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Manuscript ID:
IJWGAFES-2025-020402

DOI: 10.5281/zenodo.15854140

DOI Link:
<https://doi.org/10.5281/zenodo.15854140>

Volume: 2
Issue: 4
April
Year: 2025
E-ISSN: 3066-1552

Submitted: 05 Mar 2025
Revised: 20 Mar 2025
Accepted: 10 Apr 2025
Published: 30 Apr 2025

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How to cite this article:
Patil, P., Chougule, V., Pawar, S., Dhumal, S., Koli, K., & Koli, R. (2025). Spatial Disparities in Affordable Housing and Urban Service Accessibility in Kolhapur, India: A GIS-Based Combined Affordability Index Approach. International Journal of World Geology, Geography, Agriculture, Forestry and Environment Sciences, 2(4), 7–25.
<https://doi.org/10.5281/zenodo.15854140>

Spatial Disparities in Affordable Housing and Urban Service Accessibility in Kolhapur, India: A GIS-Based Combined Affordability Index Approach

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Abstract

The importance of affordable housing in the context of sustainable and just city development has been well documented. However, inequities in access to affordable housing and in the quality of urban services in many accelerating urban centers still remain, exacerbating and reinforcing socio-spatial disparities. This study paper analyzes the spatial variation in affordable housing in Kolhapur City, India, by integrating GIS with a Combined Affordability Index (CAI). The CAI integrates standardized land price measures with human service distribution, including health, education, and finance, into an evidential, spatially explicit classification of urban affordability. The results show that less expensive areas with cheap land prices are often poorly provided for, whereas high-priced zones still tend to enjoy the access to urban services, which consolidates the process of socio-spatial differentiation. Zones of moderate affordability reflect mixed compromises along the service availability versus housing cost spectrum. These findings highlight the need for policy making that integrates space and that is able to tackle both housing affordability and access-to-service issues in tandem. The GIS-based CAI seems to be replicable and provides a tool for prioritizing interventions and addressing spatial justice in other medium-sized cities in India.

Keywords: Affordable housing; spatial inequality; urban services; Combined Affordability Index; spatial justice

Introduction

The importance of affordable housing as a foundation for equitable urban development and social sustainability is well recognized world wide across the globe (UN-Habitat, 2020). Disparities in access to affordable housing and to critical urban services have widened as cities grow under the strains associated with urbanization (Angel et al., 2016; Turok & McGranahan, 2013). These inequalities are especially prevalent in dynamic urbanizing areas, where spatial inequality and socio-economic segregation hinder a more inclusive form of economic growth (Sassen, 2014; Hamnett, 2020). In the case of India, with the urban population expected to exceed 600 million by 2030, affordable housing is an infrastructural necessity but also a strategic social asset (Kundu 2014; Ministry of Housing and Urban Affairs 2022). Cheap housing is that which is available to low- and middle-income households at rates where they can still meet their other basic needs such as education, health, and nutrition (Stone, 2006; Haffner & Hulse, 2021). The scarcity of affordable housing also creates conditions for growing social exclusion, as marginalized groups find themselves stigmatized in informal settlements with substandard infrastructure and limited access to services (UN-Habitat, 2015; Roy, 2011). Researchers have reported on the spatiality of affordable housing and how it shapes opportunities, social mobility, and community resilience (Galster, 2019; Scanlon et al., 2014). An insufficient supply of affordable housing has been linked to higher urban poverty rates, greater vulnerability to displacement, vulnerability and intergenerational poverty risk (Desmond, 2016; Lee et al., 2020).

Spatial unevenness in low-cost housing is closely associated with the spread of urban amenities such as education, health, and financial infrastructure (Samad et al., 2018; Ramachandraiah, 2019). The poorest may live in marginal and poorly served areas, where services are inaccessible, leading to an entrenched disadvantage (Patel, 2017; Kumar et al., 2021). The role of public transport networks is also very important, as poor connectivity creates greater exclusion and reduction in jobs (Ghosh, 2020; Lucas, 2012). The resolution of these complex challenges will require need spatially explicit analyses with the ability to pinpoint hotspots of intervention (Yuan et al., 2021; Kim et al., 2018). Geographic Information Systems (GIS) and spatial disparities in urban housing and services Geographic Information Systems (GIS) have become an important assets for mapping, analyzing, and visualizing spatial disparities in urban housing and services (Aljoufie et al., 2013; Sliuzas et al., 2008).

GIS-supported methods enable scholars and policy makers to integrate and analyze data on various aspects (e.g., land values, location of services, and demographic characteristics) for evidence-informed urban planning (Bhatta, 2010; McLafferty, 2018). Other studies have also developed a GIS to rank housing interventions and improve urban service delivery (Acioly, 2010; Kamruzzaman et al., 2021; Jiang et al., 2017). In India, given its fragmented municipal governance structure, GIS can also work as an integrating decision-support tool for housing policy (Kumar & Koteeswara, 2014; Anand & Rademacher, 2011).

