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Microclimatic Impacts and Human Comfort Condition of Large-Scale Urban Park in Dhaka City at Summer Time (Mid-April to Mid-July): Mirpur Botanical Garden Park as a Case Study

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Abstract

Urban parks are of paramount importance in ensuring the availability of green spaces and the improvement of the overall quality of life in highly populated urban areas. The complex surface structure of urban parks generates an environment with distinct microclimatic characteristics. They influence the use of outdoor spaces, particularly in scorching and arid regions. The present work aims to investigate the climatic condition and climatic factors (temperature and humidity) of the park during the peak summertime. It also intends to examine the level of comfort experienced by users in an urban park located in Dhaka city. The project comprised of measuring the climatic factors (temperature and humidity) from various locations (natural and built-up area) inside the park. The investigation also included a subjective survey with queries about the perceived level of user comfort. The current apparel of individuals and the peak visitation time of day were also recorded. GIS, SPSS, Microsoft Excel, and other tools were used to analyse the research data. Results reveal that the park has "Hot Spots," "Cool Spots," and a "Moderate Spots," making garden temperature swings easier to explain. Also, the botanical garden's lower-temperature zones have excellent human comfort ratings, indicating a pleasant and satisfying experience. The study shows how microclimatic factors affect park design and provides a roadmap for improving urban parks. Greenery and cooling may make metropolitan communities healthier and happier in the park. This research attempts to lessen urban heat island impacts through park design and improve community vitality.

Keywords

Urban Heat Island, Human Comfort Condition, Microclimate, Urban Green Space

1. Introduction

Microclimates play a crucial role in promoting health, comfort, and well-being, particularly in urban areas where environmental stress is prevalent. Urban parks are essential in providing a cooler environment, offering relief from the heat. The "microclimate" of a park refers to the specific climatic conditions within its boundaries, which can differ from the surrounding urban environment. Factors such as park design, vegetation, surface materials, and proximity to buildings influence these microclimates, affecting thermal comfort (Liu et al., 2023). Understanding these factors is essential for enhancing park functionality and improving visitor comfort, especially during extreme heat.

Urban parks serve as valuable spaces for recreation, physical activity, and social interaction, significantly contributing to the quality of life of city residents. However, the effectiveness of urban parks largely depends on their ability to provide thermal comfort, especially during hot summer months. The urban expansion of cities is linked to various environmental issues, one of which is the Urban Heat Island (UHI) effect. The urban heat island effect is characterised by the temperature differential between urban areas and their surroundings, stemming from two interrelated processes. The primary factor is the alteration of land cover due to urbanisation, which replaces natural surfaces with impervious materials like asphalt and concrete. The second pertains to urban activities, primarily transportation and industry, which generate thermal emissions that contribute to urban heating (Villanueva-Solis, 2017).

This phenomenon can cause temperatures that are 1.0 to 6.0 degrees Celsius higher than in non-urban areas, leading to discomfort and increased energy consumption (Taha et al., 1988; Oke, 1982). The urban heat island effect results in a decrease in thermal comfort in both indoor and outdoor urban environments, as well as an increase in energy consumption for cooling (Vidrih & Medved, 2013). Mega-cities globally have experienced an increase in temperature due to several factors, including alterations of urban surfaces, emission of anthropogenic heat, development of urban canyons, and depletion of flora. Significant disparities in temperatures between rural and urban areas are documented in numerous cities, with central urban zones designated as "heat islands" (Dhakal & Hanaki, 2002).

In cities undergoing rapid urbanization, like Dhaka, mitigating the UHI effect is crucial for ensuring comfort (Dimoudi et al., 2013).

In order to mitigate the adverse environmental consequences of the UHI effect in urban areas, numerous studies have investigated the factors that mediate the UHI effect. A common conclusion of this prior research is that vegetation and water have cooling and humidifying functions, which are the primary factors that mitigate the

UHI effect (Wang et al., 2020). Green spaces are vital for moderating urban temperatures. Urban vegetation can reduce air conditioning needs by up to 80%, lower surface temperatures by as much as 17˚C, and reduce outdoor temperatures by 2 to 8˚C compared to built-up areas (Dhakal & Hanaki, 2002; Taha et al., 1988). In tropical cities like Dhaka, where summers are long and hot, increasing urban green spaces is a key strategy for combating the UHI effect. Akbari and Dionysia (2016) emphasize the importance of urban green spaces (UGSs) in mitigating heat in rapidly urbanizing cities like Dhaka, the rising temperatures in Dhaka are a stark indicator of climate change's impact, with severe heat waves largely driven by the loss of green spaces, open areas, and wetlands, intensifying these effects (Fahim, 2024).

In Dhaka, summers, which last from mid-April to July, have become more intense over the past decades due to shifting national seasonal trends. With rising temperatures, the demand for shaded areas has increased. However, Dhaka has seen a significant reduction in its green spaces, contributing to the rise in temperature. According to Global Forest Watch, Dhaka's green cover decreased from 14% in the early 1990s to 5.9% recently (Mahmud & Mahmud, 2024). This loss has intensified the UHI effect, increasing the city's reliance on air conditioning and reducing outdoor comfort. Studies show that the amount of land covered by buildings has increased significantly, further exacerbating the urban heat problem (Islam, 2023).

The reduction of green spaces in Dhaka is alarming. A study published in Plos Sustainability and Transformation revealed that green space in Dhaka North City Corporation has dropped by 66% from 92.21 sq km in 1992 to 31.40 sq km in 2022, reducing green cover from 47% in 1992 to just 16.17% in 2022 (Islam, 2023). This loss has worsened the UHI effect, increasing discomfort in the city (Issue-I, 2020; Zaman, 2024).

