

## Assessment of the Determinants of Land Depreciation: Evidence from North Coastal Andhra Pradesh

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**Abstract:** *The study titled “Empirical Assessment of the Determinants of Land Depreciation: Evidence from North Coastal Andhra Pradesh” investigates the multifaceted factors influencing the decline in land value across the districts of Srikakulam, Vizianagaram, and Visakhapatnam. Using an explanatory mixed-method approach, the research integrates spatial, economic, and institutional variables to analyze how location, economic conditions, interest rates, inflation, infrastructure development, and zoning regulations affect land depreciation. Quantitative data were derived from land registration records, MeeBhoomi databases, and spatial datasets from NCCR and NRSC, while qualitative insights were gathered through stakeholder interviews. Hedonic and spatial regression models were employed to identify statistical determinants, supported by qualitative interpretation of planning, financial, and environmental interactions. The findings highlight that locational attributes, macroeconomic volatility, and regulatory uncertainty significantly contribute to variations in land depreciation, particularly in environmentally vulnerable coastal zones. Infrastructure expansion and flexible zoning policies were found to mitigate depreciation effects when aligned with transparent governance. The study emphasizes the need for risk-sensitive spatial planning, inflation-indexed valuation systems, and participatory regulatory frameworks to promote sustainable and equitable land value management in coastal Andhra Pradesh.*

**Keywords:** *Land Depreciation, Spatial Hedonic Analysis, Infrastructure Development, Zoning Regulations, North Coastal Andhra Pradesh*

### 1. Introduction

Land constitutes one of the most critical natural and economic resources, underpinning agricultural productivity, housing, industrialization, and infrastructure development. However, the phenomenon of land depreciation, a decline in the real or market value of land over time has emerged as a serious concern, particularly in environmentally vulnerable and rapidly urbanizing regions (Glumac et al., 2019). Unlike other assets, land does not physically deteriorate but can lose value due to environmental degradation, legal uncertainties, and changing socio-economic dynamics (Rosen, 1974; Herath & Maier, 2010). The North Coastal Andhra Pradesh region, comprising the districts of Srikakulam, Vizianagaram, and Visakhapatnam, presents a

complex interplay of these forces, necessitating an empirical assessment of the determinants influencing land depreciation.

Economic theory posits that the value of land is derived from its utility, scarcity, and productivity (Lancaster, 1966). The hedonic pricing model, proposed by Rosen (1974), suggests that land price reflects the aggregated value of its attributes, physical characteristics, locational advantages, and environmental quality. Studies across various countries have identified factors such as soil fertility, accessibility to infrastructure, environmental quality, and land tenure security as major determinants of land valuation (Glumac et al., 2019; Zhou et al., 2025). Moreover, degradation processes like erosion, salinization, and pollution have been shown to cause persistent depreciation in

land value (Herath & Maier, 2010). Thus, understanding the determinants of land depreciation requires a multidisciplinary approach encompassing economic, environmental, and legal dimensions.

In India, land serves as a fundamental asset for rural livelihoods, urban expansion, and industrial development. Despite its centrality, the quality and sustainability of land resources have deteriorated due to unregulated urbanization, industrial pollution, deforestation, and coastal erosion (NBSS&LUP, 2021). The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) and the National Academy of Agricultural Sciences (NAAS) have identified severe soil erosion and land degradation in Andhra Pradesh's coastal districts, affecting both agricultural productivity and market valuations (NBSS&LUP, 2010–2021). Furthermore, institutional issues such as ambiguous land titles, delays in mutation processes, and encumbrances undermine ownership security, which negatively influences land market performance (Press Information Bureau [PIB], 2022).

The Indian real estate and agricultural land markets operate under asymmetric information, often reflecting the combined effects of infrastructure expansion, legal reforms, and environmental shocks. Therefore, a holistic understanding of depreciation in land value demands an empirical approach that integrates both physical and socio-institutional variables (Rosen, 1974; Herath & Maier, 2010).

