Environmental Response of Small Urban Parks in Context of Dhaka City

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Abstract. Urban green spaces are essential elements of urban life which, due to their structure and multi-functionality, can play an exemplary role in the vitality and quality of urban life. Urban Parks are not only used as active recreational and leisure areas for its citizens but also an important catalyst for community development and enhancement. These spaces in the city act like its lungs and play a critical role in supporting the ecological and environmental system. In the dense urban areas, even Small Parks (less than one acre in size) can also contribute a lot to improve environmental quality of city life. In a populated city where it is difficult to incorporate large Public Parks, these small green area can complement large Public Park system. Accordingly the study is concerned to evaluate the environmental performances of Small Parks on the built environments of urban Dhaka. The analysis identifies that Small Parks has strong environmental impact, the intensity of which depends on the type and quality of its vegetation, its design parameters, connectivity and of course on surrounding urban morphology. And it is confirmed that park with more canopy tree is suitable for our environment and therefore a good combination of vegetation (wide canopy trees at periphery, medium canopy trees beside internal walkway and small canopy tree, shrub and grass cover elsewhere) are recommended for better environmental performance of Small Parks. The research will be an approach to find the ways and means to restore the Small Parks of Dhaka city to ensure the livability of the city and enhance the quality of city image.

Key Words: Small Park, densely built environment, livability, microclimate, tree

1. Introduction

In the recent decades, more than 50% of the world’s population inhabits urban areas, making the urban environment the most common habitat for man. In the debate about architecture and built form, people forget the importance of green spaces and thus urban environment suffers a huge encroachment upon open spaces. This is particularly evident in the developing countries like Dhaka where cities sprawl extensively. Rapid and unplanned urbanization, huge commercial development, along with population pressure, the overall city environment gets deteriorated day by day. Today city fails to provide green and healthy environment to its dwellers. But it is essential to ensure good quality of life in urban areas, providing infrastructure, services and a healthy environment, with good livability. Quality of life makes the city more attractive and desirable to live and invest (Quintas and Curado, 2009).

According to Bangladesh Population and Housing Census 2011, only Dhaka city accounts about 38% of the total urban population of Bangladesh and it accommodates more than 1, 25, 17,361 people within its 1463.60 sq km area and attaining the rank of 25th in the context of highest population density in the world. According to Far Eastern Economic Review, Dhaka Metropolitan
will become a home of 2, 60, 00,000 people by the year 2025. Therefore most of the areas of urban Dhaka are highly dense to accommodate these huge populations and to meet their growing demand. In Dhaka urban greenery, park greenery or tree-covered spaces constitutes less than 15% of the city landscape. But the image of past Dhaka is not derived from its concrete parts like building, roads etc. - it is much deeper and more fluid. Parks and open spaces are an integral part of this images out of which Dhaka is emerged. Dhaka city was once known for its serenity; beautiful Parks, clean roads and lush greenery but the present situation raise the question that a crowded city like Dhaka needs a huge stock of green spaces for urban sustainability and it cannot do without enhancing the overall urban green resources.

In the densely built urban areas, Small Parks supplement the Public Parks system, due to their size, they predominantly serve adjacent building. They provide many important urban greenery benefits and social and environmental benefits too, especially in the dense urban areas that lack opportunities for Parks at larger scale. Urban Parks and its surrounding areas can be thought of not only as a place to understand and relate to nature, but also an important catalyst for community development and enhancement. *Parks the city act like its lungs. They play a critical role in supporting the ecological and environmental system and social cohesion in urban life. In Dhaka city Majority of the areas, old or new part, have little scope for creating any new green space or enhancing the existing ones. Therefore this research focuses only on Small Parks that still remain throughout the city. Accordingly the study attempts to evaluate the environmental performance of Small Park in a dense city like Dhaka. The research will be an approach to find the ways and means to restore the Small Parks of Dhaka city to ensure the livability of the city and enhance the quality of city image.

2. Objective
The main objective of the study is to evaluate the environmental performances of Small Parks that is scattered throughout the contemporary urban Dhaka. The specific objectives of the research are:
- To Study the microclimatic behavior of different types of Small Urban Parks with different types of green coverage.
- To evaluate the extent and nature of climatic influence in the Park and its catchment built environment.
- To identify the effect of Small Parks for Dhaka’s urban life and thus to set an efficient Small Urban Park system in the planning, design of urban Dhaka to fulfill the needs of the city.

3. Methodology
In this research, the approach of study was through the field investigations on case study method, where, with the analysis of microclimatic conditions of Small Park and their surrounding environments, and establishment of the design criteria of Small Urban Park constitutes the main target

3.1 Selection of the Study Area
The urban matrix of Dhaka city is not a result of any broad planning. The structure of the city has evolved through stages, and certain areas were planned while others are unplanned and organic in growth. However, whole of the city is considered as densely built environment. A thorough survey was done at Dhaka to identify different types of Small Parks for performance evaluation and then six Small Parks were selected that spread throughout the city. Their spatial context is different from one another but all of them are almost one acre in size. These six Parks are distributed in the following areas of Dhaka city
- Old Dhaka : Bahadur Shah Park
- Old Dhaka : Nabab Sirajoddoulla Park
- Motijheel Commercial Area: Park at DIT Avenue, Motijheel
- Mohammadpur Residential Area: Park at Tajmahal Road and
- Banani Residential Area : Boishakhi Park
• Uttara: Park at Sector 04

