

A Study of Urban Heat Island and Its Mapping

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Abstract: *Urban heat island is one of the most important concerns in a developing country like India. The change in climate is due to the human activities such as industrialization and urbanization. The surface cover is increasing throughout the year, since the urban structures consumes and re-radiate heat it becomes the are the main cause for urban heat island. The urban heat island phenomenon is mainly seen in highly populated, urbanized and industrialized cities than in semi urban and rural areas. This paper mainly concentrates to mapping the temperature in Ernakulam city and to determine which are the places are under urban heat island phenomenon. Temperature was taken by manual and the mapping of temperature was done by using the software Arc map ten. From the analysis of the data the change in temperature was 6°C between urban and its surroundings.*

Keywords: Urban heat island, Temperature, Analysis, Mapping, Zoning

1. Introduction

The heat island is a phenomenon of increase in heat in the city than the surrounding rural areas due to human activities like urbanization, industrialization, traffic density, increasing level of pollutants and also due to the decrease in green cover and vegetation. The phenomenon is mainly due to high density of buildings and urban structure that absorb solar radiation, the use of highly absorbing materials, the lack of green spaces etc. The various factors that influence the heat are city size, impervious surfaces, topography, anthropogenic heat release and meteorological conditions. Increased urban temperature exacerbate the consumption of energy for cooling purposes, increases the peak electricity demand, intensify pollution problems, causes human discomfort and health problems. The global mean temperature has increased by approximately 0.8°C. The temperature change has to be documented for various purposes such as, layout design, mitigation measurement application, base form modeling, comfort analysis, pollution controlling etc.

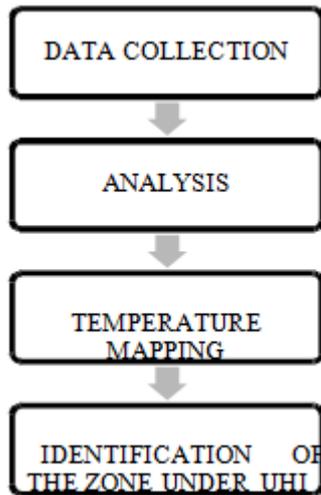
Various mitigation measures can be adapted for decreasing the heat is traditional cool roof materials, cool pavements, reflective materials, land cover change, thermo chromic coatings and claddings etc. the effectiveness of each method was analyzed and the result were also documented in various papers.

There was a study conducted to predicting the the magnitude of energy use and energy savings. It conducts a case study of office building in 15 cities with different climatic conditions. There was an increase in energy for cooling purposes and decrease in energy for the heating purposes. [Sub Y: 2014]. The factors which place a significant role in urban heat island are building configuration, land surface and street path. The adjacent heat sources decreases the urban heat island effect.[Paul coseo and Larissa L: 2014]. There was a study conducted by using ENVI- met for determine the effect of cool surfaces. The extreme weather conditions make a serious impact on the energy consumption, global environmental quality and health impact mainly in the low income people

[Mattheeos S 2014]. The past studies show that change in temperature has a significant impact on the energy consumption of the building [Santamouris M 2014]. Urban topology and the urban vegetation shading affect the storing of solar radiation throughout the day. The concept of cool city (combination of cool pavements, cool roof and adding urban vegetation) made a significant role for decreasing the heat [Yupeng W: 2015]. Heavy weight construction results in lower energy consumption as compared to light weight construction and the implementation of ad-hoc cooling system in existing building may leads to decrease in energy consumption due to less heating effect. [Kolokotroni M 2011]. The temperature during the summer period was depending largely on the color properties of the materials. The temperature coefficients of light color materials were lower than those of the dark color materials. [Hassan R, Essam A 2013]. By using the reflective materials with high albedo, reflective materials redirect more radiation and reduce surface temperatures, which in turn lead to lower air temperatures. [Jiachuan Y, Zhi- Hua W 2015]. The chosen form and the design layout are the most concerning parameters for decreasing the effect of UHI for the upcoming buildings [Christopher O 2015]

1.1. Methodology

The research methodology is aimed at urban heat island and its mitigation. The various factors affecting urban heat island measurement was identified through various analyses. Based on industrialization, density of population and traffic volume the area of study was fixed. The selected area was then divided into different zones based on the urban and semi urban areas. Data collection was done by using digital thermometer from different zones. Analysis of the obtained data was done by using the software Arc Map 10.



2. Analysis

The urban heat island is mainly located in the cities, because of study was mainly concentrated in Ernakulam city. Based on industrialization, density of population and traffic volume the area of study was fixed. Total identified area is divided into urban and semi urban areas. The selected area was then divided into different zones. Area under the authority Cochin Corporation was taken as the urban and the total area was divided into five zones based on the boundary markings of the authority. In each zone there was ten individual points. The area surrounding the Cochin Corporation was taken as the semi urban area and it is considered as one zone.

Total 70 stations are considered for the analysis. The temperature data was collected in the month of October in the year of 2015. Data collection was done by using digital thermometer from different zones. The time duration was selected as the time between 11.00 AM to 2 PM for obtaining peak temperature data. Analysis of the obtained data was done by using the software Arc Map 10.

