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Enhancing the Green Outdoor Spaces Towards Creating Sustainable Residential Neighborhoods in Egypt, Port Said City as a case study

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Abstract

Green outdoor spaces are essential for promoting social interaction and improving sustainability and quality of life in residential neighborhoods. However, in Egyptian cities like Port Said, these spaces are often neglected due to limited space, resources, and development pressures. This neglect contributes to pollution, rising crime, and weakened community bonds, negatively affecting residents' well-being. This study addresses a critical gap by integrating resident satisfaction, sustainability indicators, and spatial design into a green-space model tailored for medium-density Egyptian neighborhoods—shifting the focus beyond Cairo. A mixed-methods approach was used, combining qualitative insights from literature and site observations with quantitative data from 247 residents in Port Said's Protex neighborhood. Findings show that 89.5% of residents are dissatisfied with the absence of green spaces and the presence of neglected lots. A strong majority (94.7%) desire accessible, well-designed green areas, with 63.5% prioritizing recreational uses and 36.5% seeking broader sustainable benefits like improved climate, social interaction, and economic potential.

The research presents a model that integrates environmental, social, and economic dimensions to enhance livability and resilience. This model offers a practical framework for urban designers, planners, and policymakers to guide the development of sustainable green spaces in current and future Egyptian residential areas.

Keywords: Green outdoor spaces – New Sustainable Green space model – residents' satisfaction – recreational spaces – neighbourhood residents' perception

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1. Introduction

1.1 Background and Context

Green spaces are recognized as an important contributor to enhancing the quality of urban life. Many cities are now working on preserving and increasing their green spaces as a part of their sustainable development plans (Dalia Aly, 2022). These spaces, encompassing gardens, parks, and greenways, serve as vital communal areas for leisure, social engagement, and recreational pursuits. They provide essential opportunities for individuals to connect with nature and foster social interactions often absent in other urban settings (Viniece Jennings, 2019), (Haase, 2022), (Mahla Tayefi, 2023). Beyond mere quantity, the quality, accessibility, and usability of green spaces significantly influence neighbourhood satisfaction and overall well-being (Yang Zhang A. E., 2017). Physical characteristics such as size, clarity, vegetation density, and design diversity (e.g., distinct sub-areas for commonality or seclusion) further determine their effectiveness as spaces for encounter and community building (Annegret Haase , 2022).

In Egypt, the planning and location of open spaces within residential areas often overlook their critical role in facilitating social interaction and relaxation (Elmorshedy, 2019). Studies on low-income housing projects in Cairo indicate that residents highly value amenities like quietude, personal space, and convenient access to services as key determinants of residential satisfaction (Hady Gamal Mabrouk, 2024). Furthermore, comparative research suggests that green spaces within mass housing developments can lead to a higher quality of life and user satisfaction compared to traditional neighbourhoods (Beyza Bahadir, 2023). Properly planned green spaces are not only significant social hubs but also crucial indicators of sustainability for maintaining the well-being of residential communities (Rao, 2021).

The urgency of adequate green space per individual is amplified by the impacts of climate change, particularly in highly urbanized and congested cities like Cairo. Climate change has made Egypt highly vulnerable, leading to an increase in heat waves and extreme weather events. The Urban Heat Island (UHI) effect, exacerbated by a lack of urban greenery, leads to elevated air temperatures and higher concentrations of pollutants, negatively impacting human health and increasing heat-related mortality (Sherif, 2023), (Alaa Ezzat, 2020). The World Health Organization (WHO) recommends that urban residents should have access to green space within 300 meters (approximately a 5-minute walk) to promote human health and encourage outdoor activity (Mariana Cernicova-Buca, 2023).

The research utilizes the Google Scholar database to search for recent studies that discuss sustainable green open spaces. The research utilizes various keywords in Google searches, including "Sustainable Green Spaces," "Green Spaces," "Liveable Green Spaces," "Residential Green Open Spaces," and "Walkable Green Spaces." The research uses a range from 2018 to 2024. The results are from around 120 research studies. The research found the 8 most important studies that discussed the concept of sustainable green open space and were like the research condition and study area. The following table presents the findings from earlier research on the concept of sustainable green open space.

Table 1. Most researches that relates to research conditions.

The research	The conducted Results
(T C Julian, 2018)	This research presents the idea of urban harvesting and farming theme parks to encourage collaboration within the community.
(Dizdaroğlu, 2022)	The study presented in this paper proposes design criteria that can facilitate the transformation of urban parks into sustainable green spaces. By advocating for revisions to future development plans, these criteria aim to enhance the capacity of urban parks to achieve sustainability.
(O C Dewi, 2018)	The primary purpose of the green open space is to fulfill the community's requirements for social contact and gathering. However, the underlying objective of this initiative is to mitigate the potential air pollution resulting from nearby activities and to safeguard the environment in pursuit of sustainability.
(Neslihan Demircan, 2019)	This study created a research framework and initiative for European Urban Allotment Gardens (UAGs) to promote social and ecologically sustainable urban development and planning. The research found that UAGs mostly fed low-income people and later their recreational needs, especially vegetables. They offered organic farming and improved neighborhood green space.
(Juan Shan, 2021)	The study examined whether smart city ideas could improve green spaces. Residential UGS have increased in number and accessibility. The research improved commercial, office, and road UGS. A planning model based on diversified and refined land-use supply can better integrate UGS's ecological performance and other functions.
(Oh-Hyun Kwon, 2021)	The study examines the correlation between urban green spaces and residents' satisfaction across various socioeconomic nations. Social support and regional GDP affect the relationship between urban green spaces and well-being. The findings reinforce the importance of urban green spaces for social cohesion and well-being.
(Arnold Mwanzu, 2023)	This study examined Kenya's urban green areas and their role in environmental sustainability to fill a knowledge gap. Well-distributed green spaces across the country will improve health, generate revenue, and promote a healthy environment.
(Diogo Guedes Vidal, 2019)	Public policy should prioritize equity in public and green space allocation and accessibility. Equity allocates these places based on community-specific characteristics, including socioeconomic status and health outcomes, to improve health and well-being for all ages. Public and green spaces are important beyond their environmental benefits.

Source: Adapted by the researcher retrived from (T C Julian, 2018), (Dizdaroğlu, 2022), (O C Dewi, 2018), (Neslihan Demircan, 2019), (Juan Shan, 2021), (Oh-Hyun Kwon, 2021), (Arnold Mwanzu, 2023), (Diogo Guedes Vidal, 2019).

The results of different studies shown in Table 1 show a lack of a sustainable green open space design. The previous researchers focused on one specific aspect of sustainable green open space and neglected the other aspects.

1.2 Problem Statement and Research Gap

Despite the general understanding of these benefits, many existing residential communities in Egypt, particularly those in medium-density urban areas like Port Said, grapple with significant challenges in integrating and providing sufficient green spaces. These challenges often stem from historical development patterns, limited land availability, and insufficient urban planning emphasis on green infrastructure. This research specifically addresses the under-researched context of medium-density residential areas outside of Egypt's capital, with the aim of filling the void regarding integrated green space solutions that consider local resident needs and sustainability dimensions.

While the importance of green spaces is recognized, there is a distinct lack of comprehensive models that synthesize residents' satisfaction, multifaceted sustainability criteria (environmental, social, and economic), and practical spatial design for specific Egyptian residential contexts. Existing studies often focus on individual aspects or broader metropolitan areas, leaving a gap in actionable frameworks for neighborhood-level intervention, especially in cities like Port Said. Existing neglected spaces compound the problem by accumulating waste, breeding insects, and impeding social interaction.

