

LAND PRICE PREDICTION ANALYSIS FOR HIG & MIG HOUSING: A CASE STUDY FOR INDORE CITY

Bachelor of planning

By

ARJUN SAXENA

2211002102



DEPARTMENT OF ARCHITECTURE AND PLANNING,
MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY.

BHOPAL (M.P.) - 462003

MAY, 2026

LAND PRICE PREDICTION ANALYSIS FOR HIG & MIG HOUSING: A CASE STUDY
FOR INDORE CITY

A THESIS PROJECT

*Submitted in the partial fulfilment of the
requirements for the award of the degree*

of

Bachelor of planning

By

ARJUN SAXENA

2211002102

Under the Guidance of

Dr. YOGESH K GARG

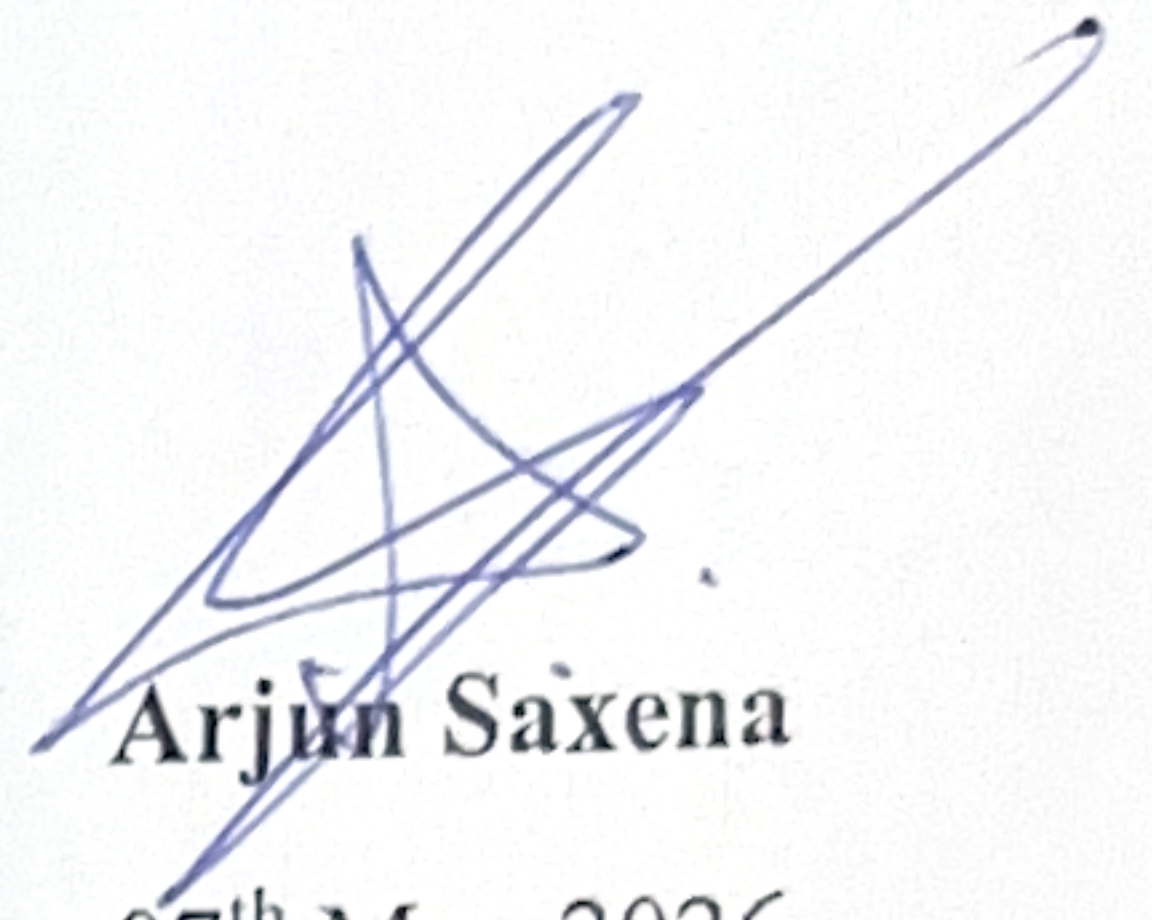


DEPARTMENT OF ARCHITECTURE AND PLANNING,
MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY,
BHOPAL (M.P.) - 462003

MAY, 2026

DECLARATION

I, **ARJUN SAXENA**, Scholar No **2211002102** hereby declare that the thesis titled "**Land Price Prediction Analysis for MIG & HIG: A Case Study for Indore City**" submitted by me in partial fulfilment for the award of degree of Bachelor of Planning, at Maulana Azad National Institute of Technology, Bhopal, India, is a record of Bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.



Arjun Saxena

Date: 07th May 2026

CERTIFICATE

This is to certify that the declaration made by **ARJUN SAXENA** is true to the best of my knowledge and that the student has worked under my guidance for one semester in preparing this thesis.

RECOMMENDED

Signature of the Guide
Dr. Yogesh K. Garg

ACCEPTED

Signature of

Dr. Nakul Dhagat

Head, Department of
Architecture and Planning

Date: 07th May 2026

Signature of

**Dr. Preeti Onkar &
Dr. Premjeet Das Gupta**

Thesis Coordinators,
Department of Architecture and
Planning

Date: 07th May 2026

TABLE OF CONTENT

CHAPTER 1 INTRODUCTION	1
1.1. Background of the study.....	1
1.2. Urban Growth and Housing Development in Indore.....	4
1.3. The Research Problem: The Crisis of Unplanned Edge Growth.....	7
1.4. Aim.....	9
1.5. Objectives	9
1.6. Novelty of the study	10
1.7. Methodology.....	10
1.8. Need for the Study.....	12
1.9. Scope of the Study.....	12
1.10. Limitation of the Study.....	13
CHAPTER 2: LITERATURE REVIEW	15
2.1. Real Estate & its market	15
2.2. ARIMA Model (Auto Regressive Integrated Moving Average).....	17
2.3. Artificial Neural Network (ANN)	18
2.4. Hedonic Price Model (HPM).....	20
2.5. Urban Economic Theory	22
2.6. Comparative Table	25
2.7. Desk Appraisals.....	26
CHAPTER 3: STUDY AREA: INDORE (MADHYA PRADESH).....	32
3.1. Introduction to the city	32
3.2. Demographic Overview.....	32
3.3. Historical Background.....	36
3.4. City Growth.....	36
3.5. Transportation.....	38
3.6. Tourism in the city.....	40
3.7. Governance and Politics	41
3.8. Reason for Selecting Indore City.....	42
3.9. Land use amd land classification.....	44
CHAPTER 4: DATA COLLECTION AND SURVEY	51
4.1. Introduction	51
4.2. Process of Data Collection	51
4.3. Details of Survey Respondents in Selected Study Areas.....	53
4.4. Questionnaire Survey	54
4.5. Parameters Considered for Land Price Analysis	56
4.6. Data Processing and Classification.....	57

4.7.	Tools and Techniques Used.....	58
4.8.	Limitations During Survey	59
CHAPTER 5: DATA ANALYSIS		61
5.1.	Introduction	61
5.2.	Area-wise Land Price Trend Analysis.....	62
5.3.	Comparative Analysis.....	77
5.4.	Major Findings of the Study	81
CHAPTER 6: VALIDATION AND CONCLUSION.....		83
6.1.	Validation	83
6.2.	Results and Discussion	84
6.3.	Discussion.....	87
CHAPTER 7: BIBLIOGRAPHY		89
7.1.		89
CHAPTER 8: ANNEXURE		92

LIST OF FIGURES

Figure 1: Urbanization throughout the world (World Urbanization Prospects, 2019)	1
Figure 2: Locating Indore City	5
Figure 3: The Impact of population and infrastructure on land prices	7
Figure 4: Flowchart showing the methodology used.....	11
Figure 5: Ward map of Indore city	32
Figure 6: Population and Absolute Growth Chart	38
Figure 7: Road Segregation Map of Indore City	39
Figure 8: Organizational structure of the city	42
Figure 9: Demarcation of area selected areas	43
Figure 10: LULC map of year 2015	45
Figure 11: LULC map of 2025	46
Figure 12: Slope map of Indore city	47
Figure 13: Indore Development plan of year 2021	49
Figure 14: LULC map.....	50
Figure 15: Chart representing the respondents	54
Figure 16: Historic Trend Analysis of Govt and Market Rates in Vijay Nagar	64
Figure 17: Chart Representing Forecasted Land Values of Vijay Nagar (2026–2030).....	66
Figure 18: Chart Representing Historic Trend Analysis of Saket Nagar.....	68
Figure 19: Chart Representing forecasted data (2026-2030).....	69
Figure 20: Chart representing Historical Land Value Trend of Sudama Nagar (2016–2025)..	71
Figure 21: Chart representing Forecasted Land Values of Sudama Nagar (2026–2030)	73
Figure 22: Chart Representing Historical Land Value Trend of Nipania (2016–2025)	75
Figure 23: Chart representing Forecasted Land Values of Nipania (2026–2030).....	76
Figure 24: Comparative Analysis of Selected Study Areas (2025)	78
Figure 25: Comparative trend chart analysis	80
Figure 26: Chart representing forecasted market data	80

LIST OF TABLES

Table 1: Summary of Literature Review Studies.....	24
Table 2: Comparative Analysis of Forecasting and Valuation Models Used in Real Estate Studies.....	26
Table 3: Description of Census characteristics of Indore	33
Table 4:Demographic parameters of the city	34
Table 5 :Decadal Growth Rate of India, Madhya Pradesh and Indore City	37
Table 6:Population and Absolute Growth of Indore City	38
Table 7:Respondent of selected area.....	53
Table 8:Parameters considered for analysis.....	57
Table 9:Tools and technique used in the study	59
Table 10:Historical Land Value Trend of Vijay Nagar (2016–2025).....	64
Table 11: Key Observations from Land Value Analysis	65
Table 12:Forecasted Land Values of Vijay Nagar (2026–2030).....	65
Table 13:ARIMA Model Performance for Vijay Nagar.....	66
Table 14 :Historical Land Value Trend of Saket Nagar (2016–2025).....	67
Table 15:Key Observations from Land Value Analysis of Saket Nagar	68
Table 16:Forecasted Land Values of Saket Nagar (2026–2030)	69
Table 17:Arima Performance for Saket Nagar	70
Table 18:Historical Land Value Trend of Sudama Nagar (2016–2025).....	71
Table 19:Key Observations from Land Value Analysis of Sudama Nagar	72
Table 20:Forecasted Land Values of Sudama Nagar (2026–2030)	72
Table 21:ARIMA Model Performance for Sudama Nagar.....	73
Table 22:Historical Land Value Trend of Nipania (2016–2025).....	74
Table 23:Key Observations from Land Value Analysis of Nipania	75
Table 24:Forecasted Land Values of Nipania (2026–2030)	76
Table 25:ARIMA Model Performance for Nipania	77
Table 26:Forecasted market rates 2030	80
Table 27:Model Comparison	81
Table 28:Validation of rates.....	83
Table 29:Comparative Table of all Area	88

ABSTRACT

This study focuses on the analysis and prediction of land prices for Middle-Income Group (MIG) and High-Income Group (HIG) residential areas in Indore. The research aims to understand the changing pattern of urban land values, assess housing affordability, and examine the major factors influencing residential land prices in different parts of the city. The study has been conducted considering the rapid urban expansion, infrastructural development, increasing migration, and changing real estate dynamics in Indore.

The research is based on both primary and secondary data sources. Primary data was collected through field surveys, buyer perception studies, and interactions with real estate stakeholders, while secondary data included government guideline values, master plan documents, land use maps, and market rate records from 2016 to 2025. The study areas selected for detailed analysis include Saket Nagar and Vijay Nagar representing HIG segments, and Sudama Nagar and Nipania representing MIG residential growth areas.

The methodology adopted in the study includes spatial analysis, land use and land cover (LULC) assessment, housing affordability analysis, and time-series forecasting techniques. The study also evaluates the relationship between accessibility, infrastructure availability, socio-economic conditions, and land valuation. To forecast future land prices, the ARIMA (1,1,0) time-series model was applied due to its suitability for trend-based real estate forecasting and its effectiveness in handling non-stationary datasets. The model demonstrated reliable forecasting performance with high R^2 values ranging between 0.87 and 0.93 across the selected locations.

The findings reveal that all study areas experienced a similar trend pattern consisting of stability during 2016–2018, a significant decline in 2019 due to the national real estate slowdown and NBFC crisis, gradual recovery during 2020–2021, and accelerated growth after 2022 driven by infrastructure development and rising urban demand. Among all locations, Vijay Nagar recorded the highest growth trend owing to its commercial importance, superior connectivity, and strong investment demand, whereas Sudama Nagar exhibited moderate and stable growth representing affordable housing characteristics. Saket Nagar showed consistent high-value appreciation, while Nipania emerged as a rapidly developing residential zone influenced by urban expansion and spillover demand from prime areas.

The forecast results indicate continued growth in land prices up to 2030 across all selected areas. Predicted market rates for 2030 are estimated to reach approximately ₹152,147 in Vijay Nagar, ₹136,811 in Saket Nagar, ₹88,255 in Nipania, and ₹68,984 in Sudama Nagar. The study concludes that land prices in Indore are strongly influenced by infrastructure projects, accessibility, economic conditions, and urban growth patterns. It further highlights that while ARIMA models are effective for short-term forecasting, external interventions such as policy changes and major infrastructure developments can significantly affect prediction accuracy. Overall, the study provides useful insights for urban planners, policy makers, real estate professionals, and researchers for promoting balanced urban growth and informed residential planning decisions in Indore city.

सारांश

यह अध्ययन इंदौर शहर में मध्यम आय वर्ग एवं उच्च आय वर्ग आवासीय क्षेत्रों के भूमि मूल्यों के विश्लेषण तथा भविष्यवाणी पर आधारित है। इस शोध का मुख्य उद्देश्य शहरी भूमि मूल्यों में समय के साथ होने वाले परिवर्तनों को समझना, आवासीय वहनीयता का मूल्यांकन करना तथा विभिन्न क्षेत्रों में भूमि मूल्यों को प्रभावित करने वाले प्रमुख कारकों का अध्ययन करना है। इंदौर शहर में तीव्र शहरी विस्तार, आधारभूत संरचना विकास, बढ़ते प्रवासन तथा बदलती रियल एस्टेट गतिविधियों को ध्यान में रखते हुए यह अध्ययन किया गया है।

अध्ययन में प्राथमिक एवं द्वितीयक दोनों प्रकार के आंकड़ों का उपयोग किया गया है। प्राथमिक आंकड़े फील्ड सर्वे, खरीदारों की प्राथमिकताओं तथा रियल एस्टेट हितधारकों से प्राप्त जानकारी के माध्यम से संकलित किए गए, जबकि द्वितीयक आंकड़ों में सरकारी गाइडलाइन मूल्य, मास्टर प्लान दस्तावेज, भूमि उपयोग मानचित्र तथा वर्ष 2016 से 2025 तक के बाजार मूल्य शामिल किए गए। विस्तृत विश्लेषण हेतु साकेत नगर एवं विजय नगर को क्षेत्रों तथा सुदामा नगर एवं निपानिया को क्षेत्रों के रूप में चयनित किया गया।

अध्ययन की कार्यप्रणाली में स्थानिक विश्लेषण (Spatial Analysis), भूमि उपयोग एवं भूमि आवरण विश्लेषण, आवासीय वहनीयता विश्लेषण तथा समय-श्रृंखला पूर्वानुमान तकनीकों का उपयोग किया गया। इसके अतिरिक्त, पहुंच, आधारभूत सुविधाओं की उपलब्धता, सामाजिक-आर्थिक परिस्थितियों तथा भूमि मूल्य के मध्य संबंधों का भी अध्ययन किया गया। भविष्य के भूमि मूल्यों का पूर्वानुमान करने हेतु ARIMA (1,1,0) मॉडल का उपयोग किया गया, जो समय-श्रृंखला आधारित रियल एस्टेट पूर्वानुमान के लिए उपयुक्त पाया गया। मॉडल ने विभिन्न क्षेत्रों में 0.87 से 0.93 तक के उच्च R^2 मानों के साथ विश्वसनीय परिणाम प्रदान किए।

अध्ययन के निष्कर्ष दर्शाते हैं कि सभी चयनित क्षेत्रों में भूमि मूल्य प्रवृत्तियों का एक समान पैटर्न देखा गया, जिसमें वर्ष 2016–2018 के दौरान स्थिरता, वर्ष 2019 में रियल एस्टेट मंदी एवं NBFC संकट के कारण तीव्र गिरावट, वर्ष 2020–2021 में क्रमिक सुधार तथा वर्ष 2022 के बाद तीव्र वृद्धि शामिल है। विजय नगर में व्यावसायिक महत्त्व, बेहतर कनेक्टिविटी तथा निवेश की उच्च मांग के कारण सर्वाधिक वृद्धि दर्ज की गई, जबकि सुदामा नगर में मध्यम एवं स्थिर वृद्धि देखी गई, जो किफायती आवासीय क्षेत्र की विशेषताओं को दर्शाती है। साकेत नगर में निरंतर उच्च मूल्य वृद्धि पाई गई, जबकि निपानिया उभरते हुए आवासीय विकास क्षेत्र के रूप में सामने आया।

पूर्वानुमान परिणामों के अनुसार वर्ष 2030 तक सभी अध्ययन क्षेत्रों में भूमि मूल्यों में निरंतर वृद्धि होने की संभावना है। अनुमानित बाजार मूल्य विजय नगर में लगभग ₹1,52,147, साकेत नगर में ₹1,36,811, निपानिया में ₹88,255 तथा सुदामा नगर में ₹68,984 तक पहुंचने का अनुमान है। अध्ययन यह निष्कर्ष प्रस्तुत करता है कि इंदौर शहर में भूमि मूल्य मुख्यतः आधारभूत संरचना विकास, पहुंच, आर्थिक परिस्थितियों तथा शहरी विकास पैटर्न से प्रभावित होते हैं। साथ ही यह भी स्पष्ट होता है कि ARIMA मॉडल अल्पकालिक पूर्वानुमान के लिए प्रभावी है, किन्तु नीतिगत परिवर्तन एवं बड़े आधारभूत विकास परियोजनाएं इसकी सटीकता को प्रभावित कर सकती हैं। यह अध्ययन शहरी नियोजकों, नीति निर्माताओं, रियल एस्टेट विशेषज्ञों तथा शोधकर्ताओं के लिए संतुलित शहरी विकास एवं बेहतर आवासीय नियोजन हेतु उपयोगी सिद्ध होगा।

ACKNOWLEDGMENT

I take this opportunity to express my immense gratitude and acknowledge the contribution of all those who enabled me to complete and present this research work. First of all, I am grateful to my guide, Dr. Yogesh k Garg, for his patient guidance throughout my thesis.

I am thankful to our coordinator, Dr. Preeti Omkar, for her valuable guidance. I am also thankful to all the other faculty members of Maulana Azad National Institute of Technology, Bhopal, who advised me at various stages and helped me in my research project.

I wish to express my earnest gratitude towards our HOD, Dr. Nakul Dhagat, for providing us congenial atmosphere for betterment of our projects.

Arjun Saxena

2211002102

CHAPTER 1 INTRODUCTION

1.

1.1. Background of the study

Urbanization is one of the most dominant processes influencing the physical, economic, social, and environmental transformation of cities across the world. During the last few decades, the world has witnessed an unprecedented increase in urban population due to industrialization, economic growth, modernization, and migration from rural to urban areas. According to the United Nations, more than half of the global population currently resides in urban areas, and this proportion is expected to rise continuously in the coming decades. In developing countries such as India, rapid urban growth has significantly increased the demand for residential housing, transportation infrastructure, commercial establishments, public services, and urban amenities. The expansion of cities has led to extensive changes in land use patterns, environmental conditions, and natural landscapes, thereby creating multiple challenges related to sustainability, environmental degradation, and disaster vulnerability.

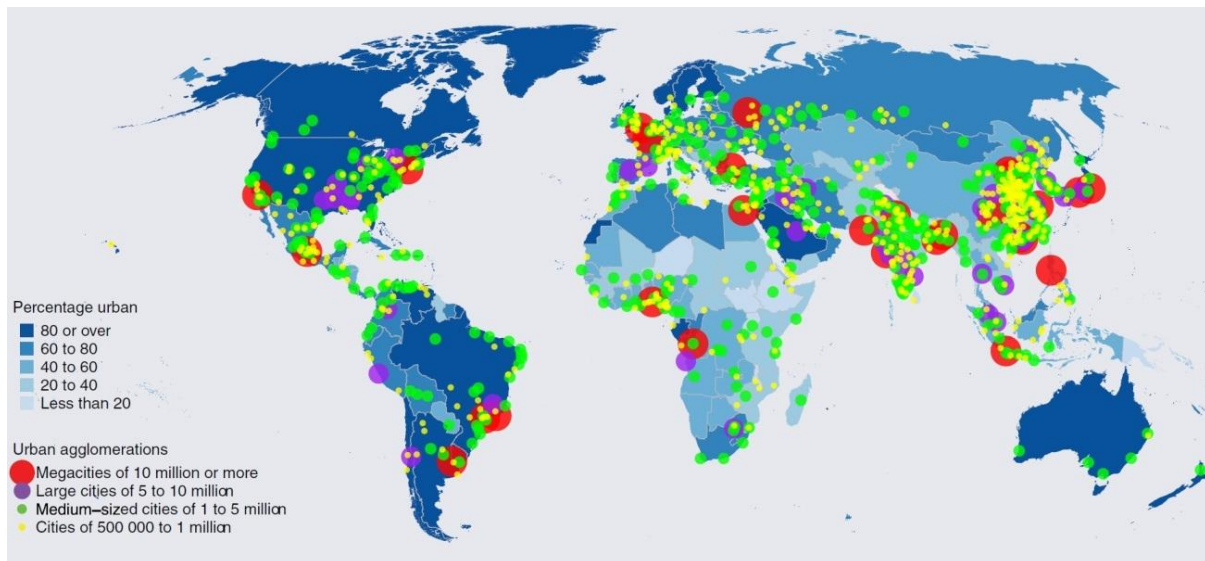


Figure 1: Urbanization throughout the world (World Urbanization Prospects, 2019)

India has experienced rapid urbanization since the post-liberalization period, particularly after the 1990s, resulting in the emergence of metropolitan regions, industrial corridors, and large-scale residential developments. Urban centers such as Delhi, Mumbai, Bengaluru, Hyderabad, Pune, Ahmedabad, and Indore have expanded rapidly due to increasing economic activities and migration flows. The growing urban population has intensified the need for housing across various income categories, including High Income Group (HIG), Middle Income Group (MIG),

and Low-Income Group (LIG) housing sectors. Government housing schemes, private real estate investments, and township developments have further accelerated urban residential expansion in many cities. However, rapid urban growth often occurs without adequate environmental assessment, land suitability analysis, and hazard management planning, thereby increasing vulnerability to natural and human-induced hazards such as flooding, soil erosion, land degradation, and landslides.

Landslides are among the most significant natural hazards affecting both rural and urban settlements worldwide. A landslide refers to the movement of rock, soil, debris, or earth materials down a slope under the influence of gravity. Landslides can occur due to various natural factors such as heavy rainfall, weak geological formations, earthquakes, slope instability, and hydrological changes, as well as anthropogenic factors including excavation, construction activities, mining, deforestation, and unplanned urban development. Although landslides are commonly associated with mountainous and hilly terrains, urban slope instability and localized land failures are increasingly being observed in rapidly developing cities due to improper land use planning and infrastructure development practices. The impacts of landslides include loss of human life, destruction of property, damage to roads and infrastructure, economic losses, environmental degradation, and disruption of urban activities.

In urban areas, residential construction activities frequently involve land modification processes such as slope cutting, excavation, filling, leveling, and alteration of natural drainage systems. These interventions disturb the natural balance of soil and rock formations and may reduce the stability of slopes and terrain surfaces. Additionally, increasing concretization and reduction of vegetation cover decrease water infiltration capacity and increase surface runoff, thereby intensifying erosion and instability during heavy rainfall events. Inadequate drainage infrastructure, poor construction practices, and excessive pressure on environmentally sensitive land further increase the probability of landslide occurrences in urban residential areas. Therefore, there is an urgent need to integrate hazard assessment and environmental sustainability principles into urban planning and housing development processes.

Indore City, located in the state of Madhya Pradesh, is one of the fastest-growing urban centers in central India and has emerged as a major commercial, industrial, educational, and service hub. The city has experienced significant demographic growth and infrastructural expansion over the last two decades, leading to increased demand for residential housing and urban land. The expansion of HIG and MIG housing colonies, integrated townships, gated communities,

and apartment complexes has resulted in extensive land transformation and rapid urban sprawl toward peripheral areas. Such rapid urban growth has increased developmental pressure on available land resources and altered the natural topography and drainage characteristics of many locations within and around the city. In several developing areas, construction activities, excavation works, improper drainage management, and land use modifications have created conditions that may contribute to localized slope instability, soil erosion, and land degradation.

The High Income Group (HIG) and Middle Income Group (MIG) housing sectors represent important components of urban residential development in Indore. HIG housing generally includes premium residential colonies, luxury apartments, villas, and gated communities equipped with advanced infrastructure and urban amenities, whereas MIG housing primarily caters to middle-class populations through affordable apartments, plotted developments, and organized residential schemes. Both housing categories require extensive land development and infrastructure provision, including roads, drainage systems, utility networks, landscaping, and construction activities. In the absence of proper site suitability analysis and hazard assessment, such developments may increase environmental risks and affect long-term urban sustainability. Hence, assessing landslide susceptibility and identifying vulnerable zones within developing residential areas has become essential for ensuring safe and disaster-resilient urban growth.

The increasing availability of advanced geospatial technologies such as Geographic Information Systems (GIS), Remote Sensing (RS), Global Positioning Systems (GPS), and Digital Elevation Models (DEM) has significantly improved the capability of researchers and planners to analyze terrain conditions, land use changes, slope characteristics, hydrological patterns, and environmental risks. These technologies are widely used for landslide susceptibility mapping, hazard zonation, spatial analysis, and urban planning applications. GIS-based landslide prediction models help in identifying high-risk zones and evaluating the relationship between environmental factors and slope instability. Such studies provide valuable support for urban planners, policymakers, engineers, and disaster management authorities in developing safer land use strategies and minimizing environmental risks associated with urban development.

