transported by wind and water flow, volcanic activities, and geochemical interactions. These are natural processes and cannot be directly controlled by urban design, but appropriate measures can be taken to reduce their impacts. Artificial factors result from human activities. Industrial activities, agricultural practices, domestic and industrial wastes, petroleum and chemical leaks, mining activities, and other factors can contribute to soil pollution. In the urban design process, industrial zones are one of the major problems contributing to urban pollution. Incorrect placement of industrial zones significantly affects the ecosystem and social life. Pollutants released from industrial, transportation, and other economic activities can reach the soil, where they are diluted and temporarily stored over long distances. Soil, an integral part of the infrastructure, is considered polluted when harmful substances adversely affect human health or the environment.

In the design of a green city, sustainable land use, environmental protection measures, and appropriate planning policies will be crucial in preventing soil pollution and reducing it. This will contribute to cities having a healthier and more sustainable environment.

Air Pollution

Air pollution is the contamination of the indoor or outdoor environment by any chemical, physical, or biological agent that alters the natural characteristics of the atmosphere. The sources of air pollution are numerous and situation specific. Outdoor pollution sources include residential energy use for cooking and heating, vehicles, energy production, agriculture/waste incineration, and industry. Some household appliances, motor vehicles, industrial facilities, and forest fires are common sources of air pollution. Among the major pollutants causing public health concerns are particulate matter, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide. For example, sulfur dioxide is a gas that contributes significantly to air pollution, constituting approximately 18% of airborne pollutants. The source of this gas is the combustion of fuel materials like coal and oil. Additionally, waste from certain industrial sectors can also release sulfur dioxide gas into the atmosphere. Sulfur dioxide is a major contributor to urban air pollution, with high levels often found in areas with heavy traffic, densely populated residential zones, and along transportation routes in urban work areas. Particularly during winter months, the emission of this gas increases during residential heating in areas where fossil fuels are used. Therefore, sulfur dioxide levels are especially high in such regions, negatively impacting urban air quality. In green city design, there are various measures that should be taken to reduce air pollution. Urban planners should prioritize implementing a plan that encourages the transition to clean energy sources and reduces the use of fossil fuels.

Water Pollution

Water is a fundamental prerequisite for the life of all organisms on Earth. For living beings to exist normally, the water they inhabit, or use must have a natural chemical composition and natural properties. As human activities alter the chemical composition and relationships within water significantly, we can say that the water is polluted. Water pollution is a global problem, and the world community faces the direct consequences of polluted water. The main sources of water pollution include the discharge of domestic and agricultural waste, population growth, excessive pesticide and fertilizer use, and urbanization. Bacterial, viral, and parasitic diseases spread through contaminated water, affecting human health. Urban planners can establish effective wastewater treatment systems to prevent water pollution, reduce excessive pesticide and fertilizer use by supporting sustainable farming practices, protect water sources in urban planning, and adopt comprehensive measures to reduce water pollution by embracing sustainable water management strategies. Water pollution is directly related to urban design. Factors such as construction in cities, industrial activities, agricultural practices, and infrastructure systems can lead to the contamination of water

sources. Proper design of a green city plays a significant role in reducing water pollution. Firstly, the impacts of infrastructure systems that can cause water pollution in green cities should be minimized. Infrastructure such as sewage systems and wastewater treatment plants play a crucial role in controlling water pollution. Proper planning and efficient operation of these systems ensure the appropriate treatment of wastewater. Secondly, urban designs focusing on green infrastructure and sustainable water management are effective in reducing water pollution. Increasing green spaces and permeable surfaces helps rainwater naturally infiltrate the soil and seep into underground water sources. Additionally, it is essential not to locate agricultural areas and industrial zones near water sources in green cities. This reduces the risk of pollution and contributes to the natural preservation of water sources. Furthermore, promoting green infrastructure (green roofs, vegetation, natural wetlands) in cities can facilitate the natural filtration and purification of water. This controls the flow of water within the city while reducing the risk of water pollution. Education and awareness campaigns are also crucial in the fight against water pollution in urban design. Raising public awareness about water usage, wastewater management, and the effects of pollution can help create a culture of sustainable water management.

Noise Pollution

Noise pollution can be defined as unpleasant, distracting, and/or physically painful noise created by humans or machines. It can be outdoor-sourced, such as from road traffic, jet planes, garbage trucks, construction equipment, certain manufacturing processes, lawnmowers, leaf blowers, or indoor-sourced. Noise pollution is a relatively underestimated issue, but it is a type of pollution that requires attention, especially due to its potential adverse effects on health. This type of pollution occurs when we are exposed to unwanted, repetitive, and high-intensity noise in our surroundings. The potential health effects of this type of pollution include increased stress levels, sleep disorders, and hearing damage. The accumulation of both natural and artificial, sudden and repetitive sounds can potentially have a negative impact on the health of humans and animals. It can be concluded that people living in densely populated areas or staying in industrial areas are most exposed to noise pollution. Individuals living in areas with high levels of noise pollution may become irritable, tense, or angry. If a person feels they cannot control the amount of noise around them, perhaps because the source of the sound is artificial and the generated noise is repetitive and systematic, these negative effects may intensify. Noise pollution is closely related to urban design and is an important factor to be considered in the planning process of a green city. Intense traffic, industrial facilities, construction activities, and other sources of noise in cities can cause noise problems that affect people's daily lives. Therefore, some strategies should be adopted in urban design to reduce noise pollution. Adequate distances between areas with different functions need to be ensured. For example, there should be enough distance between residential areas and busy roads. This reduces the risk of people living in homes being affected by traffic noise. Additionally, noise sources such as entertainment venues or industrial areas should be located away from residential areas.

The adverse effects of noise pollution, which should not be underestimated, can be mitigated through infrastructure planning, noise barriers, proper placement of green spaces, and noise control in vehicles. Thus, a green city design away from noise pollution can be achieved.

Visual Pollution

Visual pollution is a situation where disturbing and harmful environmental images created by humans come together, and such images can disrupt the natural landscape, negatively impact health, and adversely affect daily life. The open storage of trash, antennas, power cables, buildings, and cars is often considered visual pollution. Overcrowding in an area also causes visual pollution. Visual pollution is often defined as the totality of irregular formations found in nature. Being exposed to visual pollution can lead to issues such as attention distraction, eye fatigue, decreased cognitive diversity, and identity loss. Visual pollution can negatively affect the livability and attractiveness of cities. Therefore, in urban design, the importance of aesthetic value should be considered, and strategies to reduce visual pollution should be adopted. This way, it is possible to ensure that people live in a more enjoyable and visually appealing environment.

