IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 12 Issue 04, April 2025
ISSN (Online) 2348 – 7968 | Impact Factor – 6.72
www.ijiset.com

Projected Increase in Population Density Due to Redevelopment and Its Impact on Urban Infrastructure in Pune

Ar. Ajinkya Jadhav (ajeenkya26@gmail.com)
Prof. Romerio Silveria (romeirasilveira@gmail.com)

Abstract:
Pune, one of India's fastest-growing metropolitan cities, is witnessing rapid urban redevelopment, leading to a substantial rise in population density in specific areas. While these redevelopment projects aim to modernize old structures and accommodate a growing population, they simultaneously place immense pressure on urban infrastructure. The increase in population density has resulted in heightened demand for civic amenities such as water supply, drainage, waste management, electricity distribution, and traffic management.
As these redeveloped areas experience a surge in occupancy, the existing infrastructure struggles to keep pace. Water shortages and irregular distribution are becoming more prevalent, while outdated drainage systems face frequent overflows and blockages, raising sanitation concerns. Waste generation has increased without adequate disposal mechanisms, leading to environmental hazards. The electricity grid is under strain due to rising power demands, resulting in voltage fluctuations and outages. Traffic congestion has worsened due to narrow roads, limited parking, and higher vehicle emissions, contributing to increased air pollution.
This study aims to project population growth using redevelopment project data, case studies, surveys, and urban development reports to analyse the infrastructural challenges arising from redevelopment-led densification. It emphasizes the need for proactive urban planning that aligns redevelopment with infrastructure expansion. Key recommendations include upgrading civic amenities, integrating smart city solutions, and implementing stricter urban development policies. Addressing these challenges will be crucial for ensuring sustainable urban growth while maintaining the quality of life for Pune's residents.

Keywords:
Population density, redevelopment projects, urban infrastructure, civic amenities, water supply, drainage, waste management, electricity, traffic congestion, pollution, urbanization, Pune city.

1. Introduction to Redevelopment Trends in Pune

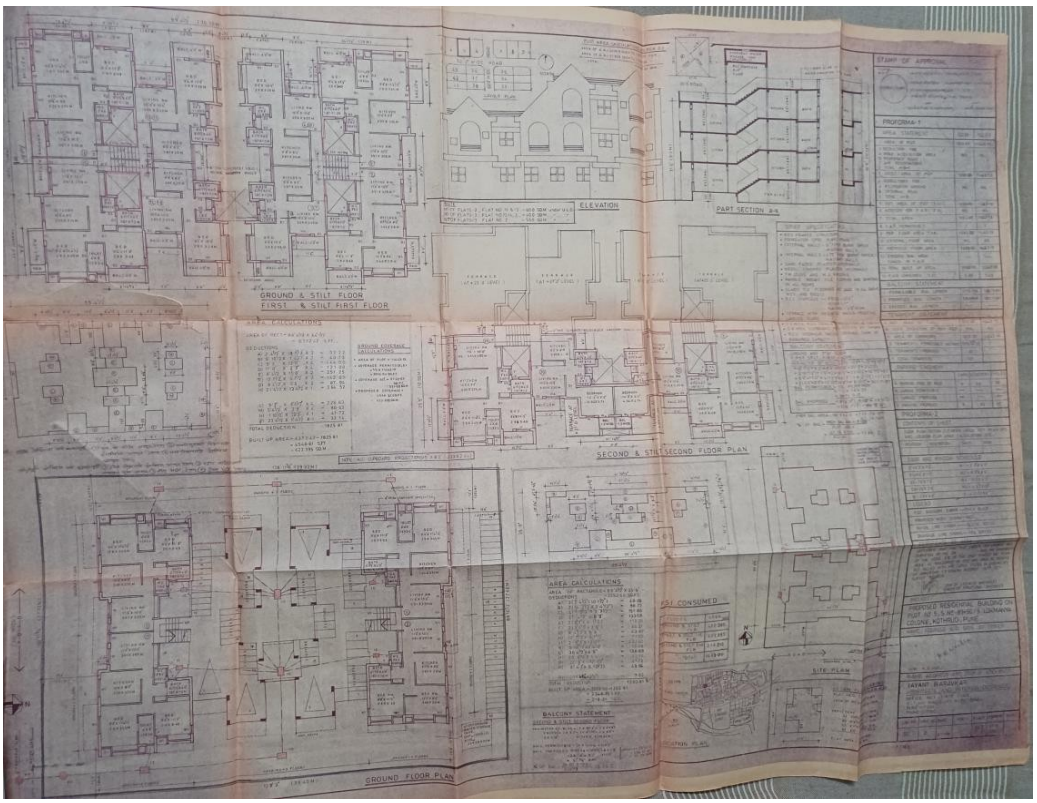
Redevelopment has emerged as a prominent urban strategy across Indian cities, with Pune standing out due to its rapid expansion, aging housing stock, and rising population pressures. Unlike greenfield developments, redevelopment focuses on rejuvenating old or dilapidated buildings, particularly in core urban areas, by replacing them with newer, high-rise, multi-storey constructions. This trend is largely driven by the increasing Floor Space Index (FSI) allowances introduced by urban authorities under the Unified Development Control and Promotion Regulations (UDCPR).
In Pune, redevelopment is mostly seen in central and older suburbs like Shivajinagar, Kothrud, Sadashiv Peth, and Pimpri-Chinchwad. The primary incentives include structural degradation, limited amenities in older buildings, and lucrative offers by developers. Residents are offered new units, often larger, with improved facilities. However, this trend also results in significantly increased population densities within the same land parcel, bringing up questions around adequacy of surrounding civic infrastructure.
Typical outcomes of this redevelopment wave include vertical expansion, rise in household units, and overall improvement in real estate value. On the downside, these projects often overlook the supporting capacity of roads, water networks, sewage systems, and waste management grids.