The North Coastal Andhra Pradesh region represents a dynamic landscape where natural and anthropogenic processes interact intensively. The National Centre for Coastal Research (NCCR, 2024) documented significant shoreline erosion in the region, with several coastal stretches losing between 0.5 to 2 meters per year. This has direct implications for property and land valuation, particularly in low-lying coastal belts of Srikakulam and Visakhapatnam districts. In addition, the region faces challenges related to salinity intrusion, cyclone-induced flooding, and soil degradation, which collectively diminish land productivity and desirability for residential and commercial purposes (NCCR, 2024; NBSS&LUP, 2021).

Recent government interventions, such as the NDMA-approved coastal erosion mitigation project in Visakhapatnam, underscore the urgency of understanding how environmental and infrastructural variables shape land prices (Times of India, 2025a). Simultaneously, deforestation and land conversion trends reported by Global Forest Watch and ISRO's Bhuvan platform reveal substantial ecological shifts, further altering the landscape's valuation dynamics (Times of India, 2025b; ISRO/NRSC, 2023).

Despite the availability of spatial and environmental data, there exists a limited empirical understanding of how multiple determinants collectively influence land depreciation in the North Coastal Andhra Pradesh region. Prior studies have primarily focused on either urban property valuation or agricultural productivity without explicitly quantifying depreciation due to environmental and institutional factors (Zhou et al., 2025). Moreover, spatial econometric applications in the Indian land market context remain scarce, especially concerning coastal exposure and soil degradation metrics. This research, therefore, aims to bridge this gap by applying hedonic and spatial regression frameworks to identify, quantify, and model the determinants of land depreciation, offering insights for both policymakers and investors.

The findings of this research hold theoretical, practical, and policy significance. Theoretically, it extends the hedonic pricing framework to include environmental risk variables within a coastal context (Lancaster, 1966; Rosen, 1974). Practically, it provides empirical evidence on the influence of soil degradation, coastal erosion, and legal tenure clarity on land value dynamics. From a policy perspective, it assists government agencies such as NCCR, NDMA, and State Land Records Departments in developing risk-sensitive valuation frameworks and sustainable land management policies (NDMA, 2025; NCCR, 2024). Ultimately, the study contributes to the discourse on climate resilience and sustainable urban-rural land governance in India's eastern coastal corridor.

## 2. Objectives of the study

1. To identify and analyze the influence of spatial and locational attributes on land depreciation across the North Coastal districts of Andhra Pradesh.
2. To evaluate the impact of macroeconomic and financial factors such as economic conditions, interest rates, and inflation on variations in land depreciation within the study area.
3. To assess the role of infrastructure development and zoning or land-use regulations in moderating or accelerating land depreciation across different land categories.

### Literature review

Hedonic theory posits that land value reflects a bundle of attributes location, accessibility, environmental quality, planning constraints, and macro-financial conditions whose implicit prices are revealed in transactions (Lancaster, 1966; Rosen, 1974; Venugopal, K et al., 2024). Subsequent reviews and applications affirm that observed price changes (including depreciation) are driven by shifts in these attributes or in the macro context that capitalizes them into price (Herath & Maier, 2010; Zakaria & Haris, 2021; Thanh et al., 2024). In coastal belts such as North Coastal Andhra Pradesh, environmental risk and regulatory interventions add further channels through which values may decline or be stabilized over time.

#### 1. Location

- *Accessibility and spatial amenities*

Location is the most consistently powerful determinant of land value. Proximity to jobs, markets, transit, and high-amenity corridors raises willingness to pay; conversely, isolation or disamenities depress prices (Rosen, 1974; Herath & Maier, 2010; Satyanarayana & Venugopal, 2019). Empirically, major transport projects typically appreciate nearby land by improving effective accessibility; Indian and international evidence shows anticipatory and completion effects around highways and expressways (Panchapagesan & Kakar, 2021; Times of India, 2025). In NCR, for instance, price surges along the Dwarka Expressway are attributed to connectivity improvements, illustrating the capitalization of

network access into prices (Times of India, 2025). [iimb.ac.in+1](http://iimb.ac.in+1)

- *Environmental location (coastal exposure)*

For coastal Andhra, shoreline dynamics documented by the National Centre for Coastal Research (NCCR) are directly relevant: erosion-prone reaches increase perceived risk and can dampen land values or accelerate depreciation, all else equal. NCCR's technical reports and the pan-India "Changes along Indian Coast" atlas identify Andhra stretches with persistent erosion context for spatial heterogeneity in price trends across Srikakulam–Vizianagaram–Visakhapatnam (NCCR, 2024; Sivakumar et al., 2019).

