Journal of Contemporary Urban Affairs

2025, Volume 9, Number 2, pages 368-386

Original scientific paper

From Connectivity to Liveability: Enhancing Urban Waterbody Accessibility through Space Syntax in Dhaka

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ARTICLE INFO:

Article History:
Received: 22 May 2025
Revised 1: 31 July 2025
Revised 2: 25 August 2025
Accepted: 29 August 2025
Available online: 3 September 2025

Keywords:
Space Syntax;
Urban Waterbodies;
Public Open Space;
Accessibility;
Spatial Integration;
Dhaka City.

ABSTRACT

Urban waterbodies play a vital role in enhancing ecological sustainability, social interaction, and neighbourhood liveability, yet in rapidly urbanising contexts such as Dhaka, they are increasingly threatened by encroachment, pollution, and reduced accessibility. This study investigates the accessibility and spatial integration of two significant urban waterbodies (Dholaikhal Narinda Pond and Shahjahanpur Jheel) under the Dhaka City Neighbourhood Upgrading Project (DCNUP), which seeks to revitalise public open spaces for disadvantaged communities. Using Space Syntax analysis, the research assesses spatial configuration through measures of Connectivity (CN), Global Integration (Rn), and Local Integration (R4) to evaluate accessibility at city and neighbourhood scales. Results indicate that Dholaikhal Narinda Pond demonstrates higher connectivity and global integration values, positioning it as a potential city-scale destination capable of enhancing urban inclusivity. By contrast, Shahjahanpur Jheel, though limited in city-wide accessibility, exhibits strong local integration, highlighting its potential as a neighbourhood-scale public space. These findings underscore the importance of aligning spatial analysis with urban design strategies to enhance accessibility and maximise social benefits. The study concludes that integrating syntactic measures into early project planning can help policymakers and urban designers anticipate patterns of use and achieve more equitable and sustainable revitalisation of public waterbodies in Dhaka.

JOURNAL OF CONTEMPORARY URBAN AFFAIRS (2025), ***9***(2), 368-386.
https://doi.org/10.25034/ijcua.2025.v9n2-3

www.ijcua.com

Highlights:	Contribution to the field statement:
-Higher connectivity (CN) increases accessibility, making Dholaikhal Narinda Pond more suitable as a city-scale public space. -Global integration (Rn) enhances spatial equity, supporting Dholaikhal's role as an inclusive urban destination. -Local integration (R4) improves neighbourhood liveability, positioning Shahjahanpur Jheel as a community-scale public space. -Intelligibility of the spatial grid predicts potential public use, guiding equitable waterbody revitalisation strategies.	This study advances urban spatial research by applying space syntax to assess accessibility of Dhaka's waterbodies, revealing distinct city- and neighbourhood-scale potentials. It contributes new evidence on how spatial configuration influences equitable public space use, offering a replicable methodological framework for sustainable urban revitalisation in rapidly urbanising contexts.

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How to cite this article? (APA Style)
Mouri, F. M., Wasi, A. A., & Nilufar, F. (2025). From Connectivity to Liveability: Enhancing Urban Waterbody Accessibility through Space Syntax in Dhaka. *Journal of Contemporary Urban Affairs*, 9(2), 368-386. https://doi.org/10.25034/ijcua.2025.v9n2-3

1. Introduction

Currently, over half of the world's population resides in dense urban areas, where life unfolds not only within buildings but also in the open spaces between them(Gehl, 2012) . These open spaces—parks, playgrounds, streetscapes, and waterbodies—are essential components of the urban environment,

contributing to livability, social interaction, mental well-being, and ecological balance. (Chiesura, 2004). In many cities, especially those in the Global South, rapid and often unplanned urbanization has led to the significant decline of open spaces. In the same way, Dhaka is a megacity with a higher population density, and has open spaces far less than the recommended standard. Dhaka has fewer green and public open spaces, such as parks and playgrounds, than any other megacity in the world (Alam et al., 2025). The 1995–2015 Dhaka Structure Plan acknowledged this fact as well and strongly suggested the preservation and maintenance of green spaces and water bodies which is essential for ecological balance and social equity. However, the rapid population growth led to a continuous decline in public open spaces over the decades. A land cover change study revealed that Dhaka City lost 7,146 hectares of green spaces between 1989 to 2020 (Nawar et al., 2022). Over the past two decades (2001–2021), the built-up area expanded by 27%, leading to the disappearance of many major open spaces, including waterbodies (Rahman, 2022). In 2020, urban green space made up only 1.9% of Dhaka's land area, reflecting a clear negligence of preservation measures (Khan et al., 2023). The draft Dhaka Structure Plan (2016-35) suggests a minimum of 20% open space; however, Old Dhaka retains only about 5%, and New Dhaka approximately 12%, including streets, sidewalks, parks, playgrounds, and waterbodies.

Among various open spaces, urban waterbodies—lakes, canals, and ponds- hold special significance. They provide not only ecological and environmental services, such as stormwater retention and microclimate regulation, but also have the potential to create peaceful, inclusive public spaces. Historically, Dhaka was once referred to as "The Venice of the East" owing to its extensive network of rivers, canals, lakes, and ponds. Despite this decline, the remaining waterbodies can still play a transformative role in urban life if they are revitalized and made publicly accessible. Numerous scholars have emphasized that accessibility is one of the most important criteria for the effective functioning of open spaces. As and when accessibility is ensured at a proper scale, many waterbodies can serve as vibrant public spaces that support social cohesion and enhance the quality of life. On the contrary, when such spaces lack accessibility, they often become underutilized, neglected, or vulnerable to antisocial activities, contributing to urban decline. Again, when an open space is located near a major road with a high level of accessibility from the city grid, it can create overcrowded situations, depriving the local community. A similar situation is observed in the Dhanmondi residential area, where the Dhanmondi Lake, being highly integrated into the city's urban spatial grid and having high accessibility, attracts a significant number of visitors (Roni et al., 2022). This has resulted in increased traffic congestion and reduced privacy for the local community. Such conditions can negatively impact the quality of life and disrupt the intended balance between community use and broader public engagement. Therefore, assessing accessibility is essential to achieving sustainability and livability in the planning and design of open spaces. Space Syntax is a widely recognized analytical method for understanding spatial configurations and evaluating accessibility in urban environments. While this technique has been employed in numerous studies to assess open space accessibility, its application prior to the implementation of open space projects remains limited.

