Effects of Growth on Urban Morphology and Land Use Pattern in Mymensingh:
A Historic Town of Bangladesh

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ABSTRACT

This study explores the effects of growth on the urban morphology and the land use pattern of a historic town Mymensingh, by analyzing the morphological transformation through Space Syntax along with the changes of land-use pattern. Mymensingh is one of the oldest and historic towns of Bangladesh that lies along the river Brahmaputra. This town was developed as an urban conglomeration during the period of the British colonists more than two hundred years ago. Through the juxtaposition of different establishments by the British colonists, local land-lords and local inhabitants at different time periods, a unique type of morphological pattern was created. Local establishments were developed within the organized colonial grids. Through the ages, the town has expanded due to the natural process of growth and change; the small colonial town has become a larger one.

According to Space Syntax, urban street configuration is considered as the most dominant factor for spontaneous development of different land-uses - where business and commercial uses naturally develops along the most integrated part of an urban grid. So, there exist a close correlation between urban morphology and land-use patterns. In the study, the effects of growth patterns of the town are analyzed through morphological analysis of Space Syntax at different time periods along with the corresponding land-use patterns. The study result shows that, though the town has expanded over time, still now the core part of the historic town acts as the morphological and functional centre as well. The planning process of such towns should be unique and sensitive considering the inherent morphology and land-use pattern for the sustainable growth of the town in future rather following the usual planning process.

Keywords: *urban growth, urban morphology, land use pattern, Mymensingh*

INTRODUCTION AND BACKGROUND

Urbanization has been considered as a potential force for growth and change and the dramatic urban transformation process has become very palpable across the world in recent years. Though the process was slower in Asia before 1980's, but it has become faster since the 1980's. In this region the rate of urbanization doubled from around 20% to 40% from 1980 to 2010. By 2050, it is projected to reach over 60% (ADB 2012). According to UN-Habitat III (2016), the Asian and Pacific region has been at the front line of this spectacular changing process during the last twenty years. Within this short time period, nearly one billion people has been added to the cities of this region. For the first time in its history, these zones stand on the cusp of having more people in urban areas than in rural areas (UN-Habitat III, 2016). According to the World Bank (2016), just within 10 years (between 2001 and 2011) the urban population of South Asia grew by 130 million, and is forecasted to go up by approximately 250 million more within the next 15 years. With the growing number of urban population in Asia, many urban areas are expanding beyond their boundaries grabbing the surrounding rural areas (UN-Habitat & ESCAP 2015).

According to Saravanan et al. (2012), Cities are usually seen to be expanding in all directions creating urban sprawl which is generally governed by different geographic and socio-economic factors like population growth and economic development. However, the growth pattern of many Asian cities are very unique and do not typically match the growth patterns of western cities. For explaining the growth pattern of cities in the Asian and Pacific regions, UN-Habitat III (2016) reports that,

"*The patterns of growth of Asian and Pacific cities increasingly defy traditional urban planning concepts, and dichotomous definitions of "rural" versus "urban" and "core" versus "periphery" are proving inadequate at capturing the complexities of the region's urban areas. Through their geographical expansion and rural-urban social and economic linkages, Asian and Pacific cities are becoming increasingly unbounded. At the intra-city level, the notion of a hermetic city comprised of a dense core contrasted with a sprawling periphery is being dispelled. Linkages and interactions between core and periphery areas are increasing and hybrid forms of density are emerging."*

But unfortunately, much of the urban growth in the most underdeveloped areas of the Asian region is expanding in insensitive ways (UN-Habitat III, 2016). Due to the rapid economic growth along with the speedy urbanization process within this area, the development of urban areas is distorting (UN-Habitat III 2016). Uncontrolled momentum of recent urban growth and land use change raises many issues which might affect the urban environment in different ways (Saravanan et al. 2012). As a result of this rapid urban growth, severe traffic congestion and degradation of natural environments is a very common phenomenon in many Asian cities. Due to this speedy urbanization process, the city areas are expanding beyond their boundaries by grabbing the rural areas which has severe impact not only on agriculture but also on forests and freshwater ecosystems. It is very unfortunate that cities in many parts of the region have not prioritized a clean urban environment or the preservation of ecosystems as part of their growth strategies, thus resulting in severe environmental degradation within and around cities (UN-Habitat III, 2016). A recent study of the South Asia sub-region utilized night lights to show the spatial growth of cities, concluding that cities have grown in land area about twice as fast as they have in population size, indicating a strong tendency for the growth to cross administrative boundaries (UN-Habitat III, 2016).

Bangladesh, a developing country of South Asia, is one of the most densely populated countries (976/sq.km., BBS Census 2011) of the world with an area of 147,570 square kilometers (BBS 2015). Not only this, it is also one of the vulnerable countries in the world regarding the climate change issue. Although, it is predominantly an agrarian country, but due to the recent trend of rapid urbanization and economic transformation process, the land use pattern is changing rapidly and many rural areas are turning to urban areas. Bangladesh has experienced an extremely high rate of urbanization during the last two decades, exceeding more than two to three times that of the national population growth rate (Sarker n.d.). A large number of people are also migrating to urban areas for income and better living condition. As a result, the urban population of Bangladesh is increasing day by day. According to a census, in 1974, only 8.8% of the country's 76 million people lived in urban areas whereas by 2004, the level of urbanization had increased to nearly 25% (BBS 2005, p. 286 & ADB 2006, p.44).

In 2005, the population of Bangladesh was estimated at more than 152 million. Since 1990, the national population growth rate has declined from 2.6% to 2.1% in 2005. By the year 2025, it is projected to fall to 1.2%. Whereas urban population growth rate was tremendously high in the 1980's and 1990's which is over 7% annually. Though, it has fallen considerably since then, but still remains at over 4% per year (United Nations 2004). By 2050, it is expected to fall to around 3%. In 2001, the total urban population was nearly 29 million. The current urban population is estimated at 38 million and is expected to reach 74 million by 2035 (ADB 2006, p.44). According to a report of ADB (2006), the entire country will become urbanized within the next 3–4 decades if it is viewed in terms of population density rather than percentage of population living in urban areas. Many rural areas in Bangladesh are already within the process of urbanization with the infiltration of urban services into rural households.