The present study, titled “*Landslide Prediction Analysis for HIG and MIG Housing: A Case Study of Indore City*,” aims to examine the relationship between urban residential development and landslide susceptibility within the context of Indore City. The study focuses on analyzing

the various physical, environmental, and anthropogenic factors contributing to slope instability and hazard vulnerability in HIG and MIG housing areas. It further seeks to identify landslide-prone zones using spatial analysis techniques and evaluate the implications of urban growth on environmental safety and sustainable development. The findings of the study are expected to contribute toward hazard-sensitive urban planning, sustainable housing development, and disaster risk reduction strategies for rapidly growing cities like Indore.

1.2. Urban Growth and Housing Development in Indore

Indore, located in the western part of Madhya Pradesh, is recognized as one of the most prominent urban centers and economic hubs of central India. The city has experienced remarkable urban transformation over the past few decades due to rapid industrialization, infrastructural development, educational growth, and expansion of commercial activities. Historically known as a trading and commercial center, Indore has gradually evolved into a metropolitan city with significant contributions in sectors such as manufacturing, information technology, education, healthcare, transportation, and real estate development. Its strategic location, improved connectivity, and economic opportunities have attracted a large number of migrants from nearby towns and rural regions, leading to continuous population growth and urban expansion. According to Census data and urban development reports, the urban population of Indore has increased significantly over the years, thereby increasing pressure on land resources, public infrastructure, housing supply, and environmental systems.

The rapid pace of urbanization in Indore has resulted in substantial physical expansion of the city beyond its traditional boundaries. Agricultural land, open spaces, peri-urban regions, and environmentally sensitive areas are increasingly being converted into residential, commercial, and institutional land uses. The growth of transportation networks, industrial corridors, commercial complexes, educational institutions, and public infrastructure has further accelerated the process of urban sprawl. Major urban development initiatives, Smart City projects, road widening programs, metro development proposals, and infrastructural investments have contributed significantly to reshaping the urban landscape of the city. As a result, Indore has emerged as one of the fastest-growing real estate markets in Madhya Pradesh, with increasing demand for residential housing across different income groups.

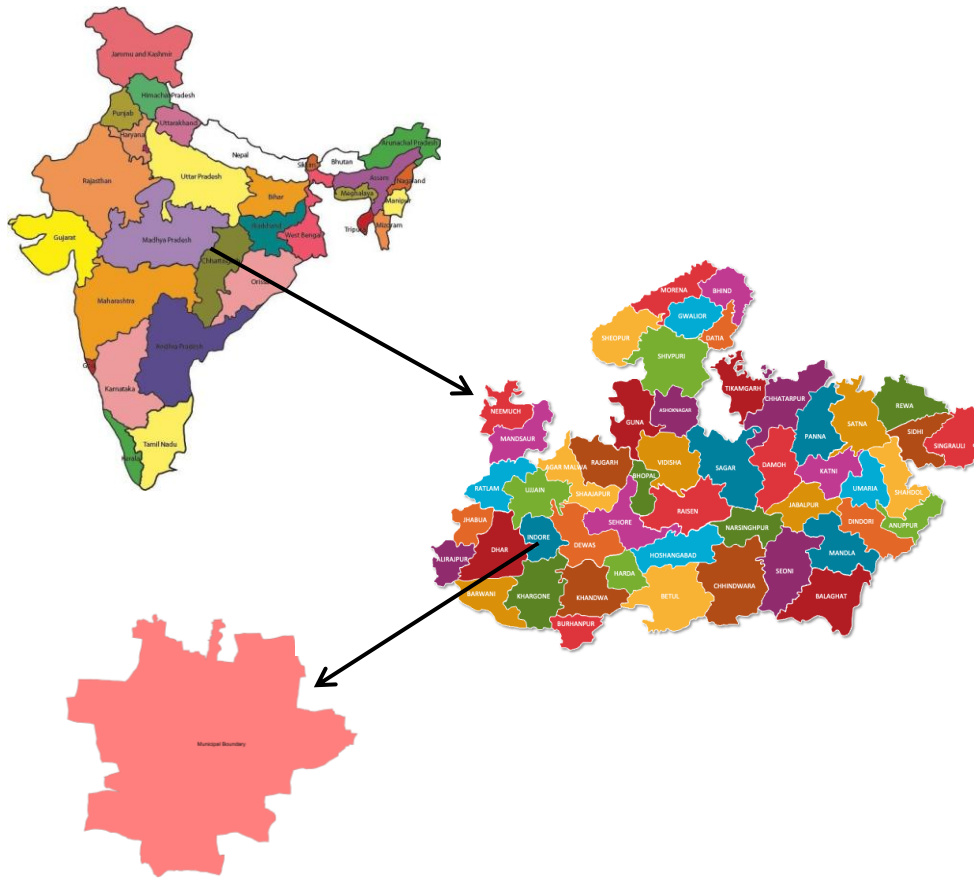


Figure 2: Locating Indore City

Housing development in Indore has expanded rapidly due to increasing urban population, changing lifestyles, rising income levels, and growing demand for modern urban amenities. Both public and private sector agencies have played an important role in the development of residential colonies, townships, apartments, and integrated housing projects throughout the city. Government organizations such as the Indore Development Authority (IDA), Housing Board, and municipal authorities have initiated several planned residential schemes, while private real estate developers have introduced large-scale housing projects equipped with modern infrastructure and lifestyle facilities. The development of ring roads, bypass corridors, and improved transportation connectivity has encouraged residential growth in peripheral areas and urban fringes, thereby increasing the spatial extent of the city.

1.2.1.1. The High-Income Group (HIG) and Middle Income Group

housing sectors have become major components of residential development in Indore. HIG housing projects generally consist of luxury apartments, villas, premium townships, gated communities, and high-end residential complexes designed to cater to economically affluent sections of society. These projects are usually characterized by advanced infrastructure, modern amenities, landscaped open spaces, recreational facilities, and high-quality

construction standards. On the other hand, MIG housing developments are primarily designed for middle-income populations and include affordable apartments, plotted developments, row housing schemes, and medium-density residential colonies. MIG housing plays a crucial role in accommodating the growing urban middle class and supporting balanced urban development within the city.

The rapid expansion of HIG and MIG housing has significantly altered the land use and environmental characteristics of many areas within Indore. Large-scale construction activities often involve land excavation, slope cutting, filling operations, and modification of natural terrain conditions to create suitable sites for residential development. Such interventions can disturb the natural stability of soil and landforms, particularly in areas with uneven topography, weak soil conditions, and inadequate drainage systems. In several newly developing areas, improper site planning, unregulated construction practices, and insufficient environmental assessment have increased the risk of land degradation, soil erosion, waterlogging, and localized slope instability. Moreover, increasing concretization and reduction of vegetation cover have affected natural drainage patterns and groundwater recharge processes, thereby contributing to environmental stress within urban areas.

Urban growth in Indore has also placed increasing pressure on urban infrastructure and public services. The rising demand for roads, drainage systems, water supply networks, sewage infrastructure, electricity, public transportation, and solid waste management has created significant planning challenges for local authorities. In many developing residential areas, inadequate drainage systems and improper stormwater management have resulted in water accumulation, surface runoff problems, and erosion during monsoon periods. These conditions may contribute to localized slope failures and instability in vulnerable zones. Climate variability and increasing intensity of rainfall events further increase environmental risks associated with rapid urban development. Therefore, sustainable urban planning and environmentally sensitive housing development have become essential for minimizing disaster risks and ensuring long-term urban resilience.

The role of geospatial technologies and modern planning approaches has become increasingly important in managing urban growth and housing development in Indore. Geographic Information Systems (GIS), Remote Sensing (RS), Global Positioning Systems (GPS), and spatial analysis tools are now widely used to monitor land use changes, analyze urban expansion patterns, assess environmental conditions, and identify hazard-prone areas. These

technologies help planners and decision-makers evaluate the suitability of land for residential development and support the preparation of hazard-sensitive land use plans. Landslide susceptibility analysis using GIS-based techniques can assist in identifying environmentally vulnerable zones and reducing risks associated with construction activities in HIG and MIG housing areas.

In the context of rapid urbanization and expanding residential development, understanding the relationship between urban growth and environmental hazards has become increasingly important for sustainable city planning. Indore's continued expansion toward peripheral regions and developing zones highlights the need for scientific assessment of terrain stability, drainage conditions, land suitability, and environmental vulnerability before undertaking large-scale housing projects. Therefore, the study of landslide prediction and susceptibility analysis in HIG and MIG housing areas of Indore City is essential for promoting safer urban development, minimizing infrastructural risks, and ensuring environmentally sustainable growth in the future.

1.3. The Research Problem: The Crisis of Unplanned Edge Growth

The rapid urban expansion of Indore, while indicative of economic progress and development, has simultaneously given rise to a critical planning challenge: the emergence of unplanned and inefficient growth at the urban periphery. As the city's core areas such as Vijay Nagar and Saket Nagar continue to experience saturation in terms of land availability and escalating prices, development pressure is increasingly being redirected towards the fringe zones. However, this outward expansion is occurring in a largely unregulated and market-driven manner, resulting in a fragmented urban structure that lacks both spatial coherence and infrastructural adequacy.

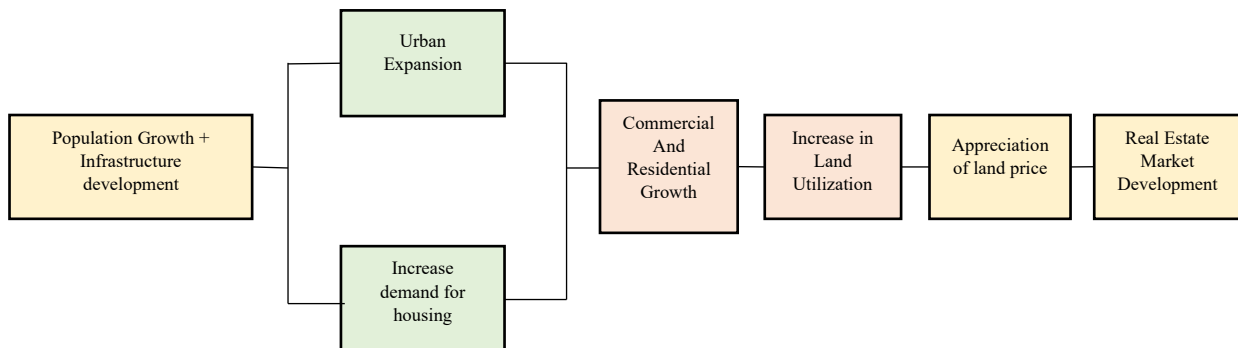


Figure 3: The Impact of population and infrastructure on land prices

One of the defining characteristics of this peripheral growth is the phenomenon of “leapfrog development,” where new residential and commercial projects emerge in isolated pockets,

bypassing intermediate land parcels. This pattern creates discontinuous urban fabric, where built-up areas are interspersed with vacant or underutilized land. Such a development trajectory is not only inefficient in terms of land utilization but also imposes significant challenges for infrastructure provision, as services such as water supply, drainage, road connectivity, and public transport must be extended across dispersed and low-density settlements. The LULC analysis conducted for the period 2015–2025 clearly demonstrates this trend, highlighting a substantial increase in built-up area in peripheral regions accompanied by a decline in agricultural land. The emergence of ribbon development along major transport corridors further reinforces the role of accessibility as a primary driver of unplanned growth. While improved connectivity enhances the attractiveness of fringe areas, the absence of coordinated land use planning leads to linear, corridor-based development that undermines long-term urban efficiency.

This unplanned edge growth is closely linked to the dynamics of land prices within the city. As land values in core areas rise sharply, developers and homebuyers are compelled to seek more affordable alternatives in peripheral locations such as Nipaniya and Sudama Nagar. While this shift initially appears to improve accessibility to housing, it often results in the creation of settlements that lack adequate infrastructure and essential services. Over time, these areas experience delayed and costly retrofitting of infrastructure, placing a financial burden on both residents and planning authorities. The time series analysis of land prices from 2016 to 2025 further reveals that this growth is not uniform but influenced by broader economic fluctuations. The sharp decline observed in 2019 across all study areas reflects a systemic market shock, while the strong recovery and accelerated growth post-2022 indicate renewed demand and investment. However, the benefits of this growth are unevenly distributed, with high-income areas experiencing rapid appreciation and peripheral zones undergoing speculative and often unstructured development.

A critical consequence of this pattern is the increasing disparity between different parts of the city. The concentration of investment and infrastructure in a few high-growth nodes leads to congestion, rising land prices, and overburdened services in core areas, while peripheral regions remain underdeveloped and poorly connected. This imbalance not only affects the efficiency of urban systems but also exacerbates social inequality, particularly for middle-income groups who are pushed towards less serviced areas due to affordability constraints. Moreover, the lack of synchronization between planning policies and market forces further

intensifies the problem. While guideline values and master plans attempt to regulate land use and development, they often lag behind actual market trends, resulting in a gap between planned and realized urban growth. This disconnect allows speculative activities to dominate land transactions, further distorting price mechanisms and contributing to unplanned expansion.

In essence, the crisis of unplanned edge growth in Indore is not merely a spatial issue but a multidimensional problem that encompasses economic, infrastructural, and social dimensions. The absence of a predictive and integrated planning framework has allowed market-driven forces to shape the city's expansion in a manner that is both inefficient and unsustainable. Addressing this challenge requires a shift from reactive planning—where infrastructure follows development—to proactive planning, where growth is anticipated, guided, and structured in alignment with long-term urban objectives. This research positions itself within this context, seeking to understand the underlying dynamics of land price variation and to develop predictive tools that can inform more balanced and sustainable urban development strategies.

1.4. Aim

The aim of this thesis is to study and predict land prices for HIG and MIG housing in Indore city by analyzing existing land values and influencing factors.

1.5. Objectives

The objectives of the present study are framed to examine the relationship between land prices, real estate market dynamics, and housing affordability in Indore city, with special reference to Middle Income Group (MIG) and High-Income Group (HIG) households. The study aims to develop a comprehensive understanding of how rapid urban growth, infrastructure development, and changing market trends influence residential land values and accessibility to housing. These objectives are structured in a systematic manner so that each stage contributes toward assessing present market conditions and predicting future residential land price patterns.

The objectives also help in identifying the socio-economic and spatial factors responsible for variations in land prices across different parts of the city. Through market assessment, buyer behaviour analysis, and affordability evaluation, the research seeks to provide a clearer understanding of residential development trends in Indore. The study further attempts to support future planning and policy decisions by analysing land price prediction for residential development.

Objective 1

To understand the factors influencing the real estate market of Indore city with reference to High Income Group (HIG) and Middle-Income Group (MIG) housing areas.

Objective 2

To predict land price trends using secondary data through statistical forecasting techniques.

Objective 3

To estimate and validate the current market value of land using both primary and secondary data sources through comparative and forecasting analysis.

1.6. Novelty of the study

The novelty of the study lies in predicting and validating residential land values using secondary data and ARIMA forecasting techniques without relying on proposal-based approaches. The study integrates statistical forecasting with actual market validation to understand future land price trends in selected HIG and MIG areas of Indore city.

1.7. Methodology

The methodology adopted for this study focuses on analysing land price prediction and housing affordability in HIG and MIG residential areas of Indore City. The research begins with defining the research aim, objectives, and questions related to land price trends, market behaviour, and affordability assessment. Both primary and secondary data sources were utilized for the study. Primary data was collected through field surveys and buyer preference analysis, while secondary data was obtained from guideline values, master plans, census records, and published reports.

After data collection, preprocessing and classification of HIG and MIG housing categories were carried out along with data cleaning and standardization. Suitable study areas were then selected based on residential growth and market significance. Spatial and market analysis was conducted using parameters such as land use and land cover (LULC) change analysis, location connectivity, infrastructure availability, and accessibility to major urban centres.

The study further included affordability analysis using price-to-income ratio and comparative assessment of housing affordability among different income groups. Time series analysis was applied to identify market trends such as growth, decline, stability, and recovery in land prices over different years. For forecasting future land prices, the ARIMA (1,1,0) model was used as a predictive analytical tool. Finally, comparative analysis and interpretation of findings were carried out to understand the relationship between urban growth, market dynamics, and residential affordability, followed by planning proposals and recommendations for sustainable residential development in Indore City.

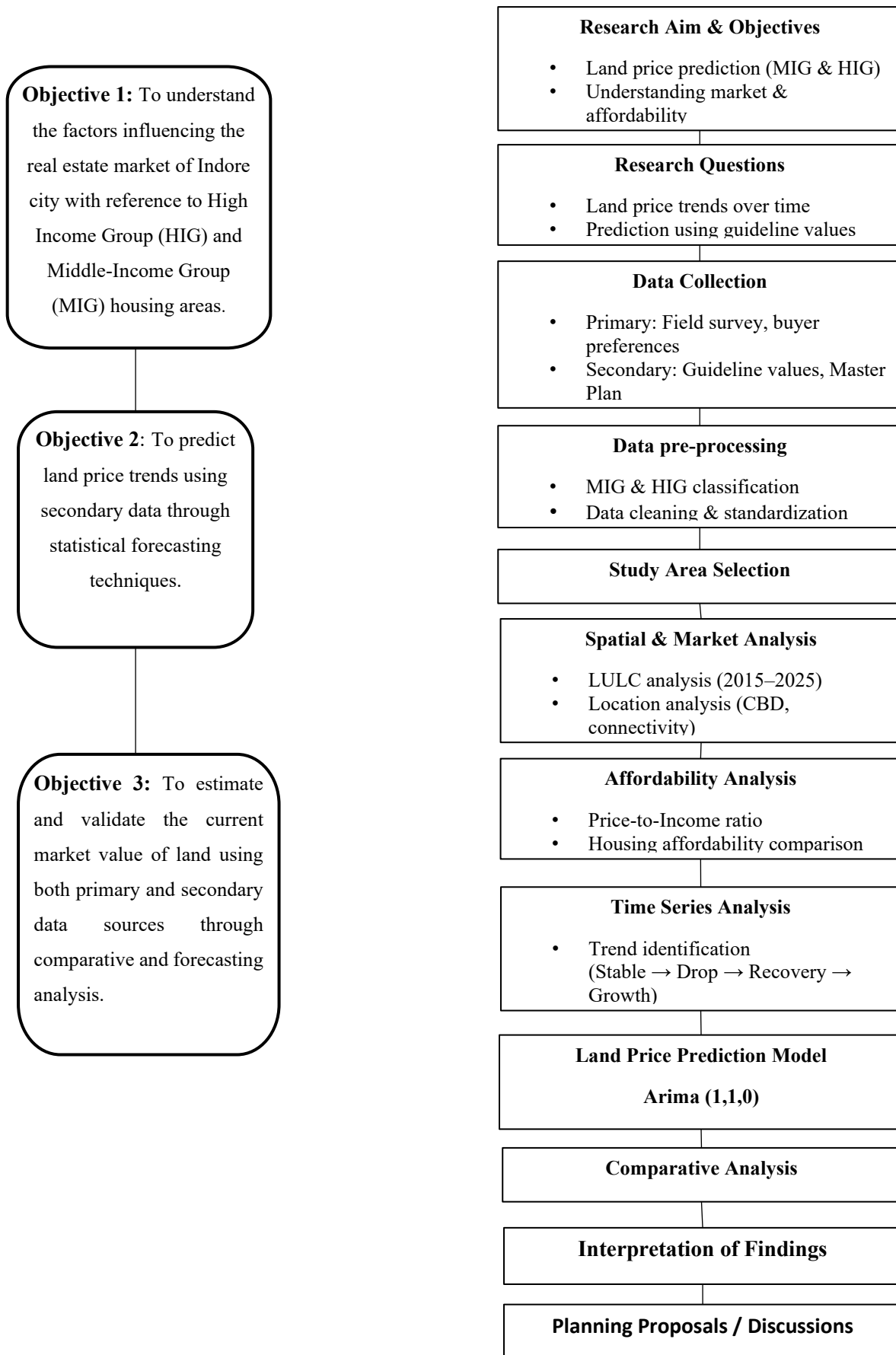


Figure 4: Flowchart showing the methodology used.

1.8. Need for the Study

Rapid urbanization in Indian cities has significantly increased pressure on urban land resources, resulting in continuous escalation of land prices and changing residential development patterns. Land price has emerged as one of the most influential factors determining housing location, affordability, and socio-spatial distribution within cities. In rapidly growing urban centers such as Indore, expansion of infrastructure, improved connectivity, and rising economic opportunities have accelerated real estate development, leading to substantial variation in residential land values across different zones. The rising land prices particularly affect housing accessibility for Middle Income Group (MIG) households, as affordable residential areas gradually shift toward peripheral locations with limited infrastructure and employment accessibility. At the same time, High Income Group (HIG) housing developments tend to concentrate in well-connected and amenity-rich areas, contributing to spatial inequality and uneven urban growth. Such disparities may increase travel distances, infrastructure burden, and urban sprawl if not addressed through informed planning interventions.

Conventional land valuation practices generally rely on prevailing market rates or government guideline values, which represent existing conditions rather than future growth potential. These approaches often fail to account for dynamic urban factors such as upcoming infrastructure projects, accessibility improvements, land use transformation, and population growth trends. As a result, planning decisions based solely on current land values may lead to inefficient land utilization and unbalanced residential expansion. In this context, predicting land price trends using spatial and analytical techniques becomes essential for sustainable urban planning. Land price prediction helps planners anticipate development pressure, identify emerging growth corridors, and guide residential development in a structured manner. It also supports policymaking related to housing provision, land management, infrastructure investment, and equitable urban expansion.

Therefore, this study is required to develop a data-driven understanding of land price determinants for HIG and MIG housing in Indore city and to establish a predictive framework that can assist planning authorities, developers, and policymakers in promoting balanced, inclusive, and sustainable urban development.

1.9. Scope of the Study

The scope of this research is focused on analysing and predicting residential land prices associated with High Income Group (HIG) and Middle-Income Group (MIG) housing

categories within Indore city. The study examines how urban development characteristics influence spatial variation in land values and how these variations can be modelled to forecast future land price trends. The study includes analysis of existing residential land price distribution across different planning zones of Indore using available market and secondary datasets. Spatial parameters such as road connectivity, proximity to commercial centres, accessibility to public transport, availability of infrastructure facilities, and neighbourhood characteristics are considered to understand their influence on land valuation.

Geographic Information System (GIS) tools are utilized to prepare spatial databases, thematic maps, and land price distribution maps. Statistical and analytical methods are applied to establish relationships between land prices and influencing variables, enabling the development of a predictive land price model for HIG and MIG housing segments. The research further aims to identify potential high-growth zones and future residential development areas based on predicted land value trends. Planning recommendations are proposed to support balanced housing distribution and efficient land utilization.

However, the study primarily focuses on spatial planning and analytical assessment rather than detailed financial feasibility analysis, investment profitability, or micro-level real estate market behaviour. The analysis is conducted at a city scale and does not extend to individual plot-level valuation or legal property assessment.

1.10. Limitation of the Study

While the study attempts to provide a comprehensive analysis of land price prediction for residential development, certain limitations exist due to practical and methodological constraints. One of the major limitations relates to the availability and accuracy of land price data. Actual property transaction values are often confidential, and therefore the study relies partly on secondary sources such as real estate portals, guideline values, and survey-based estimates, which may differ from real market transactions.

Land prices are influenced by multiple socio-economic and behavioural factors such as market speculation, developer expectations, and policy changes, which are difficult to quantify precisely within analytical models. Consequently, prediction results represent estimated trends rather than exact future market values. The prediction model developed in this study is based on selected spatial and infrastructural variables. Other influencing aspects such as sudden economic fluctuations, policy reforms, infrastructure mega-projects, or changes in investment patterns may alter future land price dynamics beyond the scope of the model.

Additionally, the research is conducted within an academic timeframe, limiting the possibility of long-term validation of predicted land values. Urban growth processes are dynamic and evolve over extended periods; therefore, continuous monitoring would be required for more accurate forecasting.

Technological and methodological assumptions used in GIS and statistical analysis may also introduce minor variations in results. Hence, findings of the study should be interpreted as planning guidance rather than precise financial valuation.

The present-day price of the real estate for this thesis has been collected from many sources such as builders, developers, stakeholders. While there may be some variations on websites like 99acres.com, housing.com, homeonline.com, magicbricks.com, etc., these discrepancies have not been taken into account.

CHAPTER 2: LITERATURE REVIEW

2.

2.1. Real Estate & its market

The real estate sector is one of the most significant components of urban and economic development, playing a crucial role in shaping the physical structure, investment environment, and socio-economic growth of cities. It contributes substantially to employment generation, infrastructure development, capital investment, and overall economic productivity. The real estate market consists of residential, commercial, industrial, institutional, and mixed-use properties that collectively influence urban expansion and land utilization patterns. In rapidly urbanizing cities, increasing population growth, migration, rising income levels, and infrastructural development continuously generate demand for housing and urban land, thereby affecting the dynamics of the real estate market. The sector not only reflects economic performance but also acts as an indicator of urban growth and development trends.

The real estate market is highly dynamic in nature and is influenced by multiple physical, economic, social, environmental, and policy-related factors. Population growth, urbanization, accessibility, infrastructure provision, transportation connectivity, employment opportunities, and availability of public services significantly affect property demand and land values. Similarly, factors such as government regulations, interest rates, housing finance availability, land use policies, and market speculation contribute to fluctuations in property prices and investment patterns. In developing urban centers, rapid expansion of transportation networks, metro projects, commercial corridors, educational institutions, and industrial areas often leads to appreciation in surrounding land values and increased real estate activities. As a result, the spatial distribution of real estate development becomes closely associated with infrastructure growth and accessibility patterns within the city.

