An Analytical Observation of Street Landscape in Urban Area Focusing on Morphology and Environment. Case Study: Sylhet City Corporation Area, Bangladesh

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Abstract: A street reflects local needs, culture, and resources, functioning best when its elements-spatial order, greenery, and user interaction—are optimally integrated. In Sylhet City Corporation, streets face issues like disjointed pedestrian paths, poor plantations, haphazard vehicular flow, and environmental degradation. This study analyzes fifteen key points along two main streets using field surveys, spatial sketches, GIS, and environmental data. It reveals strong interrelations between tree cover, pedestrian flow, air quality, and surface temperature, highlighting how spatial morphology and greenery directly influence usability and comfort. The outcomes propose structured spatial zoning, green pockets, underground utilities, and collaborative planning to create functional, livable street environments.

Keywords: Street Landscape; Street Plants; Street Morphology; Pedestrian Activities; Street Pockets.

INTRODUCTION

Sylhet, Bangladesh's third fastest-growing city, follows Dhaka and Chattogram in urban expansion (Mohammad Shamsul Arefin, 2021). It is a major

tourist destination, featuring tea gardens, Jaflong, Lalakhal, Bichnakandi, Bholagonj, Ratargul swamp forest, and the sacred Mazars of Hazrat Shahjalal (R.) and Hazrat Shah Paran (R.). Historically, Sylhet evolved as the country's spiritual capital, shaped by political, cultural, and religious migrations, reflected in mosques, temples, Akhadas, and Mazars embedded in its urban fabric (Kawshik Saha, 2020).

Key streets link spiritual, cultural, and commercial hubs, including Ambarkhana, Zindabazar, Bandarbazar, and Chowhatta. However, rapid urbanization and migration have caused congestion, particularly along major corridors (Iqbal Ahmed Chowdhury, 2012); (Bijit Kumar Banik, 2009). Poor pedestrian infrastructure, pollution, and traffic worsen urban mobility (Hossain, 2009). Sylhet's streets span 188.49 km, with two main arterial roads forming its mobility spine (Jiban Chandra Deb, 2013). Streets shape social interactions and vibrancy but suffer from poor maintenance and lack of greenery (Mathew Carmona, 2013) (Jacobs, 1961).

Green spaces, crucial for sustainability, are scarce, with 404 of 486 surveyed streets lacking trees (Nicholas Smart, 2020) (Jiban Chandra Deb, 2013). Limited urban policies and encroachments hinder landscape initiatives (Sharma, 2022). Strategic urban forestry, pedestrian-friendly planning, and green infrastructure can enhance Sylhet's resilience and livability.

Streets are fundamentally important as they link various parts of a city and enable all kinds of movement. They serve as the urban voids—breathing spaces—between the densely packed concrete structures, often providing green corridors within the city. The city is divided administratively into 27 wards, and the street network is categorized into two classes: Main Roads (MR) and Link Roads (LR). These roads have a total cumulative length of 188.49 kilometers, where 51.37 kilometers are classified as Main Roads and 137.12 kilometers are Link Roads. (Jiban Chandra Deb, 2013). Two spinal city streets, crisscrossed to each other, from East to West and North to South; one is from Hazrat Shah Paran (R.) Mazar point to Tukerbazar bus stand point and another from Airport point to Bandarbazar point, have been considered in this research work and, divided into fifteen most vibrant points considering the SL values and uses to carry the study.

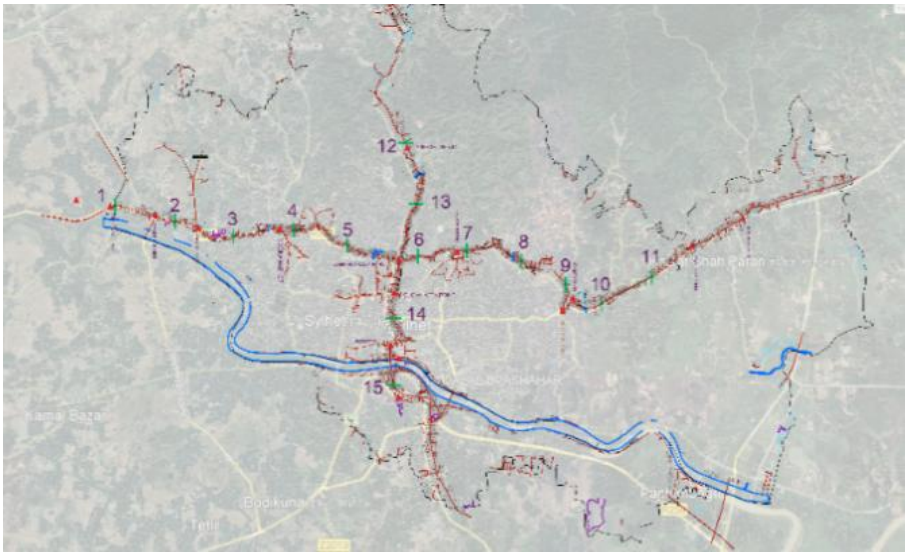


Figure 1: 15 vibrant points on the spinal streets of SCC area (author).

Almost all the streets, in Upazila and Union area, are seems already carpeted with pitch and/or concrete and/or pave materials whereas the streets, in village, seems around half with soft ground and/or hard materials. And, the number of bridge and culvert are similar in number in all areas. A remarkable difference can be seen in terms of gap length between these two areas. So, the SCC area is almost covered with hard surfaced streets but the quality of materials these are made is still poor. (LGED, Sylhet, 2022).

Chart 01: Street length and built materials of Sylhet zone.

Street database as on September 2022					
Street type	**Earthen length (km)**	**Paved length (km)**	**Total length (km)**	**Bridge/culvert length (km)**	**Gap length (km)**
Upazila	2,687.03	3,4021.28	36,708.31	436.54	79.24
Union	9,386.19	32,481.82	41,868.01	355.27	81.02
Village A	72,352.65	50,063.22	1,22,415.87	487.34	181.28
Village B	1,03,912.58	34,017.14	1,37,929.71	327.43	162.15
Total street	1,88,338.45	1,50,583.46	3,38,921.90	1,606.56	503.68
Source: (LGED, Sylhet, 2022)					

This study explained the existing areas based on hotspots in Sylhet. These hotspots define the terminal points, accessibility, functionality, touristic values and aesthetics of this zone. The whole study was divided into 2 (two) categories. As-

1. Hotspots within the SCC Area and
2. Hotspots beyond the SCC area

The notable reasons of the hotspots that are largely mobilizing the integrative activities within the SCC area are tourism, religious belief,

commercial pattern, educational institution, administrative zone, manmade landmark, local topography and presence of strong nature

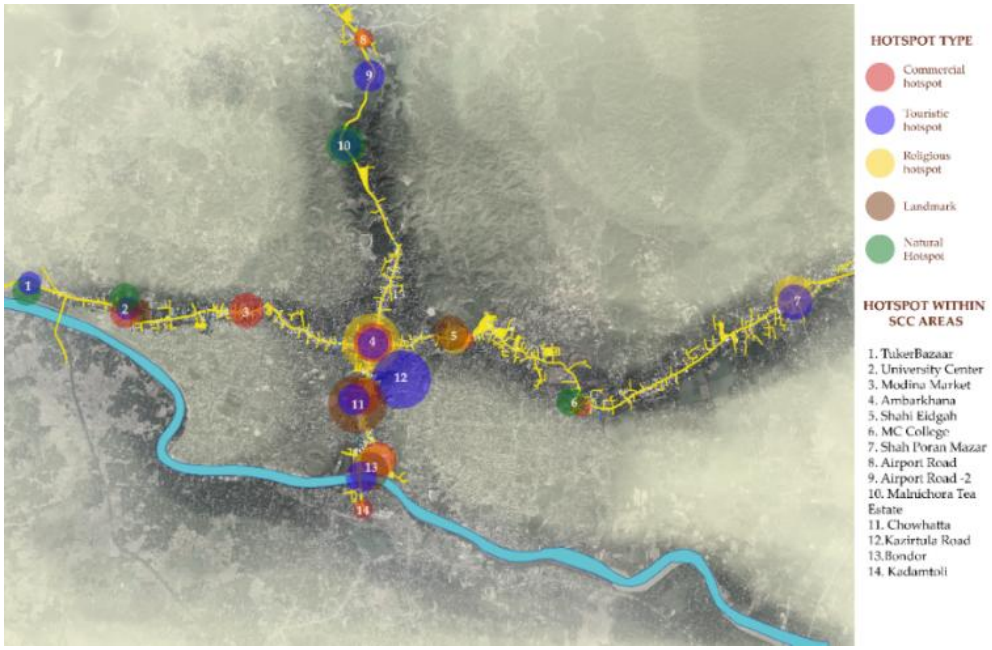


Figure 2: Notable hotspots along the spinal streets of SCC area (author).

The city area is remarkably rich with attractive human catching manmade and natural elements that entertain tourists from the country over the year. The most prominent religious hotspot, locates at the center Hazrat Shahjalal (R.) Mazar. The second largest shrine located a bit remotely, Hazrat Shah Poran (R.) Mazar, and lastly the Shahi Eidgah, a mosque complex incorporating with Urban landscape. All these together ensure almost every Islam believer to visit this city area at least once in life, and huge number visit here several time even a year. Internally, the business activities here is differently vibrant due to having foreign currency (pound). The commercial hotspots are commonly the core areas that define city growth. Shahjalal University Avenue, old city fabric Amberkhana, Shahi Eidgah, historical MC College, scenic Airport-street, Chowhatta cultural belt, landmarks in Bandar, historical Kean Bridge and Ali Amzad clock, Bandar signifies, Kadamtoli inter district terminals defines the commercial hotspots. Amberkhana being the center, leads the commercial sector with huge touristic and shrine-based business-like hotels, restaurants and banks etc. These signature landmarks enhance to the touristic approach and a large number of livelihoods depends on it.

Beyond the SCC area, the hotspots are basically reserve forests, stone quarries, Haors, hilly topography and tea estates mostly. So, these attract most of the tourists in this sector.