Like other South Asian countries, rapid urban growth plays an increasingly significant role in the economic development process of Bangladesh. In last few decades, this rapid urbanization process in Bangladesh is perhaps inevitable in a situation of a globalised market economy without a national system having minimum control over the development process (Sarker n.d.). Conversely, this speedy and insensitive urban growth is a great threat for ensuring sustainable urban development (ADB, 2006). But Bill Hillier (2004) argues in his book *Space is the Machine* that the design of cities largely depends on how we understand them. As a result, it is a burning issue at the moment for Bangladesh to realize the uniqueness of the morphology and growth pattern of different cities through years for sustainable urban growth rather following typical ways of urban development.

REVIEW OF LITERATURE

This section investigates the historical background of Mymensingh. It also addresses the basic theories and concepts of Space Syntax that deals with urban morphology.

Past and present Mymensingh town

Mymensingh was a former district of British India and one of the historic towns of Bangladesh at present. It was established by the British East India Company in 1787 A.D. (Bangladesh Bureau of Statistics 2011). During the colonial era, it was within the Dhaka Division of Eastern Bengal and Assam and occupied a portion of the alluvial valley of the river Brahmaputra. At that time, the administrative headquarters were at Nasirabad, currently called Mymensingh Town. The 'East India Company' acquired Mymensingh as the 'Dewani Grant' from the Mughal Emperor in 1765 (BBS, 2013). Before the colonial era, Mymensingh was a part of the kingdom of Kumrupa. Sultan Hossain Shah of Gaur occupied this area and named it Nasrat Shahi after the name of his son Nasrat Shah. During the period of the Mughal Emperor Akbar, this area was renamed Mominshahi Pargana after the name of a prominent lieutenant of the Sultan of Bengal, Mominshah. In 1787 this area was named once again as Mymensingh, during the early parts of the British era (BBS 2013). During the period of British Colonists, Mymensingh was a small town extended linearly along the River Brahmaputra. The linear distance of the town was approximately 1.5 miles then and the width of the town was marked by - the river Brahmaputra and the rail track almost parallel to the river. As a result, on the northern part, the river and on the southern part, the rail track acted as two bold edges of the historical part of the linear town (Aziz 2016).

During the colonial period, the major streets of the town were built to connect different administrative buildings mostly used by the colonists. Afterwards, local land lords (Locally known as *Zamindars)*, established their lavish villas near the river with large open spaces and encompassed by high walls. They also developed a number of educational institutes like schools and colleges within the town. Local bazaars were also established within the near proximity of the river as the goods were transported by the river. At that time period, the urban blocks were larger and the street patterns seem to be organized. Later, a number of organic pattern of streets were inserted within the larger blocks to connect local neighborhoods with the colonial urban grid (Aziz 2016). After that, different commercial areas were developed within the near proximity of the central zone and different residential areas were developed spontaneously at different peripheral areas within the town. Hence, the streets of the town were first established by the colonists and later by the local inhabitants. As a result, there exist different establishments both implanted by the British colonists and by the locals that intermingled with each other within near proximity (Aziz 2016). (Figure 1)

Figure 1:
Local Bazaar Streets in the Historic part of Mymensingh (Source: Field Survey 2014)

While explaining the characteristics of such Colonial Cities of Africa, Asia and South America, Dutt et al.(1994) states that,

> *"These cities was characterized by 'white settlement' areas with planned street design, spacious houses, clubs, theatres and administrative buildings – an implant of western form in the newly established colony. The 'natives' or 'locals' on the other hand served the colonial administration and lived in separate unplanned neighborhoods of poor living standards not too far from the rich. These centers became the headquarters of the colonial powers."*

According to McGee (1971) the colonial city was a collection of a number of communities where each community is pursuing its own way of life and tended to cluster around its own activities. The elites in such colonial cities lived around the city centre that was the focal point of administrative, religious and business activities. In the colonial period, such type of social and functional segregation was very evident in Mymensingh. Even the differences were very prominent in urban street pattern created by different communities (Aziz 2016).

At present, Mymensingh is one of the divisional headquarters of Bangladesh which is located about 118 kilometer north of the capital Dhaka (BRAC 2015) and as per the census of BBS (2011) the population density of Mymensingh City is 5493/sq. km. Though it was a small scaled town in the colonial

era, now it is a busy town, growing haphazardly in different directions with a number of urban problems. Very recent rapid and uncontrolled urban growth distorts the unique urban characteristics and uncontrolled motorization creates traffic congestion at busy nodes (Aziz 2016). But very little research has been found that provide the guidelines for the sustainable urban development of these colonial towns in Bangladesh. (Figure 2)

Methods and Theories of Space Syntax

Space Syntax is a set of theories and techniques for analyzing the spatial configuration conceived by Bill Hillier and colleagues at the Bartlett, University college London in the 1980s (Berhie & Haq 2017). This analytical method is developed mainly in the arena of architecture and urban design for understanding the morphological logic of urban grids (Hillier, 1996; Hillier & Hanson, 1984). Within the last several years the practical implementation of Space syntax has been more common not only in architecture but also in urban design disciplines (Koohsari et al., 2014). Hillier and Hanson (1984) introduced and explained the method of Space syntax in their seminal book titled *The Social Logic of Space*. According to Hillier et al. (1987, p. 363),

> *Space syntax...is a set of techniques for the representation, quantification, and interpretation of spatial configuration in buildings and settlements. Configuration is*

Figure 2:
Recent traffic congestion at the main spine of the Historic part, Ganginarpar Node, of Mymensingh town due to the uncontrolled urban growth; (Source: Field Survey 2014)

defined in general as, at least, the relation between two spaces taking into account a third, and, at most, as the relations among spaces in a complex taking into account all other spaces in the complex.