Recognizing the urgent need to reclaim and repurpose these vital urban resources, DCNUP aims to improve the urban open spaces in unplanned and underdeveloped neighborhoods to make Dhaka more liveable by creating safer, more accessible, and user-friendly public spaces for all residents, with a particular emphasis on the needs of women, the elderly, youths, and people with disabilities. As part of this project, two proposed sub-projects—Dholaikhal Narinda Pond in the Nayabazar-Sutrapur area and Shahjahanpur Jheel in the Khilgaon-Basabo area—are targeted for redevelopment, transforming into accessible public open spaces with appropriate amenities for the citizens' well-being. Such development projects focusing on revitalizing water bodies can increase property values and encourage more socio-economic activities in the surrounding areas. They can attract residents, local businesses, and informal economic activities (e.g., street vendors, cultural events). However, the success of these projects depends largely on ensuring accessibility on a proper scale. Both of these waterbodies remain largely inaccessible and underutilized. Dholaikhal Narinda Pond is surrounded by informal structures and physical barriers that limit public accessibility and visibility, while Shahjahanpur Jheel lacks defined access points and proper pedestrian connectivity to the surrounding neighborhoods. As a result,

these spaces have failed to serve their potential contribution to society as a public space. The success of these projects depends largely on their accessibility. It is essential to assess whether these spaces should primarily serve their immediate neighbourhood communities or be integrated into the broader city-wide network. This raises a critical question about the scale and nature of accessibility and how it affects the potential of these waterbodies to become a vibrant and functional public space, either at the neighbourhood level or at the city scale. To address this question, this study employs Space Syntax analysis, a well-established tool for assessing accessibility in urban areas. By examining connectivity and spatial integration (Global Rn and Local R4), the analysis provides valuable insights into the accessibility of the two sites. The data-driven findings of the space syntax analysis, accompanied by insights gathered from the literature review, can help urban designers in formulating design strategy focusing on accessibility, considering local and city scales. Thus, the study attempts to provide some recommendations for the revitalization of such waterbodies to transform them into accessible open spaces. The paper has four sections. The first section discusses the conceptual framework of open space and the significance of accessibility as a primary criterion of open space. It also introduces the theoretical foundations of space syntax and a brief overview of syntactic measures, which are used to assess accessibility. The second section presents the methodology carried out in this research. The third section focuses on the result of the syntactic analysis. In the last section, the paper concludes with a discussion, followed by limitations of the research and further recommendations.

2. Literature Review

2.1 Theoretical Definition and Qualitative Criteria of Open Space

Various researchers have defined open space as the public and private land that is accessible to everyone (Ho et al., 2021). It is typically characterized by openness, inclusivity, and the potential for public use. Such spaces often support recreation, social interaction, and community engagement. They range in scale from small playgrounds to expansive recreational areas like hunting grounds (Khan, 2014). Nilufar (2000) identifies three primary functions that open spaces serve-

a) It can serve recreational purposes, fulfilling both physical and psychological needs, thereby addressing essential social and psychological aspects of human well-being.
b) It can help preserve and enhance essential environmental resources and ecological systems—such as air, water, soil, and plant life
c) It can influence economic development decisions related to land use patterns and land values, local economy, tourism, etc

In the book, “Urban Open Spaces- Designing for User Needs”, Francis (2003) mentions four characteristics for a good public open space (POS)- accessibility, activities, comfort, and sociability. In assessing various public spaces ranging from the city scale to the neighbourhood scale, researchers found some common features among the most successful and interactive ones. These successful spaces typically share four qualities determined by Mark Francis: (a) they are accessible to all; (b) they encourage diverse public activities; (c) they provide a sense of comfort and visual appeal; and (d) they foster an environment where social interaction naturally occurs. Thus, public open spaces have direct as well as indirect impact on the economic upliftment of the surrounding community.

Mark Francis also identified inaccessibility as one of the major reasons why public space fails to draw people. Studies indicate that the spatial articulation and proximity of urban open spaces significantly depend on their accessibility (Coombes et al., 2010; Swanwick, 2009; Wright Wendel et al., 2012). In efforts to preserve and enhance the value of existing urban open spaces, Thwaites & Simkins (2006) emphasize that in cities, human experiences are shaped by the organization of spatial elements and street connectivity. Well-designed spatial articulation and enhanced connectivity of the urban spatial grid can significantly improve people's engagement with the open spaces and outdoor environment. Therefore, to ensure accessibility to POS, streets should be planned and designed as vital parts of the urban spatial grid (Zhai et al., 2021).

However, over the decades, Dhaka grew organically due to the lack of controlled development and planning. This unplanned growth adversely impacted street connectivity and significantly affected the accessibility of the city's public open spaces. In several open spaces throughout Dhaka, access is

limited due to narrow streets and discontinuous sidewalks (Khan & Tabassum, 2024). The accessibility of urban open spaces serves as a key indicator for assessing a city's overall livability. Ensuring good accessibility to public open spaces is crucial for allowing residents to fully experience the ecological and social benefits provided by parks. When people can easily reach and use these spaces, they are more likely to engage in recreational and community activities. Studies have also shown a strong positive correlation between access to open spaces and higher levels of happiness among urban residents (Zhang & Zhou, 2018). Accessibility measurement can be used to assess the effectiveness and rationality of the spatial layout of public service facilities. It also provides a basis for comparing the strengths and weaknesses of different planning schemes (Long et al., 2023). In the case of Dhaka, it has been observed that many projects suffer from a lack of accessibility at the proper level, considering the city or regional level. In fact, research initiatives are rarely undertaken to investigate accessibility in the case of implementing any Public Open Space (POS) project in Dhaka.

2.2 Space Syntax Measures and Accessibility to Open Space

To determine the spatial arrangement of urban landscapes, users' temporal spatial behaviour, the routes they choose, and the relational patterns that connect different spaces, other studies have used computational simulations, such as space syntax (T. Zhang et al., 2020). Space Syntax is a method for describing and analyzing the relationships between social structure and spatial structure (Khan, 2014). The analysis of the urban grids is based on the axial map, where every street intersection within the urban grid is recorded as an intersection of axial lines (Hanson, 1989). It focuses on comprehending how human movement, interaction, and accessibility to urban environments are influenced by morphology and spatial configuration of urban spaces following the theory of Natural Movement (Jabbari et al., 2018; Mohamed et al., 2024; Valipour et al., 2019). Space Syntax is conceptually derived from the Theory of Natural Movement, and the two are closely interrelated in explaining how spatial configuration influences urban mobility. According to the "Theory of Natural Movement," as proposed by Hillier, the physical layout of streets primarily determines patterns of pedestrian and vehicular movement, independent of land use (Hillier et al., 1993). Integrated spaces will become increasingly important in urbanity, as they are located along people's regular movement network. Space Syntax builds on this foundation by providing a quantitative and analytical framework to model and measure these spatial relationships. Using tools like axial maps, Space Syntax translates the abstract idea of natural movement into measurable spatial properties. Syntactic metrics offer a reliable proxy for estimating where people are likely to move, eliminating the need for time-consuming and resource-intensive pedestrian counts. In this framework, movement is seen as an emergent property of spatial form, meaning that a well-constructed spatial analysis can provide sufficient insight into mobility patterns without direct observation. Therefore, it identifies which streets in the urban grid are most likely to attract movement.