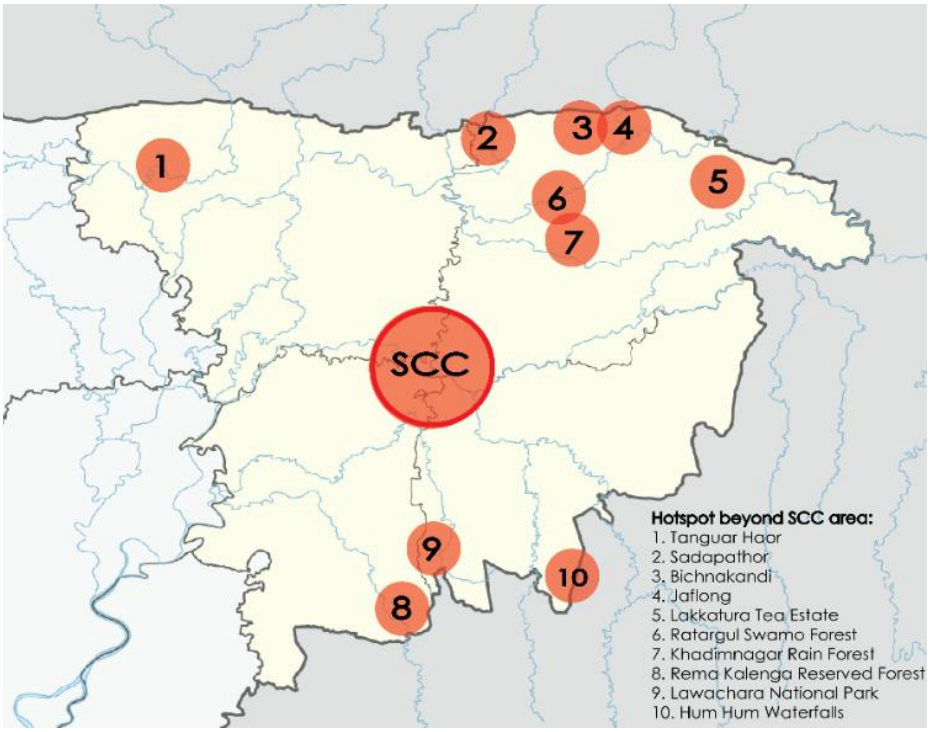
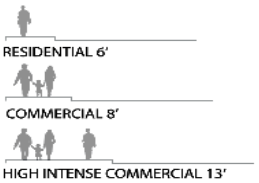
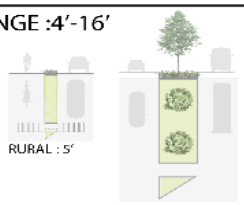
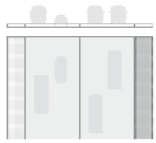
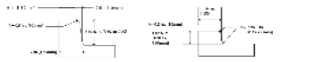
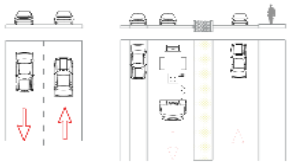
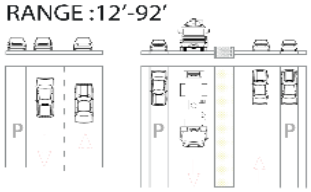
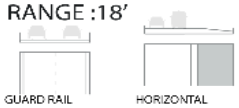
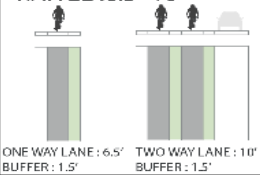
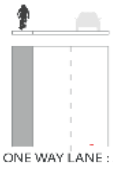


Figure 3: Notable hotspots beyond the SCC area (author).

The 'TanguarHaor' (second largest freshwater wetland of Bangladesh), white stone quary (sadapathor, Bichnakandi), Stone-quarry and hill view (Jaflong), Lakkatura Tea Estate, Ratargul Swamp Forest, Khadim-nagar Rain Forest, Rema Kalenga Reserved Forest, Lawachara National Park, Hum-hum waterfalls are the hotspots mostly work as a tourist hotspot. Hotels, Boat Service, Forest-museum, restaurants type functions have gradually up risen the tourism-based economy here in Sylhet.

A relationship between street and its aspects has been shown by the NACTO (National Association of City Transportation Official, USA), IRS (Indian Road Congress) and BRTC (Bangladesh Road Transport Corporation) NACTO shows a guideline for urban street design. This pertains to a collective of ninety-one cities and transit agencies in North America that was established with the goal of sharing transportation ideas and insights, as well as for collaboration on transportation issues on a national level. In a whole, it defines the principles and practices of urban street and transportation process. The Guide outlines both a clear vision for complete streets and a basic street map for how to bring them to fruition. So, in this study, we are particularly focusing on the street, standards and usability in Bangladesh, India and USA. It will be a comparative analysis that will help us to understand the various practices of these countries and identify the possible changes.

Chart 02: NACTO guideline on street aspects.

STREET ELEMENTS & STANDARDS	INDIAN STANDARD	BANGLADESH STANDARD	AMERICAN STANDARD
WALKWAY	RANGE :6'-13'  	RANGE :6'-13'  	RANGE :4'-5' 
Median	RANGE :4'-16'  	RANGE :4'-18'  	RANGE :4'-80' 
Shoulder:	RANGE :1.5'-16'  	RANGE :1.5'-16'  	RANGE :2'-8' 
CURBS	N/A	RANGE :1'-2'  	RANGE :1'-2' 
CARRIAGE WAY	RANGE :18'-92'  	RANGE :12'-92'  	RANGE :12'-92' 
CLEARANCE	RANGE :3'-13' 	RANGE :18'  	RANGE :7'-10' 
NON MOTORISED TRACK	RANGE :6.5'-10'  	RANGE :6.5'-10'  	RANGE :5' 

METHODOLOGY

This research integrates both qualitative and quantitative methods to collect, analyze, and synthesize data. The approach involves primary surveys, self-observation, and secondary data sources to explore the relationship between the street landscape (SL) and street users.

The study relies on primary data collected through in-person observations, sketches, photographs, and noting passersby's self-thinking over a ten-month period. Data were gathered from 50 individual and group street users, with qualitative analysis employed to sort and process this information to identify patterns and behaviors. Secondary data sources, including books, articles, newspapers, and magazines, were used to understand the historical and theoretical background of SL aspects in the case site (SCC), while quantitative analysis facilitated the statistical evaluation and synthesis of data.

The research analyzed the streets through 15 strategic points, employing sectional studies to understand spatial characteristics and documenting existing greenery along the roads. This helped in identifying and categorizing the vegetation present in these areas. In addition, expert consultation and interactive discussions were conducted, where materials were shared with field experts and resource persons to gain deeper insights into SL aspects, landscape environments, and street plant profiles.

Technical analysis and mapping were conducted using various software, including AutoCAD, Photoshop, Illustrator, Google Earth, Google Street Map, and photometry techniques, to process the collected data. The landscape assessment through GIS was used to synthesize findings from the 15 strategic points, allowing for a structured intervention planning process. Merging the assessment findings enabled the mapping of key areas for future interventions and improvements.

This structured approach ensures a comprehensive analysis of the SL aspects and its relationship with the street users, ultimately guiding strategic interventions for landscape enhancement.

Chart 03: Methodology Chart

Step	**Method**	**Tools and Techniques**	**Outcome**
Primary Data Collection	Observation, trace analysis, interviews	Photographs, sketches, field notes	Understanding user interaction with SL
Sampling	50 individual and group users	Self-thinking analysis, qualitative sorting	Identifying behavioral patterns
Secondary Data Collection	Literature review	Books, articles, newspapers	Background history and theoretical framework
Street Analysis	Sectional studies, greenery documentation	Field surveys, GIS mapping	Understanding spatial characteristics and existing vegetation
Expert Consultation	Open discussions	Expert insights, resource sharing	Validating landscape elements

Technical Analysis	Landscape assessment	AutoCAD, GIS, photometry	Identifying strategic intervention points
Mapping and Strategy Development	Data synthesis	Google Earth, GIS mapping	Defining key areas for landscape improvement

RESULT

15 case points analysis: We have selected 15 vibrant points around the spinal streets of SCC area crisscrossed to each other to analyze the street-pedestrian-activity, inter relationship, landscaping elements, greenery, open public space and built form (fig: 3). As-

Point 01 (Tukerbazar): In this section, we got usual elements like streets, pedestrians, median and landscape. Each of the street lane is 20' and has 4' pedestrian (interrupted) and a landscape zone in between. A thin 2' median is seen in the section too.

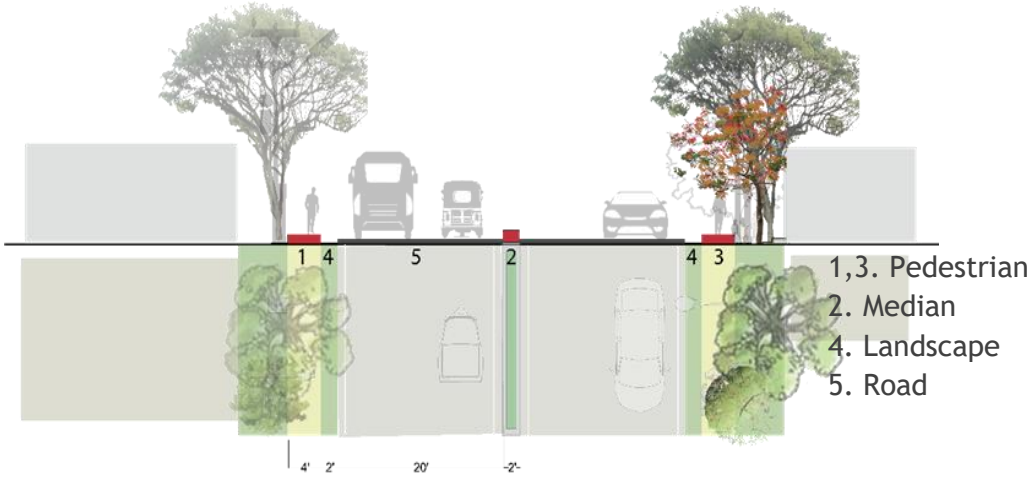


Figure 4: Tukerbazar street analysis (section; plant profile: chart4)(author).

