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Study the vegetation as urban strategy to mitigate urban heat island in mega city Cairo

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Abstract

Cairo shows high temperature in comparison to its adjacent suburban and rural areas and this phenomenon is known as urban heat island "UHI". A review of literature has shown that vegetation has a significant effect on UHI mitigation.

The objective of this paper is to investigate the effect of vegetation on UHI mitigation in Cairo based on field measurements. Mobile temperature measurements had been carried out in adjacent greenery and non greenery spaces during summer time. The recommendations of this study will help urban planners to find the manual to know how to use vegetation to mitigate UHI.

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1. Introduction

Cairo is Egypt's largest city with the highest rate of urbanization. It has a population of 40 million citizens in greater Cairo with average of 25000 citizens per km² (Abo Ghazala et al.) [1]. Cairo urbanization contributed to wide changes in many factors during last 20 years (1996-2013) such as population, pollution rate, using cars and green area fraction. The population increased during this period rapidly from 15.5 million to 40 million citizens. The

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ownership of cars increased from 700.000 cars to 2 million cars. Therefore, the CO2 concentration increased from 1 PPM to 10 PPM. The person's portion from green areas decreased significantly from 4m/person to 6cm/person (Abo Ghazala et al.) [1]. All these factors contributed to high temperature in Cairo therefore UHI effect.

1.1 UHI definitions, reasons and characteristics

Usually, people feel high temperature in the cities in comparison to its adjacent rural areas. This phenomenon is known as urban heat island "UHI". Figure (1) shows high temperature in the city especially in the downtown of the city and low temperature in suburban and rural areas (Gartland) [2]. Akbari showed the difference between temperature in cities and rural areas as shown in figure (2) (Akbari) [3].

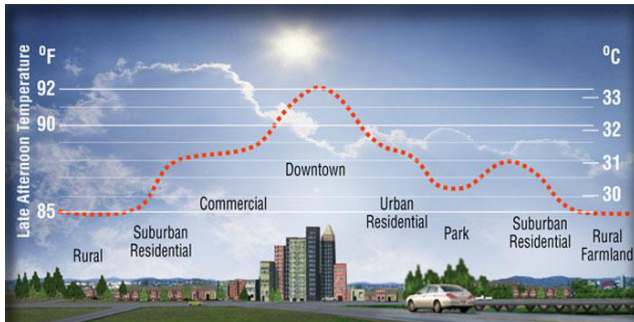


Figure (1) High temperature in city downtown

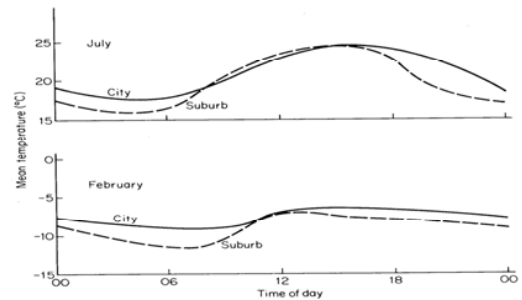


Figure (2) High temperature in the city in comparison to rural areas

Urban heat island is caused due to numerous reasons. Firstly, Materials that are used in the cities are dark and impermeable which absorb more heat rather than the materials which are used in rural areas. Secondly, dense buildings in the cities cause deep canyons which trap more heat. Thirdly, lack of green areas and vegetation in the cities Figure (3). Finally, anthropogenic heat which is caused due to human activities such as car pollution and air conditioning use Figure (Dodmon) [4].

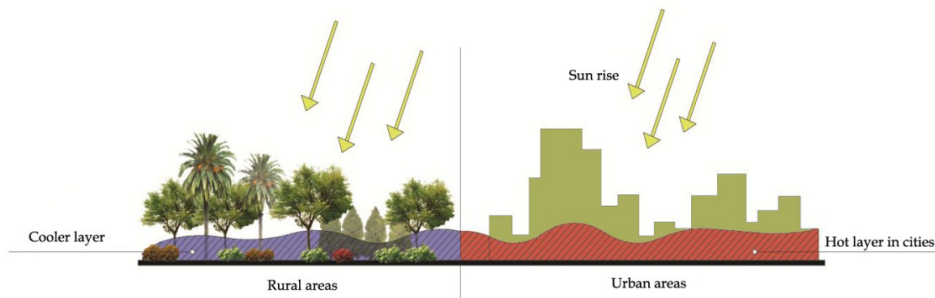


Figure (3) Cool temperature in rural areas due to dense vegetation

Urban heat island has a critical side effects as it is not just affect thermal comfort for human in outdoor spaces but it increase mortality rates. The governments pay huge amounts of money regarding energy consumption in indoor spaces and infrastructure maintenance (Gartland) [2]. Urban heat island has a direct relationship with different indicators. Firstly, Peterson assumed in 2003 that each city with population of 10000 citizens has a warming effect but Oke and Torok said that each city with population of 100000 citizens has a warming effect (Oke and Torok) [5]. Numerous researchers differed on cities classifications which cause warming but they referred the

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