Larger urban parks, due to their greater size and diverse vegetation, are more effective at mitigating heat and providing cooling effects compared to smaller green spaces (Givoni, 1991). These parks create "cool islands" in the urban heat environment, reducing surrounding temperatures. Research by (Koc et al., 2018) found that urban green spaces contribute to 10.9% of the total cooling effect, with parks accounting for 6.7% and smaller green areas for 4.2%. The cooling capacity of urban parks depends on factors such as park size, vegetation density, and water features (Cao et al., 2010; Spronken-Smith & Oke, 1998).

In addition to their cooling effects, urban parks improve public health by providing spaces for relaxation, physical activity, and social interaction. The cooling effects of parks are especially important in reducing heat stress in cities like Dhaka (Aram et al., 2019). As climate change continues to impact urban environments, enhancing the cooling capacity of urban parks will become increasingly important. Future research must focus on identifying effective strategies to expand the cooling benefits of parks, aligning with the goals of sustainable urban development. The impacts of UHI are significantly mitigated by greenspaces and water bodies, which also provide valuable information for sustainable urban planning. Additionally, green greenspaces are nature-based solutions that serve as an effective benchmark for green capital. Dhaka, a rapidly expanding city impacted by climate change, is a prime example of this requirement (Tahia et al., 2025).

This study aims to investigate the microclimatic effects of large-scale urban parks in Dhaka during summer, focusing on how park design, vegetation, and local urban conditions influence thermal comfort and the UHI effect. The findings will contribute to the development of more sustainable, human-centered urban parks that improve public health and mitigate urban heat.

This research aims to measure and analyze the microclimatic impact and human comfort conditions inside the large-scale park of Dhaka city in the Summertime. To fulfill the aim some objective has been taken. These are:

1) To analyze climatic condition specially two main climatic factors (temperature and humidity) inside the park;

2) To observe the relationship between climatic factor and different structure (Artificial and Natural);

3) To observe and analyze the thermal comfort for the park users.

2. Methodology

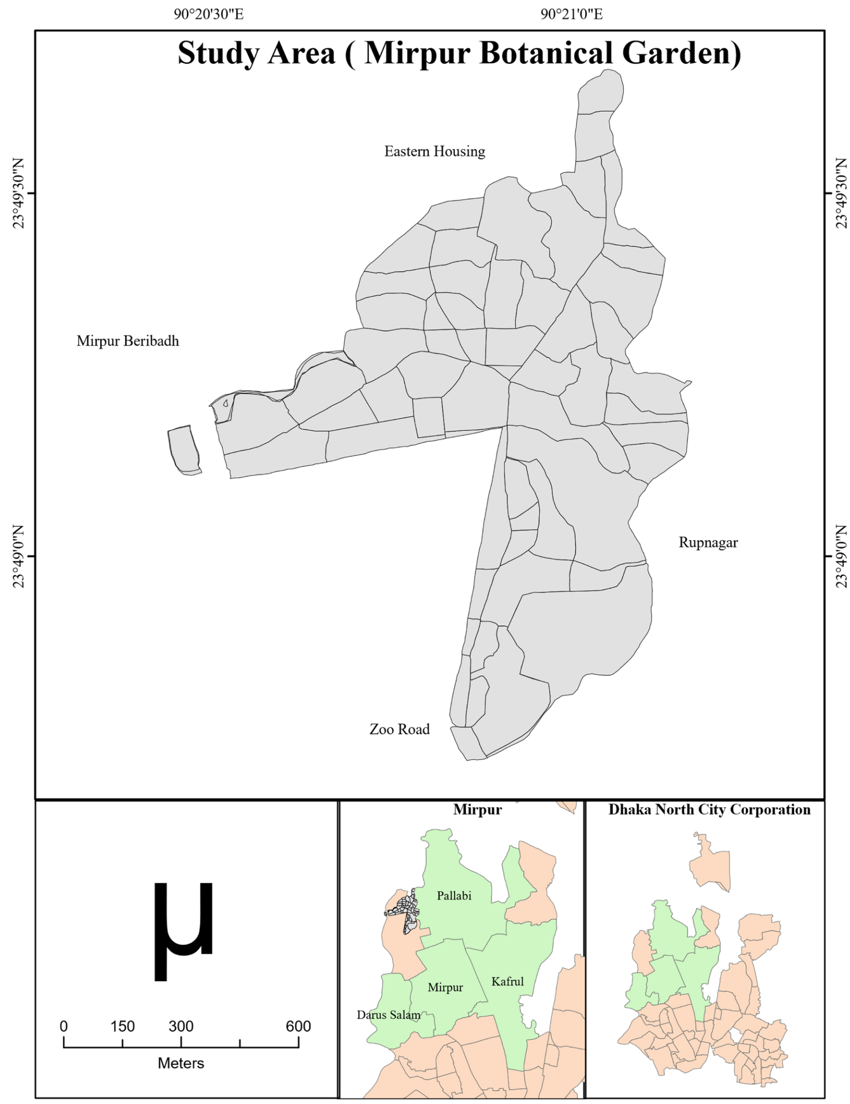
2.1. Study Area Selection

The National Botanic Garden of Bangladesh and the Bangladesh National Herbarium together make up the greatest plant conservation effort in the country. Together, they cover a combined area of around 84 hectares (210 sections of land). It began in 1961 and holds almost 100,000 preserved plant specimens. The garden was carefully designed to offer educational and leisure opportunities near the zoo. The Bangladesh Forest Department, part of the Ministry of Environment and Forests, manages the forest's 57 parts. The garden has 56,000 tree, herb, and shrub species plus a large aquatic plant collection (Shoab, 2018). **Map 1** illustrates the selected study region.