Several space syntax metrics, such as Connectivity, Integration, Control, and Choice, can be used to evaluate the accessibility of spaces. These metrics aid in comprehending how the spatial arrangement of urban areas influences mobility and navigation (Yamu et al., 2021). According to (Hossain et al., 2025) Researchers can comprehend the potential connection between the physical form, spatial arrangement, and social dynamics in an urban setting by analyzing accessibility through space syntax. There are four first measures, which in turn are correlated to create second-order measures.

a) Integration

Integration in space syntax refers to the efficiency how a space may be accessed from every other space in a given spatial system. It also refers to the relative shallowness or depth of any spatial system as perceived from a particular location within it. Rankings of the integration values are made from the most segregated line to the most integrated. The term "integration core" refers to the collection of the most integrated streets, whose nature, form, size, coverage, and other characteristics are primarily determined by the geometry, connection, and structure of the urban system as well as how it is growing. Understanding the local spatial structure of integrated lines (R=3 or 4) is another application of the method, which involves computing a

more immediate measure that provides integration value among the spaces up to three or four steps away from the root (Khan, 2014). Empirical research has now shown that integration closely matches patterns of space occupancy, use, and movement seen in towns and cities across the globe**.**

b) Choice (CH)

Choice (CH), the second metric, indicates how much of a specific element (axial line) should be covered by the shortest paths connecting every space in the spatial system to every other space. One dynamic global metric is the global choice (Khan, 2014).

c) *Connectivity (CN*)

Connectivity (CN) is the number of spaces that immediately connect a space of origin. It is a local syntactic metric that is constant. A higher CN number denotes greater mobility possibilities and improved accessibility.

d) Control (CV)

The degree of choice a location offers its near neighbours as a destination is represented by the Control (CV) (Hanson, 1989).

Space syntax provides quantitative evaluations of various levels of accessibility inside the urban spatial network by analyzing network centrality. Researchers emphasize the value of space syntax techniques in evaluating open spaces' usability to improve their social and physical functionality in a city (Long et al., 2023; Tannous et al., 2021). Previous researchers found a relationship between road network analysis from space syntax and public open space accessibility. If the streets adjacent to the parks are more integrated, the accessibility to the parks is also higher (Huang et al., 2020). Currently, a number of studies have adopted the space syntax method for quantitatively assessing accessibility of various types of spaces (Khan, 2014; Rahman & Nilufar, 2024). Syntactic analysis has also been used to evaluate urban waterbodies' accessibility. A study used space syntax and GIS to assess the Songxi River's urban riverfront accessibility through axial and segment models, analyzing integration and choice (Luo & Lin, 2023). Another study applied space syntax to analyze global and local integration of access routes at Dhaka's Hatirjheel Lakefront to understand accessibility (Hossain et al., 2025).

All these studies found a strong correlation between the spatial integration of a city's street network and accessibility of adjacent open spaces. Given the city's complex urban fabric and irregular street connectivity, ensuring the scale of public accessibility and engagement remains a significant challenge, often contributing to the failure of projects in achieving their intended goals. Therefore, such a method can be effective in the decision-making process for determining the level and scale of accessibility of urban projects in dense developed cities like Dhaka.

3. Materials and Methods

3.1 Study Design and Setting

The study setting includes dense, mixed-use neighborhoods in Nayabazar-Sutrapur and Khilgaon-Basabo. The selected study areas for this research are Dholaikhal Narinda Pond and Shahjahanpur Jheel. These waterbodies are two significant sub-projects under the DCNUP targeted for redevelopment as large-scale recreational spaces. However, both projects face critical challenges related to accessibility, which is essential for transforming them into functional public spaces.

Table 1: List of Study Area.

Sl no	Name of the open space	Zone	Ward No	Area (sq m)	Open space Category
1.	Dholaikhal Narinda Pond Development	Nayabazar-Sutrapur	44	14,200	Waterbody
2.	Shahjahanpur Jheel Development	Khilgaon-Basabo	11	21,290	Waterbody

Figure 1. Satellite image of Dholaikhal Narinda Pond.

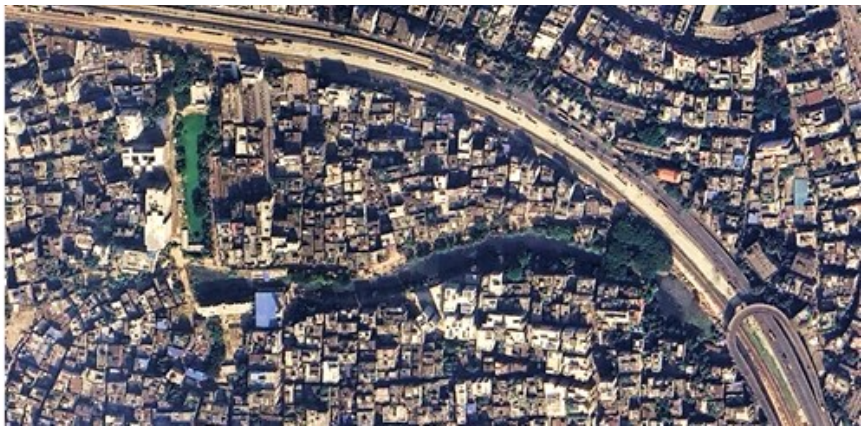

Figure 2. Satellite image of Shahjahanpur Jheel.

The study adopts a quantitative method. The research was conducted through a combination of literature review, field surveys, and space syntax analysis. A literature review was conducted to establish the theoretical framework, while fieldwork documented existing physical conditions and accessibility barriers. Axial map of Dhaka city was produced, and syntactic measures (Connectivity, Integration Rn and R4) were analyzed using DepthmapX. Regression analysis was employed to examine the relationship between the syntactic measures (Rn-CN and Rn-R4) for understating the intelligibility of the study areas and determine the level and scale of accessibility of the two sites. Based on the analytical outcomes, design suggestions were formulated to strengthen the socio-spatial integration of the revitalized waterbody sites.

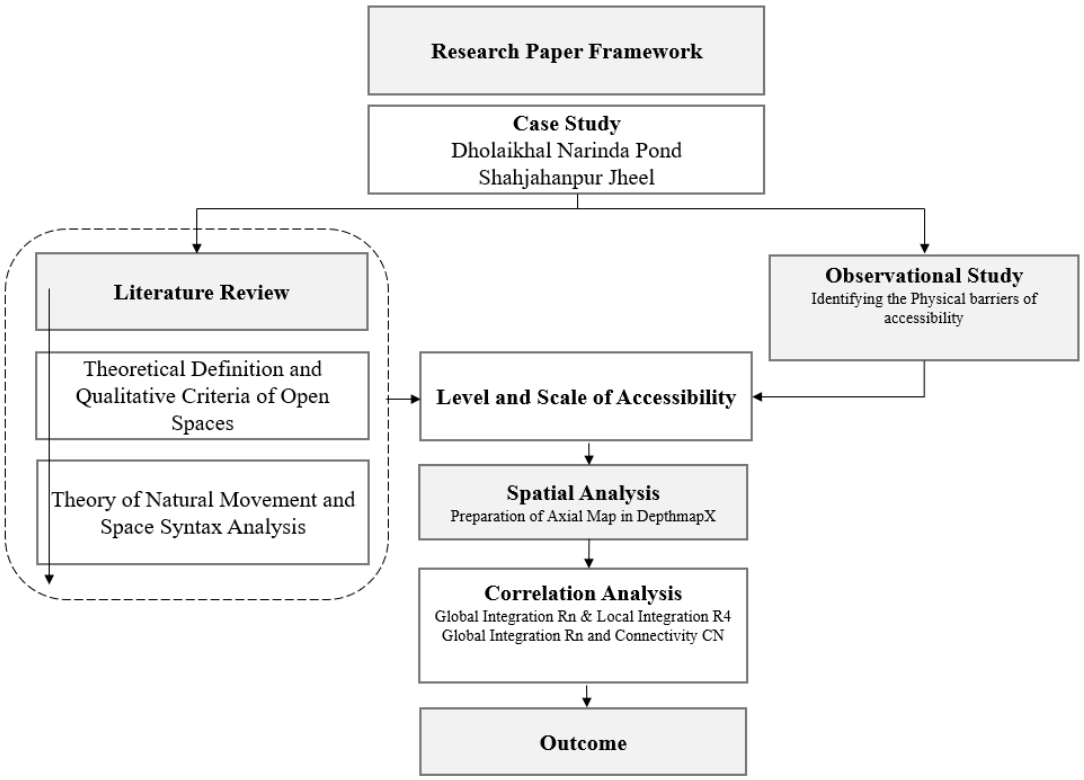

Figure 3. Research framework.