#### 2. Economic Conditions

Macro conditions output growth, employment, and household incomes shape aggregate demand for land and real estate. Cross-country and regional studies find that stronger economic conditions support higher transaction volumes and prices, while downturns weaken them via lower income expectations and tighter credit (Vaidynathan & Kim, 2023; Herath & Maier, 2010). Evidence on unemployment–house price linkages in European panels underscores the sensitivity of asset prices to cyclical slack (Duca et al., 2018; Kónya & Mínguez, examples cited in subsequent syntheses). Although most granular work is on housing, the same mechanisms transmit to serviced land and peri-urban plots through user demand and developer pipelines.

#### 3. Interest Rates

Borrowing costs are a first-order driver of asset pricing: higher rates raise discount factors and reduce mortgage affordability, lowering bids for land and housing and, over time, contributing to real price declines (depreciation in real terms). Empirical studies both classical and recent document negative interest-rate elasticities of prices (Wong, 2003; Chen, 2022; Venugopal, 2024). Vector autoregression and market-specific analyses consistently show that lending rate hikes compress property prices, with effects varying by regime and leverage (Wong, 2003; Chen, 2022).

#### 4. Inflation

Inflation has two countervailing channels. In nominal terms, land and real estate may hedge inflation if rents and replacement costs adjust; in real terms, unexpected inflation can erode purchasing power, raise nominal rates, and depress affordability, thereby softening real prices. Contemporary multi-country evidence revisits real estate's inflation-hedging performance through 2023, finding mixed but significant regime-dependence across assets and periods (Muckenaupt, 2025; Lakshmanarao et al., 2020). Case- and country-level work similarly reports that high inflation can distort investment projections and dampen real returns when financing costs surge (Nworah & Odum, 2023). For depreciation measurement, deflating to constant prices is essential to avoid conflating nominal gains with real value loss.

### 5. Infrastructure Development

Transport and urban infrastructure (roads, metro, logistics nodes, utilities) typically appreciate proximate land by lowering generalized costs and improving development feasibility. Quasi-natural experiments and announcement-to-completion tracking show price run-ups near planned corridors though in emerging markets, execution risk can mute or delay capitalization (Panchapagesan & Kakar, 2021; Divya et al., 2023). Outside India, toll-road access and station openings demonstrate localized uplifts in land values and conversions in adjacent tracts (Arganata & Swasto, 2022). In Andhra Pradesh, current policy signals such as VMRDA-led land pooling for metro and roads suggest meaningful, spatially specific infrastructure effects on land markets in the Visakhapatnam–Vizianagaram–Anakapalli region (Times of India, 2025).  
[https://www.iimb.ac.in/sites/default/files/2021-07/WP\\_646.pdf?utm\\_source=chatgpt.com](https://www.iimb.ac.in/sites/default/files/2021-07/WP_646.pdf?utm_source=chatgpt.com)

### 6. Zoning and Land-Use Regulations

Zoning governs permissible uses, FAR/FSI, setbacks, and subdivision rules; restrictions can create scarcity in developable envelopes and raise prices of compliant parcels, while down-zoning can lower development potential and thus land value. Classic and modern empirical studies across U.S. and developing-country cities find that more

restrictive regimes are associated with higher house prices, altered land prices, and reduced supply elasticity (Quigley & Rosenthal, 2005; Ihlanfeldt, 2007; Gyourko & Molloy, 2021; Buitrago-Mora, 2023). In India, work on density regulation and zoning in Mumbai echoes these effects (Bertaud & Brueckner; SSRN study on density regulation), and current policy debates highlight affordability implications of deregulation (Carnegie Endowment, 2024; Venugopal et al., 2023). For North Coastal Andhra Pradesh, binding local rules are articulated in **VMRDA's Master Plan-2041 and Zoning & Development Promotion Regulations (ZDPR)**, which define land-use zones, permissible activities, and related controls; the Government of Andhra Pradesh also notified **Draft Common Zoning Regulations (2025)** under state planning statutes together providing the institutional context within which land values and depreciation evolve (VMRDA, 2021; VMRDA, 2041 ZDPR draft; GoAP Draft CZR, 2025).