Point 02 (Temukhi): A 26' feet street lane can be seen in this section. Elements like 4' pedestrian on both sides of the street and 5’ median on the middle are found on this section.

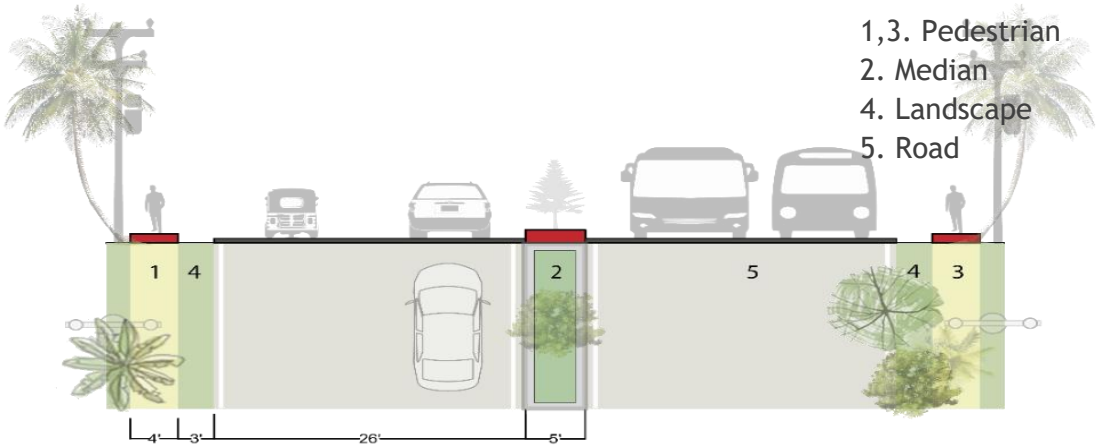


Figure 5: Temukhi street analysis (section; plant profile: chart4) (author).

Point 03 (SUST gate): This section holds activities like Outdoor food court, sittings, small vendor shops, in its huge landscape zone of 15'. The road lane is basically 20' and the pedestrian is 5' on the width. Median is 3' with various roadside plantation.

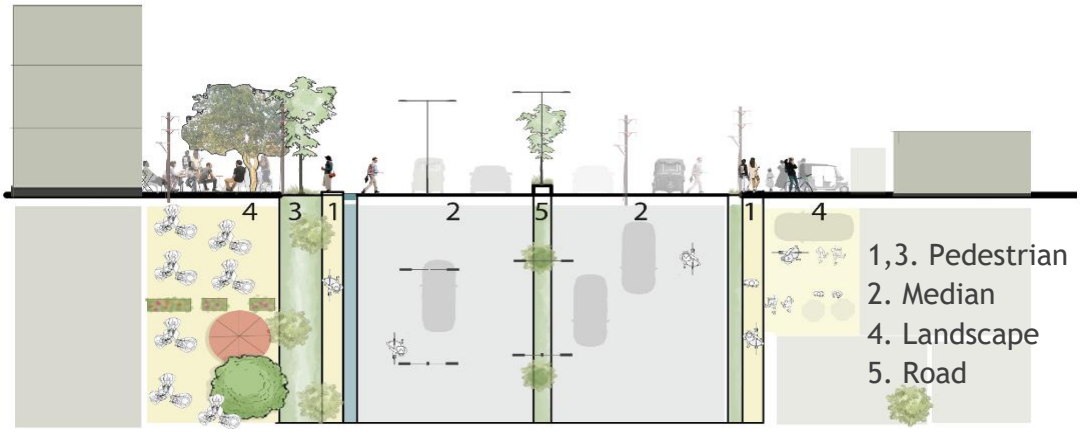


Figure 6: SUST gate street analysis (section; plant profile: chart4) (author).

Point 04 (Mount Adora Hospital): This section is before a hospital function; thus, it has a zebra crossing and speed breaker. Road lane width is 20' and 6' pedestrian. Median consists of various plantations in a width of 3'.

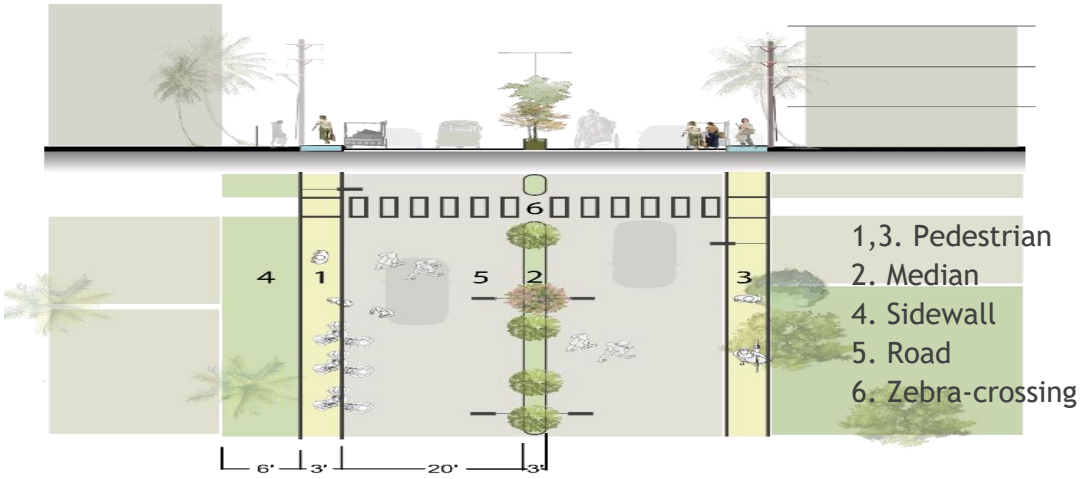


Figure 7: Mount Adora Hospital-street analysis (section; plant profile: chart 4)(author).

Point 05 (Modina Market): This section upholds a market area and has 26' road width.4' pedestrian and 3' sidewalks can be found that connects to the bazaar. The 2' median is well controlled and has green access.

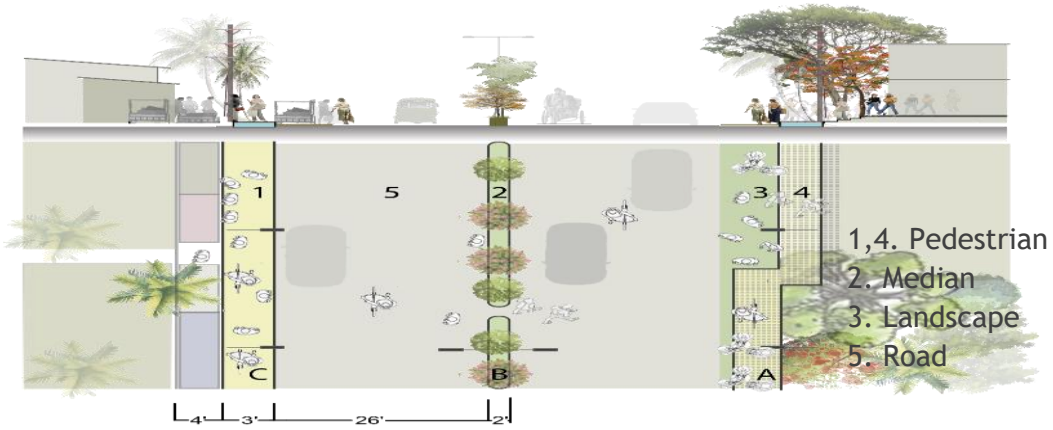


Figure 8: Modina market street analysis (section; plant profile: chart4)(author).

Point 06 (Ambarkhana): It is a sectional picture of Sylhet's one of the most prominent commercial area having a 25 ' road width and 4 ' pedestrian. No median is seen here. It is always busy on traffics and doesn't have sufficient pedestrian space.

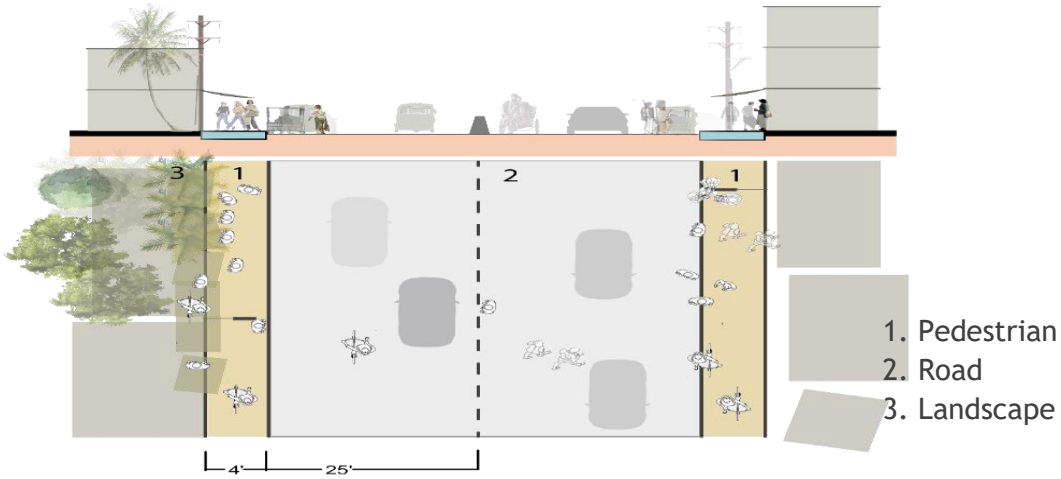


Figure 10: Ambarkhana street analysis (section; plant profile: chart4)(author).

Point 07 (Shahi Eidgah): In this section, the road lane is 20' in width and 3' pedestrian access. The road does not have median.