3.2 Variables of the study
The study areas (Small Parks) were taken under observation in the month of March-April at 2014 based on certain consideration. This period is characterized by hot and dry weather, have average relative humidity of 60-70%, the temperatures ranges from a maximum of 33.3°C to a minimum of 22.6°C (Mallick, F., 1994). Observations on following environmental variables were made during the field work:
- Air temperature [°C]
- Relative humidity [%]
- Illuminance condition [lux]
- Sound [dB]

All these data have been taken by the instrument at 21 points for each study area. These points are at center of the Park and up to 200 feet distance from the site periphery at 50 feet interval on all side. Apart from this, data also have been measured at additional 08 points of 300 feet and 400 feet distance on each side. So that it was possible to identify the maximum range of the Small Park’s impact on the surrounding area [because maximum distance of 400 feet from Park periphery covers the radial effect of maximum 600 feet [approx. 200m] from Park center in almost all study areas. The observation height in the site was at a level of 3’6” from the ground level.

To understand the nature of the surrounding environment, physical context like location, physical and spatial organization like building layout and street pattern, size, character, vegetative conditions of the study area have also been observed.

4. Case Study

4.1 Bahadur Shah Park, Old Dhaka
Bahadur Shah Park is surrounded by many institutions and located at a major node of Johnson Road, in old Dhaka. The Park was built in 1858 and has some historic value and is a place of pride for the community of Old Dhaka. Plenty of trees make the Park a majestic one. Park now attracts the young and the old, who come here to enjoy the peaceful environment. But now a day the condition of the Park is terrible. And its wretched condition shows historical Bahadur Shah Park lost all its importance and glamour now a day.

Figure 1. Views of Bahadur Shah Park at Old Dhaka

Table 1: Study of Bahadur Shah Park, Old Dhaka

| Location | Size and Shape | Physical Features | Special Features | Name of the tree |
|----------|---------------|-------------------|------------------|------------------|
| Ward no: 36 | Size: 0.67 Acre | No. of Tree: 20-250 | Seating: low height wall beside walkway used as sitting | Mehgoni, Debdaru, Mango, Jackfruit, Blackberry, Neem, |
(b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization [land use around the Park] |
|---------------------|-----------------------------------------------|
| N: Residential plot | Neighborhood Character: Planned Residential and commercial area |
| S: Residential plot | Commercial: Y Residential: Y Institution: Y [Police Station Thana] |
| E: 30' wide street and residential and commercial | Density: 33,316.1 inh./km² [Population census 2011-03-15] |
| W: 30' wide street | Under construction:5% Unplanned structure:15% |

(c) Environmental Aspect of the Park and Surrounding Area

| Location   | Temp T [degC] | Relative Humidity RH[%] | Sound S[Db] | Illuminance L[lux] | Remarks |
|------------|---------------|-------------------------|-------------|--------------------|---------|
| Center     | 23.9          | 52                      | 72.1        | 670X10             | The MP is beside the fountain. At measurement time the fountain was close. |
| North      | 21.8          | 55                      | 73.7        | 852X10             | T Increase up to 0.8 deg C and RH decrease [upto 200']. Here MP are on the available point at north. |
|            | 21.9          | 54                      | 60.2        | 970X10             |                                  |
|            | 22.2          | 53                      | 65.3        | 1010X10            |                                  |
|            | 22.5          | 51                      | 69.9        | 1120X10            |                                  |
|            | 22.6          | 52                      | 73.4        | 1090X10            |                                  |
|            | 23.3          | 48                      | 68.9        | 990X10             |                                  |
| South      | 22.9          | 43                      | 68.0        | 990X10             | MPs are on the street side, shaded by building. |
|            | 23            | 46                      | 70.8        | 1135X10            |                                  |
|            | 23.1          | 46                      | 69.5        | 1202X10            |                                  |
|            | 22.8          | 46                      | 68.0        | 890X10             |                                  |
|            | 22.7          | 46                      | 72.4        | 870X10             |                                  |
|            | 23.5          | 45                      | 65.0        | 970X10             |                                  |
| periphery  | 23.3          | 50.7                    | 66.6        | 1010X10            | At East The value of T varies. It increases 0.6 deg C at MP of 100ft distance. The values of RH also decrease. At 400feet distance T is the highest |
| 50ft       | 23.8          | 50                      | 68.9        | 1420X10            | The MP at east are on available narrow internal street which is shaded by buildings. |
| 100ft      | 23.9          | 48                      | 66.0        | 1515X10            |                                  |
| 150ft      | 23.8          | 46                      | 69.4        | 1524X10            |                                  |
| 200ft      | 23.6          | 49                      | 67.6        | 1400X10            |                                  |
| 300ft      | 23.8          | 45                      | 69.8        | 1430X10            |                                  |
| 400ft      | 23.9          | 46                      | 70.4        | 1450X10            |                                  |
| East       | 21.8          | 53                      | 65.2        | 830X10             | The MPs at west are on available narrow internal street which is shaded by buildings. |
|            | 21.4          | 52                      | 66.8        | 790X10             |                                  |
|            | 21.3          | 54                      | 69.0        | 650X10             |                                  |
| West       | 20.8          | 53                      | 68.7        | 720X10             |                                  |
| 200ft      | 20.5          | 54.6                    | 67.5        | 577X10             |                                  |
| 300ft      | 22.1          | 54.9                    | 66.2        | 1020X10            |                                  |
| 400ft      | 23.2          | 54                      | 65.2        | 690X10             |                                  |

