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An Assessment of Microclimatic Variations A Study in Dhaka City, Bangladesh

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Dated: 15 July 2015

Introduction

Dhaka, the administrative capital and commercial hub of Bangladesh is one of the megacities of the world and it has a population of 15 million (BBS, 2012). This city has experienced high rate of physical and population growth since 1981 (Islam, 2005). This high growth rate has created tremendous pressure on urban land, utility service and other amenities of urban life. A substantial growth of built up areas is transforming the landscape from natural cover type to Impervious Surface (IS) and this growth is linked with the formation of urban heat island and microclimatic conditions in Dhaka city (Raja, 2012). Kakon and Nobuo (2009) have identified microclimatic conditions in Dhaka city while working with sky view factor but they have emphasized on variations of solar radiation caused by Sky View Factor (SVF). Burkat et al. (2011) have also conducted a study on urban heat island and microclimate of Dhaka city. Their study was solely based on analyzing the effects of urban heat environment on cardiovascular mortality rate. In the present research atmospheric temperature and relative humidity are taken into account and the study is totally devoted to climatological research.

Objectives

The specific objectives of the research are

- to find out spatio-temporal variation of air temperature and relative humidity of Dhaka city
- to provide a better understating of the causes of microclimatic condition and heat island in Dhaka city with the help of existing literature.

Data Sources And Methodology

Dhaka city is situated between 23°42' N and 23° 54' N latitudes and 90°20' E and 90°28' E longitudes Four sites were selected in Dhaka City (Fig 1). From them Agargaon, where weather station of Bangladesh Meteorological Department is located was chosen as reference site. Other three study sites were: Motijheel, Sugunbagicha-Kakrail and Dhaka University Campus Area where mobile weather stations were installed with the help of portable devices.

Methods of Data Collection

For this research, air temperature and relative humidity data, twice in a day (at 12pm and 6pm) of 30 consecutive days of November, 2013 were collected. Three portable digital indoor-outdoor hygrometer (Model: SH-110) were used for this data collection.

Findings and Discussion

Among the four study sites, Motijheel area has the highest mean air temperature at 12pm in November and the recorded mean air temperature is 29°C (Table 1). This is 1.2°C more than the recorded air temperature of Dhaka University area and 0.7°C more than Segunbagicha-Kakrail area. So within a distance of 2 km 4% difference of air temperature has been identified in the research. It brings the testimony of heat island formation

in Motijheel area. Similar Motijheel area has the highest mean air temperature 27.3°C at 6 pm. It is 2.5°C more than the recorded mean air temperature of Agargaon, BMD.