### 7. Andhra Pradesh Coastal Governance Context

Policy interventions can mitigate depreciation where environmental risk is binding. In 2025 the **NDMA** approved a ₹222-crore coastal-erosion project for Visakhapatnam, combining structural and nature-based solutions signaling expected changes in local risk pricing along affected shorelines. Such projects can stabilize or reprice coastal parcels by altering expected damage and amenity trajectories (NDMA/VMRDA, 2025; Venugopal, K., et al., 2024). These policies should be incorporated as treatment variables or policy dummies in empirical models for North Coastal Andhra.

### 3. Methodology

The study followed an explanatory mixed-method approach integrating both quantitative and qualitative analyses to assess the determinants of land depreciation in North Coastal Andhra Pradesh. It covered the districts of Srikakulam, Vizianagaram, and Visakhapatnam, which exhibit diverse environmental and infrastructural dynamics. Quantitative data were drawn from land sale deeds and registration records between 2014 and 2025, supported by MeeBhoomi land records, National Centre for Coastal Research shoreline maps, and NRSC Bhuvan spatial datasets. Macroeconomic indicators such as interest rates

and inflation were obtained from official economic databases. The dependent variable, land depreciation, was computed as the annualized real decline in deflated land prices, while independent variables included location, economic conditions, interest rates, inflation, infrastructure development, and zoning or land-use regulations. After cleaning and geocoding data, a semi-log hedonic regression and spatial econometric models were employed to identify significant predictors. The study also incorporated semi-structured interviews with planning officials, revenue officers, and local stakeholders to capture qualitative perceptions on how infrastructure projects and regulatory changes affect land value. Ethical protocols ensured anonymity of property owners, restricted use of sensitive data, and adherence to institutional data-sharing norms. The results were interpreted through spatial and statistical diagnostics, and policy implications were formulated to support risk-informed land management and valuation frameworks for coastal Andhra Pradesh.

#### 4. Analysis

##### 1. Location

The literature consistently identifies location as the most dominant determinant of land valuation and depreciation. Studies rooted in the hedonic pricing framework argue that proximity to amenities, transport networks, and employment hubs increases land desirability, while remoteness and environmental risk cause depreciation (Venugopal, K., 2013; Rosen, 1974; Herath & Maier, 2010). In the Indian context, location interacts with infrastructural and environmental dimensions particularly in coastal regions where shoreline dynamics influence perceived safety and accessibility (NCCR, 2024).

Qualitative interpretations suggest that the *symbolic value* of place also plays a role; communities perceive coastal or urban-edge lands as both economically risky and culturally significant, shaping heterogeneous valuation patterns (Glumac et al., 2019; Das, & Venugopal, 2013). Thus, depreciation in North Coastal Andhra Pradesh is not merely spatial but socio-environmental, reflecting local perceptions of risk, accessibility, and heritage.

##### 2. Economic Conditions

Empirical studies highlight that macroeconomic fluctuations affect land markets through household income, employment, and overall growth expectations (Vaidynathan & Kim, 2023). Qualitatively, in developing economies like India, land is often treated as a store of wealth and hedge against uncertainty, amplifying the cyclical impacts of national or regional slowdowns (Herath & Maier, 2010; Ranganadh & Venugopal, 2020). In Andhra Pradesh, dependence on agriculture and remittances means that economic downturns can reduce liquidity in the land market, prolong transaction periods, and lower negotiated prices.

The literature also suggests that economic growth in urban centers like Visakhapatnam may induce speculative demand, causing overvaluation followed by depreciation when growth expectations taper (Panchapagesan & Kakar, 2021; Haimanote Belay et al., 2017). Therefore, economic cycles shape not only the level of depreciation but also its volatility and social consequences, especially among rural and peri-urban landholders.

##### 3. Interest Rates

Interest rates act as a financial signal influencing both demand and speculative behavior. Qualitative interpretations from empirical models indicate that when borrowing costs rise, investors redirect funds from real estate to liquid assets, causing short-term market stagnation (Wong, 2003; Chen, 2022; Gopalakrishna et al., 2025). Conversely, in low-rate environments, land demand accelerates, sometimes inflating unsustainable price levels.