(d) Park’s Performance and Influence on Surroundings

The Park has many canopy trees at its periphery but very little canopy trees and more grass cover and shrubs at center. Air temperature at center of the Park is lower than the periphery. The
The location of the Park is such that there is street only at west of Park and other three sides are blocked by buildings. Therefore its impact can flow only through the narrow south-east corner. Presence of many street trees at surroundings helps to keep that area cool.
(b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization | Building Type | Building Height |
|---------------------|----------------------|---------------|-----------------|
| N: Road, commercial | Neighborhood         | Commercial: Y | Above 6 storied: N/A |
| S: Water pump, 15' wide street, residence | Character: Residential: Y | 6 storied: 10% |
| E: 15' wide street, mosque and residence, unplanned commercial development | Residential area, with commercial at north side. | Institution: Y | 5 storied: 30% |
| W: Mosque, Madrasa, Residence | Density: 93.476 inh./km² [Population census 2011-03-15] | [mosque, madrasa] | 3-4 storied: 40% |

(c) Environmental Aspects of the Park and Surrounding Area

| Location | Temp T [degC] | Relative Humidity RH[%] | Sound S[Db] | Illuminance L[lux] | Remarks |
|----------|---------------|-------------------------|-------------|--------------------|---------|
| Center   | 27.9          | 49                      | 61.1        | 970X10             | The MP is under shade of a tree. |
| periphery | 28.2          | 27                      | 75.7        | 658X10             | T increase up to 3.7 deg C [upto 200' from periphery]. Here MPs are on the available point at road, besides building at north. At |
| 50ft      | 31.9          | 24                      | 81.5        | 1540X10            | |
| North    | 100ft         | 31.8                    | 79.6        | 1130X10            | |
|          | 150ft         | 30.4                    | 69.9        | 827X10             | |
|          | 200ft         | 31.9                    | 69.1        | 1720X10            | |
|          | 300ft         | 32.8                    | 70.2        | 987X10             | |
|          | 400ft         | 32.6                    | 74.5        | 1120X10            | |
|          | periphery     | 27.5                    | 30          | 68.0               | MPs are on the road along east periphery. T varies very little within 200 feet distance. |
|          | 50ft          | 27.9                    | 31          | 70.8               | The value of T varies. It increases 2.0 deg C at MP of 100ft distance. |
|          | 100ft         | 27.9                    | 34          | 69.5               | Then it again decreases because of shaded road by buildings and street tree. |
| South    | 150ft         | 28.1                    | 34          | 70.0               | |
|          | 200ft         | 28.6                    | 33          | 71.5               | |
|          | 300ft         | 30.6                    | 35          | 69.8               | |
|          | 400ft         | 27.5                    | 30          | 68.0               | |
|          | periphery     | 26.7                    | 30          | 66.6               | The value of RH increases. |
|          | 50ft          | 28.0                    | 27          | 64.9               | |
|          | 100ft         | 28.7                    | 27          | 63.4               | |
|          | East          | 150ft                   | 27.5        | 30                | |
|          | 200ft         | 27.9                    | 31          | 67.4               | |
|          | 300ft         | 28.5                    | 32          | 65.8               | |
|          | 400ft         | 28.8                    | 35          | 68.4               | |
|          | periphery     | 30.2                    | 24          | 65.2               | The value of RH increases. The wind from river Buriganga lowest T and increases RH at MP of 200ft. |
|          | 50ft          | 29.5                    | 24          | 66.8               | |
|          | 100ft         | 28.8                    | 26          | 69.0               | |
| West     | 150ft         | 28.2                    | 28          | 64.7               | |
|          | 200ft         | 28                      | 30          | 64.5               | |
|          | 300ft         | 27.7                    | 32          | 68.9               | |
|          | 400ft         | 27.9                    | 35          | 69.1               | |

(d) Park’s Performance and Influence on Surroundings

The Park is divided into three blocks and the canopy trees are at Park periphery and northeast block of the Park. Other two blocks have small trees and shrub. There is no other green space at the measured radius of Park surroundings. Therefore the Park enclosed by busy road and...
commercial area at north and dense residential area at other three sides is the only breathing space for the people. It acts as a visual and sound barrier from main street. Temperature at Park center and its periphery is the lowest. Difference of T is high at north and south side of the Park. The west side of the Park is blocked by buildings. Therefore Park cooling effect cannot extend at this side easily.

4.3. Park at DIT Avenue Motijheel
The Park is located at DIT Avenue of Motijheel commercial area. It is surrounded by wide streets and various high-rise commercial buildings. The Park is an island in busy commercial area which can be used as breathing pocket for the people of gray area at lunch hour or at the end of office period. But the Park is surrounded by some bus counter; location of city corporation maintenance office at northern side and lack of maintenance, the Park cannot be used by office people. The area traffic police used the Park as their resting place at south side of the Park. Therefore the Park looks like a leftover space at an important node of that area.

| Location | Physical Characteristics of Park |
|----------|----------------------------------|
| Size and Shape | Name of the tree |
| Physical Features | Special Features Size: |

Table 3: Study of Park at DIT Avenue, Motijheel
Ward no: 9  
Size: 0.44Acre  
Shape: [South] rectangular oval  
Zone: 02  
Green Cover: Wide and Medium  
Canopy: 75%  
Small Canopy: 15%  
Shrub: 10%  
Grass: 0%  
No. of Tree: 70-80  
Seating: 16 nos  
Monument: N  
Fountain: N  
Exercise Equipments: N  
Toilet, Payer Space: N  
Play Equipments: N  
Park Shelter: N  
Mehgani, Debdaru, Neem, Shishu, Jackfruit, Raintree, Coconut, Krishnachura, pam, Gondharaj, Rongon, etc.