3.3 Historical Background and Present Condition of the Study Area

A field survey was carried out to observe the current scenario, record the present conditions, identify the accessibility barriers, and comprehend the social dynamics of the study areas in order to thoroughly analyze the geographical accessibility of the study areas. Relevant maps were collected from government authorities.

Figure 4. Figure-Ground Maps of Dholaikhal and Shahjahanpur Jheel.

3.3.1 Dholaikhal Narinda Pond

This site is located in Ward 44, near Dholaikhal Street, Sutrapur, and has its unique charm, reflecting the effervescent history of Old Dhaka. It was originally a part of the Dholaikhal canal excavated during the Mughal period between 1608 and 1610. This canal served both defensive and navigational purposes, flowing through the heart of the city and connecting the Balu River near Demra to the Buriganga River. Over time, the canal became clogged with debris and was eventually transformed into an underground drainage system in certain sections. Dholaikhal Narinda Pond, which spans 4.2 hectares of land and serves as a retention site, is a minor section of the historic Dholaikhal (Das & Islam, 2010). The surrounding neighbourhood is predominantly residential, with many metal workshops operating at the ground level. The area has witnessed significant changes, with remnants of the canal's historical significance still evident in the urban landscape.

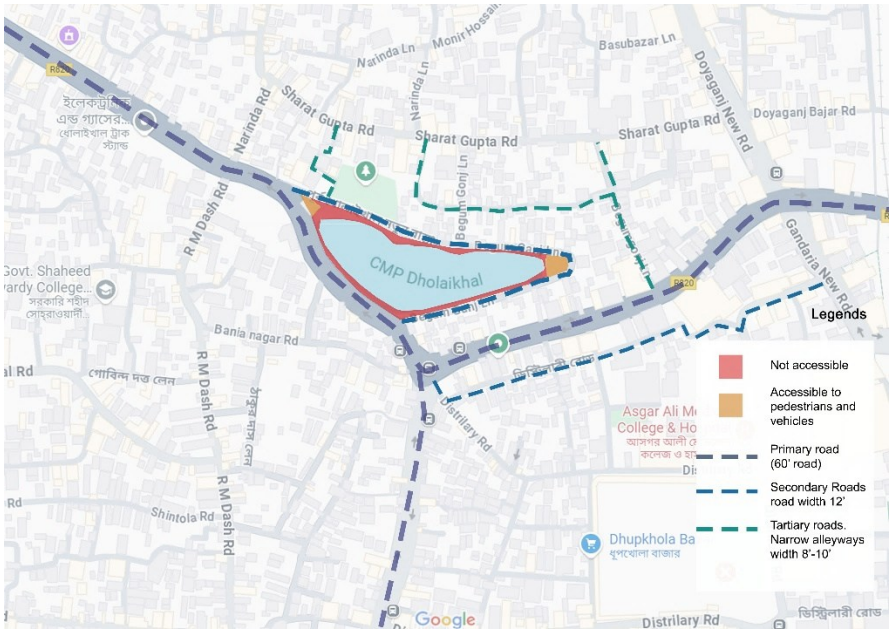

Figure 5. Map of accessibility Dholaikhal Narinda Pond.

Figure 6. Surrounding environment of the Dholaikhal Narinda Pond.

Dholaikhal Narinda Pond currently suffers from several critical spatial challenges that hinder its potential as a public open space. The site lacks direct access from the surrounding street network and visual permeability, as perceived by potential users, as it is enclosed by a boundary wall. The adjacent informal structures also work as a physical barrier and obstruct sightlines. Moreover, the pond itself is in a state of severe neglect, with accumulated dirt and waste contributing to water pollution and further deterring engagement. This physical enclosure, combined with the absence of designated access points and poor connectivity with the surroundings, results in a significant lack of accessibility. Therefore, limits the effective prevention of community interaction with the waterbody and has no connection with the surrounding neighbourhood. As a result, the space remains entirely unused by the public and

has no public activity. These factors have collectively disconnected the pond from the surrounding urban fabric, making it an underutilized space. Thus, accessibility became a primary design issue during revitalization.

3.3.2 Shahjahanpur Jheel

Shahjahanpur is one of the historical Jheels of Dhaka, which is relatively bigger in size. It is located to the northwest of the Central Railway Station, in a dense, middle-low-income residential neighbourhood of Dhaka. Over the years, encroachments, sewage pollution, and land repurposing for development have changed the Jheel's dynamics. These changes have significantly altered its original character and affected the surrounding community. The site is delimited by the railway tracks to the east. This creates a physical separation and limits accessibility, which gives the neighbourhood an introverted character.

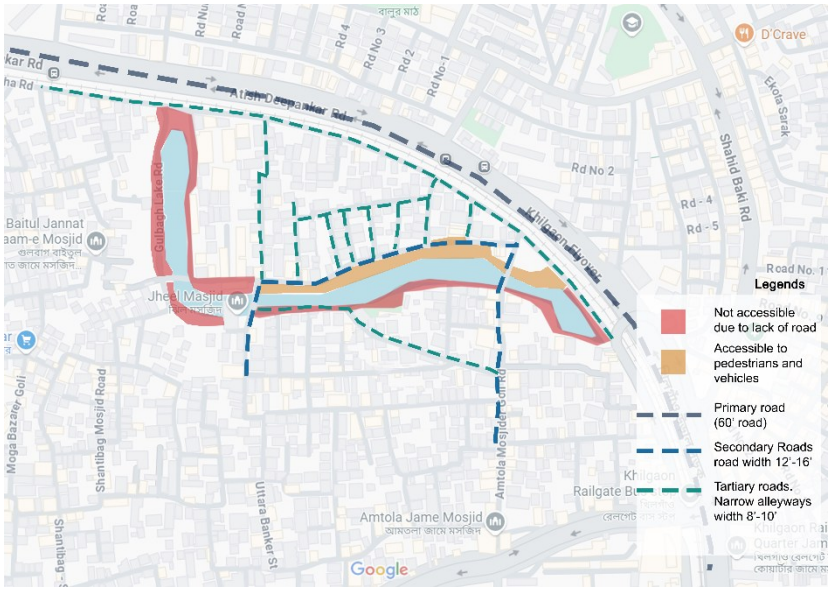

Figure 7. Surrounding environment of the Dholaikhal Narinda Pond.

Figure 8. View of the surrounding urban environment of the Shahjahanpur Jheel.