The residential real estate sector forms one of the most important segments of the urban housing market, particularly in relation to High Income Group (HIG) and Middle Income Group (MIG) housing development. HIG housing generally caters to economically affluent populations through premium residential colonies, luxury apartments, villas, and gated communities equipped with modern infrastructure and amenities. In contrast, MIG housing focuses on providing affordable and organized residential options for middle-income households. The increasing demand for planned housing developments in urban areas has accelerated the growth of both HIG and MIG residential sectors. However, rapid expansion of residential construction

activities often creates pressure on land resources and leads to extensive transformation of natural landscapes and peri-urban areas.

Urban real estate development frequently involves large-scale land modification processes such as excavation, leveling, filling, slope cutting, and infrastructure installation to create suitable construction sites. These interventions can alter the natural terrain, drainage systems, and environmental characteristics of the area. In many cases, unplanned or excessive development activities contribute to environmental degradation, waterlogging, soil erosion, and instability of land surfaces. Such conditions become more critical in areas characterized by uneven topography, weak soil conditions, poor drainage, or environmentally sensitive landscapes. Therefore, environmental assessment and hazard analysis have become increasingly important components of real estate planning and sustainable urban development.

The growth of the real estate market is also closely associated with investment behavior and land price appreciation. Urban land is considered a valuable economic asset, and its value generally increases with improvements in infrastructure, accessibility, and urban services. Investors, developers, and property buyers often prefer locations with better transportation facilities, commercial potential, educational institutions, healthcare services, and recreational amenities. Consequently, land prices vary significantly across different parts of a city depending on location advantages and development potential. In rapidly growing cities like Indore, expansion of roads, ring roads, metro proposals, Smart City initiatives, and commercial hubs has contributed to increasing land values and accelerated residential development in peripheral areas.

The real estate market is further influenced by changing socio-economic conditions, demographic trends, and lifestyle preferences of urban populations. Increasing income levels, nuclear family structures, modernization, and changing housing aspirations have led to growing demand for organized residential townships and integrated housing projects. At the same time, affordability remains one of the major concerns in urban housing markets, particularly for middle-income households. Rising land prices, construction costs, and infrastructural expenses often affect the accessibility of housing for different income groups. Therefore, understanding market trends, affordability patterns, and spatial distribution of residential development is essential for balanced and inclusive urban growth.

In recent years, advanced technologies such as Geographic Information Systems (GIS), Remote Sensing (RS), spatial modelling, and statistical forecasting techniques have been increasingly

used in real estate research and market analysis. These technologies help in analyzing land use changes, property value distribution, urban expansion patterns, infrastructure influence, and environmental vulnerability. GIS-based spatial analysis enables researchers and planners to identify suitable locations for development, assess risk-prone areas, and understand the relationship between urban growth and land market dynamics. Predictive models such as ARIMA are also used for forecasting future land price trends and understanding market behavior over time. Such analytical approaches support evidence-based planning and informed decision-making in urban development processes.

In the context of Indore City, the real estate market has experienced substantial growth due to rapid urbanization, infrastructural investments, economic development, and increasing housing demand. The expansion of HIG and MIG residential developments has transformed the urban landscape and increased developmental pressure on land resources. Large-scale housing projects, commercial developments, transportation improvements, and urban infrastructure initiatives have contributed to rising land values and changing market dynamics within the city. However, uncontrolled urban expansion and intensive construction activities may also increase environmental risks and create challenges related to sustainability and land stability. Therefore, studying the real estate market and its interaction with urban growth, infrastructure development, and environmental factors is essential for promoting safe, sustainable, and resilient urban development in rapidly growing cities like Indore.

2.2. ARIMA Model (Auto Regressive Integrated Moving Average)

The ARIMA model, also known as the Auto Regressive Integrated Moving Average model, is one of the most widely used statistical techniques for time series forecasting and trend prediction. It is commonly applied in economics, finance, urban studies, and real estate market analysis to forecast future values based on historical data patterns. The ARIMA model is particularly useful for analyzing real estate prices because land and property values often fluctuate over time due to urbanization, infrastructure development, economic conditions, government policies, demand and supply relationships, and market behavior. By identifying historical trends and variations in data, ARIMA helps predict future land price movements and market conditions with considerable accuracy.

The ARIMA model consists of three major components: Auto Regression (AR), Integration (I), and Moving Average (MA). The Auto Regression component explains the relationship between current observations and past observations of the dataset. The Integration component

is used to make the time series stationary by removing trends and differencing the data. The Moving Average component analyses the relationship between observations and residual errors from previous periods. These three components together form a predictive model capable of analysing complex time-dependent datasets and generating future forecasts.

The ARIMA model is generally represented as ARIMA (p, d, q), where:

p = number of autoregressive terms

d = number of differencing operations

q = number of moving average terms

In this study, the ARIMA model is used for predicting land price trends in HIG and MIG residential areas of Indore City. Historical land value data collected from guideline rates, market prices, and real estate records are analyzed to identify growth trends, fluctuations, and future market behavior. The model helps in understanding how urban growth, infrastructure development, and socio-economic changes influence property values over time. ARIMA forecasting provides planners, developers, and policymakers with valuable insights for future urban development and investment planning.

The ARIMA model is highly suitable for real estate forecasting because it can handle trend-based data and identify market cycles such as growth, decline, recovery, and stabilization. It also assists in evaluating long-term investment opportunities and supports evidence-based planning decisions. In rapidly urbanizing cities like Indore, where land values continuously change due to infrastructure expansion and increasing housing demand, ARIMA-based forecasting becomes an important analytical tool for understanding future urban growth patterns and residential market dynamics.

2.3. Artificial Neural Network (ANN)

Artificial Neural Network (ANN) is an advanced computational and machine learning technique inspired by the structure and functioning of the human brain. The model consists of interconnected processing units called neurons, which work together to analyze data, recognize hidden patterns, and generate prediction outputs. ANN has become one of the most widely used techniques in real estate analysis, urban studies, forecasting, and spatial prediction because of its ability to handle nonlinear and multidimensional datasets. In rapidly changing urban environments, property prices and land values are influenced by several interconnected factors such as accessibility, infrastructure development, socio-economic conditions, land use patterns,

transportation connectivity, environmental quality, and market demand. Traditional statistical models often face limitations while analyzing these complex interactions, whereas ANN models can effectively process large volumes of data and improve prediction accuracy.

The ANN model generally consists of three major layers: the input layer, hidden layer, and output layer. The input layer receives information related to different variables affecting land prices, the hidden layer processes the information through interconnected neurons, and the output layer generates the final prediction or forecast. During the training process, the model adjusts its internal weights and biases in order to minimize prediction error and improve performance. ANN models are highly adaptive and capable of learning from historical data patterns, making them suitable for land price prediction, housing market analysis, investment forecasting, and urban growth modelling.

In real estate studies, ANN models are useful for identifying relationships between property prices and variables such as infrastructure accessibility, road connectivity, transportation networks, Neighborhood quality, commercial development, and socio-economic characteristics. The model performs particularly well in situations where market behavior is highly dynamic and nonlinear. Researchers have applied ANN techniques for property valuation, demand forecasting, land suitability analysis, and prediction of urban expansion trends. The ability of ANN to process both quantitative and qualitative variables simultaneously makes it an effective analytical tool for complex urban environments.

In the present study, ANN is utilized to analyze land price prediction in HIG and MIG residential areas of Indore City. Variables related to location accessibility, urban infrastructure, socio-economic conditions, and Neighborhood characteristics are incorporated into the model to understand their influence on property values. The ANN approach helps in identifying hidden market patterns and generating more accurate forecasts for future land price trends. The use of ANN contributes toward evidence-based urban planning, sustainable residential development, and efficient real estate market assessment.

ANN Formula

The output of an Artificial Neural Network can be represented as:

$$Y = f(\sum_{i=1}^n w_i x_i + b)$$

Where:

Y = Predicted output

w_i = Weight assigned to each input

x_i = Input variable

b = Bias term

f = Activation function

2.4. Hedonic Price Model (HPM)

The Hedonic Price Model (HPM) has been widely accepted and studied in real estate valuation and price prediction analysis. Researchers have identified that the model is highly effective for estimating property prices because it considers the influence of multiple characteristics and attributes associated with a property. The model overcomes several limitations of traditional appraisal methods, which often depend on subjective judgment and manual evaluation techniques. In contrast, the hedonic pricing approach uses statistical analysis and objective data to estimate property values, thereby reducing appraisal bias and improving consistency in valuation results.

The hedonic pricing approach is extensively used in housing market analysis because it explains how different property characteristics contribute toward the final market value. Property prices are generally influenced by factors such as location, accessibility, infrastructure facilities, transportation connectivity, structural characteristics, neighborhood quality, environmental conditions, and socio-economic factors. The model evaluates the implicit value of each of these attributes and determines their contribution toward land and housing prices. Due to its flexibility and adaptability, the model can be utilized in various sectors including residential, commercial, and urban land valuation studies.

The hedonic pricing model is especially useful in real estate markets where property values are highly dynamic and influenced by multiple interconnected variables. In urban areas, factors such as proximity to the Central Business District (CBD), road connectivity, public transportation, educational institutions, healthcare facilities, and commercial development significantly affect residential property values. The model helps in understanding these complex relationships and supports more accurate prediction of land prices. Researchers have

also applied the model to analyze the impact of infrastructure projects, metro connectivity, green spaces, and neighborhood amenities on surrounding property values.

One of the major strengths of the Hedonic Price Model is its ability to analyze nonlinear interactions between variables. Real estate markets are complex in nature and often influenced by fluctuating economic conditions, urban growth patterns, investment activities, and consumer preferences. The model can incorporate these dynamic relationships and generate more precise valuation outcomes compared to traditional methods. In many cases, simpler linear regression techniques are used for analyzing basic relationships, whereas advanced machine learning and regression-based approaches are applied for high-dimensional datasets and more complex market scenarios.

The hedonic pricing technique is considered highly reliable because it uses measurable variables and quantitative analysis instead of relying solely on expert opinions. The model provides transparent and interpretable results that help researchers, planners, investors, and policymakers understand how different factors influence land and property values. It is particularly effective in rapidly urbanizing cities where land prices continuously change due to infrastructure expansion, population growth, transportation development, and increasing housing demand.

The basic concept of the Hedonic Price Model can be expressed as follows:

$$\textit{Price} = f(\textit{structure}, \textit{location}, \textit{neighborhood})$$

Where property value is considered a function of structural characteristics, locational attributes, and neighborhood conditions. Structural characteristics include plot size, building quality, age of property, and architectural design. Locational characteristics include accessibility to transportation systems, commercial centers, and public facilities. Neighborhood characteristics represent environmental quality, socio-economic conditions, infrastructure availability, and surrounding land use patterns.

The general regression form of the Hedonic Price Model is represented as:

$$P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + \epsilon$$

Where:

P = Property Price

β_0 = Constant term

$\beta_1, \beta_2 \dots \beta_n$ = Regression coefficients

$X_1, X_2 \dots X_n$ = Independent variables influencing price

ε = Error term

The model may simultaneously examine multiple variables such as accessibility, land size, infrastructure quality, socio-economic conditions, Neighborhood characteristics, and urban amenities. This multidimensional approach allows the model to produce more accurate and reliable price predictions than conventional valuation methods. The hedonic model is also capable of handling nonlinear relationships between variables, making it suitable for complex urban real estate markets where prices are continuously affected by dynamic economic and infrastructural conditions.

In the context of this study, the Hedonic Price Model is applied to analyze land price variations and residential market behavior in HIG and MIG housing areas of Indore City. Variables such as location accessibility, infrastructure availability, transportation connectivity, Neighborhood quality, socio-economic conditions, and urban development characteristics are considered for evaluating their influence on residential property values. The model assists in understanding the spatial variation of land prices and supports future land price prediction analysis within the rapidly urbanizing environment of Indore City.

2.5. Urban Economic Theory

Urban Economic Theory explains the economic relationships that influence urban growth, land use patterns, transportation systems, and real estate markets within cities. The theory focuses on how accessibility, infrastructure, employment opportunities, and economic activities affect the spatial organization of urban areas and determine land values. It provides a conceptual framework for understanding why different land uses and residential developments are distributed unevenly across cities.

One of the major concepts within urban economic theory is the Bid-Rent Theory, which states that land values decrease with increasing distance from the Central Business District (CBD). Areas located closer to employment centers and commercial zones generally experience higher land values due to better accessibility and concentration of urban activities. Infrastructure development such as highways, metro systems, transportation corridors, and public facilities further increases land demand and contributes to price appreciation. As a result, urban growth and real estate development are strongly influenced by accessibility and economic opportunity.

Urban economic theory also explains the process of urban expansion and socio-economic differentiation within cities. High-income populations generally occupy premium residential areas with better infrastructure and accessibility, while middle-income groups tend to settle in moderately accessible regions with affordable land prices. Such spatial differentiation influences the development of HIG and MIG residential sectors and contributes to variations in land prices and housing affordability.

In rapidly urbanizing cities like Indore, urban economic principles play an important role in shaping residential growth patterns, investment behavior, and real estate market dynamics. Expansion of transportation infrastructure and commercial development significantly affect land values and contribute to urban sprawl. Therefore, urban economic theory provides an important basis for understanding spatial variation in property prices and future urban development trends.

Bid-Rent Theory Formula

$$R = f(d)$$

Where:

R = Land Rent / Land Value

d = Distance from CBD

Inverse Relationship:

$$R = \frac{k}{d}$$

Where:

k = Constant

d = Distance from urban center

Literature / Research Paper	Study Area	Methodology Used	Parameters Considered	Major Findings	Relevance to Present Study
Integrating Machine Learning and Hedonic Regression for Housing Price Prediction: A Systematic International Review of Model Performance and Interpretability	Multiple cities across Asia, Europe, America, and Australia	Hedonic Regression, Neural Networks	Location accessibility, property characteristics, infrastructure, neighborhood quality, socio-economic indicators	Machine learning models showed higher prediction accuracy, while hedonic models improved interpretability of land price factors	Supports the integration of ANN and Hedonic Price Model for land price prediction in HIG and MIG housing areas
Hedonic, Residual, and Matching Methods for Residential Land Valuation	Maricopa County, Arizona, USA	Hedonic Modeling, Residual Estimation, Matching Techniques	Vacant land sales, neighborhood quality, structural characteristics, land use, property value	Hedonic and matching techniques were effective for residential land valuation and identifying important price influencing factors	Provides conceptual and methodological support for residential land valuation analysis in the study area
Forecasting the Land Price using Statistical and Neural Network Software	Chennai Metropolitan Area (CMA), Tamil Nadu, India	Multiple Regression Analysis and Artificial Neural Network (ANN)	GDP, inflation, population growth, guideline value, construction cost, urban growth indicators	ANN models produced more accurate land price forecasts compared to conventional regression models	Supports ANN-based land price prediction methodology adopted in the present study
Analyzing the Housing Needs and Demands of Growing Middle-Income Group (MIG) in India	Rohtak City, Haryana, India	Primary Survey, Urban economic theory, Comparative Market Analysis	Housing affordability, Price-to-Income Ratio, infrastructure accessibility, location, amenities	Significant affordability gap observed between market rates and government rates; infrastructure strongly influenced property values	Useful for understanding housing affordability, socio-economic segregation, and MIG housing demand in Indore City

Table 1: Summary of Literature Review Studies

2.6. Comparative Table

Various forecasting and valuation models have been used in previous real estate and urban studies for predicting land prices and analyzing housing market behavior. Each model possesses different strengths, limitations, data requirements, and applicability depending upon the research objectives and dataset characteristics. Therefore, a comparative analysis of major forecasting models was carried out to identify the most suitable technique for the present study.

S. No.	Model	Full Form	Working Principle	Advantages	Limitations	Applicability in Present Study	Reason for Selection / Rejection
1	ARIMA	Auto Regressive Integrated Moving Average	Uses historical time-series data to identify trends and forecast future values based on autoregression and moving averages.	Simple, reliable, suitable for time-series forecasting, effective for trend analysis, easy interpretation.	Requires stationary data and may not capture sudden external shocks.	Used for forecasting government and market land prices from 2026–2030.	Selected due to availability of limited historical data, suitability for trend-based forecasting, and better interpretability.
2	ANN	Artificial Neural Network	Uses machine learning algorithms and interconnected nodes to identify nonlinear relationships in datasets.	High prediction capability, handles complex nonlinear patterns, adaptive learning.	Requires large datasets, high computational complexity, difficult interpretation.	Considered during literature review but not applied in the present study.	Rejected due to limited dataset availability and complexity for undergraduate-level research.
3	HPM	Hedonic Pricing Model	Estimates property value based on physical, environmental, and neighborhood characteristics.	Identifies influence of individual parameters on property prices.	Requires extensive primary data and multiple independent variables.	Used conceptually to understand factors affecting land values.	Not selected because the study mainly focuses on trend forecasting rather than parameter-based valuation modeling.
4	Linear Regression	Statistical Regression Model	Establishes relationship between dependent and	Simple analysis, easy	Limited accuracy for fluctuating or	Reviewed during literature study for	Not selected because land price trends showed

S. No.	Model	Full Form	Working Principle	Advantages	Limitations	Applicability in Present Study	Reason for Selection / Rejection
			independent variables using a linear equation.	interpretation, widely used.	nonlinear market trends.	understanding price behavior.	dynamic time-series variations better suited for ARIMA.
5	Multiple Regression Analysis	Advanced Regression Technique	Predicts values using multiple influencing variables simultaneously.	Useful for identifying parameter influence and correlation strength.	Requires large datasets and assumptions such as multicollinearity testing.	Useful in theoretical understanding of land value determinants.	Not applied due to limited parameter-based quantitative dataset.
6	GIS-Based Spatial Analysis	Geographic Information System Analysis	Uses spatial mapping and geographic data to analyze urban growth and land value distribution.	Strong spatial visualization and mapping capability.	Does not independently forecast future prices.	Used for spatial understanding of selected study areas.	Used as a supporting analytical tool rather than forecasting technique.
7	Time Series Trend Analysis	Historical Trend Forecasting	Analyzes historical trends and price movements over time.	Useful for identifying growth patterns and fluctuations.	Less accurate without statistical modeling support.	Used as a preliminary analytical approach before ARIMA forecasting.	Integrated with ARIMA for improved forecasting reliability.

Table 2: Comparative Analysis of Forecasting and Valuation Models Used in Real Estate Studies

‘Although ANN provides high prediction capability for nonlinear datasets, the present study selected ARIMA due to limited historical dataset size, better interpretability, lower computational complexity, and suitability for trend-based time-series forecasting’.

2.7. Desk Appraisals

This study investigates the importance of desk appraisal techniques in understanding residential land valuation, housing affordability, and land price prediction through different national and international studies. Desk appraisal is a secondary research approach that utilizes published papers, reports, journals, government records, market surveys, and statistical datasets to analyze real estate market behavior and urban growth patterns. These studies provide insights into the relationship between infrastructure, socio-economic characteristics,

accessibility, neighbourhood quality, and housing demand without conducting extensive physical field surveys.

The present study reviews four major literature studies conducted in different geographical contexts:

1. International Review of Hedonic Regression and Machine Learning Models
2. Chennai Metropolitan Area, Tamil Nadu
3. Maricopa County, Arizona, USA
4. Rohtak City, Haryana

These desk appraisals help in understanding the applicability of ANN models, hedonic price modelling, socio-economic segregation, and housing affordability analysis within the context of HIG and MIG residential development.

2.7.1. International Review of Hedonic Regression and Machine Learning Models

This international study investigates the integration of machine learning techniques and hedonic regression models for housing price prediction across multiple cities in Asia, Europe, America, and Australia. The study evaluates the predictive performance, interpretability, and efficiency of different price forecasting approaches in the real estate sector. The research compares traditional hedonic regression methods with advanced machine learning models such as Artificial Neural Networks (ANN), Random Forest, and other data-driven techniques for estimating residential property prices.

The study reveals that machine learning approaches provide higher predictive accuracy due to their ability to process nonlinear relationships and large multidimensional datasets. However, hedonic models remain important because they offer better interpretability and understanding of locational and structural factors influencing property prices. The analysis indicates that combining hedonic modeling with machine learning techniques improves forecasting efficiency and supports more informed urban planning and policy-making decisions.

The study identifies several important factors influencing housing prices, including:

- Location accessibility
- Transportation connectivity
- Infrastructure availability
- Neighborhood quality
- Socio-economic conditions

- Environmental quality
- Structural characteristics of buildings
- Distance from commercial centers

The findings suggest that advanced predictive models are highly useful for rapidly urbanizing cities where real estate markets are dynamic and influenced by multiple interacting variables. The study concludes that integration of ANN and hedonic approaches can improve land price prediction and housing market analysis for sustainable urban development.

2.7.2. Chennai Metropolitan Area, Tamil Nadu

This study focuses on forecasting land prices in the Chennai Metropolitan Area using statistical regression techniques and Artificial Neural Network (ANN) models. The analysis was conducted using monthly land market data collected from thirteen locations within Chennai between 1997 and 2011. The study examines the influence of economic, demographic, and infrastructural variables on urban land values and compares the efficiency of traditional regression methods with ANN-based forecasting approaches.

The research indicates that ANN models produce more accurate prediction results than conventional statistical regression because of their capability to identify nonlinear market relationships and hidden patterns in real estate datasets. Economic indicators such as GDP growth, inflation rate, population increase, infrastructure development, and construction costs were found to significantly affect land price variation across the metropolitan region.

The study identified the following major factors influencing land prices:

- Population growth
- Economic development
- Infrastructure projects
- Guideline values
- Transportation connectivity
- Construction costs
- Urban expansion
- Accessibility to commercial centers

The results reveal that southern and western parts of Chennai experienced faster land value appreciation due to rapid infrastructural growth and increasing urbanization. The study

highlights the usefulness of ANN models in predicting future land prices and supporting urban planning decisions related to residential development and infrastructure investment.

2.7.3. Maricopa County, Arizona, USA

This study examines residential land valuation methods in Maricopa County, Arizona, by comparing hedonic pricing models, residual estimation techniques, and matching approaches used for property appraisal. The research focuses on evaluating the effectiveness of different valuation methods for mass appraisal systems and residential land price estimation. The study uses vacant land sales, developed property transactions, and Neighborhood market characteristics to estimate residential land values within the county.

The hedonic pricing model was found to be highly effective in analyzing the relationship between property prices and locational, structural, and neighborhood attributes. The study indicates that land value is significantly influenced by accessibility, neighborhood quality, proximity to services, and environmental conditions. The matching approach provided reliable results for estimating land values in areas with similar neighborhood characteristics and development patterns.

The study identified major residential land valuation parameters such as:

- Accessibility to transportation networks
- Distance from city center
- Neighborhood quality
- Availability of public services
- Environmental characteristics
- Proximity to schools and hospitals
- Land parcel size
- Commercial development intensity

The research concludes that hedonic pricing models are highly useful for real estate valuation because they can evaluate multiple variables simultaneously and provide accurate estimation of residential land prices. The findings emphasize the importance of location and neighborhood characteristics in determining urban land values.

2.7.4. Rohtak City, Haryana

This study analyzes the housing needs, affordability conditions, and residential preferences of the Middle-Income Group (MIG) population in Rohtak City, Haryana. The research was conducted using primary surveys, housing market analysis, and socio-economic assessment to understand the gap between housing demand and affordability among middle-income households. The study also examines the impact of infrastructure, accessibility, and neighborhood facilities on residential property values and buyer preferences.

The findings reveal that rapid urbanization and increasing property prices have significantly affected housing affordability for middle-income groups. The Price-to-Income Ratio (PIR) analysis indicates affordability stress among MIG households due to rising market prices and limited availability of affordable housing options. Infrastructure development, public amenities, transportation facilities, and accessibility to employment centers were found to strongly influence residential location preferences and property demand.

The study identifies the following major factors affecting housing affordability and residential demand:

- Housing price variation
- Household income level
- Accessibility to workplace
- Availability of public transport
- Infrastructure facilities
- Educational and healthcare services
- Neighbourhood environment
- Availability of affordable housing schemes
- Loan and financing facilities
- Government housing policies

The research recommends integrated planning strategies and government intervention for improving housing affordability and balanced urban development. The study further highlights the importance of socio-economic analysis and infrastructure planning in addressing urban housing challenges for middle-income populations.

Most previous studies focused either on machine learning-based forecasting, hedonic valuation, or affordability analysis independently. Limited studies have comparatively analyzed HIG and MIG residential land price trends in rapidly growing Indian tier-2 cities using time-series forecasting techniques integrated with urban growth analysis. Furthermore, limited research has been conducted specifically for Indore city considering both government guideline values and actual market rates. Therefore, the present study attempts to address this

gap through ARIMA-based land price forecasting and comparative analysis of HIG and MIG residential areas.

CHAPTER 3: STUDY AREA: INDORE (MADHYA PRADESH)

3. CITY PROFILE

3.1. Introduction to the city

Indore, located in the western part of Madhya Pradesh, is one of the fastest-growing cities in central India. Known as the commercial capital of the state, the city has developed as an important center for trade, education, industry, and real estate development. Indore is well connected through road, rail, and air transportation, which has significantly contributed to its urban and economic growth.

The city has experienced rapid urbanization due to increasing population, migration, infrastructural development, and industrial expansion. Major projects such as the Super Corridor, Smart City Mission, and Metro Rail development have accelerated residential and commercial growth in different parts of the city. Areas such as Vijay Nagar, Nipania, Saket Nagar, and Sudama Nagar have witnessed noticeable changes in land use and property values over the years.

Indore is also recognized for its improved civic infrastructure and urban management. The growing demand for residential housing, especially in HIG and MIG sectors, has increased the importance of studying land price trends, affordability, and real estate market dynamics within the city.

