
The Impact of Urban Greening on Residential Real Estate Development in Bhubaneswar, Odisha, India

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Abstract

This study explores the impact of urban greening on residential real estate development in Bhubaneswar, Odisha, India, utilizing both primary and secondary data from 2010 to 2023. Primary data was collected through a survey of 100 residents, focusing on property values, housing affordability, and socio-economic dynamics in both greened and non-greened areas. Secondary data includes real estate market records, municipal reports, and information from greening initiatives. The statistical analysis reveals a strong correlation between proximity to green spaces and rising property values, with properties near green spaces seeing a 25% increase in value. Additionally, housing density increased by 40% in greened areas, particularly in suburban regions, compared to a 17% rise in non-greened areas. However, the study also highlights significant affordability challenges, as 75% of lower-income residents in greened areas reported difficulty affording housing. Displacement emerged as a key issue, with 50% of residents in greened areas observing the displacement of long-term residents due to rising rents and property taxes. The study identifies the phenomenon of "green gentrification," where urban greening leads to the displacement of economically vulnerable populations. Policy recommendations include inclusionary zoning, property tax relief, and the development of affordable housing near green spaces to prevent further displacement and ensure equitable access to urban greening benefits. These measures are essential for balancing the environmental and economic gains of urban greening with social equity.

Keywords: Urban greening, real estate development, housing affordability, displacement, Bhubaneswar, property prices, socio-economic dynamics, green gentrification.

Introduction

Urban greening has become a central focus in discussions of sustainable urban development across the globe. As cities continue to expand and confront environmental challenges, urban greening initiatives are increasingly seen as essential for creating livable and resilient cities (Anguelovski et al., 2018). These initiatives typically involve the creation and expansion of parks, greenways, tree-lined streets, and other green infrastructure aimed at improving environmental quality. By mitigating the urban heat island effect, improving air quality, and making recreational spaces available for residents, urban greening plays a vital role in improving the quality of life in cities (Mitchell & Popham, 2008). However, while the environmental and public health benefits of urban greening are well-documented, these initiatives also have complex socio-economic ramifications, particularly when it comes to real estate development and housing affordability (García-Lamarca et al., 2019).

In cities around the world, green spaces have become attractive to real estate developers and affluent homebuyers, often leading to significant increases in property values in areas adjacent to green zones. This phenomenon, commonly referred to as "green gentrification," occurs when urban greening projects designed to benefit all residents which on the other hand lead to the displacement of lower-income households, who are priced out of their neighborhoods as property values and rents soar (Curran & Hamilton, 2012). Cities like New York, Barcelona, and Berlin have experienced this trend, where the development of parks and green spaces has inadvertently contributed to social inequality by excluding marginalized populations who can no longer afford to live in newly gentrified areas (Anguelovski et al., 2018).

Bhubaneswar, the capital city of Odisha, India, offers a unique context for examining the relationship between urban greening and real estate development. With a population exceeding a million people, Bhubaneswar is undergoing rapid urbanization as part of India's Smart Cities Mission (Srivastava et al., 2020). As part of its urban development strategy, the city has undertaken several urban greening projects, including the creation of new parks, tree-planting initiatives, and the establishment of green belts. These efforts aim to enhance the city's resilience to climate change, improve public health, and make Bhubaneswar more attractive to investors and residents alike (Bhubaneswar Smart City Ltd., 2021).

However, as Bhubaneswar's real estate market grows in tandem with these greening projects, concerns regarding the social equity of these developments have emerged. Specifically, there are increasing worries about rising property values, the displacement of lower-income residents, and the potential for green gentrification (Srivastava et al., 2020). As urban greening improves the quality of life for some residents, it risks creating further socio-economic divides by making greened areas unaffordable for lower-income groups.

This paper seeks to address these concerns by investigating the following key research questions:

- How has urban greening influenced residential real estate prices in Bhubaneswar?
- What is the relationship between green space development and housing density in the city?
- What are the socio-economic consequences of greening, particularly with regard to housing affordability and social equity?

Through a combination of quantitative and qualitative methods, this study aims to provide a comprehensive analysis of how urban greening has impacted residential real estate development in Bhubaneswar. Additionally, the paper offers policy recommendations to ensure that the benefits of greening are equitably distributed across all socio-economic groups, preventing the exclusion of marginalized populations from the advantages of sustainable urban development.

Literature Review

Urban greening has emerged as a key component of sustainable urban development in cities

across the globe. The growing emphasis on creating livable, resilient urban environments has driven interest in incorporating natural elements into urban planning and development. Urban greening involves the integration of parks, greenways, tree-lined streets, and other natural infrastructure into cities to improve environmental conditions, enhance public health, and provide social and recreational opportunities for residents (Anguelovski et al., 2018). While urban greening offers a range of environmental and social benefits, it also presents complex socio-economic challenges, particularly concerning real estate markets, housing affordability, and social equity.

In the context of rapidly urbanizing cities, urban greening is viewed as an essential strategy for mitigating the negative environmental effects of urbanization, such as air pollution, the urban heat island effect, and the loss of green space. Research has consistently shown that the presence of green spaces can help reduce urban temperatures, improve air quality, and enhance biodiversity, contributing to more sustainable and healthy urban environments (Mitchell & Popham, 2008). However, the implementation of urban greening projects often intersects with real estate development, resulting in unintended socio-economic consequences, including rising property values and the displacement of lower-income residents. This phenomenon, referred to as "green gentrification," is an emerging concern in cities worldwide.

Urban greening is widely recognized for its environmental and public health benefits. The creation and expansion of parks, greenways, and tree-lined streets have been linked to improved air quality, reduced urban heat island effects, and enhanced stormwater management (Tzoulas et al., 2007). For instance, trees and vegetation absorb pollutants such as nitrogen dioxide and particulate matter, which are commonly found in high concentrations in urban areas due to vehicular traffic and industrial activities. By reducing these pollutants, green spaces can contribute to improved respiratory health and overall well-being for city residents (Mitchell & Popham, 2008).

Furthermore, urban green spaces have been shown to play a critical role in moderating local temperatures. The urban heat island effect, where cities experience higher temperatures than surrounding rural areas due to the concentration of heat-absorbing materials such as asphalt and concrete, can be mitigated through the introduction of vegetation and green infrastructure (Tzoulas et al., 2007). Parks and tree-lined streets provide shade, reduce surface temperatures, and improve thermal comfort, making cities more resilient to the impacts of climate change, including heatwaves and extreme weather events.