Various strategies and policies should be implemented to prevent visual pollution in cities. Visual

pollution has a significant impact on the livability and aesthetics of cities. The measures mentioned above are just a few methods that can be used to reduce visual pollution in cities. Since each city has its unique needs and priorities, developing solutions tailored to local conditions is important. Taking these measures is essential when designing a green city to prevent visual pollution.

Electro Magnetic Pollution

Electromagnetic pollution is a term that refers to the unwanted effects arising from electromagnetic fields in our environment. Electromagnetic pollution is associated with the intensity and impact of electromagnetic radiation emitted from sources such as power lines, wireless communication devices, radio frequency (RF) signals, Wi-Fi networks, cell phone towers, and other electronic devices. This type of pollution is considered a concern because it might have adverse effects on environmental and human health. For example, a study found that the incidence of brain cancer was 7 times higher among workers on power lines. In the urban design process, electromagnetic pollution should be addressed by considering various factors. Firstly, in green city design, efforts are made to minimize environmental effects by avoiding sources of electromagnetic radiation such as power lines, cell phone transmitters, and other electromagnetic radiation sources. Therefore, an urban planner can design electrical infrastructure outside residential areas, and in residential areas and prioritize low-radiation technologies such as underground cabling. This way, exposure to electromagnetic radiation for residents and the natural environment in green cities is minimized. Similarly, the requirement the sensitive areas with high human density, such as schools, hospitals, and parks maintaining low levels of electromagnetic radiation should always be considered by the urban planner. High-voltage lines should be at least 50 meters away from each side of a house, and their height should be 9 meters and 45 centimeters. Additionally, electromagnetic pollution should be taken into account in building design. Using electromagnetic shielding materials can help limit the electromagnetic fields inside buildings. Electrical installations and communication systems in buildings should be designed appropriately to minimize electromagnetic radiation emissions to protect against electromagnetic pollution.

Public awareness and education campaigns should inform the public about electromagnetic pollution. It is essential for individuals to be knowledgeable about the potential effects of everyday electronic devices and wireless communication technologies. This way, individuals can make informed choices to keep electromagnetic radiation levels low in their living and working environments. The establishment and enforcement of standards and regulations are also crucial to keeping electromagnetic pollution under control. Standards defining acceptable levels of electromagnetic radiation should be established at national and international levels, and compliance with these standards should be ensured.

Being Healthy

Health is not merely the absence of disease and disability; it is a complete state of physical, mental, and social well-being. In the context of green city design, the criterion of being healthy is crucial. A healthy city enhances overall well-being, reduces healthcare costs, minimizes environmental impacts, and improves residents' quality of life.

The condition of being healthy in a city can be evaluated from physical, psychological, and sociological perspectives. When designing a green city, necessary measures and regulations should be implemented in all three aspects. The following are explanations of the measures and practices to be taken in these three approaches and contexts.

Physical Health

Physical health is directly related to the design of a city, and the physical environment of cities is a crucial factor for people to lead a healthy life. The design of a green city requires the creation of environments that encourage people to engage in physical activities, provide healthy transportation options, and consider environmental factors that enhance the quality of life. Strong and environmentally friendly communities bring about increased mental and physical well-being. Green cities, due to their inherent environmental and community-centric principles, are naturally more walkable. A recent survey showed that 57% of those who described their communities as walkable also rated their quality of life as "high". People

living in walkable cities also engage in more daily exercise, leading to a lower risk of cardiovascular diseases. Increased walkability requires fewer vehicles on the road, meaning less pollution. Additionally, this factor creates a self-renewing system by providing cleaner and more breathable air.

In the design and planning of a green city, the urban planner should consider the factors influencing people's physical health, and make efforts to create environments that support them in leading a healthy life.

Psychological Health

Psychological health refers to an individual's emotional and mental well-being. It involves maintaining emotional balance, developing coping skills for stress, forming healthy relationships, and achieving overall life satisfaction. Living in a city can encompass various factors that may have negative effects on emotional and mental health for some individuals. However, the impact of urban living on mood disorders can vary from person to person, and numerous factors can influence these effects. Some of these factors include:

- Stress: Cities often have factors like high population density, fast-paced lifestyles, traffic congestion, noise, and other stressors. These factors can increase stress levels and contribute to emotional health problems.
- Lack of Natural Environment: Limited green spaces and the absence of a natural environment in cities can weaken people's connection to nature, potentially impacting emotional well-being. Recent research has shown that spending as little as two hours per week in nature leads to a higher quality of life compared to those who do not.
- Social Isolation: Even within a large urban population, social isolation and feelings of loneliness can be prevalent. This can contribute to the emergence of emotional health problems.
- Transportation Challenges: Traffic congestion and long commute times in cities can lead to time pressure and stress in people's daily lives, potentially having negative effects on emotional health.

Green cities should be designed to encourage interconnectedness. Studies show that individuals who feel more connected to others have lower rates of anxiety and depression. Therefore, a green city designer should create spaces and opportunities that facilitate people interacting with each other. Social spaces encourage community gatherings, enhance neighborhood relationships, and promote interaction among individuals. These social bonds allow people to live in an environment filled with a sense of support and solidarity, contributing to feeling better psychologically.

Urban design is a crucial factor influencing people's psychological health. The presence of natural and green spaces, strengthening social connections, and human-friendly architectural design elements help cities have positive effects on psychological health. Therefore, in the planning and design stages of a green city, a perspective on psychological health should be considered, and an environment supporting people's well-being should be created by the urban planner.

Sociological Health

Sociological health is a concept that focuses on individuals' social environments and societal relationships. Factors such as individuals' roles in society, social norms, group interactions, and social support are essential in terms of sociological health. Sociological health is associated with elements like forming social identity, maintaining social relationships, integrating into society, and experiencing social justice. Given that social structures, interpersonal relationships, and social bonds in a city have significant effects, sociological well-being is closely related to urban design. Cities are complex social spaces where different social groups come together, interact, and coexist. Therefore, urban design should be considered a crucial factor in sociological well-being, and when designing a green city, people's sociological health should be taken into account. The social structures of cities are places where various segments of society live together and interact. In designing a green city, it is important to encourage the integration of different social groups and promote social equality. Green city design should consider measures to address potential issues arising from the coming together of people with different religious views. Socially balanced and

diverse neighborhoods allow individuals to interact with people from different cultural, ethnic, and socio-economic backgrounds. This strengthens social ties, increases social solidarity, and reduces social isolation. Social life in a city can be analyzed based on specific criteria:

- Forming groups,
- Adhering to rules and norms, and
- Undergoing the process of socialization.