3.2. Demographic Overview

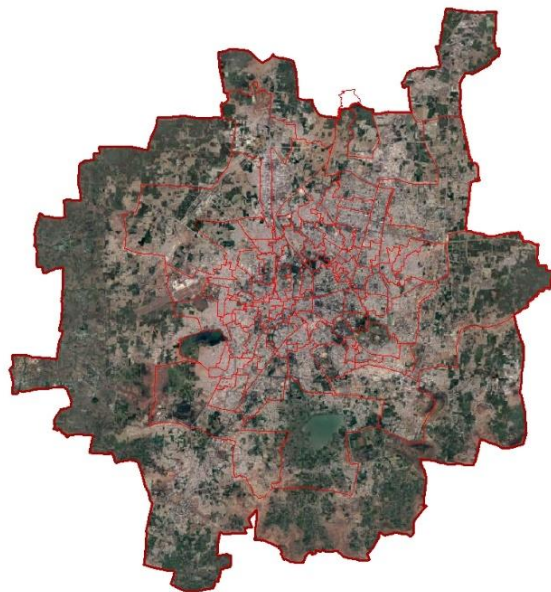


Figure 5: Ward map of Indore city

Description	Indore
Urban Agglomeration	Indore
Government	Municipal Corporation
UA Type	Million Plus UA/City
State	Madhya Pradesh

Table 3: Description of Census characteristics of Indore

3.2.1. Population

Based on the Census of 2011, the population of Indore city was approximately 2.1 million, making it the most populated city in Madhya Pradesh. Due to rapid urbanization, industrial development, migration, and infrastructural expansion, the city has experienced continuous population growth over the past decade. The development of commercial corridors, educational institutions, IT parks, and industrial zones has significantly contributed to increasing residential demand and urban expansion within the city. It is estimated that the urban population of Indore has crossed 3 million in recent years, indicating rapid metropolitan growth and increasing pressure on urban infrastructure and housing facilities.

The city is administratively governed by the Indore Municipal Corporation (IMC), which is responsible for managing civic infrastructure, public services, sanitation, transportation, and urban development activities within the municipal boundary. Indore is divided into multiple administrative wards for efficient urban governance and management. The municipal administration plays an important role in implementing planning policies, infrastructure projects, and Smart City initiatives aimed at improving urban living conditions and promoting sustainable development.

Indore has emerged as a major economic and commercial center in central India due to the presence of industries, educational institutions, healthcare facilities, transportation networks, and large-scale residential development. The city has witnessed substantial growth in both HIG and MIG housing sectors because of increasing migration and employment opportunities. Rapid urban growth and infrastructure development have also influenced land value appreciation and real estate market expansion in different parts of the city.

S. No.	Demographic Parameters	Indore Municipal Corporation
1	State/District	Madhya Pradesh / Indore
2	No. of Wards	85
3	Total No. of Households	5,20,000 (Approx.)
4	Total Population	21,67,447
5	Sex Ratio (Females/1000 males)	928
6	Literacy Rate	87.38%

Table 4: Demographic parameters of the city

3.2.2. Literacy Rate of Indore

The literacy rate in Indore Urban Agglomeration is approximately 87.38%, which is higher than the national urban average. The male literacy rate in Indore is around 91.84%, while the female literacy rate is nearly 82.55%. The total number of literate individuals in the Indore Urban Area (UA) is estimated to be more than 16 lakh persons. Out of this, male literacy contributes a major share, indicating a comparatively higher educational attainment among the urban population. The steady increase in literacy rate reflects the city's educational development and growing urbanization.

3.2.3. Population of Children in Indore

The number of children aged 0–6 years in Indore Urban Agglomeration accounts for nearly 11% of the total population. The child population in the city reflects continuous urban growth and migration trends. Male child population slightly exceeds the female child population, maintaining the overall demographic pattern of the city. The presence of educational institutions, healthcare services, and residential colonies has contributed to the growth of family-oriented settlements in Indore.

3.2.4. Indore's Sex Ratio

The sex ratio of Indore Urban Agglomeration is approximately 928 females per 1000 males, which is close to the national urban average. The child sex ratio in the 0–6 age group is comparatively lower, indicating demographic imbalance similar to other rapidly urbanizing Indian cities. However, the city has shown gradual improvement in female literacy, healthcare accessibility, and employment participation, contributing positively toward social development indicators.

The projected population of Indore city in 2025 is estimated to exceed 3.5 million, while the metropolitan population is expected to be significantly higher due to rapid peripheral development. The most recent official census was conducted in 2011, and present projections are based on historical population growth trends and urban expansion patterns. Indore continues to emerge as one of the fastest-growing urban centers in Madhya Pradesh because of industrialization, educational institutions, and commercial activities.

3.2.5. Geographical Overview

Indore district is located in the western part of Madhya Pradesh on the Malwa Plateau region. The district lies between approximately 22°11' North Latitude and 75°50' East Longitude. The region is characterized by fertile black cotton soil and relatively flat topography with gentle undulations. The city is situated near the banks of the Khan and Saraswati rivers, which are tributaries of the Kshipra River.

The overall geographical setting of Indore supports urban development, transportation connectivity, and industrial growth. The city experiences a strategic location connecting major cities such as Bhopal, Mumbai, Ahmedabad, and Nagpur through road and rail networks.

3.2.6. Rivers

The major rivers influencing the region include the Khan River, Saraswati River, and Kshipra River. These rivers contribute to the drainage pattern and water availability of the city. Seasonal streams and lakes also play an important role in maintaining the urban ecological balance.

3.2.7. Forest Area

The forest cover within Indore district is limited compared to other districts of Madhya Pradesh. However, green belts, urban parks, and peripheral plantation zones contribute significantly toward environmental sustainability and ecological balance in the urban region.

3.2.8. Climate

Indore experiences a subtropical climate with three distinct seasons: summer, monsoon, and winter. The summer season extends from March to June, while the monsoon season generally occurs from June to September. Winters remain moderate and pleasant from November to February. The average annual rainfall of the city is approximately 900–1000 mm. Temperatures may rise above 40°C during peak summer and fall below 10°C during winter months.

3.2.9. Area

The total geographical area of Indore district is approximately 3,898 square kilometres. The urban area under Indore Municipal Corporation occupies a major portion of the district's developed land use, while peripheral regions consist of agricultural and rural settlements.

3.2.10. Languages

The primary languages spoken in Indore are Hindi and Malwi, while English is widely used for educational, commercial, and administrative purposes. Marathi, Gujarati, and Urdu are also spoken by different communities residing within the city.

3.3. Historical Background

Indore is one of the most significant commercial and educational centers of Madhya Pradesh. The city developed historically as a trade hub due to its strategic location on major trade routes of central India. Indore was established under the Holkar dynasty and later emerged as an important administrative and commercial city during the Maratha period.

The city derives its name from the historic Indreshwar Temple. During the rule of the Holkars, especially under Maharani Ahilyabai Holkar, Indore witnessed remarkable growth in infrastructure, administration, and trade activities. Over time, the city transformed into an industrial and educational center with the development of textile industries, manufacturing units, IT parks, and institutions such as IIT and IIM Indore.

Today, Indore is recognized as the commercial capital of Madhya Pradesh and has consistently ranked among the cleanest cities in India under the Swachh Bharat Mission. The city continues to experience rapid urban growth supported by infrastructure development, transportation improvements, real estate expansion, and increasing investment opportunities.

3.4. City Growth

The historical growth of Indore city has been strongly influenced by trade, industrialization, transportation, and migration. Initially developed around the old market core and Rajwada area, the city expanded toward Vijay Nagar, Palasia, Nipania, and other peripheral regions due to increasing urbanization and real estate development.

The establishment of educational institutions, industrial estates, and commercial complexes accelerated population growth and urban expansion. Major infrastructure projects such as the BRTS corridor, Super Corridor development, metro project, and ring road connectivity have further contributed to the city's transformation into a modern metropolitan center.

Indore has experienced continuous population growth since independence. The rapid increase in residential colonies, commercial hubs, and transportation facilities reflects the city's expanding economic importance within central India.

Year	India (%)	Madhya Pradesh (%)	Indore (%)
1951	13.31	18.02	22.45
1961	21.64	24.70	35.12
1971	24.80	28.67	42.56
1981	24.66	35.27	51.85
1991	23.86	26.84	39.74
2001	21.54	24.34	32.11
2011	17.64	20.30	26.63

Table 5 :Decadal Growth Rate of India, Madhya Pradesh and Indore City

Year	Total Population	Absolute Growth
1951	310859	—
1961	402321	91462
1971	572580	170259
1981	827026	254446
1991	1091674	264648
2001	1474968	383294

Year	Total Population	Absolute Growth
2011	1964086	489118

Table 6: Population and Absolute Growth of Indore City

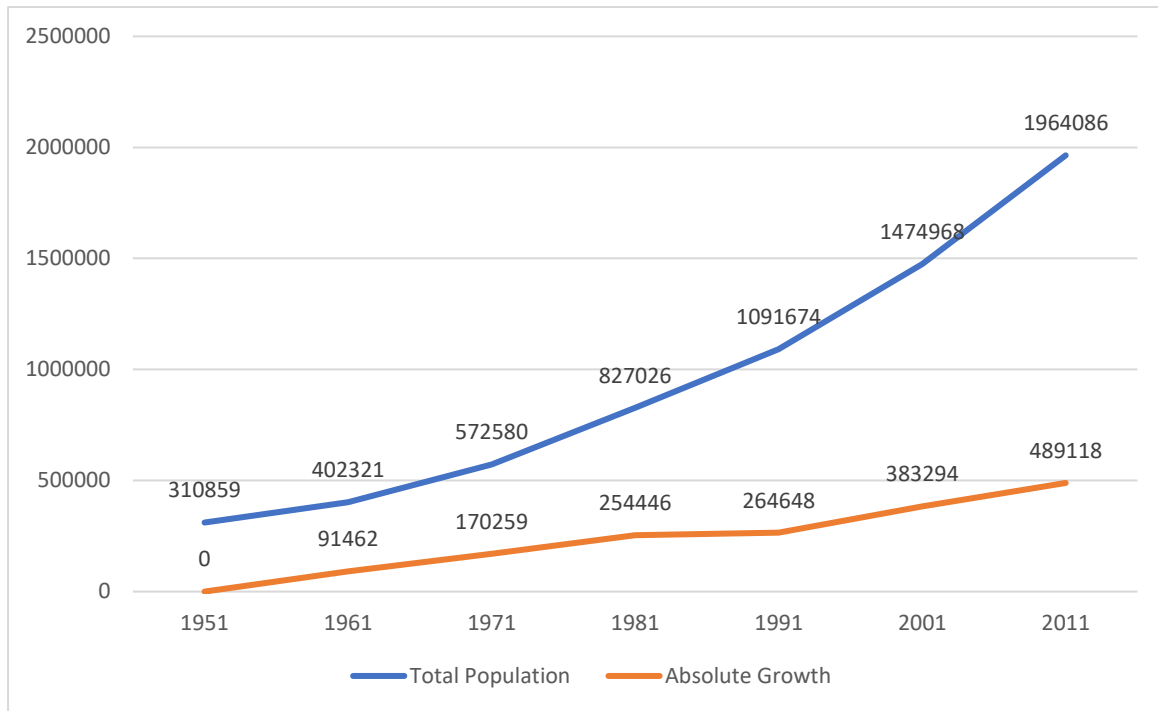


Figure 6: Population and Absolute Growth Chart

3.5. Transportation

Indore is one of the major transportation hubs of Madhya Pradesh and is well connected through road, rail, and air networks. The city is served by the Devi Ahilyabai Holkar Airport, which provides regular domestic flight connectivity to major metropolitan cities such as Delhi, Mumbai, Bengaluru, Hyderabad, and Ahmedabad. Indore Junction is the primary railway station of the city and connects Indore with important cities across India through broad gauge railway lines.

Road transportation forms the backbone of urban mobility in Indore. The city is connected through major National Highways and State Highways, which enhance regional accessibility and support commercial and industrial activities. The important highways passing through or near Indore include:

NH-52 – Connecting Indore with Jaipur and other northern regions.

NH-47 – Linking the city with Ahmedabad and Nagpur corridors.

NH-59 – Providing connectivity towards Dhar and Gujarat region.

State Highway (SH-27) – Connecting nearby urban and rural settlements within Madhya Pradesh.

State Highway (SH-31) – Supporting inter-district transportation and accessibility.

The city also has an efficient urban transportation system consisting of the Indore BRTS corridor (iBus System), city buses, auto-rickshaws, app-based taxi services, and developing metro rail infrastructure. Major arterial roads such as AB Road, Ring Road, Super Corridor, and MR-10 Road play a crucial role in reducing congestion and improving intra-city connectivity.

The transportation network of Indore significantly contributes to urban expansion, real estate development, and economic growth by improving accessibility between residential, commercial, and industrial areas.

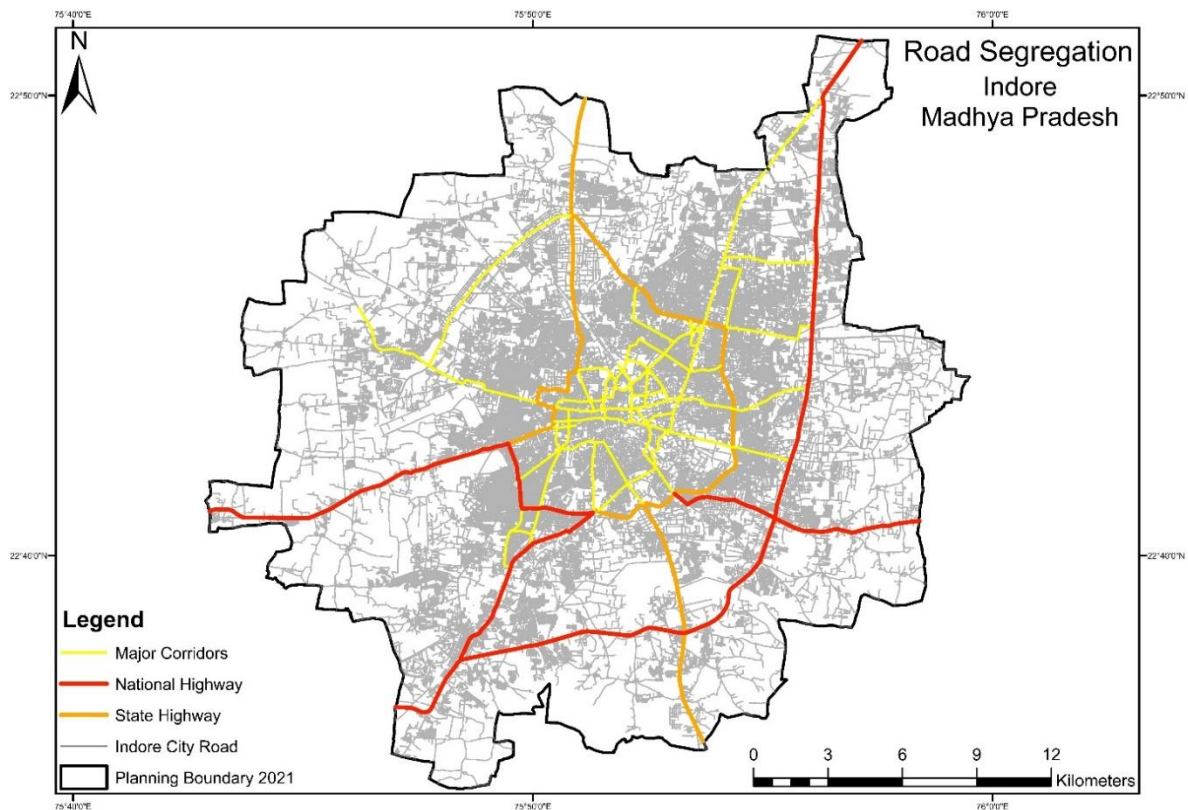


Figure 7: Road Segregation Map of Indore City

3.6. Tourism in the city

Indore is one of the most prominent tourists, commercial, and cultural centers of Madhya Pradesh. The city holds significant importance due to its rich historical background, architectural heritage, religious places, vibrant markets, and modern urban infrastructure. Over the years, Indore has emerged as an important urban tourism destination in Central India, attracting a large number of domestic as well as international visitors.

Historically, Indore developed under the Holkar dynasty and became an important administrative and trade center of the Malwa region. The architectural influence of the Holkar rulers can still be observed in several heritage structures located within the city. Rajwada Palace, situated in the old city area, is one of the most famous historical landmarks and represents a blend of Maratha, Mughal, and French architectural styles. Lal Bagh Palace is another important heritage site known for its grand architecture, royal interiors, and historical significance.

The city is also known for its religious tourism. Khajrana Ganesh Temple is among the most visited temples in Madhya Pradesh and attracts thousands of devotees throughout the year. Other important religious destinations include Annapurna Temple, Kanch Mandir, Bada Ganpati Temple, and Gommatgiri Jain Temple. These religious centers contribute significantly to local tourism activities and economic development.

Indore is widely recognized for its food tourism and street food culture. Areas such as Sarafa Bazaar and Chappan Dukan are popular among tourists for traditional Malwa cuisine and street food varieties. The city has gained national recognition for cleanliness under the Swachh Bharat Mission, which has positively influenced tourism growth and improved the urban environment.

Apart from local attractions, Indore also functions as a gateway city for several nearby tourist destinations such as Ujjain, Omkareshwar, Maheshwar, Mandu, and Dhar. Due to its strategic location and well-developed transport network, tourists often use Indore as a base city while visiting these important heritage and pilgrimage centers.

The transportation infrastructure of the city supports tourism activities efficiently. Devi Ahilyabai Holkar Airport provides domestic and limited international connectivity, while the railway station and major highways connect Indore with important cities including Bhopal, Mumbai, Delhi, Ahmedabad, and Nagpur. The presence of hotels, restaurants, shopping centers, and recreational facilities further enhances the tourism potential of the city.

Tourism plays an important role in the economic development of Indore by generating employment opportunities in sectors such as hospitality, transportation, retail trade, food services, and tourism management. Continuous urban development, infrastructure improvement, and promotion of cultural heritage have strengthened the position of Indore as one of the leading tourism destinations in Madhya Pradesh.

3.7. Governance and Politics

Indore is governed by the Indore Municipal Corporation (IMC), which is responsible for the administration and management of civic services within the city. The Municipal Corporation functions under the provisions of the Madhya Pradesh Municipal Corporation Act and is headed by the Mayor, who is elected by the residents of the city. The administrative operations are managed by the Municipal Commissioner, appointed by the Government of Madhya Pradesh.

The city is divided into several municipal wards for administrative convenience and effective delivery of public services. Each ward is represented by an elected councillor responsible for addressing local issues and representing citizens in municipal decision-making processes. The Municipal Corporation manages essential urban services including water supply, solid waste management, road maintenance, drainage, street lighting, public health, sanitation, and urban infrastructure development.

Indore Development Authority (IDA) plays a significant role in urban planning, land development, housing schemes, and infrastructure projects within the city. The authority is responsible for preparing development plans, regulating land use, and promoting planned urban growth. Other important agencies involved in city governance include the Public Works Department (PWD), Madhya Pradesh Housing Board, Traffic Police Department, and Smart City Development Limited.

Indore has gained national recognition for effective urban governance and implementation of public welfare programs, particularly under the Swachh Bharat Mission. The city has consistently ranked among the cleanest cities in India due to efficient municipal management, public participation, and improved waste management systems.

Politically, Indore is one of the most influential urban centers in Madhya Pradesh. The city is represented in both the Madhya Pradesh Legislative Assembly and the Parliament of India. Major national political parties actively participate in local governance and electoral activities. Political leadership in the city significantly influences urban development projects,

infrastructure investments, transportation improvements, and implementation of public policies.

In recent years, the adoption of smart city initiatives, digital governance systems, public participation mechanisms, and sustainable urban management practices has strengthened administrative efficiency in Indore. These governance measures have contributed to improving the quality of life, infrastructure facilities, and overall urban development of the city.

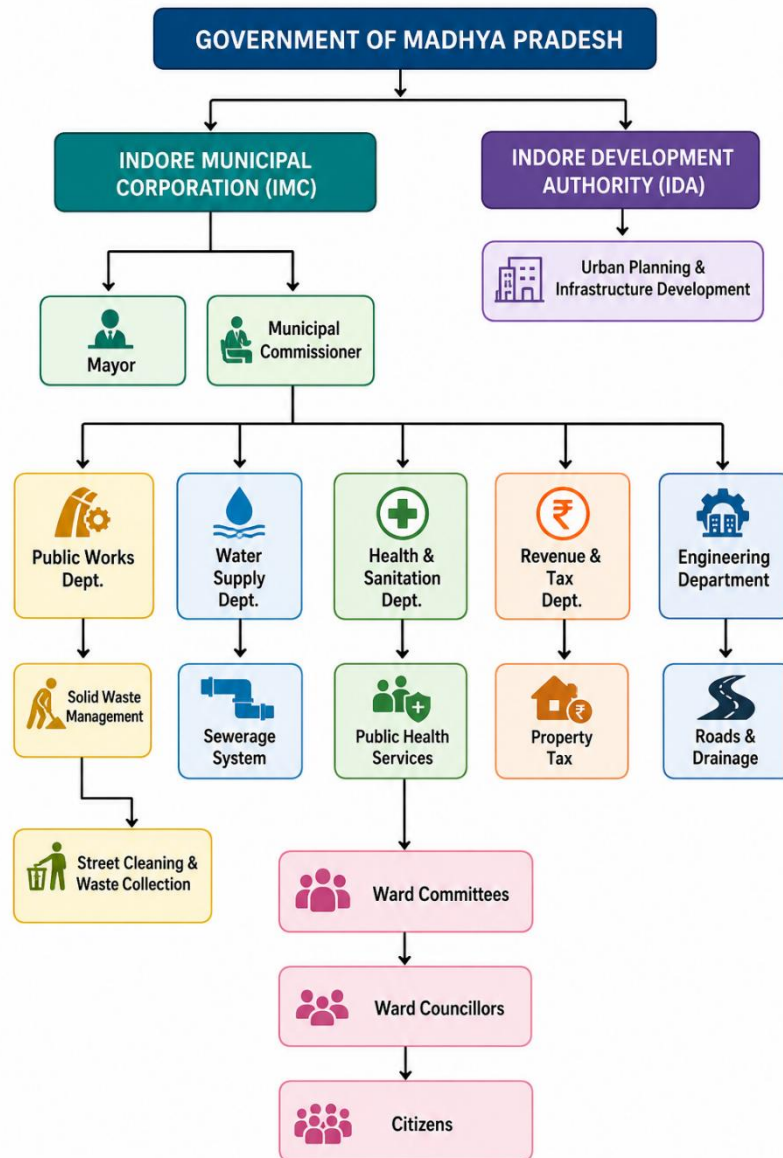


Figure 8: Organizational structure of the city

3.8. Reason for Selecting Indore City

Indore has been selected for the study due to its rapid urban growth, increasing population, expanding infrastructure, and rising real estate activities. The city is one of the major

commercial and educational centers of Madhya Pradesh and has experienced significant development in recent years through projects such as the Smart City Mission, Indore Metro, Super Corridor, and improved transportation networks. These developments have greatly influenced land use and property values across the city.

Indore also provides a suitable case for studying variations in land value because different parts of the city show different growth patterns based on infrastructure, accessibility, and socio-economic conditions. The city has witnessed continuous expansion in residential, commercial, and institutional development, making it appropriate for analyzing urban land dynamics.

For the present study, four areas of Indore — **Vijay Nagar, Nipania, Saket Nagar, and Sudama Nagar** — were selected to represent different income groups and development characteristics. Vijay Nagar and Saket Nagar were selected as high-income and rapidly developing areas with high land values, commercial activities, and modern infrastructure facilities. On the other hand, Saket Nagar and Nipania were selected as comparatively middle and lower-middle income areas showing moderate land value growth and different urban development patterns.

The selection of these areas helps in comparing variations in land prices, infrastructure influence, accessibility, and socio-economic characteristics within different parts of Indore city.

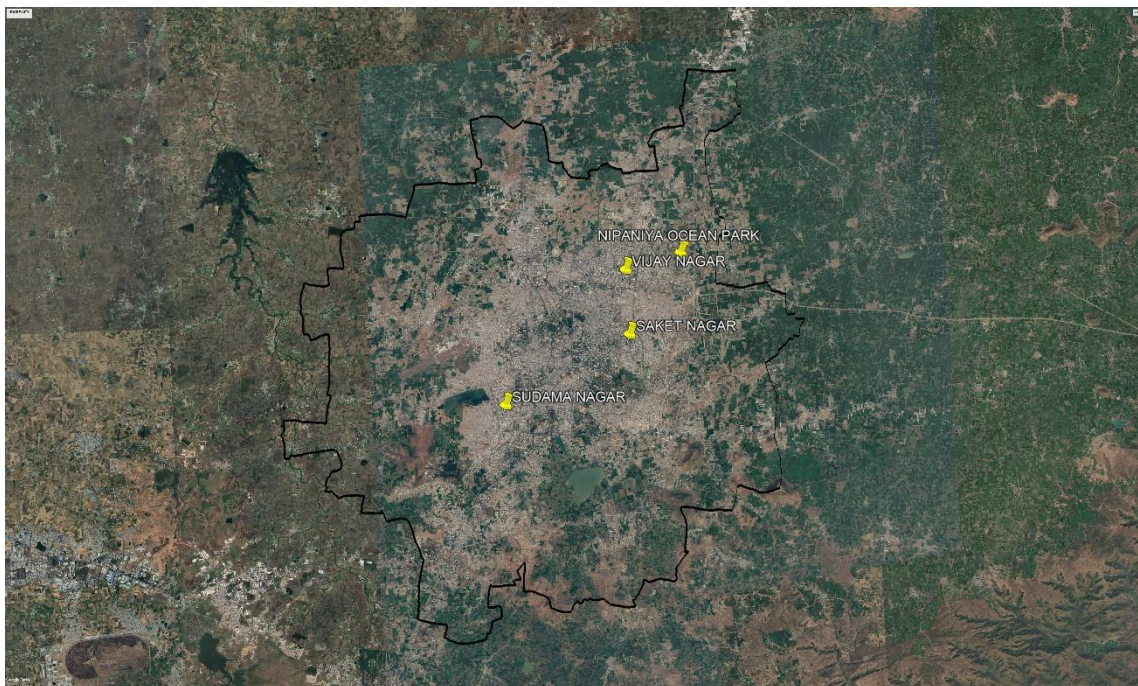


Figure 9: Demarcation of area selected areas

3.9. Land use and land classification

3.9.1.1. Land Use Land Cover

(LULC) analysis plays a crucial role in understanding the spatial dynamics of urban growth and its impact on land value distribution. In rapidly growing cities such as Indore, changes in land use patterns directly influence the structure of the real estate market, particularly in relation to residential development for different income groups. The transformation of land from agricultural and open spaces into built-up areas reflects the intensity and direction of urban expansion.