In addition to these environmental benefits, urban greening has been associated with numerous public health advantages. Studies have demonstrated that access to green spaces is linked to reduced stress, lower rates of depression, and improved mental health outcomes (Mitchell & Popham, 2008). Physical activity levels tend to be higher in neighborhoods with access to parks and recreational areas, contributing to better cardiovascular health and reduced risks of chronic diseases such as obesity and diabetes (Maas et al., 2006). These findings underscore the importance of incorporating green spaces into urban planning to promote the physical and mental well-being of residents.

While the environmental and health benefits of urban greening are well-documented, the socio-economic impacts of these initiatives are increasingly coming under scrutiny. Urban greening can significantly influence real estate markets, leading to increased property values in areas near newly developed parks, greenways, and other green infrastructure. As green spaces become more desirable, they attract higher-income residents, developers, and investors, resulting in rising property prices and rents in adjacent neighborhoods. This process, known as green gentrification, has been observed in cities across the globe, including New York, Barcelona, and Berlin (Anguelovski et al., 2018).

Green gentrification occurs when urban greening projects, designed to improve environmental quality and public health, inadvertently displace lower-income residents. As property values

rise, long-term residents who can no longer afford the increased housing costs are forced to relocate, often moving to less desirable areas with fewer amenities and less access to green space (Curran & Hamilton, 2012). This displacement exacerbates existing social inequalities, as wealthier residents benefit from the improved quality of life associated with green spaces, while lower-income residents are excluded from these benefits.

The displacement effects of green gentrification are particularly pronounced in cities where real estate markets are already under pressure due to rapid urbanization and population growth. In these contexts, the introduction of green spaces can accelerate real estate speculation, driving up housing costs and contributing to housing shortages for lower-income populations (García-Lamarca et al., 2019). This dynamic creates a paradox in which urban greening projects, intended to enhance environmental sustainability and social well-being, contribute to increased social and spatial inequalities.

Numerous studies have documented the phenomenon of green gentrification in cities around the world. In New York City, the development of the High Line, an elevated linear park built on a former railway line, has been widely cited as an example of green gentrification (Curran & Hamilton, 2012). The construction of the park transformed a previously industrial area into a highly desirable neighborhood, attracting real estate developers and affluent homebuyers. Property values in the surrounding area increased dramatically, leading to the displacement of long-term residents and the conversion of industrial spaces into luxury apartments and commercial properties. While the High Line is celebrated for its innovative design and environmental benefits, it has also become a symbol of the socio-economic challenges associated with urban greening.

Similar trends have been observed in European cities. In Barcelona, the city's "superblock" initiative, which aims to reduce traffic and create pedestrian-friendly green spaces, has contributed to rising property values and rents in neighborhoods near newly developed parks and plazas (García-Lamarca et al., 2019). While the superblock project is intended to improve environmental quality and public health, it has also led to the exclusion of lower-income residents, who can no longer afford to live in gentrified areas. The displacement of these residents has sparked debates about the social equity of urban greening projects and the need for policies to ensure that the benefits of greening are equitably distributed.

In Berlin, the city's efforts to create new parks and green spaces as part of its sustainable urban development strategy have similarly contributed to green gentrification (Wachsmuth & Weisler, 2018). As property values rise in greened areas, long-term residents are often priced out of their neighborhoods, leading to increased social polarization. In response to these challenges, Berlin has implemented policies aimed at protecting affordable housing and preventing displacement, including rent control measures and the preservation of social housing in gentrifying neighborhoods.

In the Indian context, urban greening has gained traction as part of the country's broader efforts to promote sustainable urban development. Indian cities such as Bangalore, Pune, and Delhi have implemented greening projects as part of their smart city initiatives, with the aim of improving environmental quality and enhancing the livability of urban areas (Srivastava et al., 2020). However, as in global cities, the implementation of these projects has been accompanied by rising property values and concerns about the displacement of lower-income residents.

Bangalore, often referred to as the "Garden City of India," has long been known for its green spaces, including parks and tree-lined streets. However, in recent years, the city's rapid urbanization and real estate development have led to the loss of green cover and increased pressure on existing green spaces. The introduction of new parks and green infrastructure as part of Bangalore's smart city initiatives has contributed to rising property values in areas near green spaces, particularly in high-demand residential neighborhoods such as Whitefield and Indiranagar. While these projects have improved the city's environmental quality, they have

also exacerbated housing affordability issues for lower-income residents (Srivastava et al., 2020).

In Pune, the creation of green belts and the expansion of public parks as part of the city's sustainable development strategy has similarly influenced real estate markets. Property prices in areas near green spaces have increased, attracting affluent homebuyers and developers. However, the rise in property values has also led to the displacement of lower-income residents, who can no longer afford to live in these gentrifying neighborhoods (Ghosh, 2019). The city's efforts to balance environmental sustainability with social equity remain a challenge, as the benefits of urban greening are often concentrated among wealthier residents.

Delhi, India's capital city, has also faced challenges related to urban greening and gentrification. As part of its efforts to reduce air pollution and improve public health, Delhi has launched several initiatives to create green corridors, plant trees, and expand parks. While these projects have contributed to environmental improvements, they have also led to increased property values in greened areas, particularly in affluent neighborhoods such as South Delhi. The displacement of lower-income residents from these areas has raised concerns about the social equity of Delhi's urban greening efforts and the need for policies to protect vulnerable populations (Ghosh, 2019).

Bhubaneswar, the capital city of Odisha, has rapidly evolved into a model for urban development in India. Its development trajectory has been shaped by various urban initiatives, particularly the Smart City Mission, which emphasizes sustainable growth through the integration of green infrastructure. Urban greening in Bhubaneswar includes efforts such as the creation of new parks, the expansion of existing green spaces, and large-scale tree-planting initiatives aimed at mitigating the environmental impacts of rapid urbanization (Mohanty, 2019). These initiatives aim to transform Bhubaneswar into a more livable, environmentally sustainable city. However, the city's real estate dynamics and socio-economic landscape are being reshaped by these urban greening efforts, leading to concerns about housing affordability and the displacement of lower-income residents.