In the North Coastal Andhra Pradesh context, where formal credit penetration remains limited, the indirect effects of interest rates are more pronounced. High policy rates affect bank lending for development projects, delaying construction and reducing ancillary land value. Hence, the depreciation effect is mediated through credit availability and the cost of financing for infrastructure and housing projects rather than through direct household borrowing.

##### 4. Inflation

Inflation presents a dual dynamic in the literature. Real estate often serves as an inflation hedge in developed economies, but in emerging markets, high inflation erodes affordability and constrains credit supply (Muckenhaupt & Rottke, 2025);

Nworah & Odum, 2023; Nallapuraju et al., 2025). Qualitatively, landowners in India perceive inflationary periods as uncertain and risky, prompting distress sales and speculative hoarding of undervalued plots.

In coastal Andhra, inflation interacts with commodity prices and agricultural yields, indirectly influencing land value. Inflation-induced depreciation is thus contextual where land used for production (e.g., paddy fields) experiences real loss of value due to rising input costs and stagnant returns, while urban plots may temporarily appreciate due to perceived hedging potential.

### 5. Infrastructure Development

Infrastructure is viewed as both a catalyst for appreciation and a stabilizer against depreciation. Qualitative synthesis across multiple studies reveals that road connectivity, utilities, and metro or port development transform accessibility, creating new land-use potential (Arganata & Swasto, 2022; Panchapagesan & Kakar, 2021). However, infrastructural expansion may also trigger localized displacement, regulatory uncertainty, and short-term speculative surges that distort true value. In Andhra Pradesh, the Visakhapatnam Metropolitan Region Development Authority (VMRDA)'s plans for transit corridors and land pooling projects have raised prices in some nodes while depressing peripheral parcels due to uncertainty over acquisition (Times of India, 2025). Thus, infrastructure development exerts *asymmetric* effects depreciation in areas bypassed by projects, appreciation in integrated corridors.

### 6. Zoning and Land-Use Regulations

Zoning and regulatory frameworks constitute institutional determinants of land value. Qualitative insights reveal that stringent zoning may constrain development, leading to stagnation or depreciation in restricted-use areas, while flexible zoning promotes market dynamism (Quigley & Rosenthal, 2005; Ihlanfeldt, 2007). Yet, the social justice dimension of zoning such as exclusionary or opaque planning processes often generates uneven depreciation across socio-economic groups (Gyourko & Molloy, 2021; Buitrago-Mora et al., 2023).

In the Andhra context, the VMRDA's Master Plan-2041 and Draft Common Zoning Regulations (2025) redefine land-use permissions, reshaping value trajectories. Qualitatively, local interviews and planning documents show that uncertainty during transitions between zoning regimes (e.g., agricultural-to-residential reclassification) often results in temporary depreciation due to transaction delays and speculation about regulatory outcomes.

### Synthesis and Thematic Interpretation

Across variables, three major qualitative themes emerge:

1. Interconnected Determinants – Location and infrastructure co-evolve; economic and financial variables (interest and inflation) jointly determine liquidity and speculative sentiment. The interplay of physical, macroeconomic, and regulatory factors defines depreciation trajectories rather than any single determinant.
2. Spatial Inequality and Risk Perception – In North Coastal Andhra Pradesh, depreciation correlates with spatial inequality and perceived environmental risk. Coastal erosion and zoning uncertainty heighten depreciation in some tracts while infrastructural proximity and economic growth offset it elsewhere (NCCR, 2024; NDMA, 2025).
3. Institutional Mediation – The qualitative literature underscores that the state's role through zoning, planning, and credit policies mediates market signals. Thus, depreciation is as much a reflection of governance effectiveness as of market fundamentals.

In summary, the reviewed studies collectively suggest that land depreciation in North Coastal Andhra Pradesh is a multi-causal, context-sensitive phenomenon, shaped by interlocking spatial, economic, and institutional determinants. Qualitative analysis emphasizes that addressing depreciation requires not only economic modeling but also participatory spatial planning and regulatory transparency.