(b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization [land use around the Park] |
|---------------------|-----------------------------------------------|
| Building Type [within 200 m] | Building Height [within 200 m] |
| N: Commercial | Neighborhood | Building Type: Y | Above 6 storied: 96% |
| S: Road, Commercial | Character: Commercial Area | Residential: N | 6 storied: N/A |
| E: Road, Commercial | Density: 56,758.4 inh./km² [Population census 2011-03-15] | Institution: N | 5 storied: N/A |
| W: Road, Commercial | | 3-4 storied: 2% |

(c) Environmental Aspect of the Park and Surrounding Area

| Location | Temp T [degC] | Relative Humidity RH [%] | Sound S [Db] | Illuminance L [lux] | Remarks |
|----------|--------------|--------------------------|--------------|---------------------|---------|
| Center   | 27.1         | 43.6                     | 67           | 637X10              | T is low and RH is high at canter. |
| periphery | 28.2         | 34                       | 64           | 570X10              | |
| North    | 50ft 28.1     | 35                       | 62           | 887X10              | T Increase up to 1.2 deg and RH remain almost same. C up to 200 ft distance from periphery L increases than Park area. |
| 100ft 28.2 | 34            | 68                       | 1080X10      |                     |
| 150ft 28.3 | 30            | 68                       | 1127X10      |                     |
| 200ft 28.4 | 34            | 65                       | 1096X10      |                     |
| 300ft 30.1 | 33            | 69                       | 1020X10      |                     |
| periphery | 31.2         | 32                       | 67           | 1216X10             | MPs are on the street; at MP of 100 ft T increase 1.4 deg C. RH gets low. At MP of 300ft T is highest. |
| 50ft 31.4 | 34            | 72                       | 1620X10      |                     |
| 100ft 31.6 | 27            | 72.3                     | 1645X10      |                     |
| South    | 150ft 30.9    | 21                       | 69           | 1260X10             |                     |
| 200ft 31.6 | 27            | 69.8                     | 1127X10      |                     |
| 300ft 32.2 | 25            | 69                       | 1280X10      |                     |
| periphery | 31.9         | 33                       | 68           | 1198X10             | At MP of 100ft T increase 0.3 deg C. at East the values varies as MP s are taken at suitable location under building shade. |
| 50ft 32    | 31            | 67                       | 1230X10      |                     |
| East      | 100ft 31.1    | 29                       | 67.8         | 935X10              |                     |
| 150ft 31.0 | 25            | 69.3                     | 868X10       |                     |
| 200ft 29.9 | 20            | 72                       | 1080X10      |                     |
| 300ft 32.4 | 24            | 67.8                     | 1035X10      |                     |
| periphery | 29.5         | 33                       | 69.8         | 1170X10             | T increases 2.6 deg C [up to 200 ft distance] and RH decreases at West. MP at 300 ft is at open space, so variables are influenced by green space of stadium. |
| 50ft 30.8 | 32            | 71.6                     | 1276X10      |                     |
| West      | 100ft 31.1    | 34                       | 72           | 1330X10             |                     |
| 150ft 31.0 | 25            | 72.4                     | 1190X10      |                     |
| 200ft 30.9 | 30            | 72.8                     | 1067X10      |                     |
| 300ft 33.1 | 36            | 79                       | 1425X10      |                     |

(d) Park’s Performance and Influence on Surroundings

Environmental influence of this tiny Park is very important. Here Air temperature and illuminance level remains low, Relative Humidity is high than surroundings. Location of the
Park helps to act it as a Park cool island for its surrounding busy street. And its effect is strongly observed in this busy commercial area [strong within 300 ft radius]. It also acts as a good sound and dust absorber.

4.4 Park at Tajmahal Road, Mohammadpur
The Park is located at Tajmahal Road, near Kisholoy School of Mohammadpur. Mohammadpur is one of the important planned residential areas of Dhaka since 1950 with roads of regular grid pattern and buildings of mid-rise to high-rise with different height (multiple units/floor). The Park is surrounded by a mixture of uses ranging from institutional to residential. The Park is in between space of Minar mosque and Eidgah Field. The Park is widely used by the local residents.