This study analyzes LULC changes over the period from 2015 to 2025 to understand how urban growth has reshaped the spatial structure of Indore. The analysis provides insights into the conversion of land, expansion patterns, and the emerging urban form, which are essential for interpreting land price variations.

3.9.1.2. Existing Land Use Pattern (2015)

The LULC map for the year 2015 represents a relatively compact and centralized urban structure. During this period, built-up areas were primarily concentrated within the core city, while the peripheral regions were dominated by agricultural land, open spaces, and green cover. Water bodies were distributed across the city and remained stable, contributing to the ecological balance of the region. The urban form at this stage exhibited characteristics of a monocentric development pattern, where most economic and residential activities were concentrated around the central areas. The gradual decrease in land use intensity from the core to the periphery indicates a traditional urban structure with limited outward expansion.

This pattern also suggests that land prices during this period were strongly influenced by proximity to the city center, with higher values in central areas and lower values in peripheral regions.

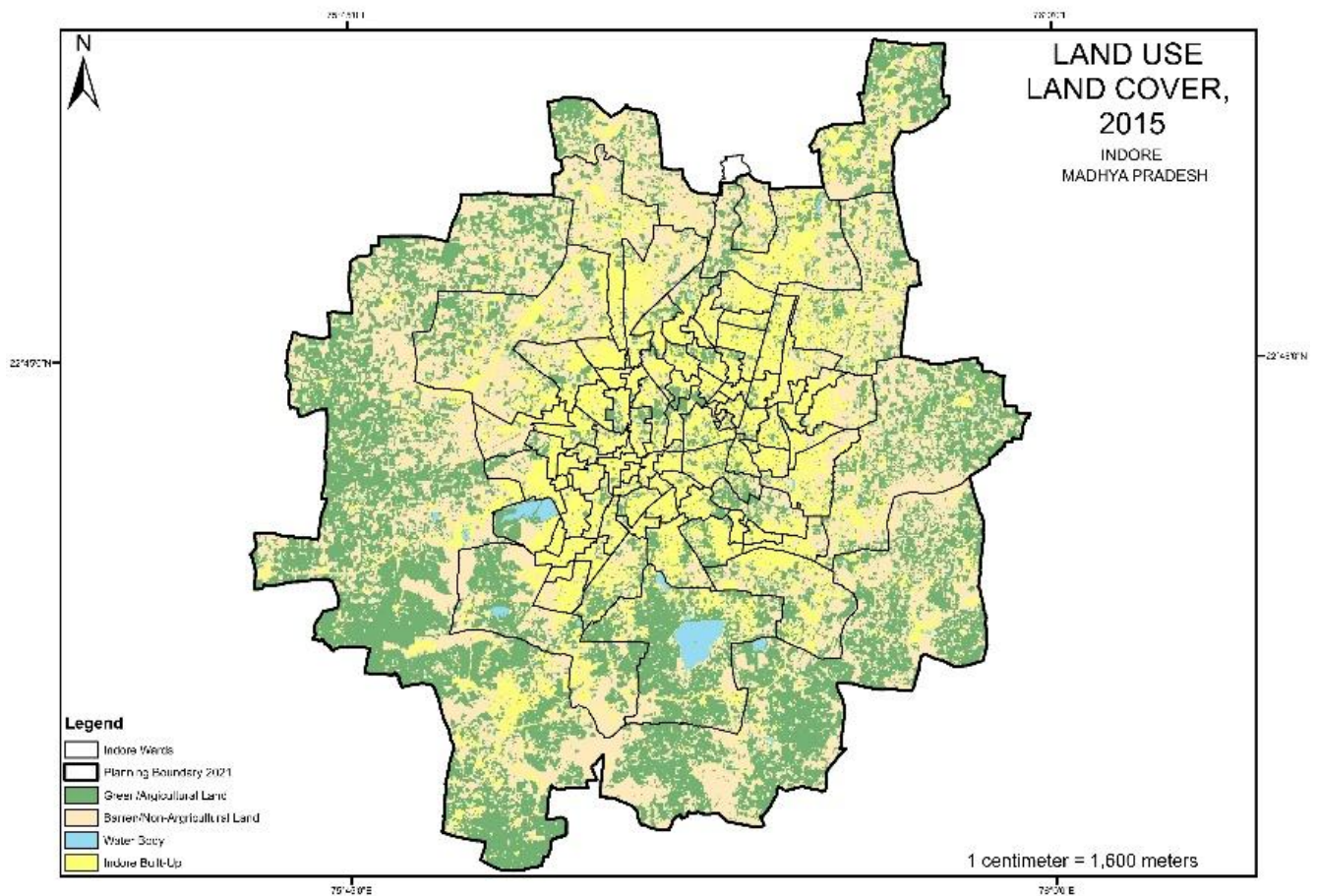


Figure 10: LULC map of year 2015

3.9.2. Land Use Transformation (2015–2025)

A comparative analysis of LULC maps from 2015 and 2025 reveals a significant transformation in the spatial structure of Indore. Over this decade, the built-up area has increased substantially, indicating rapid urbanization and expansion of residential and commercial developments. This growth is particularly prominent in peripheral areas, reflecting a shift in development pressure from the core to the outskirts of the city. The increase in built-up area has been accompanied by a noticeable reduction in agricultural and green land. Large portions of agricultural land have been converted into residential layouts, commercial spaces, and mixed-use developments. This conversion highlights the growing demand for urban land driven by population growth, economic expansion, and real estate investment. Barren land has also shown a slight increase, which indicates transitional phases of development where land is being prepared for future construction activities. This suggests ongoing urban expansion and continuous pressure on available land resources.

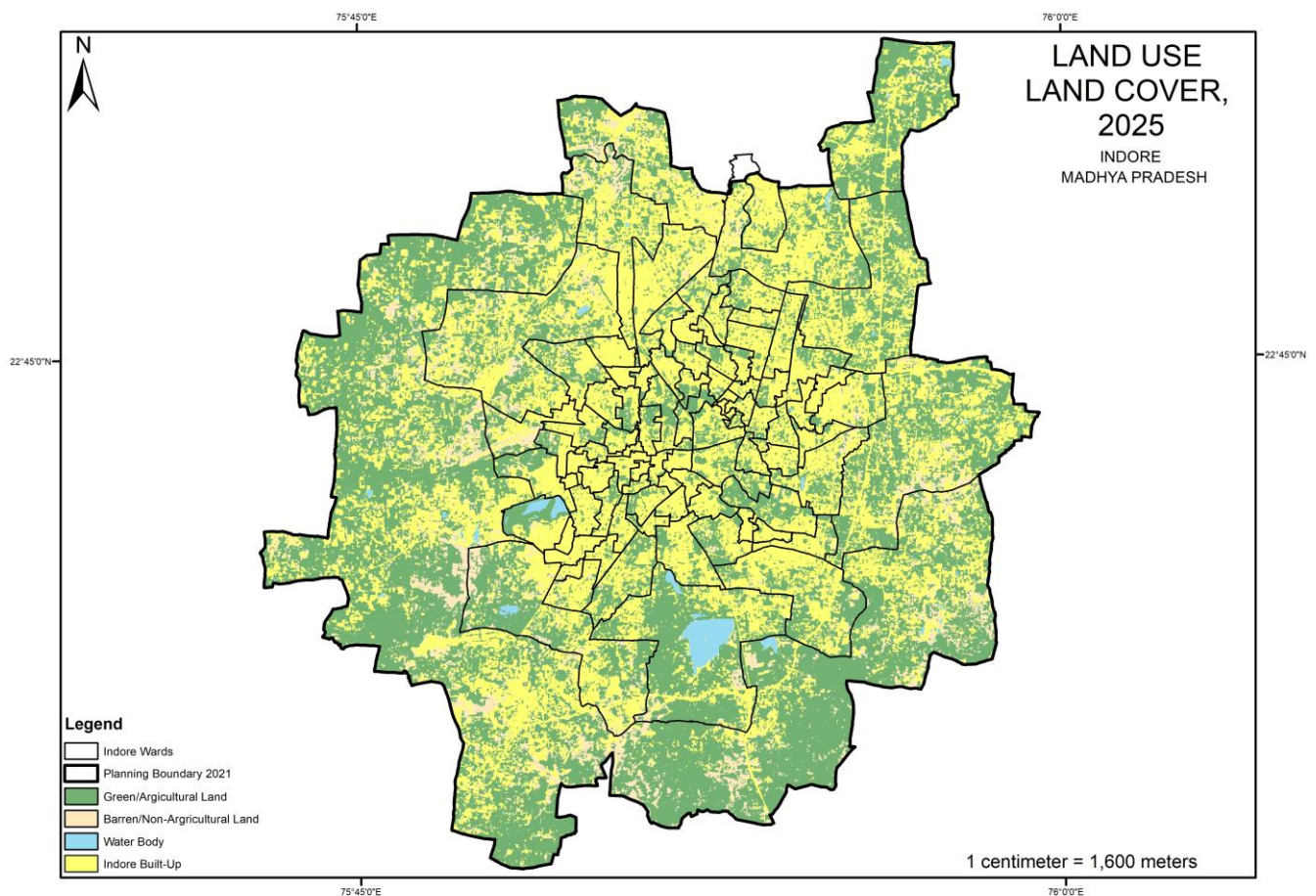


Figure 11: LULC map of 2025

Despite these changes, water bodies have remained relatively stable, although minor fragmentation is observed in some areas. This stability indicates that while urban growth has been rapid, certain natural features have been preserved to some extent.

3.9.3. Changing Urban Growth Pattern

One of the most significant findings of the analysis is the transformation in the urban growth pattern of Indore. The city has evolved from a compact urban form in 2015 to a more dispersed and radial structure by 2025. This shift reflects the influence of infrastructure development, particularly road networks, in shaping urban expansion.

The peripheral areas of the city have experienced maximum change, with high development pressure observed along the urban fringes. Growth is no longer confined to the core but is spreading outward in multiple directions, leading to the formation of new residential and commercial clusters.

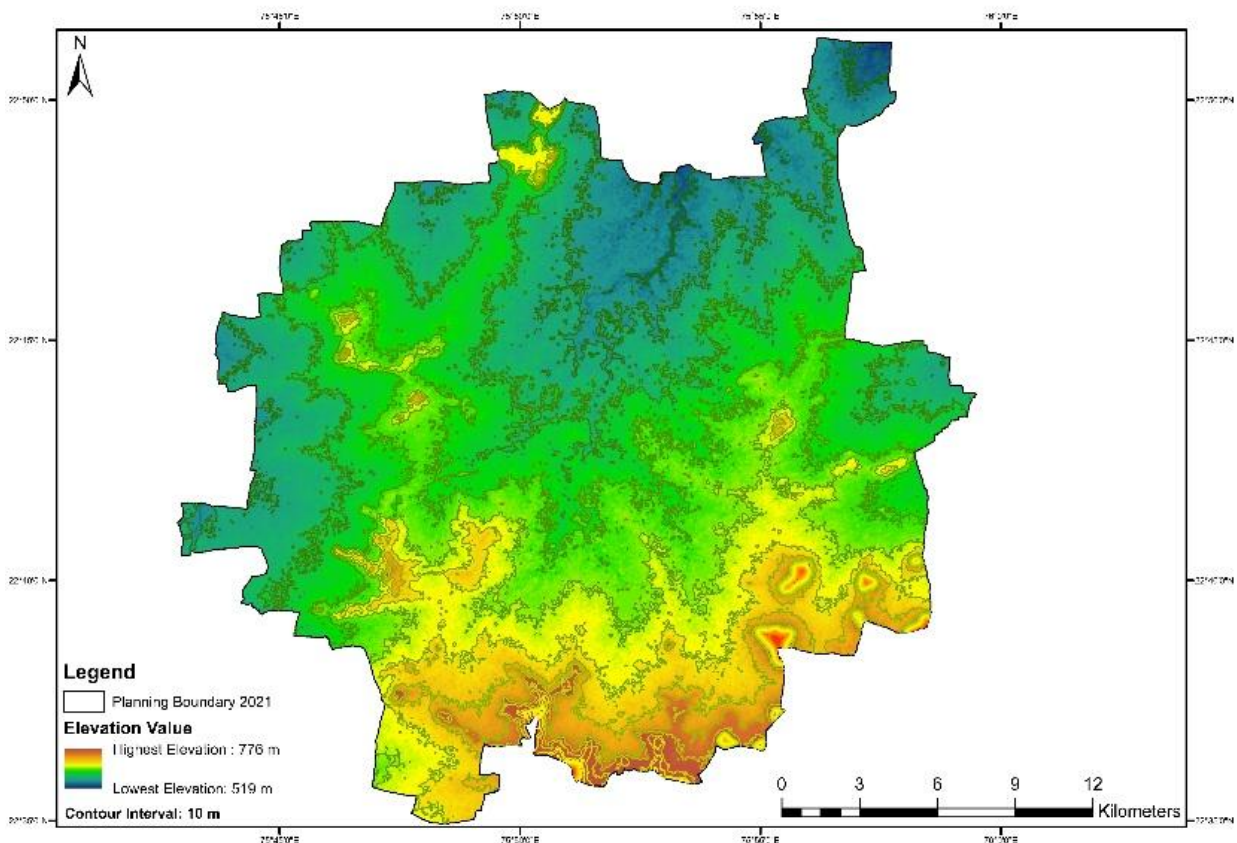


Figure 12: Slope map of Indore city

A prominent feature of this transformation is the emergence of ribbon development along major transport corridors. Development has occurred linearly along highways and arterial roads, indicating that accessibility is a key driver of land use change. While this pattern facilitates connectivity, it also leads to inefficient land utilization and scattered development.

3.9.4. Topographical Influence on Urban Expansion

The elevation map of Indore indicates variations in terrain that influence the direction and intensity of urban growth. Areas with relatively lower elevation and gentle slopes have experienced higher levels of development due to ease of construction and better accessibility.

In contrast, regions with higher elevation or uneven terrain have shown comparatively slower development. This demonstrates that topographical conditions play a supporting role in determining land use patterns and urban expansion.

The combination of topographical suitability and infrastructure availability has guided the spatial distribution of growth, further influencing land prices in different parts of the city.

3.9.5. Master Plan and Planned Development

The Indore Master Plan 2021 provides a framework for planned urban development, outlining land use zoning, infrastructure provision, and growth corridors. However, the comparison between the master plan and actual LULC patterns reveals a gap between planned and realized development.

While certain areas have developed in accordance with the master plan, significant portions of urban growth have occurred in an unplanned or semi-planned manner, particularly in peripheral regions. This mismatch highlights the influence of market forces, which often drive development faster than planning regulations can accommodate.

The deviation from planned land use has implications for infrastructure provision, land value distribution, and overall urban efficiency.

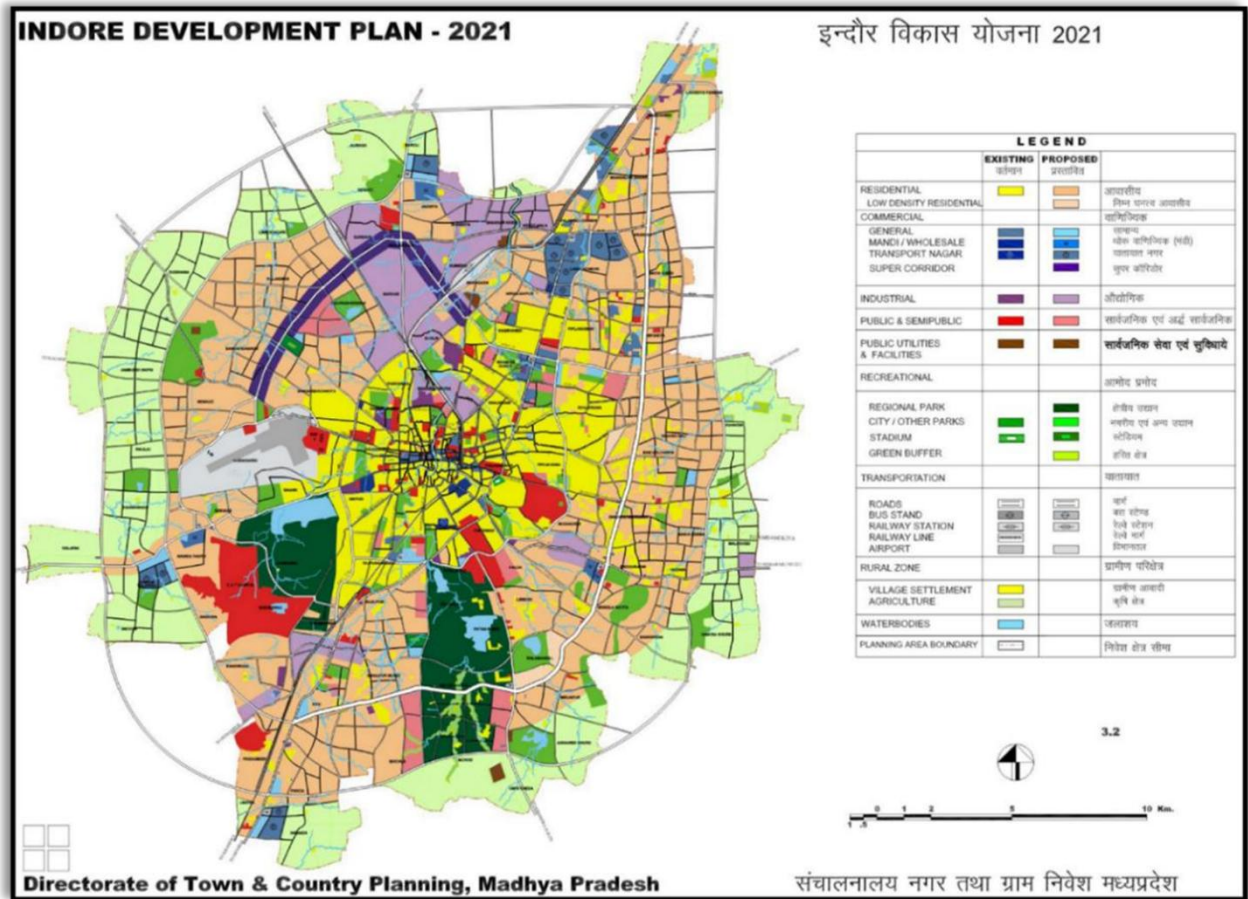


Figure 13: Indore Development plan of year 2021

3.9.6. Implications on Land Price Dynamics

The observed changes in land use and urban growth patterns have a direct impact on land price dynamics in Indore. The expansion of built-up areas into peripheral regions has led to an increase in land values in these locations, particularly in areas with good connectivity and infrastructure.

At the same time, the concentration of development in specific high-demand zones has resulted in uneven price escalation, contributing to spatial disparities in land values. The conversion of agricultural land into urban uses has further intensified speculative activities, influencing price fluctuations.

The shift towards a dispersed and corridor-based growth pattern indicates that land prices are increasingly determined by accessibility and infrastructure rather than mere proximity to the city center. This transformation underscores the need for integrated planning approaches that can guide development in a more balanced and sustainable manner.

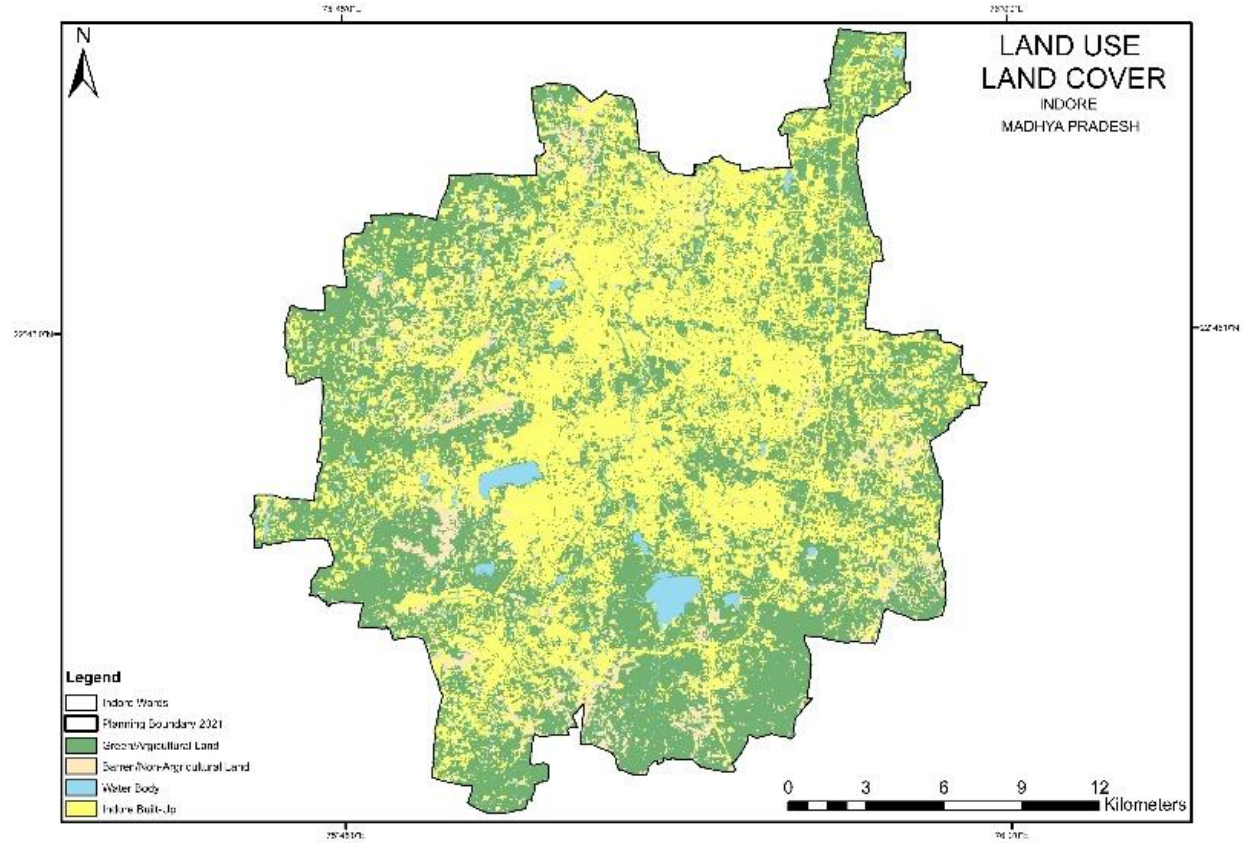


Figure 14: LULC map

3.9.7. Summary of Findings

The LULC analysis clearly demonstrates that Indore is undergoing rapid urban transformation characterized by expansion of built-up areas, reduction in agricultural land, and the emergence of dispersed growth patterns. The shift from a compact to a radial urban form, coupled with ribbon development along transport corridors, highlights the changing dynamics of urban expansion.

These changes have significant implications for land price variation, affordability, and planning interventions. The findings emphasize the need for a structured and predictive approach to urban development that can address the challenges of unplanned growth and ensure sustainable land use management.

CHAPTER 4: DATA COLLECTION AND SURVEY

4.

4.1. Introduction

A comprehensive understanding of the factors influencing real estate prices in the study area was obtained through literature review, field surveys, and secondary data collection. The study identifies various parameters affecting land and property values in Indore city using the Hedonic Pricing Model approach adopted by different researchers. These parameters include Neighborhood characteristics, accessibility factors, infrastructure facilities, environmental conditions, socio-economic variables, and property attributes.

The data collection process was designed to examine the relationship between urban development and variations in land values across selected areas of Indore city. Both primary and secondary data sources were utilized to ensure reliability and accuracy in the analysis. The identified parameters and survey variables used for the study are discussed in the following sections and tables.

4.2. Process of Data Collection

The data collection process for the present study was carried out systematically to analyze the factors affecting real estate prices and land value variations in Indore city. Both primary and secondary sources of data were used to obtain comprehensive information related to property prices, infrastructure facilities, accessibility, socio-economic characteristics, and neighborhood conditions. The collected data was further classified, organized, and analyzed for the purpose of the study.

The process of data collection was conducted in two stages. The first stage involved the collection of primary data through field surveys and interactions with respondents, while the second stage focused on gathering secondary data from government reports, planning documents, published literature, and online sources.

4.2.1. Primary Data Collection

Primary data was collected through field surveys conducted in the selected study areas of Indore city, namely Vijay Nagar, Saket Nagar, Nipania, and Sudama Nagar. The survey was carried out to understand the variations in land values and identify the major factors influencing property prices in different income group areas.

Structured questionnaires and personal interactions were used for collecting information from residents, property dealers, local shop owners, and real estate stakeholders. The survey included questions related to property prices, accessibility, infrastructure availability, transportation facilities, environmental quality, neighborhood characteristics, commercial development, and public services.

The data regarding actual market rates of land and properties was collected through direct interactions with brokers, builders, property owners, and professional valuers operating in the selected study areas. These interactions helped in obtaining realistic and prevailing market values for residential and commercial properties.

Field observations were also conducted to examine the physical conditions of the study areas, road connectivity, land use patterns, surrounding amenities, and ongoing urban development activities. The collected primary data helped in understanding the local real estate market conditions and the perception of residents regarding land value appreciation.

4.2.2. Secondary Data Collection

Secondary data for the study was collected from various published and unpublished sources. The data was obtained from government departments, Indore Development Authority (IDA), Indore Municipal Corporation (IMC), Census of India reports, master plans, research papers, journals, books, websites, and planning documents.

Secondary information included demographic details, land use data, infrastructure development reports, road network information, population statistics, transportation data, guideline values, and historical property price trends. Satellite imagery, maps, and GIS-based spatial data were also referred to for understanding the spatial growth and urban expansion of the city.

The secondary data supported the primary survey findings and provided a broader understanding of urban growth patterns, infrastructure development, and real estate trends in Indore city. Both primary and secondary data were integrated for further analysis and interpretation in the study.

4.3. Details of Survey Respondents in Selected Study Areas

A total of 20 successful survey responses were collected from each selected study area, namely Vijay Nagar, Saket Nagar, Nipania, and Sudama Nagar, resulting in a total sample size of 80 surveys for the study.