- Park Dimensions: 210 Acres.
- City Corporation: Dhaka North City Corporation (DNCC).
- Relative Location: Mirpur, a northern suburb of Dhaka, adjacent to the Dhaka Zoo.
- Absolute Location: 23.8127˚ N, 90.3476˚ E.
- Park Status: Design quality and well maintained.
- Park Type: Extra—large park.

2.2. Data Sources and Methods

The data in this study is derived from multiple sources. Each type of data facilitates the discovery and analysis of a variety of facts. The study comprises both qualitative data and quantitative data. A descriptive and spatial analysis was conducted on the collected data for this study using ArcMap 5.8, IBM SPSS, and Excel 2010. The primary data obtained from survey responses resulted in a more thorough investigation. Fifteen locations have been designated inside the park based on important landscapes both naturally and manmade to gather data on temperature and humidity. The sampling catches spatial variation all around the garden and evaluates the effect of various surfaces and human activities on temperature and humidity. It provides a comprehensive understanding of the distribution and interactions among various microclimates within the garden.



Map 1. Study area (Source: Author, 2023).

Between mid-April and mid-June, temperature and humidity data were collected from these 15 locations at three-day intervals. The data collection occurred around midday, specifically between 12 PM and 1 PM for getting the highest ambient temperatures of the day. Focusing on this timeframe enables the study to assess the park's effectiveness in mitigating heat and enhancing human thermal comfort during peak activity hours. The 15 points can be categorized into three principal groups. AR827 is used for collecting climatic data from these 15 places. The Smart Sensor AR827 is a temperature humidity meter is a device that measures the amount of moisture in the atmosphere. Humidity measurement tools are typically based on measurements of another quantity such as temperature, pressure, mass, or a mechanical or electrical change in a substance as moisture is absorbed. By calibrating and calculating these measured numbers, humidity can be measured (*AR827 Humidity Temperature Meter_Shenzhen Xima Yinghao Trading Co., Ltd.*, n.d.-b).

Collecting data are shown in degrees Celsius for temperature and as a percentage for relative humidity. A comprehensive mapping analysis from the collected climatic data was conducted using ArcMap software which effectively illustrated the climatic conditions of the park. The premise of Inverse Distance Weighting (IDW) interpolation is that neighboring values are more closely related than distant ones (*Creating Maps Using Inverse Distance Weighted interpolation—ArcMap|Documentation*, n.d.-b).

The values at unsampled locations are determined by IDW by assigning weights to known data points based on their distance from the target location. The spatial distribution of temperature and humidity within the park was visualized using interpolated maps or plots. The site's temperature and humidity are correlated using Microsoft Excel 2010.

A questionnaire survey which was segmented into two sections has been conducted to get the public's perspective on comfort conditions. The opening segment of the discussion focused on actions and clothing whereas the second section categorized the selected 15 locational points into two groups. The first group comprises locations with low temperatures, while the second group includes locations with high temperatures. Subsequently, 105 respondents were surveyed to evaluate each area's comfort level. The inquiries were constructed utilizing the Likert scale, comprising five things with values spanning from one (Very Low) to five (Very High). Based on the survey, SPSS (correlation analysis) was used to find out what the connection was between people's level of comfort and weather conditions (temperature). It was used to find the relationship's direction and strength. The GPS coordinates of these 15 locations were documented. To find the proportion of the clothing rate and the visiting rate, Excel was used. Scattered plots were used to show the relationship between "Temperature" and "Human Comfort Level." The graphical representation of the characteristics, which included natural, man-made, and aquatic factors, shows the relationship connection between the two variables.