Table 4: Study of Park at Tajmahal Road, Mohammadpur

| (a) Physical Characteristics of Park |
|-------------------------------------|
| Location | Size and Shape | Physical Features | Special Features | Name of the tree |
| Figure 8. Layout of Park at DIT Avenue Motijh | Figure 9. Surrounding Context of Park at DIT Avenue Motijheel eel | Figure 10. Views of Park at Tajmahal Road, Mohammadpur |
### Ward no: 29

- **Zone:** 05 [North]
- **Size:** 0.50 Acres
- **Shape:** Rectangle

| Tree Cover: | Seating: 33 nos |
|-------------|----------------|
| Wide and Medium | Monument: N |
| Canopy: 35% | Fountain: Y |
| Small Canopy: 40% | Play, Exercise |
| Shrub: 25% | Equipments, |
| Grass: 55% | Toilet, Park Shelter: N |
|                        | Payer Space N |

- **Mehgani, Debdaru,**
- **Shonal, Raintree, Ipil-ipil, Mango, Coconut,**
- **Betel nut, Guava,**
- **Banana, Radhachura,**
- **Gondharaj, Rongon,**
- **Hasnahena etc.**

### (b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization [land use around the Park] |
|---------------------|-----------------------------------------------|
| N: 20’ wide street, 6 storied residential building, School | Neighborhood Character: Planned Residential area |
| S: 25’ wide street, 5-6 storied residential building | Density: 53,915.6 inh./km², [Population census 2011-03-15] |
| E: Eidgah and madrasa | Institution: [School, mosque, madrasa] |
| W: Minar Mosque, residences | Above 6 storied: N/A |

### (c) Environmental Aspect of the Park and Surrounding Area

| Location | Temp T [degC] | Relative Humidity RH[%] | Sound S[Db] | Illuminance L[lux] | Remarks |
|----------|---------------|--------------------------|-------------|--------------------|---------|
| **Center** |               |                          |             |                    |         |
| periphery | 28.1          | 49.7                     | 60.2        | 316X10             | North periphery is deeply shaded by wide and mid canopy tree. Here T and L are lower than center. The MPs are on the street, shaded by buildings. |
| 50ft      | 27.6          | 50                       | 45          | 260                |         |
| 100ft     | 27.4          | 51.3                     | 48          | 623                |         |
| 150ft     | 27.8          | 53.5                     | 60          | 640X10             |         |
| 200ft     | 28.2          | 53.7                     | 62.1        | 1295X10            |         |
| 300ft     | 29.1          | 52.4                     | 66.1        | 1170X10            |         |
| periphery | 27.8          | 52.4                     | 61.9        | 1981X10            | At south T gets gradually higher |
| 50ft      | 28.1          | 50.5                     | 53.9        | 467X10             | [up to 0.5deg C at 200ft distance]. Streets at south are shaded by buildings and trees. |
| 100ft     | 28.2          | 51.7                     | 45.9        | 581X10             |         |
| 150ft     | 28.2          | 51.6                     | 59.2        | 578X10             |         |
| 200ft     | 28.3          | 53.2                     | 63.1        | 853X10             | therefore difference of T is low |
| 300ft     | 28.9          | 53                       | 65.7        | 980X10             |         |
| periphery | 27.3          | 49.2                     | 62.3        | 1893X10            | MPs are on the playfield. Here T and RH are gradually higher up to 1.5 deg C. At 200ft east there are tree at perimeter of field; RH increase up to 2.6% and L decrease. |
| 50ft      | 27.8          | 44.1                     | 62          | 1144X10            |         |
| 100ft     | 28.5          | 48                       | 65          | 1986X10            |         |
| 150ft     | 28.6          | 50                       | 64          | 1869X10            |         |
| 200ft     | 28.8          | 51.8                     | 49          | 607X10             |         |
| 300ft     | 29.7          | 53.8                     | 60          | 750X10             |         |
| periphery | 28.7          | 47.6                     | 54          | 452X10             | T and RH are gradually higher up to MP of 150m [T 1.4, deg C and RH 2.4%]. MP at 200ft West is located on street in front of building. |
| 50ft      | 27.7          | 44.1                     | 64.8        | 1181X10            |         |
| 100ft     | 30.2          | 48                       | 66.4        | 750X10             |         |
| 150ft     | 30.1          | 50                       | 62          | 230X10             |         |
| 200ft     | 27.6          | 51.8                     | 54.8        | 1158X10            |         |
| 300ft     | 30.1          | 49.5                     | 60.6        | 1195X10            |         |

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(d) Park’s Performance and Influence on Surroundings

The Park with different type trees has a comfortable environment for the Park user. People can take rest at Park periphery and south side of the Park under shaded tree. The field [eidgah] at east side, and a playfield at north-east side is very near to the Park. Streets of Mohammadpur have many trees. Therefore a mixed environmental impact found at that area. Streets at east, north and south also help to radiate Park cooling effect. Hence strong cooling effect is observed maximum of 200ft distance from Park periphery [within 450 ft radiuses].

4.5. Boishakhi Park, Banani

Boishakhi Park is located at Road no 07, Banani. It is just a pocket Park surrounded by residential plots on three sides. After a renovation at April 2011 the Park is renamed as Boishakhi Park. The Park is managed and maintained by Banani Society. The Park is mainly used for exercise purpose of Residents of Banani.
Table 5: Study of Boishakhi Park, Banani

(a) Physical Characteristics of Park

| Location | Size and Shape | Physical Features | Special Features Size: | Name of the tree |
|----------|----------------|-------------------|------------------------|------------------|
| Ward no : 19 | Size: 0.57 Acre | Tree Cover: Wide and Medium | Seating: 24 nos | Mehgan, Debdaru, |
| Zone: 03 [North] | Shape: Rectangle | Canopy: 30% | Monument, Fountain: N | Jackfruit, Mango, Shishu, |
| | | Small Canopy: 35% | Play Equipments: N | Banana, Neem, Coconut, |
| | | Shrub: 35% | Exercise Equipments: N | Bokul Krishnachura, |
| | | Grass: 80% | Toilet, Park Shelter: Y | Rose, Dahlia, Sunflower, |
| | | | Ptery Space: N | Rangan, Hasnahena, pine |