In view of this, the current study examines spatial inequities in affordable housing and urban service accessibility and provision in Kolhapur city (Figure 1). Kolhapur is a typical medium-sized Indian city in transition with a fast pace of economic and social change and consequent increased demand in its housing markets (Patil et al., 2020). Utilizing ward-level land price and accessibility of basic services, this study attempts to come up with a Combined Affordability Index (CAI) to classify the urban area according to the degree of service linkage and affordability. This approach adds to the nascent literature on spatial justice and urban equity in India (Kundu, 2019; Tiwari & Rao 2016). This study has implications for policymakers and urban planners to support informed decisions in attempts to achieve inclusive housing development and alleviate social and economic segregation (e.g., Tripathy & Bhattacharya, 2020; Kumar & Dhingra, 2021).

Thus, the research objectives of this study paper can be specified as follows: (i) to measure spatial variations in affordable housing among the Kolhapur city wards (Figure 2, Figure 3), (ii) to estimate the accessibility of basic urban services (healthcare, education, financial facilities) across these wards, and (iii) to combine these measurements to produce a combined Affordability Index through the use of GIS. This methodological framework is to contribute to promoting more equitable and sustainable urban policy interventions (Bertolini et al., 2018; Sun et al., 2020).

Methodology

The review used ward-level data to assess housing affordability with respect to two central considerations (Figure 2):

Price of Land: Lower price of land means more affordability.

Amenities: More basic amenities mean that a location is easier to access and more desirable.

1. Using these parameters:

Most Affordable- Locations with the lowest land price and highest facility count.

Moderately Affordable- Locations with balanced land price and facility availability.

Least Affordable- Locations with high land prices and minimal facilities.

This method used employs ward-based data and evaluates housing affordability based on in two factors: land price and number of facilities. These indicators were measured, normalized, and synthesized.

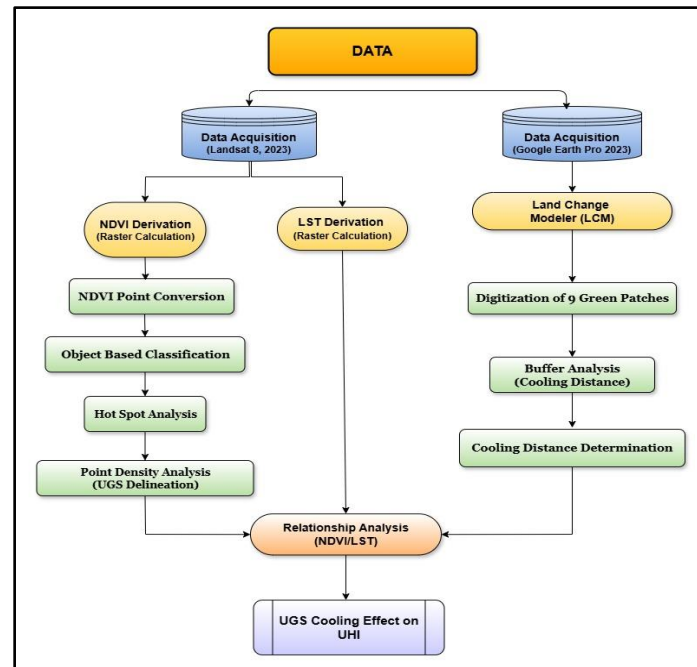


Fig. 2: Research Methodology

Together according to a scoring system and classified places within each ward. The following are the methodology and the formulas that have been applied:

2. Criteria for Evaluation

Land Price (LP):

Land price directly affects affordability. Lower land prices indicate greater affordability for Low- and middle-income families. The affordability score for land prices was computed as: follows an inverse function of the price:

$$\text{Land Price Score (LPS)} = \frac{\text{Max Price} - \text{Land Price}}{\text{Max Price} - \text{Min Price}}$$

Where:

Land Price is the price per unit of land at a specific location.

Max Price and Min Price are the highest and lowest land prices within the ward, respectively.

The score was normalized between 0 and 1, with 1 representing the most affordable land price.

Facilities (F):

Facilities increase the desirability of a location. These include:

Educational institutions: Schools, colleges, and preschools.

Healthcare services: Hospitals and clinics.

Financial services: Banks and ATMs.

The facility score was computed as the ratio of the number of facilities at a location to the maximum facilities available at any location within the ward.

$$\text{Facility Score (FS)} = \frac{\text{Facilities at Location}}{\text{Max Facilities in Ward}}$$

Where:

Facilities at Location is the count of facilities in a specific location.

Max Facilities in Ward had the highest number of facilities at a single location within the ward.

3. Combined Affordability Index:

To rank locations, the land price and facility scores are combined into a single metric called the **Combined Affordability Index (CAI)**. The weights assigned to each criterion were adjusted based on their relative importance. In For this study, equal weights were assumed.

$$\text{CAI} = w_1 \times \text{LPS} + w_2 \times \text{FS}$$

Where:

w_1 and w_2 are the weights assigned to the land price Score and facility scores, respectively.

Here, $w_1 = w_2 = 0.5$

LPS is the normalized Land Price Score.