Shahjahanpur Jheel does not have any prominent visual barrier like Dholaikhal Narinda Pond; it still suffers from limited accessibility. Access to the site is limited primarily from the adjacent primary roads. Access is mostly restricted to the internal circulation network, having narrow, unpaved streets and alleys. Many of these streets are discontinuous and lack proper pedestrian infrastructure. Additionally, encroachments and private landholdings along the Jheel's edge further constrain public access at several points. While some informal activities, such as a local *Bazaar*, take place along the water edge, overall public activity of the space is limited. The waterfront edge is fragmented and has no defined pedestrian access to the waterbody.

3.4 Spatial Analysis

To assess the spatial configuration and accessibility of the two study areas, Space Syntax analysis was carried out using DepthmapX, which is a widely used tool for quantitative assessment. The axial map of Dhaka was generated in DepthmapX, representing the city's road network through the fewest and longest lines of sight and potential movement. The axial map served as a key analytical tool for examining the spatial integration of the study areas in relation to the broader urban grid of Dhaka, highlighting the degree to which these areas are spatially integrated or segregated.

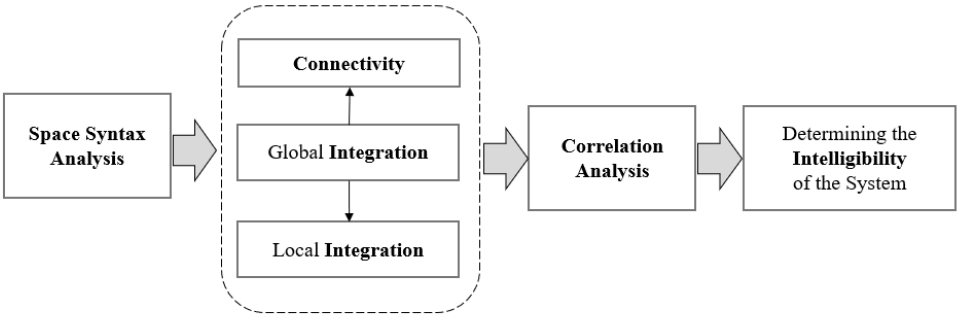

Figure 9. Analytical framework.

Using the axial map, global (Rn) and local (R4) integration values, and connectivity (CN) values were extracted and analyzed to determine the relative spatial accessibility of the study area. The intelligibility of the system was measured by the correlation of global integration-connectivity (Rn-CN) and global integration-local integration (Rn-R4). From a local level to a broader city context, it results in a strong sense of grid reliability. Following the space syntax analysis, the required scattergram plots, correlation charts,and graphs were produced. This analysis helped reveal the degree to which the spatial structure supports or hinders accessibility.

The overall spatial structure of Dhaka appears to be well integrated with the other spaces at the centre and gradually segregates towards the outer side of the city (Figure 10). The syntactic measures-connectivity and integration (Rn and R4) of Dhaka and the study areas are listed in Tables 2, 3 and 4. Integration values ending at or above 1 indicate strong integration, while more segregation is indicated by integration values between 0.4 and 0.6.

Table 2: Maximum, Minimum, and Mean Connectivity, and Integration (Global and Local) Value of Dhaka.

Maximum, Minimum, and Mean Connectivity, and Integration (Global and Local) Value of Dhaka			
	CN	**Rn**	**R4**
Min	1	0.430179	1.09697
Average / Mean	6.72046	0.765563	1.89624
Max	84	1.17387	3.77738

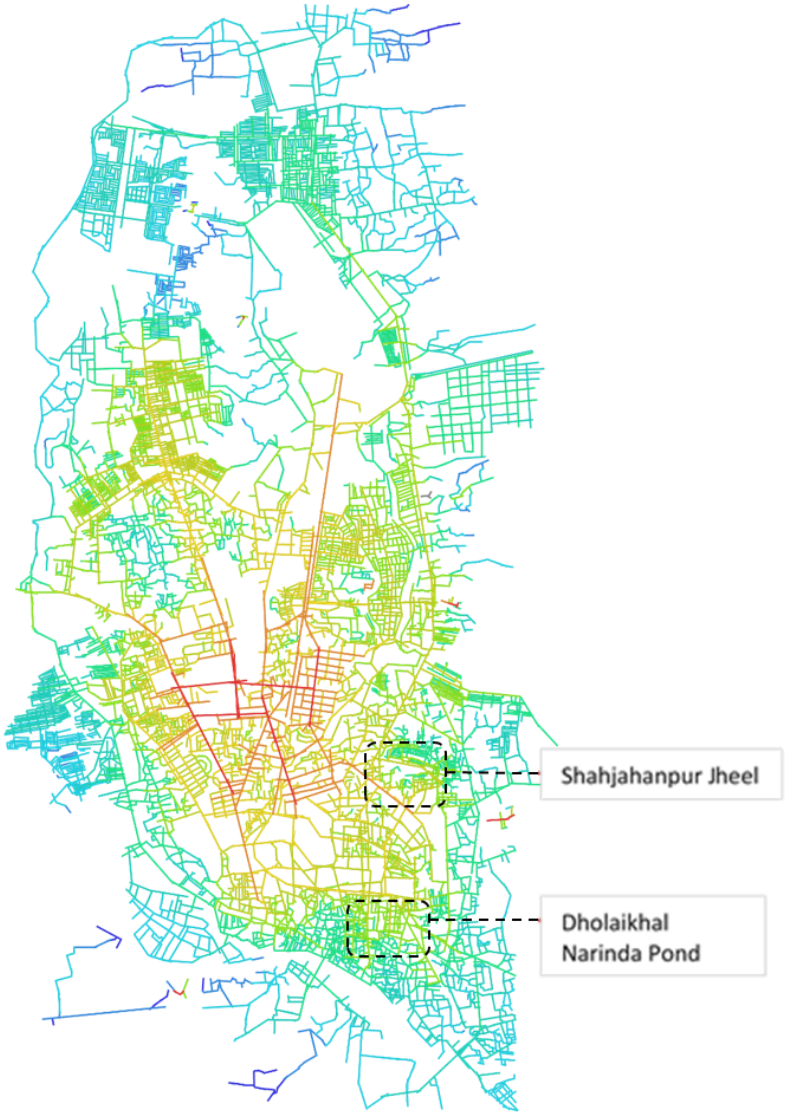

Figure 10. Integration map of Dhaka (produced by authors in DepthmapX).

Table 3: Connectivity and Integration Values of Dholaikhal Narinda Pond.

Connectivity and Integration Values of Dholaikhal Narinda Pond

Sl No	Access Roads	Road Type	CN	Rn	R4
1	Dholaikhal Road	Primary Road	13.00	0.750829	2.31568
2	Begumganj Lane	Secondary Road	3.53	0.763939	1.74706
3	East Dholaikhal New Road	Secondary Road	4.00	0.771046	2.063479
4	New Doyagonj Road	Primary Road	7.00	0.812399	2.10207
5	Distillary Road	Primary Road	5.00	0.798859	2.07016
6	Gendaria New Road	Primary Road	31.00	0.946619	2.915960
7	Kather Pool New Road	Primary Road	7.52	0.746217	2.08281

Table 4: Connectivity and Integration Values of Shahjahanpur Jheel.