1.3 Objectives and Hypotheses

This research aims to develop a new, integrated model for sustainable green outdoor spaces that addresses the identified needs and challenges in the case study area. The research starts by identifying the key characteristics of sustainable green outdoor spaces and their direct influence on residents' satisfaction. Then, it assesses the current state of green spaces and residents' satisfaction in the selected Protex residential neighbourhood in Port Said City. The main finding provides an implementation outline for applying this proposed model to guide urban planners, developers, and stakeholders in creating resilient, healthy, and sustainable residential communities in similar Egyptian contexts. Future research can discuss how activities contribute to achieving social sustainability in residential neighbourhoods within Egyptian communities.

1.4 Significance and Structure of the Paper

This study adopts a **mixed-methods approach** to develop a context-specific model for sustainable green outdoor spaces in medium-density Egyptian neighborhoods, with a focus on the Protex residential area in Port Said City. The methodology integrates both qualitative and quantitative research techniques to ensure comprehensive data collection and analysis, as shown in Figure 1.The research sequence is designed as the following:

Literature Review: An extensive review of existing literature was conducted to examine theoretical frameworks, sustainability metrics, spatial design principles, and resident satisfaction in relation to urban green spaces. This helped identify existing gaps, particularly the lack of studies addressing medium-density neighborhoods outside of Cairo.

Site Analysis and Observations: Field visits and on-site observations were carried out in the Protex neighborhood to document current land use, availability and condition of green spaces, and patterns of social behavior in public areas. This step provided critical spatial and environmental context for the study.

Quantitative Survey A structured questionnaire was distributed to **247 residents** of the Protex neighborhood using random sampling. The survey collected data on residents' satisfaction with their living environment, perceived benefits and shortcomings of existing outdoor spaces, and their preferences for future green space functions (e.g., recreation, environmental enhancement, and social interaction).

Data Analysis: Quantitative data from the survey were analyzed using descriptive statistics to identify trends in resident attitudes. Qualitative insights from open-ended responses and field notes were thematically analyzed to complement and contextualize the quantitative findings.

Model Development and Validation: Based on the synthesized findings, a new green-space design model was developed. The model was reviewed and validated through expert consultation with urban planners and landscape architects familiar with the Port Said context.

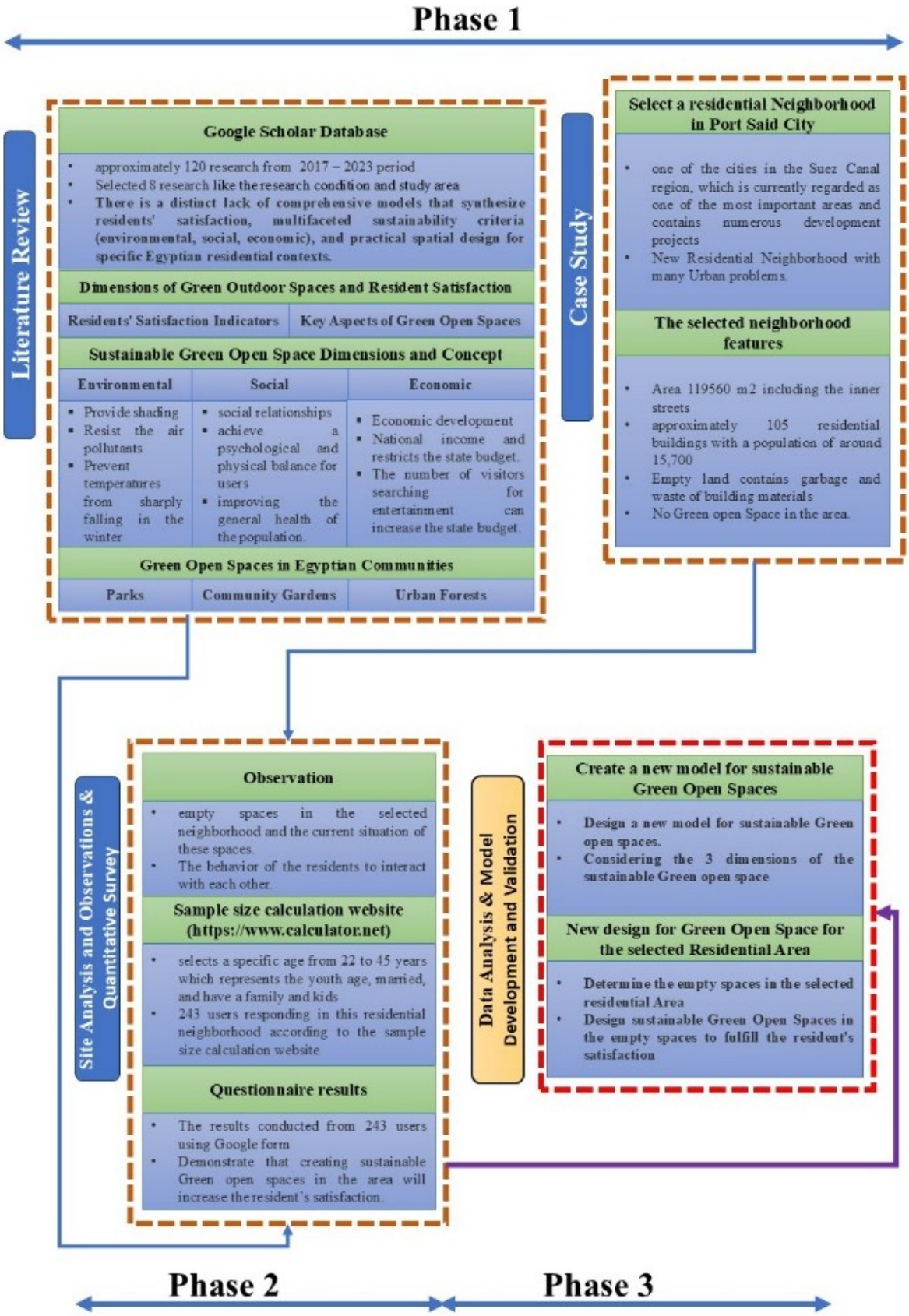


Figure 1. The Research Methodology.

1.5 Literature Review

1.5.1 Dimensions of Green Outdoor Spaces and Residents' Satisfaction

Studies consistently highlight the interconnectedness between urban green spaces and the quality of urban life, influencing both subjective perceptions and physiological responses (Jun Qin, 2013).

1.5.1.1 Key Aspects of Green Open Spaces

The design and characteristics of green spaces are critical to their effectiveness:

- **Color and Density of Vegetation:** The aesthetic appeal, variety of plant life, and density of vegetation significantly contribute to environmental satisfaction (Jun Qin, 2013).
- **Availability and Accessibility:** Easy and equitable access to green spaces is paramount for enhancing urban quality of life. Proximity to homes and convenient pathways directly correlates with increased life satisfaction and overall well-being (Morar, Radoslav, Spiridon, & and Păcurar, 2014), (Mariana Cernicova-Buca, 2023). Higher availability of green areas is consistently linked to greater neighborhood satisfaction (Yang Zhang A. E., 2017).
- **Cleanliness and Maintenance:** Residents visit well-maintained and clean green spaces more frequently, which positively impacts their well-being. Conversely, poor maintenance can deter use and negate potential benefits (Ayala-Azcárraga, 2019), (Christopher L. Ambrey, 2017).
- **Shape and Size of Green Spaces:** The physical dimensions and layout contribute to their functionality. Larger, well-designed parks can encourage physical activity and foster social interactions (Akpinar, 2016).
- **Clarity and Diversity of Design:** Clear layouts and diverse design elements, such as distinct sub-areas for various activities (e.g., quiet zones, active play areas), promote social interaction, reduce conflict, and cater to a wider range of user needs (Kati Vierikko, 2020), (Haase, Annegret, 2022).
- **Amenities:** The presence of playgrounds, outdoor fitness equipment, seating areas, and walking paths encourages physical activity and recreation (Akpınar, 2019), (Yaqiong Jiang, 2022).