The concept of sociological health can be considered an integral part of green city design. Therefore, such design should create areas where different social groups live together and interact, encourage social interaction, support social justice, and ensure social equality. This way, socially healthy, supportive, and inclusive living environments can be established in cities.

RESEARCH AREA

Sarajevo, the capital of Bosnia and Herzegovina, is the most significant political, socio-economic, educational, and cultural center. From a mathematical and geographical perspective, the city center is located approximately at the geographical coordinates of 43° 51' North latitude and 18° 25' East longitude. While Bosnia and Herzegovina are situated in the southeastern part of the European continent, it is in the northwest corner of the Balkan Peninsula. To the east of Bosnia and Herzegovina is Serbia, to the southeast is Montenegro, and to the north and west is Croatia (Figure 1).

FIGURE 1
GEOGRAPHİCAL LOCATİON OF THE CITY OF SARAJEVO

The history of Sarajevo is rooted in centuries of development under the influence of various civilizations. The city was founded during the Roman Empire period and became part of the Byzantine Empire. However, its true historical significance began in the mid-15th century when the city was conquered by the Ottoman Empire. During the Ottoman Empire period, Sarajevo became the capital of the Bosnia Eyalet, and the city was adorned with many mosques, bridges, and bazaars. The traces of the Ottoman period are still visible in the city. Sarajevo's historical urban development has integrated factors such as sustainability, efficient use of natural resources, planned urbanization, and preservation of cultural heritage, addressing the needs of both today and the capacity to meet the requirements of future generations sustainably.

Today, Sarajevo stands out for its rich cultural heritage, ethnic and religious diversity, architectural traces from the Ottoman and Austro-Hungarian periods, and symbol of peace. Besides being an attractive destination for tourists, it continues to be an important political and economic center as the capital of Bosnia and Herzegovina. Despite the challenges it has faced throughout history, Sarajevo has managed to preserve its identity and is thus considered a historical and cultural treasure.

Examination of Sarajevo in Terms of Green City Criteria

The analysis conducted in this section aims to demonstrate how green Sarajevo is and which criteria it hypothetically fulfills based on the given criteria. The city's status in terms of low consumption of resources, low-pollution production, and being healthy is examined from the perspective of the specified criteria.

Low Consumption of Resources in Sarajevo

In this section of the research, the minimal consumption of water and energy resources is examined through the city of Sarajevo. The assessment of *low consumption of water* includes criteria such as water-efficient infrastructure, grey and rainwater harvesting, water pricing and incentives, landscape-appropriate plant selection, water conservation education, and smart water management. The city is also examined from the perspective of criteria set for the *low consumption of energy resources*.

Minimal Water Consumption in Sarajevo. Sarajevo's geographical location and historical reliance on water sources have held strategic importance for Sarajevo and the entire region of Bosnia and Herzegovina. In Sarajevo, the entire population consumes spring water from natural sources, which is crucial for physical health. These water resources have played a critical role in sustaining life in the city and supporting its cultural development. The study in this section examines Sarajevo through the lens of green city criteria set for ensuring the low consumption of water resources.

Water-Efficient Infrastructure. The use of low-flow fixtures, dual-flush toilets, and sensor-based irrigation systems is not regulated by municipal or local authorities in the city of Sarajevo. Despite the absence of legal regulations or laws, investors implement these practices for water conservation purposes in newly constructed buildings.

Greywater and Rainwater Harvesting. There is no centralized facility in the Sarajevo region for the treatment and collection of rainwater for later use. However, the law specifies that the collection and use of rainwater on private properties are permitted.

Water Pricing and Incentives. Similar to green cities, the tiered pricing system, where the unit cost of water increases with rising water consumption, is implemented in the regulations of the Sarajevo city. The increase in prices based on consumption results in a corresponding rise in costs as water consumption increases. This rule applies to the household consumption category.

Landscaping With Suitable Plant Selection. In Sarajevo, the city employs plant species that are slow-growing, evergreen, drought-tolerant, easily maintained, including cypress, common oak, boxwood, laurel, myrtle, and box plants. Planting trees that are sustainable, require minimal irrigation, and do not require additional work and cleaning in their surroundings is handled with special importance. The use of drought-resistant plants during the summer months is also a considered factor.

Water Conservation Education. Water conservation education in the Sarajevo region encompasses all segments of society, from small children in schools to adults. In 2016, the Sarajevo municipality issued instructions on ways to save water at home. The aim of the education is to increase awareness about water conservation. Both the government and non-governmental organizations play a crucial role in educating the public about water consumption.

Smart Water Management. In Sarajevo, there are no legal regulations covering smart technologies related to smart water management, such as early leak detection and efficient water use planning in a green city, and these technologies are not being utilized. Individuals can independently acquire and use these technologies based on their preferences and economic conditions, independent of local authorities.

In conclusion, the city of Sarajevo hypothetically does not meet most of the criteria set for the conservation of water resources and the reduction of water consumption.

Minimal Consumption of Energy Resources in Sarajevo. For Sarajevo, energy sources play a crucial role in supporting the city's economic growth, sustaining industrial activities, and meeting the daily energy needs of daily life, forming the foundation for comprehensive development. These energy sources play a vital role in maintaining the city's social and economic balance, ensuring environmental sustainability, and enhancing the quality of life. Regarding the conservation of resources, the consumption of energy sources is a significant aspect. In Sarajevo, the consumption of energy sources for the conservation of resources has been examined based on criteria such as the use of solar, wind, hydroelectric, biomass, and geothermal energy.

Solar Energy. Sarajevo, situated in a temperate continental climate region influenced by both northern continental and southern Mediterranean climates, experiences an annual average temperature of 9.5 °C. While there is no solar production facility established by local authorities, individuals are permitted to harness solar energy on their land or rooftops under current laws. Incentive programs support individuals constructing solar power plants for personal energy needs, with initiatives to sell excess electricity. The city boasts diverse solar applications, from panels and solar trees in the streets to solar benches providing ambient lighting and USB charging ports. The interest in solar energy extends to private companies, with major installations on shopping malls and hospitals contributing to sustainability efforts.