Bhubaneswar's urban greening initiatives are aligned with the broader goals of India's Smart Cities Mission, which emphasizes the importance of environmental sustainability and green infrastructure in urban planning. The city has been focusing on creating more green spaces to improve environmental quality, reduce the urban heat island effect, and provide recreational areas for its residents (Patnaik et al., 2020). The urban greening projects also aim to increase the city's resilience to climate change by improving air quality, increasing vegetation cover, and promoting biodiversity (Bhubaneswar Development Authority, 2017).

Bhubaneswar has invested in a series of projects to enhance its green infrastructure, such as the creation of new parks in areas like Kalinga Nagar, Rasulgarh, and Chandrasekharpur, the expansion of existing parks, and the planting of trees along major roads and public spaces. According to a report by the Bhubaneswar Municipal Corporation (2018), the city planted over 100,000 trees as part of its "Green Bhubaneswar" initiative, aiming to increase green cover by 10% by 2025. These projects contribute to making Bhubaneswar a more attractive destination for investors and residents, promoting its image as a green, sustainable urban center.

The link between urban greening and real estate development in Bhubaneswar is evident from the rising property values in areas adjacent to newly developed green spaces. As green infrastructure projects enhance the environmental appeal and livability of neighborhoods, property values in those areas have surged (Mohapatra & Mohanty, 2019). Similar to patterns observed in global cities, the creation of parks and greenways in Bhubaneswar has made these neighborhoods more attractive to higher-income residents and developers, leading to a rise in property prices and real estate investments.

A study by Mohapatra (2020) reveals that residential property prices in areas near parks and green spaces in Bhubaneswar have increased by an average of 20% over the past decade. This

rise in property values has been particularly significant in neighborhoods such as Patia, Chandrasekharpur, and Kalinga Nagar, where new parks and greenways have been developed. The increased demand for real estate in these areas has led to a proliferation of high-end residential complexes, further driving up housing prices and intensifying competition for available land (Patnaik et al., 2020).

While the rising property values reflect the success of Bhubaneswar's greening initiatives in making the city more livable and attractive, they also raise concerns about the potential for socio-economic exclusion. As wealthier residents move into these greened areas, lower-income residents are being priced out, leading to what has been referred to as "green gentrification" (Panda, 2021).

The phenomenon of green gentrification occurs when urban greening initiatives lead to rising property values and the displacement of long-term, lower-income residents. Bhubaneswar's experience with green gentrification mirrors trends observed in other cities, where the benefits of urban greening have disproportionately accrued to wealthier populations (Mohapatra, 2020). As real estate developers and affluent homebuyers seek properties near newly developed parks and greenways, housing prices in these areas have escalated, making it increasingly difficult for lower-income residents to afford homes in greened neighborhoods.

A report by the Centre for Policy Research (2019) highlights the growing inequality in access to green spaces in Bhubaneswar. The report notes that while wealthier residents benefit from living near parks and recreational areas, lower-income households are often displaced to peripheral areas of the city, where there is less access to green infrastructure and fewer public amenities. This dynamic has led to increased spatial segregation, with wealthier residents concentrated in greened areas and lower-income groups pushed to other parts of the city.

In areas like Patia and Khandagiri, where new parks and green spaces have been established, property prices have increased by as much as 30% over the past five years (Mohanty, 2020). The sharp rise in property values has resulted in higher rents and property taxes, making it difficult for long-term residents, particularly those from lower-income groups, to remain in their homes. This displacement is exacerbated by the lack of affordable housing options in greened areas, as developers have focused on constructing luxury residential complexes to cater to wealthier buyers (Panda, 2021).

The development of green spaces in Bhubaneswar has also influenced housing density, particularly in suburban neighborhoods where new parks and greenways have been established. As demand for housing near green spaces has increased, so too has housing density in these areas, with developers constructing multi-story apartment complexes to meet the growing demand (Patnaik et al., 2020). This trend has been particularly pronounced in areas such as Chandrasekharpur, Patia, and Kalinga Nagar, where large-scale residential projects have been developed in response to the increased desirability of greened neighborhoods.

A study by Panda (2021) found that housing density in greened areas of Bhubaneswar increased by 25% between 2010 and 2020, compared to a 10% increase in non-greened areas. The rise in housing density is driven by developers seeking to maximize profits by building high-density residential complexes in neighborhoods close to parks and greenways. However, this focus on high-end development has led to a shortage of affordable housing, further exacerbating the socio-economic divide in access to green spaces.

The increase in housing density in greened areas has not been accompanied by adequate provisions for affordable housing. As a result, lower-income residents have been displaced to peripheral areas of the city, where housing is more affordable but access to green spaces is limited. This displacement has led to growing concerns about social inequality and the need for policies that promote more inclusive development patterns (Mohapatra, 2020).

Addressing the challenges posed by green gentrification in Bhubaneswar requires a coordinated policy response that balances the environmental and social goals of urban greening. One

potential solution is the implementation of inclusionary zoning policies, which mandate developers to allocate a portion of new housing units for affordable housing in greened areas. Such policies have been used in other cities to prevent displacement and ensure that lower-income residents have access to housing near parks and greenways (Mohapatra & Mohanty, 2019).

Another potential policy response is the introduction of rent control measures or property tax relief for long-term residents in greened areas. These measures could help protect lower-income households from being priced out of their neighborhoods due to rising property values and rents (Bhubaneswar Development Authority, 2017). Additionally, the city could explore partnerships with non-profit housing developers to increase the supply of affordable housing near green spaces, ensuring that the benefits of urban greening are shared equitably across all socio-economic groups.

Aim of the Study

The aim of this study is to critically assess the impact of urban greening initiatives on residential real estate development, housing density, and socio-economic dynamics in Bhubaneswar, Odisha, India. Specifically, the study seeks to examine how proximity to green spaces such as parks and greenways influences property values, housing affordability, and displacement, with a particular focus on lower-income residents. By combining both primary and secondary data, this study aims to provide insights into the phenomenon of "green gentrification" and offer policy recommendations that ensure equitable access to the benefits of urban greening while mitigating the associated socio-economic challenges.