Space Syntax investigates the spatial structure of cities by first modeling their network of spaces (non built up areas) (Koohsari et al., 2014). Space Syntax quantifies spatial layout of spaces using a set of spatial descriptors that are generally calculated based on the notion of *'axial map'* (Figure 1). An axial map comprises the *'…longest and fewest….* 'lines that covers all the spaces in an urban layout and connects them with each other (Koohsari et al., 2014). Additionally, axial lines are *"the longest visibility lines for representing individual linear spaces in urban environments"* (Liu & Jiang, 2012) and they are assumed to be *"… the sight lines for people moving in a spatial network"* (Koohsari et al., 2014).

The Space Syntax method involves measuring the accessibility of all parts of an urban network under consideration from each individual street segment. The intent is to "…*provide a comprehensive description of spatial structure and the hierarchy of connectedness without evoking information about land use or making assumptions about desirable or typical trips* (Ozbil et al., 2015). Through this method, the particular concentration is specified to the number of direction changes that are required for moving from one location to another (Ozbil et al., 2015). Integration is a static global measure that describes the average depth of a space to all

other spaces in the system. The higher integration value of the axial line, the less is depth (Peponis & Wineman, 2002). For reaching a highly integrated street, one has to make fewer turns, whereas more changes of direction are required to arrive at less integrated streets (Kostakos, 2010). The spaces of a system can be ranked from the most integrated to the most segregated (Klarqvist, 1993). The global integration index (Rn) reflects the average topological distance in a network, that is to say the number of direction changes from each line segment. The local integration (R3) index (with a radius of 3) which reflects the topological proximity of a line to its nearby axial lines (two turns away from a given axial line) to all the other lines within a network (Cambra et al., 2017). (Figure 3)

According to Space Syntax Lab. (2008), every axial line in the axial map has an integration value that differs from one line to another. This value of integration reflects the importance of the axial line and how it is related to all other spaces within the network. Once the integration of each space of the whole system has been calculated, the integration core which illustrates the important deep structure of a spatial system can be identified. The integration core "… *forms the pattern of most integrated line of an urban system.*" (Space Syntax Lab., 2008). The nature of integration core, its size, and space depends on the shape, connectedness, and geometry of the urban system and also on its mode of growth. If the integration values of lines be sorted and ranked from highest to the lowest, the lines of highest integration values can then be presented on
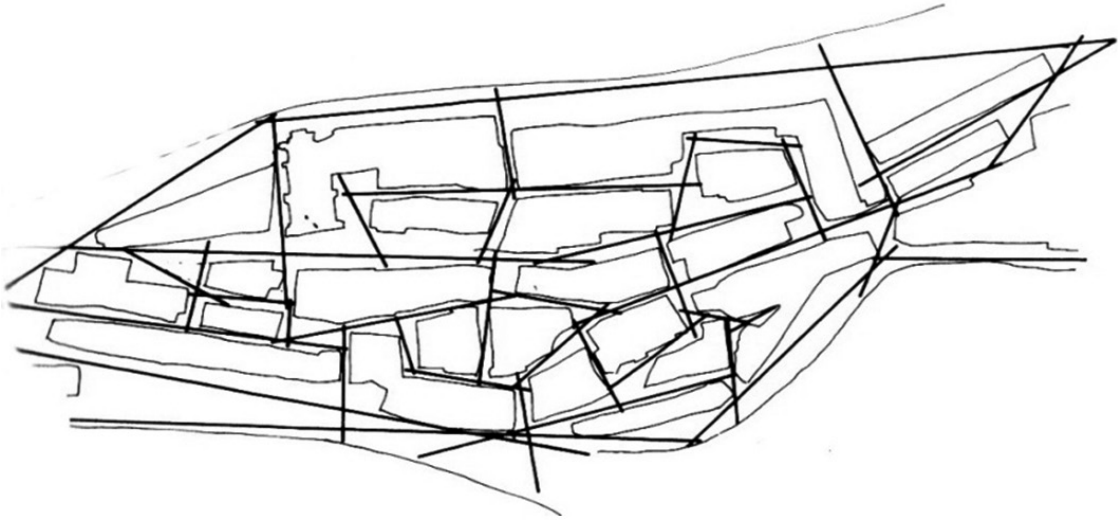
Figure 3:
The axial map as a representation of spatial form (Hillier & Hanson, 1984)

the map. The most integrated values are called the 'integration core'. According to Hillier et al. (1993), the most integrated lines in an urban system are those lines that are most familiar to the people. According to Karimi (1997),

"*the centre of integration – or the syntactic centre of the city –typically matches the geographical centre. Though the physical shape the core can vary from city to city, but two forms are more common; linear extensions and deformed grids. Regardless of its shape, the core which is always the final destination of all major routes, matches the location of the central bazaar*".

While explaining the effectiveness of quantitative attributes of Space Syntax analysis for measuring the hierarchy of urban elements Karimi (1997) also states that,

"the quantitative attributes of Space Syntax analysis enable extending the argument of urban element in organic cities to a more precise extent. By using this property, the degree of incorporation of each urban element can be measured, creating a 'rank order' or 'class order' which shows the hierarchy of urban elements inside the grid."

By determining the quantitative values of each axial line, the significance of the line within the urban grid can be measured through Space Syntax analysis. (Figure 4)

For explaining the relationships among urban morphology, movement pattern and land-use pattern two classical theories namely the 'Theory of Natural Movement' and the 'Theory of Movement Economy' are widely used in Space Syntax. These theories are described below.

According to 'Natural Movement theory' - urban street configuration primarily determine the amount of urban movement. The dynamics of local area within a city is the function of its global structure. The change of land use in certain area is predominately governed by the global spatial configuration (Hillier et al. 1993, Berhie and Haq 2017). Hillier et al. (1993) asserts that urban street configuration acts as the prime generator of movement within urban systems whereas land use is a by-product of movement. Land use pattern cannot modify or transform the configuration but can only have a multiplier effect on the basic movement pattern established by the spatial configuration itself .The phenomena that the basic movement pattern generated by urban gird configuration itself is called 'natural movement' (Berhie and Haq 2017).