1.5.1.2. Residents' Satisfaction Indicators

The benefits derived from green spaces translate into various indicators of residents' satisfaction:

- **Physical Activity:** Green spaces encourage walking, jogging, and other forms of exercise, which are vital for physical health (Wang'ombe, 2024), (Matthias Braubach, 2017).
- **Safety:** Perceived safety significantly influences the use and benefits of green spaces. Higher safety levels improve physical health, social relationships, and overall life pleasure (Ayala-Azcárraga, 2019), (Christopher L. Ambrey, 2017).
- **Pleasant Emotions and Happiness:** Access to urban green spaces is positively associated with both cognitive (life satisfaction) and emotional (pleasant emotions) well-being. Ecological quality, exposure, availability, closeness, and quantity are key indicators of happiness derived from these spaces (M.S. Syamili, 2023).
- **Leisure and Relaxation:** Green spaces provide opportunities for respite from urban life, reducing stress and promoting mental well-being (Mariana Cernicova-Buca, 2023).
- **Social Interaction:** Well-designed green spaces with appropriate seating, pathways, and recreational facilities encourage people to linger and interact, fostering social cohesion and reducing loneliness (Pranav Gupta, 2024), (Weijian Zhang, 2024), (Shanta Pragyan Dash, 2024). They can also serve as venues for community events, strengthening social bonds and promoting a sense of belonging (Weijian Zhang, 2024), (Marianne Nabil Guirguis, 2022).
- **Environmental Quality:** Green spaces improve air quality, regulate microclimates by reducing the urban heat island effect, and lessen noise pollution, all of which contribute to a healthier living environment (Na Ta, 2021), (Varun Athokpam, 2024), (Nursah'aidah Md Sahak, 2025).

Figure 2 summarizes the most important green open space aspects and the most effective residents' satisfaction indicators, illustrating their interconnectedness.

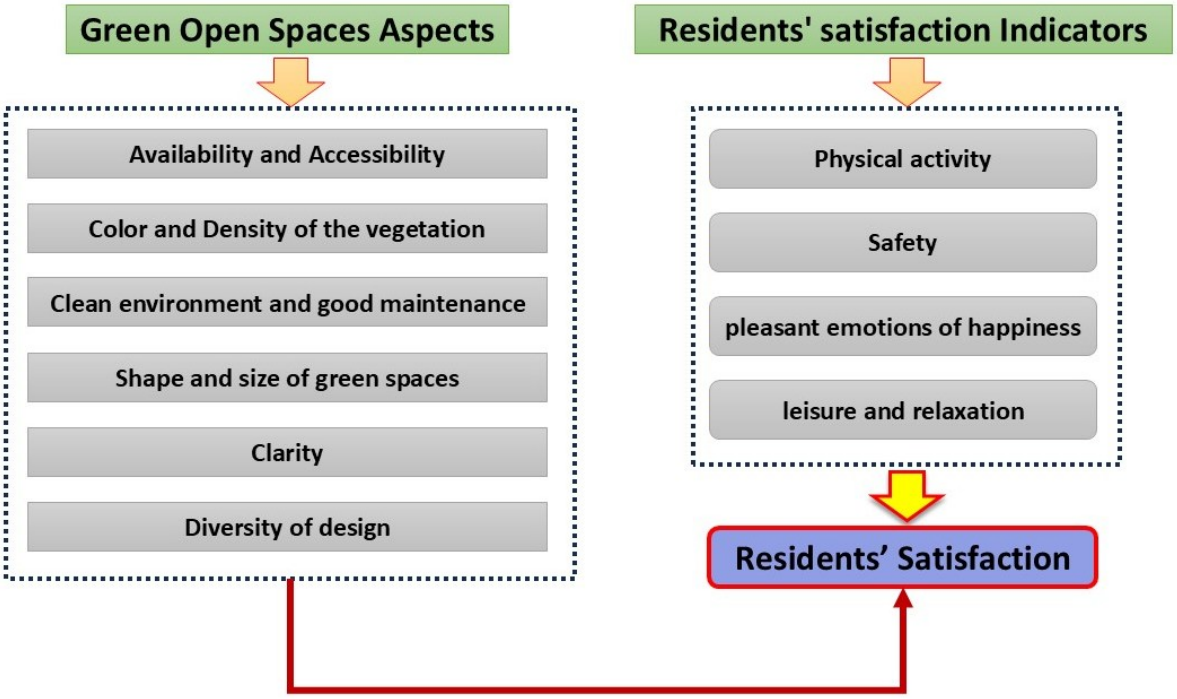


Figure 2. The most effective green space aspects and the Residents' Satisfaction indicators.

Subjective perceptions of green spaces, including physical, aesthetic, and psychological aspects, significantly influence residents' overall satisfaction. Green open spaces are not just aesthetic additions to urban and residential areas; they are vital for the physical, mental, social, and environmental well-being of residents, contributing significantly to their overall satisfaction and quality of life.

1.5.2 The concept of sustainable Green Open Spaces

Green spaces, whether natural or man-made, serve multifaceted roles in urban environments. They offer avenues for sports, recreation, and entitlement services, provide crucial light and air between buildings, and act as "lungs" for cities (Salma I. Dwidar, 2019). Beyond recreation, cities are increasingly leveraging greening initiatives for public health, economic development, and environmental remediation (Merham M. Keleg G. B., 2022), (Yang Zhang A. E., 2017). Such work includes preparing communities for climate change, restoring ecosystems, and safeguarding nature. Sustainable green spaces offer various ecosystem services that enhance urban life. These services directly improve health and well-being. Each type of green space possesses unique characteristics, including size, plant cover, species richness, ecological quality, accessibility, amenities, and design, all of which influence their effectiveness as community gathering places (Haase, 2022), (Abass, 2021). Neighborhood green spaces serve as vital links between people and nature, benefiting individuals and the environment. They contribute to purifying the air, balancing microclimates, reducing noise, and protecting wildlife (Na Ta, 2021). Climate studies consistently highlight the direct impact of green spaces in mitigating urban heat. For instance, average air temperatures on summer days can be approximately 3.5 degrees Celsius lower in green areas compared to non-green areas in studies (M., S., & D., 2019), (Masterson, 2023), (Wei Liu, 2022), (Xinyi Qiu, 2023) (Xiangdong Xiao, 2022). The integration of green spaces is a cornerstone of sustainable neighborhood development, as illustrated in Figure 3.

Figure 3. The concept of green spaces in every sustainable neighbourhood.