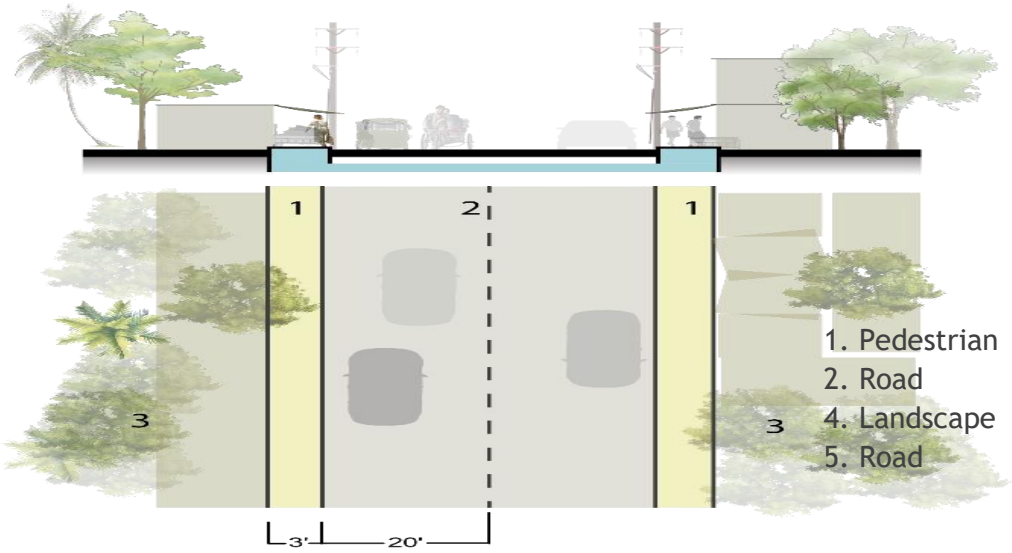


Figure 9: Shahi Eidgah street analysis (section; plant profile: chart4)(author).

Point 08 (Arambagh): The section depicts 20' road lane with 3' pedestrian. Sidewalks are seen which is extended from the pedestrian and green shaded.

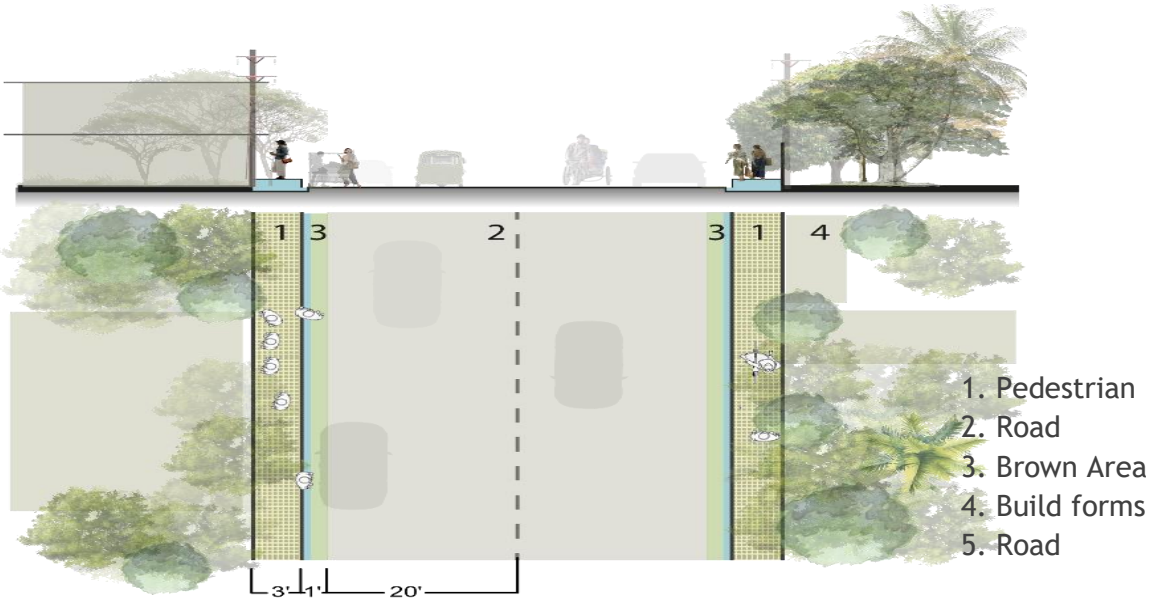


Figure 11: Arambagh street analysis (section; plant profile: chart4)(author).

Point 09 (Tilagarh): This section consists of 25' road lane width. A sidewalk and tree plantation over the two sides of roads. No median on the road. But the pedestrian is 4'.

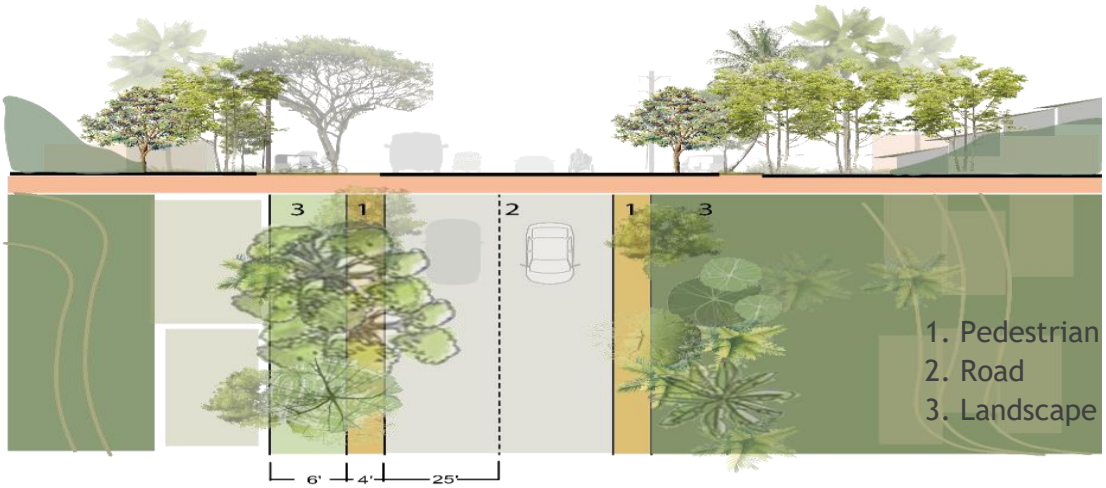


Figure 12: Tilagarh street analysis (section; plant profile: chart4)(author).

Point 10 (MC College): In this section 20' road lane is seen with a 3' pedestrian and 5' sidewalks. A remarkable landscape space and waterbody on both sides. The Chora used to be a useable water source in 90's, now sabotaged.

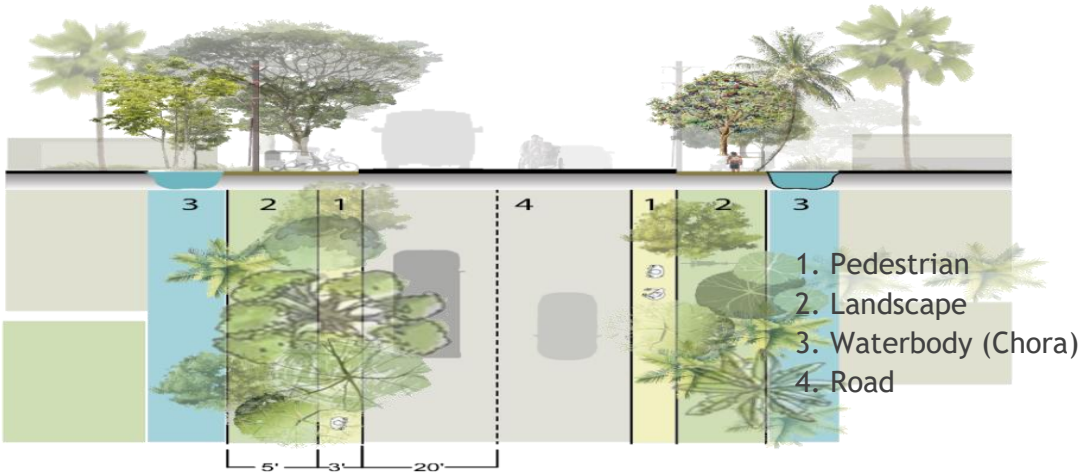


Figure 13: MC College Street analysis (section; plant profile: chart 4)(author).

Point 11 (Shah Poran R.): This section holds a spiritual connectivity with 28' road lane and 3' pedestrian and a 3' grey area in between them. A landscape area of 6'width with greenery and a unique element foot over bridge can be seen here.

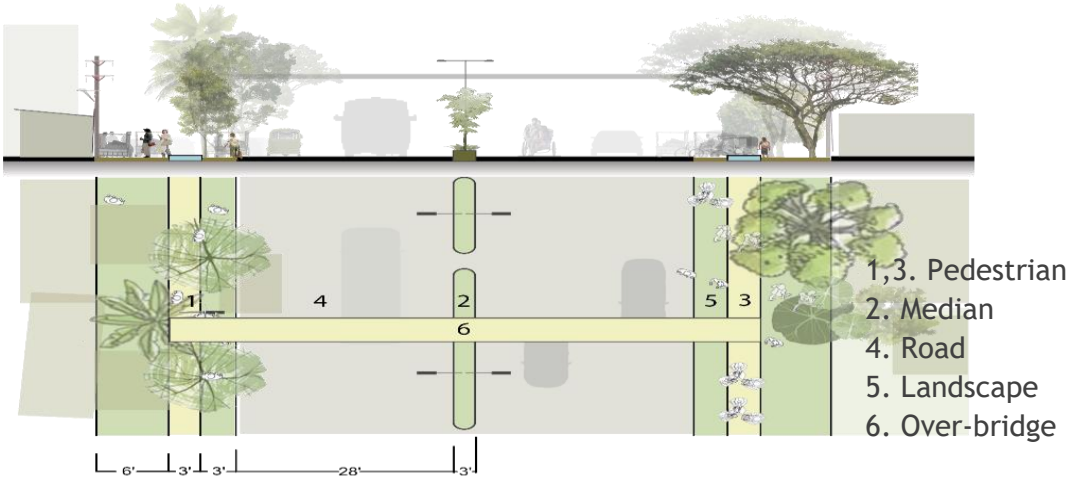


Figure 14: Shah Poran (R.) street analysis (section; plant profile: chart 4)(author).