Figure 4:
An example of an axial map analysis according to the Space Syntax technique: warmer colored lines are the more integrated lines, while the cooler colored lines represent the more segregated lines within an urban system, where red colored lines expresses the highly integrated urban core. (Source: Space Syntax Lab. 1999)

On the other hand, theory of 'Movement Economy' deals with how movement generated by the spatial configuration shapes land use pattern. Hillier (1996) asserts that the land use pattern intrinsically follow the hidden property of spatial configuration. Land uses like retails and commercial activities naturally migrate to more integrated streets to take the economic benefit of movement generated by the spatial configuration. The process of attracting land uses and multiplying the amount of movement has a cyclic character shaping the land use and centrality patterns of urban areas (Berhie and Haq 2017).

Hillier (1996) explains that the layout of space first generates the pattern movement, and then movement-seeking land uses migrate to movement-rich street segments producing more movement (multiplying movement), which again attracts more retail and other uses. This leads to the adaptation of the local grid to accommodate the greater density and mix of land uses. This dynamic process is called the 'movement economy' (Hillier et al., 1993; Hillier 2008; Topçu, Topçu, and Deniz, 2007; Berhie and Haq, 2017).

METHODOLOGY

This study was conducted in a number of sequential stages. In the first stage, detail field surveys were conducted to assess the present land use pattern of the town. Secondly, available GIS based land use maps of different time periods were collected from secondary sources to assess the land use pattern at present and also in the past.. The changes of land use patterns were observed and analyzed to find out the changing pattern through the courses of time. In stage three, the configurational analysis of Mymensingh Town was done with the help of the Space Syntax Method. The Space Syntax simulation of the Axial Maps of Mymensingh Town of different time periods was done, with the help of the software DepthMap X, to understand the morphological transformation and the growth pattern of the town from past to present. In the final stage of this research, the process of urban transformation and the changing land use pattern are analyzed to find out the relationships.

Morphological character in 1926

Through analyzing the axial map of Mymensingh Town of 1926 (Figure 5A), it is observed that the town was divided in comparatively larger blocks and the most integrated part of the town (red marked line) belonged to the central linear part near Ganginarpar Node. Station Road, Ganginarpar Road and Ram Babu Road are observed to be within the most integrated part of the town and act as the morphological core ot the town. Along with these roads, Coronation Road (Zilla School Road),

Kanchijhuli Road, Park Avenue Road and Strand Road are also within highly integrated part of the town which is directly connected with the core part of the town.

From the land use data of 1926, it is observed that the local bazaar areas (mechua bazaar) are situated near the Station Road and Ganginarpar Node. Girls School (Vidyamoyee), City School and Zilla School are situated along the Ram Babu Road. Annondamohon College is also situated near the Zilla School area. Park Avenue Road and Strand Road leads towards the residential areas of the colonial administrators (Shahab Quarter).

Morphological character in 1977

If the axial map of 1977 (Figure 5B) is compared with the axial map of 1926 (Figure 5A) it is observed that the town area was not extended outwards, rather, the previous urban blocks were divided into smaller urban blocks with the incorporation of inner connecting roads. It seems that, an inward urban growth occurred during a long span of more than fifty years. But the most interesting finding is that, the morphological core (most integrated partred marked in Figure 5B) of the town still belongs to the previous zone (segments near Ganginarpar Node). Station

Road, Ganginarpar Road and Ram Babu Road are situated in the core area. A portion of Durgabari Road and C. K. Ghosh Road, which are connected with Ganginarpar Node, also belongs to the most integrated part of the town.

While analyzing the land use map of Mymensingh in 1977, it is seen that the Railway Station (established by the colonists) and schools like Vidyamoyee School and City Collegiate School, Aloka Cinema Hall (established by the local landlords) are concentrated along the morphological core (most integrated part) of the town. The traditional local bazaars like Mechua Bazaar and Zilapy Potti, spontaneously grown by the locals, are also situated near the morphological core.

Morphological character in 1995

If the axial map of 1995 (Figure 6) is compared with the previous axial maps of 1977 and 1926 (Figure 5A & 5B), it is clear that, outward urban expansion occurred especially towards the southern part of the town. But the historic part of the town still belongs to the most configurationally significant part of the town (act as the morphological core/centre of the town). Even the morphological core of the Historic part was more prominent than before. Ganginarpar
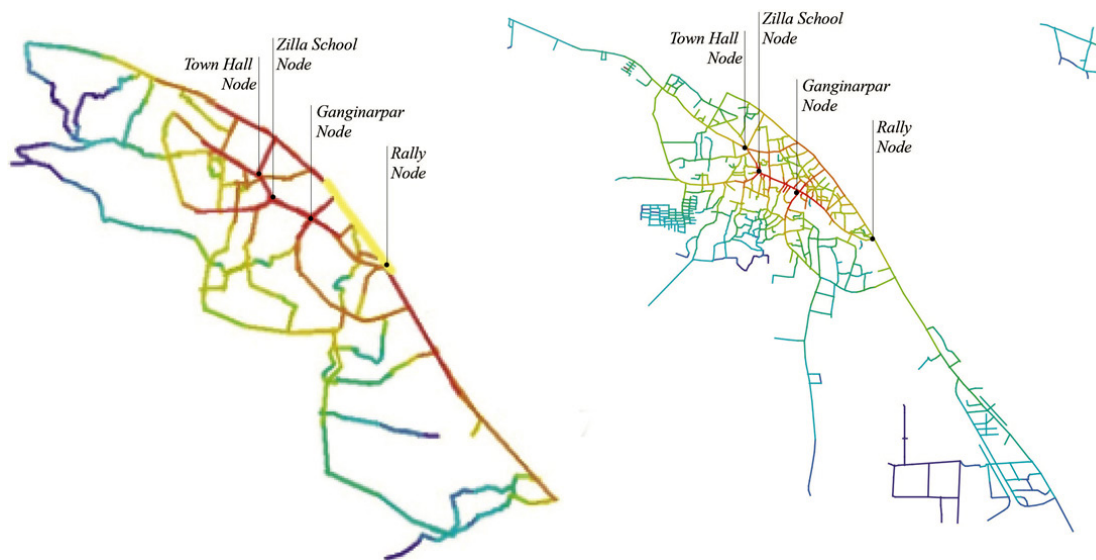