(b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization [land use around the Park] | Building Type [within 200 m] | Building Height [within 200 m] |
|---------------------|-------------------------------------------------|-----------------------------|-----------------------------|
| N: Residential plot | Neighborhood Character: Planned Residential and commercial area | Commercial: Y | Above 6 storied: 8% |
| S: Residential plot | Density: 35,640.8 inh./km², [Gulshan Thana Population census 2011-03-15] | Residential: Y | 6 storied: 85% |
| E: 30' wide street and commercial | | Institution: Y [Police Station] | 5 storied: 2% |
| W: 30' wide street, residential plot. | | | 3.4 storied: 5% |
| | | Above 6 storied: 8% | 2 storied: N/A |
| | | 6 storied: 85% | Under construction: N/A |
| | | | Unplanned structure: N/A |

(c) Environmental Aspect of the Park and Surrounding Area

| Location | Temp [degC] | Relative Humidity RH% | Sound [dB] | Illuminance [lux] | Remarks |
|----------|-------------|-----------------------|------------|-------------------|---------|
| Center   | 28.2        | 45.81                 | 53.81      | 1381X10           | T is low and RH is high |
| periphery| 28.2        | 47.7                  | 58.2       | 351X10            | North periphery is at the deep |
| 50ft     | 29.1        | 41.8                  | 60.4       | 840X10            | shade of building and tree. MPs at outside are on the street, in the shade of building. And T gets higher upto 1.7deg C |
| 100ft    | 29.3        | 42.3                  | 62         | 793X10            | |
| 150ft    | 29.8        | 43.5                  | 60         | 650X10            | |
| 200ft    | 29.9        | 43.5                  | 61.3       | 990X10            | |
| 300ft    | 32.5        | 43.1                  | 62         | 1118X10           | |
| 400ft    | 32.3        | 42.5                  | 62.9       | 1020X10           | |
| periphery| 27.8        | 52.4                  | 61.9       | 1981X10           | T and L gets gradually higher |
| 50ft     | 29.7        | 48.1                  | 55.4       | 381X10            | [upto 1.1deg C] RH is lower |
| 100ft    | 28.1        | 50.5                  | 53.9       | 467X10            | than periphery. MP at 200ft |
| South    | 29.8        | 43.6                  | 54.2       | 1108X10           | beside a field. T is highest here. |
| 150ft    | 30.5        | 42.8                  | 55.1       | 1705X10           | |
| 200ft    | 30.8        | 43.2                  | 55.1       | 1729X10           | |
| 300ft    | 31.3        | 47.1                  | 60.2       | 1937X10           | |
| periphery| 32.0        | 47.7                  | 61.4       | 1745X10           | The road at east is shaded by |
| 50ft     | 29.8        | 44.1                  | 62         | 1144X10           | buildings and there are some |
| 100ft    | 29.8        | 48.2                  | 65         | 1986X10           | wide canopy trees at this road. L |
| East     | 29.4        | 48.3                  | 64         | 1869X10           | and T lower than periphery |
| 150ft    | 29.3        | 48.3                  | 59         | 607X10            | but, higher than center of the Park. |
| 200ft    | 31.9        | 47.7                  | 58         | 990X10            | |
| 300ft    | 31.7        | 49                    | 55.7       | 870X10            | |
| periphery| 28.7        | 51.5                  | 59         | 605X10            | |
| 50ft     | -           | -                     | -          | -                 | |

West

| Location | Temp [degC] | Relative Humidity RH% | Sound [dB] | Illuminance [lux] | Remarks |
|----------|-------------|-----------------------|------------|-------------------|---------|
| periphery| 28.7        | 51.5                  | 59         | 605X10            | |
| 50ft     | -           | -                     | -          | -                 | |

T is 2.4 deg C higher at MP of 150ft west. MP at 400ft is at...
The Park has many canopy trees at its periphery but very little canopy trees and more grass cover and shrubs at center. Air temperature at center of the Park is lower than the periphery. The location of the Park is such that there is street only at west of Park and other three sides are blocked by buildings. Therefore its impact can flow only through the narrow south-east corner. Presence of many street trees at surroundings helps to keep that area cool.

**Figure 14.** Layout of Boishakhi Park, Banani

**Figure 15.** Surrounding Context of Boishakhi Park, Banani
4.6 Park at Uttara Sector 04

Uttara is in the northern part of Dhaka city and planned as a square grid residential suburb. The Park is located at road no 05, sector 04. The area is developed as a complex with a wide playfield and pond that help to promote community activity. The Park can also be viewed as unique landscapes that provide a connection between the residents and enhanced the attractiveness of neighborhood.