2. Methodology and Scope of Analysis

This study utilizes a quantitative projection method using standardized redevelopment data applied to a base plot of 1000 sqm. Data points such as average family size, water usage norms, waste generation coefficients, and power demand per household are used to estimate load impacts pre- and post-redevelopment.

The study then scales this data to a 1 sqkm. macro view which can be further scaled to larger area to understand the broader implications for Pune's civic systems. Existing reports from Pune Municipal Corporation (PMC), UDCPR guidelines, and academic literature form the basis of infrastructural norms and planning assumptions. Findings are further contextualized using local case study trends, helping derive a realistic projection of urban pressure and service gaps.

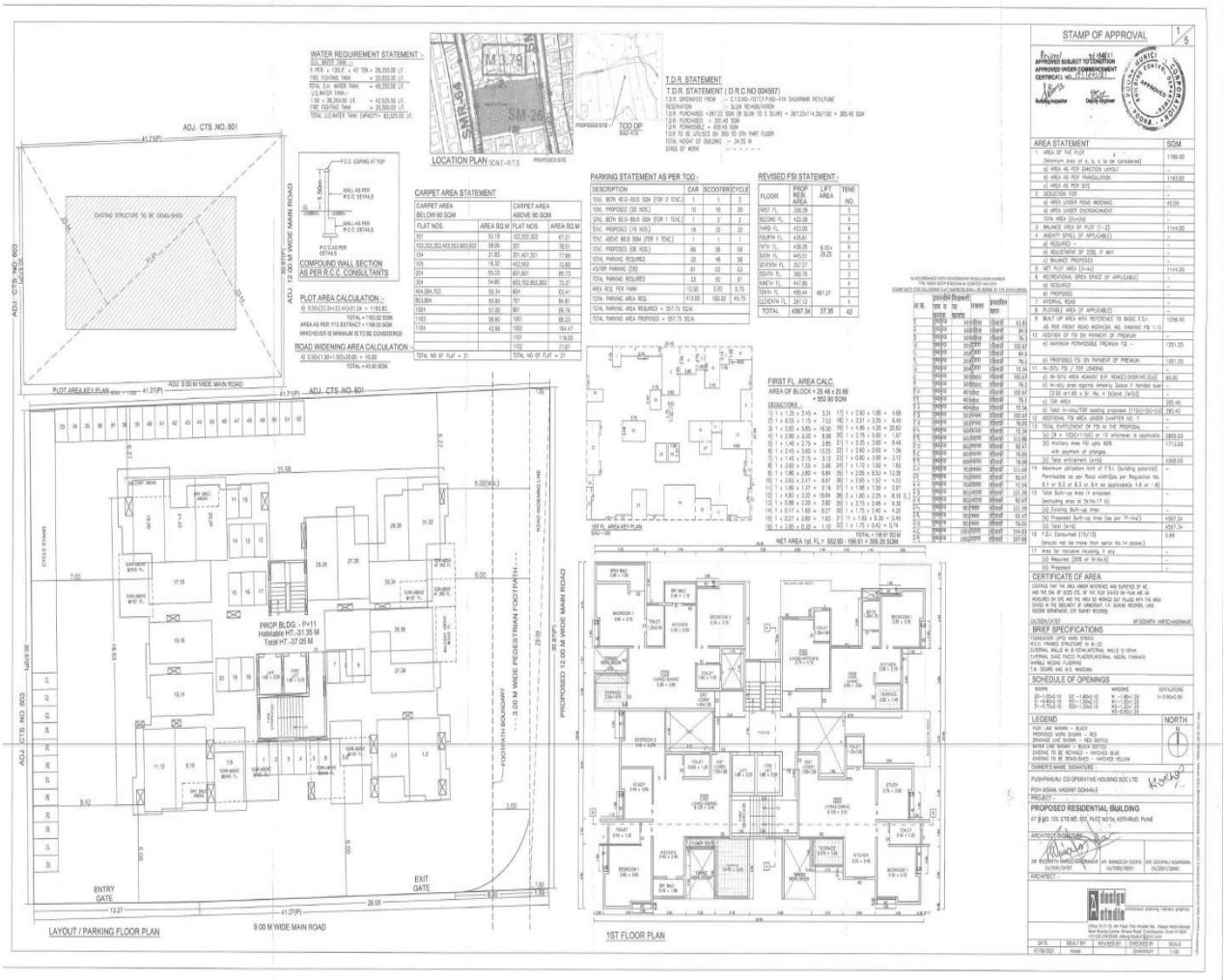
3. Redevelopment Scenario using a case study: Population Growth and Density Projections



