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A Study of Urban Morphology of Patna

by **Smriti Divya,** *Assistant Professor,*
Department of Geography,
Fatima Degree College, Phulwari Sharif,
Gonpura, Patna - 801505, India
Email: smriti.divya20@gmail.com

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Abstract:

This paper explores the urban morphology of Patna, one of the oldest inhabited cities in South Asia, through a theoretical approach. Tracing its evolution from the ancient city of Pataliputra to the contemporary urban fabric of a designated Smart City, the study analyzes the spatial transformations influenced by historical, colonial, and post-independence urban developments. Using frameworks such as the Conzenian approach, space syntax theory, and postcolonial urban theory, the research identifies Patna's unique morphological patterns, characterized by linear riverine growth, layered historical cores, and emerging unplanned expansions. The paper emphasizes the importance of integrating morphological understanding into sustainable urban planning and heritage conservation efforts, especially in cities with complex historical geographies like Patna.

Keywords: Urban Morphology, Patna, Spatial Structure, Conzenian Approach, Smart City Planning

1. Introduction:

Urban morphology, or the study of the shape, organisation, and evolution of urban areas, provides an important foundation for understanding how cities evolve over time. Urban morphology, which examines spatial patterns, land use, street networks, and architectural forms, reveals the underlying sociopolitical, cultural, and economic processes that shape urban areas (Whitehand, 2001). Patna, one of South Asia's oldest continuously inhabited cities, is an excellent case for morphological research due to its deep historical roots, complex urban fabric, and modern alterations. Founded as Pataliputra in the 5th century BCE by the Magadhan empire, the city has gone through ancient imperial, mediaeval Islamic, colonial British, and modern Indian stages.

Each historical age has left its mark on the city's spatial organisation. Patna's current urban structure is influenced by the linear growth along the southern bank of the Ganges River, which began in ancient times. The Mughal and colonial eras included organic and grid-based planning aspects, respectively, whereas post-independence development resulted in fast unplanned expansion and infrastructural stress. Despite being named a Smart City in 2016 by India's national effort, Patna's urban growth has been mainly uncoordinated, with informal settlements coexisting with formal projects. A theoretical examination of Patna's urban morphology, using frameworks such as Conzenian town-plan analysis, space grammar, and postcolonial urban theory, can reveal the complexity of its urban form and guide more inclusive and sustainable urban development.

2. Objective:

To examine Patna's morphological evolution, identify dominant spatial patterns, and critically engage with theories that explain the city's unique urban structure.

3. Study Area:

The present study focuses on Patna, the capital city of Bihar, situated in the eastern part of India along the southern bank of the river Ganga. Geographically,

Patna lies between latitude 25°37′N to 25°41′N and longitude 85°5′E to 85°16′E, at an average elevation of 53 metres (174 feet) above sea level (Government of Bihar, 2020). The city stretches over an area of approximately 250 square kilometres, making it one of the largest urban agglomerations in eastern India.