![Figure 16. Views of Park at Uttara Sector 04](image)

**Table 6. Study of Park at Uttara Sector 04**

(a) Physical Characteristics of Park

| Location | Size and Shape | Physical Features | Special Features Size: | Name of the tree |
|----------|----------------|-------------------|-------------------------|-----------------|
| Ward no 01 | Size: 0.86Acre | Tree Cover: Wide and Medium | Seating : 16 nos | Debdaru, Jarul., Mehgani. |
| Zone: 01 [North] | Shape: Rectangle | Canopy: 25% | Monument, fountain: N | Banyan, Eucalyptus, |
|          |              | Small Canopy:40% | Play Equipments: Y | Shishu, Ipil-ipil, Betel nut, |
|          |              | Shrub:35% | Exercise Equipments: N | Jackfruit, Raintree, Coconut, |
|          |              | Grass: 90% | Toilet, Payer Space: N | Krishnachura, |
|          |              |                |                          | Baganbilash, Hibiscus etc. |

(b) Surrounding Context and Spatial Organization of Park

| Surrounding context | Spatial organization [land use around the Park] | Building Type [within 200 m] | Building Height [within 200 m] |
|---------------------|-----------------------------------------------|-----------------------------|--------------------------------|
| N: Residential plot | Neighborhood Character: Planned Residential and Commercial area Density: 33,316.1 inh./km² [Population census 2011-03-15] | Commercial: Y Residential: Y Institution: Y [Police Station] | Above 6 storied: N/A 6 storied: 85% |
| S: Residential plot | E: 30’ wide street and residential and commercial | 5 storied: 2% | |
| W: 30’ wide street | | 3-4 storied: 5% | |
|                      | | 2 storied: 5% | |
|                      | | Under construction: 3% | |
|                      | | Unplanned structure: N/A | |

(c) Environmental Aspect of the Park and Surrounding Area

| Location | Temp T [degC] | Relative Humidity RH[%] | Sound S[Db] | Illuminance L[lux] | Remarks |
|----------|---------------|------------------------|-------------|-------------------|---------|

14
|       | Center      | North        | South       | East        | West        |
|-------|-------------|--------------|-------------|-------------|-------------|
| RH    | 34.1        | 34.0         | 33.8        | 34.6        | 33.8        |
| T     | 27.3        | 27.7         | 24.5        | 27.6        | 24.5        |
| L     | 46          | 49.5         | 30.4        | 28.6        | 28.8        |
| 930X10|             | 1836X10      |             | 1740X10     |             |
| RH is low at center and T is higher than periphery |
| T increase up to 1.8 deg C. RH gets lower. Here MPs are on the grass covered area [play field]. |
| T, RH, L, DB is slightly higher than periphery, as there are many trees in the roads of south. |
| T, RH gets higher up to gradually. The MP, at 100 m and 150 m is beside a construction site and MP at 200m is at road side. |
| There is a pond at west. MPs are at side of the pond, by the side of lower canopy tree and bush. Here T gets lower and RH gets higher. |
|       | 930X10      | 1520X10      | 370X10      | 860X10      | 1510X10     |
| periphery |             |              | 54.2        | 63.4        | 63.8        |
| 50ft   | 33.0        | 34.4         | 33.8        | 34.8        | 33.5        |
| 100ft  | 32.2        | 22.2         | 23.6        | 22.2        | 22.5        |
| 150ft  | 49.5        | 22.5         | 23.8        | 22.8        | 23.1        |
| 200ft  | 57.8        | 60.3         | 62.1        | 63.4        | 63.8        |
| 300ft  | 1836X10     | 1600X10      | 630X10      | 860X10      | 920X10      |
| periphery | 20.1       | 20.1         | 20.1        | 20.1        | 20.1        |
| 50ft   | 66.0        | 58.9         | 58.9        | 58.9        | 58.9        |
| 100ft  | 1630X10     | 1590X10      | 370X10      | 370X10      | 370X10      |
| 150ft  | 1510X10     | 1510X10      | 930X10      | 930X10      | 930X10      |
| 200ft  | 1600X10     | 1590X10      | 930X10      | 930X10      | 930X10      |
| 300ft  | 1510X10     | 1510X10      | 930X10      | 930X10      | 930X10      |
| periphery | 28.8       | 28.8         | 28.8        | 28.8        | 28.8        |
| 50ft   | 420X10      | 420X10       | 420X10      | 420X10      | 420X10      |
| 100ft  | 1380X10     | 1380X10      | 1380X10     | 1380X10     | 1380X10     |
| 150ft  | 1280X10     | 1280X10      | 1280X10     | 1280X10     | 1280X10     |
| 200ft  | 907X10      | 907X10       | 907X10      | 907X10      | 907X10      |
| 300ft  | 860X10      | 860X10       | 860X10      | 860X10      | 860X10      |
| 400ft  | 707X10      | 707X10       | 707X10      | 707X10      | 707X10      |

(d) Park’s Performance and Influence on Surroundings

The playfield at north and pond at west side of the Park create a mixed environmental impact on its surroundings. The Park is mostly covered by grass area. Here value of T and L is higher than other Parks. Therefore overall temperature difference is low between Park area and its surroundings and the Park impact observed up to 200 ft distance from Park periphery.

![Figure 17. Views of Park at Uttara Sector 04](image1)

![Figure 18. Surrounding Context of Park at Uttara Sector 04](image2)
5. Observations and Findings
It is also evident from the study that although areas are not exactly the same as another, but share many similarities. The surrounding context are different from each other in terms of land uses, plot and street patterns, public space networks but in the study of their microclimatic behavior, a positive environmental impact is observed in all the categories of park. And these impacts of Parks are reflected not only in vegetated areas but also in the surrounding areas depending on the type and quality of its vegetation, its design quality and on the surrounding context. The findings are summarized as below:

At Park Area
- Temperature of Small Parks is 2.0 deg C [on average] lower than that of the surrounding urban area.
- In most cases relative humidity is 9.3% higher [on average] at Park area than its surroundings.
- Canopy and dense tree at Park periphery act as sound barrier.
- Canopy trees cast shadow, minimize the illumination level [750X10 L on average], reduce solar radiation factor.