Figure 5 A & B:
Axial Analysis Map of Mymensingh in A) 1926 B) 1977 (Source: Nilufar 2014)
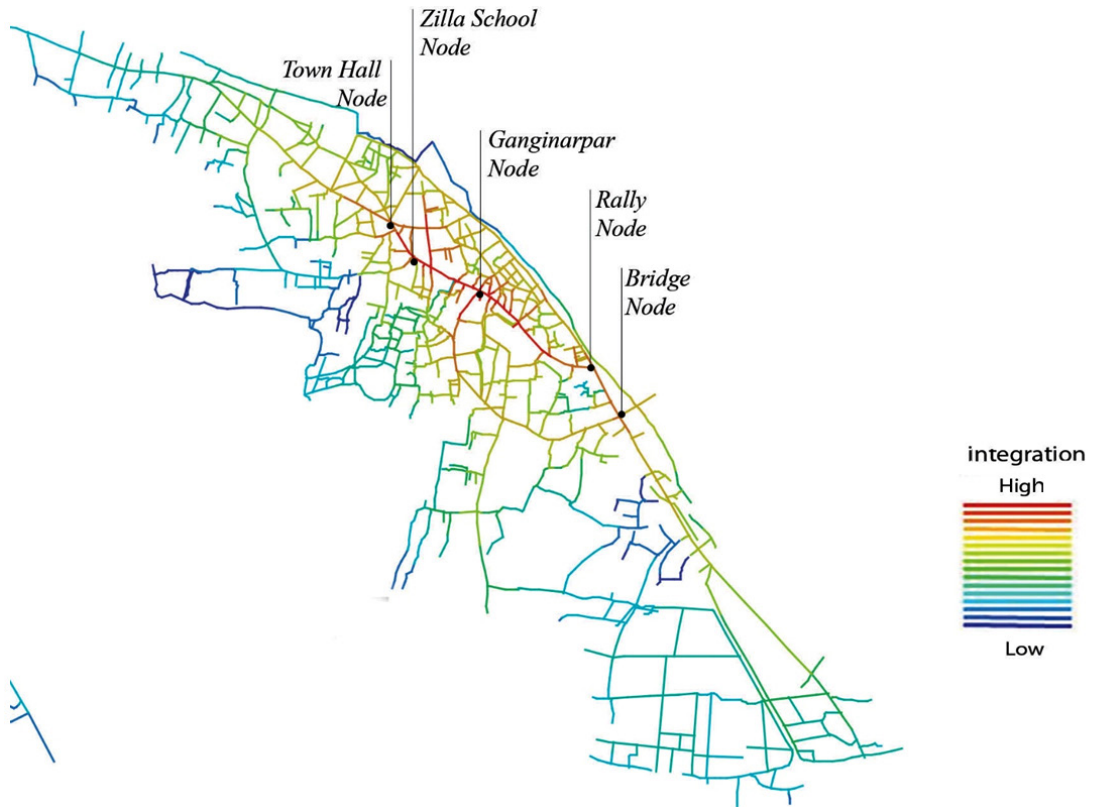
Figure 6:
Axial Analysis Map of Mymensingh in 1995. (Source: Nilufar 2014)

Road, Ram Babu Road and Station Road still stands on the most integrated part (See Figure 9). The core area, the red marked zone, extends towards the Town Hall intersection at one end and towards Rally intersection at another end. In some areas, the larger urban grids were again broken down to smaller grids. In case of land use, it is observed that incorporation of Shambhujang Bridge (at Bridge Node), which connects other parts of the river with the town, and the Agricultural University at the southern part seems to be accountable for bringing significant morphological changes near Bridge Node (See Figure 6) and other connected areas.

Morphological character in 2014

If the axial map of 2014 (Figure 7) is compared with the previous axial maps of 1977, 1926 and 1995 (Figure 5A, 5B and 6), it is apparent that the town has expanded in a southward direction. Incorporating the bypass road at the southern end has greatly affected the city morphology. Newly developed streets have connected the Historic Part with the southern section. It is also seen that most of the zones of the southern portion seem to have grown spontaneously. But the most interesting thing is that, the morphological core of the Historic Part (streets through Ganginarpar Node) still acts as the morphological core of the whole town. Moreover, other historic streets which were not within the morphological core in previous maps, have become a part of the morphological core of town. As a result, the Historic Part of the town has become morphologically more prominent in the map of 2014 (Figure 7) and the newer developments still remain segregated (blue colored lines) from the core town area.
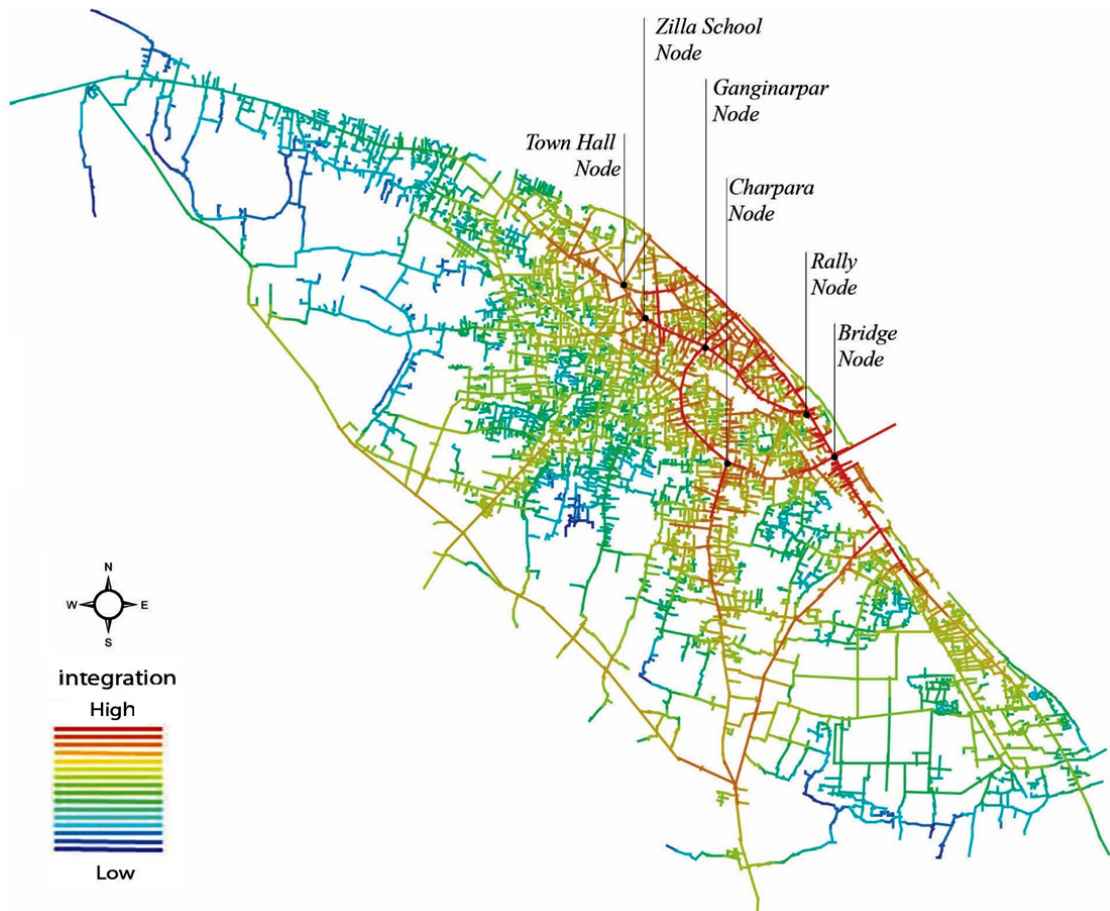
Figure 7:
Axial Analysis Map of Mymensingh in 2014 (Source: Author 2016)