FS is the normalized Facility Score.

The CAI ranges from 0 to 1:

CAI close to 1 indicates high affordability (low price and high facilities).

CAI close to 0 indicates low affordability (high price and low facilities).

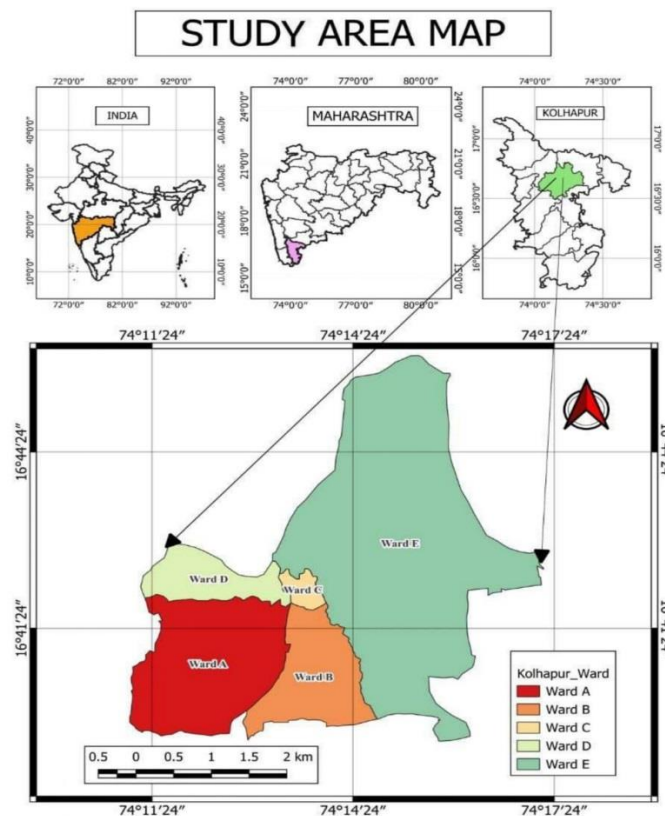


Fig. 1

4. Categorization of Locations

Using the Combined Affordability Index, locations are categorized into three levels of affordability:

Most Affordable: Locations with the highest CAI values.

Moderately Affordable: Locations with mid-range CAI values.

Least Affordable: Locations with the lowest CAI values.

The thresholds for categorization can be adjusted based on the data distribution. For instance:

CAI > 0.7: Most Affordable

$0.4 \leq \text{CAI} \leq 0.7$: Moderately Affordable

CAI < 0.4: Least Affordable

Results and Discussion

1. Results

Geospatial analysis of affordable housing and service accessibility in Kolhapur city revealed significant variations in the potentialities of housing affordability and urban service accessibility. Through the application of the combined affordability index (CAI), three location categories were established (Tables 1 to– Table 5):