There is a strong correlation between the lack of social interaction in communities and the scarcity or inappropriate design of parks (S A Salih, 2018). Green spaces have a significant impact on how residents in diverse socioeconomic neighborhoods perceive social and environmental interactions, particularly in low-income areas where green space is often viewed as a key indicator of quality of life (Francisco de la Barrera, 2016). Research suggests that designing green spaces to be perceived as large, visible, clean, and well-maintained can effectively encourage physical activity and improve public health (Akpinar, 2016). Objectively, a green area with plants and a lively atmosphere fosters social interaction. Large, appealing parks can encourage walking, which is beneficial for health (Cohen DA, 2007), (Sugiyama T, 2010). Furthermore, a direct relationship exists between contact with green spaces and therapeutic effects on both physical and mental health (Mahla Tayefi, 2023). Studies also indicate that green open spaces can foster business practices and contribute to economic growth (S Ali, 2021). Urban and community green spaces offer a wide array of benefits, categorized primarily into social, environmental, economic, and health dimensions. Accessible natural spaces enhance social interactions, mitigating loneliness and isolation (Weijian Zhang, 2024), (Shanta Pragyan Dash, 2024). In densely populated Egyptian cities, green spaces provide a crucial respite from urban intensity and promote social engagement (Ahmed Ayman, 2024). Well-designed and accessible green areas, equipped with seating, walking paths, and recreational facilities, encourage prolonged stays and interaction (Pranav Gupta, 2024). They also serve as ideal venues for community events, fostering social bonds. Cultural festivals, sports activities, and educational programs held in green spaces can unite diverse groups and cultivate a strong sense of belonging and community identity (Weijian Zhang, 2024), (Marianne Nabil Guirguis, 2022). The health advantages of green spaces are well-documented, especially in urban settings like Egyptian cities. They facilitate physical exercise, vital for overall health, by encouraging activities such as walking and jogging (Matthias Braubach, 2017), (Wang'ombe, 2024). Another significant health benefit is the reduction of the urban heat island effect; greenery cools the surroundings through evapotranspiration, aiding urban populations in coping with heat (Varun Athokpam, 2024), (Nursah'aidah Md Sahak, 2025). By incorporating these diverse benefits, sustainable green spaces turn into a vital resource for addressing environmental and sustainability challenges. Table 2 summarizes the key dimensions of sustainable green open spaces.

Table 2. The dimension for sustainable green open spaces Source: **(Salma I. Dwidar, 2019)**,

The Dimension	Description
Environmental Dimension	Green spaces filter pollutants, purify the air, reduce the heat island effect in cities, and provide habitat for varied plants and animals. By sequestering carbon dioxide and generating oxygen, green spaces can mitigate climate change.
Social Dimension	Communities gather in green spaces to socialize and develop relationships. Green spaces can also host concerts, festivals, and one-day markets, which foster community.
Economical Dimension	Cities benefit economically from green places. They boost tourism and property values, boosting the economy. Maintenance and management of green spaces can create jobs.
Health Dimension	Green places improve urban and community health. Green places improve mental health, reduce stress, promote physical activity, and improve overall health and well-being.

Designing sustainable urban parks and green spaces, guided by these dimensions, consistently proves to be a significant urban resource, promoting the health, longevity, and comfort of inhabitants. Figure 4 visually represents the significance of green spaces in connecting residents to nature.

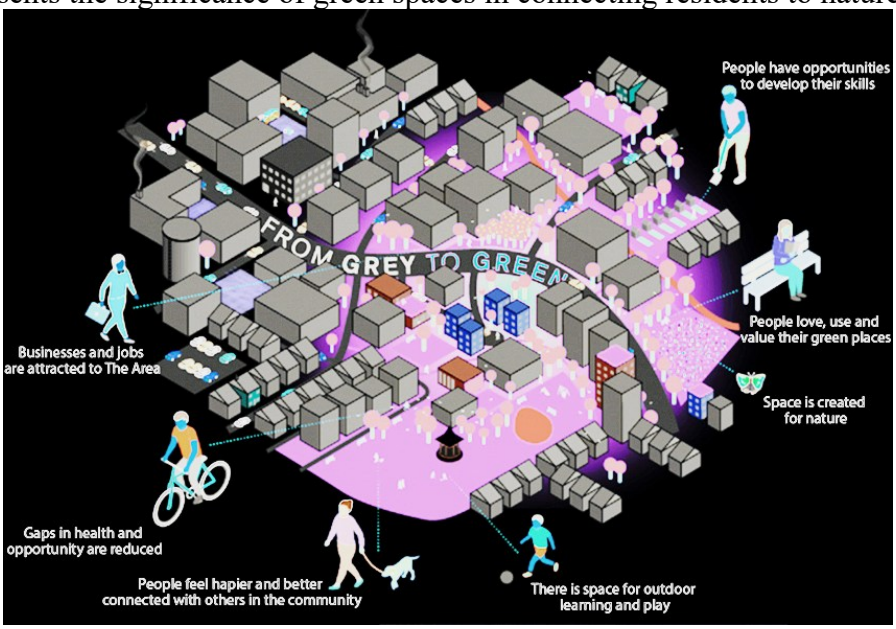


Figure 4. Green spaces for people and nature.

Figure 5 further illustrates the key elements of designing sustainable green open spaces and their benefits for improving residents' physical and mental health.

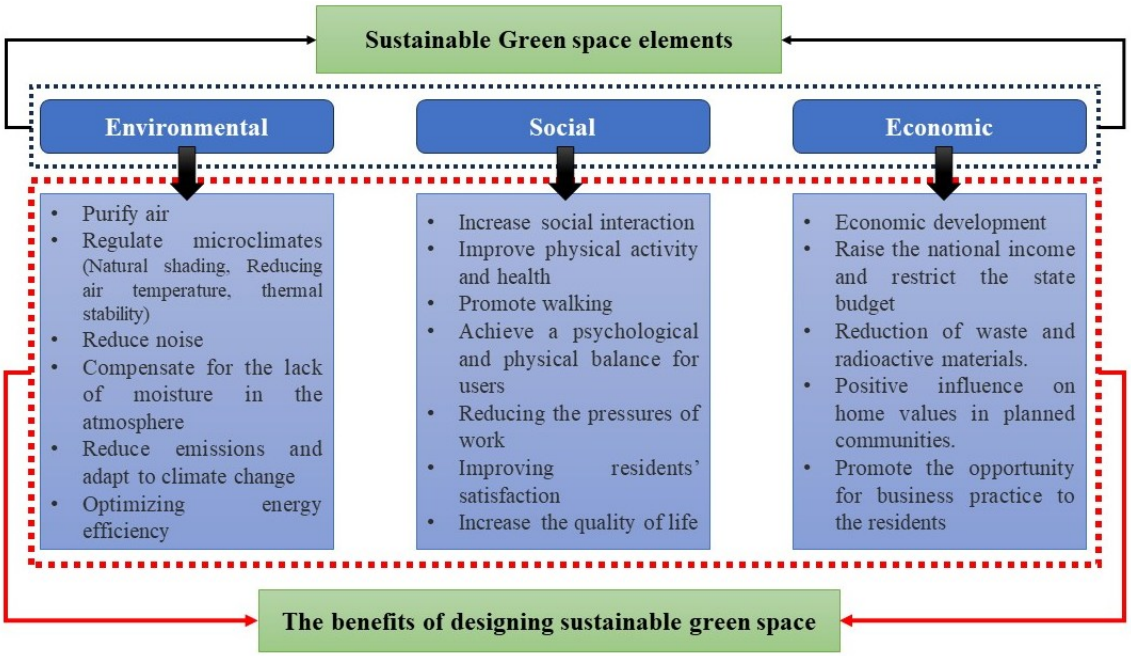


Figure 5. Sustainable green space elements and their benefits.