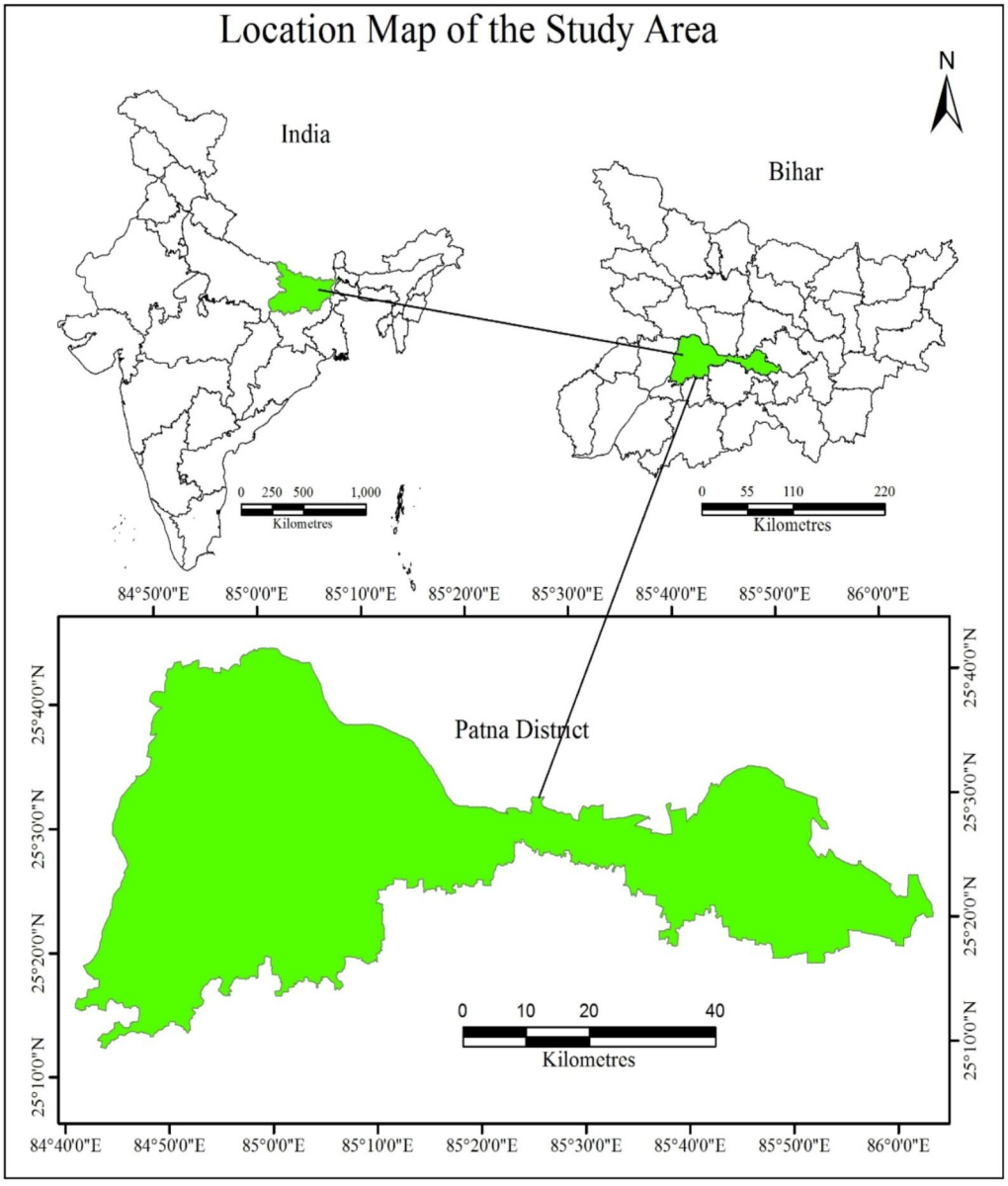

Fig. 1: Map of the study area

Patna occupies a strategic location in the Indo-Gangetic Plain, which has historically supported dense human settlement due to its fertile alluvial soil and abundant water resources. The city is bordered by the Ganges River to the north, the Punpun River to the south, the Gandak River to the west, and the Son River to the southwest. This riverine geography has not only influenced the agricultural economy of the region but also facilitated trade, cultural exchange, and religious pilgrimages across centuries (Singh, 2012). The historical core of Patna, formerly known as Pataliputra, was established near present-day Kumhrar, an area known for archaeological remnants of the Mauryan Empire.

4. Results and Discussion:

4.1 Historical Evolution and Spatial Organization:

4.1.1 Ancient Foundations: Pataliputra

The history of Patna begins with Pataliputra, which was founded by Ajatashatru, the Magadha king, in 490 BCE. Pataliputra, which was strategically situated at the meeting point of the Ganges and Son rivers, was the capital of the Mauryan and Gupta empires, among others. The city, which was protected with timber walls punctuated by 64 gates and complemented by 570 towers, was characterised during the Mauryan period as a parallelogram that measured roughly 14.5 km in length and 2.4 km in width. Megasthenes, a Greek diplomat who lived in Pataliputra, wrote on its splendour, highlighting its effective municipal government and striking urban design.

