



From Green Belt Barrier to Urban Corridor: Mapping NOIDA's Spatial Transformation and its Impact on the Yamuna River Basin (1984-2024)

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ABSTRACT

This study investigates the spatial transformation of NOIDA (New Okhla Industrial Development Authority) in India, focusing on the period 1984-2024. It examines the shift from a “Green Belt Barrier” concept to a burgeoning urban corridor and analyses the corresponding impact on the Yamuna River Basin. The research employs mapping techniques to delineate the NOIDA’s land use patterns and assess their environmental consequences on the Yamuna basin. The report covers a significant timeframe, capturing the evolution of NOIDA from a planned industrial area to a major urban center.

INTRODUCTION

NOIDA Established in 1976 under the U.P. Industrial Area Development Act, NOIDA has evolved into a well-planned, integrated, and contemporary industrial city. It is connected to Delhi via a modern network of roads, national highways, and the state-of-the-art DND flyover, providing inter-road connections to every region of the nation. NOIDA, which covers 20,316 hectares and has many completely developed sectors, provides a high level of living free from pollution and an extremely supportive industrial environment. Its distinctive infrastructure also offers an abundance of unmatched advantages. With its wide, smooth roads, developed land, reliable power supply, clean and safe drinking water, reliable telephony, and magnificent residential

complexes surrounded by greenery, it now stands as an enviable monument to the idea of an integrated industrial township worldwide.

LITERATURE REVIEW

The purpose of this study of the literature is to locate and evaluate previous academic research on the geographical change of the New Okhla Industrial Development Authority (NOIDA) and its effects on the Yamuna River Basin between 1984 and 2024.

The following important areas will be the focus of studies:

Plans and strategies related to urban growth in NOIDA: This includes examining the original designs for NOIDA as a green belt barrier and how these have changed over time to account for extensive urbanization. The rise of NOIDA will have an environmental impact. Research on the implications of urbanization on the Yamuna River Basin, including encroachment into floodplains, biodiversity, and water quality, will be conducted.

Social and economic effects of NOIDA's transformation: In this section, pertinent research will examine how the city's expansion has affected people's livelihoods, demography.

METHODOLOGY ADOPTED

Remote Sensing Data: Acquire Landsat imagery (or similar) from the USGS Earth Explorer or National Remote Sensing Centre (NRSC) for 1984, 2000, 2010, and 2024. This will allow you to map land use changes over time.

GIS Data: Collect GIS data from NOIDA authority or relevant government agencies. This could include maps depicting the Green Belt Master Plan, land use maps, and administrative boundaries.

Environmental Data: Collect data on water quality parameters from the Central Pollution Control Board (CPCB) or Yamuna River Board (YRB) for the study period.

Land Use Change Analysis: Utilize remote sensing data to classify land cover (e.g., green areas, built-up areas, water bodies) for each year. Calculate the percentage change in each category between years to quantify NOIDA's spatial transformation.

Spatial Mapping: Overlay the land use maps with NOIDA's Master Plan and administrative boundaries to understand the planned versus actual growth patterns.

RESEARCH

The origins of modern-day Noida town can be traced back to 1972, when the Uttar Pradesh government, aware of the increasing pressure from speculative land deals in this area, which was close to Delhi and had backward development characteristics, designated 50 villages in the former Bulendshahar district as the "Yamuna-Hindon-Delhi Border Regulated area" in accordance with the U.P. Regulation of Building Operations Act, 1958. This area lacked an urban center.

Both the 1956 Interim General Plan for Greater Delhi and the 1962 First Master Plan of Delhi suggested that special consideration be given to the planned decentralization of large-scale economic operations from Delhi and the establishment of communities surrounding Delhi. This made it possible to construct warehouses and industrial buildings in a number of locations around Delhi, which sparked speculation about the availability of real estate and raised the risk of unapproved and unplanned development activities.

Although the newly designated Regulated Area's governing Authority took into consideration a number of development-related factors, they were unable to significantly contribute to the creation of a new urban center. Ultimately, the Uttar Pradesh government informed 36 villages of the "Yamuna-Hindon-Delhi Border Regulated" on April 17, 1976.