Building Orientation. According to the law defined by local authorities, buildings must be constructed based on the best possible solution for orientation to benefit from sunlight and reduce additional energy costs. "Urban construction land is primarily divided into various regions based on the natural and positional advantages of the land, existing public infrastructure conveniences that may arise during use. Factors among natural and ecological conditions include land slope, location, and sunlight, which should be optimally evaluated for environmentally friendly construction."

Trombe Wall. The construction of residential units implementing the Trombe wall, as one of the passive energy-saving methods, is not legally mandatory in Sarajevo or Bosnia and Herzegovina. The use of a Trombe wall is only an option for individuals who aim to construct a sustainable housing unit.

Wind Energy. In 2021, the construction of the first wind turbine that could place Sarajevo among the green energy producers has commenced. According to this project, wind energy is planned to be utilized for electricity generation. Sarajevo is deemed geographically suitable for the construction and use of wind energy, and this is corroborated by municipal announcements indicating the construction of more wind turbines in the vicinity of Sarajevo.

Hydroelectric Energy. In the region where the city of Sarajevo is located, hydroelectric power plants have been operated throughout history. The plant suffered damage during the war and was subsequently shut down. Later, these plants were declared as a national monument of Bosnia and Herzegovina. Currently, there are no active hydroelectric power plants in the Sarajevo region.

Biomass Energy. When it comes to biomass energy, the city officials of Sarajevo are collaborating with the Municipal Public Enterprise "Sarajevo Forests" on biomass production, specifically the utilization of forest residues. Biomass includes wood biomass, wood fuel, and wood industry waste. Wood fuel represents the classical and oldest form of utilizing wood potential, but more emphasis is being placed on the use of resources considered as "waste" in recent times. Therefore, the Municipal Public Enterprise "Sarajevo Forests" produces pellets for heating purposes in homes. With these steps, pellets can become more accessible for the citizens.

Geothermal Energy. So far, the systematic utilization of geothermal resources has not occurred in Bosnia and Herzegovina, indicating that the energy potential of the hot spring with a temperature of 58°C near Sarajevo has not yet been assessed. In areas where thermomineral water emerges, a small portion of this potential is typically used for heating tourist, thermal, and commercial buildings through heat pumps. However, overall, the widespread use of such renewable energy for heating purposes is minimal and limited throughout Bosnia and Herzegovina. The main reasons for this are generally the high investment costs required for geological and hydrogeological research and the risk of non-evaluation of investments made in conducted research.

In summary, Sarajevo exhibits a notable misalignment with the majority of the criteria established for energy consumption, particularly concerning the diversity of energy sources. The research underscores that

the city predominantly prioritizes solar energy, evident in its emphasis on the incorporation of solar technologies. However, the utilization of alternative energy sources remains in its nascent stages, primarily evident in newly initiated projects. This unbalanced reliance on solar energy, while commendable for its sustainability, raises concerns about the city's resilience and adaptability in the face of evolving energy demands. The research suggests that diversifying the energy portfolio could enhance Sarajevo's energy security and contribute to a more comprehensive and sustainable approach. As the city navigates its energy landscape, there is a growing need for strategic planning and investment in a mix of renewable and alternative energy sources to ensure a resilient and environmentally conscious energy future.

Low Production of Pollution in Sarajevo

In this section of the research, the city of Sarajevo is examined in terms of the criterion of minimizing pollution. The criteria are evaluated through *soil, air, water, noise, visual, and electromagnetic pollution*.

Low Production of Soil Pollution in Sarajevo. According to some research, it has been determined that both Sarajevo and the Bosnia and Herzegovina region's soils contain heavy metals and chemicals that pollute soil properties and products grown in the soil. Sarajevo city has four industrial zones, namely Ilidza, Ilidza, Hadzici, and Vogosca. All industrial zones are located outside the city of Sarajevo. Local authorities in Bosnia and Herzegovina provide instructions to companies regarding which waste they should filter and not release into the environment, addressing soil pollution. Additionally, educational programs on soil pollution are conducted, covering all segments of the population.

Low Production of Air Pollution in Sarajevo. Sarajevo Valley is characterized by two main air corridors named based on geographical features: the Miljacka corridor and the 'Main Road' corridor. Both air corridors are generally oriented in the east-west direction. In addition to these two main corridors, additional local air corridors have been identified. These local corridors, while much shorter than the main corridors, play a significant role in providing clean air to the city. The city of Sarajevo has been grappling with radon gas and air pollution for years. Air pollution, particularly during winter months, poses a significant threat to public health. This issue persists in the summer months as well, fueled by rising temperatures, agricultural activities, and construction. Nitrogen dioxide maintains an annual average level of 20 micrograms per cubic meter in the city, which is below the permitted limit of 40 micrograms per cubic meter. The burning of fossil fuels, heating facilities, schools, and increased winter traffic often stand out as major air pollutants, leading many residents to believe that the problem of air pollution ends with the conclusion of winter. However, Balkan cities are frequently ranked at the top on the IQAir page monitoring global air quality. Therefore, at the beginning of the winter of 2021, Sarajevo ranked near the top among the world's four most polluted metropolises. In 2022, Sarajevo became the most polluted capital in Europe with an average PM2.5 concentration of 32.4 micrograms per cubic meter of air. This level of air pollution exceeds the World Health Organization's PM2.5 guidelines by approximately six times. In 2023, measurements at four points in Sarajevo recorded values up to 200 micrograms per cubic meter ($\mu g/m^3$). Dirty air is the most significant threat to the health of Sarajevo's residents and visitors. According to recent data, daily average PM10 particle concentrations still exceed the "alert" level limits (150 micrograms per cubic meter). This high pollution has the potential to cause serious harm to individuals, especially those who already have health problems. According to WHO estimates, Bosnia and Herzegovina is one of the countries with the highest death rates from diseases caused by air pollution. Measures such as energy efficiency have a direct impact on reducing pollutant emissions and, consequently, lowering concentrations, leading to a positive effect on human health. In Sarajevo, which aims to progress on the green city path, various measures are being taken to reduce air pollution. One such measure is to warn the public about excessive air pollution through the media, advising vulnerable groups, including small children, pregnant women, the elderly, those with chronic illnesses, weak individuals, and sensitive persons, to avoid going outside in critical situations. Additionally, minimizing the use of motor vehicles that meet EURO3 and lower standards is encouraged. Municipalities are also increasing green spaces in urban planning. Sarajevo predominantly uses electric-powered public transportation, mainly trams and trolleybuses. Discounted monthly cards are available for all segments of the population for public transportation, encouraging people to use it. In recent years, local authorities have subsidized up to 10% of the cost of electric vehicles, which

have gained significant popularity. This subsidy aims to reduce air pollution and promote the use of electric vehicles. Another advantage in improving air quality in Sarajevo is the use of pellets for heating.