Existing Building Plan

3.1 Existing Condition (Pre-Redevelopment)

- Plot Size: 1000 sqm
- Residential Units: 16 (8 × 1BHK + 8 × 2BHK)
- Population:
  - 1BHK (8 units × 4 people) = 32 people
  - 2BHK (8 units × 5 people) = 40 people
  - Total Population: 72 people
- Population Density: 72 people / 1000 sqm = 72,000 people/sqkm



Proposed Building Plan – P52100023681 RERA Website: https://maharera.maharashtra.gov.in/

3.2 Post-Redevelopment Condition

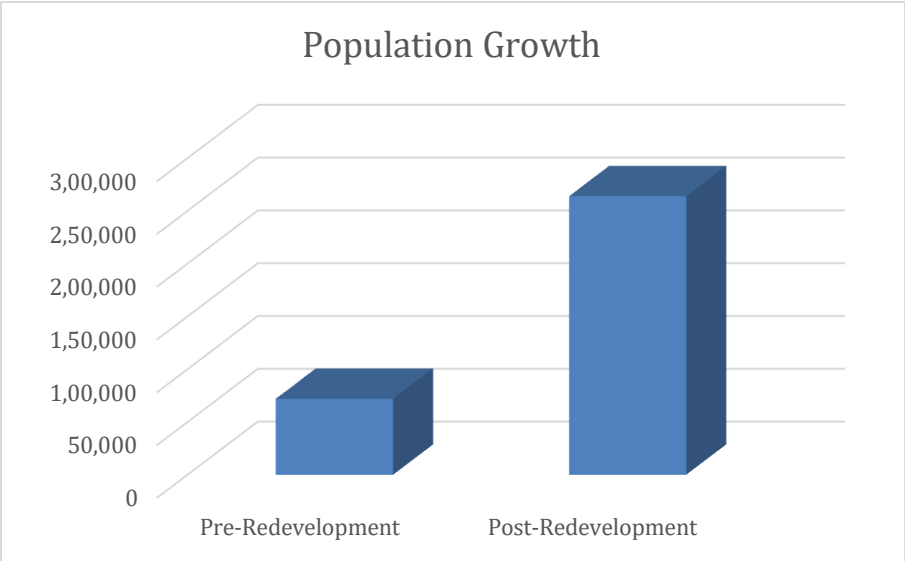
- Residential Units: 48 (24 × 2BHK + 24 × 3BHK)
- Population:
  - 2BHK (24 units × 5 people) = 120 people
  - 3BHK (24 units × 6 people) = 144 people
  - Total Population: 264 people
- Population Density: 264 people / 1000 sqm = 264,000 people/sqkm

3.3 Net Population Growth

- Increase = 264 - 72 = 192 people per 1000 sqm
- Population Growth Rate: ~267%

3.4 Net Population Growth When scaled to 1 sqkm.

- When scaled to 1 sqkm (1,000 such plots):
- Pre-Redevelopment Population = 72,000 people
- Post-Redevelopment Population = 264,000 people
- Net Increase: 192,000 people per sqkm



Net Population Growth When scaled to 1 sqkm.