Point 12 (Airport-street): A 25' road lane width and 4 ' unpaved pedestrian is consisted in this section. No median on the road but it shows a large number of tree plantation on both side of roads.

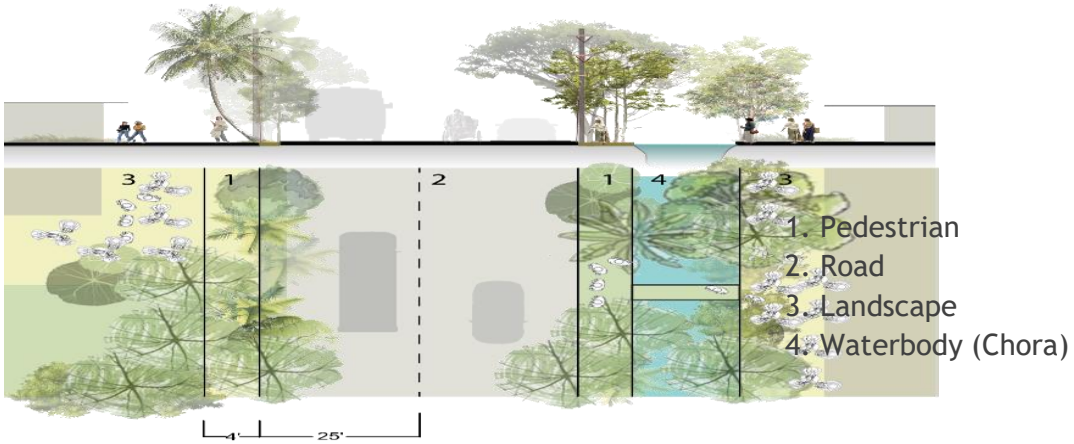


Figure 15: Airport Street analysis (section; plant profile: chart 4) (author).

Point 13 (Chowkidekhi): The section depicts 25' road lane with 3' pedestrian. Sidewalks are seen which is extended from the pedestrian and green shaded with loads of trees. No median is seen.

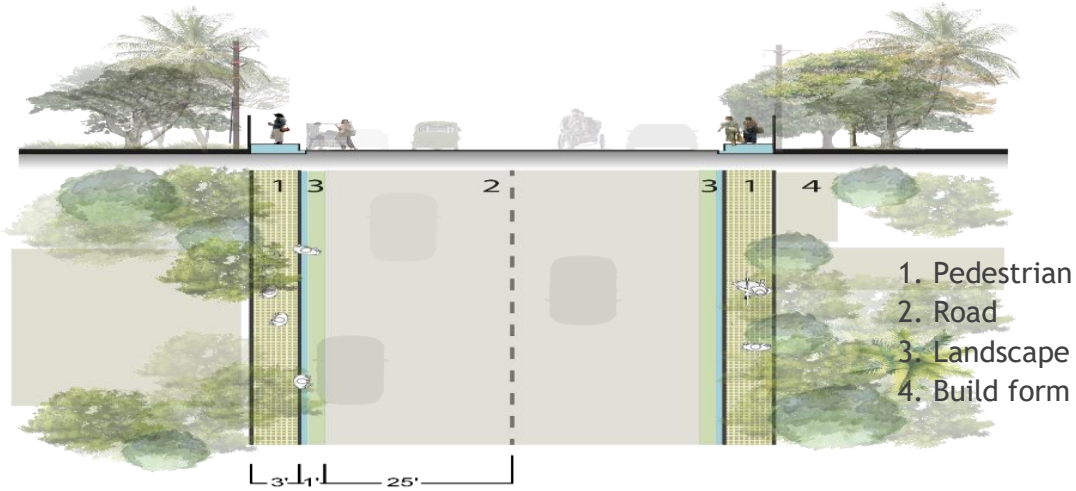


Figure 16: Chowkidekhi street analysis (section; plant profile: chart 4)(author).

Point 14 (Chowhatta): This section consists of 25' road lane width. No median on the road. But the pedestrian is 3'.

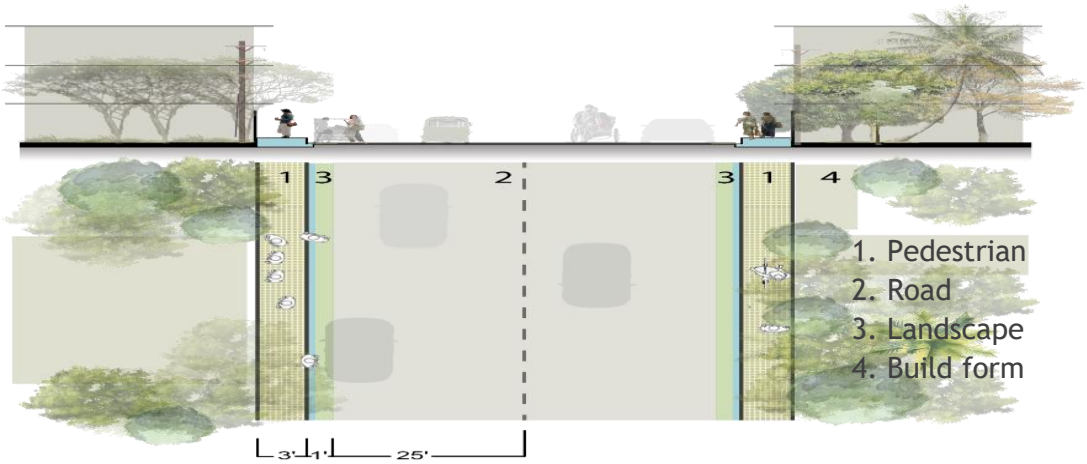


Figure 17: Chowhatta street analysis (section; plant profile: chart 4) (author).

Point 15 (Bandarbazar): This section is another terminal point of Sylhet and have important elements like Keane Bridge gate. Road lane width 25'- and 3.5'-feet pedestrian is seen...but the under the bridge a 13' median is created.

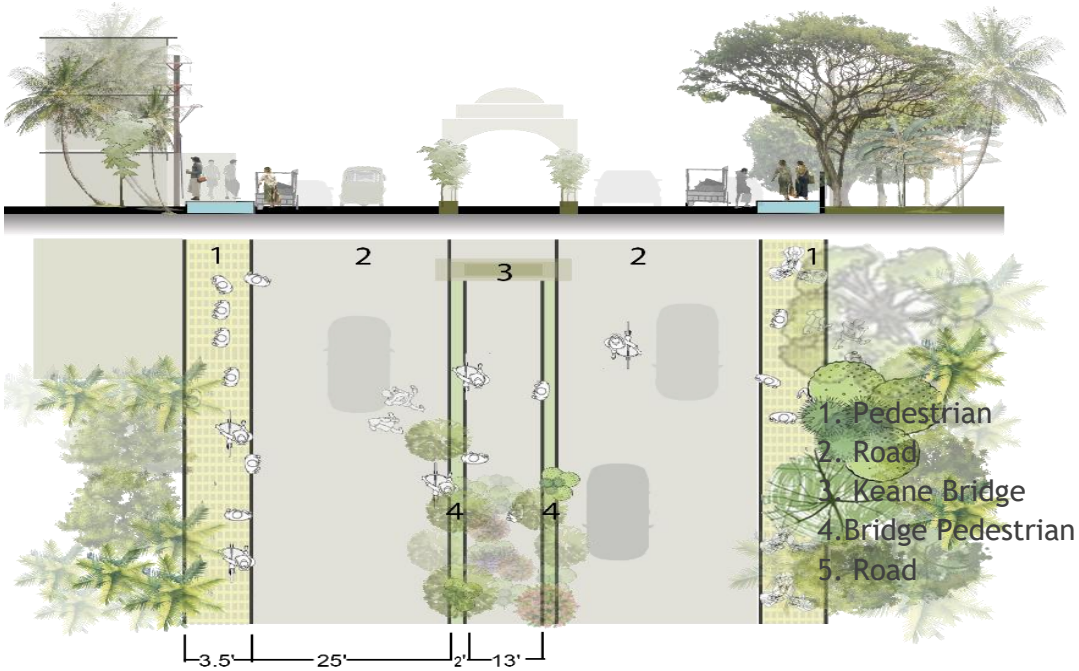


Figure 18: Bandarbazar street analysis (section; plant profile: chart 4) (author).

4 Thematic Sections on street findings: This study come to sum-up the below findings by 4 thematic sections (Fig: 19 (1,2,3,4)) on the crisscrossed spinal streets of SCC area according to the above analyses by spatial aspects, sections

and plant profiles. It would help to understand on the average existing street condition of the considered case streets of the SCC area. The study found that the ratio between natural and manmade settings are remarkable decreasing and increasing respectively from Airport to Ambarkhana, Tilagarh to Ambarkhana, Tukerbazar to Ambarkhana, and then Bandar to Ambarkhana. As-

1. Airport to Ambarkhana: In this thematic section, we can analyze the gross idea of the street-pedestrian ratio and the greenery ratio adjacent to the street's landscapes. Builtform is much lesser than other areas and greenery is dominant in this zone as a huge part of this area covered with 'Malnichora Tea estate'. Paved pedestrian and median lessen as we move towards the Airport Street from Ambarkhana. Beside these unpaved pedestrian and green zones are connected where various food courts are functional and people visit here at holidays.

2. Tilagarh to Ambarkhana: The section indicates a good amount of greenery zone beside the street areas and the road width is increased. Median is not so prominently found. An average of 24' road lane width and 4' pedestrian is seen here. Shah Poran (R.) Mazar point, MC college, Shahi Eidgah point creates a commercial zone around this belt that includes restaurants, markets etc.