CHANGING OF LAND USE PATTERN

By analyzing the contexts of the Historic period, it is observed that Mymensingh Town was a small-scaled town between the edge of the Brahmaputra River and the rail track established by the colonists. It extends linearly from Rally Node to Town Hall Node (Figure 5A). Like other colonial towns, there were distinguished zones within the town but in close proximity; administrative zones, station area, and residential zones for the administrative rulers. The cultural hub of the town, Town Hall, was established near the Town Hall Node (Figure 5A) which was situated in-between the   residential zone of the

colonists (*Shaheb Quarter*) and the administrative zone (*Kachari)*. Colonial establishments like the railway station and the spontaneously and locally developed bazaar zone were situated at the morphological centre, near the Ganginarpar Node. These sections of the town are very close to each other (Figure 8).

A hospital established by the local land lords named Surja Kanto (S. K.) Hospital was situated at the southern end near the Rally Node. Most of the large-scale educational institutes developed by the local land lords, like Vidyamoyee School (Girl's school), Zilla School (Boy's school), Anondomohon College were situated near the morphological centre of the
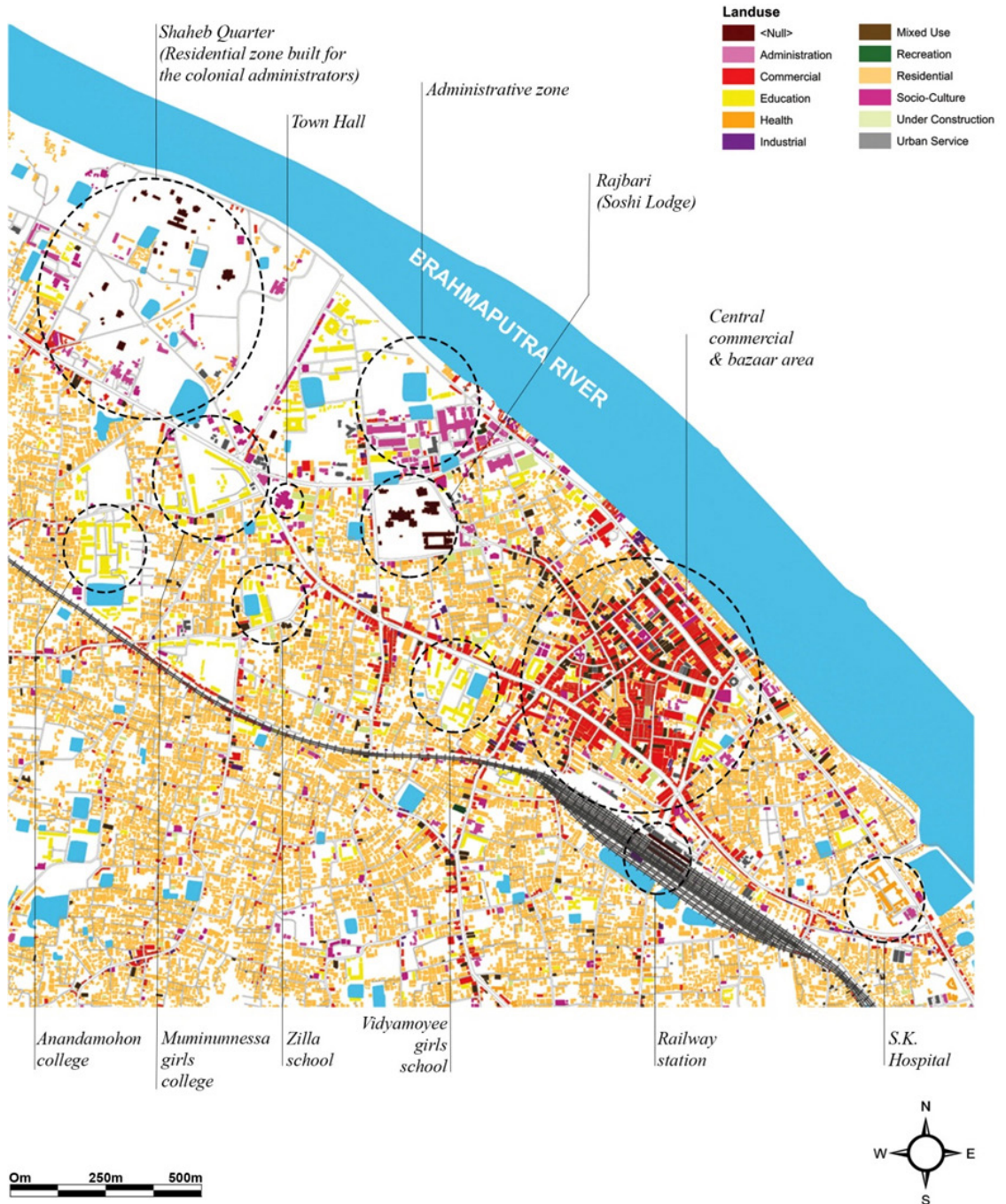
Figure 8:
Significant land-uses at present within the historic part of Mymensingh
(Source: Field Survey 2014, Source of base map: Urban Development Directorate (UDD) 2014)