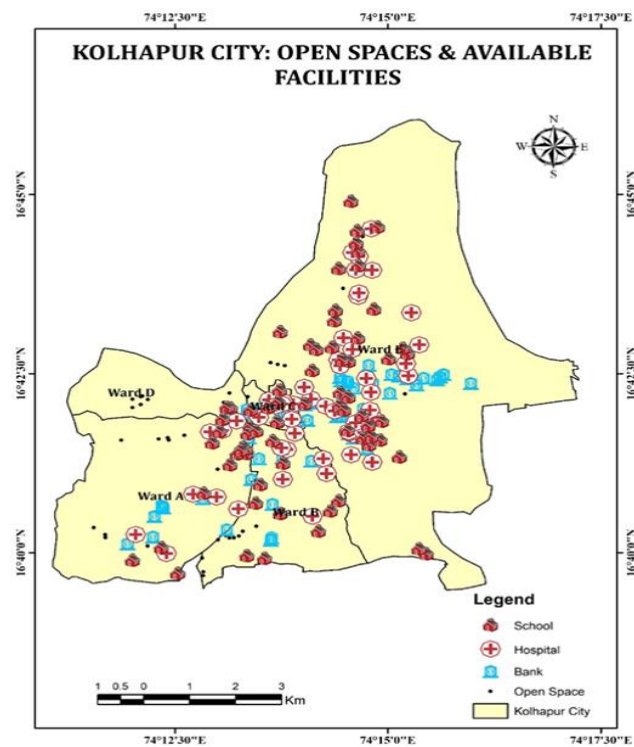


Fig. 3

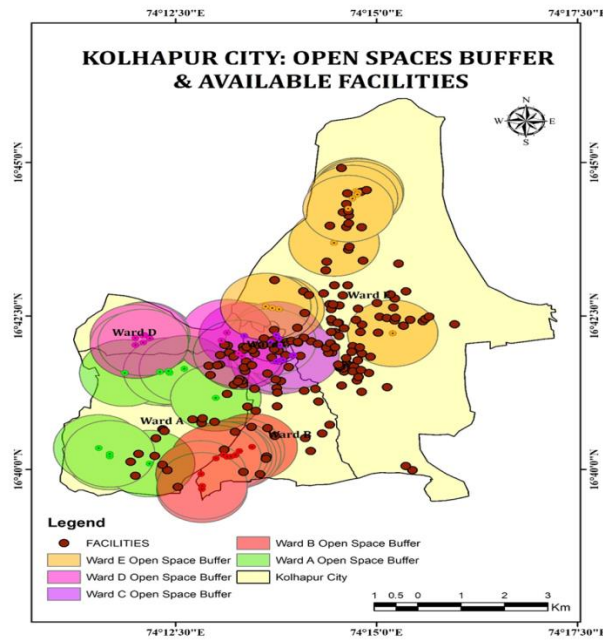


Fig. 4

Table 1: Land Prices and Available Facilities in Ward A

Location Point within ward A	Land Price	Available Facilities
5A	1108	Sanjeevan english medium school
		Shrawasti hospital kolhapur
		Nagojirao patankar high school
		New life multispeciality hospital
		Eurokids pre-school kolhapur gangavesh
4A	1731	Sanjeevan english medium school
		Shrawasti hospital kolhapur
10A	1800	Podar international school kolhapur (CBSE)
		State bank of india
		State bank of india radhanagari
		Galaxy hospital
8A	1800	State bank of india
		Galaxy hospital
6A	2022	Panchaganga sahakari bank
		Krishna hospital
		Deccan hospital kolhapur
		Tiny hearts pre school
		New english medium school
		Saraswat bank sambhaji nagr branch
		8 no school
		NKGSB co-op. bank Ltd. main branch
		Maharashtra high school and junior collage
		S M lohia high school
		Vimala goenka english medium school
		New high school
		Princess padmaraje girls high school
		Kolhapur highschool
		Sanjeevan english medium school
		Shrawasti hospital kolhapur
		Nagojirao patankar high school
9A	3000	Podar international school kolhapur (CBSE)
		State bank of india
		State bank of india radhanagari
		Galaxy hospital

1A	5500	Sanjeevan english medium school Shrawasti hospital kolhapur
7A	6599	Kalamba girls high school Podar international school kolhapur (CBSE Vimal hospital DY patil vidyaniketan cbse scho State bank of india State bank of india radhanagari Galaxy hospital RBL bank Ltd.

Source: Field work, 2024

Table 2: Land Prices and Available Facilities in Ward B

Location Point within ward B	Land Price	Available Facilities
7B	1562	Jyotirlinga school ICICI bank ATM K star multispeciallity hospital
4B	2333	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school Bank of india ATM Kolhapur urban co-op bank Ltd. ICICI bank ATM K star multispeciallity hospital
6B	3077	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school Bank of india ATM Kolhapur urban co-op bank Ltd. ICICI bank ATM K star multispeciallity hospital
10B	3516	Kalamba girls high school Vimal hospital
9B	3673	Kalamba girls high school Vimal hospital
1B	4488	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school Bank of india ATM Kolhapur urban co-op bank Ltd. ICICI bank ATM Mahad colony anganvadi no. 121 K star multispeciallity hospital jana small finance bank Ltd. Buds international school , kolhapur
5B	4528	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school Bank of india ATM Kolhapur urban co-op bank Ltd. ICICI bank ATM K star multispeciallity hospital
8B	4954	Kalamba girls high school Jyotirlinga school Vimal hospital DY patil vidyaniketan cbse scho ICICI bank ATM
3B	5348	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school Bank of india ATM Kolhapur urban co-op bank Ltd. ICICI bank ATM K star multispeciallity hospital Buds international school , kolhapur
2B	5485	Shrimati lakshmibai jarag vidyamandir kolhapur Jyotirlinga school

		Bank of india ATM
		Kolhapur urban co-op bank Ltd.
		ICICI bank ATM
		Mahad colony anganvadi no. 121
		K star multispeciality hospital
		jana small finance bank Ltd.
		Buds international school , kolhapur

Source: Field work, 2024

Table 3: Land Prices and Available Facilities in Ward C

Location Point within ward C	Land Price	Available Facilities
3C	2019	Dr zakir husain urdun marathi school - vidya mandir
		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispeciality hospital
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
8C	3050	CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
		Fort international academy and motessori school
		Kpc multispeciality hospital
		Sai sparsh childrens hospital
		Buds international school , kolhapur
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highscool kolhapur
		Dr zakir husain urdun marathi school - vidya mandir
		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		ICICI bank kolhapur rajaramपुरi
		Federal bank
		SBI bank
		ICICI bank ATM
		ICICI bank LTD.
		Kolhapur district central co-operative bank Ltd.
		Warna hospital and institute of nuro surgery
		The karad urban co-operative bank
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispeciality hospital
		DR. vasdagekar hospital
		TJSB bank kolhapur branch
		Janata sahakari bank LTD. pune