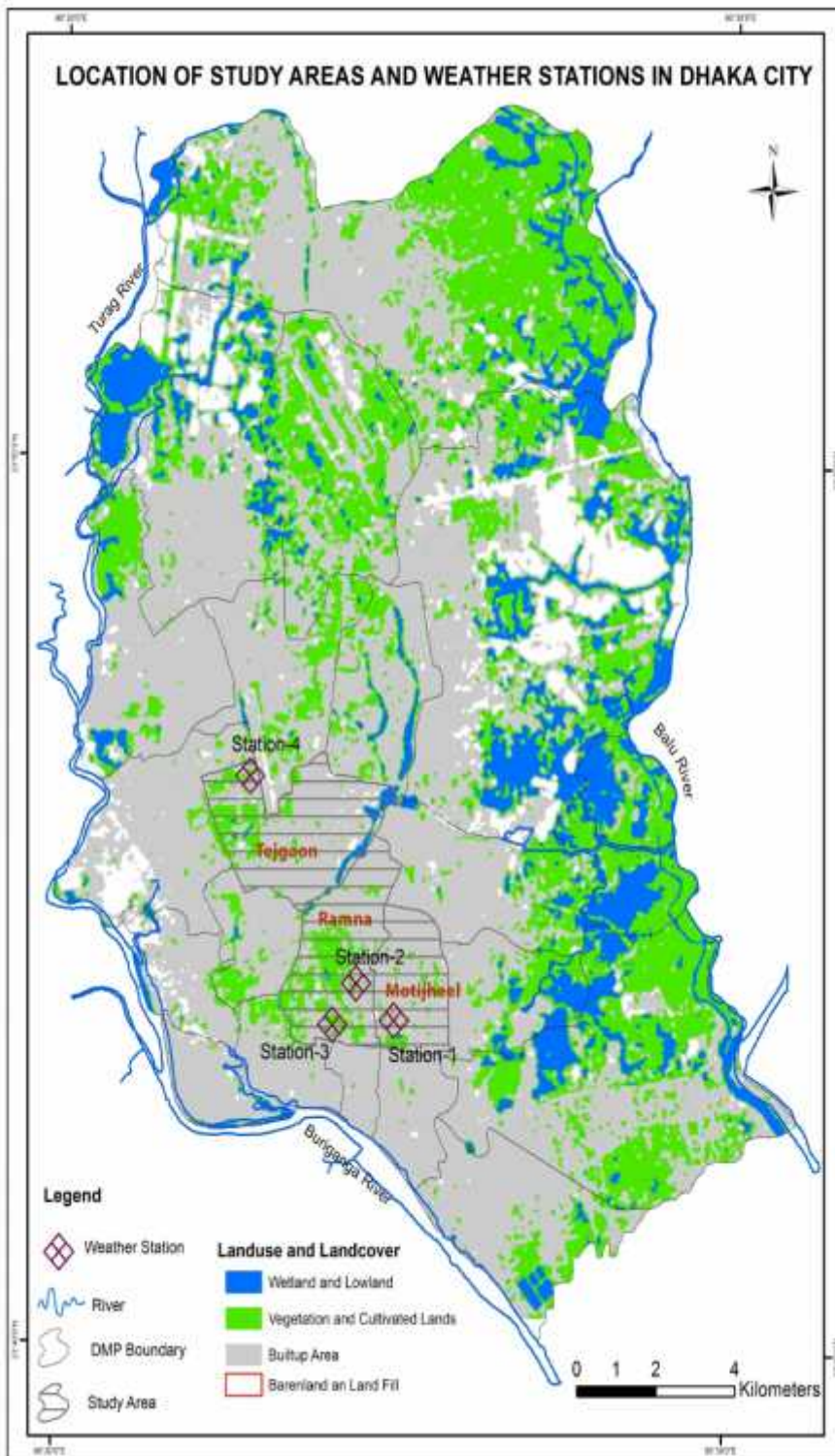


Fig 1: Location of Study Areas and Weather Stations in Dhaka City

This difference of temperature was only 0.2°C at the noon but it has showed an increasing trend at evening more precisely at 6pm. The difference of temperature between Motijheel and Segunbagicha-Kakrail is 1.4°C and between Motijheel and Dhaka University is 1.6°C. So in the evening the difference has increased than in the noon. This difference is about 5.8% within 2 km of CBD (Central Business District: Motijheel) and 9% with in 7 km of CBD.

Mean relative humidity at 12 and 6 pm in November shows different type of pattern. BMD, Agargaon area has the lowest 44% mean relative humidity from four areas (Table 2). Surprisingly other three areas have similar mean relative humidity and it is 49%. In the evening or 6pm Dhaka university area has the highest mean relative humidity and it is 63%. While Motijheel area has the lowest relative humidity and it is 53%.

For this study, air temperature and relative humidity were taken at two times of a single day for 30 days of November month, 2013. So the differences of air temperature and relative humidity of these two times of a single day may indicate microclimatic condition as air temperature and relative humidity are linked to each other.

Our research has found differences of air temperature and relative humidity among study sites. Paired sample t test suggests that this difference is significant at the evening and Motijheel area has significant differences of air temperature and relative humidity than the other areas. The main urban microclimatic condition that our research has found is urban heat island condition. Like the air temperature land surface temperature map of April, 2014 of Dhaka city (Fig 4) also suggests the formation of heat island condition and microclimatic variations in Dhaka city. For Dhaka city probable causes are dwindling forest cover, open spaces and wetlands, changes in urban

morphology, increasing anthropogenic heat generation, increasing building density, concrete surfaces and dark-colored roof tops (Raja, 2012).

Table 1: Mean Air Temperature of Four Study Areas at 12pm and 6pm

Area	Mean Temperature (°C) at 12pm	Mean Temperature (°C) at 6 pm
Motijheel	29.0	27.3
Segunbagicha	28.3	25.9
Dhaka University	27.8	25.7
Agargaon, BMD	28.8	24.8

Source: Field Data and BMD November, 2013

Table 2: Mean Relative Humidity of Four Study Areas at 12pm and 6pm

Area	Mean Relative Humidity(%) at 12pm	Mean Relative Humidity(%) at 6pm
Motijheel	49	56
Segunbagicha	49	57
Dhaka University	49	63
Agargaon, BMD	44	62