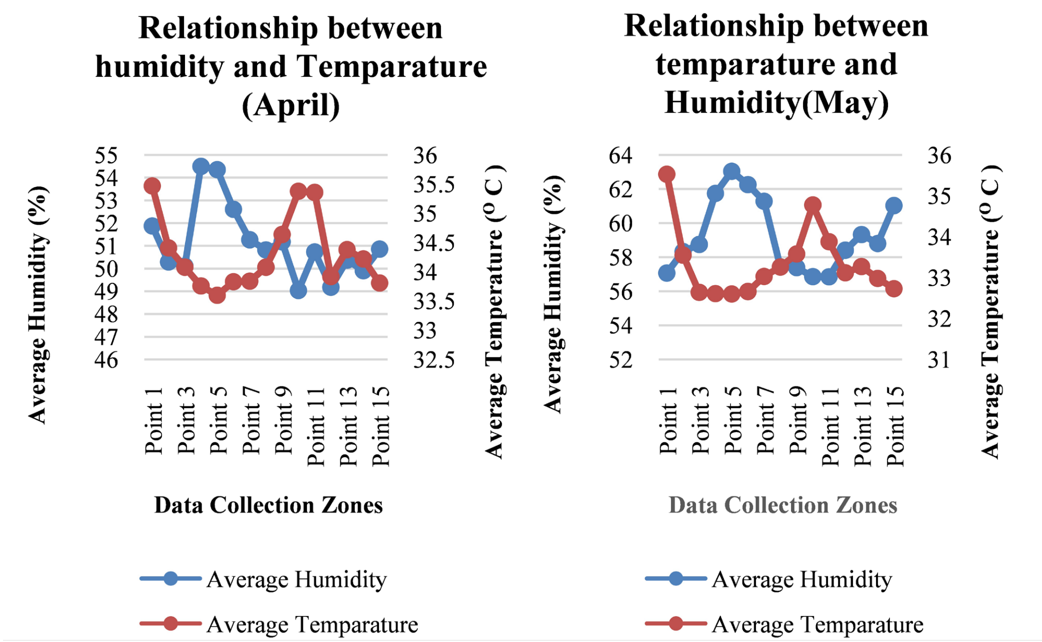
3. Result and Discussion

3.1. Conditions of the Temperature and Humidity Inside the Park

We subjected the 15-point selection to climatic measurements (temperature and humidity) during April and May. By looking at data and using interpolation methods, we can find different areas in Mirpur Botanical Garden that have different levels of temperature and humidity. These areas are affected by two weather factors: temperature and humidity. Furthermore, we have used the colour variations to classify a variety of microclimatic conditions. This classification system, which comprises "Hot Spots", "Cool Spots", and "Moderate Spots", offers a straightforward and intuitive method of understanding and communicating the temperature disparities among the garden's various regions (Mavrakou et al., 2018). Based on temperature, the red, yellow, and blue zones are classified as the hot, moderate, and cool zones, respectively. Different classified temperatures have been taken for different months. As temperature generally remains high in April, the classification of the zone is hot, temperate, and cold spots in different ranges. In April, the hot spot, moderate spot, and cold spot ranges from 34.66˚C to 35.47˚C, 34.23˚C to 34.65˚C, and 32.6˚C to 34.22˚C, respectively, while the ranges in May are 34.56˚C to 35.53˚C (hot), 33.58˚C to 34.55˚C (moderate), and 32.6˚C to 33.57˚C (cold).

Generally, the presence of built-up areas, natural vegetation, and water bodies all have an impact on the way temperature is distributed within a park. The relationship between temperature and humidity with physical and artificial structures that make up a park is complex and intricate, and it is one of the most important factors that determines the microclimate within the park. Urban parks are an effective way to decrease the temperature because vegetation and water areas act as heat sinks (Poudyal et al., 2009). **Table 1** depicts the physical features of the park. Vegetated areas comprise several zones such as point-2, point-4/5/6, point-7/8, point-13, and point-15. Among them, points (5, 7, 13) are dominated by a high canopy area where sunlight can barely reach, while point 4 and point 8 represent grassland areas where the space is open and directly heated by sunlight. Point-3, point-12, point-14 are representing the waterbody and the rest of the point represent built-up area inside the park.

In the study, the maximum temperature was recorded at 35.47˚C in April and 35.53˚C, where the lowest temperature was recorded at 32.6˚C in both April and May. **Table 1** depicts the detailed temperature. An urban forest or park can mitigate urban heat islands (UHI) by obstructing solar radiation from warming adjacent buildings and surfaces, cooling the air through evapotranspiration, and diminishing wind velocity (Akbari et al. 2001). According to the analysis, in April, point 1, Point 10, and Point 11 are identified as hot spots. The presence of open spaces and paved surfaces contributes to the elevated temperature in these zones. These surfaces absorb and retain more heat during the day, which they then release at night, thereby intensifying the urban heat island effect. Points 3 - 8, 12, and 14, 15 represent lower temperature zones and serve as cool spots in the park in **Map 2**. Because of shading for lots of different kinds of tertiary level trees with dense canopy and waterbody (lily pond) recording temperatures in April in these points are 33.6˚C to 33.83˚C and in May the value 32.6˚C (**Figure 1**). Among these, point 4, 5, 6 and 15 are suspected to the lowest temperature. This occurs due to the presence the denser canopy diminishes direct sunlight exposure and enhances moisture retention, resulting in increased humidity levels. Similarly, Proximity to ponds and lakes aids in temperature moderation. In the study point-3, 7 & 12 adjacent to a water body, exhibits marginally reduced temperatures (34.08˚C, 33.83˚C, 33.92˚C in April and 33.62˚C, 33.03˚C, 33.12˚C in May), as water bodies lower air temperature and augment moisture levels via evaporation. According to Jauregui (1997) and Jonsson (2004), Enhanced vegetative cover and elevated-albedo surface materials are tactics that can be employed to induce cooling effects in urban environments. In May, the vegetation's canopy is denser than in April, and it covers most of the surface inside the park areas.