During the field survey process, additional respondents were approached in each area to achieve the required number of valid responses, as some individuals were unwilling to participate in the survey. In Vijay Nagar, approximately 28 respondents were approached, out of which 20 respondents agreed to participate while 8 respondents declined. In Saket Nagar, around 24 respondents were contacted, among which 20 respondents provided valid survey responses. Similarly, in Nipania, nearly 32 individuals were approached, and 20 respondents agreed to participate in the survey and provide the required information. In Sudama Nagar, approximately 25 respondents were contacted, out of which 20 respondents participated successfully in the survey process.

The respondents included residents, brokers, builders, property owners, valuers, and local stakeholders associated with the real estate sector. The survey process helped in collecting detailed information regarding market rates, infrastructure facilities, accessibility, neighborhood conditions, and other factors influencing land values in the selected study areas.

S. No.	Study Area	Total Respondents Approached	Valid Survey Responses Collected	Respondents Declined
1	Vijay Nagar	28	20	8
2	Saket Nagar	24	20	4
3	Nipania	32	20	12
4	Sudama Nagar	25	20	5
	Total	109	80	29

Table 7: Respondent of selected area

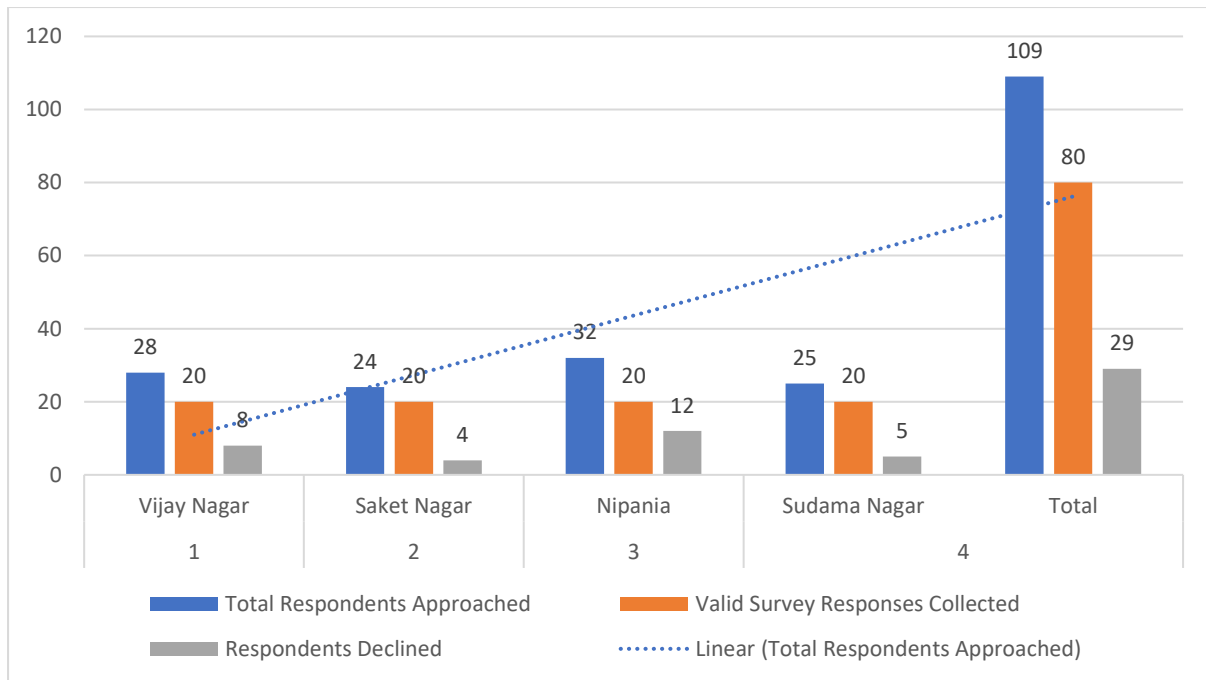


Figure 15: Chart representing the respondents

4.4. Questionnaire Survey

1. Name of Respondent (Optional): _____
2. Type of Respondent:
 - ☐ Broker
 - ☐ Builder
 - ☐ Property Owner
 - ☐ Valuer
 - ☐ Resident
 - ☐ Other _____
3. Contact Number (Optional): _____
4. Type of Property:
 - ☐ Residential Plot
 - ☐ Flat/Apartment
 - ☐ Independent House
 - ☐ Commercial Plot
 - ☐ Commercial Shop
 - ☐ Other _____
5. Approximate Size of Property/Plot:

_____ sq.ft / sq.m
6. What is the current actual market rate of land/property in this area?

₹ _____ per sq.ft / per sq.m

7. What was the approximate market rate 5 years ago?
₹ _____ per sq.ft / per sq.m
8. According to you, how much has the property value increased in recent years?
☐ Less than 10%
☐ 10% – 25%
☐ 25% – 50%
☐ More than 50%
9. What is the government guideline value in this area?
₹ _____ per sq.ft / per sq.m
10. What is the average selling price generally demanded by owners/builders?
₹ _____ per sq.ft / per sq.m
11. What are the major factors increasing property prices in this area?
☐ Road Connectivity
☐ Metro Project
☐ Commercial Development
☐ Infrastructure Facilities
☐ Educational Institutions
☐ IT/Industrial Growth
☐ Better Neighborhood
☐ Other _____
12. Who are the major buyers in this area?
☐ Investors
☐ End Users
☐ Builders
☐ Business Owners
13. Do you expect property prices to increase further in the next 5 years?
☐ Yes
☐ No
☐ Maybe
14. Any suggestions or observations regarding land prices and real estate growth in this area:

4.5. Parameters Considered for Land Price Analysis

The value of urban land and residential properties is influenced by multiple physical, socio-economic, infrastructural, environmental, and locational factors. In order to understand the variation in land prices within the selected HIG and MIG residential areas of Indore city, several important parameters were identified and analyzed during the study. These parameters were selected based on literature review, questionnaire surveys, FDG and real estate market characteristics. The selected variables help in understanding the relationship between urban development and real estate price variation across different study areas.

One of the major parameters considered in the study was location and accessibility. Properties located near major roads, highways, commercial centers, educational institutions, healthcare facilities, and transportation corridors generally possess higher market value due to improved accessibility and connectivity. Areas such as Vijay Nagar and Saket Nagar showed higher land prices because of their strategic location and better road infrastructure.

Infrastructure facilities were also considered as an important parameter affecting land value. Availability of water supply, drainage systems, electricity, paved roads, street lighting, public transport, and civic amenities significantly influence residential attractiveness and property demand. Well-developed infrastructure contributes toward appreciation of land values and encourages real estate investment in urban areas.

Another important parameter included in the study was neighborhood quality and environmental condition. Clean surroundings, open spaces, green areas, low pollution levels, and organized residential environments positively influence property prices. HIG residential areas generally showed better neighborhood conditions compared to MIG areas, resulting in noticeable differences in market rates.

Socio-economic characteristics such as income group, population density, affordability level, occupation patterns, and lifestyle preferences were also considered during the analysis. HIG areas usually attract high-income populations seeking premium housing and modern amenities, whereas MIG areas mainly consist of middle-income households looking for affordable residential options. These socio-economic differences create variation in housing demand and land values within the city.

The study also considered commercial and infrastructural development as an important factor influencing land price appreciation. Areas experiencing rapid commercial growth, metro

proposals, IT sector development, shopping complexes, and institutional expansion generally witness higher real estate demand and investment potential.

Additionally, government guideline values, prevailing market rates, future development potential, and transportation connectivity were analyzed to understand their impact on land price variation in different study areas. These parameters collectively helped in evaluating the spatial dynamics of the real estate market and identifying the factors responsible for land value appreciation in Indore city.

Parameters	Description
Location Accessibility	Proximity to major roads, highways, commercial centers, and public facilities influencing property value.
Road Connectivity	Availability and quality of internal roads, arterial roads, and transportation networks.
Infrastructure Facilities	Availability of water supply, drainage, electricity, street lighting, and public services.
Commercial Development	Presence of malls, markets, offices, and commercial activities affecting land demand.
Population Density	Concentration of population and level of urbanization in the area.
Land Use Characteristics	Existing land use pattern such as residential, commercial, mixed-use, or institutional development.
Market Demand	Current demand for residential and commercial properties in the area.
Government Guideline Value	Official land value prescribed by government authorities for registration purposes.
Actual Market Rate	Prevailing property rate collected through brokers, builders, owners, and valuers.
Future Development Potential	Impact of upcoming infrastructure projects, metro development, and urban expansion.

Table 8: Parameters considered for analysis

4.6. Data Processing and Classification

After the completion of primary and secondary data collection, the collected information was systematically processed, organized, and classified for further analysis. Data processing was carried out to improve accuracy, remove inconsistencies, and prepare the dataset for statistical and spatial analysis. Since the study involved multiple sources of information, proper classification and standardization of data were necessary for obtaining reliable results.

The first stage of data processing involved **data cleaning and verification**. Survey responses collected from different study areas were checked carefully to identify incomplete entries, inconsistent responses, duplicate information, and outlier values. Some responses were excluded from analysis due to lack of sufficient information or unrealistic market values that

significantly deviated from prevailing market trends. Only valid and reliable survey responses were considered for final analysis.

The collected data was then classified into different categories based on study area, property type, income group classification, infrastructure condition, and market characteristics. Residential areas such as Vijay Nagar and Saket Nagar were primarily categorized under High Income Group (HIG) areas, while Nipania and Sudama Nagar were analyzed under Middle Income Group (MIG) and mixed residential categories. This classification helped in comparing land price behavior and housing characteristics among different socio-economic groups.

The market rate data collected from brokers, builders, owners, and valuers was standardized into common units such as price per square foot and price per square meter for easy comparison and analysis. Government guideline values and actual market rates were separately tabulated to understand the variation between official valuation and prevailing market conditions.

Tabulation and coding of survey responses were also performed using spreadsheet techniques. The processed data was organized into tables, charts, graphs, and statistical formats for further interpretation. Spatial classification of study areas based on accessibility, infrastructure, and neighborhood conditions was also carried out to support comparative analysis.

The processed dataset formed the basis for applying analytical methods such as trend analysis, affordability assessment, comparative analysis, and land price prediction models used in the study. Proper data processing and classification improved the accuracy and reliability of the overall research findings.

4.7. Tools and Techniques Used

Various tools and techniques were used in the study for data collection, processing, spatial analysis, statistical interpretation, and land price forecasting. The use of these tools helped in conducting systematic analysis and improving the reliability of the research findings.

MS Office software, particularly Microsoft Excel and Microsoft Word, was used for data entry, tabulation, preparation of charts, graphs, tables, and documentation of the study. Excel was used for organizing survey responses, market rate data, and statistical calculations, while Word was used for report preparation and formatting of the thesis document.

Geographic Information System (GIS) techniques were used for spatial analysis and preparation of thematic maps related to the study areas. GIS helped in understanding spatial variation in land values, accessibility conditions, urban growth patterns, and infrastructure

distribution within Indore city. The software also assisted in visualization and mapping of selected HIG and MIG residential areas.

Google Earth was used for satellite image interpretation, location analysis, and understanding land use characteristics of the selected study areas. It helped in identifying road connectivity, surrounding infrastructure, urban expansion patterns, and physical characteristics of different residential locations within the city.

Statistical Package for Social Sciences (SPSS) software was used for statistical analysis and processing of the collected survey data. SPSS assisted in organizing, classifying, and analyzing the primary and secondary datasets related to land prices and real estate market conditions.

The ARIMA (Auto Regressive Integrated Moving Average) Model available within SPSS software was used for time series analysis and forecasting of future land price trends. The model was applied using historical market rate data collected from the selected study areas to analyze growth patterns, fluctuations, and future appreciation trends in land values. The use of ARIMA helped in predicting future real estate market behavior and understanding long-term land price trends within Indore city.

S. No.	Tools / Software Used
1	MS Office (Excel & Word)
2	GIS (Geographic Information System)
3	Google Earth
4	SPSS Software
5	ARIMA Model (in SPSS)

Table 9: Tools and technique used in the study

4.8. Limitations During Survey

During the survey process, several limitations and challenges were encountered while collecting primary data from the selected study areas. One of the major difficulties was obtaining accurate and reliable information regarding actual market rates, as many respondents

were hesitant to disclose property prices and investment details. Some respondents refused to participate in the survey, while a few provided incomplete or inconsistent information.

Variations in market rates quoted by brokers, builders, owners, and valuers also created difficulty in identifying standardized property values for analysis. Time constraints and limited accessibility to certain residential areas further affected the survey process. In addition, availability of updated secondary data and official market records was limited in some cases.

Despite these limitations, sufficient valid responses and reliable datasets were collected to carry out the analysis and achieve the objectives of the study effectively.

CHAPTER 5: DATA ANALYSIS

5.

5.1. Introduction

The data analysis for the present study was carried out using SPSS software to examine the variation in land prices and housing affordability within the selected residential areas of Indore city. The analysis was conducted using both primary and secondary datasets collected through questionnaire surveys, field observations, market investigations, and government records. SPSS software provided a systematic platform for organizing, processing, and analyzing the collected data in an efficient and reliable manner.

Initially, descriptive statistical methods were used to summarize and interpret the collected survey data related to land prices, infrastructure facilities, accessibility, neighborhood quality, and socio-economic characteristics of the selected study areas. Statistical measures such as mean, percentage, frequency distribution, and trend comparison were used to understand the variation in property values across HIG and MIG residential areas including Vijay Nagar, Saket Nagar, Nipania, and Sudama Nagar.

The collected market rate data obtained from brokers, builders, property owners, and valuers was carefully analyzed to identify differences between government guideline values and actual market prices prevailing in the city. Comparative analysis was also carried out to understand the influence of infrastructure development, transportation facilities, commercial activities, and urban growth on land value appreciation.

Further, the ARIMA (Auto Regressive Integrated Moving Average) model available in SPSS software was used for forecasting future land price trends based on historical market rate data. The forecasting analysis helped in identifying growth patterns, fluctuations, and future appreciation trends in the selected residential areas. The use of ARIMA improved the understanding of long-term real estate market behavior and assisted in predicting future property value trends within Indore city.

The results obtained from the statistical analysis were represented through tables, charts, graphs, and comparative illustrations for better interpretation and understanding. The use of SPSS software enabled systematic analysis of real estate data and provided meaningful insights regarding urban growth, housing affordability, and land price dynamics in Indore city.

5.2. Area-wise Land Price Trend Analysis

This section presents a detailed analysis of the historical trend of government guideline values and actual market rates in the selected study areas of Indore city. The analysis has been carried out for the period from 2016 to 2025 in order to understand the pattern of land value appreciation, market fluctuations, and the influence of infrastructure and urban development on real estate growth. The selected areas include Vijay Nagar, Saket Nagar, Nipania, and Sudama Nagar, representing both high-income and middle-income residential categories.

The comparison between government rates and actual market rates helps in identifying the gap between official valuation and real market behavior. Government guideline values represent the officially notified minimum land values used for property registration purposes, whereas market rates indicate the actual transaction values observed through field surveys and stakeholder interactions. The variation between these two values reflects the influence of demand, location advantages, accessibility, infrastructure availability, and investment potential.

The trend analysis further helps in understanding the spatial variation of land prices within the city and highlights the impact of urban expansion and economic development on different residential zones. The selected areas show different growth characteristics based on their stage of development, connectivity, surrounding land use, and socio-economic profile. High-income areas such as Vijay Nagar and Saket Nagar exhibit comparatively higher land appreciation due to commercial growth, premium residential demand, and better infrastructure facilities. On the other hand, emerging and middle-income areas such as Nipania and Sudama Nagar demonstrate moderate but stable growth patterns influenced by affordability and gradual urban expansion.

The year-wise analysis also reflects the impact of market fluctuations on property prices. A temporary decline in land values can be observed around 2019 in most areas, indicating the influence of economic slowdown and reduced market activity during that period. However, post-2022 trends indicate strong recovery and increasing land appreciation due to renewed investment, infrastructure projects, urban growth, and rising housing demand within Indore city.

The analysis of historical land values forms the foundation for future forecasting using the ARIMA model. By understanding past trends and growth behavior, the study establishes a reliable basis for predicting future land price movements and evaluating the future investment

potential of the selected areas. The following sub-sections provide a detailed area-wise analysis of government rates, market rates, observed trends, growth patterns, and forecasting outcomes for each selected study area.

5.2.1. Vijay Nagar

Vijay Nagar is one of the most developed and commercially significant areas of Indore city. The area has emerged as a major residential, institutional, and commercial hub due to its strategic location, excellent road connectivity, and concentration of urban activities. The presence of shopping complexes, educational institutions, corporate offices, hospitals, hotels, and entertainment centers has significantly contributed to the increase in land values over time. The area is well connected through major arterial roads and experiences high real estate demand from both residential buyers and investors.

The analysis of government guideline values and actual market rates from 2016 to 2025 indicates a strong upward trend in land prices within the area. During the period from 2016 to 2018, the government rates remained relatively stable at approximately ₹80,000 per sq.m., while the market rates remained around ₹100,000 per sq.m. This stability reflects balanced market conditions and steady investment demand during the period. However, a noticeable decline in both government and market values was observed during 2019, where government rates reduced to nearly ₹64,000 per sq.m. and market rates dropped to approximately ₹92,000 per sq.m. This decline may be associated with the overall slowdown in the real estate sector, reduced transaction activities, and economic uncertainty during that period.

After 2020, the area gradually recovered and witnessed continuous appreciation in land values. From 2022 onwards, a significant increase in both government and market rates can be observed, indicating renewed investor confidence, rapid infrastructure development, and increasing commercial importance of the area. By 2025, the government rate reached approximately ₹107,000 per sq.m., while the market rate increased to nearly ₹126,978 per sq.m. The widening difference between official and market rates reflects the premium nature of the locality and high speculative investment demand.

The ARIMA forecasting analysis indicates that Vijay Nagar is expected to continue its upward growth trend in the coming years. The forecasted market rate for 2030 is estimated to reach approximately ₹152,147 per sq.m., indicating sustained appreciation due to increasing urbanization and infrastructure expansion. The high R^2 value obtained from the forecasting model suggests strong model reliability and stable market behavior within the area. Overall,

Vijay Nagar demonstrates very high investment potential and represents one of the strongest real estate markets within Indore city.

5.2.1.1. Historic data evaluation

Year	Govt Rate (₹/sq.m.)	Market Rate (₹/sq.m.)	Difference (%)
2016	80,000	100,000	25
2017	80,000	100,000	25
2018	80,000	100,000	25
2019	64,000	92,000	43.75
2020	68,000	96,000	41.17
2021	68,000	102,000	50
2022	83,000	106,000	27.71
2023	83,000	112,000	34.93
2024	83,000	122,000	46.98
2025	107,000	126,978	18.67

Table 10:Historical Land Value Trend of Vijay Nagar (2016–2025)

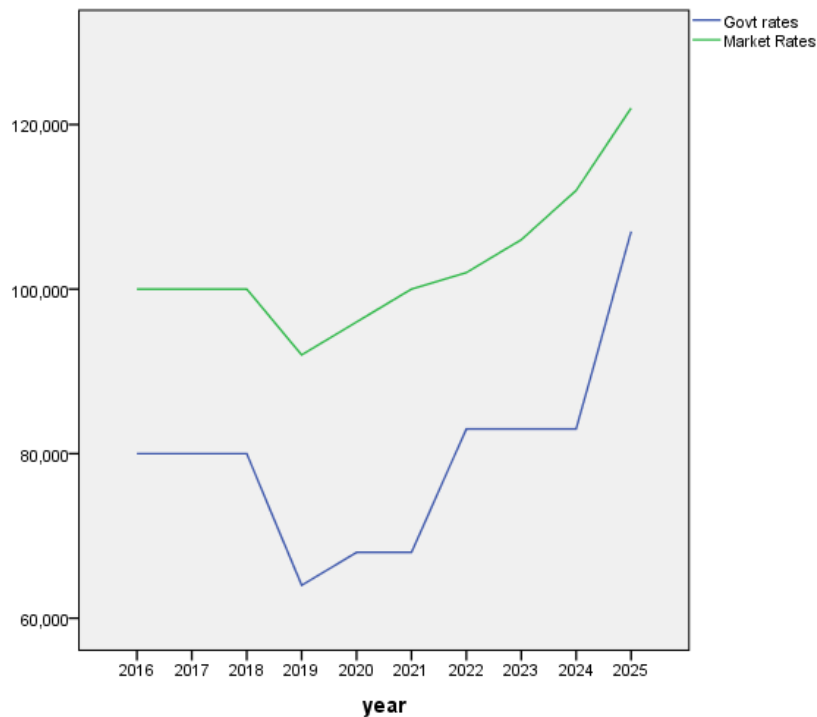


Figure 16:Historic Trend Analysis of Govt and Market Rates in Vijay Nagar

5.2.1.2. Key Observation

Parameter	Observation
Area Category	High Income Group (HIG)
Nature of Development	Commercial + Residential
Stable Period	2016–2018
Decline Year	2019
Recovery Phase	2022 onwards
Highest Govt Rate	₹107,000
Highest Market Rate	₹126,978
Growth Nature	Strong Upward Trend
Investment Potential	Very High
Major Growth Drivers	Commercialization, accessibility, infrastructure

Table 11: Key Observations from Land Value Analysis

5.2.1.3. Forecasted data

Year	Forecast Govt Rate	Forecast Market Rate
2026	110,048	130,379
2027	115,516	136,036
2028	121,028	141,425
2029	126,541	146,787
2030	132,053	152,147

Table 12: Forecasted Land Values of Vijay Nagar (2026–2030)

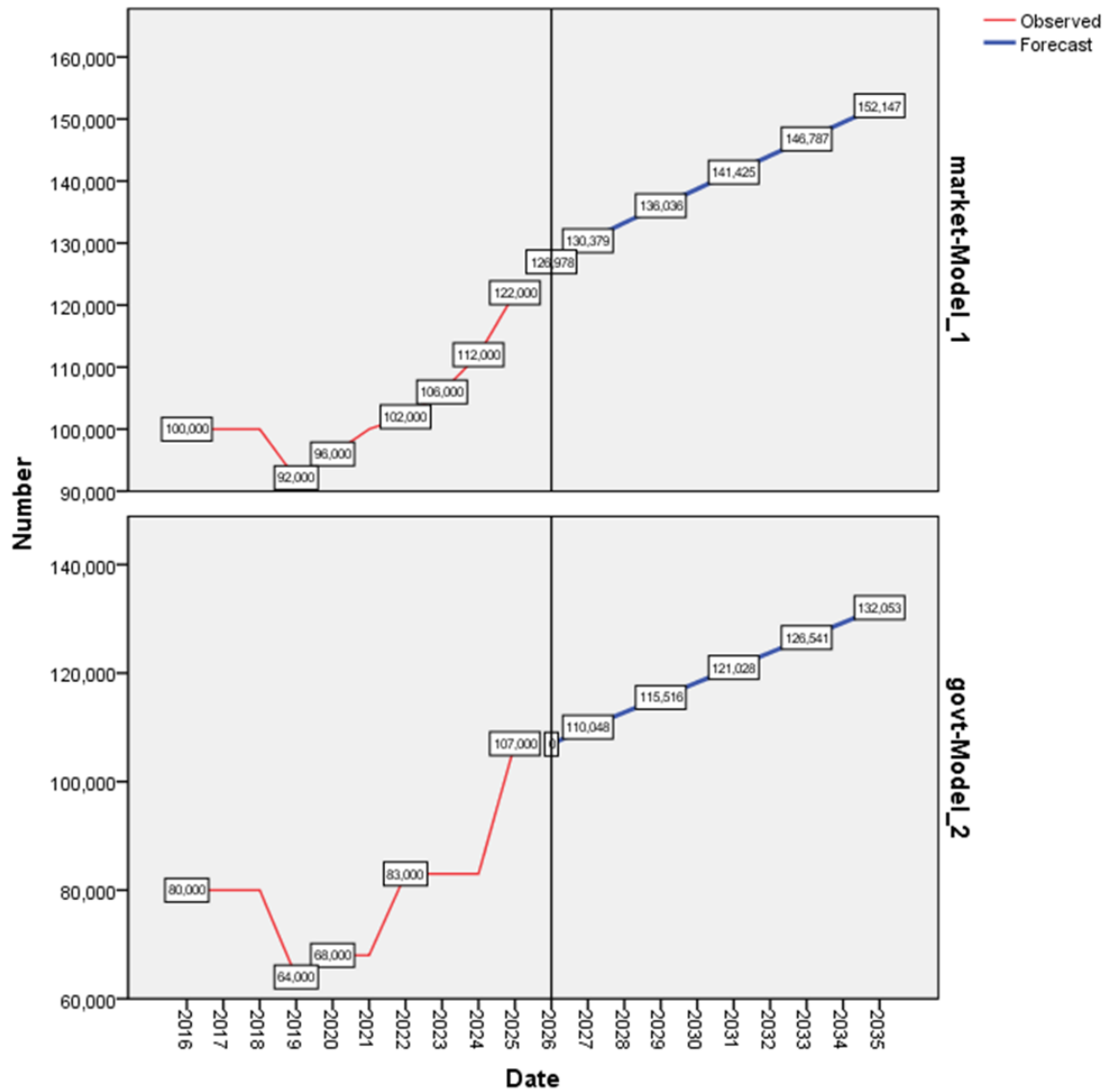


Figure 17: Chart Representing Forecasted Land Values of Vijay Nagar (2026–2030)

5.2.1.4. Model Performance

Model	R ²	Stationary R ²	RMSE
ARIMA(1,1,0)	0.93	0.81	Low

Table 13: ARIMA Model Performance for Vijay Nagar

5.2.2. Saket Nagar

Saket Nagar is one of the prominent high-income residential areas of Indore city known for its organized urban development, premium residential environment, and strong infrastructural facilities. The area has experienced significant real estate growth due to its strategic location, excellent connectivity, and proximity to major commercial, institutional, and healthcare centers. The presence of quality residential colonies, educational institutions, shopping facilities, and improved transportation networks has contributed to continuous land value appreciation within the locality. Saket Nagar primarily attracts upper-middle and high-income population groups and is considered one of the stable residential investment zones of the city.