Source: Field Data and BMD November, 2013

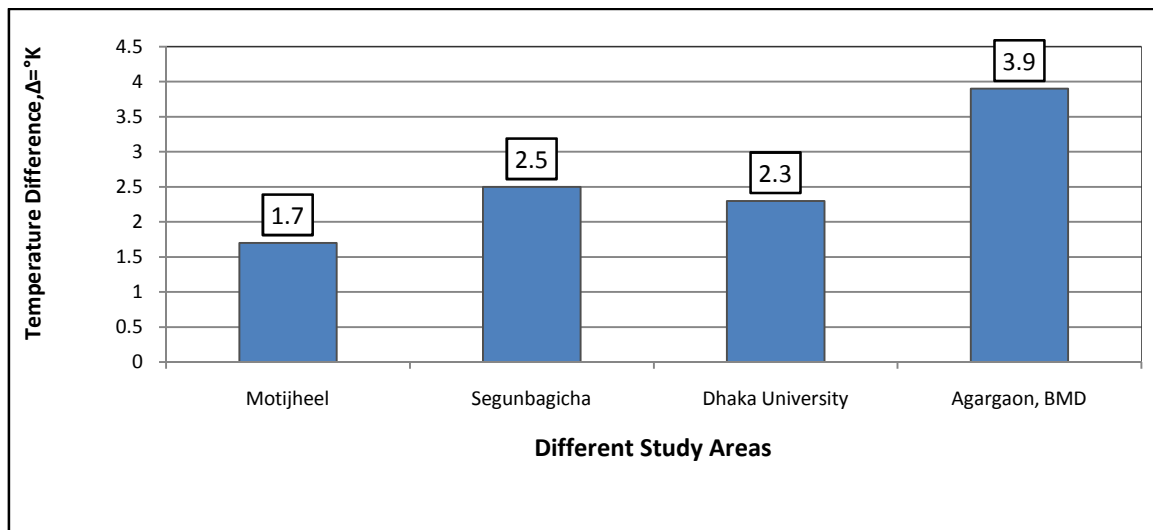


Fig 2: Mean Range of Air Temperature (Between 12 pm and 6 pm)

Source: Field Data and BMD, November, 2013

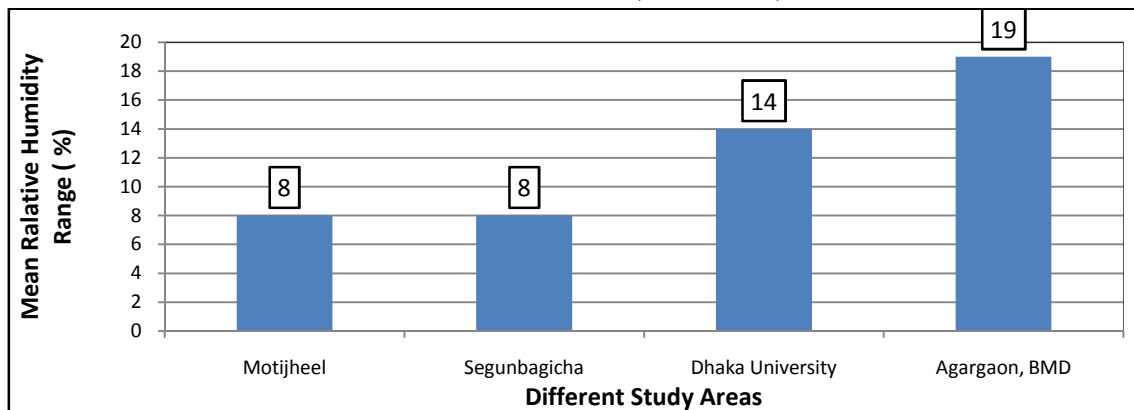


Fig 3: Mean Range of Relative Humidity (Between 6pm and 12 pm)