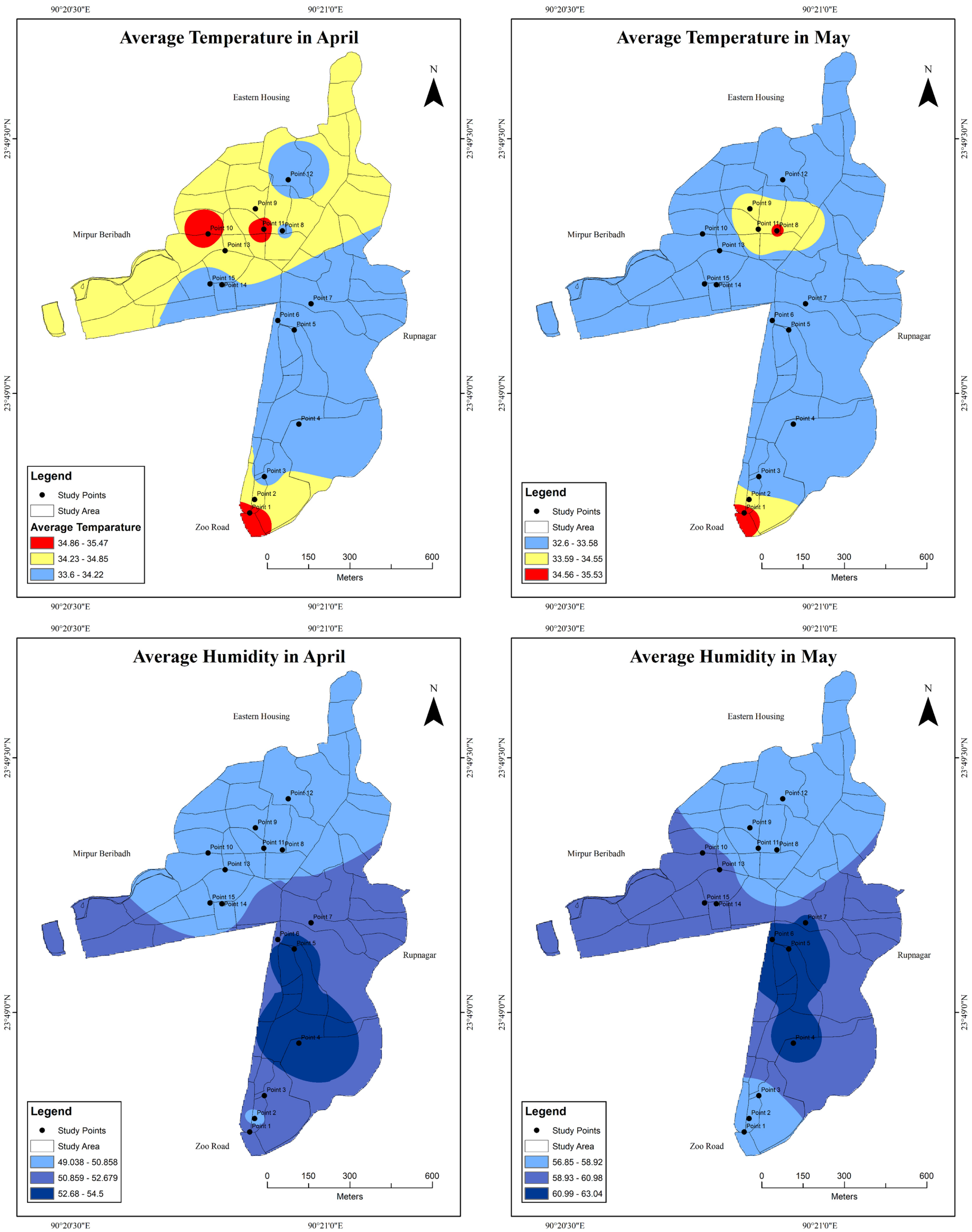


(Data source—Field work, 2023)

Figure 1. Relation between temperature and humidity in April and May.

Table 1. Average temperature and humidity of April and May month.

Points	Location		Average Temperature (Degree Celcius)		Average Humidity (%)		Features
	Latitude	Longitude	April	May	April	May	
Point 1	23˚48'44.31" N	90˚20'50.69" E	35.47	35.53	51.87	57.07	Entrance Gate
Point 2	23˚48'49.33293" N	90˚20'50.15119" E	34.41	33.55	50.28	58.33	Large tree
Point 3	23˚48'50.74125" N	90˚20'51.7463" E	34.08	32.64	50.11	58.75	Lake
Point 4	23˚48'57.16601" N	90˚20'54.14759" E	33.76	32.61	54.5	61.74	Grassland
Point 5	23˚49'7.46924" N	90˚20'56.31946" E	33.6	32.6	54.35	63.04	Large Tree
Point 6	23˚49'19.00" N	90˚20'59.71" E	33.83	32.66	52.61	62.26	Road under trees
Point 7	23˚49'04.99" N	90˚20'55.90269" E	33.84	33.03	51.26	61.28	Shrub Vegetation
Point 8	23˚49'19.15" N	90˚20'54.93" E	34.08	33.26	50.82	57.43	Rose Garden
Point 9	23˚49'21.74" N	90˚20'51.75" E	34.64	33.58	51.17	57.39	Child zone (park)
Point 10	23˚49'18.79" N	90˚20'46.17" E	35.38	34.78	49.03	56.86	Office
Point 11	23˚49'19.35" N	90˚20'52.74" E	35.36	33.88	50.73	56.85	Watch tower
Point 12	23˚49'25.17" N	90˚20'55.62" E	33.92	33.12	49.17	58.41	Lake
Point 13	23˚49'16.81" N	90˚20'48.19" E	34.38	33.27	50.36	59.33	Bamboo clamp
Point 14	23˚49'16.79" N	90˚20'48.23" E	34.22	32.98	49.9	58.8	Pond
Point 15	23˚49'9.74832" N	90˚20'56.3038" E	33.81	32.73	50.85	61.03	Dense tree



Map 2. Interpolated temperature and humidity of botanical garden in April and May (Source—Field, 2023).