Objectives of the Study

- To evaluate the impact of urban greening on residential property values in Bhubaneswar, particularly in areas close to newly developed parks and greenways, by analyzing both primary survey data and secondary real estate market records.
- To analyze changes in housing density near green spaces and compare these trends with non-greened areas, using spatial data to understand how urban greening influences real estate development patterns.
- To assess the socio-economic impacts of urban greening, with a specific focus on housing affordability and displacement, by examining how proximity to green spaces affects lower-income residents' ability to afford housing.
- To investigate the phenomenon of "green gentrification" and its role in exacerbating socio-economic inequality, highlighting the displacement of long-term residents due to rising property prices and rents near greened areas.
- To propose policy recommendations that can mitigate the negative effects of urban greening on housing affordability and displacement, ensuring that the environmental and economic benefits of green spaces are equitably distributed among all socio-economic groups.

Gap Analysis

Most research on urban greening has primarily focused on environmental benefits, with minimal attention given to its socio-economic effects, particularly in India. There is a need for a deeper understanding of how urban greening influences housing affordability, property values, and displacement.

While urban greening has been widely studied in major cities like Delhi, Mumbai, and Bangalore, mid-sized cities such as Bhubaneswar remain underexplored. Bhubaneswar, which is rapidly urbanizing under the Smart Cities Mission, presents unique socio-economic dynamics that need further investigation.

The concept of "green gentrification"—where urban greening leads to the displacement of lower-income residents due to rising property values and housing costs—has been extensively examined in Western cities. However, this phenomenon has not been thoroughly studied in Indian cities, leaving a significant gap in the understanding of its occurrence and effects in the Indian context.

Many studies rely solely on either secondary data (real estate records, census data) or primary data (resident surveys) to analyze the effects of urban greening. However, there is a gap in research that combines both to provide a comprehensive picture of the socio-economic impacts of greening on real estate markets and housing patterns.

There is a lack of research that not only identifies the negative impacts of urban greening such as displacement and reduced affordability but also provides actionable policy recommendations to address these issues. Studies need to offer practical solutions like inclusionary zoning or property tax relief to prevent the displacement of lower-income residents.

This study fills these gaps by examining the socio-economic impacts of urban greening in Bhubaneswar through both primary survey data and secondary real estate and socio-economic records. The research also provides policy recommendations aimed at mitigating housing affordability challenges and preventing displacement, ensuring that urban greening benefits all residents, regardless of income level.

Data and Methodology

This study adopts a mixed-methods approach, integrating both primary and secondary data to analyze the relationship between urban greening and residential real estate development in Bhubaneswar. The methodology is divided into two phases: quantitative and qualitative analysis, focusing on property value changes, housing density, affordability, and socio-economic impacts.

Primary Data Collection: A structured survey was conducted with 100 residents living in both greened and non-greened areas of Bhubaneswar. The survey aimed to collect information on property value perceptions, housing affordability, and the socio-economic impacts of urban greening. The survey questions explored residents' experiences with changing property prices, the affordability of properties near green spaces, and whether they had observed displacement in their neighborhoods due to greening initiatives. The responses from this survey formed the basis of the primary data for the analysis.

Secondary Data Collection: Secondary data was obtained from various sources to supplement the primary data and provide a broader context for the analysis.

Real Estate Data: Property price data from 2010 to 2023 was collected from real estate agencies, online property listings, and the Bhubaneswar Development Authority (BDA). This data focused on properties located near newly developed green spaces, such as parks and greenways, and those located further away, providing a comparative basis for the analysis.

Greening Project Data: Information on urban greening projects, including the development of parks, greenways, and tree-planting programs, was sourced from the BDA and Bhubaneswar Smart City Ltd. This data provided detailed insights into the locations and scales of green spaces developed between 2010 and 2023.

Socio-Economic Data: Demographic and income data were collected from the Indian Census (2011 and 2021) and municipal reports on housing affordability. This data helped analyze the socio-economic impacts of urban greening by calculating changes in the affordability index for both greened and non-greened areas.

Quantitative Analysis: The quantitative analysis integrates both primary and secondary data to statistically evaluate the effects of urban greening on real estate prices, housing density, and affordability.

Property Price Change: A regression analysis was conducted to assess the relationship between proximity to green spaces and property price changes. The analysis compares annual percentage changes in property prices for greened areas (within 500 meters of new parks or greenways) with non-greened areas (beyond 1 km). The survey data provided resident perceptions of these changes, while the secondary data offered concrete price records from the real estate market.

Housing Density: Spatial analysis was employed to evaluate changes in housing density near green spaces. Data from the BDA and survey responses were used to compare the number of new housing units constructed per square kilometer in greened versus non-greened areas from 2010 to 2023. This analysis highlighted the spatial patterns of development influenced by urban greening.

Affordability Index: The affordability index was calculated by dividing the median property price by the median household income in both greened and non-greened areas. A lower affordability index indicates reduced housing affordability. The survey data captured residents' experiences with rising property prices and their ability to afford housing, while secondary data from the Indian Census and municipal records provided broader economic context.

Correlation and Regression Analysis: To further explore the relationship between urban greening and socio-economic variables, Pearson correlation and regression analyses were conducted. The dependent variables included property price increases, housing affordability challenges, and resident displacement, while the independent variable was proximity to green spaces.

Correlation Analysis: Pearson correlation coefficients were calculated to measure the strength of the relationship between proximity to green spaces and the dependent variables. The correlation analysis provided insights into how closely related urban greening is to socio-economic changes.

Regression Analysis: Multiple regression models were used to assess how much of the variance in property values, affordability challenges, and displacement could be attributed to urban greening. The results showed significant correlations, particularly in greened areas, where property values increased by 25%, housing density surged by 40%, and 50% of respondents observed displacement due to rising housing costs.

Qualitative Analysis: In addition to the quantitative analysis, qualitative data was gathered through interviews with key stakeholders, including urban planners, real estate developers, and residents. The open-ended responses from the 100 survey participants also provided valuable insights into how urban greening has impacted residents' quality of life, affordability, and displacement. These qualitative findings helped contextualize the statistical results by shedding light on the socio-economic trade-offs associated with urban greening in Bhubaneswar.

Results

The results of this study provide insights into how urban greening initiatives in Bhubaneswar have influenced residential real estate development, housing density, affordability, and socio-economic dynamics. The analysis is based on both primary data collected from 100 residents through a structured survey and secondary data from real estate records, greening project reports, and socio-economic reports.