Based on figures 4 and 5, the research can conclude that green spaces are an invaluable part of a sustainable and healthy city. They provide physical, mental, and environmental benefits for citizens, and the movement to create greener cities is increasing.

1.5.3 Green open spaces in the Egyptian Community

Resident satisfaction with green spaces in Egyptian cities is influenced by various factors, including the type and design of the green space, its accessibility, and the prevailing cultural and social context. Different types of green spaces, such as urban forests, community gardens, and parks, contribute uniquely to residents' satisfaction.

Parks, as one of the most common green spaces in Egyptian cities, are well-known for enhancing inhabitant satisfaction. Initiatives like Al-Azhar Park in Cairo exemplify broader public space revitalization efforts aimed at addressing the city's green space deficit and improving quality of life (El-Feki, 2014), (Ahmed Ayman, 2024).

However, the effectiveness of parks in fostering user satisfaction is often contingent upon their maintenance and management. For instance, a survey of 48 public parks in Cairo highlighted how poor maintenance, commercialization, and lack of integration with their surroundings significantly diminished user experience (Dalia Aly, and Branka Dimitrijevic, 2022).

Community gardens represent unique green spaces offering environmental, social, and economic benefits. Being smaller and more localized than parks, they hold value in densely populated metropolitan areas. In Egypt, community gardens could effectively reduce urban heat islands and encourage social interaction. These gardens tend to increase user satisfaction by fostering a sense of ownership and community engagement (Elmaghraby, 2019), (Sally M. Murshed, 2021). Beyond environmental advantages, community gardens also provide opportunities for education and cultural exchange. Integrating urban agriculture into green space planning could further address food security and sustainability in Cairo. However, challenges such as water scarcity and land availability in arid cities like Cairo can hinder their widespread implementation (Ahmed Ayman, 2024), (Elmaghraby, 2019).

Urban forests constitute another significant green area, vital for purifying air, reducing noise, and regulating climate. Their presence can significantly improve environmental quality and resident contentment in Egyptian cities. Green corridors and networks, as proposed for Alexandria, could

enhance urban livability (Amer, 2010). Egypt also emphasizes the role of urban forests in mitigating the heat island effect; tree planting and creation of shaded areas boost thermal comfort in public spaces, making them more appealing to residents (Khalil, 2024). Nevertheless, limited funding, water shortages, and competing land uses sometimes impede urban forestry programs in Egyptian cities (Ahmed Ayman, 2024), (Kafafy, 2010).

The impact of green spaces on residents' satisfaction is therefore diverse, depending on the specific type of green space, its design, and the local context. Table 3 provides a summary of how different green space types in Egypt affect residents' satisfaction.

Table 3. The impact of the green space types on Residents' Satisfaction.

Type of Green Space	Key Features	Impact on Satisfaction
Parks	Large-scale green areas with recreational and cultural significance.	High satisfaction due to their role in social and personal well-being; however, maintenance issues can reduce satisfaction.
Community Gardens	Small-scale, localized green spaces with social and economic benefits.	High satisfaction due to community involvement and environmental benefits; resource constraints can limit their effectiveness.
Urban Forests	Tree planting and green corridors for ecological and social benefits.	High satisfaction due to their role in mitigating the urban heat island effect and improving air quality; challenges include funding and water scarcity.

Source: *Adapted by the researcher retrieved from* (Ahmed Ayman, 2024), (Kafafy, 2010), (Khalil, 2024), (Amer, 2010), (Elmaghraby, 2019), (Sally M. Murshed, 2021)

While community gardens offer numerous benefits, challenges such as resource allocation and social dynamics can hinder their success. Addressing these barriers is essential for maximizing the potential of community gardens across all income levels. The following table 4 discusses the benefits of community gardens for each income level.

Table 4. The benefits of community gardens for all income levels

Residents' income level	Benefits
Low-Income Residents	**Food Security:** Community gardens help low-income families access nutritious food, reducing reliance on expensive grocery stores. **Social Support:** These gardens create networks of support, enhancing community ties and resilience.
Middle-Income Residents	**Health Improvement**: Middle-income residents benefit from increased physical activity and healthier diets through gardening. **Community Engagement:** Participation in garden activities fosters a sense of belonging and community pride.
High-Income Residents	**Aesthetic and Recreational Value:** High-income individuals may appreciate community gardens for their beauty and leisure spaces, contributing to urban greening. **Sustainability Initiatives:** They can engage in sustainable practices, promoting environmental awareness and community development.

Source: *Adapted by the researcher retrieved from* (Buabeng F., 2022), (Karissa N. Raskin, 2021), (Clare Hume, 2022), (Andrew Cumbers, 2017), (Nada samir El Habibi, 2023)

According to the benefits of community gardens outlined in Table 4, it is essential to establish a community garden in the residential neighborhood that caters to all income levels to maximize benefits and enhance residents' satisfaction within the Egyptian community.

Green spaces in Egyptian residential neighborhoods have many benefits, but they face obstacles that must be overcome. Urban green spaces are few, making them a major issue. Cairo, for example, is losing green spaces owing to urban encroachment and development, stressing the necessity for green space policies (Dalia Aly, and Branka Dimitrijevic, 2022), (Kafafy, 2010). Another difficulty is accessibility. Green places may not be accessible to all residents, especially low-income ones. Access to green places must be equal to maximize their social, health, and community benefits (Shanta Pragyan Dash, 2024), (Pranav Gupta, 2024). Despite these challenges, Egyptian residential neighborhoods can benefit from green spaces. Urban planning projects that include green infrastructure in new developments can boost green space availability. Community-led green space maintenance and improvement can also instill a sense of ownership and responsibility (Ahmed Ayman, 2024), (Merham M. Keleg G. B., 2022).

2. Materials and Methods

The selected case study is Port Said City, one of the cities in the Suez Canal region, which is currently regarded as one of the most important areas and contains numerous development projects. (Amr N. Mohamed, 2022) The study areas will be chosen as medium-sized areas for a residential complex called the Protex neighborhood. The neighborhood is in the El-Dawahy district in Port Said City. All study areas are nearly finished, and almost all housing units are inhabited. The area of the residential complex is approximately 119560 m², including the inner street area and the services, with a total number of buildings of approximately 105 residential buildings. Figure 6 shows the master plan for the selected neighborhood and the street network.

Figure 6. Protex residential neighbourhood master plan and streets network
Source: Google Earth Pro 2023.

The neighborhood has no green spaces in its original design. It has more than one space that could be a green space, as these spaces are empty land. These areas contain garbage and waste building

materials, which make them a source of disease and insects. The following figure 7 shows the empty spaces in the selected neighborhood and the current situation of these spaces.