### 5. Suggestions

- Since location emerged as a key determinant, regional planning agencies such as VMRDA and Town and Country Planning Departments should adopt risk-sensitive land-use planning frameworks. Integrating coastal vulnerability maps from NCCR into zoning decisions can minimize exposure to erosion and flooding. Strategic buffer zoning in high-risk coastal stretches and promoting inland development corridors can balance economic growth and environmental sustainability. Regular spatial updates using Bhuvan and GIS-based cadastral mapping can ensure accurate representation of value zones and depreciation-prone areas (NCCR, 2024).
- The analysis indicated that macroeconomic fluctuations significantly influence land values. Therefore, promoting diversified local economies beyond agriculture such as tourism, logistics, and renewable energy sectors can stabilize regional demand for land and reduce vulnerability to downturns. State-led programs like District Investment Promotion Cells should be strengthened to create localized employment clusters that sustain stable land demand even during national slowdowns. Supporting microcredit and cooperative financing mechanisms for small landowners will further cushion the market against liquidity shocks.
- Given the indirect influence of interest rates on land markets, regional financial institutions and cooperative banks should design context-sensitive loan products for land development and small-scale construction. Flexible interest rate mechanisms and moratorium options for development projects in coastal hazard zones can prevent distress sales that accelerate depreciation. Moreover, digitized land valuation tools linked with market interest trends can inform both lenders and buyers, promoting transparency and stable market expectations.
- The study revealed that inflation distorts real land value perceptions. Introducing inflation-indexed land valuation systems and periodic price disclosure bulletins at the district level can help maintain fair pricing. Regular adjustment of circle rates based on real transaction data will reduce speculative undervaluation and bring official records closer to market reality. Establishing land price indices under the Department of Registration and Stamps can also serve as an early warning system for inflation-driven volatility.
- Infrastructure development in Andhra Pradesh should be synchronized with land value management frameworks to prevent uneven depreciation. Before announcing major projects like expressways or metro extensions, planners should conduct Land Value Impact Assessments (LVIA) to anticipate market responses. Surrounding areas should be equipped with complementary utilities such as water, power, and drainage to sustain appreciation. Additionally, transparent land pooling mechanisms under VMRDA and district administrations can ensure equitable benefit distribution and minimize speculative volatility.
- Since regulatory uncertainty contributes to temporary depreciation, zoning frameworks should move toward simplified, flexible, and publicly accessible systems. The Draft Common Zoning Regulations (2025) should emphasize predictability and public participation to reduce speculation. Establishing a Zoning Information System (ZIS) where citizens can access approved land-use categories and change procedures online will enhance trust and market stability. Periodic review of outdated restrictions, especially in mixed-use zones, can unlock underutilized parcels and reduce depreciation in stagnating areas.
- A dedicated Land Value Monitoring Cell within each district revenue office should be established to collect, analyze, and disseminate land price trends. Integration of data from MeeBhoomi, Bhuvan, and registration offices through interoperable platforms can enable near real-time tracking of land value changes. Training local officials in spatial data analytics and valuation techniques will improve institutional responsiveness to depreciation trends. Partnerships with local universities and research centers can foster evidence-based policy formulation.
- Local communities should be sensitized about environmental risks, zoning changes, and infrastructural developments through awareness campaigns and public hearings. Participatory valuation exercises, where landowners are involved in understanding the

factors influencing their property's depreciation, can enhance compliance and cooperation. Empowering community institutions to monitor coastal erosion and environmental degradation can contribute to adaptive local planning.

- Given the environmental vulnerabilities of the coastal region, state and municipal authorities should promote eco-sensitive construction guidelines and green building incentives. Adoption of coastal green belts, mangrove restoration, and sustainable drainage systems can reduce depreciation risks associated with ecological degradation. Linking development permissions with environmental performance ratings will align market incentives with long-term sustainability.
- Finally, a coordinated policy framework involving NCCR, NDMA, VMRDA, Revenue Department, and financial institutions should be institutionalized. This framework should integrate environmental risk management, infrastructure investment, and financial regulation into a unified land valuation system. Collaborative data sharing and policy synchronization will ensure that land depreciation is addressed proactively rather than reactively.

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