Connectivity and Integration Values of Shahjahanpur Jheel					
Sl No	**Access Roads**	**Road Type**	**CN**	**Rn**	**R4**
1	Atish Dipankar Road	Primary Road	29.00	1.02045	2.96263
2	Shahjahanpur Road	Primary Road	20.00	1.004932	2.63088
3	Aamtola Mosjid Goli Road	Secondary Road	23.00	0.956867	2.750479
4	Jheelpar Road East	Secondary Road	3.00	0.977161	2.46262
5	Jheelpar Road north	Secondary Road	9.00	0.929055	2.34635
6	Jheelpar Road south	Secondary Road	7.75	0.917772	2.23913
7	Neighborhood Unnamed Street 1	Tertiary Road	7.02	0.984203	2.586422
8	Neighborhood Unnamed Street 2	Tertiary Road	8.23	0.984912	2.668161

4. Results

4.1 Syntactic Analysis of Dholaikhal Narinda Pond

Dholaikhal Narinda Pond's spatial arrangement demonstrates a key position within Old Dhaka's urban grid. The primary access node is formed by the convergence of four key streets: Dholaikhal Road, Doyagonj New Road, Kather Pool New Road, and Distillery Road. This junction acts as a critical spatial node, offering a structurally strategic entrance to the site. Among the access routes, Gendaria New Road exhibits the highest connectivity value (CN = 31) and a significantly high global integration value (Rn = 0.946), placing the study area near the city's integration core. This indicates that Gendaria New Road is not only highly connected to adjacent segments but also exhibits high spatial proximity within the urban network, establishing it as a principal circulation axis with strong potential to enhance accessibility to the site.

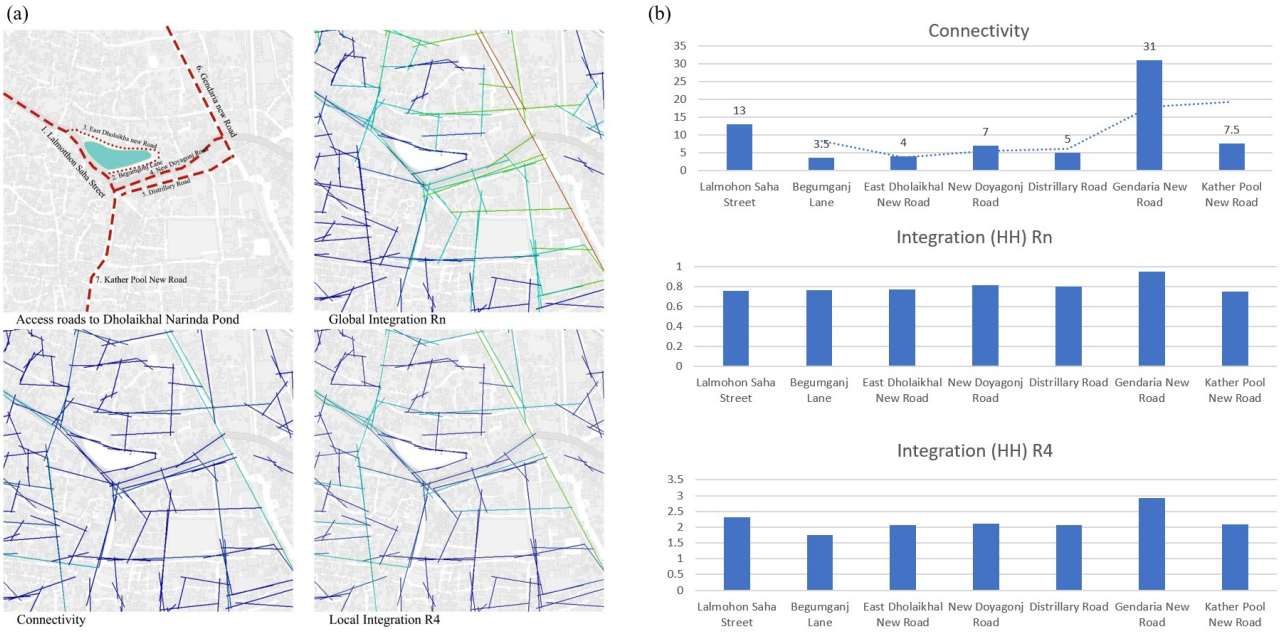

Figure 11 (a). Axial Maps of Dholaikhal Narinda Pond.
Figure 11 (b). Graphs showing connectivity, Global and Local integration values of Dholaikhal Narinda Pond.

Other access roads - such as Dholaikhal Road, Doyagonj New Road, and Distillery Road- exhibit moderate connectivity values (ranging from CN 5 to 13) and global integration values ranging from Rn = 0.746 to 0.812 (Figure 11 b). These values closely approximate the mean city-wide metrics (CN = 6.72; Rn = 0.765), suggesting that these streets, while not as dominant as Gendaria Road, are still relatively well integrated into Dhaka's spatial hierarchy and can support moderate levels of pedestrian and vehicular flow. Additionally, the site is accessible from secondary neighborhood streets such as Begumgonj Lane and East Dholaikhal New Road, both of which have comparable global integration values (Rn ≈ 0.763–0.771). Although their connectivity values are relatively low (CN = 3.5–4.0), their spatial depth within the network indicates potential for improved local accessibility, especially if supported by physical and visual permeability enhancements. However, from the field survey, it was seen that the current physical barriers hinder accessibility. The pond is entirely enclosed by a boundary wall, which restricts direct visual and physical access from surrounding streets and neighborhoods. From a syntactic perspective, while the axial network around the pond exhibits promising integration characteristics, the lack of permeability at the boundary interface inhibits its functional role as a public space.

4.2 Syntactic Analysis of Shahjahanpur Jheel

The spatial structure of Shahjahanpur Jheel reveals a locally coherent but peripherally situated site within Dhaka's broader axial network. The site is located near two major roads – Shahjahanpur Road and Atish Dipankar Road, which have comparatively higher Connectivity, local and global integration value. However, the Jheel itself lacks direct frontage on these primary corridors and instead remains spatially recessed, accessible solely via internal neighbourhood streets. The principal approach to the site is through Amtola Masjid Road, a secondary neighbourhood street that connects the Jheel to the major roads. This secondary road plays an important role in site accessibility with relatively high values- CN 23, Rn 0.956867, and R4 2.750479, thereby functioning as the primary connector between the Jheel and the surrounding urban fabric. The other surrounding neighborhood streets show local integration (R4) values that are consistently high, ranging from 2.631 to 2.963 (Figure 12 b), suggesting a spatially coherent and legible local system. This suggests that Shahjahanpur Jheel is quite accessible within its immediate surroundings due to the well-integrated local street network. However, from the physical survey, it was observed that these are very narrow roads, limiting their capacity to support vehicular movement and functioning primarily as pedestrian pathways. In contrast, the global integration values (Rn), while moderate to high, are not uniformly strong across all streets. This indicates that the Jheel is relatively segregated from the larger city grid.