Low Production of Water Pollution in Sarajevo. The abundance of water resources in Sarajevo and Bosnia-Herzegovina underscores the region's environmental significance. The preservation and sustainable management of these water resources emerge as imperative considerations, particularly within the urban context of Sarajevo. The city is endowed with an impressive network of approximately 1,380 springs, serving as vital sources of water that have historically played a fundamental role in sustaining life and fostering cultural development. However, the pristine state of these water sources has faced mounting threats in recent years, primarily attributed to the surge in large-scale construction projects within the city limits. The rapid urbanization and infrastructural expansion have triggered concerns over the potential contamination and degradation of these invaluable water reservoirs. The escalating risks to Sarajevo's water sources have prompted vigilant monitoring efforts by environmental protection agencies. These agencies play a pivotal role in assessing the water quality, identifying potential contaminants, and implementing remedial measures to safeguard the integrity of the water supply. The critical interplay between urban development and environmental preservation underscores the need for strategic interventions to mitigate the adverse impacts on water resources. The proliferation of construction activities necessitates a delicate balance between the requirements of urban growth and the imperative to conserve the natural ecosystems that underpin the region's ecological health. One of the key measures employed to address water contamination issues is the monitoring and treatment of wastewater. By actively monitoring and treating wastewater before its discharge into water bodies such as the Miljacka and Bosnia-Herzegovina rivers, environmental authorities strive to mitigate pollution levels. The treatment processes aim to remove harmful pollutants, pathogens, and contaminants, thus contributing to the overall improvement of water quality. This concerted effort not only safeguards the health of aquatic ecosystems but also holds broader implications for public health, as the quality of drinking water sources is intricately linked to the well-being of the city's residents.

The nexus between urban development, water resource management, and environmental conservation in Sarajevo and Bosnia-Herzegovina demands thoughtful and informed strategies. While the region boasts an abundance of water sources, the escalating threats posed by urbanization necessitate proactive measures to ensure the sustainability and health of these vital resources. The ongoing efforts of environmental protection agencies, coupled with wastewater treatment initiatives, underscore the commitment to strike a harmonious balance between urban growth and the preservation of natural ecosystems, thereby safeguarding the water resources that are integral to the region's ecological and societal well-being.

Low Production of Noise Pollution in Sarajevo. There is a clear law related to noise in Sarajevo. This law aims to protect human health, work and living spaces, and the environment in general by determining permissible noise levels, noise protection measures, noise measurement and recording methods, and noise limits based on the purpose of space usage and the time of day (day or night). Local authorities in Sarajevo have made a decision regarding the replacement of public transportation vehicles, expecting the new vehicles to produce less noise. The surroundings of tram lines in the city are organized with sound-absorbing materials, plants, and trees. Additionally, residential areas in highway zones around the city are protected with sound barriers. Noise concentration in Sarajevo is particularly intensified in the area where the city's main arteries, the busiest streets for both vehicle traffic and pedestrian movement, are located. As shown in the noise map below, the central part of the city is the most intense in terms of both vehicle traffic and human activity. To the east of Sarajevo, there is an airport, one of the city's major noise sources. Despite being 20 km away from the city center, as the city expanded, the airport remained in a narrow area with dense residential units. This situation has led to significant noise intensity in areas such as Dobrinje and Ilidza. The city hosts two active stadiums, and during stadium events in the Grbavica and Koševo areas, there is a high concentration of noise pollution.

Less Production of Visual Pollution in Sarajevo. Visual pollution in Sarajevo is associated with significant traffic congestion, especially during commuting hours, leading to long queues of vehicles and contributing to visual clutter in the city. Due to its rich history, Sarajevo has seen the restoration of buildings damaged during the recent war, and historic institutions have been repurposed. The Mayor of Sarajevo

initiated a project for the reconstruction of buildings damaged during the war and those deteriorated over the years, aiming to improve the city's visual pollution. Throughout 2023, many damaged structures have undergone substantial restoration. Abandoned buildings are almost nonexistent in the central area of Sarajevo. The post-war period and continuous urban development have made it challenging for such structures to persist in the city. Some abandoned buildings with historical significance are currently undergoing negotiations, acquisition, and efforts to repurpose these areas. There are very few informal settlements (shanty) in the city. The number of advertisements on billboards is reasonable, and there are almost no prominent ads in the historical part of the city. Graffiti, mostly contributed by the younger population, is typically found on aging buildings, which are becoming increasingly scarce. Based on observations during the research, it can be said that visual pollution is minimal in Sarajevo.

Low Production of Electromagnetic Pollution in Sarajevo. Sarajevo experiences widespread electromagnetic pollution caused by various factors. Among these factors, transformer stations in residential areas and television signal relays near residential areas are the most significant contributors. According to the World Health Organization, high-voltage lines should be at least 50 meters away from each side of a house, a distance also enforced by Sarajevo authorities. Large transformer stations are located outside the city, but phone signal transmitters are placed on hilly areas surrounding Sarajevo. Electromagnetic pollution is a topic for educational programs targeting all levels of society. These programs aim to raise awareness about the health hazards of electromagnetic pollution and emphasize the risks, particularly for vulnerable segments of the population.

In conclusion, based on the research conducted, Sarajevo partially meets some of the criteria for minimizing resource consumption, while falling short on others. However, in areas where criteria are not met, the public is actively educated and informed to enhance awareness.