town between the Ganginarpar Node and Town Hall Node. The central spine connects both the ends of the town from Rally Node to Town Hall Node through Ganginarpar Node. Along this historic road the railway station, central bazaar zone and the educational institutes are still functioning. Another peripheral road flows along the edge of river and touches the significant *Ghats,* or the boat landing stages from the past. (Figure 8)

By analyzing all the axial maps drawn from different historic maps it is evident that the main central zone of the town (Zones near the Station Road, Ganginarpar Road and Ram Babu Road - See Figure 9) are within the morphological centre of the town from the colonial period to present times. It also acts as the functional centre of the town from the historic past to present times. The colonial establishments like the administrative zones, railway station, educational institutes by the local land-lords (*Zamindars)*, and locally and spontaneously established zones like traditional bazaars and commercial zones are still functioning along this highly integrated morphological core. In latertimes, due to the incorporation of Shambhuganj Bridge and Agricultural University at the south-eastern part, the medical college at Charpara Node and the bypass street at the southern part, the core area extends toward the Bridge Node and Charpara Node (Figure 7). But still the Historic core of the town acts both as the functional and morphological centre of the town.
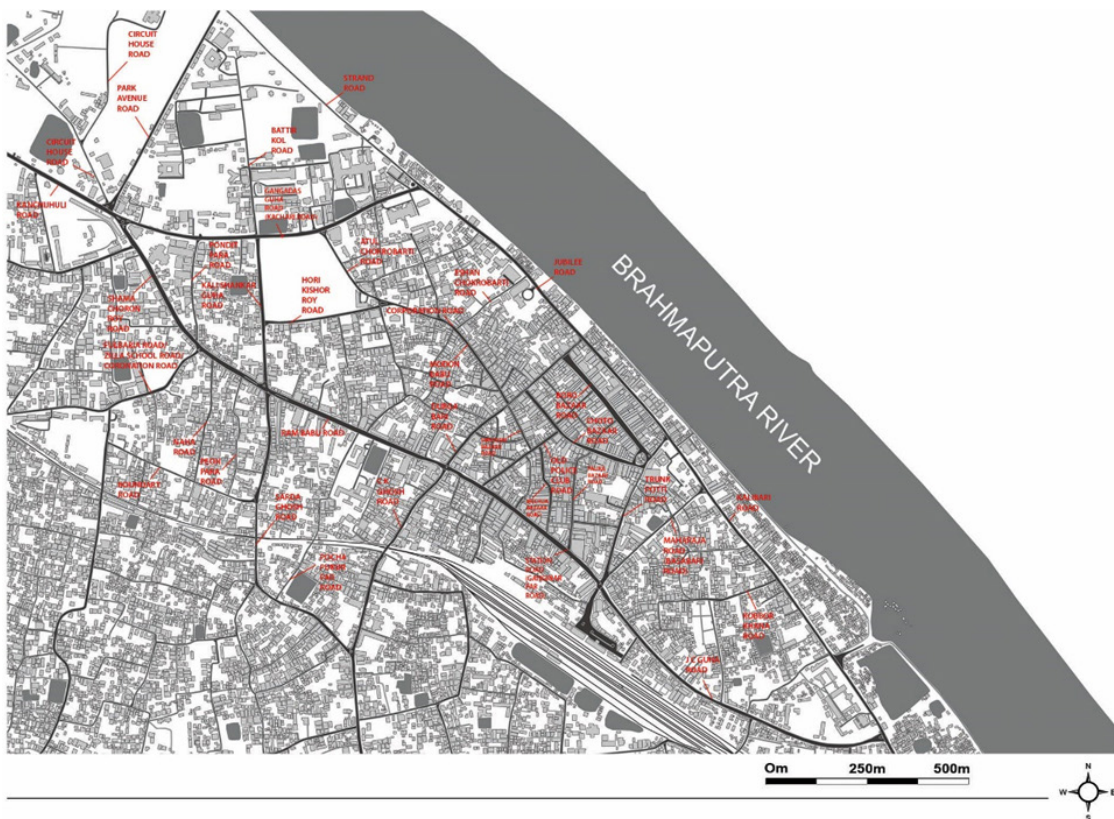

Figure 9:
Significant streets within the 'Historic Part' of Mymensingh
(Source: Field Survey by Author 2014, Source of base map: Urban Development Directorate (UDD) 2014)

FINDINGS AND ANALYSIS

The analysis and findings of the research are discussed in the following sections.

Growth Pattern of Mymensingh

The growth pattern of Mymensingh is very unique. Though it was a small-scale linear town during the colonial period, inward urban growth was observed over a long span of time. The river Brahmaputra in the north and the railroad track on the south act as strong barriers for expanding the town towards northern and southern directions for a longer span of time. Eventually, the town expanded organically towards the southern part by crossing the barrier of the railroad tract, but keeping the spatial and functional significance of the Historic Part established by the British colonists. Although the Historic Part has some formal arrangements of an urban layout, the later urban growth both inward and outward is observed to be organic in manner. Still, the river Brahmaputra acts as a strong barrier for the urban expansion towards the north so the town is mainly observed to expand towards the southern direction. But the morphological centre of the town still belongs to the Historic Part of the town (Figure 7).