		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
2C	3413	KMC savitribai phule hospital
		Bhavani mandap main rajaram highscool kolhapur
		Dr zakir husain urdun marathi school - vidya mandir
		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispecility hospital
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
4C	3450	Fort international academy and motessori school
		Krayons international school
		NKGSB co-op. bank Ltd. main branch
		Fino payment bank
		Vimala goenka english medium school
		Kpc multispeciality hospital
		Princess padmaraje girls high school
		Sai sparsh childrens hospital
		Kolhapur highscool
		Buds international school , kolhapur
		Union bank of india
		Vidyapeeth highscool and jr. collage
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highscool kolhapur
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Pishawikar hospital and vansh IVF fertility center
		Bank of baroda
		Mamta meternity and surgical hospital
		The kolhapur urban cooperative bank Ltd.
		Masai childrens hospital

		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
5C	3530	Shri chahaji chhatrapati mahavidyalaya kolhapur
		Krayons international school
		Fino payment bank
		Kpc multispeciality hospital
		Sai sparsh childrens hospital
		Buds international school , kolhapur
		Union bank of india
		Vidyapeeth highschoool and jr. collage
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highschoool kolhapur
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
6C	4230	Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispecility hospital
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Krayons international school
		Fino payment bank
		Kpc multispeciality hospital
		Sai sparsh childrens hospital
		Buds international school , kolhapur

		Union bank of india
		Vidyapeeth highschool and jr. collage
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highschool kolhapur
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispeciality hospital
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.
		United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
9C	4341	Buds international school , kolhapur
		Vidyapeeth highschool and jr. collage
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highschool kolhapur
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Pishawikar hospital and vansh IVF fertility center
		Bank of baroda
		Mamta meternity and surgical hospital
		The kolhapur urban cooperative bank Ltd.
		Masai childrens hospital
		Bank of india CSP
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Ramakrushna bal mandir
		Deshbhushan high school
		DR. vasdagekar hospital
		Janata sahakari bank LTD. pune
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		Ashwini hospital
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		United bank of india
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		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur

		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
1C	4343	Buds international school , kolhapur
		KMC savitribai phule hospital
		Bhavani mandap main rajaram highschool kolhapur
		Kids world school
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		Bank of baroda
		Mamta meternity and surgical hospital
		Masai childrens hospital
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
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		CPR hospital kolhapur
		Sardovaya superspeciality hospital
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7C	4440	Kpc multispeciality hospital
		Sai sparsh childrens hospital
		Buds international school , kolhapur
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		Bhavani mandap main rajaram highschool kolhapur
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		SBI bank
		ICICI bank ATM
		ICICI bank LTD.
		Kolhapur district central co-operative bank Ltd.
		Warna hospital and institute of nuro surgery
		The karad urban co-operative bank
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Deshbhushan high school
		Metro multispeciality hospital
		DR. vasdagekar hospital
		TJSB bank kolhapur branch
		Janata sahakari bank LTD. pune
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		class
		Commercial co-operative bank ltd.

10C	5000	United bank of india
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Sardovaya superspeciality hospital
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
		Vidyapeeth highschool and jr. collage
		Bhavani mandap main rajaram highschool kolhapur
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Pishawikar hospital and vansh IVF fertility center
		Eurokids pre-school kolhapur gangavesh
		The kolhapur urban cooperative bank Ltd.
		Masai childrens hospital
		Bank of india CSP
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Ramakrushna bal mandir
		Deshbhushan high school
		Rainbow play school
		DR. vasdagekar hospital
		Surya hospital and dignostic centre with dibetic care
		Ashwini hospital
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur
		Shri chahaji chhatrapati mahavidyalaya kolhapur

Source: Field work, 2024

Table 4: Land Prices and Available Facilities in Ward D

Location Point within ward C	Land Price	Available Facilities
2D	2500	Vidyapeeth highschool and jr. collage
		Shrawasti hospital kolhapur
		Nagojirao patankar high school
		Bhavani mandap main rajaram highschool kolhapur
		New life multispeciality hospital
		Kids world school
		Pishawikar hospital and vansh IVF fertility center
		Eurokids pre-school kolhapur gangavesh
		The kolhapur urban cooperative bank Ltd.
		Masai childrens hospital
		Bank of india CSP
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Ramakrushna bal mandir
		Deshbhushan high school
		Rainbow play school
		CPR hospital kolhapur
3D	3000	New life multispeciality hospital
		Kids world school
		Pishawikar hospital and vansh IVF fertility center