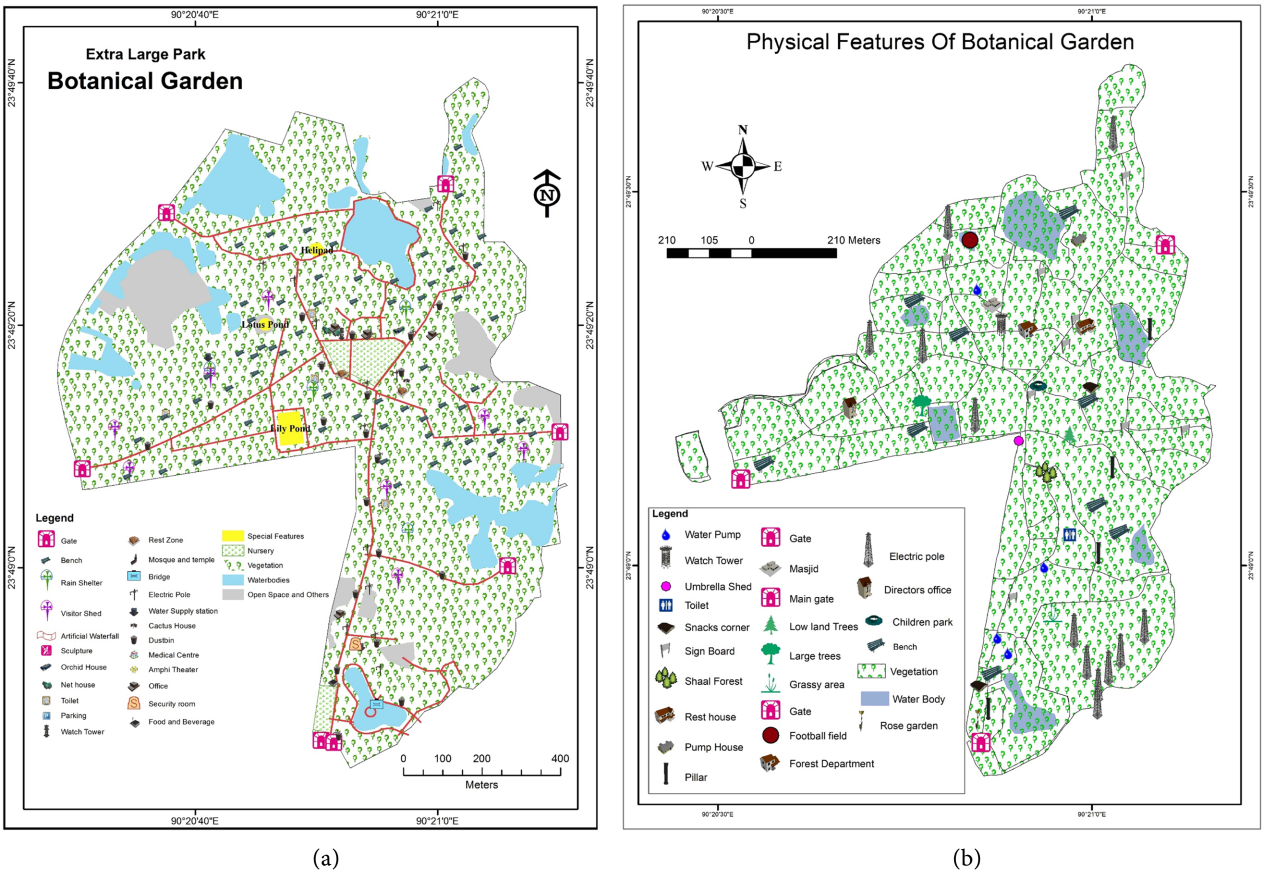
Similarly, the humidity is also classified into three regimes—higher humidity, moderate humidity, and lower humidity—and ranges are in April 52.68% - 54.5%, 50.85% - 52.67%, and 49.03 - 50.85%, respectively, while in May it is classified into 60.99% - 63.04%, 58.93% - 60.98%, and 56.85% - 58.92%. Humidity levels are comparatively low in April and higher in May. The highest humidity was recorded 54.5% at point-4 in April while at point-5 was 63.04% in May. Because of presenting the high canopy vegetation the highest humidity can occurred. Green space and the presence of a waterbody inside the park are responsible for increasing humidity in this zone. Also, temperature plays a pivotal role for higher humidity—lower temperature can heat the surface a little so that the air remains moist, which occurs with high humidity. The denser canopy diminishes direct sunlight exposure and enhances moisture retention, resulting in increased humidity levels. Dense vegetation enhances evapotranspiration, leading to reduced temperature increases and elevated humidity levels. Urban parks with woods can diminish surface water runoff by intercepting precipitation, absorb pollutants, emit hydrocarbons, and alter solar radiation, air temperature, wind velocity, and relative humidity. On the other hand, the lowest humidity in the park is 49.03% (April) and 56.85% (May), which represents point-10 and point-11, respectively. Due to the presence of built-up areas and open spaces, the humidity falls. In this zone, the temperature represents the highest value and is considered a hot zone. From this analysis, the temperature and the humidity show the vice-versa scenario in Figure 1.

The maps in (Map 2) provide a detailed and unambiguous depiction of the microclimatic influences that are prevalent in various regions of the garden. The temperatures in the red and yellow-marked areas on the map, defined by elevated temperatures and reduced relative humidity, were higher in April than in May. Furthermore, the relative humidity was significantly lower than it was in May. Nevertheless, both months experienced elevated temperatures immediately followed by periods of reduced humidity. Table 1 represents the study zones from where the temperature and humidity data were collected, and Map 2 represents the spatial distribution of average temperatures and humidity in April and May across different locations in the garden.

3.2. Relationship between Climatic Factors and Different Artificial and Natural Structures

The park's physical characteristics were identified using an earlier map (Map 3(a)), and then, after doing field research and making observations, a revised physical feature map of the Botanical Garden was prepared (Map 3(b)). In this area, both man-made and naturally occurring structures have been mapped. The park's elements are displayed in Table 2.

The presence of built-up areas, natural vegetation, and water bodies all have an impact on the way temperature is distributed within a park. The relationship between temperature and humidity with physical and artificial structures that make up a park is complex and intricate, and it is one of the most important factors that determines the microclimate within the park. Temperature and humidity levels are both subject to change as a result of the presence of various physical and artificial structures. Temperature and humidity tend to have the opposite relationship especially during the warmer months of the year in natural settings. Figure 1 illustrates an inverse correlation between average humidity and average temperature.



Map 3. (a) Sample map for study location selection. (Source-Saika ,2017) (left side) and; (b) Physical Features of Botanical Garden.

Table 2. List of physical and man-made elements inside the garden.