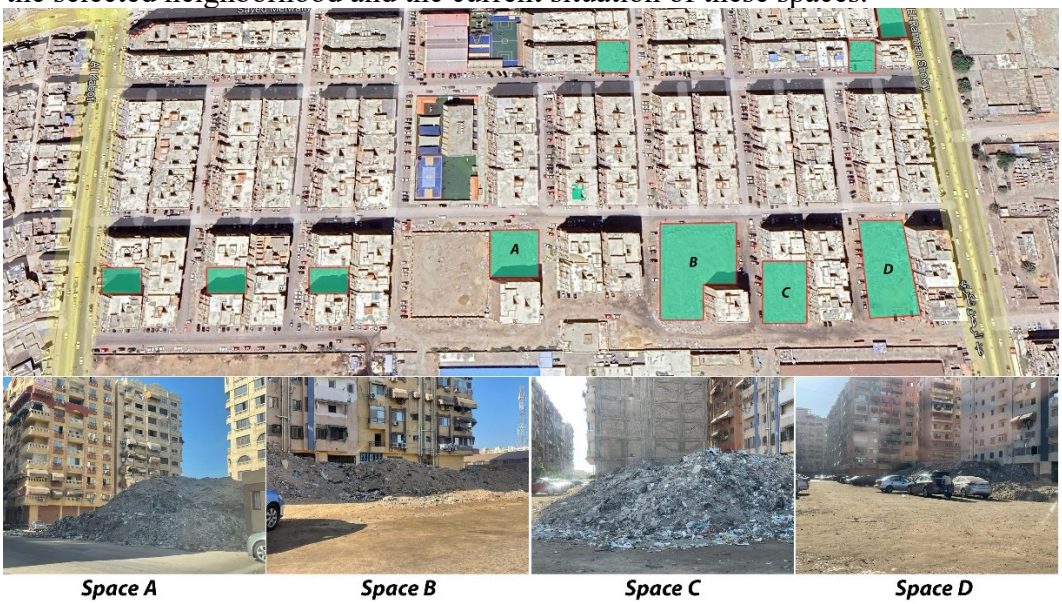


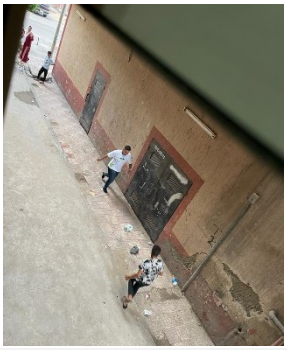
Figure 7. The current situation for the empty spaces.

After removing the garbage from the selected neighborhood, we can design the empty spaces shown in Figure 7 as sustainable green spaces. These spaces can achieve the residents' satisfaction in their neighborhood, as they will decrease the pollution, increase social interaction and activities, and improve the economic base for the residents and the city.

In the selected neighborhood, there are no spaces for the residents to interact with others. Residents use the streets and pavement to interact with each other and engage in various activities. This trend is due to the lack of open spaces. This behavior causes a lot of risks, such as road accidents, decreased safety, and distorting the overview in the residential neighborhood. Figure 8 below illustrates the current state of social life in the selected neighborhood.

Kids are chatting and playing in the street, and the pedestrian

The family makes their social interaction and activities in the pedestrian



Kids playing football between buildings

Figure 8.Current status of the social life in the selected neighbourhood.

The research employs a questionnaire method to evaluate residents' needs for a green open space in their neighborhood, gauge their satisfaction with the current conditions, and gather their opinions on establishing a sustainable green open space.

The neighborhood has around 15,700 residents of various ages and sexes (male and female). The research selects a specific age range of 22 to 45 years, which includes youth who are married and have families with children. This age represents around 80% of the current residents, around 12,560. Table 5 contains the questionnaire conditions. The questionnaire requires 243 users responding in this residential neighborhood, according to the sample size calculator (https://www.calculator.net), as shown in Figure 9.

Table 5. The questionnaire condition.

Condition	Description
Neighborhood Population	15,700 Person
Age for users	22-45 years (Youth age and married family)
Sex for users	Male and Female
Neighborhood according to age and sex	12,560 Person (80% of the total population)

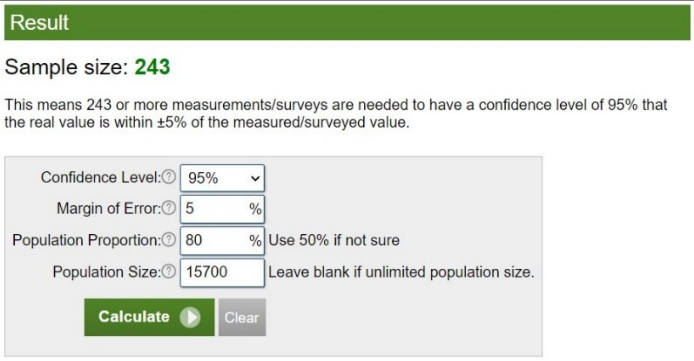


Figure 9. the sample size used in the questionnaire.
Source: https://www.calculator.net

3. Results

The analysis of the questionnaire responses (n = 247) reveals a strong consensus among residents regarding dissatisfaction with their neighbourhood environment.

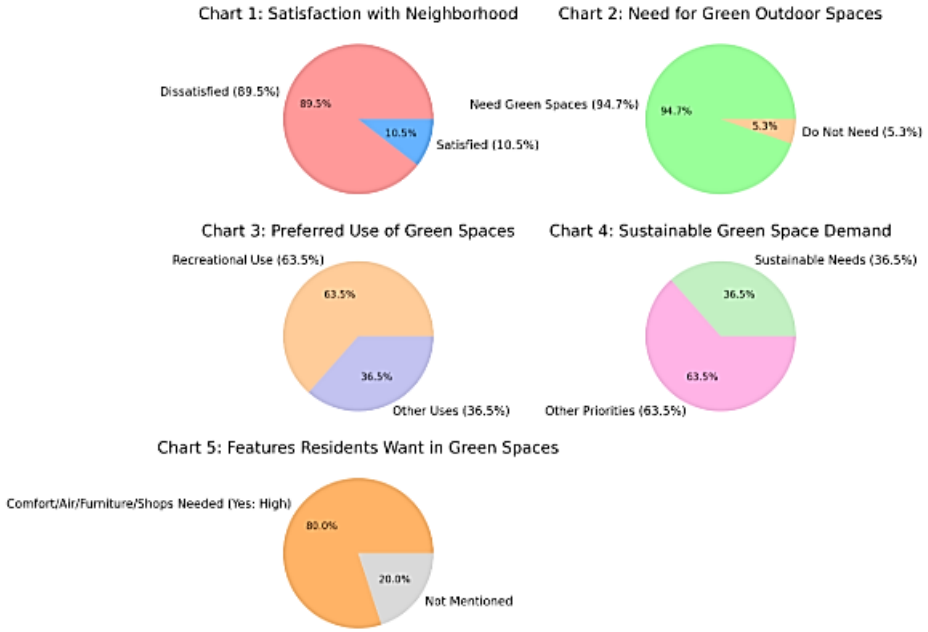


Figure 10. Survey Results on the Selected Neighbourhood for Green Space Needs.

As illustrated in Figure 10, Chart 1 shows that 89.5% of respondents reported dissatisfaction, primarily due to the absence of green spaces and the presence of empty lots filled with garbage, which they identified as sources of disease and insects.

According to Chart 2, an overwhelming 94.7% of participants expressed a clear need for green outdoor spaces, indicating they would regularly use such spaces if available. Chart 3 shows that 63.5% of respondents desire these areas for recreational purposes, while Chart 4 highlights that 36.5% seek sustainable green spaces that promote climatic comfort, social interaction, and economic opportunities, such as small-scale investment or income-generating activities.

Furthermore, as represented in Chart 5, residents stated that green spaces featuring pure air, affordable seating, social gathering areas, and convenient amenities like fast food and beverage kiosks would significantly increase their satisfaction with the neighbourhood.
Overall, the results suggest that the creation of sustainable, well-designed green outdoor spaces is strongly linked to enhancing residents' quality of life and satisfaction within their residential environment.