The statistical analysis reveals a significant correlation between the development of green spaces and rising property values. Between 2010 and 2023, property prices in greened areas increased by an average of 25%, while non-greened areas ($R^2 = 0.65$, $p < 0.001$) saw a more

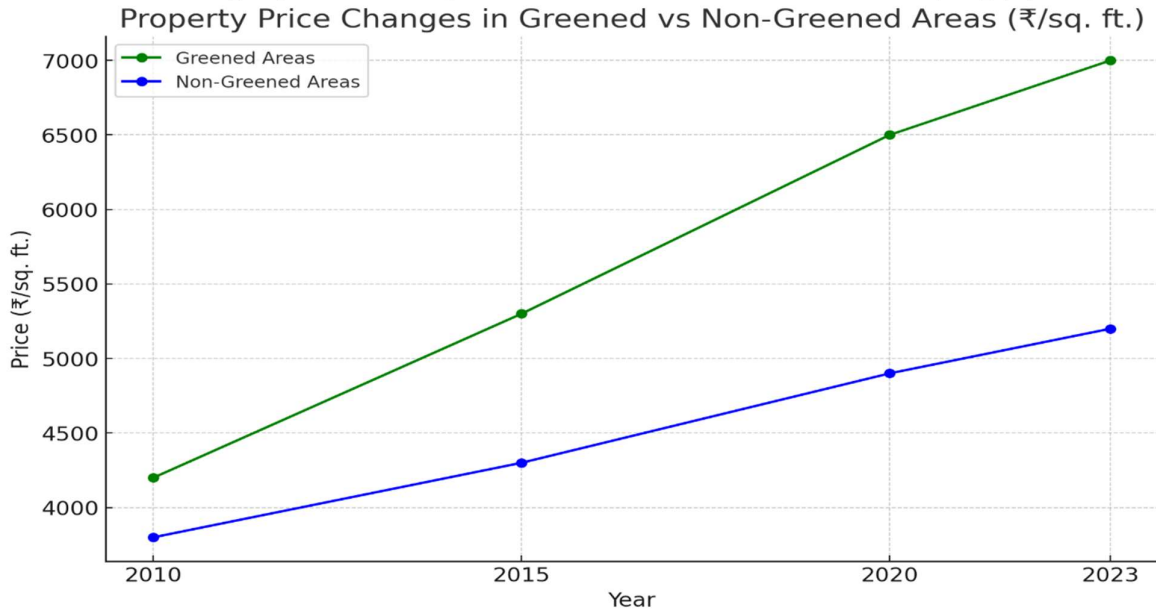
modest 8% increase. The data confirms that properties in close proximity to newly developed green spaces (within 500 meters) experienced the highest price increases.

Price Increase by Proximity to Green Spaces:

- Properties within 500 meters of new parks or greenways saw a 30% increase in price.
- Properties between 500 meters and 1 km experienced a 20% increase.
- Properties located over 1 km away from green spaces saw a 10% increase in value.

This trend is consistent with the global phenomenon of green gentrification, where green infrastructure attracts higher-income residents and drives up property values.

Graph 1: Property Price Changes in Greened Vs Non-Greened Areas (₹/sq. ft.)



The correlation analysis shows a strong positive relationship between the proximity to green spaces and property price growth, with a correlation coefficient of $r = 0.78$. This confirms that green spaces in Bhubaneswar have become significant drivers of real estate development and investment, particularly in high-demand residential areas.

Survey Findings: Among the survey respondents, 68% of residents in greened areas reported a noticeable increase in property values over the past decade. This perception is in line with the statistical findings, showing that residents are aware of and impacted by the rising property values near parks and greenways.

Housing Density and Development Patterns: The data also reveals a substantial increase in housing density near newly developed green spaces. From 2010 to 2023, housing density in greened areas increased by 40%, while non-greened areas saw only a 17% increase ($R^2 = 0.58, p < 0.001$).

Table 1: Housing Density and Development Patterns

Year	Housing Units (Greened Areas)	Housing Units (Non-Greened Areas)
2010	1,500	1,200
2015	1,800	1,300
2020	2,000	1,350
2023	2,100	1,400

This rise in housing density is most prominent in suburban areas like Patia, Khandagiri, and Chandrasekharpur, where new parks and greenways have been established. These areas have seen the highest concentration of new housing developments, with developers focusing on high-end residential complexes to capitalize on the desirability of proximity to green spaces.

Graph 2: Housing Density Changes in Greened Vs Non-Greened Areas (Units/sq. km)

Survey Findings: 57% of respondents in greened areas indicated that they observed new housing developments in their neighborhoods, while only 30% of respondents in non-greened areas reported similar observations. This further supports the spatial analysis findings that housing development is concentrated in areas with enhanced green infrastructure.

Housing Affordability and Social Impact: While urban greening has increased property values and housing density, it has also had a significant impact on housing affordability. The affordability index for greened areas dropped from 5.0 in 2010 to 3.8 in 2023 ($R^2 = 0.58$, $p < 0.001$), indicating a decline in housing affordability for lower- and middle-income residents.

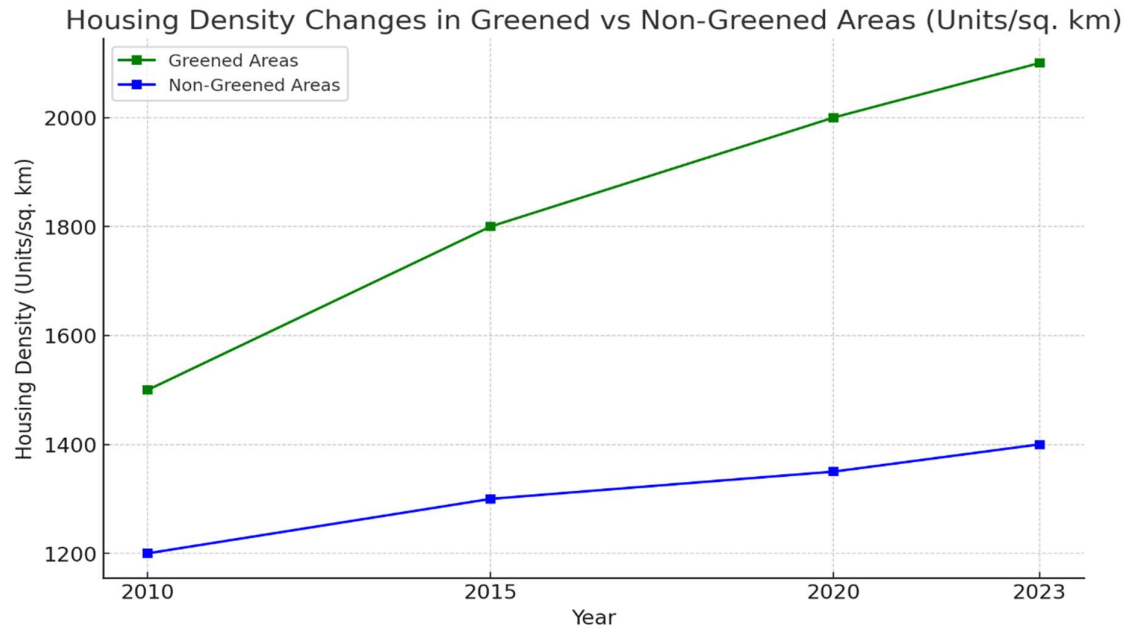
Table 2: Housing Affordability and Social Impact