3.Tukerbazar to Ambarkhana: A decent amount if green zone is seen in this area as the section depicts. Street lane width and pedestrian width is around 20' and 4' respectively, and maintains a prominent median around the whole street network. This section connects some important functions such as bus stand, SUST, Hospital, bazar, religious spots, food facilities, residential and commercial functions together

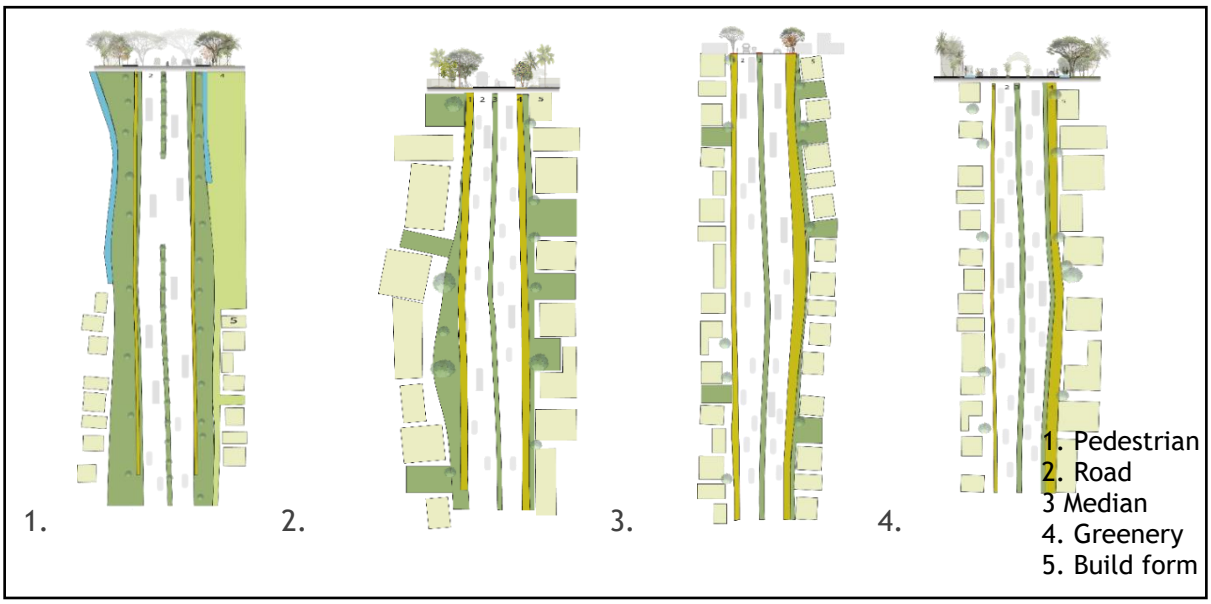


Figure 19(1): Thematic findings on Airport to Ambarkhana street (author).
Figure 19(2): Thematic findings on Tilagarh to Ambarkhana street (author).
Figure 19(3): Thematic findings on Tukerbazar to Ambarkhana street (author).
Figure 19(4): Thematic findings on Ambarkhana to Bandarbazar street (author).

4. Bandarbazar to Ambarkhana: This thematic section shows that the greenery decreased as the commercial zones are prominently increased. Built forms are prioritized, green areas lessen, streets, pedestrian and medians are prominent and an average of 20' road lane width, 3' pedestrian width are seen here. Various activities and functions are connected in this zone as an economic zone. Functions like mazars, banks, markets, cultural spots, government offices are seen here prominently.

Chart 04: Plant profile of 15 points:

Plant Type	**Plant Name**	**Available Locations**
Grass	Bamboo (Bambusa tulda)	1B, 1C, 10B, 10C, 12B, 12C, 5B, 5C, 9B, 9C
	Bermuda grass (Cynodon dactylon)	1B, 1C, 10B, 10C, 12B, 12C, 5B, 5C, 9B, 9C, 14A
	Weedy Grasses (Eleusine indica, Digitaria spp.)	1B, 1C, 4A, 7A, 7C, 10B, 10C, 12B, 12C, 5B, 5C, 9B, 9C, 13C, 15A
Bushes	Dracaena (Dracaena marginata)	1B, 7A
	Moiurpakkhi (Thuja occidentalis)	5B
	Patabahar (Codiaeum variegatum)	1B, 7A, 7C, 11A
	Jasmine (Jasminum sambac)	10B, 15B
Shrubs	Banana (Musa acuminata)	10A, 12A, 6C
	Beli ful (Jasminum sambac)	4B
	Gate flower (Catharanthus roseus)	7C
	Hasnahena (Cestrum nocturnum)	13C
	Kagojful (Bougainvillea glabra)	6C
	Kathgolap (Plumeria alba)	7C
	Modhumaloti (Mombretum indicum)	6A
	Papaya (Carica papaya)	10A, 1B
	Rangon (Ixora coccinea)	4B, 5B, 7C, 15B
	Shiuli (Nyctanthes arbor)	8A
Trees	Coconut (Cocos nucifera)	1C, 11C, 12C, 13C, 15A, 2B, 4C, 5C, 6A, 7C, 8A
	Debdaru (Polyalthia longifolia)	10B, 11B, 15A, 1B, 3A, 3B, 4B, 5B, 7B
	Daiji (Acer palmatum)	2A, 2C
	Kadam (Neolamarckiacadamba)	10A, 10B, 12B, 12C, 15B, 1A, 1C, 3B, 7A
	Koroi (Albizia procera)	11B, 12C, 15B, 1B, 2A, 3B, 5A, 5B, 7A
	Mahagoni (Swietenia macrophylla)	13B, 14A, 1C, 2A, 4B, 5C, 7A
	Mango (Mangifera indica)	10A, 13A, 14A, 1C, 2C, 4A, 4C, 5A, 6C, 7B, 8A, 9C
	Neem (Azadirachta indica)	11A, 11B, 14A, 1B, 2B, 4C, 5B, 7B
	Palm (Arecaceae spp.)	11B
	Papaya (Carica papaya)	11B
	Radhachura (Caesalpinia pulcherrima)	11B, 1B, 4B
	Raintree (Samanea saman)	10B, 12B, 12C, 13B, 15A, 15B, 1A, 1C, 2A

We analyzed 15 points to identify the plant profile only in the street and existing scenario of tree coverage. Here, A and C denotes the left and right side of the pedestrian and B denotes the median.

The flora survey along 15 Sylhet sites identifies diverse species grouped under grasses, bushes, shrubs, and trees—trees holding the maximum. Widespread trees like Kadam, Raintree, Mango, and Neem indicate a dense canopy cover, while bushes like Coconut and Rangon offer utility as much as aesthetics. Bushes like Patabahar and grasses like Bamboo are selectively found. Tukerbazar Point (Point 1) is special with most plant diversity, with all categories of its zones. The least diverse is Chowhatta Point (Point 14), where two tree species are found and no grasses, bushes, and shrubs.

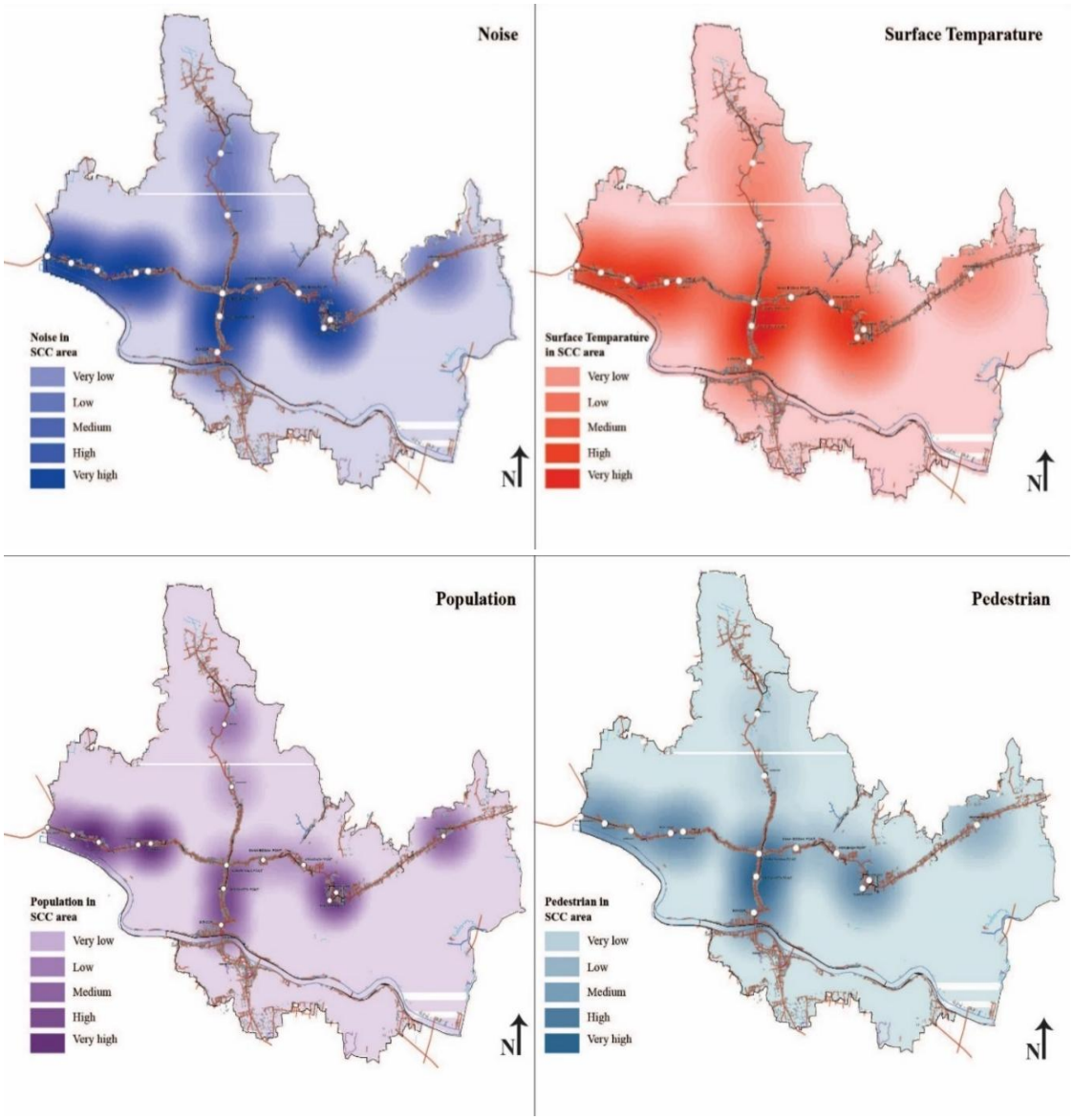
Based on the analysis of the 15 points in Sylhet City Corporation (SCC), we created a structured table summarizing key quantitative data, including temperature,surface temperature, noise, pedestrian flow, tree cover percentage, and air quality index (AQI). Additionally, I will apply basic statistical analysis to validate the findings.