		Eurokids pre-school kolhapur gangavesh The kolhapur urban cooperative bank Ltd. Masai childrens hospital Bank of india CSP ICICI bank ATM Veershaiv co-op bank Ltd. mandai branch Marigold school Syndicate bank kolhapur branch ADV.shamraoji shinde satyashodhak sahakari bank LTD. Ramakrushna bal mandir Deshbhushan high school Rainbow play school CPR hospital kolhapur
4D	3350	Maharashtra high school and junior collage S M lohia high school Vimala goenka english medium school New high school Princess padmaraje girls high school Kolhapur highschool Sanjeevan english medium school Buds international school , kolhapur Union bank of india Vidyapeeth highschool and jr. collage Shrawasti hospital kolhapur Nagojirao patankar high school Bhavani mandap main rajaram highschool kolhapur New life multispeciality hospital Kids world school Dr zakir husain urdun marathi school - vidya mandir Pishawikar hospital and vansh IVF fertility center Eurokids pre-school kolhapur gangavesh The kolhapur urban cooperative bank Ltd. Masai childrens hospital Bank of india CSP SBI bank ICICI bank ATM Veershaiv co-op bank Ltd. mandai branch ICICI bank LTD. Marigold school Syndicate bank kolhapur branch ADV.shamraoji shinde satyashodhak sahakari bank LTD. Ramakrushna bal mandir Deshbhushan high school Rainbow play school DR. vasdagekar hospital Surya hospital and dignostic centre with dibetic care Ujjivan small finance bank-kolhapur branch Nehru high school and jr. collage kolhapur Asian multispeciality hospital kolhapur CPR hospital kolhapur
1D	4331	Maharashtra high school and junior collage S M lohia high school Vimala goenka english medium school New high school Princess padmaraje girls high school Kolhapur highschool Sanjeevan english medium school Buds international school , kolhapur Union bank of india Vidyapeeth highschool and jr. collage Shrawasti hospital kolhapur Nagojirao patankar high school

		Bhavani mandap main rajaram highscool kolhapur
		New life multispeciality hospital
		Kids world school
		Dr zakir husain urdun marathi school - vidya mandir
		Pishawikar hospital and vansh IVF fertility center
		Mamta meternity and surgical hospital
		Eurokids pre-school kolhapur gangavesh
		The kolhapur urban cooperative bank Ltd.
		Masai childrens hospital
		Bank of india CSP
		SBI bank
		ICICI bank ATM
		Veershaiv co-op bank Ltd. mandai branch
		ICICI bank LTD.
		Marigold school
		Syndicate bank kolhapur branch
		ADV.shamraoji shinde satyashodhak sahakari bank LTD.
		Ramakrushna bal mandir
		Deshbhushan high school
		Rainbow play school
		DR. vasdagekar hospital
		Surya hospital and dignostic centre with dibetic care
		Ujjivan small finance bank-kolhapur branch
		Nehru high school and jr. collage kolhapur
		Asian multispeciality hospital kolhapur
		CPR hospital kolhapur

Source: Field work, 2024

Table 5: Land prices and available facilities in ward E

Location Point within ward E	Land Price	Available Facilities
1E	5600	Surya hospital and dignostic centre with dibetic care
	5600	United bank of india
	5600	Ujjivan small finance bank-kolhapur branch
	5600	Nehru high school and jr. collage kolhapur
	5600	Asian multispeciality hospital kolhapur
	5600	CPR hospital kolhapur
	5600	Shri chahaji chhatrapati mahavidyalaya kolhapur
	5600	Pristine womens hospital
	5600	Fort international academy and motessori school
	5600	Ep school
	5600	St xavier high school
	5600	Chhatrapati shahu vidyalaya
7E	6000	Parkruti hospital
	6000	Central school
	6000	Hari hospital
	6000	Shree samarth pead hospital and polyalinic
	6000	Daffodils english medium school (CBSE), KOLHAPUR
	6000	Prince shivaji school
	6000	Blossom english medium school
	6000	Om sai once surgery center multispeciality hospital
	6000	Little petals play and nursery school
8E	6300	jivan kalyan prathamik vidyalaya
	6300	Parkruti hospital
	6300	Shree hospital
	6300	Chhatrapati rajaram high school
	6300	Central school
	6300	Hari hospital
	6300	Shree samarth pead hospital and polyalinic
	6300	Daffodils english medium school (CBSE), KOLHAPUR
	6300	Prince shivaji school
		Blossom english medium school
		Om sai once surgery center multispeciality hospital

		Little petals play and nursery school jivan kalyan prathamik vidyalaya
4E	6350	Holy cross convent high school Shri dattabal english medium school Shahu agriculture technical school Seva hospital Lifecare multispeciality hospital Parkruti hospital Shree hospital Chhatrapati rajaram high school Central school Hari hospital Shree samarth pead hospital and polyalinic
2E	6500	Ujjivan small finance bank-kolhapur branch Nehru high school and jr. collage kolhapur Asian multispeciality hospital kolhapur CPR hospital kolhapur Shri chahaji chhatrapati mahavidyalaya kolhapur Pristine womens hospital Fort international academy and motessori school Ep school St xavier high school Chhatrapati shahu vidyalaya
5E	7800	Central school Hari hospital Shree samarth pead hospital and polyalinic Daffodils english medium school (CBSE), KOLHAPUR Prince shivaji school Blossom english medium school Om sai once surgery center multispeciality hospital Little petals play and nursery school jivan kalyan prathamik vidyalaya
9E	7850	Parkruti hospital Shree hospital Chhatrapati rajaram high school Central school Hari hospital Shree samarth pead hospital and polyalinic Daffodils english medium school (CBSE), KOLHAPUR Prince shivaji school Blossom english medium school Om sai once surgery center multispeciality hospital Little petals play and nursery school
10E	8000	Orental medium school Shri ram multispeciality hospital Siddhivinayak nursing home IDFC first bank-kolhapur branch SVC co-operative bank LTD. Apex hospital Unity small finance bank-ruikar colony, kolhapur Unity small finance bank-ruikar colony Bank of maharashtra Bank of maharashtra Bank of baroda Rngnath hospital Veershaiv co. op. bank HDFC bank IndusInd bank Tulip trumacare and multispeciality hospital Axis bank branch kolhapur Canara bank-small and medium enterprise branch Pulse hospital