4. Discussion

The research aims to enhance the selected residential neighborhood by transforming the empty spaces into green open areas that meet the residents' needs. The new design for the empty spaces considers good climatic conditions, furniture, and space, such as a kids' area space, skating space, reading space, and sitting areas, to improve the social activities and interaction, and space for fast food and drink to serve the users. These spaces are a first step in trying to create a sustainable green open space to fulfill the residents' needs in this residential neighborhood. By implementing this new design in the selected neighborhood, the residents' satisfaction with their neighborhood will be achieved. The following figure 8 shows the old neighborhood design without green open spaces and the new design with green open spaces.
According to questionnaire results and based on the proposed design for the selected residential neighborhood, the research could demonstrate that creating a sustainable green open space—as shown in Figure 11—in a residential neighborhood will increase residents' satisfaction.

The Current situation (Before Green open spaces)

The Proposed design (After Green open spaces)

Figure 11. the residential neighbourhood before & after green open spaces.

The previous figure, 11, shows the difference between the current residential neighborhood and the proposed green open spaces in the same neighborhood. The percentage of green open spaces according

to the area of the residential neighborhood in the current neighborhood is 0%, and after the proposed green open spaces, it is 10.01%. This percentage is low, but it is considered a good step in this neighborhood to create a sustainable community to increase residents' satisfaction.

The research could imply a new sustainable green open space model that can be applied in the residential neighborhood in Port Said City to help the urban planners and stakeholders achieve sustainability in the residential neighborhoods and enhance the residents' satisfaction with their neighborhood. This new model can be used as a prototype for green open space in the residential neighborhood in Port Said. This new model consists of green elements such as grass and trees to work as a natural shading, decrease the temperature, and filter the polluted air in the outdoor space to achieve a good environmental condition in the outdoor space. It should include a kids' area in a protected area such as the middle of the space protected by a green fence to increase safety for the kids, contain a sitting area with good-quality furniture for sitting and talking, and contain space for other activities such as dancing, skating, and relaxing to increase the social interaction and social ties. Green space should include an area for mini shops to serve space users. These shops could be for fast food and drinks, and mini markets for kids' candy. The foundation of these shops encourages the residents to use the green open space, as these shops fulfill their needs in such a recreational space. By creating these elements in one green open space, the space becomes a sustainable green space, fulfilling the residents' needs and then increasing the residents' satisfaction with their neighborhood. The following Figure 12 represents the new model that the research implied. The implied model will help to create resilient, healthy, and sustainable cities.

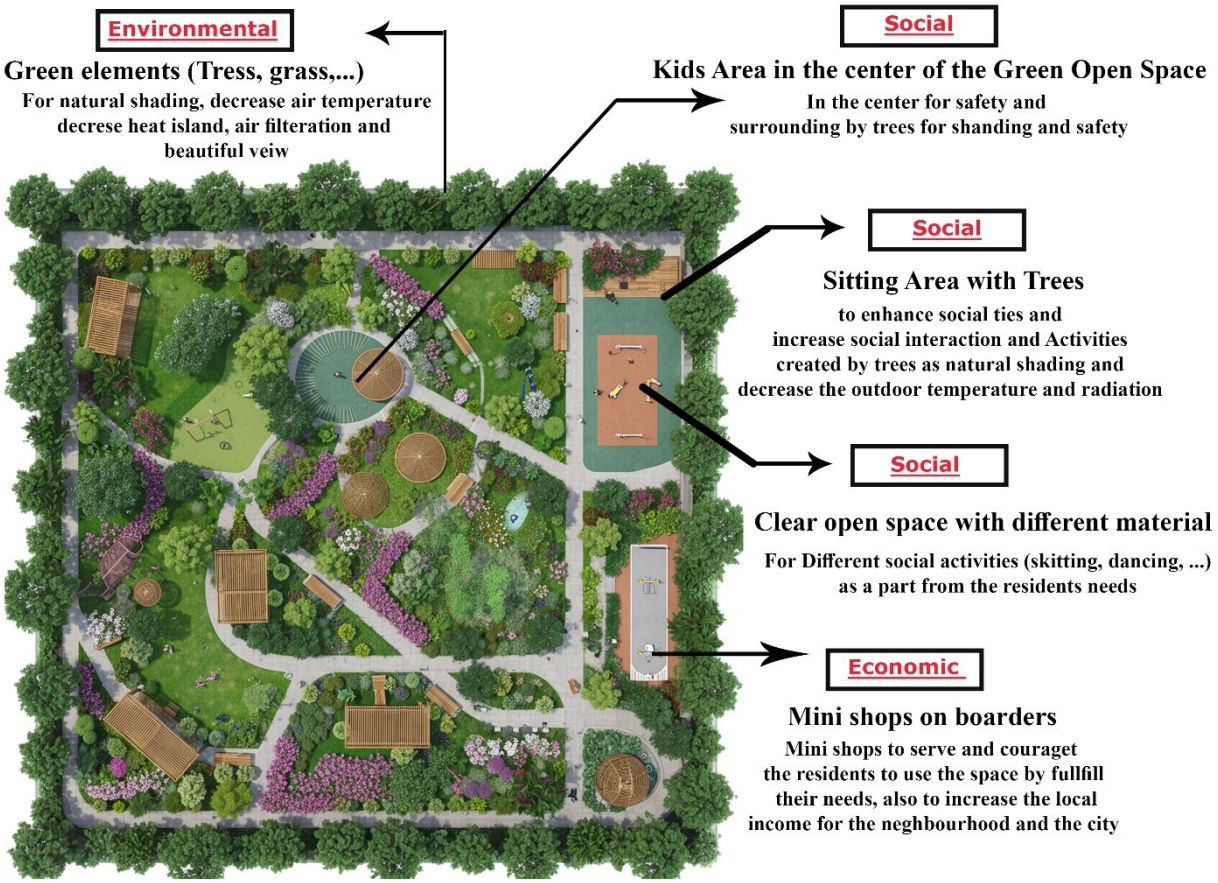


Figure 12. Sustainable Green Open Space model in a residential neighbourhood.

The model, illustrated in Figure 12, demonstrates the sustainability concept for green open spaces in a residential neighborhood of Port Said city by addressing key sustainability factors: economic, environmental, and social. The model will be valid in a residential neighborhood in Egypt with an area for green open spaces of not less than 650 m² connected to at least one street. This model, as shown in Figure 12, will help urban planners and decision makers to create a sustainable green open space in a residential neighborhood in Port Said, to be a step toward creating a resilient and sustainable city in Egypt.