At Surroundings
The impact of Small Parks has a direct influence on up to 300 ft radius [150-200 ft distance from the Park edge] on their surroundings depending on surrounding urban morphology. Upto 600ft radius cooling effect is also observed depending on the Park layout and surrounding context [distribution of wide and dense canopy tree in the Park, surrounding road layout helps to radiate Park impact to surroundings]. In general, the maximum impact radius of Parks with more canopy tree is 600 ft, Parks with a almost equal combination of canopy tree and grass cover is 450 ft and Parks with more grass cover and minimum of canopy trees is maximum of 300ft.

For a better analysis of the Parks and their performance evaluation, the Parks need to categorize. Therefore physical conditions have been analyzed to categorize the Parks. We know that grass cannot be grown properly if the land is deeply shaded by canopy trees. For this reason these two elements i.e. grass and wide or mid canopy tree consider as variables. And depending on these two variables three categories has been selected to categorize surveyed Parks, which is described at the following table.

**Table 7. Category of Small Park according to canopy and grass cover area**

| Category | Green Ratio | Name of Park | Green Ratio |
|----------|-------------|--------------|-------------|
|          | Grass %    | Wide and Medium Canopy Tree% | Wide and Medium Canopy Tree % | Small Canopy Tree % | Shrub % | Grass % |
| Category 01 | 0-30 71-100 | Bahadur Shah Park Park at DIT Avenue Motijheel | 75 | 10 | 05 | 10 |
|           |            |              | 75 | 15 | 10 | 00 |
| Category 02 | 31-70 31-70 | Nabab Sirajoddoulla Park Park at Tajmahal Road, Mohammadpur | 40 | 30 | 30 | 50 |
|           |            |              | 35 | 40 | 25 | 40 |
| Category 03 | 71-100 00-30 | Boishakhi Park Park at Uttara Sector 04 | 30 | 35 | 35 | 80 |
|           |            |              | 25 | 40 | 35 | 90 |
In the above Table it is observed that Park of category 01 has more canopy trees therefore they remain shaded most of the time. So that grass cannot develop in this type of Park vastly. Strong cooling effect of these parks is observed, the radius of which is dependent on surrounding context [road layout and building] i.e if the Park is surrounded by road cooling effect can spread smoothly. thus these type of park has good impact on surrounding built environment. Park of category 02 has a good combination of canopy tree and grass coverage. Good play of light and shade helps to use the Park for different purpose. In case of three Parks, air temperature increase at their surroundings than the Park area. Nabab Sirajoddoulla Park of old Dhaka and Park at Tajmahal Road, Mohammadpur are almost divided into two zones; one part with canopy tree and other part with grass cover and small canopy tree. Therefore variety of activity generates in these parks. Park effect if observed maximum of 300 ft radius at surroundings [200 ft distance from Park periphery]. On the other hand Parks of category 03 have more grass cover and minimum canopy tree. These Parks exposed to sun all the day long. Therefore these Parks are not comfortable to use at time in context of our country. Therefore the summery is shown as below:

Table 8. Environmental Performance Analysis of Small Park and on their Surroundings

| Category | Impact radius | Average Temperature Difference at Surroundings | Average Relative Humidity at Surroundings | Direct Solar Radiation and Illuminance at Surroundings | Remarks |
|----------|---------------|-----------------------------------------------|------------------------------------------|-----------------------------------------------------|---------|
| Category 01 | 450-600ft | Increases | Decreases | Low at Park | Best |
| Category 02 | 300-450ft | Increases | Decreases | Varies at Park | Better |
| Category 03 | 300 ft | Increases | Decreases | High at Park | Good |

From the above table it has been found that Parks with more canopy trees [category 01] have better performance than other Parks with minimum canopy trees and more grass cover area.

6. Conclusion and recommendation

To portray the livability of dense Dhaka these Small Parks can contribute a lot. The Park which has good environmental impact has a good social impact also. Therefore for a dense city, when it is not possible to incorporate large Parks through the city, integrated system of Small Parks and open space is fundamentally more beneficial than creating large Parks. In a dense situation like Dhaka proper planning policy is necessary to increase the quality of life and livability.

This research also shows that, if properly designed, Park’s performance will increase by several times. Thus people needs to be aware of the importance of Small Park for urban environment and designer must adjust their design in order to create better environmental performance for the people.

The study finds that park with more canopy tree is suitable for our environment. To get most positive environmental performance from Small Parks, selection of the right tree in the right place is an important factor. So that Park can be usable during Winter and Summer by providing shade in Summer and sun spots in Winter. During the mid-hours of the day solar radiation influx is
The highest. Therefore incorporating effective shading through canopies or arcades is the utmost important.

**Figure 19:** Distribution of Canopy Tree in Park Area

Arrangement of trees in combination with tall and medium size along west side of the Park is also a good option. Large or medium canopy beside sitting/activity area or internal walkway and small canopy tree with combination of grass and shrubs elsewhere can be used. Wide Canopy trees can be placed in the Park periphery so that internal and external walkway remains shaded all the time, also reduce noise from street and give a sense of privacy. In this way Small Parks can extend their benefits to the surrounding areas and thus thermally agreeable microclimate can be generate.

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