		Korgaonkar highschool
3E	8300	CPR hospital kolhapur
		Shri chahaji chhatrapati mahavidyalaya kolhapur
		Pristine womens hospital
		Fort international academy and motessori school
		St xavier high school
		Chhatrapati shahu vidyalaya
6E	9000	Central school
		Hari hospital
		Shree samarth pead hospital and polyalinic
		Daffodils english medium school (CBSE), KOLHAPUR
		Prince shivaji school
		Blossom english medium school
		Om sai once surgery center multispeciality hospital
		Little petals play and nursery school
		jivan kalyan prathamik vidyalaya

Source: Field work, 2024

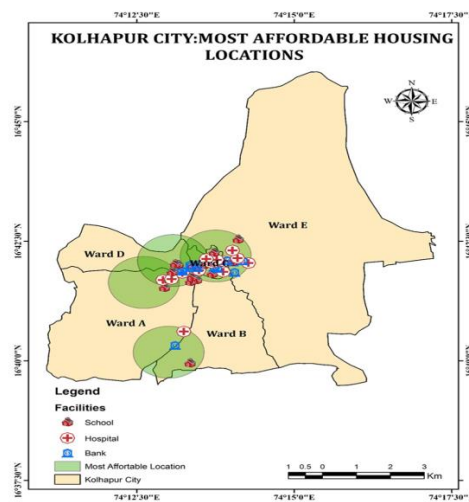


Fig. 5

Most affordable areas, where low land prices were concurrent with high facility counts (e.g., Ward A-5A; land price ₹1,108 with multiple educational and health facilities), were indicative of spatially inclusive settings supporting low- and middle-income populations (Figure 5). Ward B-7B, Ward C-3C and Ward D-2D depicted similar trends, all illustrating justice in access to health, education and financial facilities.

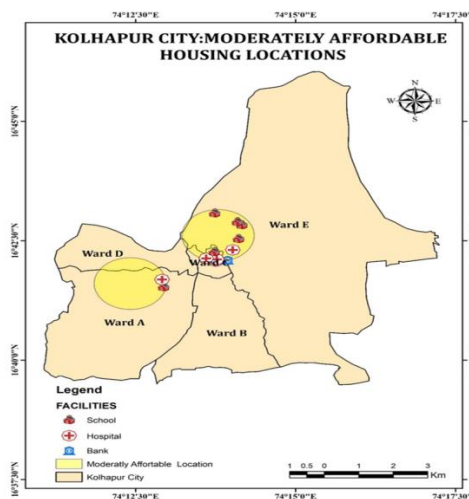


Fig. 6

Moderately Affordable neighborhoods showed the trade-off between the cost of land and facility availability was moderate, such as Ward A-4A and Ward E-1E. The areas retained relatively affordable housing options, but also experienced modest service availability restrictions, especially where high quality services were concentrated such as parks, which escalates the value of the land (Figure 6).

Least affordable areas, such as Ward A-1A (land price ₹5,500), exhibited high land prices with relatively low bare minimum facilities, highlighting serious affordability disparities. Although Sanjeevan English Medium School and Shrawasti Hospital exist within the settlement, high land prices limit the possibility for low-income residents to increase socio-spatial segregation (Figure 7).

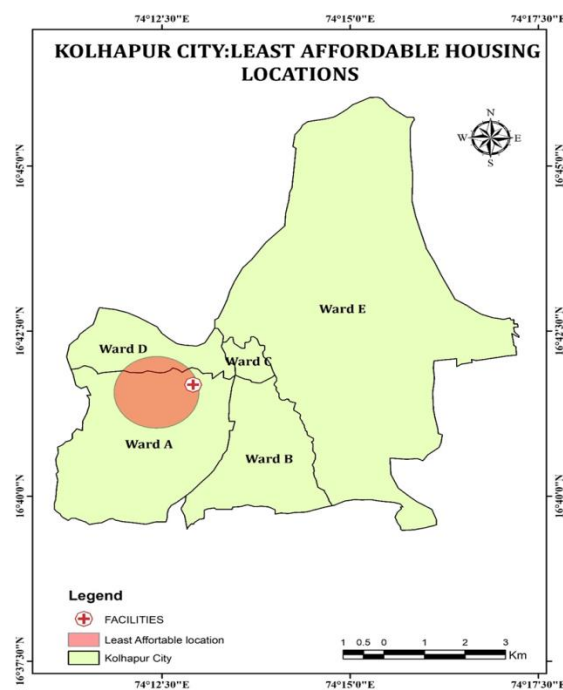


Fig. 7

The CAI, ranging from 0 to 1, provided a quintessential measure of these differences, and higher values indicated affordable and well-serviced places. The GIS spatial displays helped to indicate that peripheral wards have experienced severe housing shortages as well as poor access to employment centres – hence vindicating the peripheral disadvantage, although the land may not be expensive at all times.