However, many of these streets have low connectivity (CN values ranging between 3.00 and 9.00), limit movement options, and reduce access from areas beyond the immediate neighborhood. It was also observed during the field survey that the poor connectivity of the internal circulation network limits accessibility from the highly integrated primary roads. While local and global integration values are strongly correlated, the site's limited physical connection to the broader urban grid constrains its accessibility at the city scale. Overall, the syntactic values highlight a fragmented spatial structure that reinforces Shahjahanpur Jheel's orientation as a neighbourhood-scale public space rather than a city-scale destination. In summary, the spatial configuration of Shahjahanpur Jheel makes it highly accessible at the neighborhood scale, emphasizing its potential to become a community-focused public space.

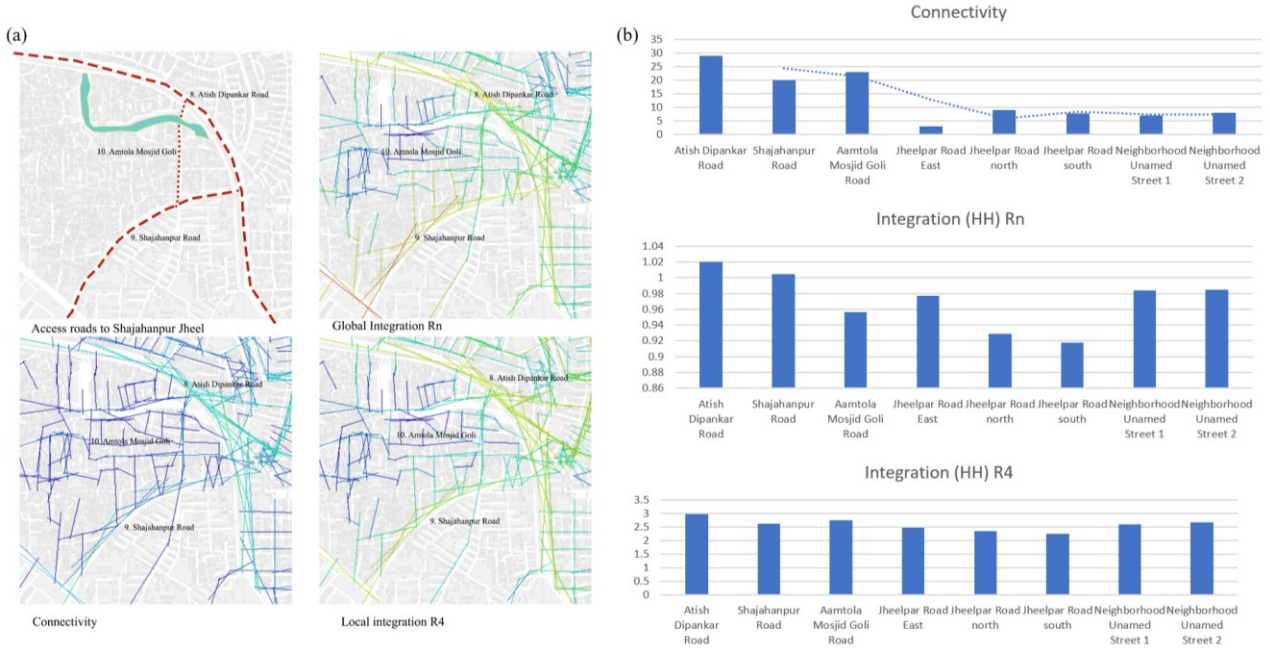

Figure 12 (a). Axial Maps of Shahjahanpur Jheel
Figure 12 (b). Graphs of connectivity, Global and Local integration values of Shahjahanpur Jheel

5. Discussion

The syntactic analysis reveals the degree and level of accessibility of the study areas compared to the city-scale and local scale. Dholaikhal Narinda Pond is well-integrated within Dhaka's urban grid, particularly due to its proximity to major intersection of highly integrated roads. Shahjahanpur Jheel exhibits strong local integration and coherence within its neighbourhood, but lacks direct access from major roads. The local roads are more segregated from city's spatial network, making the Jheel functionally more suited as a neighbourhood-scale public space rather than a city-wide destination.

Table 5: Correlation value of Global and Local Measures of the two study areas.

Correlation value of Global and Local Measures of the two study areas				
Study Area	**Correlation value R of Rn-R4/ Intelligibility**	**Equation**	**Correlation value R of Rn-CN/ Intelligibility**	**Equation**
Dholaikhal Narinda Pond	0.823178155	y = 4.2858x - 1.2371 R^2 = 0.6776	0.8470453	y = 118.4x - 84.41 R^2 = 0.7175
Shahjahanpur Jheel	0.819626194	y = 5.3213x - 2.5911 R^2 = 0.6718	0.4874873	y = 128.01x - 111.04 R^2 = 0.2376

Between the two study areas, Dholaikhal Narinda Pond is located at a major point where four main roads of Old Dhaka intersect. The connectivity (3.5–31.0) and global integration (0.746–0.947) of the surrounding roads closely align with average city values (CN 6.72; Rn 0.766), indicating the site has better accessibility. Therefore, the site fulfils Mark's criteria of being a good public space. In the scattergram (Figure 13a), global Integration vs connectivity shows a strong positive correlation (R≈ 0.85), indicating that roads can be easily accessed from different parts of the city, attracting a larger population. Additionally, the global vs. local integration scattergram (Figure 13 b) also shows a strong positive correlation (r ≈ 0.82). This balance suggests Dholaikhal's local access roads are also well-connected locally and reasonably integrated at the city scale. In both cases, the tangent of the slope is also very steep. These correlations indicate that Dholaikhal has the potential to draw residents and

attract visitors from the larger part of Dhaka. Rethinking the physical enclosure, along with the formalization of entrance points at high-integration nodes, would significantly enhance the site's accessibility and its potential to serve as a city-scale urban destination. Few interventions, like providing a sidewalk in the key avenues leading to a formal entrance plaza at the intersection point of the primary roads, can create a more inviting entrance to the pond. By removing the existing physical boundary, and adding a few more access points on the north and east sides of the study area, accessibility can be enhanced. Additionally, widening the neighborhood streets- East Dholaikhal New Road and Begumganj Lane, and upgrading them to a more inviting promenade will encourage walking and cycling activity. These interventions will significantly benefit the local residents as well.

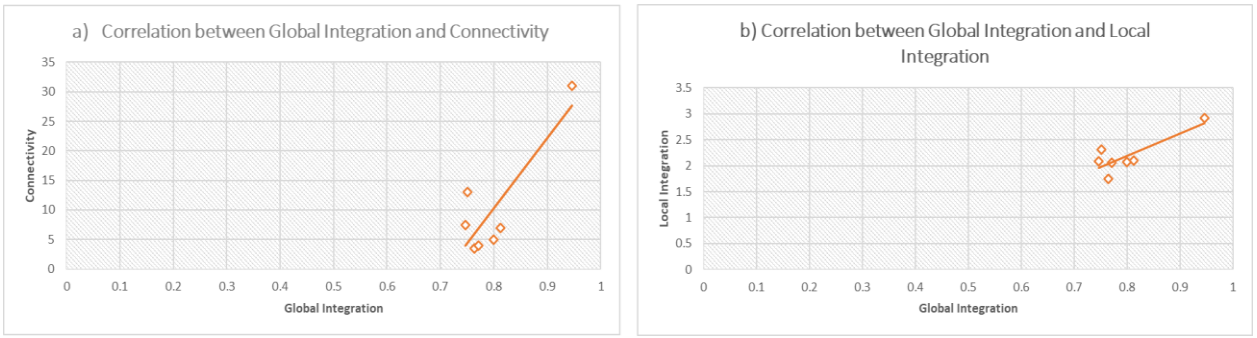

Figure 13 (a). Scattergram of Rn vs CN of Dholaikhal.
Figure 13 (b). Scattergram of Rn vs R4 integration of Dholaikhal.