In order to guarantee the area's planned development for industrial and related applications, the State Government also established the New Okhla Industrial Development Authority (NOIDA), a new statutory agency. In light of this, the Authority created a master plan for the region for 1991.

The Plan's goals were to:

create developed sites for roughly 10,000 small-scale industrial units;
employ about 41,000 industrial workers; and
create an environment that is favourable for living and working for those involved in manufacturing and related activities. Lastly, the Plan aimed to create an integrated township for a final population of 3,75,000 workers.

But even before the Plan could be put into action, the fundamental presumptions upon which it was built had to be fundamentally revised. According to industry experts, the site sizes were too large for the type of industrial units that were supposed to be situated there. The presumptive worker densities were also excessively low.

The 10,000 industrial sites would, according to updated estimates, employ at least 220,000 people. Assuming a 27.5 percent worker participation rate and a town density of 148 people per hectare, Noida's design population was increased to one million. Because most of this population was once within the Yamuna river basin and had been reclaimed by building embankments along the river, it was a sizable population to plan in an ecologically challenging area.

It was estimated that the new town's urbanisable area would be 3,360 hectares. In accordance with planning guidelines, spaces were set aside for community amenities. It was intended that the internal transport system for Noida would be connected with the proposed Mass Rapid Transit System (MRTS) for Delhi, in addition to providing suitable transportation amenities to connect the new town with Delhi and other nearby cities like Ghaziabad and Faridabad.

The region between the rivers Hindon and Yamuna, which includes 81 villages and over 20316 hectares of land, has been declared under NOIDA by the state government. In light of this, the Authority decided to update and modify the Noida Master Plan. A team of consultants from the School of Planning and Architecture in New Delhi was given the responsibility of updating the master plan. Since the construction of an expressway to connect Noida with Greater Noida was proposed, it was felt during the preparation of the revised plan that unplanned development, particularly commercial uses, was likely to occur along the entire length of the expressway in the absence of a plan to control such development.

The NCR Planning Board's afore mentioned observation, the rapidly evolving development scenario in the region, the expansion of Delhi, Ghaziabad, Gurgaon, Faridabad, and other cities within the region, numerous large-scale infrastructure projects, as well as initiatives to draw in and support private investment for the area's development, all made it necessary to consider extensive revisions for the Master Plan - 2021. Therefore, at its 149th meeting on April 8, 1988, the Noida Authority determined that a new plan for Noida needed to be created. Later, on September 24, 2008, it was decided that the NCR Planning Office in Ghaziabad will assist in the preparation of the Master Plan. In light of this, a fresh satellite image was properly obtained, digitalized, and the required fieldwork was completed for the Draft Master Plan, which was created for the five prospective years of 2031 with assistance from the NCR Planning Office in Ghaziabad.

The main features of the plan, i.e., the design concept, the proposals regarding the integrated physical development of Noida up to the year 2031, and the sub-division and zoning regulations have been described in detail in this report. The report is also illustrated with the help of maps, which are enclosed with it.

OBJECTIVES

The following goals have been incorporated into the Noida Master Plan - 2031:

- i) Create a master plan for Noida 2031 that addresses the following goals: a) achieving integrated development of Noida and its environs; b) accommodating future population growth up to the year 2031. This plan should be developed within the framework of broad policies for the development of the U.P. Sub-region of the National Capital Region and take into consideration the proposed strengthening of the road and rail infrastructure and the development pressures due to the creation and development of various activities in the adjoining area, Greater Noida, Delhi, Ghaziabad, etc.
- ii) To take advantage of the region's strong growth potential as a result of its close vicinity to Delhi, a major city, and public investment in both the region and its surroundings.
- iii) To encourage employment-generating activities at locations that are well-suited for such activities and offer a pleasant atmosphere for people to work and enjoy a good quality of life, such as small-scale industrial work opportunities, offices spaces, institutions, commercial centers, IT parks, etc.