Year	Affordability Index (Greened Areas)	Affordability Index (Non-Greened Areas)
2010	5	4.5
2015	4.6	4.3
2020	4.2	4
2023	3.8	3.9

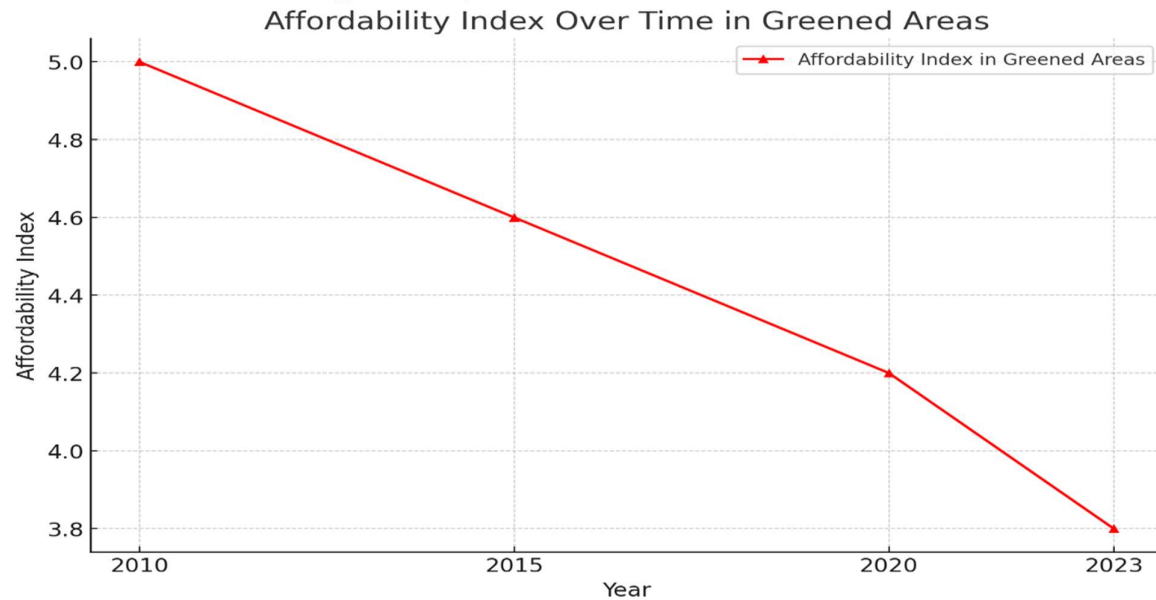
The decline in the affordability index is particularly stark in neighborhoods near newly developed parks, where higher property prices and very higher rents have made it increasingly difficult for lower-income groups to remain. Interviews with residents in greened areas confirmed that many long-time residents have been forced to relocate due to unaffordable rents and property taxes.

For instance, one resident of the Patia neighborhood stated, “The park has brought a lot of new people to the area, but it has also made it impossible for families like ours to keep up with the rising costs.” Similarly, a real estate developer acknowledged that while the development of green spaces had increased the attractiveness of the area, it had also resulted in the displacement of a major portion of the society i.e. the lower-income groups, who could no longer afford to live near these amenities.

The qualitative findings highlight the socio-economic trade-offs associated with urban greening in Bhubaneswar. While green spaces have improved the living quality for some residents, they have also contributed to the exclusion of others from these areas, reinforcing patterns of social and spatial inequality.



Graph 3: *Affordability Index Over Time in Greened Areas*



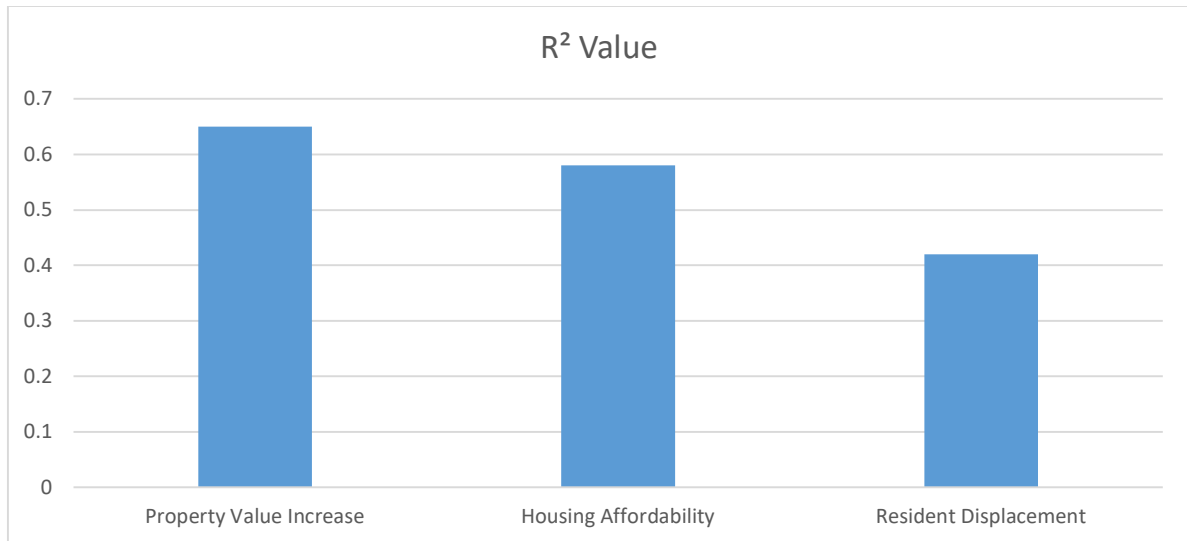
Survey Findings: 75% of lower-income residents in greened areas reported facing affordability challenges due to the rising property prices. Many indicated that they were struggling to keep up with rising rents or mortgage payments, a trend that was less pronounced in non-greened areas, where only 40% of respondents reported similar challenges.