4. Impact on Urban Infrastructure

4.1 Water Supply

- Average Daily Water Consumption: 135 liters/person/day
- Pre-redevelopment: 72,000 × 135 = 9.72 million liters/day
- Post-redevelopment: 264,000 × 135 = 35.64 million liters/day
- Additional Demand: ~25.92 MLD

4.2 Waste Management

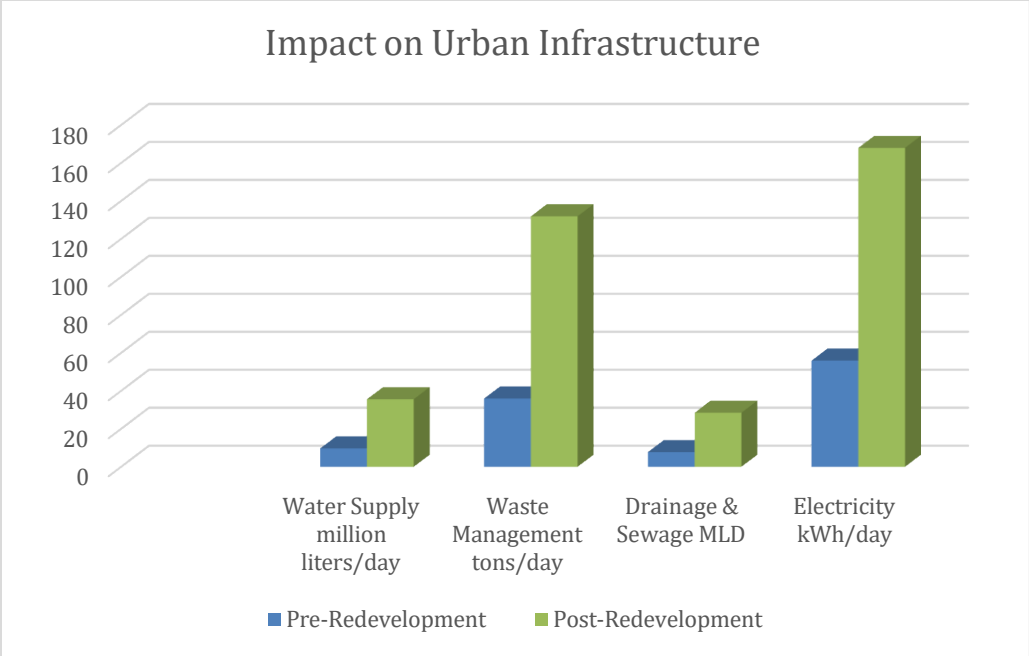
- Average Solid Waste Generation: ~0.5 kg/person/day
- Pre: 72,000 × 0.5 = 36 tons/day
- Post: 264,000 × 0.5 = 132 tons/day
- Additional Load: 96 tons/day

4.3 Drainage & Sewage

- Sewage Generation: 80% of water consumed becomes wastewater
- Pre: ~7.78 MLD
- Post: ~28.51 MLD
- Additional Load: ~20.73 MLD

4.4 Electricity

- Average Household Consumption: ~3.5 kWh/day
- Pre: 16 units × 3.5 = 56 kWh/day
- Post: 48 units × 3.5 = 168 kWh/day
- Load Tripling Per Plot



Impact on Urban Infrastructure

4.5 Traffic and Air Pollution

- Redevelopment typically brings 2–3 cars per new household
- Narrow roads, limited parking = Congestion
- Vehicle emissions = Air pollution (NO_2, $PM_{2.5}$ rise)
- Worsening AQI, especially in older core areas

5. Implications and Recommendations

The densification effect of redevelopment is substantial, with potential to quadruple the urban population within the same footprint. Without synchronized infrastructure upgradation, quality of life will degrade significantly.

Recommendations:

- Integrated Planning: Align redevelopment with infrastructure capacity
- Smart Water Management: Rainwater harvesting, greywater reuse
- Decentralized Waste Processing: Local composting and biogas units
- Sewage Network Revamp: Pipe resizing, separation of stormwater and sewage
- Traffic Management: Wider roads, public transport, parking solutions
- Policy Reform: Cap densification without infrastructure readiness

6. Inferences and Impacts

The study highlights the stark consequences of unregulated urban redevelopment through a micro-to-macro simulation based on a standard 1000 sqm plot model. When scaled to a city level (1 sqkm), it becomes evident that redevelopment could lead to a 267% increase in population density, escalating from 72,000 to 264,000 people per square kilometer. This densification, though advantageous in terms of optimizing land use and modernizing housing stock, drastically alters demand dynamics for civic amenities and infrastructure.