WORK DETAIL

The planning team, which included town planners from the NOIDA Authority, GNIDA Authority, Yamuna Expressway Authority, and NCR Planning Cell, Ghaziabad, developed the following works to be included in the Master Plan in order to accomplish these goals:

- 1) Briefly analyze the following elements using the draft Master Plan 2021 document and additional secondary source data:

- i. Topography and physiographic aspects;

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| ii. Soil properties and climate; | | |
| iii. | Regional | context |
| iv. Patterns of land use; | | |
| v. Hydrological studies of surface flow, subterranean water table, and aquifer; | | |
| vi. Patterns of transportation; and | | |
| vii. Patterns of settlement | | |

- 2) Examine the patterns of growth and related issues over various time periods.
- 3) Examine the opportunities and limitations of development in Noida and the surrounding territories, and pinpoint possible locations for planned future expansion within the urbanisable boundaries of the city.
- 4) Examine the Authority's land commitments, both present and prospective, for different activities.
- 5) Using the analyses above as a basis, project the following factors for the target year 2031: i. Population; ii. Industrial and other economic and employment-generating activities; and iii. Area requirements for residential, commercial, industrial, recreational, public and semi-public, and transportation-related uses; facilities, and infrastructure in the city.
- 6) Create a master plan for the city for the year 2031 that includes recommendations for changes to land use, redensification, urban design elements, etc. pertaining to the area covered by the earlier Plans, while also incorporating the provisions of the previously prepared and approved Master Plan documents of Noida and any changes made from time to time.
- 7) Create a comprehensive transport network plan that includes the networks needed to connect the city to Delhi and other nearby communities.
- 8) Create a Concept Plan for the Landscape Structure at the city level.
- 9) Create zoning regulations, which could be helpful in the process of creating sector-specific or local-level plans.
- 10) Create the required documentation and illustrations, outlining the plan's recommendations.

PHYSICAL CHARACTERISTICS OF THE PLANNING AREA

REGIONAL CONTEXT, AREA AND LOCATION

Noida is listed as one of the Central NCR (CNCR) towns in the National Capital Region's (NCR) Regional Plan - 2021, along with Ghaziabad - Loni, Gurgaon, Faridabad, Bahadurgarh, and Kundli. According to the plan, the Central NCR's opportunities should be fully utilized in order to compete with the NCT of Delhi on the basis of comparable employment, economic activity, a comprehensive transportation system, housing, social infrastructure, and environmental and quality of life. The U.P. Sub-Region is currently developing a sub-regional strategy. But Noida will undoubtedly play a big part in the framework of the NCR, the CNCR, and the Sub-Region. As part of a growing conurbation that includes Faridabad, Greater NOIDA, Bulandshahar, Meerut, and Ghaziabad in addition to Delhi, NOIDA is eventually expected to develop into a stand-alone town with well-planned and established business, industrial, trade, and commerce, residential, institutional, and recreational activities.

PHYSIOGRAPHY

Any area's physiographic characteristics define the possibilities and limitations for a town's expansion and development. The town of Noida is located between Hindon and Yamuna in the Yamuna basin. The region's topography is primarily plain, with a slope that gradually changes from northeast to southwest at a rate of 0.2-0.1%. The lowest elevation is 195 meters above MSL close to Garhi village in the southwest of the region, and the highest point is 204 meters above MSL near Parthala Khanjarpur village in the northeast. The majority of Noida is located below 200 meters above mean sea level. It should be mentioned that Noida is the lowest point in relation to the areas around it, and that the area's overall level is lower than the Yamuna River's peak flood level. The area is only kept from flooding because to the construction of an embankment along the Yamuna and Hindon rivers. However, efficient storm water and sewage disposal is hampered by the area's overall low elevation.

CLIMATE

This region sees two extremes of climate since its climate is similar to that of central India. The summer months of March through June see maximum temperatures reaching over 45 degrees Celsius. The winter season lasts from October through February, with a low temperature of roughly 4 degrees Celsius. Beginning the first week of July and lasting through the end of September is the monsoon season. Even though Noida boasts sizable green spaces and well-developed green areas, the rising amount of suspended particulate matter (SPM) in the air is a reason for concern due to the city's extensive development activity.