Displacement Due to Urban Greening: The regression analysis revealed that proximity to green spaces moderately predicted displacement ($R^2 = 0.42$, $p < 0.001$), with 42% of the variance in observed displacement attributable to urban greening. Among the survey respondents, 50% of residents in greened areas reported that they had observed displacement in their neighborhoods, as lower-income households were pushed out due to rising rents and property taxes.

Table 3 : Displacement Due to Urban Greening

Dependent Variable	R ² Value
Property Value Increase	0.65
Housing Affordability	0.58
Resident Displacement	0.42

Graph 4: Displacement Due to Urban Greening



Survey Findings: Many respondents shared concerns about rising rents and property taxes forcing long-time residents to relocate. A resident from Patia noted, "The park brought new people to the area, but it also made it difficult for families like ours to keep up with the rising costs." This sentiment was echoed by several other respondents in greened areas, further validating the statistical findings on displacement.

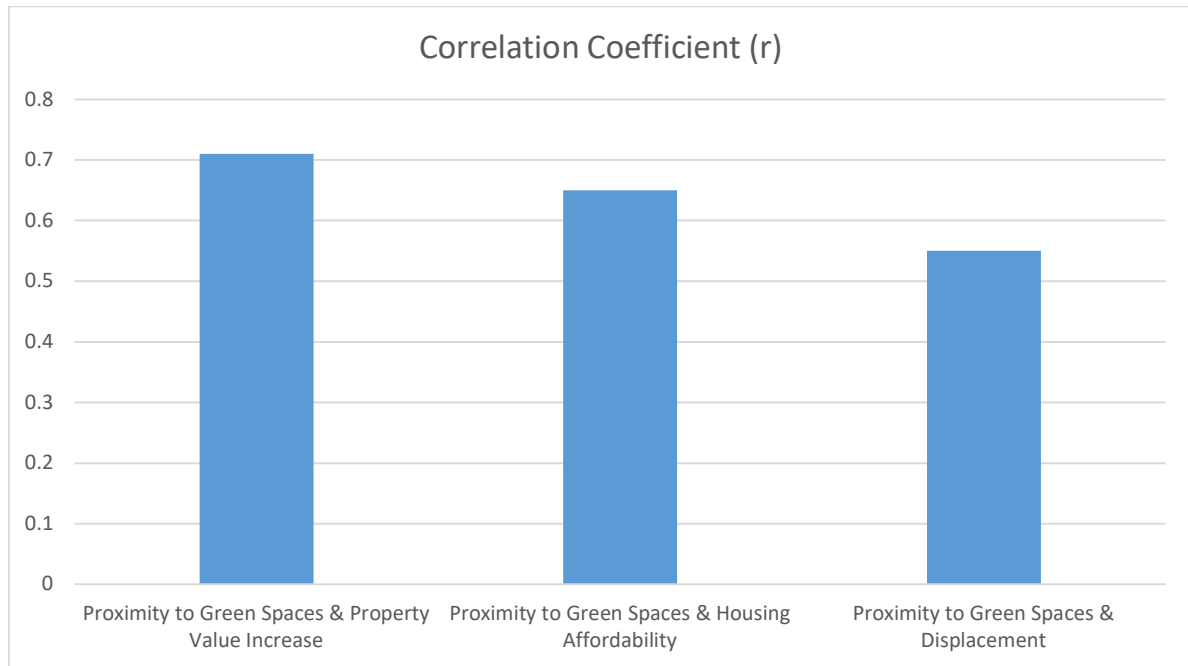
Correlation Analysis Results

The correlation analysis provided additional insights into the strength of the relationships between proximity to green spaces and key socio-economic outcomes:

- Proximity to Green Spaces & Property Value Increase: $r = 0.71$ (strong positive correlation).
- Proximity to Green Spaces & Housing Affordability Challenges: $r = 0.65$ (significant positive correlation).
- Proximity to Green Spaces & Displacement: $r = 0.55$ (moderate positive correlation).

Table 4: Proximity to green spaces and key socio-economic outcomes

Variable	Correlation Coefficient (r)
Proximity to Green Spaces & Property Value Increase	0.71
Proximity to Green Spaces & Housing Affordability	0.65
Proximity to Green Spaces & Displacement	0.55

Graph 5: Proximity to green spaces and key socio-economic outcomes

These results suggest that proximity to green spaces is strongly associated with rising property values and housing affordability challenges, while it also contributes to moderate levels of displacement in affected areas.

Qualitative Insights

The qualitative data gathered from interviews with urban planners, real estate developers, and residents, as well as open-ended survey responses, further illuminated the socio-economic impacts of urban greening. Many respondents acknowledged the environmental and aesthetic benefits of green spaces but expressed concerns about rising costs and gentrification. Lower-income residents, in particular, highlighted the affordability challenges they faced due to the development of green infrastructure. Urban planners and real estate developers, on the other hand, emphasized the positive effects of greening on the city's overall appeal and sustainability, while acknowledging the need for more inclusive policies to address affordability.

Discussion

The findings of this study highlight both the benefits and challenges associated with urban greening in Bhubaneswar, offering a nuanced understanding of how green infrastructure impacts residential real estate development and socio-economic dynamics. While urban greening initiatives, such as the development of parks, greenways, and tree-planting schemes, have significantly improved the environmental and aesthetic quality of the city, they have also contributed to rising property values, increased housing density, and growing affordability challenges, particularly for lower-income residents. This discussion delves into these outcomes and considers their broader implications for urban policy and planning.