Sarajevo Being Healthy

Dedicating a comprehensive segment to the evaluation of Sarajevo's overall health, this study undertakes a nuanced exploration grounded in meticulous analysis across three pivotal dimensions: physical, psychological, and social health. The scrutiny of the city's well-being initiates with an in-depth assessment of physical health criteria, meticulously investigating elements such as urban design, walkability, prevalence of recreational spaces, and the accessibility of sustainable transportation options like cycling paths. This endeavor aims to unveil the extent to which Sarajevo's urban environment actively promotes a healthy lifestyle and contributes to the overall physical well-being of its diverse populace. Simultaneously, the exploration extends to psychological health, delving into the intricate interplay between environmental factors and the mental well-being of Sarajevo's residents. Variables like noise pollution, city layout, and the effectiveness of regulatory measures are scrutinized, as well as the role of green spaces and recreational areas in mitigating stressors and fostering positive mental outlooks. The examination further unfolds into the social health dimension, unraveling how Sarajevo nurtures community engagement, social cohesion, and inclusivity. By closely scrutinizing public spaces, parks, and community hubs, the study seeks to reveal how these elements contribute to a sense of belonging and connectedness within the diverse population of Sarajevo. Initiatives encouraging social interactions, such as communal activities and the promotion of cycling, are also analyzed for their effectiveness in cultivating a vibrant and socially healthy urban environment. Through this holistic examination, the study aims to provide valuable insights into Sarajevo's overall health, identifying strengths and potential areas for improvement, and contributing to the creation of an urban landscape that fosters a thriving and well-balanced experience for its residents.

Physical Health of Sarajevo. Sarajevo is a city situated geographically on a plain that extends from the historical part of the city, Bascarsija (Baščaršija), to the newer expansion area of Ilidza (Ilıca). The city is surrounded by hills, but the main urban area is located on the plain where the tram line runs. The majority of the population in Sarajevo has a walking distance to their initial destinations, typically within a timeframe of up to 5 minutes. The primary horizontal connection of the city is found in a plain where the largest parks and promenade areas are situated. These spaces serve as the main meeting and recreational spots for the residents of Sarajevo. Based on research findings, it can be concluded that the city is entirely conducive to walking. The increasing preference for bicycle traffic as a practical and economical means of transportation,

along with growing awareness, has prompted the Sarajevo City Administration to initiate a project to build a bicycle lane in the capital of Bosnia and Herzegovina. Today, almost the entire city of Sarajevo is surrounded by a bicycle lane, established by the city administration, where residents can enjoy cycling in nearby parks with sports facilities. Many citizens now use bicycles and electric scooters to commute to and from work, aiming to avoid traffic congestion and opt for a more sustainable transportation option. The walking and recreational opportunities in the city, along with activities in the natural environment, contribute to supporting cardiovascular health. Especially during the winter months, local authorities in Sarajevo impose restrictions on outdoor activities for certain population groups due to intense air pollution. Doctors recommend reducing the time spent outdoors for at-risk groups such as the elderly, children, pregnant women, and individuals with respiratory and heart problems, directly impacting physical health and freedom of movement. The impact of noise pollution on physical health in Sarajevo is within normal levels. There is a clear law regarding noise intensity, regulating public order and tranquility, and specifying regulations for noise sources in public and private properties during certain hours. Sarajevo, along with the entirety of Bosnia and Herzegovina, is surrounded by a green ecosystem that facilitates access to healthy nutrition and locally produced foods. As mentioned earlier, the entire population in Sarajevo consumes water from the tap, one of their natural sources, which positively influences physical health.

Psychological Health of Sarajevo. Living in the city can positively impact individuals' psychological health by providing access to extensive cultural opportunities, social interactions, and career prospects. The diversity and dynamism of city life can support personal development, offering a positive living experience. However, urban living also brings about specific psychological challenges. As the capital of Bosnia and Herzegovina, Sarajevo has the highest population density in the country, increasing the demands on city resources. In this context, the psychological well-being of Sarajevo residents is analyzed based on specific criteria such as stress, lack of natural environment, social isolation, and challenges in accessing public transportation. Stress is a fundamental issue across all age groups in society and can arise due to a fast-paced lifestyle, heavy traffic, and noise. The majority of Sarajevo's population works in government institutions, forming the working class, with some employed in the private sector. Stress is often related to the work environment and surroundings. Given that Sarajevo is surrounded by nature, mountains, parks, and natural resources, concerns about the lack of a natural environment are not widespread. Green spaces and parks can have positive effects on psychological health, reducing stress, promoting mental relaxation, and improving overall mood. Sarajevans are known for being a social and friendly people, spending a significant amount of time together, so issues of social isolation are not common. Additionally, there are no significant challenges in accessing the city's public transportation system, which is accessible to all residents.

The Sociological Health of Sarajevo. Sarajevo places great importance on social health for its residents and remains committed to being a green city. Therefore, social health is an essential component of the criteria for being a green city. The social life of Sarajevo residents is vibrant, filled with various events throughout the year. City dwellers have the opportunity to come together in public spaces, parks, squares, and collective activities. Green public areas are typically positioned along the city's main thoroughfare and are surrounded by hilly areas in the vicinity of the city. Among these events, there are well-known activities such as the Sarajevo Film Festival, which takes place in the city center every year. Social interaction can help reduce social isolation. A healthy social lifestyle in the city gives residents a greater sense of confidence. The city, by bringing together various cultures, nations, and beliefs in peace, has been referred to as the "Jerusalem of Europe." When examined based on the specified criteria in Sarajevo:

- Group Formation: Socialization in Sarajevo varies with the participation of diverse social groups through strong family ties, working-class union solidarity, vibrant university student life, interactions in educational environments among teachers, and various associations. These groups contribute to forming a rich and diverse social fabric in the city.
- Adherence to Rules and Norms: In Sarajevo, people generally adhere to religious, moral, customary, fashion, and legal norms. These norms are considered the general values of society,

and individuals achieve harmony within the community by showing widespread respect for traditional and cultural norms.

- Undergoing the Socialization Process: Sarajevo's social structure provides an environment that allows individuals to socialize by interacting with different identities and experiences.

As a result, according to the examinations conducted in Sarajevo, the city meets the criteria for being healthy. The rich diversity in the social structure of Sarajevo allows people to interact with different identities, while strong social bonds and adherence to norms enable various groups in the city to live together harmoniously. Psychological and social health conditions meet the specified criteria.