Station name, latitude, longitude and temperature are documented in the table. The maximum distance of 3 Km and the minimum distance of 850 m in urban areas.

The consideration of the stations is based on the following factors,

- Importance of the place

- o Urban
- o Semi urban
- o Rural

- The probability of change in temperature
- By considering the surroundings such as

- Influence of water sources.
- Density of buildings
- Street density
- Traffic volume
- Population
- Nearby industries

The stations and the distance between the stations are based on the above factors. The temperature is taken as the average of three days of the considering stations.

Table 1: Places of Zone 2

Sl no	Places	Nearest place	Distance between points
1	Lissie junction	Lissie junction	0 Km
2	Kachenipady	Lissie junction	1.5 Km
3	Kaloor signal Junction	SRM junction	800 m
4	SRM junction	Pacahalm	3.3 Km
5	Pacahalm	Marine Drive, kaloor	3 Km
6	Marine Drive, kaloor	Maharajas	1.7 Km
7	Ayyappankavu	Kachenipady	900 m
8	Maharajas	Kadavanthra	3.2 Km
9	Kadavanthra	Thammanam	2 Km
10	Tatapuram	Pachalam	1 Km

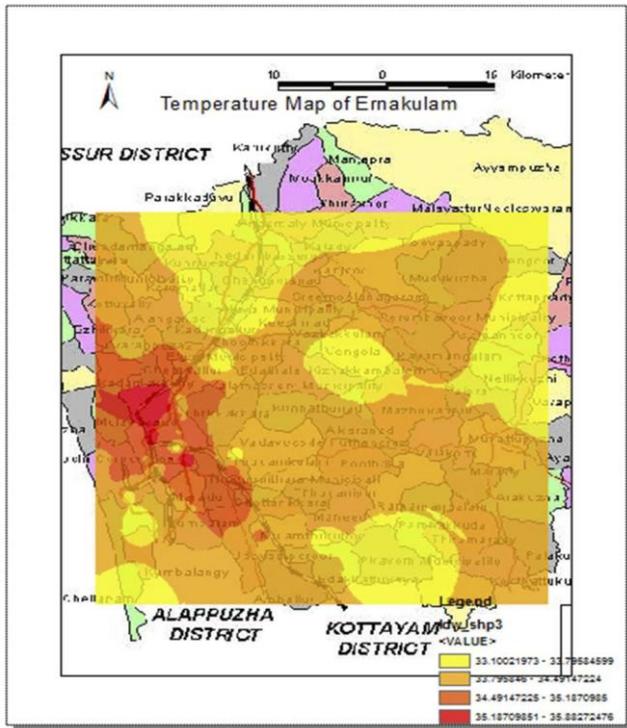
3. Discussion and Conclusion

From the collected data and its analysis zone with peak temperature has zone two and three. From the urban area climate analysis the change in temperature is about 6°C between urban and semi urban areas and about 1°C - 1.5°C under the area of Cochin corporation.

The change in temperature is based on the factors such as,

- The Ernakulum city has the influences of nearby water sources such as Lake Vembanattu and the Arabian sea
- Cochin metro construction works • High traffic volume
- Higher level of population
- Less vegetation and greenery
- Increase in surface cover due to high rise
- Higher level of pollutants.

These are the main factor which leads to the buildings temperature change inside the city.

Figure 1: Temperature Map of Ernakulam

- [9] Santamouris M (2014) "On the energy impact of urban island and global warming on buildings" International Journal of Energy and building
- [10] Sub Y. and Augenbroe G., (2014), "Urban Heat Island Effect on Energy Application Studies of Office Buildings", International Journal of Energy and Buildings, Vol:77, pp: 171-179
- [11] Yupeng W (2015) "Comparing the effects of urban heat island mitigation strategies for Toronto, Canada" International Journal of Energy and building

References

Journal Articles

- [1] Adrien Dhalluin and Emmanuel Bozonnet (2015) "Urban heat island and sensitive building design- a study in some French cities" International Journal of sustainable cities and society
- [2] Hassan R, Essam A et.al (2013) "On the colours and properties of building surface materials to mitigate urban heat islands in highly productive solar regions" International Journal of building and environment.
- [3] Jiachuan Y, Zhi-Hua W et.al (2015) "Environmental impacts of reflective materials: Is high albedo a „silver bullet“ for mitigating urban heat island?" International Journal of Renewable and Sustainable Energy Reviews
- [4] Kolokotroni M (2011) "London's urban heat island: Impact on current and future energy consumption in office buildings" International Journal of Energy and building
- [5] Hassan R, Essam A et.al (2013) "On the colours and properties of building surface materials to mitigate urban heat islands in highly productive solar regions" International Journal of building and environment.
- [6] Mattheos Santamouris (2014) "On the impact of urban overheating and extreme climatic conditions on housing, energy, comfort and environmental quality of vulnerable population in Europe" International Journal of Energy and Building
- [7] Noushing K., Youssef D.(2015), "Effect on the urban heat island in Beirut", Urban Climate
- [8] Paul Coseo, Larissa Larsen (2014) "How factors of land use/land cover, building configuration, and adjacent heat sources and sinks explain urban heat islands in Chicago" International Journal of Landscape and Urban Planning