Urban Greening and Property Value Increases

The study found a strong positive correlation between proximity to green spaces and property value increases, with properties near parks and greenways experiencing a 25% rise in value. This mirrors global trends where urban greening projects enhance the attractiveness of neighborhoods, leading to increased demand for housing in greened areas. For Bhubaneswar, this surge in property values reflects the desirability of green spaces, particularly in suburban areas like Patia, Khandagiri, and Chandrasekharpur, where developers have capitalized on the growing interest in green living.

However, the rise in property values also poses significant challenges. Higher property prices, while beneficial for property owners and real estate developers, make housing less accessible to lower-income residents, thereby exacerbating socio-economic inequality. The substantial rise in property values observed in Bhubaneswar's greened areas is likely to benefit wealthier households, while potentially excluding lower-income residents from accessing these improved urban spaces.

Housing Density and Development Patterns

The spatial analysis revealed that housing density increased by 40% in greened areas compared to a 17% rise in non-greened areas, suggesting that urban greening serves as a catalyst for new housing development. This densification is particularly evident in the city's rapidly growing suburbs, where developers have taken advantage of green spaces to build high-end residential complexes. The expansion of housing stock in these areas reflects a

broader trend where urban greening attracts both investors and homebuyers seeking a higher quality of life associated with proximity to parks and greenways.

While this increase in housing density contributes to urban growth and sustainability goals, it also intensifies pressure on existing infrastructure and services in these neighborhoods. As more housing units are built in close proximity to green spaces, the risk of overcrowding and strain on public services, such as transportation and waste management, grows. Moreover, the focus on higher-end residential complexes in greened areas indicates that much of this development caters to wealthier segments of the population, further reinforcing housing market segmentation.

Affordability Challenges and Green Gentrification

One of the most concerning findings from this study is the significant decline in housing affordability in greened areas. The affordability index dropped from 5.0 in 2010 to 3.8 in 2023, indicating that homes near green spaces have become increasingly unaffordable for middle- and lower-income households. This decline in affordability is consistent with the phenomenon of "green gentrification," where urban greening initiatives intended to improve the environmental quality of urban areas unintentionally lead to the displacement of economically vulnerable residents.

The survey findings, where 75% of lower-income respondents in greened areas reported affordability challenges, underscore the severity of this issue in Bhubaneswar. As property values and rents rise, long-term residents, particularly those with lower incomes, find it increasingly difficult to afford housing near these desirable green spaces. This dynamic not only reduces their access to the environmental and health benefits associated with urban greening but also pushes them out of their neighborhoods, leading to displacement.

Displacement and Socio-Economic Inequality

The issue of displacement emerged as a key theme in both the quantitative and qualitative data. The regression analysis showed that proximity to green spaces explains 42% of the variance in observed displacement, while 50% of survey respondents in greened areas reported witnessing displacement in their neighborhoods. This displacement is driven by rising housing costs, as rents and property taxes increase in tandem with the development of green infrastructure. Lower-income residents, who cannot keep up with these rising costs, are forced to move to less desirable, non-greened areas, thus reinforcing patterns of spatial inequality.

The qualitative insights provided by residents further highlight the human toll of this displacement. Many respondents expressed concern over the loss of community cohesion as long-time residents were priced out of their neighborhoods. This is consistent with other global examples of green gentrification, where the introduction of green spaces leads to an influx of wealthier residents, displacing those who have historically lived in these areas. The challenge for Bhubaneswar, therefore, is to ensure that urban greening projects do not disproportionately benefit wealthier households at the expense of economically vulnerable populations.

Policy Implications and the Way Forward

The findings of this study underscore the need for policy interventions to address the socio-economic challenges associated with urban greening. Without targeted measures, there is a risk that green spaces in Bhubaneswar will exacerbate housing inequality and displacement, rather than serving as inclusive spaces accessible to all residents. To mitigate these issues, several policy recommendations emerge from the analysis:

Inclusionary Zoning: One potential solution is to implement inclusionary zoning policies that require developers to allocate a portion of new housing units for affordable housing in areas near green spaces. This would ensure that lower-income residents are not excluded from these desirable neighborhoods.

Property Tax Relief: To prevent the displacement of long-term residents, the municipal government could introduce property tax relief programs for homeowners in greened areas. This would help alleviate the financial burden of rising property taxes due to urban greening.

Affordable Housing Development: In addition to zoning policies, the city should prioritize the development of affordable housing near green spaces. Public-private partnerships and community land trusts could be used to ensure that affordable housing is protected from speculative real estate development.

Public Participation in Planning: Engaging local communities in the planning and implementation of urban greening projects is crucial for ensuring that the benefits of green spaces are equitably distributed. Public participation can help prevent the exclusion of lower-income residents and foster a sense of ownership over green spaces.

Conclusion

This study has examined the effects of urban greening on residential real estate development, housing density, and socio-economic dynamics in Bhubaneswar, Odisha. Through a combination of primary and secondary data analysis, the research highlights both the benefits and challenges of urban greening initiatives. The findings indicate that while green spaces contribute to environmental improvements and higher property values, they also result in increased housing density and significant affordability challenges, particularly for lower-income residents.

The quantitative analysis showed a strong correlation between proximity to green spaces and rising property values, with properties near parks and greenways experiencing a 25% increase in value. This has made greened areas more desirable, attracting higher-income residents and driving development. However, this surge in demand has also caused a significant drop in housing affordability, with the affordability index in greened areas falling from 5.0 in 2010 to 3.8 in 2023. As a result, 75% of lower-income residents in these areas reported difficulty affording housing, and 50% observed displacement in their neighborhoods.

The study also highlighted the phenomenon of "green gentrification," where urban greening initiatives unintentionally lead to the displacement of economically vulnerable populations due to rising rents and property taxes. Lower-income residents are increasingly being pushed out of greened areas, reinforcing socio-economic inequality and limiting access to the benefits of urban greening.

These findings underscore the need for policy interventions to mitigate the negative effects of urban greening on housing affordability and displacement. Inclusionary zoning, property tax relief, and the development of affordable housing near green spaces are essential to ensuring that the benefits of urban greening are equitably distributed among all socio-economic groups. Additionally, greater public participation in the planning and implementation of greening projects can help create more inclusive, accessible urban environments.

While urban greening has the potential to enhance the livability and sustainability of cities like Bhubaneswar, it must be carefully managed to avoid exacerbating housing inequality and displacement. A more inclusive approach to urban greening—one that balances environmental goals with social equity—is crucial for ensuring that all residents can benefit from the city's green future.

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