2. Discussion

These findings highlight the existence of a consistent spatial disparity in Kolhapur's housing terrain. As noted in the global urbanization literature (UN-Habitat, 2020; Sassen, 2014), affordable housing enclaves are usually exposed to under-serviced urban services, whereas they are also situated in the city periphery where transport connectivity is low. This is consistent with what has been found in the India's urban sector, where even low-cost peripheral housing has weak regulatory and employment connections (Kundu, 2019; Tripathy & Bhattacharya, 2020).

The study's GIS-based CAI, capable of being replicated and requiring only data to implement, is a data-based approach for mapping affordability in an integrated manner that includes the both land price and service accessibility, in contrast to the one-dimensional measures adopted in most housing research (Bhatta, 2010; Aljoufie et al., 2013). As an evidence-based policy, this index advocates for more equitable interventions, facilitating an assessment of urban "affordability hotspots and service deserts.

Moreover, and this is worth further discussion, there is a heavy risk of spatial segregation. Low-income people remain spatially and economically excluded, even when they reside in affordable housing pockets (Galster, 2019), where as while affluent areas benefit from better facilities. This uneven spatial distribution of opportunities heightens social exclusion and weakens the long-term urban resilience.

The study concludes that urban policy should shift from simply supplying affordable housing to promoting strong service accessibility and inter locked transport infrastructure, especially in moderately and least affordable areas. Mixed zoning, selected subsidies, and improved accessibility can be options for combating these divides and as well as halting the formation of urban poverty (Lucas, 2012; Bertolini et al., 2018).

Moreover, the institutionalization of regular GIS-based monitoring may assist in adjusting urban policies in real time to new affordability patterns and demographic changes. This form of monitoring, facilitated by the CAI, can allows local governments to allocate their resources in more effective and equitable ways and hence support the principles of spatial justice and inclusive development (Patel, 2017; Kumar & Dhingra, 2021).

Conclusion

The present study critically examined spatial variations in affordable dwelling and urban service accessibility in Kolhapur City using a combined affordability index (CAI)-based GIS. The findings revealed exposed the existence of strong patterns of spatial disparity, in which groups of affordable housing were frequently deprived of urban facilities, while better-served localities were out of the reach of the less affluent because of high land values. This double whammy perpetuates socio-economic segregation and deprives low-income and middle-income households of opportunities.

The research confirms that a CAI developed using land price and as well as accessibility to services as inputs is a practical, replicable, and policy-relevant method to map housing affordability gaps. These results highlight the importance of comprehensive urban planning interventions that focus as much on affordable housing to expand access to education, health services, and financial services. Policies such as mixed-use zoning, targeted subsidies, and better transportation links can help alleviate these inequities and create more inclusive and resilient cities.

In summary, this study enriches the expanding literature on spatial justice and urban equity by introducing empirically based and scalable canons for evidence-guided urban policy in medium-sized urban Indian contexts.

Recommendations

- Increase affordable housing in underserved wards by promoting private-public partnerships to develop low-income housing in the informal and industrial zones currently poorly serviced.
- Invest in health, education, and financial infrastructure in low CAI communities to enhance urban service delivery.
- Invest in transportation and increase access by weaving together affordable housing and commercial clusters with immediate job centers, minimizing travel time, and increasing the economic well-being of residents.
- Use a mixed-use zoning policy with a combination of residential, business, and public facilities (commercial) to consider building a district in a way that is convenient and reduces land price increases.
- Embed GIS-based monitoring systems to periodically evaluate affordability and service gaps so that policies respond to urban growth trends.

Policy Implications

These results emphasize the urgent demand for more evidence-based and spatially explicit policy planning to counteract fragmented planning strategies. Comprehensive policies that not only address housing affordability but also service accessibility are needed to consider the two jointly rather than separately.

Urban policy should incorporate the following tools:

- Lower land prices by reforming regulatory zoning.
- Promote service delivery in the development of affordable housing and make investment decisions based on the basis of measure of spatial affordability obtained from the CAI.
- Space-saving measures such as these will contribute to spatial justice, and the decreased social segregation, and more sustainable, equitable urban growth facilitated by space that space-saving saving can facilitate.

Future Research Directions

- Longitudinal studies can trace changes in affordability patterns over time and offer evidence of the effectiveness of the policy.
- Comparative studies in vari medium-sized Indian cities would confirm the applicability of the CAI and would test its transferability to diverse urban morphologies.
- The incorporation of new variables, such as eco-sustainability, disaster resistance, and climate adaptation indices, would help improve the CAI to more thoroughly support urban policies more thoroughly.

Acknowledgment

Nil.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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