Physical Features		Man-made Features	
Vegeted Area	High wood	Non-vegetated area	Open space
	Low wood		Football field
	Mixed wood	Amenity	Bench
	Grassland		Visitor's shed
Waterbody	Pond		Water supply station
	Lake		Mosque
			Gate
			Public toilet
		Other	Road
			Bridge
			Official area

In point no 3, 4, 5, 6, 7,12, and 15 have recorded the lowest temperatures, Because of shading for lots of different kinds of trees and plants recording temperatures in April in these points are 33.6˚C to 34.08˚C and in May the values are 32.03˚C to 32.73˚C (**Figure 1**). The denser canopy diminishes direct sunlight exposure and enhances moisture retention, resulting in increased humidity levels. Also, adjacent to a water body, exhibits reduced temperatures and heightened humidity as water bodies lower air temperature and augment moisture levels via evaporation. The humidity levels are comparatively low in April and high in May. The minimum value was recorded from point 10 and point 14 respectively 49.03% and 49.9% for the month of April. Humidity is lower in Study Points 1, 2, 8, 9, and 10 whereas these points exhibit the highest levels of temperature. Locations including open spaces or paved surfaces (Study Locations 1, 10, 11) exhibit elevated temperatures in April (35.47˚C, 35.38˚C, 35.36˚C) and May (35.53˚C, 34.78˚C, 33.88˚C). These surfaces absorb and retain more heat during the day, which they then release at night, thereby intensifying the urban heat island effect. The absence of shade and moisture sources results in reduced humidity in April (49.03% at Point 10) relative to vegetated areas. In May the Minimum humidity were recorded from point 10 and point 11 respectively 56.86% and 56.85%. Grasslands and nurseries offer mild cooling; however, they are less effective than wooded area because of insufficient canopy coverage.

Same negative correlation between temperature and humidity in May is noticed, but humidity here is higher than in April again. In May, the differences become much more pronounced due to pre-monsoon atmospheric conditions. The areas of thicker vegetation enhance evapotranspiration, which increases humidity and lowers temperature. As a result of the pre-monsoon weather, places that are shaded and near plants will likely have higher levels of humidity at certain times and more moisture in the air overall.

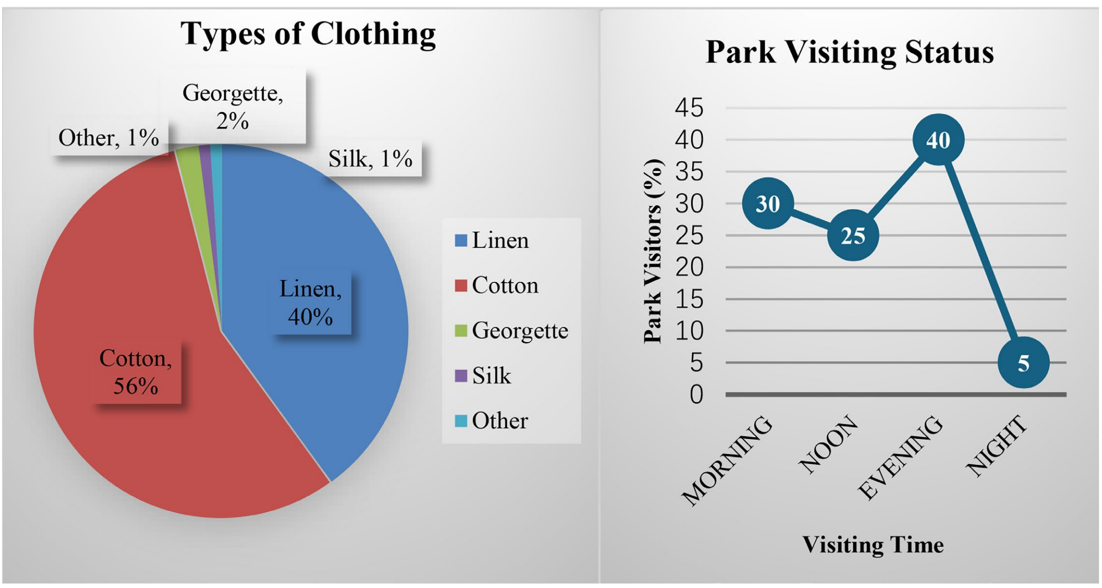
3.3. Thermal Comfort of the Park Users

For analysis of thermal comfort 105 questionnaire survey has been conducted where the responders are mainly the park visitors. In the questionnaire survey different human thermal comfort activities was inquired. Among the questions some definite question has been asked to respond. These are activity inside the park, Visiting hour in the park, Clothing type, Fabric of the clothes wear in the park as well as the comfort zone in Mirpur Botanical Garden. The percentage of fabrics worn by park visitors throughout the summer is ascertained from the survey results. From the analysis, 56% respondent wear Cotton fabrics because of highly permeable and absorbent, allowing the body to remain cold and dry. During the summer, park visitors predominantly favor cotton fabric, followed by linen, which accounts for up to 40% of preferences. Linen is another natural fiber that is ideal for summer clothing. It is even more breathable than cotton and has superior moisture-draining properties, making it an ideal fabric for sweltering and humid environments. Typically, linen garments are loose-fitting, allowing air to circulate readily and providing a breezy and comfortable feel (Ellis, 2024). The next preferred fabric is georgette, comprising only 2%. Subsequently, silk and other materials account for 1% each shown in Figure 2.

At responding of the visiting hour, the most respondents prefer evening and 40% of all visitors arrive at the garden in the evening or afternoon. Lower temperatures, a tranquil ambiance, and the chance to engage socially or bond with family probably render this the favored season for many. Followed by the evening aggregated the next gathering time is morning, about 30% respondents visit the park in the morning. Because of the milder climate and invigorating ambiance, which are conducive to walking, jogging, or appreciating the natural surroundings morning is chosen by visitors. After that, the visitation rate decreases by approximately 25% during lunchtime shown in Figure 2. Elevated temperatures and intensified sunlight may contribute to this decrease, making outdoor activities less enjoyable during this period. Only 5% of tourists arrive at night, indicating a significant decrease. This result from restricted sight, safety issues, or limited visiting hours in the garden after dusk.

Pearson's correlation analysis shows a strong negative relationship between "Comfort Level" and "Temperature." In particular, the degree of comfort moves down as the temperature increases. In Figure 3, the Pearson Correlation Coefficient of −0.885 signifies a negative correlation between temperature and comfort level. This signifies that as temperature increases, comfort level correspondingly diminishes.