4.1.2 Colonial Transformation:

Patna saw substantial change during British colonial administration, especially after it was designated as the headquarters of the newly created province of Bihar and Orissa in 1912. The New Capital Area developed as a result of the city's westward expansion to accommodate administrative functions. The Patna High Court and the Secretariat are two prominent examples of the Indo-Saracenic and Renaissance architectural styles that defined this region. One example of neo-classical architecture is the Patna High Court, which was built by architect Joseph Fearis Munnings and opened in 1916. Similarly, one of the biggest government structures in the city is the Patna Secretariat, which was also designed by Munnings and finished in 1917. It has the Indo-Saracenic architecture.

4.2 Theoretical Frameworks in Urban Morphology:

Several theoretical models are used in urban morphology, the study of the shape and structure of urban areas, to examine and understand how cities are arranged spatially. A number of traditional models provide important insights into the patterns of urban development in Patna.

Ernest Burgess (1925) developed the Concentric Zone Model. According to Ernest Burgess's Concentric Zone Model, metropolitan districts radiate outward from a central business district (CBD) in concentric rings, each of which represents a distinct socioeconomic group and land use. According to this model, which is based on observations of Chicago, socio-economic status and distance from the city centre are correlated.

Using this concept, the central business district (CBD) of Patna can be defined as the historical district along the Ganges River, which includes Patna City and the former administrative centres. Transitional zones with a mix of residential and commercial uses encircle this core, followed by working-class residential zones and, farther out, middle- and upper-class residential districts. The historical development and socio-economic stratification of the city are reflected in this spatial arrangement.

4.2.1 Sector Model (Homer Hoyt, 1939):

According to Homer Hoyt's Sector Model, cities grow in sectors or wedges that radiate out from the central business district, frequently along transit corridors. This model highlights how environmental and transportation variables influence urban land usage. Major thoroughfares like Bailey Road and Ashok Rajpath have shaped Patna's urban growth, with residential and business districts growing alongside them. For example, Hoyt's sectoral growth pattern is demonstrated by the proliferation of residential neighbourhoods and commercial establishments along Bailey Road.

4.2.2 Multiple Nuclei Model (Chauncy Harris & Edward Ullman, 1945):

According to Harris and Ullman's Multiple Nuclei Model, cities should create a number of "nuclei" or centres around which various kinds of activity can

be found. Given that not all development emanates from a single central business district, this model takes into consideration the intricacy of urban growth. Patna demonstrates the traits of this paradigm, with a number of discrete hubs acting as administrative, commercial, and residential hubs, including Rajendra Nagar, Kankarbagh, and the New Capital Area. The city's varied development and the decentralisation of operations outside of the historic core are reflected in these several nuclei.

4.3 Contemporary Urban Dynamics:

Patna has experienced tremendous urban change in recent decades, characterised by both vertical and horizontal growth. The city's response to growing population pressures, economic development, and infrastructure demands is reflected in this increase.

4.3.1 Vertical and Horizontal Growth:

According to research conducted between 2015 and 2018 using Synthetic Aperture Radar (SAR) remote sensing techniques, Patna saw significant vertical expansion, especially in the periphery, and modest horizontal growth through infill processes (Prakash et al., 2023). The construction of high-rise structures and infrastructure projects in these locations caused the vertical expansion to reach about 4 meters annually. The city core, which is already heavily inhabited, had little vertical expansion; instead, densification within already-existing urban spaces was the main focus.

4.3.2 Influence of the Ganges River:

The urban structure of Patna is still significantly shaped by the Ganges River. To improve east-west communication and reduce traffic on main thoroughfares like Ashok Rajpath, the Loknayak Ganga Path (JP Ganga Path), a 20.5 kilometre motorway along the river, is being built. This four-lane, partially elevated motorway, which runs from Digha in the west to Deedarganj in the east, improves traffic flow and encourages business along the riverbank. But there are drawbacks to being close to the Ganges. Because of its low height in relation to the river's flood levels, Patna is vulnerable to flooding, especially during the monsoon season. Waterlogging is made worse by the city's saucer-shaped geography, as demonstrated during the 2019 floods, when multiple parts stayed underwater for days.