FLORA AND FAUNA

Although there are now no natural forests in the area, the vegetation there is of the sub-tropical deciduous type. Large expanses of agricultural land are intermingled with significant tree species, including Shishum, Mango, Jamun, Imlu, and Babul. The Gulmohar, Ashok, Eucalyptus, and Chameli trees are the most common decorative trees in the area. It's evident from the wildlife that there aren't many wild animals in this region. The pig and monkey are the most prevalent animals in the region. Peacocks, ducks, partridges, and snipes are among the birds that are frequently spotted in the area, especially close to the protected vegetation area. The Okhla Bird Sanctuary is located in the Yamuna, next to the Okhla barrage, and was built by the Uttar Pradesh government. During the winter, migratory birds call this bird sanctuary home.

DRAINAGE

The Yamuna river flows westward while the Hindon river flows eastward, enclosing the planning area. There are several perennial and non-perennial drains in the region in addition to these two major rivers. Therefore, it seems sense that the drainage channels all follow the slope that runs from northeast to southwest. The Yamuna and Hindon rivers are both at their mature stages. One non-perennial Hindon channel that has been left out is 10 and may be found mainly in the region's center, close to Sharfabad hamlet. Stormwater from the Noida region empties mostly into the Yamuna River and also partially into Hindon. The planning area has several ponds and drains in addition to the rivers Yamuna and Hindon.

DEMOGRAPHIC CHARACTERISTICS

GROWTH AND DISTRIBUTION OF POPULATION

The population of Noida city grew by nearly 400 per cent during 1981-91 and 108 percent during 1991-2001. This is not surprising because the period represented the takeoff stage of the new town, which was founded in 1976. A study completed by the School of Planning and Architecture, New Delhi (SPA), estimated that the population of Noida had increased to 2,11,534 in 1995. The study also suggested that as much as 20 per cent of the population lived in jhuggi clusters, another 48 per cent in the urban villages and only 32 per cent resided in the developed residential sectors. A detail survey conducted by the Noida Authority and district administration in 2008 indicates that there are about 11000 hutments in Noida. The Authority has taken up the resettlement plan of these hutments. Population of Noida, as reported by the Census of India, 2001 was 305058 persons. The census enumeration in 2010 indicates that the population of Noida in the year 2010 is more than 10 lakhs.

AGE COMPOSITION

The School of Planning and Architecture, New Delhi, undertook a Socio-Economic and Transportation Study in 1987 that offers a thorough breakdown of the age-sex makeup of Noida's population. According to this report, the working age group of 15–60 years old accounted for 65.39 percent of the population, while children under the age of 15 made up 30.74 percent. The comparatively younger group of individuals in this age range, who were between the ages of 15 and 40, made up as much as 45.93 percent. Elderly people over 60 made up just 3.87 percent of the population. A new town's population is primarily made up of people in working age groups, which is indicative of its rapid growth due to employment prospects.

SEX RATIO

In 1991, the notified area's population sex ratio was 782, which is relatively low when compared to most other cities. However, the primary reason for this low number is that Noida City was still in its early stages of development at the time, with the majority of its population being recently arrived migrants who were primarily lone migrants. As the city has grown, the original lone migrants have brought their families to reside with them, as seen by the 1995 study's findings that the sex ratio had increased to 895. As a result, the proportion of children and the elderly in the population has increased.

LITERACY RATE

According to the 1991 census, the literacy rate is 65.68 percent, which is significantly lower than the national average for the urban population, which was 73.08 percent. Additionally, it is just somewhat below than Ghaziabad, United Arab Emirates, which has a literacy rate of 67%. Noida's low literacy rate can be attributed, in part, to the city's attraction of a huge number of migrants from nearby villages and small towns, the majority of whom lack formal education.

Noida's literacy rate, which was more than 80% in 2001, has significantly improved since the city's early years

of development. Nearly every area of Noida has seen the development of educational facilities, which has raised the city's standards for general education and literacy.