1. Quantitative Data Summary from the 15 Points

Chart 05: Environmental data of 15 points (Field Survey data)

Location / Environment	Temperature (°C)	Surface Temperature (°C)	Tree Coverage	Noise (dB)	Light (lux)	Population	Pedestrian Flow	AQI
Tukerbazar	26.8	28.9	58%	91.4	3589	11,453	2000	70
Temukhi	27.1	31.2	30%	93.7	3832	19,356	2100	90
Sust Gate	26.4	30.5	45.50%	92.9	3479	30,305	1700	75
Mount Adora	26.5	30.2	52.30%	93.1	4006	9262	1800	85
Modina Market	28.5	33.3	28%	95.4	3953	31,685	2500	95
Ambarkhana	28.9	36.5	5%	98.25	4308	11,956	3400	110
Arambagh	24.4	28.3	54.70%	90.23	2963	11,453	1400	85
Airport Rd	22.9	26.7	67.20%	86.6	3109	19,085	1100	75
Shah Poran Rd	28.2	30.3	44.80%	92.5	3338	26,331	2400	88
Mc College	27.8	31.3	47.80%	91.8	4102	18,290	1850	80
Tilagarh	28.1	32.5	37.90%	96.6	3449	20,038	2300	78
Chowkidekhi	24.5	26.9	68.50%	84.73	2967	10,508	1200	72
Shahi Eidgah	24.4	28.3	54.70%	90.23	3189	11,309		
Chowhatta	28.3	33.5	24.30%	96.23	3968	20,691	2800	100
Bandarbazar	28.5	33.9	26.80%	97.40	3719	22,917	3500	110

2. GIS Analysis



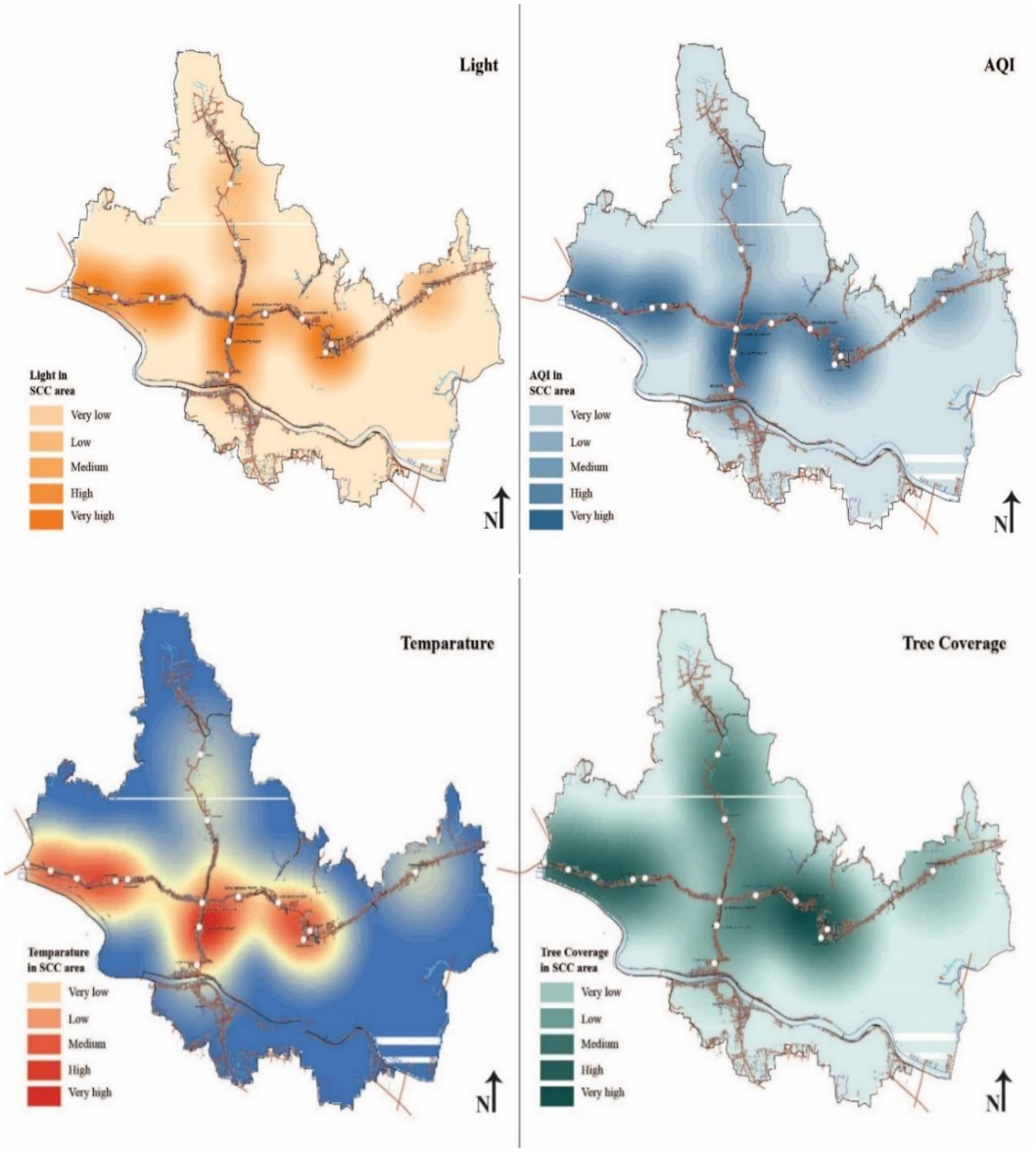


Figure 23: GIS analysis of 15 points based on parameters

We created GIS based maps according to the table's information to understand and analyze the road's correlation within Temperature (°C), Surface Temperature (°C), Tree Coverage, Noise (dB), Light(lux), Population, Pedestrian Flow, AQI.

3. Statistical Analysis

- Correlation Analysis
- Street Width vs. Pedestrian Flow

A moderate positive correlation is observed between street width (as reflected by higher pedestrian capacity zones) and pedestrian flow. Areas such as SUST Gate (30,305 pedestrians) and Modina Market (31,685 pedestrians), which are typically connected to wider arterial streets, accommodate significantly

higher foot traffic compared to smaller, local streets like Chowkidekhi (10,508) or Tukerbazar (11,453). This suggests that wider streets encourage and support more pedestrian activity.

- Tree Cover vs. AQI (Air Quality Index)

A strong negative correlation (r = -0.97) exists between tree cover and AQI. Areas with high tree coverage, such as Chowkidekhi (68.5%), Airport Road (67.2%), and Arambagh (54.7%), report lower AQI values (72, 75, and 85 respectively). In contrast, Ambarkhana (5% tree cover) and Chowhatta (24.3%) suffer from very poor air quality with AQI values of 110 and 100 respectively.

- Pedestrian Flow vs. AQI

A positive correlation is evident, indicating that areas with more pedestrian traffic also tend to have worse air quality. For example, Bandarbazar (3500 pedestrians) and Chowhatta (2800 pedestrians) both show very high AQI levels (110 and 100), likely due to the concentration of people, congestion, and vehicular emissions in these commercial hubs.

4. Regression Model: Tree Cover vs. Air Quality

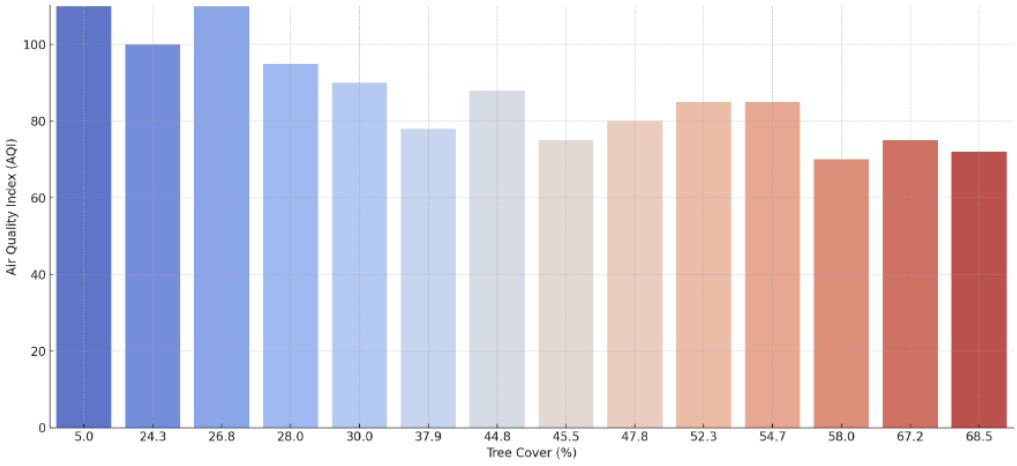


Figure 24: Tree Cover vs. Air Quality

A simple linear regression was conducted to quantify how tree cover percentage affects air quality (measured by AQI).

Regression Equation:
AQI=116.47−0.9915 × (Tree Cover %)

Interpretation:

- For every 1% increase in tree cover, the AQI is predicted to decrease by approximately 0.99 points.
- This confirms that more trees lead to significantly cleaner air.

Model Summary:

- R-squared value: 0.970
  The model explains 97% of the variation in AQI, indicating a very strong fit to the observed data.
- p-value (<0.0001):
  This makes the relationship between tree cover and AQI statistically significant.
- F-statistic = 418.1 (p ≈ 0.000):
  Further supports the model's robustness and reliability.

5. Grounded Insights from the Table

- Streets with >35% tree cover (e.g., Mount Adora – 52.3%, SUST Gate – 45.5%, MC College – 47.8%) consistently maintain AQI below 85, confirming the model's predictions.
- Streets with <25% tree cover, such as Ambarkhana (5%), Bandarbazar (26.8%), and Chowhatta (24.3%), all record AQI values over 100, indicating significantly poorer air quality.
- Chowkidekhi, with the highest tree coverage (68.5%), demonstrates excellent air quality (AQI 72), making it a benchmark location.