The Pearson correlation is crucial between temperature and human comfort for understanding how physical settings effects visitors comfort experiences. This indicates that with each rise in temperature, there is a concomitant decrease in comfort level. The association is statistically significant ($p < 0.01$), indicating that random chance does not affect the outcome. The significant negative association (−0.885)



(a) (b)

Figure 2. (a) Types of clothing (Source-Field Data, 2023); (b) Park visiting status of the park users (Source—Field Data, 2023).

between temperature and comfort level underscores the influence of the physical environment on human comfort in the Mirpur Botanical Garden. Regions with elevated temperatures typically linked to barren areas, asphalt surfaces, or heat-absorbing edifices generally diminish comfort levels (Such as points 1, 4, 7, 8, 9, 10, 11, 13) These regions are devoid of the cooling influences of vegetation, arboreal shade, or aquatic bodies. In contrast, cooler regions with vegetation (such as point 2, 3, 5, 6, 12, 14, 15) sustain elevated comfort levels by reducing temperatures via evapotranspiration and shade, so alleviating the heat island effect. Figure 4, visualize the correlation between "Human Comfort Level" and "Temperature." This provides a graphical representation of the relationship between the two variables.

Correlations			
		Temperature	Comfort Level
Temperature	Pearson Correlation	1	−.885**
	Sig. (2-tailed)		.000
	N	105	105
Comfort Level	Pearson Correlation	−.885**	1
	Sig. (2-tailed)	.000	
	N	105	105
**Correlation is significant at the 0.01 level (2-tailed).			

Figure 3. Pearson's correlation co-efficient.

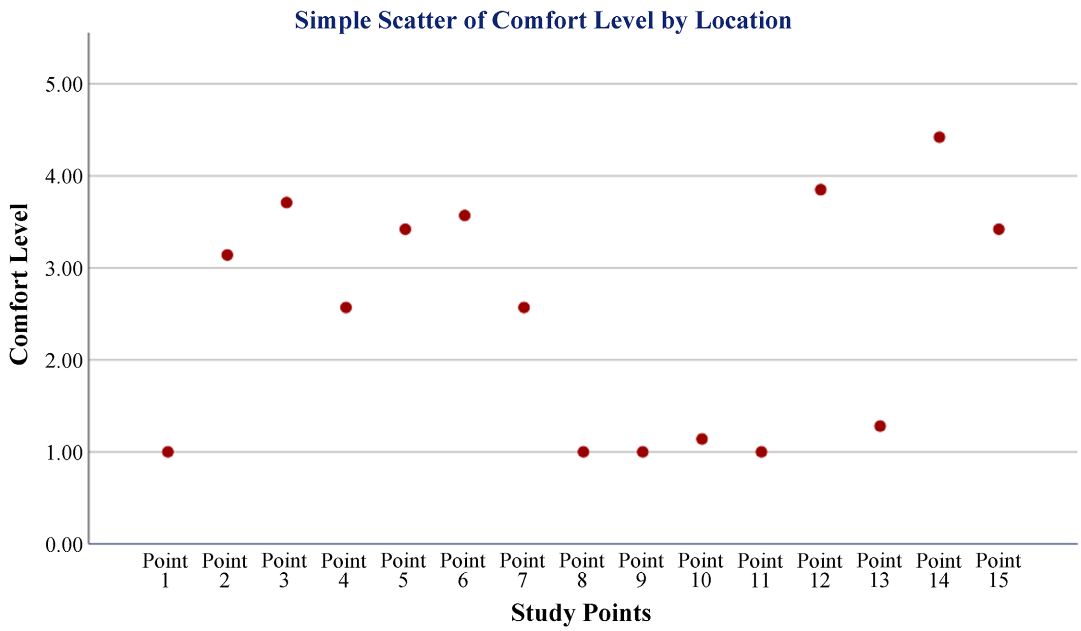


Figure 4. Scatter plot of Comfort level by location Source—(Field, 2023).

The scatter plot illustrates the variations in comfort ratings across different locations within the Mirpur Botanical Garden. Urban microclimates significantly influence individuals' perceptions in park activity areas, with urban mountain parks differing from conventional urban parks (Cheng et al., 2020). These spaces offer various functions for urban residents, including enjoyment, leisure, entertainment, and fitness (He et al., 2020). Elevated comfort levels (above 3.0) are observed in areas rich in vegetation, such as grasslands, mixed forests, or regions near water bodies (Study points 2, 3, 5, 6, 12, 14, 15), where natural cooling processes help maintain comfort. In contrast, reduced comfort levels (below 2.0) are found in locations with sparse vegetation, including open spaces, asphalt roads, and heat-absorbing surfaces (Study points 1, 4, 8, 9, 10, 11, 13), which experience higher temperatures due to a lack of shade and the urban heat island effect. The variation in comfort levels highlights the microclimatic differences within the garden, influenced by factors such as physical structures, vegetation density, and the presence of water bodies.

4. Conclusion

The research on microclimatic impacts and human comfort conditions in a large urban park in Dhaka during the summer shed light on the complex relationship between environmental factors and human experiences. This study's findings offer valuable insights into the challenges and opportunities for enhancing the overall visitor experience and well-being within the park's dynamic microclimates. By incorporating these insights into park design, management strategies, and visitor engagement initiatives, more pleasant and sustainable urban environments can be created that contribute to the overall quality of life. In the context of Dhaka's ongoing urbanization, the research has implications for mitigating urban heat island effects. The design of the park can contribute to the regulation of the local climate by implementing heat-reducing features and maximizing vegetation cover. It also offers helpful advice for enhancing the urban park experience and nurturing healthier, happier communities.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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