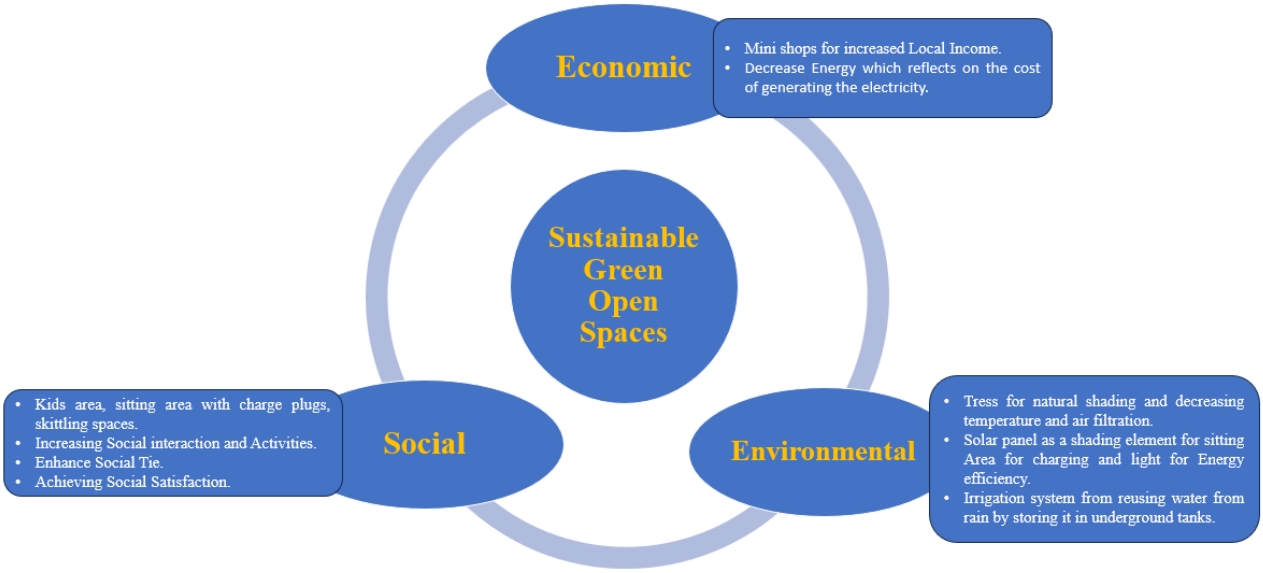


Figure 13. Sustainable Green Outdoor Spaces Aspects.

To ensure the success and sustainability of this design proposal, it is crucial to carefully consider the approach to its execution. The research suggests an implicit model with three main aspects that must be followed and combined to imply the proposed green outdoor space model. These aspects can be concluded by incorporating green spaces into urban planning and development, making them

accessible to all members of the community, and maintaining green spaces. Figure 14 summarizes the three main aspects along with their suggested indicators.

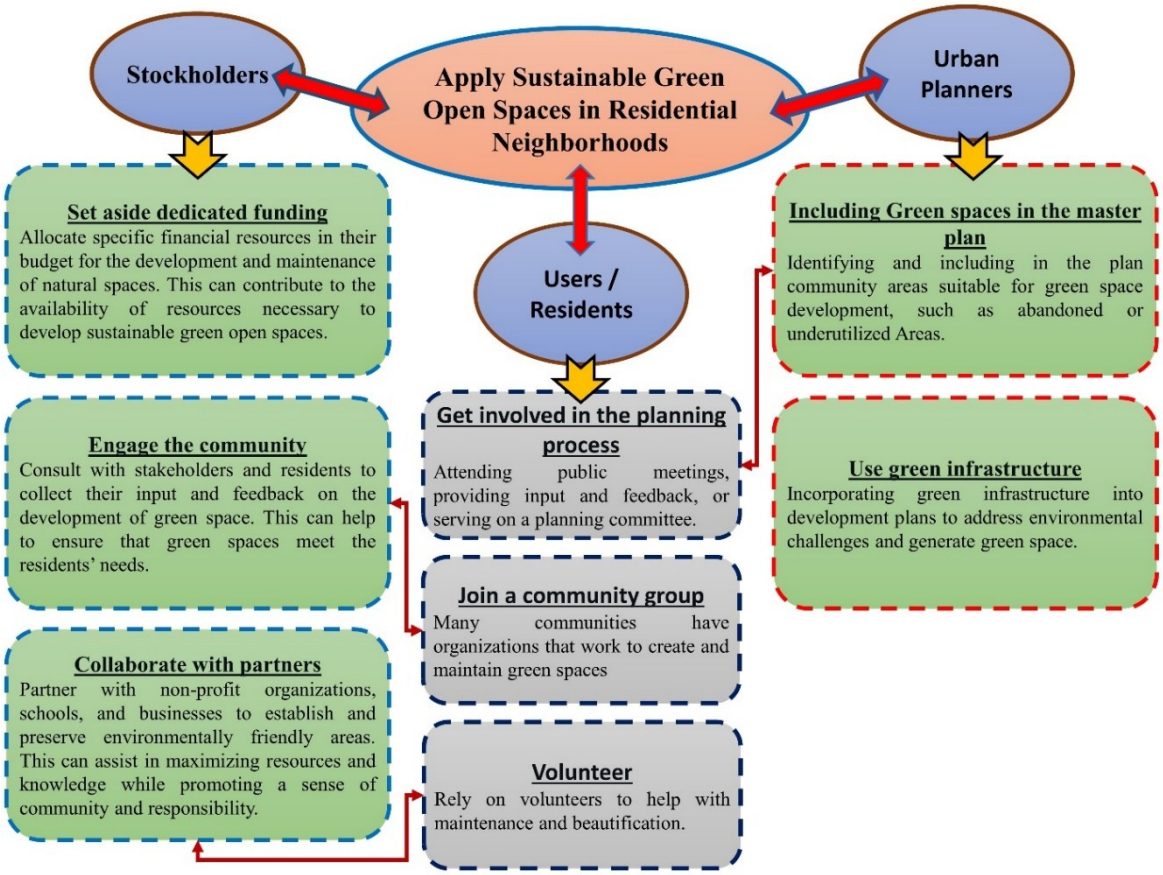


Figure 14 Implementation outline for applying the proposed sustainable green outdoor spaces model

The previous Figure 14 concludes the implementation outline for applying the proposed sustainable green space model in a residential neighborhood in Egypt. The aspects of the implementation outline are interdependent and overlapping; to ensure the success of the sustainable green outdoor space model, each element must be considered without disregarding the others. Creating a healthy environment can be achieved by considering sustainable green outdoor spaces in the residential neighborhood and applying these spaces using the implementation outline.

5. Conclusion

Urban green spaces are the result of human planning and creation; they can serve the same needs for residents as natural greenery. However, in cities, another value is added to these spaces, which is the characteristic of local people, which can influence the social values of the green areas.

The research emphasizes the urgent need to enhance green outdoor spaces in Egyptian residential neighborhoods, with Port Said's Protex neighborhood serving as a case study. The findings confirm a significant lack of accessible, clean, and functional green spaces, leading to low levels of resident satisfaction and missed opportunities for social, environmental, and economic sustainability. By applying a mixed-methods approach—combining literature review, site analysis, and resident surveys—the study identified key gaps and opportunities in green space planning.

The proposed sustainable green open space model integrates environmental, social, and economic dimensions and is specifically tailored to the medium-density context of Port Said. This model not only addresses spatial and climatic considerations but also emphasizes usability and inclusivity, ensuring green spaces respond directly to residents' needs and aspirations. The proposed design interventions, such as shaded seating, children's play areas, activity zones, and small-scale commercial outlets, demonstrate how neglected spaces can be transformed into active, community-oriented hubs.

Ultimately, the research establishes that sustainable green spaces are essential components of healthy, resilient cities. The suggested model serves as a replicable framework for similar urban contexts across Egypt and can guide urban planners, architects, and decision-makers in prioritizing green infrastructure. A shift in urban development priorities is critical, moving from viewing green spaces as optional amenities to recognizing them as fundamental infrastructure for sustainable living. Implementing this model is a strategic step toward achieving social well-being, environmental resilience, and economic vitality in Egyptian urban communities.

Future research should focus on evaluating the long-term impact of implemented green space models, integrating activity-based designs, and exploring climate-responsive planting. Studies on digital tools and policy frameworks can further enhance planning and management. These directions will strengthen sustainable, resident-centered urban development in Egypt.

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The author(s) declare(s) no conflicts of interest.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author/s.

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The author solely conducted the conceptualization, research design, data collection, analysis, and interpretation. The author also wrote and edited all sections of the manuscript.

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