DISCUSSION

Tree Coverage as a Vital Regulator of Environmental Quality:

The analysis shows that tree coverage plays a crucial role in maintaining environmental balance, exhibiting strong negative correlations with surface temperature (-0.97), noise (-0.91), and AQI (-0.86). Areas with high tree coverage, such as Chowkidekhi (68.5%), Airport Road (67.2%), Arambagh (54.7%), and Mount Adora (52.3%), benefit from cooler temperatures, lower noise levels, and cleaner air. These places should be protected and serve as models for green infrastructure planning in other parts of the city.

Conversely, urban zones like Ambarkhana (5%), Modina Market (28%), Chowhatta (24.3%), and Bandarbazar (26.8%) suffer from extremely low tree coverage. These areas also report the highest levels of pollution and heat, confirming the critical need for urban greening. Immediate steps should be taken to introduce green belts, increase roadside plantation, and create pocket parks in these tree-deficient areas.

Surface Temperature Reflects Urban Stress:

Surface temperature, which is strongly correlated with noise (0.94), AQI (0.82), and pedestrian flow (0.92), acts as a reliable indicator of urban stress. High temperatures often coincide with congestion and pollution. For instance,

Ambarkhana (36.5°C), Bandarbazar (33.9°C), Chowhatta (33.5°C), and Modina Market (33.3°C) are among the hottest locations in the city, and they also experience high AQI and intense human activity (Field Survey Data).

These findings point to the urgent need for applying urban cooling strategies in these areas. Potential solutions include the use of heat-reflective or permeable pavement materials, green roofing, and street trees. Increasing surface albedo and shading can significantly reduce the urban heat island effect, improving both environmental and human comfort.

Pedestrian Flow Linked to Pollution and Discomfort:

Areas with high pedestrian flow often overlap with environmental stress zones. Locations such as Bandarbazar (3500 people), Ambarkhana (3400 people), Chowhatta (2800 people), and Modina Market (2500 people) not only experience dense foot traffic but also record elevated levels of heat, noise, and air pollution. These conditions threaten walkability and overall urban livability. (Field Survey Data)

To improve pedestrian comfort, it is essential to design shaded pathways, install vegetation barriers along walkways, and enhance public realm elements such as benches, water fountains, and resting zones. These measures would create a healthier, more pleasant walking environment, especially in commercial and transit-heavy areas.

Population Density Isn't the Problem:

Interestingly, the data indicates that population density does not directly cause environmental degradation. For example, SUST Gate (30,305 people) and Shah Poran Road (26,331 people) (Field Survey Data) have high population counts, yet they maintain moderate AQI levels and manageable noise due to better tree coverage and spatial planning. This reveals that density can be sustainable if supported by proper design strategies.

Therefore, urban densification should not be discouraged; rather, it should be accompanied by green infrastructure, open spaces, and pollution control interventions. The focus must be on smart planning instead of limiting growth.

Localized Strategy for Sustainable Urban Planning:

In conclusion, this correlation analysis identifies clear patterns and offers site-specific strategies to improve Sylhet's urban environment. Ambarkhana should be prioritized for massive tree plantation and urban cooling due to its extreme heat and lack of vegetation. Chowhatta and Bandarbazar require urgent interventions, such as shaded walkways, green rooftops, and pollution barriers, to improve air quality and comfort. Modina Market, a busy and noisy area, would benefit from façade greening, acoustic buffers, and shaded public spaces.

At the same time, Chowkidekhi, with its high tree coverage and balanced environment, should be preserved and used as a reference for future neighborhood development. This area demonstrates that incorporating nature into urban settings leads to measurable environmental benefits. Overall, the city must adopt a climate-responsive, pedestrian-friendly planning approach rooted in data and evidence.

Urban Street Design and Environmental Enhancement Recommendations

1. Electric/Solar Pole Arrangement

- Misplacement Issue: Existing electric poles are haphazardly placed, cluttering the skyline with cables.
- Proposed Actions:
    - Replace all electric poles with solar poles to reduce overhanging cables and improve aesthetics.
    - Remove poles from the median to clear visual and physical clutter.
    - Position poles between the pedestrian zone and vehicular lanes only.

2. Underground Cabling

- Eliminate overhead wires for a barrier-free, cleaner urban view.
- Cables should be routed underground, either:
    - Between buildings and pedestrian paths, or
    - Beneath the vehicular street.

3. Urban Street as Public Space

- Streets are urban voids with potential to become urban plazas, green zones, or walkable corridors.
- Possible spatial sequence:

Building → Green strip → Pedestrian (with pockets/activities) → Green belt → Vehicular lanes (with clear markings) → Median → Repeat on opposite side.

4. Street Pockets for Public Use

- Identify underused spaces around intersections and activate them with:
    - Street food vendors (regulated),
    - Seating/furniture,
    - Landscaping,
    - Lighting.
- This improves pedestrian flow and frees up main street space.

5. Street Width and Traffic Movement

- Based on NACTO guidelines, the existing width is sufficient.
- Key Enhancements:
    - Introduce street markings and stoppage points,

- Discourage 3-wheelers, promote intra-city buses,
- Strengthen law enforcement and public awareness.

6. Street Demarcation

- Clear lane division for:
  - Slow-moving vs. fast-moving vehicles,
  - Human-pulled carts,
  - Bicycle lanes,
  - Crosswalks and stoppage zones.
- Training and enforcement are crucial.

7. Pedestrian Walkways

- Enough scope exists to widen and enhance pedestrian paths.
- Design variation in paving, textures, and interactive features will improve walkability and comfort.
- Ensure universal accessibility.

8. Planting Strategy and Urban Forestry (E. Gregory McPherson, 1997)

- Existing unplanned plantations reduce environmental benefits.
- Strategic planting based on spatial needs and environmental roles:
  - Noise and air filter plants,
  - Shade, medicinal, flowering, and fruit trees,
  - Low shrubs, bushes, herbs, and grasses,
  - Species selected by height, foliage density, shape, and seasonal variation.
- Regular pruning is necessary for maximum environmental and spatial value.

9. Median Landscaping

- Medians should:
  - Use grass, shrubs, and linear trees,
  - Avoid dense or wide-spread plantings,
  - Be used for solar panels, mini wind turbines, or light greenery if narrow (<1.5m),
  - Avoid concrete fencing; bush fences are more aesthetic and ecologically beneficial.

Chart 06: Proposed tree list with the existing (author).

Plant Type	**Plant**	**Plant**
Grass	Bamboo (Bambusatulda)	Buffalo Grass (Stenotaphrum secundatum)
	Bermuda Grass (Cynodon dactylon)	Vetiver Grass (Chrysopogon zizanioides)
Bushes	Dracaena (Dracaena marginata)	Moiurpakkhi (Thuja occidentalis)
	Patabahar (Codiaeum variegatum)	Jasmine (Jasminum sambac)
	Gate flower (Catharanthus roseus)	Modhumaloti (Combretum indicum)

	Rangon (Ixora coccinea)	Kagojful (Bougainvillea glabra)
Shrubs	Banana (Musa acuminata)	Beli ful (Jasminum sambac)
	Duranta (Duranta erecta)	Hasnahena (Cestrum nocturnum)
	Kathgolap (Plumeria alba)	Shiuli (Nyctanthes arbor)
	Togor (Tabernaemontanadivaricata)	Belembu (Averrhoa bilimbi)
Trees	Kadam (Neolamarckiacadamba)	Koroi (Albizia procera)
	Mahagoni (Swietenia macrophylla)	Mango (Mangifera indica)
	Neem (Azadirachta indica)	Radhachura (Caesalpinia pulcherrima)
	Raintree (Samanea saman)	Krishnochura (Delonix regia)
	Dumur (Ficus racemosa)	Shupari (Areca catechu)
	Atafol (Annona squamosa)	Boroi (Ziziphus mauritiana)
	Amra (Spondias pinnata)	Guava (Psidium guajava)
	Jam (Syzygiumcumini)	Sissoo (Dalbergia sissoo)
	Koroch (Pongamia pinnata)	Arjun (Terminalia arjuna)
	Cham fruit (Artocarpus chama)	Kathbadam (Prunus dulcis)
	Akashmoni (Acacia auriculiformis)	Date palm (Phoenix dactylifera)
	Debdaru (Polyalthia longifolia)	Kanchan (Bauhinia variegata)
	Chatim (Alstoniascholaris)	Tal (Borassus flabellifer)
	Kamranga (Averrhoa carambola)	Segun (Tectona grandis)
	Tetul (Tamarindus indica)	Batul (Shirakiopsis indica)
	Bot (Ficus benghalensis)	Jarul (Lagerstroemia speciosa)
	Palm (Arecaceae spp.)	Papaya (Carica papaya)
	Coconut (Cocos nucifera)	Jhau (Tamarix dioica)

CONCLUSION

This research shows how spatial morphology and greenery shape the street landscape of Sylhet. In tree covered streets, for example, Chowkidekhi and Airport Road, air quality and surface temperatures are relatively lower. On the other hand, densely commercialized areas like Ambarkhana and Bandarbazar suffer from overheating and pollution due to lack of green spaces. Statistical analysis confirms strong correlations among vegetation, environmental comfort, and pedestrian experiences.

It's not population density that affects urban livability; it's the lack of balance between building and natural elements. Sylhet requires climate adaptive street planning those centers on people, featuring shaded pathways, organized greenery, and proper utility placement. Such enhancements can turn stressed transit corridors into public spaces that are healthier and more resilient. We have resources to ensure a livable environment on the streets of SCC area. Only few considerations like few modifications, few policies, proper planting, proper spatial distribution, law enforcement, public awareness and proper management can enhance the vocabulary and value of the case streets of SCC area.

Acknowledgement: This research was funded by SUST Research Center, SUST, Sylhet, Bangladesh.

Abbreviation: SL: Street Landscape, SCC: Sylhet City Corporation, MR: Main Road, LR: Link Road, NACTO: National Association of City Transportation Official, IRS: Indian Road Congress, BRTC: Bangladesh Road Transport Corporation.

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