- Water Supply Stress: Water demand rises from 9.72 MLD to 35.64 MLD per sqkm, highlighting the urgent need to augment existing water supply systems. Without infrastructure upgrades, this will result in frequent shortages, over-extraction of groundwater, and disputes over allocation.

- Solid Waste and Sanitation Burden: The solid waste generation triples (from 36 to 132 tons/day), severely burdening municipal waste management facilities. If unaddressed, this can lead to increased landfill use, illegal dumping, and degraded urban hygiene.
- Drainage and Sewage System Overload: Sewage discharge jumps from 7.78 MLD to 28.51 MLD, necessitating larger capacity pipelines, modern treatment plants, and integration of stormwater and greywater separation. Legacy systems in core areas will be incapable of managing such volumes.
- Power Load Amplification: Electricity demand triples at the micro level, which, when scaled, puts stress on distribution networks and peak hour supply. Without proactive grid planning and the introduction of renewable energy sources, brownouts and inefficiencies will follow.
- Traffic Congestion and Pollution: Increased car ownership per household without corresponding changes in road width or public transport will worsen traffic congestion, accident rates, and air quality (especially PM2.5 and NO2 concentrations). Old city zones like Sadashiv Peth and Kothrud will be particularly vulnerable.

Effects of Redevelopment Environment

- Air Quality Deterioration due to construction activity and vehicle growth.
- Noise Pollution during and after construction.
- Urban Heat Island Effect due to loss of tree cover and rise in built-up areas.
- Strain on Green Cover as redevelopment usually results in tree cutting and open space reduction.

7. Findings and Suggestions for Government Planning Bodies

7.1 Pre-Approval Infrastructure Assessment:

- Enforce mandatory infrastructure audits before redevelopment permissions.
- Require feasibility reports for utility networks and services.

7.2 Density Cap Linked to Infrastructure Readiness:

- Implement FSI controls tied to available or planned capacity of infrastructure.
- Introduce area-wise maximum dwelling thresholds.

7.3 Zonal Infrastructure Upgrade Funds:

- Create Development Impact Charges (DICs) earmarked for local infrastructure enhancements.
- Public-private partnerships for smart infrastructure solutions.

7.4 Master Plan Recalibration:

- Update Development Plans (DP) to reflect redevelopment clusters.
- Introduce Local Area Plans (LAPs) that integrate land use and infrastructure.

7.5 Infrastructure Upgradation Strategies

- Smart Water Management:
- Enforce rainwater harvesting and greywater reuse at building level.
- Digitally monitor consumption and leakage.

7.6 Decentralized Solid Waste Solutions:

- Promote local biogas and composting units.
- Incentivize community-managed waste segregation systems.
  Sewage and Drainage Modernization:
- Upgrade old networks using GIS mapping.
- Build separate stormwater drains to prevent flooding and overflow.

7.7 Electric Grid and Renewable Integration:

- Mandate rooftop solar, smart meters, and energy-efficient designs in new buildings.

7.8 Mobility and Pollution Control:

- Promote non-motorized transport (NMT), dedicated cycling lanes.
- Expand BRTS, metro, and e-bus networks before occupancy of redeveloped buildings.

7.9 Green Infrastructure:

- Retain minimum green space per population unit
- Develop vertical gardens and micro-climate buffers in urban cores.

8. Conclusion

The data demonstrates that redevelopment, if left unchecked and unaccompanied by infrastructure reinforcement, poses serious sustainability threats. Pune must adopt a proactive, policy-driven approach that ensures urban growth is matched by infrastructural resilience. Long-term planning, community involvement, and technological integration are vital for balancing modernization with livability.

Bibliography

1. Pune Municipal Corporation Development Plan Reports (2017–2022)
2. Unified Development Control and Promotion Regulations (UDCPR), Government of Maharashtra
3. Census of India (2011) – Urban Household Data
4. Central Pollution Control Board – Guidelines on Waste Management
5. Maharashtra Electricity Regulatory Commission (MERC) Reports
6. Research Articles from the Journal of Urban Planning and Development
7. PMC Water Supply & Drainage Department White Papers
8. Indian Green Building Council (IGBC) Smart City Infrastructure Guides
9. RERA Website: https://maharera.maharashtra.gov.in/