Morphological transformation of Mymensingh

Through the analysis of the morphological transformation of the town from its historic past to present times, it is observed that initially the town had some formal arrangements consisting of large urban blocks (Figure 5A). But it is observed that after the colonial period, the inward organic growth broke the larger urban blocks into smaller but informal segments (Figure 5B). Within the last twenty years, although the town has expanded towards the southern part in an organic way, the Historic Part still acts as the morphological centre of the town.

By analyzing the different Axial Maps of the town through Space Syntax, it is found that the central morphological core of the town was concentrated near the Ganginarpar Node during the colonial period in 1926. But more than fifty years later, in 1977, that same zone still retained its spatial significance although the morphology of the town had changed a great deal. Even after 18 years, in 1995, the core area of the Historic Part retained

its spatial significance. Although the town started to expand organically towards southern part by incorporating agricultural land, the central core area extended toward Rally Node. In 2014, the core area extends in different directions, but the Historic Core retains its spatial significance. The other streets in the Historic Part are observed to become more spatially significant, especially the roads along the along the river; Kalibari Road, Jubilee Road, Kachari Road, Strand Road (See Figure 9). It also includes the significant roads that connect the spinal roads with the roads along the river; Moharaja Road, Trunk Potti Road, Kali Shanker Guha Road and Durgabari Road (See Figure 9).

Changes in land use pattern

At the founding of the town, the colonial rulers established their administrative zones, (*Kachari),* the Recreational Zone, (Town Hall), the Residential Zones (*Shaheb* Quarters), and the railway station in close proximity. On the other hand, the local landlords, the *Zamindars*, established their residential villas (*Shoshi* lodges), and a large number of educational institutes like Vidyamoyee School (Girl's school), Zilla School (Boy's school), Anondomohon College and a hospital (S. K. Hospital) within near proximity to the colonial establishments. The locals developed their residential zones within these sections but in smaller urban segments. A large commercial and bazaar area was developed near the core (Ganginarpar Node) by the locals. The commercial district and the bazaar are located between the railway station and the river. Some later establishments like Agricultural University, Medical College Hospital, and the Shambhuganj Bridge were placed by the government at different edges of the historic town. The newer residential zones were developed by the locals surrounding these recent establishments. In case of the town's expansion it is observed that the later developed educational institutes and the residential zones that incorporated the agricultural lands situated at the outskirt of the Historic Town. By analyzing and comparing the land use distribution pattern in Mymensingh in 1994 and 2014 (Figure 10 & 11), it is very clear that the percentage of agricultural land is decreasing alarmingly and the percentages of residential and educational zones are increasing. From the land use distribution graph of Mymensingh from 1994 to 2014, it is seen that the agricultural land decreases from 38% to 13% whereas residential zone increases from 29% to 35% and the educational zone increases from 9% to 16% (Figure 10 & 11)
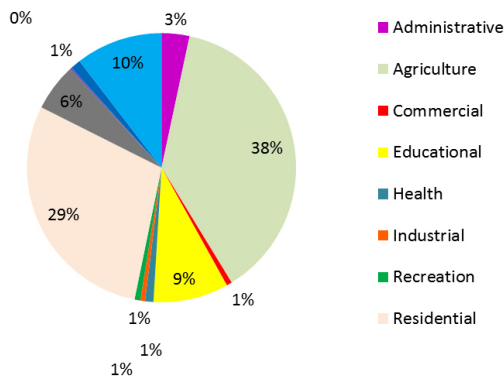
Figure 10:
Land-Use Distribution in Mymensingh 1994,
(Source: Mymensingh Strategic Development Plan,
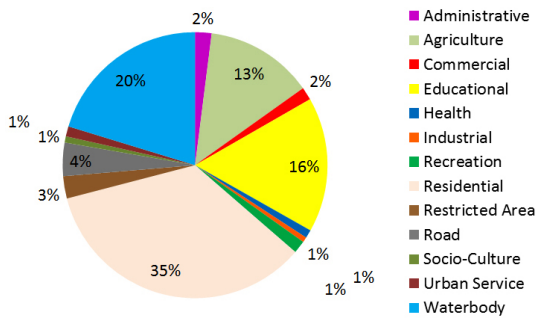*Urban Development Directorate (UDD) 2015)*

Figure 11:
Land-Use Distribution in Mymensingh 2014,
(Source: Mymensingh Strategic Development Plan,
Urban Development Directorate (UDD) 2015)

CONCLUSION

The findings of this research tend to support a number of key findings that may have implications for urban planning and design decisions for the sustainable growth of such historic towns like Mymensingh.

In the different stages of urban growth, the morphology of Mymensingh has changed in different ways. First it expands through inward growth within the colonial urban grid. Later, outward growth towards the southern part took place. Both types of growth are seen to be organic. From the colonial past, the colonists and the *Zamindars* placed different establishments near the highly integrated central core of the town and the locals developed the in-between zones with residential areas and bazaars. Later, the government built by-pass roads and a bridge on the outskirts of the town. Again, the locals established residential areas surrounding and towards these newer developments. Although the latest developments are functioning in their own ways, the Historic Part is still functioning more vibrantly than the newer ones.

In case of the morphological transformation process, although the morphology of the town has changed at different times in different ways, the Historic Part still stands at the morphological centre of town. While there was inward growth at the first phase, and there was outward growth along with newer establishments, the Historic Part retains its spatial significance, more meaningfully than before.

The Historic Part retains both the functional and morphological importance through years and now still functions as a vibrant lifeline of the town. But due to the process of faster growth, the Historic Part faces different urban problems, like environmental degradation, traffic congestion, and over density. As the pace of newer development is not controlled to cope up with the Historic Part, different types of unwanted urban problems are making inroads within this part of town.

In the case of Historic Part of towns like Mymensingh, the inherent morphology and the land-use pattern plays a key role for future growth. While newer developments need to be established or newer planning process is to be implemented, the inherent morphology and the transformation process of the Historic Part along with the existing land-use pattern should be considered for maintaining sustainability of future growth. Rapid and haphazard urban growth should be avoided and sensitive planning process should be implemented considering the spatial and functional significance and sensitivity of the Historic Part of the town rather following the typical planning process.

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