The city's vulnerability is increased by elements like flooding, insufficient drainage systems, and changes in rainfall patterns brought on by climate change. In order to overcome these obstacles, coordinated urban planning that takes into account both the risks posed by environmental hazards and the benefits offered by the riverside is necessary. Resilient urban development in Patna requires enforcing laws against encroachments, improving drainage infrastructure, and putting sustainable land use methods into effect.

4.4 Difficulties and Possibilities:

The complex topography of Patna's urban morphology is influenced by social inequality, environmental stressors, infrastructure limitations, and fast urbanisation. A diversified strategy that incorporates community involvement, sustainability, and planning is needed to address these issues.

4.4.1 Stress on the Infrastructure:

Because of the city's rapid urbanisation and population increase, the infrastructure is under a lot of strain. Prolonged road closures and excavation have resulted from ongoing projects like the Patna Metro and the double-decker flyover on Ashok Rajpath, which have seriously impacted traffic and raised safety concerns. Disruptions are reported by local companies and residents, with some areas having poor illumination, especially at night, and drainage overflows. The public's dissatisfaction has been made worse by the agencies' lack of collaboration.

4.4.2 Environmental Degradation:

Unplanned urban growth has led to the loss of waterways and green areas, which exacerbates the urban heat island effect. According to studies, urban development and encroachment have caused Patna's green cover to drastically decline during the previous few decades. Higher land surface temperatures brought on by the substitution of impermeable surfaces for vegetation have an effect on the city's microclimate and raise energy consumption.

4.4.3 Socio-economic Disparity:

There are glaring differences in Patna's accessibility to facilities and services in various locations. Research shows that while the northern and eastern

regions of the Patna Municipal Corporation area fall behind, the middle and southern regions have greater development of household amenities. Accessing essential services like water, sanitation, healthcare, and education is difficult in slum areas like Kamla Nehru Nagar, underscoring the need for focused efforts.

4.4.4 Opportunity for Sustainable Development:

Notwithstanding these obstacles, Patna has the chance to guide its urban growth in an inclusive and sustainable manner:

- **Integrated Urban Planning:** Resilient infrastructure and balanced urban growth can be achieved by putting into practice comprehensive plans that take historical contexts and future growth into account.
- **Green initiatives:** can help slow down environmental deterioration by conserving and restoring green areas. The liveability of the city can be improved by establishing parks and implementing urban forestry techniques.
- **Equitable Service Delivery:** Socio-economic gaps can be closed by concentrating on the fair allocation of facilities and services. Planning procedures that involve communities guarantee that growth will satisfy the various demands of locals.

Through integrated planning and community involvement, Patna may solve social injustices, environmental issues, and infrastructure deficiencies, transforming its urban morphology into a model of inclusive and sustainable development.

5. Conclusion:

Patna's urban morphology exemplifies a dynamic interplay between historical legacies, geographical placement, and contemporary urban dynamics. Patna's spatial evolution reflects greater sociopolitical and economic upheavals, from its inception as Pataliputra, an ancient city strategically placed along the Ganges River, to its metamorphosis under British colonial control and subsequent modern improvements. The city's old layout, which features a parallelogram shape with defended timber walls and many gates, exemplifies early urban design sophistication. This basic structure laid the groundwork for future additions and alterations.

Patna has seen rapid urbanisation in recent decades, with both horizontal development into peripheral districts and vertical rise within the city centre. This expansion has been impacted by causes like as population growth, economic development, and infrastructure initiatives such as the Loknayak Ganga Path, which aim to improve connectivity and urban transportation.

Understanding Patna's urban morphology using theoretical frameworks such as the Concentric Zone Model, Sector Model, and Multiple Nuclei Model provides important insights into its spatial dynamics. These models contribute to the understanding of residential, commercial, and administrative zone patterns, as well as the impact of transportation corridors on urban growth.

For urban planners and policymakers, understanding Patna's morphological evolution is critical to promoting sustainable and equitable urban growth. This includes balancing historical preservation with modern infrastructure needs, resolving environmental concerns, and encouraging fair access to urban facilities. By connecting planning initiatives with the city's distinct historical and geographical environment, stakeholders may guarantee that Patna's expansion is both resilient and representative of its rich history.

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