RESULTS

The research focused on the low consumption of water and energy resources in the city of Sarajevo. In the examination of low water consumption, research was conducted based on criteria such as water-efficient infrastructure, gray and rainwater harvesting, water pricing and incentives, landscape-appropriate plant selection, water conservation education, and smart water management. Similarly, the city was examined in terms of criteria established for minimal consumption of energy resources.

The geographical location of Sarajevo and its historical dependence on water resources have been strategically important for Sarajevo and the entire Bosnia and Herzegovina. This factor has encouraged people to adopt healthy eating habits, and the ease of access to locally produced food in a green ecosystem has been effective. Healthy nutrition is directly linked to the physical health and digestive systems of the population. In Sarajevo, the entire population consumes spring water from natural sources which is crucial for maintaining life in the city and supporting its cultural development. These water sources have been a fundamental element for Sarajevo to sustain its existence and serve as a significant center throughout history. As for energy resources in Sarajevo, they support the city's economic growth by sustaining industrial activities and meeting the daily energy needs of daily life, laying the foundation for comprehensive development. These energy resources play a vital role in maintaining the social and economic balance of the city, ensuring environmental sustainability, and enhancing the quality of life.

CONCLUDING REMARKS

City policies generally focus on improving the quality of life in urban environments. Sarajevo, as the capital of Bosnia and Herzegovina, has faced a series of challenges throughout its history in the development of the urban environment and the pursuit of the designation of a green city. Based on research results, the city of Sarajevo does not meet most of the established criteria for energy resource consumption. The use of solar panels is generally dependent on individual users, and there is currently no city or state-level solar energy production in the Sarajevo region. Similarly, wind or hydro energy production has not been identified in Sarajevo. The hydroelectric power plant that Sarajevo had in the past was damaged during the war. Biomass energy production is generally used for heating purposes during winter by producing wood charcoal. The systematic use of geothermal sources in Bosnia has not happened to date, and the energy potential of the thermal spring with a temperature of 58°C in the vicinity of Sarajevo has not been evaluated. In regions where thermal-mineral water emerges, a small portion of this potential is often used for heating tourist, thermal, and commercial buildings through heat pumps. However, in general, the widespread use of this type of renewable energy for heating purposes is minimal throughout Bosnia and Herzegovina. The main reasons for this are usually the high investment costs required for geological and hydrogeological research and the uncertainty of the return on investments made for such research. Apart from the importance given to solar energy, new projects for other energy sources are being implemented. Sarajevo meets some criteria for low consumption of identified resources, but others have not been provided yet. According to some studies, both the soils in Sarajevo and the Bosnia and Herzegovina region contain heavy metals and chemical substances that pollute soil properties and the products grown in the soil. Local authorities in Bosnia and Herzegovina are currently instructing companies not to release any waste into nature without filtering. In addition, training on minimizing soil pollution is provided to all segments of the

population. The city of Sarajevo has been struggling with radon gas and air pollution for years. Air pollution, especially in winter months, poses a significant threat to health. Moreover, although people assumes the opposite, the pollution still persists in the summer months along with increased temperature, as well as agricultural, and construction activities. With the yearly approximate level of 20 micrograms per cubic meter in the city, the situation indicates a dangerous level of air pollution.

Sarajevo is geographically located in a flat area stretching. The city is surrounded by hills, but the main urban area is located on a plain where the tram is located. The main horizontal connection in Sarajevo is located in a plain where the city's largest parks and walking areas are located. These areas are the main venues for residents of Sarajevo to meet and recreate. According to research, the majority of the population in Sarajevo has a walking time to their first stop, which is generally up to 5 minutes. The main hills surround the city, but the main urban area is located in a flat area where the tram is located. Sarajevo has been deemed entirely pedestrian-friendly based on the research. Overall, Sarajevo seems to meet the criteria for being healthy. The physical, psychological, and social health of city residents is at a satisfactory level. Sarajevo residents maintain both their physical and mental health through activities mostly carried out in a natural environment. Their psychological and social health is evaluated by the established criteria. Therefore, according to the examinations conducted in Sarajevo, the city presents a positive picture of maintaining a healthy standard of living for its residents.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my family for their unwavering support throughout my work. A special thanks to my husband who have stood by me in all times.

REFERENCES

Aliagaoğlu, A., & Mirioğlu, G. (2019). Balıkesir Şehrinde Su Tüketimi: Coğrafi Bir Yaklaşım. *Coğrafi Bilimler Dergisi*, *17*(2), 260–280.

Angel, S., Parent, J., Civco, D., & Blei, A. (2011). *The Dimensions of Global Urban Expansion: Estimates and Projections for All Countries, 2000-2050*.

Ayar, B., Yalçın, Z., & Dağ, M. (2023). Rüzgârı Hasat Etmek: Türkiye'de Rüzgar Enerjisinin Fizibilitesi ve Gelişmeleri Üzerine Bir Araştırma. *Avrupa Bilim Ve Teknoloji Dergisi*, pp. 43–49.

Bergmann, E. (1997). *The cities in the Federal Republic of Germany- On the way to sustainable urban development? City with a Future*.

Burton, E., Jenks, M., & Williams, K. (2003). *The compact city: A sustainable urban form?*

Calthorpe, P. (2010). *Urbanism in the Age of Climate Change* (pp. 49–61, 119–126).

Ceylan, H. (2022). *Çevre Kirliliği, 5*.

Collyer, F. (2015). *The Palgrave Handbook of Social Theory in Health, Illness and Medicine*.

Donia, R.J. (2006). *Sarajevo a Biography* (pp. 76–77).

Edin, H. (2014). *Problems and possibilities of sustainable management, Sarajevo, Bosnia, and Hercegovina*.

Galitskova, Y., & Murzayeva , A. (2016). *Urban Soil Contamination*.

Gazel, B. (2022). *Evaluation of Urban Open and Green Spaces in the Context of the Concept of Livability* [Master thesis. Necmettin Erbakan University, Konya, Türkiye].

Hoel, D., Berwick, M., Gruijl, F., & Holick, M. (2016). *The risks and benefits of sun exposure*.

Husika, A., & Suljić, V. (2019). Priority measures to improve air quality in the Sarajevo Canton.Kasım 2023. Retrieved June–September 13, 2023, from https://ba.boell.org/sites/default/files/policy_brief_-_bhs.pdf

Inderst, G., Kaminker, C., & Stewart, F. (2012). *Defining and Measuring Green Investments*.