Source: Field Data and BMD, November, 2013

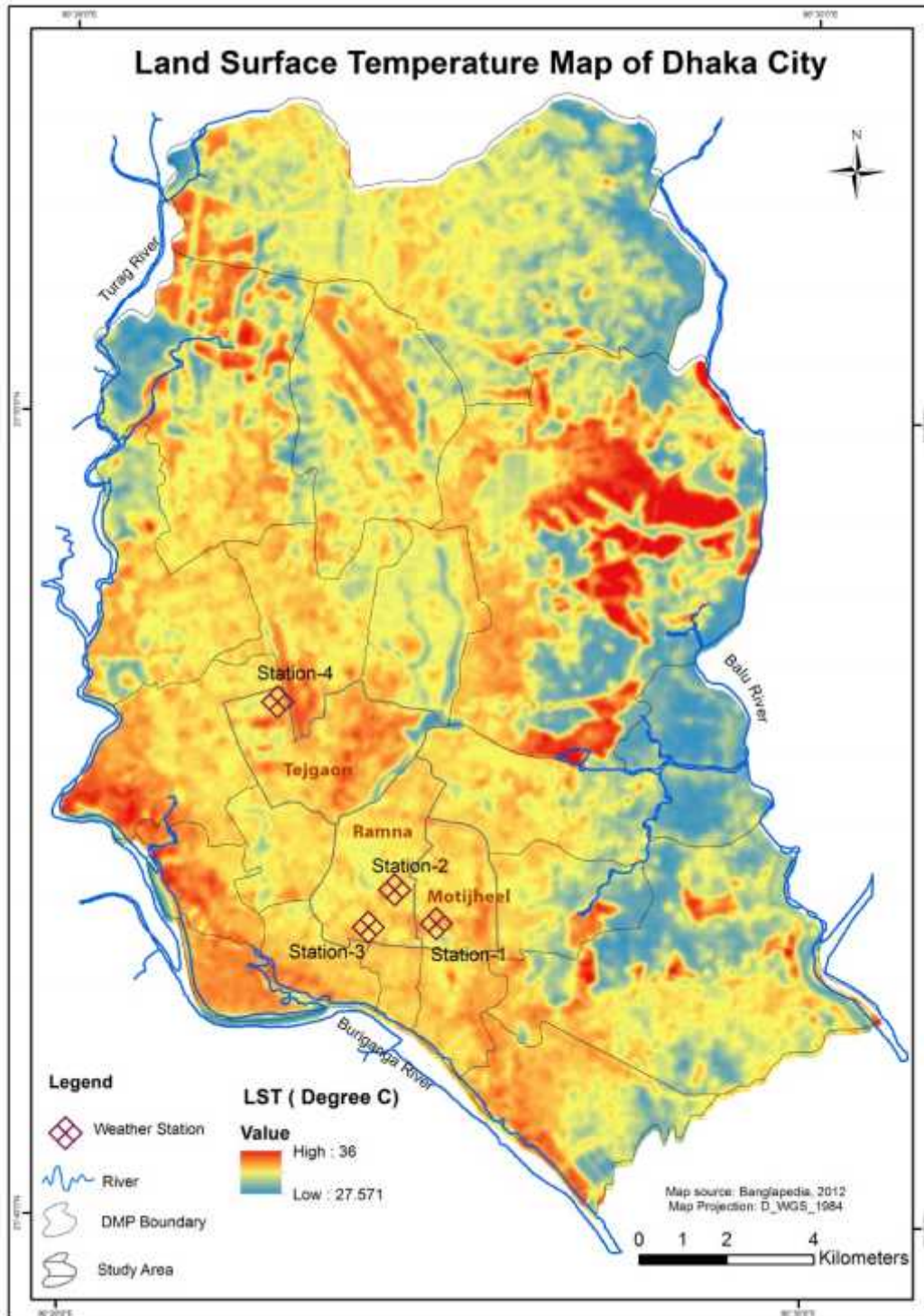


Fig 4: Land Surface Temperature Map of Dhaka City (April, 2014)

Conclusion

From this study it is evident that Motijheel, the commercial area and CBD of Dhaka city has highest mean air temperature than other three study areas and this statement is true for both the cases of 12 pm and 6 pm.

The study has covered four areas of Dhaka city to give an idea of the increasing microclimatic condition and urban heat island formation. More rigorous studies are required to find out the broader perspective of worsening heat environment in Dhaka city.

Acknowledgements

This study would not be possible without the help of Rehnuma Parveen, Assistant Professor, Department of Architecture, Bangladesh University of Engineering and Technology, BUET. We acknowledge Maliha Mamtaz and Syed Murad Islam for their help in data collection.

References

- Bangladesh Bureau of Statistics (2012). Population Census 2011, Community Series, Zila: Dhaka, BBS, Government of Bangladesh, University Press Limited, Dhaka, Bangladesh
- Bangladesh Meteorological Department (2013). 3 Hours Interval Data for the Month of November, 2013: Dhaka Station, Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka.
- Burkart, K., Schneider, A., Breitner, S., Khan, M.H., Kramer, A. and Enlicher, W. (2011). The effect of atmospheric thermal conditions and urban thermal pollution on all-cause and cardiovascular mortality in Bangladesh, *Journal of Environmental Pollution*, 159 (2011). 2035-2043.
- Islam, N. (2005). Dhaka Now: Contemporary Urban Development, Bangladesh Geographical Society.
- Kakon, A.N. and Nobuo, M. (2009). The Sky View Factor Effects on Microclimate of a City Environment: A Case Study of Dhaka City, Proceedings of the Seventh International Conference on Urban Climate, 29-30 July, 2009, Yokohama, Japan.
- Raja, D.R. (2012). Spatial Analysis of land Surface Temperature in Dhaka Metropolitan Area, *Journal of Bangladesh Institute of Planners*, Vol 5.