In contrast, Shahjahanpur Jheel is deeply embedded in a densely built, compact residential fabric. Its spatial configuration fosters a neighbourhood-oriented public space. The scattergram (Figure 14a) reveals a weaker correlation between connectivity vs global integration (R≈0.49), indicating that connectivity does not consistently align with global integration. This suggests irregular spatial relationships, that the neighborhood streets are not well-integrated into the broader city network.

However, the spatial analysis (Figure 14 b) reveals a strong correlation between local and global integration (R≈ 0.82). Although neighbourhood streets are more segregated from the city's spatial network, the site has better accessibility within the confined neighborhood context. Again, this also fulfils Mark's criteria of accessibility, considering the neighborhood scale. It can serve the local movement effectively. This reflects a coherent and intelligible local network emphasizing the Jheel's role as a neighborhood-oriented public space. The spatial analysis suggests that the accessibility of Shahjahanpur Jheel should be limited to the neighborhood residents only. Therefore, design interventions should focus on limiting accessibility to the neighbourhood only.

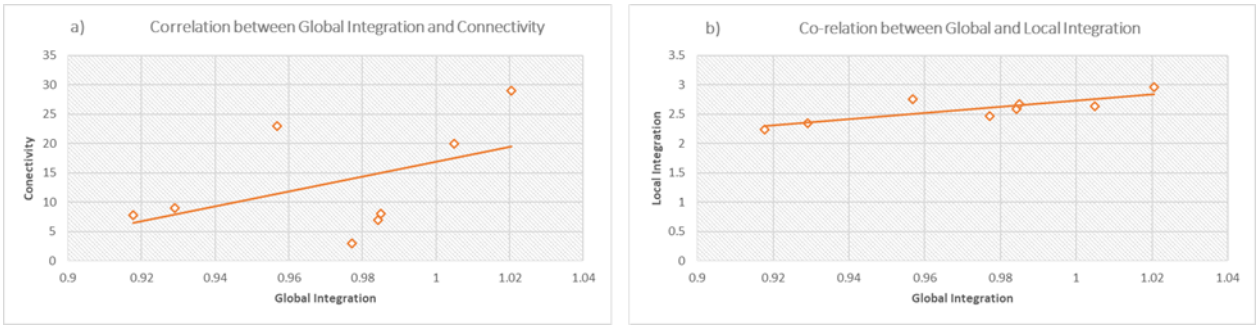

Figure 14 (a). Scattergram of Rn vs CN of Shajahanpur Jheel.
Figure 14 (b). Scattergram of Rn vs R4 integration of Shajahanpur Jheel.

Improvement of the local access routes, enhancing pedestrian walkways, and creating inviting edges along the Jheel is required for Jheel's revitalization. Additionally, widening the narrow feeder lanes, promenade along the water edge, and street furniture, walking and cycling trails, introducing *ghats* to access the waterbody, and provision for fishing and swimming activity, etc., will promote vibrant activities along the Jheel. This will, in turn, result in making the Jheel an inviting local gathering place and enhancing daily social interaction.

Finally, the results align with Hillier's theory that pedestrian movement patterns are shaped primarily by the spatial configuration of the urban grid. It is also evident in other research as well, where accessibility was assessed through space syntax analysis, public spaces can function more effectively and be used by the public more frequently when they are located in a highly intelligible spatial system appropriate to the scale- city or neighbourhood level.

6. Conclusion

This study examined the accessibility and spatial integration of Dholaikhal Narinda Pond and Shahjahanpur Jheel through the lens of space syntax, with the aim of understanding how urban waterbodies can function as inclusive public spaces in rapidly urbanising Dhaka. Using syntactic measures of connectivity (CN), global integration (Rn), and local integration (R4), the analysis quantified accessibility at both city and neighbourhood scales, addressing a critical gap in evaluating open spaces prior to redevelopment. The results highlight distinct spatial potentials for the two sites. Dholaikhal Narinda Pond exhibited high connectivity values (CN up to 31) and strong global integration (Rn ≈ 0.95), supported by strong correlations between integration and connectivity (R ≈ 0.85). These measures place it close to Dhaka's integration core, indicating strong potential as a city-scale public space. By contrast, Shahjahanpur Jheel, though more segregated at the city scale, demonstrated consistently high local integration (R4 values between 2.63 and 2.96) and a strong correlation between local and global integration (R ≈ 0.82), reinforcing its potential as a neighbourhood-scale community space. Together, these findings confirm that accessibility is scale-dependent and must be considered when designing inclusive urban interventions.

The broader contribution of this research lies in linking spatial configuration to social equity and liveability in dense urban contexts. The intelligibility of the spatial grid, measured by the correlation of global integration with connectivity and local integration, proved to be a reliable predictor of potential public use. This demonstrates that space syntax offers policymakers and urban designers an evidence-based framework to anticipate patterns of accessibility and design revitalisation strategies that align with both community and city-wide needs. In doing so, the study advances beyond conventional qualitative approaches, offering measurable insights into how urban waterbodies can enhance inclusivity and social cohesion. Despite its contributions, the study acknowledges limitations, particularly its focus on spatial metrics without incorporating long-term behavioural or socio-cultural dynamics. Future research should complement syntactic analysis with community engagement, post-implementation movement studies, and ecological assessments to capture broader dimensions of liveability. Nevertheless, the methodological framework developed here is replicable for other dense, informal urban contexts across the Global South, providing both theoretical and practical guidance for sustainable and equitable revitalisation of waterbodies as public open spaces.

Acknowledgements

This study was conducted as part of the authors' M.Arch. course Urban Morphology at the Department of Architecture, Bangladesh University of Engineering and Technology (BUET), Dhaka.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest
The author(s) declare(s) no conflicts of interest.

Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Institutional Review Board Statement
Not applicable.

Credit author statement
Conceptualization: F.M.M. and F.N. Data curation: F.M.M and A.A.W. Formal analysis: F.M.M and A.A.W. Investigation: F.M.M. and A.A.W. Methodology: F.M.M. and F.N. Project administration: F.M.M., A.A.W and F.N. Writing— original draft: F.M.M. Writing—review and editing: F.M.M., A.A.W and F.N. All authors have reviewed and approved the final version of the manuscript.

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How to cite this article? (APA Style)
Mouri, F. M., Wasi, A. A., & Nilufar, F. (2025). From Connectivity to Liveability: Enhancing Urban Waterbody Accessibility through Space Syntax in Dhaka. *Journal of Contemporary Urban Affairs*, 9(2), 368-386. https://doi.org/10.25034/ijcua.2025.v9n2-3