LAND USE AND DEVELOPMENT IN NOIDA TOWN

An attempt is made to use the land as best as possible for the development of the community through the process of land use planning. Land use planning, which offers clear guidelines and a roadmap for the future development of the planned area, determines the future size, pattern, and direction of growth, form, etc. of the area.

The Land uses were divided into seven category in the following way:

- 1 Residential
- 2 Commercial
- 3 Industrial
- 4 Public and Semi Public
- 5 Transportation
- 6 Organised open spaces
- 7 Unusable water bodies

RESIDENTIAL DEVELOPMENT

About 3358 hectares, or 36.45 percent, of Noida's 9211 hectares of developed land are used for residential purposes. The 1980s saw the majority of residential sector development. A total of 1,559.45 hectares were developed into at least 33 sectors. One of Noida's most significant policies has been the development of group housing with the goals of better utilizing the existing land, accommodating a larger population, and providing inexpensive housing units.

INDUSTRIAL DEVELOPMENT

In Noida, the growth of the industrial sectors has happened gradually. Consequently, a total of 973 hectares of industrial land were developed, resulting in the provision of 6,658 plots under the Export Promotion Zone Development Schemes and Phases I, II, III, and Extension. In 1998, there were 3587 small-scale units and 235 medium- and large-scale units registered in Noida. About 1267 hectares of industrial property has been developed by the year 2010. Noida has emerged as a desirable location for industrial investment by entrepreneurs due to its proximity to Delhi.

COMMERCIAL DEVELOPMENT

The development of residential, industrial, and institutional properties comes before the development of commercial areas. The proportion of commercial development is lower than anticipated. A total of 102 hectares of developed land are utilized for commercial purposes in various parts of the city. One city center, comprising roughly 98.59 hectares of land in sectors 32 and 25A as well as a few smaller sub-district centers, is suggested in the Noida Master Plan 2021. About 35 hectares of Sector 18 have been developed as a major business district. Nearly every area of Noida has seen the development of handy local and sector-level shopping centers.

AGRICULTURE AREA

Approximately 378.47 hectares of land, mostly along the Yamuna embankment, are intended for agricultural usage. This region lies between several sections and the embankment. It is suggested that this land be used mostly for farm houses, with a maximum of 10% of the land being covered. The remaining 90% of the developed farm houses will be left open and mostly green. Nearly every Indian city has seen encroachment, unplanned and unauthorized colonization, and the growth of unapproved urban extension when agricultural land is next to urban operations. The agricultural area's urban areas are expanded through subsequent Master Plan exercises.

RIVER FRONT DEVELOPMENT AREA

The two Yamuna and Hindon river embankments surround Noida. In general, urbanization is suggested for the region between these two embankments. More than 5000 hectares of land along the banks of both rivers have not been recommended for urban development because this is essentially a flood-prone area. The Yamuna River experiences insufficient flow and volume of water for much of the year. The river's water flow has decreased as a result of Delhi's excessive water use, rapid urbanization, and encroachment on the riverbanks. The untreated sewage water that pours from buildings has contaminated the river to a great degree.

Nonetheless, the Yamuna River produces extremely high water flows during rainy seasons, and occasionally floods in Delhi and Noida are caused by rainwater spilling from dams. Preserving areas vulnerable to flooding is crucial. Consequently, there have been no proposals for urban activities along the banks of either river.

RECOMMENDATIONS

Environmental Impact: involves analyzing data on pollution levels, changes in flora and fauna, and the impact on wetlands and aquifers; changes in livelihood patterns, and the emergence of new social classes.

Urban Planning Strategies: involves analyzing land-use patterns, transportation infrastructure, and the integration of green spaces.

Explore future scenarios for Noida's development and their potential implications for the Yamuna River Basin: using modelling techniques to assess the impact of different growth patterns on water resources, pollution levels, and urban sprawl.

Investigate policy recommendations for mitigating the negative impacts of Noida's development and promoting sustainable urban growth: proposing measures for pollution control, green infrastructure development, and promoting more compact and walkable urban design.

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