Kalair, A., Abas, N., Saleem, M., Kalair, A., & Khan, N. (2020). *Role of energy storage systems in energy transition from fossil fuels to renewables*.

Karakuyu, M., Keçeli, A., & Çelikoğlu, S. (2015). *Kent Çalışmaları II*.

Koç, E., & Kaya, K. (2015). *Enerji Kaynakları–Yenilenebilir Enerji Durumu*.
Kumar, B., & Devi, S. (2023). *Pollution to Solution*.
Lam, P., Oliver, P., & Mauss, B. (2017). *The Psychological Health Benefits of Accepting Negative Emotions and Thoughts: Laboratory, Diary, and Longitudinal Evidence*.
Lingvay, D., & Bors, A. (2018). *Electromagnetic pollution and its effects on living matter*.
Maczulak, A. (2010). *Renewable Energy: Sources and Methods*.
Manzella, A., Allansdottir, A., & Pellizzone, A. (2019). *Geothermal Energy and Society*.
Martinez, A., Ortega, J., Napoles, F., & Gonzalez, M. (2014). *Resources, Conservation and Recycling, Optimal design of rainwater collecting systems for domestic use into a residential development*.
Mehmed, B. (2020). *Urban development of the city of Sarajevo, Sarajevo, Bosnia Herceg*.
Mercan, B. (2014). *Orta Olçekli Hidroelektrik Enerji Tesislerin İncelenmesi için Örnek Bir Çalışma Regülatörü ve Hes*. (Yüksek lisans tezi). İstanbul Teknik Üniversitesi, Enerji Enstitüsü, Yenilenebilir Enerji Anabilim Dalı Enerji Bilim ve Teknoloji Programı, İstanbul.
Morillas, J., Gozalo, G., Gonzalez, D., & Moraga, P. (2018). *Noise Pollution and Urban Planning*.
Moseley, D., Marzano, M., Chetcuti, J., & Watts, K. (2013). Green networks for people: Application of a functional approach to support the planning and management of greenspace. *Landscape and Urban Planning, 116*.
Neag, R., Mascca, E., & Pascan, I. (2009). *Actual aspects regarding the IFRS for SME – Opinions, debates, and future developments*.
Sanchez, E., & Izard, J. (n.d.). Performance of photovoltaics in non-optimal orientations: An experimental study. *Energy and Buildings, 87*.
Sarajevo Canton Assembly. (2013). Retrieved November 10, 2023, from https://skupstina.ks.gov.ba/node/2030
Sarajevo Canton. (2020). *Green Cantonal Action Plan for Sarajevo*. Retrieved June 19, 2023, from https://www.ebrdgreencities.com/assets/Uploads/PDF/EBRD-Sarajevo-GCAP-FINAL-EN-v5-2-For-ISSUE.pdf
Simić , J., & Ikić, S. (2022). *Geothermal power plant and a possible development in Bosnia*.
Službene novine Kantona Sarajevo. (2017). Retrieved September 18, 2023, from https://www.paragraf.ba/propisi/kantona-sarajevo/zakon-o-upravljanju-zajednickim-dijelovima-zgrade.html
Stansfeld, S., & Matheson, M. (2003). *Noise pollution: Non-auditory effects on health*.
Tarjuelo, J., Rodriguez, D., Juan , A., & Ricardo, C. (2012). *Landscape and Urban Planning, Efficient water, and energy use in irrigation modernization: Lessons from Spanish case studies*.
Thomas, K., & Granberg, A. (2023). *Quantifying Visual Pollution from Urban Air Mobility*.
Tuna, M., Armut, S., & Tanrıvermiş, H. (2022). Pricing of drinking and irrigation water in Turkey and the necessity of developing tariff-based pricing studies. *Akdeniz Faculty of Economics and Administrative Sciences Journal*, pp. 58–73.
UN. (2012). *The future we want*. Retrieved October 30, 2023, from https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf
UN. (2014). *2014 revision of World Urbanization Prospects*.
UN. (2016). *The Sustainable Development Goals Report 2016*. New York, NY, USA: United Nations.
UN. (2017). *World Population Prospects: 2017 Revision*. Retrieved June 22, 2023, from https://desapublications.un.org/publications/world-population-prospects-2017-revision
UN. (2018). *Sustainable Development Goals Report 2018*. Retrieved May 27, 2023, from https://unstats.un.org/sdgs/files/report/2018/thesustainabledevelopmentgoalsreport2018-en.pdf
UN. (2022). *The Sustainable Development Goals Report 2022*. Retrieved December 2, 2023, from https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf
UN. (2023). *United Nations Handbook 2023–24*. Retrieved October 10, 2023, from https://www.un.org/sexualviolenceinconflict/wp-content/uploads/2023/09/auto-draft/UN-Handbook-2023-24.pdf

United Nations. (1992). *Brundtland Report*. United Nations Conference on Environment and Development.
United Nations. (2021). *Air pollution in Bosnia and Herzegovina*.
Wang, Y., Xian, C., Jiang, Y., & Ouyang , Z. (2020). *Environment, development and sustainability*.
Wasmi, T. (2021). *Biomass Energy*.
WHO. (1948). *Constitution of the World Health Organization*. Retrieved October 17, 2023, from https://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1
WHO. (2008). *World Health Statistics 2008*. Retrieved June 5, 2023, from https://www.who.int/publications/i/item/9789241563598
WHO. (2015). *World health statistics 2015*. Retrieved October 15, 2023, from https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/world-health-statistics-2015.pdf
WHO. (2016). *World Health Statistics 2016*. Retrieved October 15, 2023, from https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/world-heatlth-statistics-2016.pdf
WHO. (2017). *World health statistics 2017.* Retrieved November 1, 2023, from https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/v-4-17162-world-health-statistics-2017.pdf
Wolch, J.R., Bryne, J.A., & Newell, J.P. (2014). Urban green space, public health, and environmental justice: The challenge of making 'just green enough.' *Landscape and Urban Planning*, *125*, 234–244.
World Health Organisation. (2008). *World Health Statistics 2008*. Paris, France: WHO Library.
World Water Council. (2016). *Mainstreaming water in global agendas*. Retrieved September 12, 2023, from https://www.worldwatercouncil.org/sites/default/files/Official_docs/WWC_Annual_Report_2016.pdf
Yener, Ş., & Cerezci, O. (2016). *Material Analysis and Application for Radio Frequency Electromagnetic Wave Shielding*.