5.2.2.1. Historic Land Value

Year	Govt Rate (₹/sq.m.)	Market Rate (₹/sq.m.)	Difference (%)
2016	85,000	98,000	15.29
2017	85,000	98,000	15.29
2018	85,000	98,000	15.29
2019	68,000	94,000	38.24
2020	72,000	99,000	37.50
2021	72,000	100,000	38.89
2022	79,000	102,000	29.11
2023	79,000	104,000	31.65
2024	93,000	110,000	18.28
2025	103,000	119,000	15.53

Table 14 :Historical Land Value Trend of Saket Nagar (2016–2025)

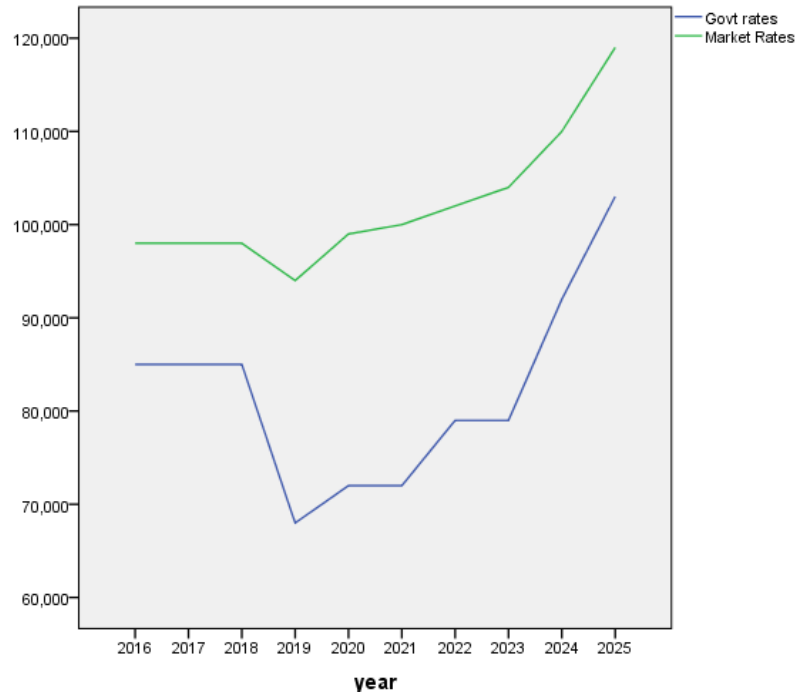


Figure 18: Chart Representing Historic Trend Analysis of Saket Nagar

5.2.2.2. Key Observation

Parameter	Observation
Area Category	High Income Group (HIG)
Nature of Development	Premium Residential
Stable Period	2016–2018
Decline Year	2019
Recovery Phase	2020 onwards
Highest Govt Rate	₹103,000
Highest Market Rate	₹119,000
Growth Nature	Stable Upward Growth

Table 15: Key Observations from Land Value Analysis of Saket Nagar

5.2.2.3. Forecasted Data

Year	Forecast Govt Rate (₹)	Forecast Market Rate (₹)
2026	108,115	123,430
2027	112,288	126,511

Year	Forecast Govt Rate (₹)	Forecast Market Rate (₹)
2028	116,451	129,194
2029	120,614	131,759
2030	124,777	136,811

Table 16: Forecasted Land Values of Saket Nagar (2026–2030)

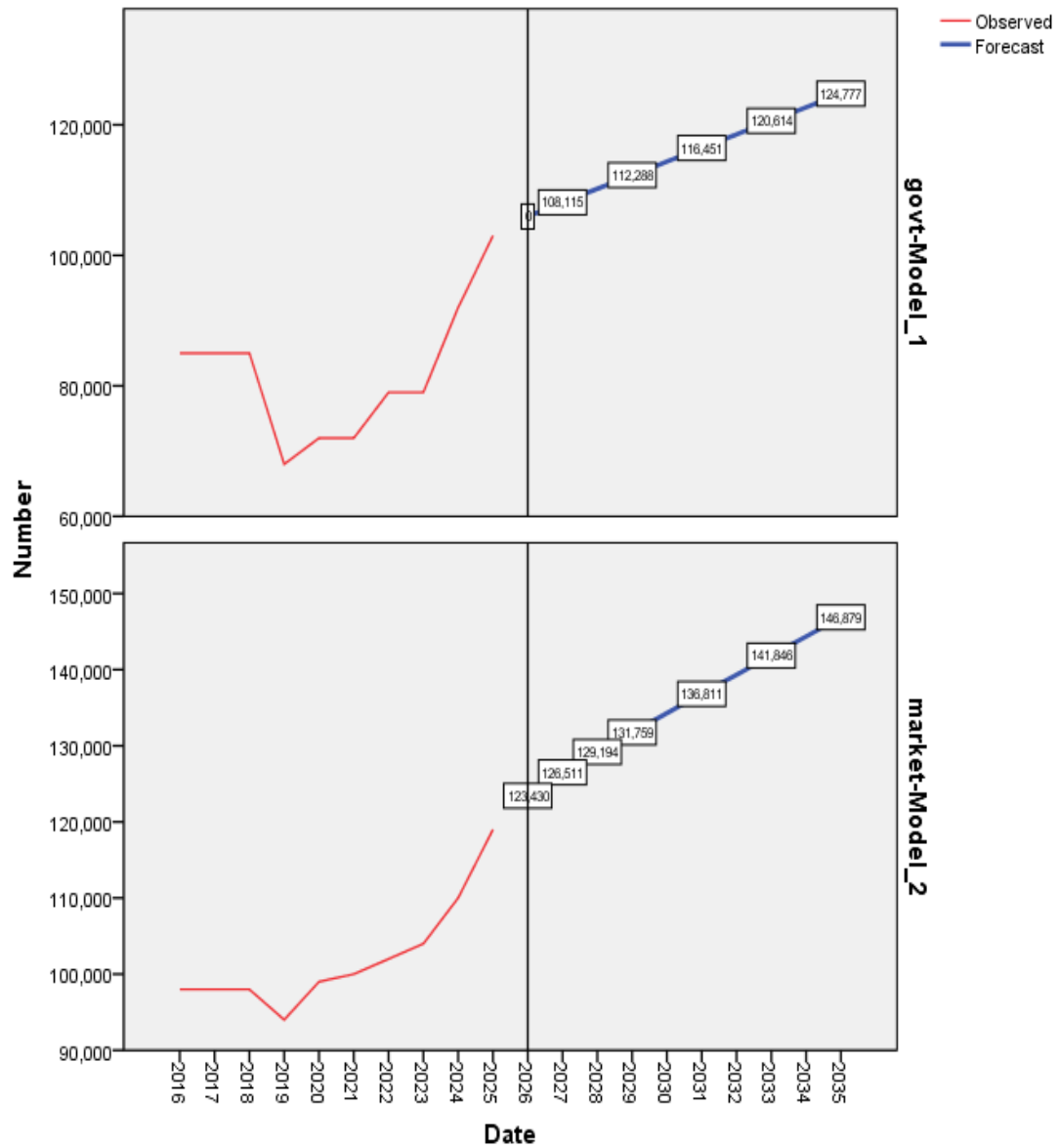


Figure 19: Chart Representing forecasted data (2026-2030)

5.2.2.4. Model Performance

Model	R ²	Stationary R ²	RMSE
ARIMA(1,1,0)	0.91	0.78	Low

Table 17: Arima Performance for Saket Nagar

5.2.3. Sudama Nagar

Sudama Nagar is one of the important middle-income residential areas of Indore city characterized by affordable housing, stable residential demand, and organized neighborhood development. The area has gradually developed as a prominent residential zone due to availability of comparatively affordable land, good internal road connectivity, local commercial activities, and access to essential public services. Sudama Nagar mainly accommodates middle-income population groups and represents a comparatively stable and balanced residential real estate market within the city.

The area has experienced moderate urban growth over the years with increasing residential development, infrastructure improvement, and expansion of local commercial facilities. Compared to premium localities such as Vijay Nagar and Saket Nagar, land values in Sudama Nagar remain relatively lower, making the area suitable for affordable residential investment and middle-income housing development. The locality demonstrates comparatively lower speculative investment and more end-user-driven market behavior.

5.2.3.1. Historic Land Value

Year	Govt Rate (₹/sq.m.)	Market Rate (₹/sq.m.)	Difference (%)
2016	39,000	43,000	10.26
2017	39,000	43,000	10.26
2018	39,000	43,000	10.26
2019	31,000	36,000	16.13
2020	34,000	39,000	14.71
2021	34,000	42,000	23.53
2022	42,000	46,000	9.52

Year	Govt Rate (₹/sq.m.)	Market Rate (₹/sq.m.)	Difference (%)
2023	42,000	50,000	19.05
2024	42,000	55,000	30.95
2025	48,000	59,000	22.92

Table 18: Historical Land Value Trend of Sudama Nagar (2016–2025)

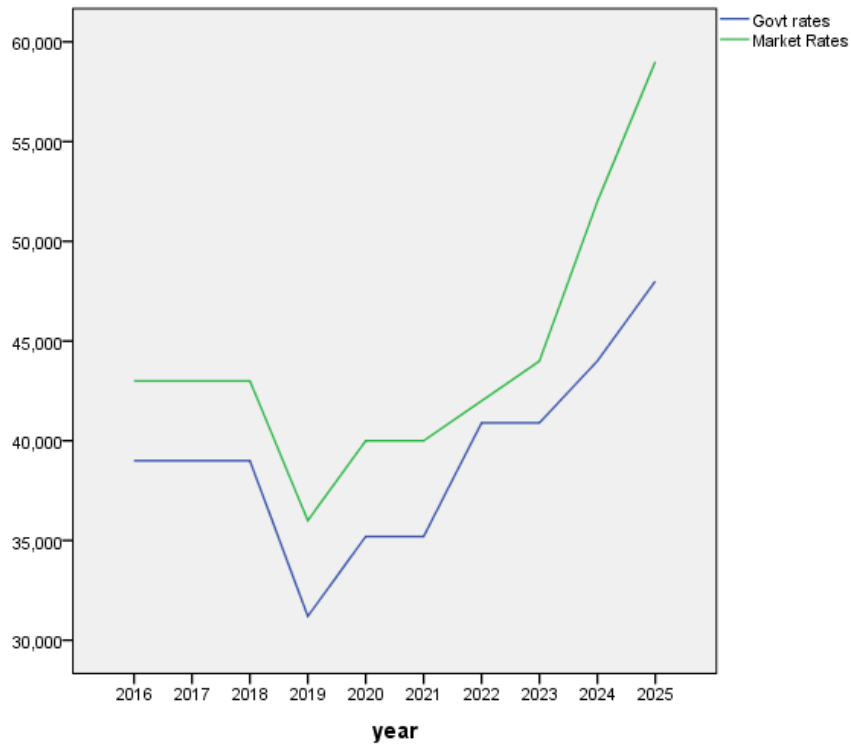


Figure 20: Chart representing Historical Land Value Trend of Sudama Nagar (2016–2025)

5.2.3.2. Key Observation

Parameter	Observation
Area Category	Middle Income Group (MIG)
Nature of Development	Residential
Stable Period	2016–2018
Decline Year	2019
Recovery Phase	2020 onwards
Highest Govt Rate	₹48,000

Parameter	Observation
Highest Market Rate	₹59,000
Growth Nature	Moderate and Stable
Investment Potential	Moderate
Major Growth Drivers	Affordable housing, infrastructure, accessibility
Market Character	End-user oriented and stable

Table 19:Key Observations from Land Value Analysis of Sudama Nagar

5.2.3.3. Forecasted Data

Year	Forecast Govt Rate (₹)	Forecast Market Rate (₹)
2026	50,476	61,188
2027	53,051	63,945
2028	55,625	66,108
2029	58,200	68,466
2030	60,774	70,825

Table 20:Forecasted Land Values of Sudama Nagar (2026–2030)

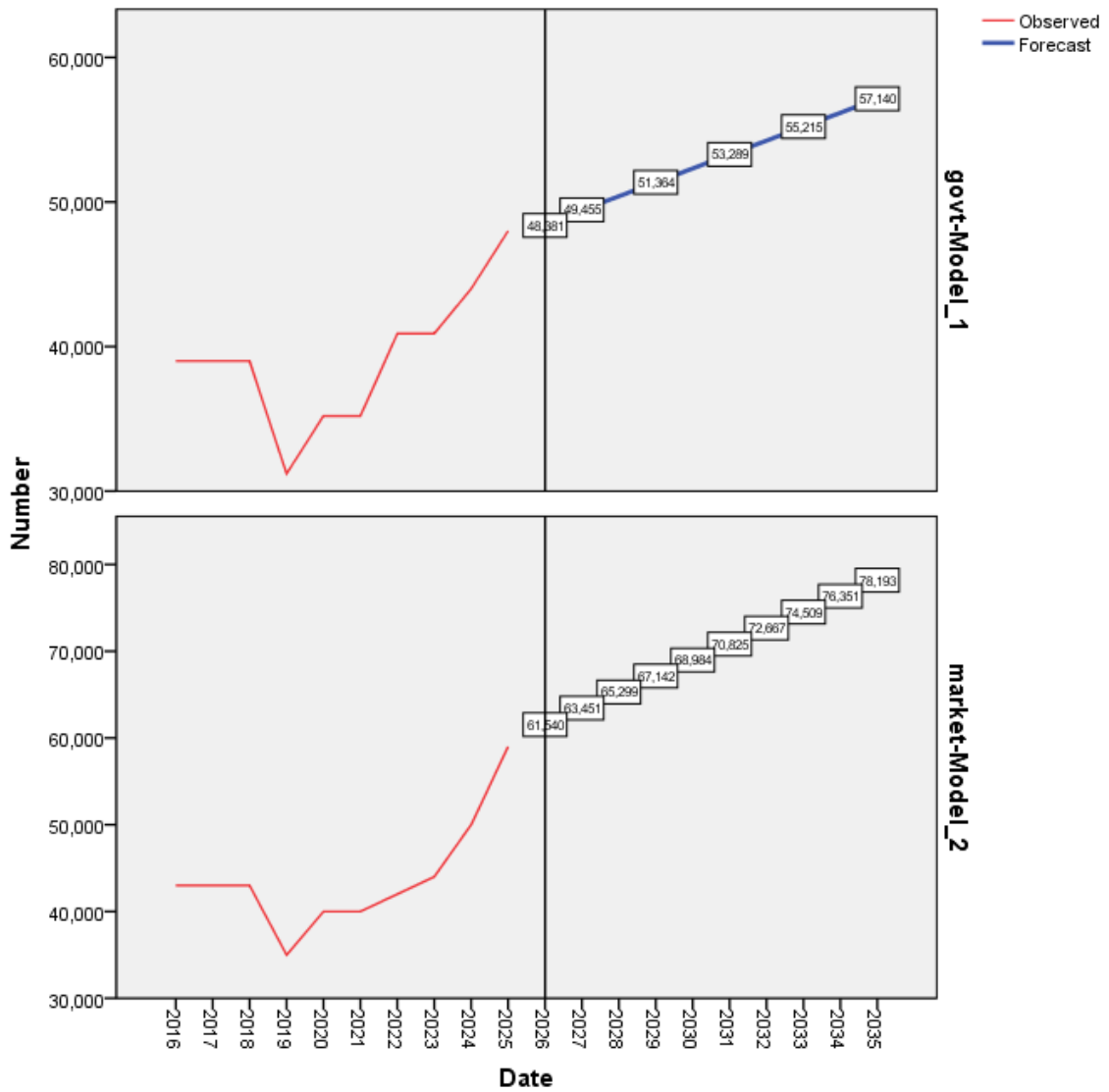


Figure 21: Chart representing Forecasted Land Values of Sudama Nagar (2026–2030)

5.2.3.4. Model Performance

Model	R ²	Stationary R ²	RMSE
ARIMA (1,1,0)	0.88	0.74	Moderate

Table 21: ARIMA Model Performance for Sudama Nagar

5.2.4. Nipania

Nipania is one of the fastest-growing emerging residential areas of Indore city located along the eastern urban growth corridor. Over the past decade, the area has witnessed rapid urban expansion due to increasing infrastructure development, improved road connectivity, and rising real estate investment activities. The locality has gradually transformed from a peripheral urban

zone into an important residential and mixed-use development corridor attracting both developers and investors.

The area has gained significant importance because of its proximity to major transportation corridors, commercial developments, educational institutions, and newly developing residential townships. The availability of comparatively larger land parcels and expanding urban infrastructure has encouraged the development of apartments, gated communities, commercial complexes, and integrated residential projects within the area. Compared to established premium areas such as Vijay Nagar and Saket Nagar, Nipania demonstrates comparatively lower current land values but significantly higher future growth potential due to rapid urbanization and infrastructure expansion.

5.2.4.1. Historical Land Value

Year	Govt Rate (₹/sq.m.)	Market Rate (₹/sq.m.)	Difference (%)
2016	35,000	37,000	5.71
2017	35,000	37,000	5.71
2018	35,000	37,000	5.71
2019	28,000	32,000	14.29
2020	31,000	35,000	12.90
2021	31,000	38,000	22.58
2022	40,000	45,000	12.50
2023	40,000	50,000	25.00
2024	47,000	56,000	19.15
2025	53,000	62,000	16.98

Table 22: Historical Land Value Trend of Nipania (2016–2025)

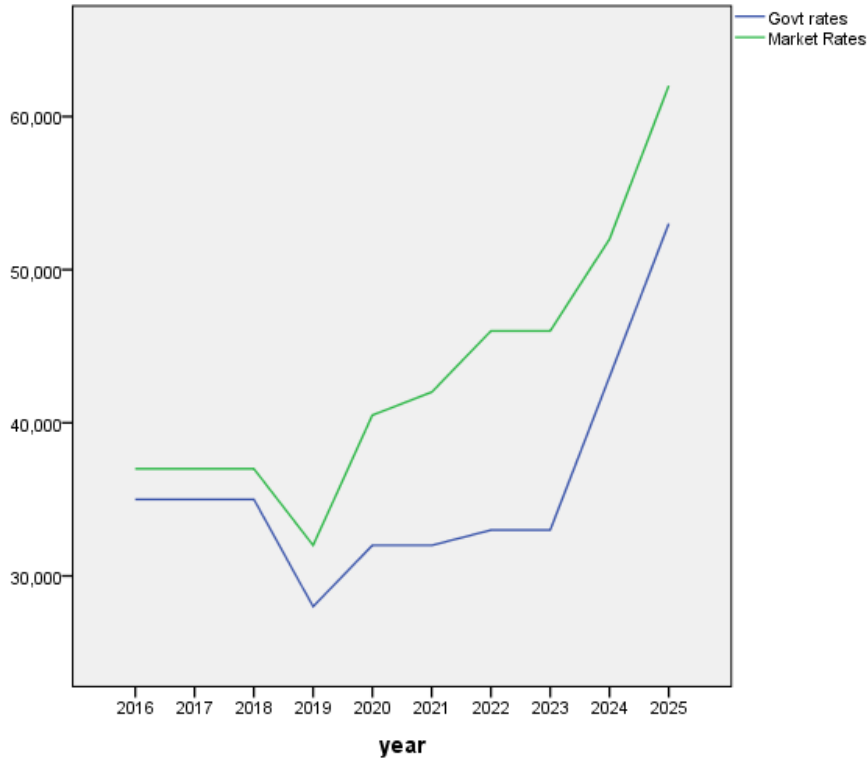


Figure 22: Chart Representing Historical Land Value Trend of Nipania (2016–2025)

5.2.4.2. Key Observation

Parameter	Observation
Area Category	Emerging HIG/MIG Residential Area
Nature of Development	Mixed Residential and Commercial
Stable Period	2016–2018
Decline Year	2019
Recovery Phase	2020 onwards
Highest Govt Rate	₹53,000
Highest Market Rate	₹62,000
Growth Nature	Rapid and Emerging
Investment Potential	Very High
Major Growth Drivers	Urban expansion, infrastructure, connectivity
Market Character	Emerging investment-oriented market

Table 23: Key Observations from Land Value Analysis of Nipania

5.2.4.3. Forecasted data

Year	Forecast Govt Rate (₹)	Forecast Market Rate (₹)
2026	56,812	67,442
2027	60,624	72,018
2028	64,436	77,094
2029	68,248	82,674
2030	72,060	88,255

Table 24: Forecasted Land Values of Nipania (2026–2030)

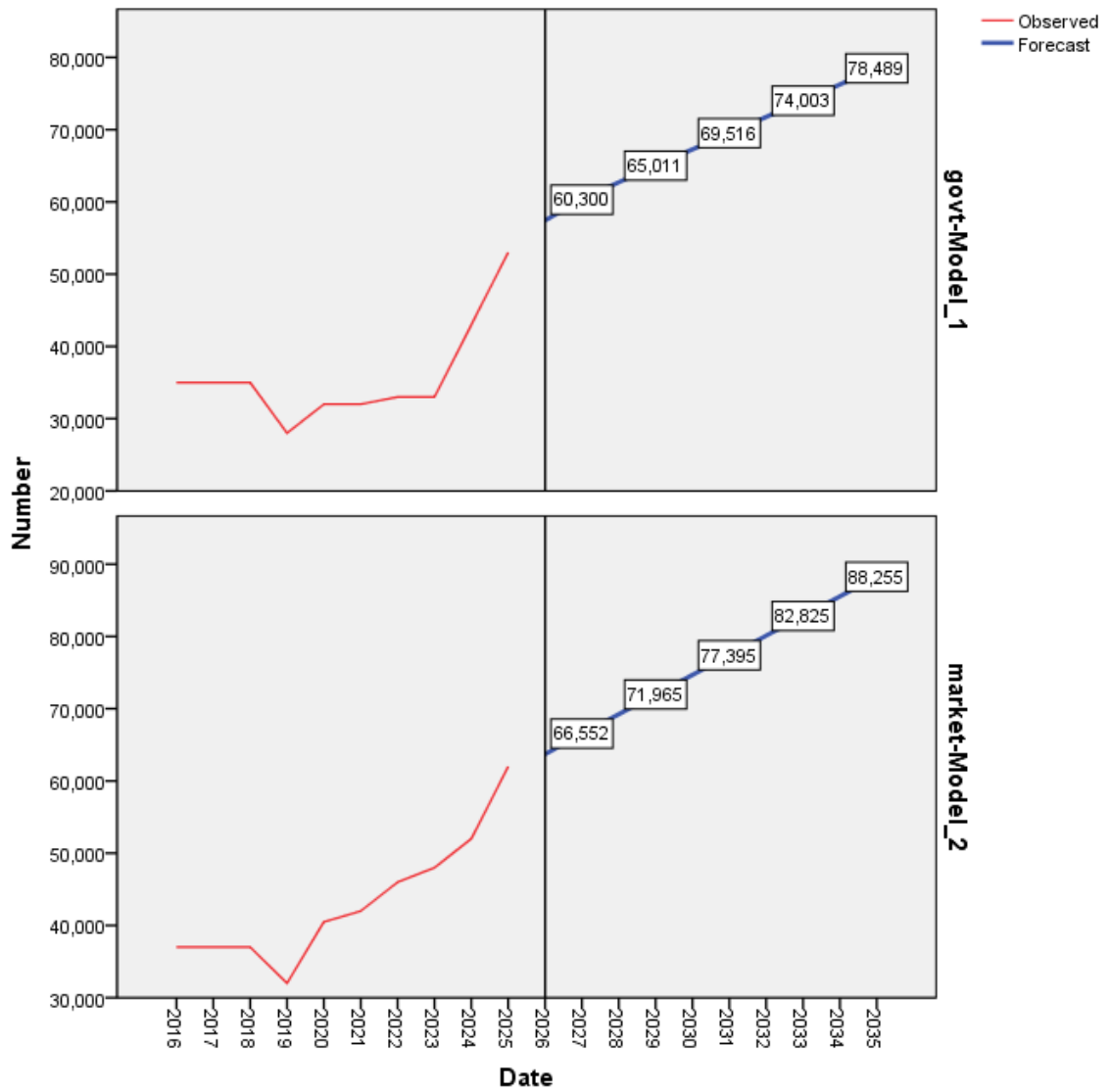


Figure 23: Chart representing Forecasted Land Values of Nipania (2026–2030)

5.2.4.4. Model Performance

Model	R ²	Stationary R ²	RMSE
ARIMA (1,1,0)	0.87	0.72	Moderate

Table 25: ARIMA Model Performance for Nipania

5.3. Comparative Analysis

The comparative analysis of the selected study areas was carried out to understand the variation in land values, market behavior, growth trends, and investment potential across different residential zones of Indore city. The comparison helps in identifying the influence of infrastructure development, accessibility, socio-economic characteristics, and urban growth on land price appreciation within High Income Group (HIG) and Middle Income Group (MIG) residential areas.

The selected study areas represent different stages of urban development and residential characteristics within the city. Vijay Nagar and Saket Nagar represent developed high-income residential areas with strong infrastructure facilities, commercial concentration, and premium housing demand. In contrast, Sudama Nagar represents a comparatively stable middle-income residential area characterized by affordable housing and moderate land value appreciation. Nipania represents an emerging urban growth corridor experiencing rapid infrastructural development, increasing real estate investment, and rising future growth potential.

The comparison between developed and emerging areas highlights the relationship between urban expansion and real estate market behavior. Developed areas generally exhibit higher land values, stable market conditions, and strong investment demand due to better infrastructure and commercial activities. On the other hand, emerging areas demonstrate comparatively lower present land values but higher future appreciation potential because of ongoing infrastructure projects and urban expansion.

The study also compares government guideline values and actual market rates to understand the difference between official land valuation and prevailing market conditions. Government rates represent the minimum property valuation fixed for registration purposes, whereas market rates indicate the actual transaction values observed in the real estate market. The analysis reveals that actual market rates are consistently higher than government guideline values in all selected areas, reflecting increasing demand, investment activity, and speculative market behavior.

The comparative analysis further helps in identifying affordability conditions, investment opportunities, and future growth patterns within different residential zones of Indore city. The findings provide a broader understanding of urban land market dynamics and support future planning and policy-making related to residential development and land value management.

Area	Category	Govt Rate	Market Rate	Growth Nature	Investment Potential
Vijay Nagar	HIG	₹107,000	₹126,978	Very High	Very High
Saket Nagar	HIG	₹103,000	₹119,000	Stable High	High
Nipania	MIG	₹53,000	₹62,000	Rapid Emerging	Very High
Sudama Nagar	MIG	₹48,000	₹59,000	Moderate Stable	Moderate

Figure 24: Comparative Analysis of Selected Study Areas (2025)

5.3.1.1. Comparative Interpretation of Selected Study Areas

The comparative analysis of the selected study areas reveals significant variation in land value trends, market characteristics, affordability conditions, and future investment potential within Indore city. These variations are primarily influenced by differences in infrastructure development, accessibility, commercial activities, socio-economic characteristics, and urban growth patterns.

Among all the selected areas, Vijay Nagar demonstrates the highest absolute land values in both government guideline rates and actual market prices. The area has emerged as one of the most commercially active and infrastructure-rich zones of Indore city. The presence of shopping malls, corporate offices, educational institutions, hospitals, and major transportation corridors has significantly increased real estate demand within the locality. The continuous appreciation in property values reflects strong investor confidence and premium residential demand. The area also exhibits a substantial gap between government and actual market rates, indicating high speculative investment and strong market-driven pricing behavior.

Saket Nagar represents a stable premium residential market characterized by organized urban development, better neighborhood quality, and consistent residential demand. Compared to Vijay Nagar, the area demonstrates slightly lower land values but higher market stability and comparatively lower fluctuations in price trends. The locality primarily attracts upper-middle and high-income residential groups seeking quality living environments and better civic infrastructure. The continuous upward trend in land values indicates long-term investment security and stable residential growth within the area.

Nipania demonstrates the highest future growth potential among all selected study areas. Although the present land values are comparatively lower than developed HIG areas, the locality is experiencing rapid urban expansion and infrastructure development. Increasing residential projects, road connectivity improvements, and commercial investments have accelerated real estate activities within the area. The forecasting analysis indicates that Nipania is expected to witness the highest percentage appreciation in future land values, reflecting its transformation into an emerging urban growth corridor and investment destination.

Sudama Nagar represents the most affordable residential market among the selected areas and mainly caters to middle-income population groups. The area demonstrates comparatively lower land values and moderate appreciation trends due to its residential character and affordability-oriented market structure. Unlike HIG areas, Sudama Nagar shows relatively stable and balanced real estate growth with lower speculative investment activities. The area is more end-user oriented and reflects stable housing demand suitable for middle-income households.

The comparative analysis also highlights that High Income Group (HIG) areas such as Vijay Nagar and Saket Nagar exhibit a larger gap between government guideline values and actual market rates. This gap reflects stronger investment demand, commercial influence, and speculative market behavior within premium urban zones. In contrast, Middle Income Group (MIG) areas such as Sudama Nagar demonstrate comparatively smaller variation between official and market values, indicating more stable and affordability-driven residential market conditions.

Overall, the comparative analysis establishes a strong relationship between infrastructure development, accessibility, socio-economic characteristics, and land value appreciation within Indore city. Developed HIG areas demonstrate higher present land values and investment concentration, whereas emerging and MIG areas exhibit affordability and future growth opportunities.

Land Price Prediction Analysis of HIG & MIG housing: A Case Study for Indore City

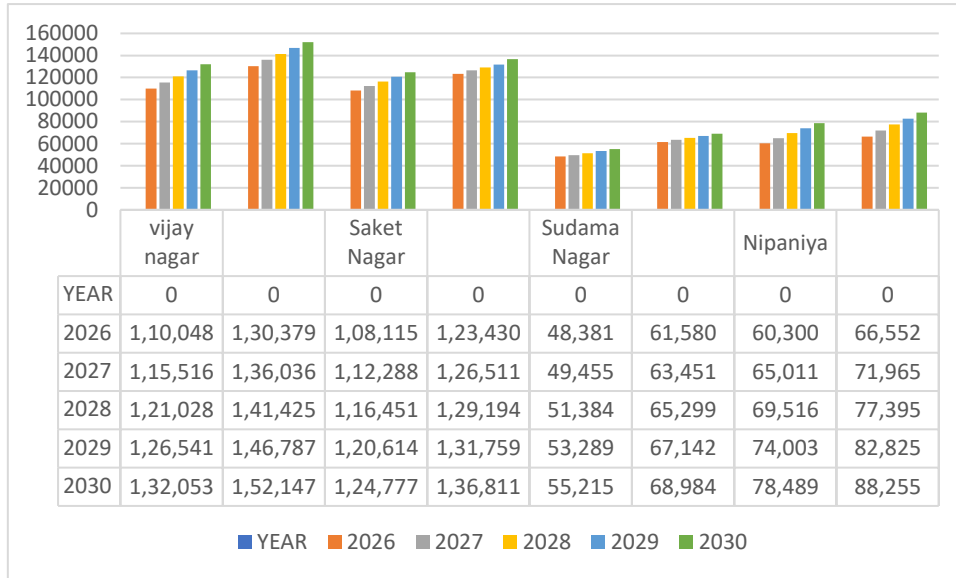


Figure 25: Comparative trend chart analysis

5.3.1.2. Market rates comparison

Area	2025 Market Rate	Forecast 2030
Vijay Nagar	₹126,978	₹152,147
Saket Nagar	₹119,000	₹136,811
Nipania	₹62,000	₹88,255
Sudama Nagar	₹59,000	₹70,825

Table 26: Forecasted market rates 2030

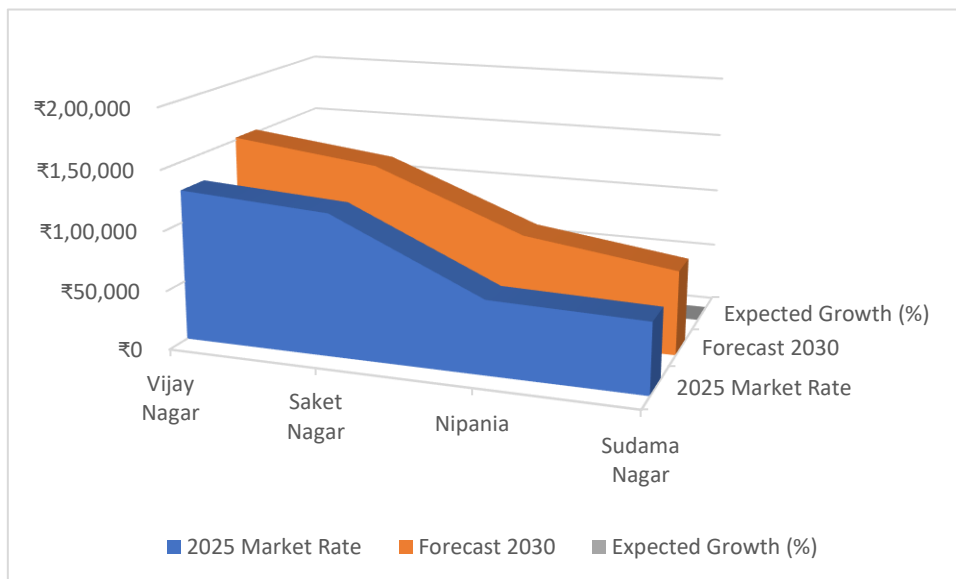


Figure 26: Chart representing forecasted market data

5.3.1.3. ARIMA Model Accuracy Comparison

Area	R ²	Stationary R ²	RMSE
Vijay Nagar	0.93	0.81	Low
Saket Nagar	0.91	0.78	Low
Nipania	0.87	0.72	Moderate
Sudama Nagar	0.88	0.74	Moderate

Table 27: Model Comparison

5.4. Major Findings of the Study

- The present study analyzed land price trends, housing market behavior, and future land value forecasting in selected HIG and MIG residential areas of Indore city using historical market data and ARIMA forecasting techniques. Based on the analysis and interpretation of collected primary and secondary data, the following major findings were identified:
- The study reveals that actual market rates are consistently higher than government guideline values in all selected study areas. This variation indicates the influence of real estate demand, infrastructure development, accessibility, and speculative market behavior on property valuation within Indore city.
- Vijay Nagar demonstrates the highest land values among all selected study areas due to its strong commercial importance, superior infrastructure facilities, excellent connectivity, and concentration of high-value residential and commercial developments. The area reflects strong investment-oriented real estate growth and premium housing demand.
- Saket Nagar exhibits stable and continuously increasing land value trends characterized by organized residential development, better neighborhood quality, and strong residential demand. The area demonstrates comparatively lower market fluctuations and high long-term investment security.
- Nipania shows the highest future growth potential among all selected areas. Rapid urban expansion, increasing infrastructure investment, improving connectivity, and growing residential development activities have significantly accelerated land value appreciation within the locality. The forecasting results indicate strong future real estate growth in the area.

- Sudama Nagar represents a comparatively affordable residential market suitable for middle-income households. The area demonstrates moderate but stable land value appreciation and relatively lower speculative market behavior compared to premium HIG areas.
- Infrastructure development and accessibility were identified as the most significant factors influencing land price appreciation within the study areas. Road connectivity, transportation corridors, commercial centers, educational institutions, and public services directly affect real estate demand and property valuation.
- The analysis indicates that HIG residential areas exhibit a larger gap between government guideline values and actual market rates due to stronger investment demand and commercial influence. In contrast, MIG residential areas show comparatively stable and affordability-oriented market behavior.
- A temporary decline in land values was observed during 2019 across most selected areas, indicating the impact of economic slowdown and reduced real estate transaction activities during that period. However, strong recovery and appreciation trends were observed after 2022.
- The forecasting analysis using the ARIMA model indicates continuous appreciation in future land values across all selected study areas till 2030. The model demonstrates satisfactory forecasting reliability and effectively captures historical growth patterns and future market trends.
- The study establishes a strong relationship between urban growth, infrastructure expansion, socio-economic characteristics, and land value appreciation within Indore city. Areas experiencing rapid urbanization and infrastructure development demonstrate comparatively higher future investment potential and real estate growth.

CHAPTER 6: VALIDATION AND CONCLUSION

6.

6.1. Validation

Validation refers to assessing a model's performance using a predicted dataset that was the output of the forecasted price. Validation serves to evaluate the model's robustness and generalizability, making sure it functions well on both fresh, untested data and the training set.

6.1.1. Validation of price

Year	Actual Market Rate (₹)	Government Rate (₹)	Difference	Percentage Error (%)	Absolute Error
2016	100000	98500	-1500	-1.50	1.50
2017	100000	101200	1200	1.20	1.20
2018	100000	99400	-600	-0.60	0.60
2019	92000	94800	2800	3.04	3.04
2020	96000	94500	-1500	-1.56	1.56
2021	102000	103500	1500	1.47	1.47
2022	106000	108400	2400	2.26	2.26
2023	112000	114000	2000	1.79	1.79
2024	122000	120500	-1500	-1.23	1.23
2025	126978	128200	1222	0.96	0.96

Table 28: Validation of rates

Mean Absolute Percentage Error = 1.56%

6.2. Results and Discussion

The analysis of land prices in the selected residential areas of Indore city highlights significant variations in growth trends, market behaviour, investment characteristics, and future appreciation patterns. The study was carried out using government guideline values, actual market rates collected through field surveys, and ARIMA forecasting techniques to understand the changing dynamics of residential land prices in both High Income Group (HIG) and Middle Income Group (MIG) areas of the city. The analysis further reflects the influence of infrastructure development, accessibility, urban expansion, and socio-economic conditions on real estate growth and residential land value appreciation. The comparative analysis reveals that premium residential areas such as Vijay Nagar and Saket Nagar possess comparatively higher land values and stronger market demand due to better infrastructure facilities, commercial concentration, institutional development, accessibility advantages, and continuous urban growth. These areas have emerged as major residential and investment-oriented zones within Indore city and continue to attract both end users and investors because of their superior urban environment and higher quality of civic amenities. The study indicates that Vijay Nagar demonstrates the highest absolute land values among all selected study areas. The presence of major commercial establishments, shopping complexes, educational institutions, healthcare facilities, hotels, and transportation corridors has significantly increased the attractiveness and investment potential of the locality. The area also benefits from excellent road connectivity and acts as one of the major commercial and institutional hubs of the city. As a result, the area exhibits strong market demand, rapid appreciation in land values, and a comparatively larger difference between government guideline values and actual market rates.

Similarly, Saket Nagar reflects the characteristics of a stable premium residential market with comparatively lower fluctuations and continuous appreciation in property prices. The area is primarily residential in nature and is characterized by organized urban development, better Neighborhood quality, planned housing patterns, and high residential demand. Compared to Vijay Nagar, Saket Nagar demonstrates comparatively stable market behaviour with moderate but consistent growth in land values. The area attracts upper-middle and high-income households seeking better residential environments and quality infrastructure facilities.

On the other hand, emerging and comparatively affordable residential areas such as Nipania and Sudama Nagar exhibit moderate but steadily increasing land value trends. These areas represent developing and affordability-oriented residential markets where land prices are

comparatively lower than established HIG areas but show significant future growth potential due to ongoing urban expansion and infrastructure improvements.

Among these areas, Nipania demonstrates the strongest future growth potential due to increasing real estate investments, improving transportation connectivity, rapid residential development, and spillover demand from nearby developed zones. The study indicates that the area is gradually transforming into an important residential and mixed-use development corridor within the eastern part of Indore city. Increasing construction activities, development of residential townships, commercial expansion, and infrastructure projects have accelerated land value appreciation within the locality. The forecasting results suggest that Nipania may experience the highest percentage increase in land prices among all selected areas during the forecast period, highlighting its emerging investment potential and rapid urban transformation.

Sudama Nagar, in contrast, demonstrates relatively stable and affordable land value patterns suitable for middle-income residential development. The area reflects comparatively lower speculative market activity and more end-user-oriented residential demand. Although the appreciation rate in land values is moderate compared to premium and emerging investment zones, the area demonstrates stable residential market characteristics and comparatively lower investment risk. The locality mainly caters to middle-income households seeking affordable housing opportunities within the city.

The study also highlights a clear variation between government guideline values and actual market rates across all selected areas. In most cases, actual market prices were found to be significantly higher than officially prescribed guideline values. This difference reflects the influence of market demand, investor activity, infrastructure advantages, commercial growth, and speculative real estate transactions. The gap between government and market values is particularly higher in premium HIG areas such as Vijay Nagar and Saket Nagar due to stronger investment concentration and commercial importance. In contrast, MIG-oriented areas such as Sudama Nagar demonstrate comparatively smaller variation between official and market values, indicating more affordability-driven and stable residential market conditions. The forecasting analysis carried out using the ARIMA (Auto Regressive Integrated Moving Average) model proved effective in understanding historical trends and estimating future land value behaviour within the selected study areas. The model successfully captured the growth pattern and trend continuity of residential land prices and generated future forecasts for the period up to 2030. The forecasting results indicate continuous appreciation in both government

guideline values and actual market rates across all selected residential zones. Developed areas are expected to maintain stable high-value growth, while emerging areas are likely to experience comparatively higher percentage appreciation due to ongoing urbanization and infrastructure expansion. The validation analysis further demonstrated satisfactory forecasting reliability with comparatively low error percentages and acceptable model performance indicators. Developed residential areas exhibited comparatively better forecasting stability due to consistent market behaviour, whereas emerging areas showed slightly higher variability due to dynamic development conditions and changing investment patterns.

However, the study also recognizes certain limitations associated with forecasting techniques such as ARIMA. Since the model primarily depends on historical trends and past market behaviour, unexpected external factors such as economic fluctuations, policy interventions, infrastructure mega-projects, market disruptions, inflation, changes in government regulations, and sudden investment shifts may affect the accuracy of long-term predictions. Therefore, although ARIMA provides useful insights regarding future trends, forecasting outcomes should be interpreted considering possible future uncertainties and market dynamics. The analysis also reflects the influence of broader economic and market conditions on residential land prices. The temporary decline observed during 2019 across most selected study areas indicates the impact of market slowdown, reduced real estate transactions, and economic uncertainty during that period. However, the post-2022 recovery trend demonstrates increasing urban growth, stronger market confidence, infrastructure improvement, and rising residential demand within Indore city. This recovery highlights the resilience of the urban real estate market and the growing importance of infrastructure-led development in shaping future land value appreciation.

Overall, the study confirms that location characteristics, infrastructure availability, transportation accessibility, neighborhood quality, commercial activities, socio-economic conditions, and urban growth patterns play a major role in determining residential land prices within Indore city. The analysis demonstrates that developed HIG areas exhibit stronger investment-oriented growth and higher land values, whereas emerging and MIG areas provide affordability advantages and future development opportunities.

The research further establishes that forecasting techniques such as ARIMA can serve as useful analytical tools for planners, investors, developers, researchers, and policy makers in understanding future real estate market trends and supporting informed decision-making

related to land management, infrastructure planning, residential development, and urban growth management. The findings of the study may contribute toward future planning strategies aimed at achieving balanced urban development, sustainable residential growth, and improved housing affordability within rapidly expanding urban areas like Indore city.

6.3. Discussion

Discussion on Planning Implications of Rapid Land Price Appreciation

The analysis of land value trends in the selected study areas of Indore city indicates significant differences in the rate of urban growth and real estate appreciation between developed areas such as Vijay Nagar and emerging areas such as Nipania. Vijay Nagar represents a mature urban zone where infrastructure, commercial development, transportation facilities, and public services have gradually evolved over time along with land value appreciation. In contrast, areas such as Nipania are currently experiencing rapid urban expansion and comparatively faster increases in land prices due to increasing investment activities, infrastructure development, and spillover growth from nearby developed areas.

The study highlights that sudden and unplanned increases in land values can create multiple urban planning challenges if development is not managed through proper planning principles and infrastructure control mechanisms. Rapid appreciation in land prices often attracts high-density residential and commercial development within a short period of time, resulting in excessive pressure on existing infrastructure and urban services. Such uncontrolled growth may lead to problems including traffic congestion, parking shortages, encroachment on public spaces, reduction in open spaces, inadequate drainage systems, and overburdened transportation networks.

In developed areas such as Vijay Nagar, gradual infrastructure expansion, wider road networks, organized commercial development, and planned land use distribution helped in accommodating increasing land values and development pressure over time. The area demonstrates how phased urban development, proper zoning regulations, and infrastructure-led planning can support rising land prices while maintaining urban functionality and accessibility.

However, in rapidly developing areas such as Nipania, similar growth patterns are beginning to emerge at a much faster pace. Increasing land prices and rapid construction activities may create future urban management issues if proper planning interventions are not implemented in advance. The study suggests that emerging growth corridors require proactive planning measures before land prices rise significantly and development intensifies.

To manage future urban growth effectively, planning principles such as controlled density regulations, adequate parking provisions, road widening policies, mixed land use control, reservation of public open spaces, and infrastructure upgradation should be implemented during the early stages of development. Transportation planning, drainage improvement, pedestrian infrastructure, and public utility expansion must also be integrated with future real estate growth projections.

The discussion further indicates that monitoring land value trends can serve as an important planning tool for identifying future high-growth areas and implementing preventive planning

strategies before urban problems intensify. By integrating land price forecasting with infrastructure planning and development control regulations, city authorities can reduce the negative impacts of sudden urbanization and promote balanced and sustainable residential growth.

Overall, the study emphasizes that rapid land price appreciation should not only be viewed as an indicator of economic growth and investment potential, but also as a signal for timely urban planning intervention. Proper implementation of planning principles in emerging areas such as Nipania can help prevent future issues related to congestion, parking shortages, encroachment, infrastructure stress, and unplanned urban expansion while ensuring sustainable urban development within Indore city.

Area	Issue	Forecast Trend	Planning Need
Vijay Nagar	Congestion	Stable High Growth	Traffic Management
Nipania	Rapid Expansion	Very High Growth	Infrastructure Planning
Sudama Nagar	Affordability	Moderate Growth	Affordable Housing
Saket Nagar	Premium Housing	Stable Growth	Controlled Density

Table 29: Comparative Table of all Area

CHAPTER 7: BIBLIOGRAPHY

7. Reference

7.1.

Source Type	Author Type	In-text Citation	Reference
Book	One Author	(Kadiyali, 2005)	Kadiyali LR (2005), <i>Traffic Engineering and Transport Planning</i> , 6th ed., Khanna Publishers, New Delhi.
	Two Authors	(Box and Jenkins, 1976)	Box GEP and Jenkins GM (1976), <i>Time Series Analysis: Forecasting and Control</i> , Holden-Day, San Francisco.
	Two Authors	(Hyndman and Athanasopoulos, 2018)	Hyndman RJ and Athanasopoulos G (2018), <i>Forecasting: Principles and Practice</i> , 2nd ed., OTexts, Melbourne. Available at: https://otexts.com/fpp3/ (Accessed on 15 March 2025).
	One Author	(Ricardo, 1817)	Ricardo D (1817), <i>On the Principles of Political Economy and Taxation</i> , John Murray, London. Available at: https://www.econlib.org/library/Ricardo/ricP.html (Accessed on 10 January 2025).
	One Author	(Hamilton, 1994)	Hamilton JD (1994), <i>Time Series Analysis</i> , Princeton University Press, Princeton.
	One Author	(Harvey, 1989)	Harvey D (1989), <i>The Condition of Postmodernity</i> , Blackwell Publishers, Oxford.
	One Author	(Lynch, 1960)	Lynch K (1960), <i>The Image of the City</i> , MIT Press, Cambridge.
	One Author	(Ratcliffe, 1978)	Ratcliffe J (1978), <i>An Introduction to Town and Country Planning</i> , Hutchinson, London.
Journal Article	One Author	(Rosen, 1974)	Rosen S (1974), Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition, <i>Journal of Political Economy</i> , Vol 82 No. 01, pp 34–55. Available at: https://www.jstor.org/stable/1830469 (Accessed on 05 February 2025).
	Two Authors	(Case and Shiller, 1989)	Case KE and Shiller RJ (1989), The Efficiency of the Market for Single-Family Homes, <i>American Economic Review</i> , Vol 79 No. 01, pp 125–137.
	One Author	(Alonso, 1964)	Alonso W (1964), <i>Location and Land Use Theory</i> , Harvard University Press, Cambridge.

Source Type	Author Type	In-text Citation	Reference
	Two Authors	(Malpezzi and Wachter, 2005)	Malpezzi S and Wachter S (2005), The Role of Speculation in Real Estate Cycles, <i>Journal of Real Estate Literature</i> , Vol 13 No. 02, pp 143–164.
Government Report	Institutional	(MOHUA, 2015)	Ministry of Housing and Urban Affairs (2015), <i>Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines – Vol I</i> , Government of India, New Delhi. Available at: https://mohua.gov.in/upload/uploadfiles/files/URDPFI-Guidelines-Vol-I.pdf (Accessed on 20 January 2025).
	Institutional	(MOHUA, 2015)	Ministry of Housing and Urban Affairs (2015), <i>Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines – Vol II</i> , Government of India, New Delhi. Available at: https://mohua.gov.in/upload/uploadfiles/files/URDPFI-Guidelines-Vol-II.pdf (Accessed on 20 January 2025).
	Institutional	(NITI Aayog, 2021)	NITI Aayog (2021), <i>Urbanisation in India</i> , Government of India, New Delhi.
	Institutional	(IMF, 2020)	International Monetary Fund (2020), <i>Global House Price Developments</i> , IMF Working Paper WP/20/XX, Washington DC.
	Institutional	(World Bank, 2020)	World Bank (2020), <i>Urban Development Overview</i> , Washington DC. Available at: https://www.worldbank.org/en/topic/urbandevelopment (Accessed on 18 February 2025).
	Institutional	(Smart City Mission, 2023)	Smart Cities Mission (2023), <i>Smart City Proposal – Indore</i> , Government of India, New Delhi.
Web Page	Institutional	(IDA, 2024)	Indore Development Authority (2024), Official Website of IDA, https://idaindore.com/ (Accessed on 10 March 2025).
	Institutional	(NIUA, 2024)	National Institute of Urban Affairs (2024), NIUA Reports, https://niua.org/reports (Accessed on 15 March 2025).
	Institutional	(SmartNet, 2024)	SmartNet NIUA (2024), Smart City Knowledge Network, https://smartnet.niua.org/ (Accessed on 15 March 2025).
	Institutional	(Census India, 2011)	Office of the Registrar General and Census Commissioner, India (2011), <i>Census of India</i> , Government of India, New Delhi. Available at:

Source Type	Author Type	In-text Citation	Reference
			https://censusindia.gov.in/census.website/ (Accessed on 05 January 2025).
	Institutional	(IMC, 2024)	Indore Municipal Corporation (2024), Official Website of IMC, https://imcindore.mp.gov.in/ (Accessed on 12 March 2025).
	Institutional	(MPRDC, 2024)	Madhya Pradesh Road Development Corporation (2024), Official Website, https://mprdc.nic.in/ (Accessed on 20 March 2025).
Edited Book / Chapter	One Author	(Muth, 1969)	Muth RF (1969), <i>Cities and Housing: The Spatial Pattern of Urban Residential Land Use</i> , University of Chicago Press, Chicago.
	One Author	(Burgess, 1925)	Burgess EW (1925), The Growth of the City: An Introduction to a Research Project, in <i>The City</i> , University of Chicago Press, Chicago.
	One Author	(Hoyt, 1939)	Hoyt H (1939), <i>The Structure and Growth of Residential Neighborhoods in American Cities</i> , Federal Housing Administration, Washington DC.

CHAPTER 8: ANNEXURE

CERTIFICATE

This is to certify that the declaration of _____ is true to the best of my knowledge and that the student has worked under my guidance for one semester in preparing this thesis.

Signature of the guide

Dr. Yogesh K Garg

ACCEPTED

Signature of
Head, Department of
Architecture and Planning
Date: _____
Place: _____

Signature of
Thesis Coordinator
Architecture and Planning
Date: _____
Place: _____

CANDIDATE'S DECLARATION

I, **ARJUN SAXENA**, Scholar No.**2211002102**, hereby declare that the thesis titled "**Land Price Prediction Analysis for MIG & HIG: A Case Study for Indore City**" submitted by me in partial fulfilment for the award of degree of Bachelor of Planning, at Maulana Azad National Institute of Technology, Bhopal, India, is a record of Bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

Arjun Saxena

Date: 4 may 2026