Evaluation of Urban Green Areas on “The City Climate; Case Study of Atatürk Forest Farm

Bayram Cemil Bilgili¹, and Şükran Şahin²

¹Asst. Prof., Cankiri Karatekin University, Çankırı, Turkey; ²Prof., Ankara University, Çankırı, Turkey.
E-Mail: cemilbilgili@gmail.com

Abstract:

Urban green areas are the areas that obtain to establish the human-nature connection in the cities and to increase the life standards of the urban dwellers. Having healthy and accurate open green space in the cities is one of the criterias of life quality. The urban green areas are considered within the urban plans building a green space system in the city and both the qualities and quantities are being paid attention in the developed countries. There are a lot of benefits of urban green areas such as physical, climatic and social benefits for the urban dwellers. Urban green areas affect the bioclimatic comfort conditions directly. In parallel to the structural development of urbanization, the growing urban heat island is one of the most important problems of current cities. The intensity of the heat islands varies according to the horizontal and vertical development of the urban structures, and the materials used for the structures. The studies that have been done on this subject have shown that the green areas designed by the qualified and developed plantation are more comfortable than the areas near them which are covered with structures. The purpose of this study is to define the effects of Atatürk forest farm—a significant green area of Ankara—on the urban ecosystem and bioclimatic comfort of the city by defining the qualifications of the area according to the temperature.

Key Terms: Urban green area, urban climate, bioclimatical comfort

Introduction:

One of the main problems of urban residents is “urban heat island” which occurs depending on the horizontal and vertical development of cities. Formed by structuring and the increasing of impermeable surfaces, urban heat island causes cities to be hotter than the rural areas around the city.

Urban heat islands increased beginning from the industrial revolution till today, parallel to population increase. Population growth in the cities set off adding new of residential areas, roads and industrial areas to existing ones and this caused conversion of rural landscape. Consequently, conversion of landscape is accelerated. Rural landscape which has been formed in centuries with the effect of biotic and abiotic factors and the forming processes of these effects quickly turned to urban landscape. This caused increase of the negative effect of urban heat islands.

“Urban heat island” was firstly defined by Luke Howard in 1820 for London, and it has been researched for several different cities in the world. Urban heat island is one of most significant climate indications of modern day civilization (Duman Yüksel ve Yılmaz 2008).

Even it changes by horizontal and vertical development of cities, the forming of urban heat island in the residential areas is described in Figure 1 (EPA 2013).

![Urban Heat Island Profile](EPA 2013a)

There are a lot of factors effecting urban heat island forming, which can be classified under two main groups; controllable or uncontrollable (Figure 2).
Urban Heat Island Mitigation:

Many study are taking action to reduce urban heat islands using main strategies are:

1) increasing tree and vegetative cover,

2) installing green roofs (also called "rooftop gardens" or "eco-roofs"),

3) installing cool—mainly reflective—roofs, and

4) using cool pavements (EPA 2013b)

Increasing green areas and plant density is the most important solution for decreasing the negative effects of urban heat island. For this purpose, defining the cooling effect of Atatürk Forest Farm (which is one of the most important green areas in Ankara) to its surroundings is aimed in this study.

Material:

The main material of this research is Atatürk Forest Farm. The arable part of Atatürk Forest Farm is 20,000 decares which is %60 of total land. %15 (5000 decares) of the rest of the land is grass and pasturage; and %25 (8000 decares) is forest, park, plot, roads or unused fields. In the 20,000 decares of arable part of AOC, polyculture agriculture is practised. Grain, animal feed, sugar beet, sapling and ornamental plants are grown (Ülger 1993).

In the farm, there is 200 decares of plantation, 250 decares of ornamental plants growing area, and 2325 decares of park and forest. Also a zoo of covering 320 decares of land had been built (Ülger 1993). Figure 3 shows the location of the research area in the city.
Method:

As part of the research, the dates of the mobile temperature measurements are determined according to Ankara station’s temperature statistics prepared for long years. The temperature data between 1975-2005 has been supplied from government, General Directorate of Meteorology. Between these years, July and August average temperature data has been listed according to highest temperature level. In the list, it’s seen that the highest temperature level was in June 2000 and again in June 2001.

The mobile temperature measurements which is made for identifying the urban heat island, according to Oke (1989) over wind speed of 6 m/s the cooling affect of the parks can not be determined. (Upmanis et al. 1998)

In this way, to determine the times which the wind speed is over 5 m/s and to repeat the measurements which had been done in that conditions; the wind speed at the date of mobile measurements are also measured with anemometer at the stationary climate station.

The route of the mobile temperature measurements in AOÇ has been prepared according to the vegetation density maps. The temporal growing of the plant material in AOÇ has been examined according to NDVI (Normalized Difference Vegetation Index). NDVI is a dependable source of information about temporal and spatial variation of green plant density in a ecosystem. (Wang et al. 2001, Zavaleta et al. 2003). For determining NDVI value, the following equation is calculated for each pixel (Jung et al.2005, Kim et.al 2006).

\[ \text{NDVI} = \frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}} \]

Results and Discussion:

The purpose of this research is to observe the cooling effect of Atatürk Forest Farm by
performing mobile temperature measurements. Temperature measurements points were chosen to represent different plant densities. In this context, plant density map of Atatürk Forest Farm has been prepared by using IKONOS satellite images (Figure 4). The mobile measurements performed around Atatürk Forest Farm is not equal to the width of the park. All measurements has been made in a 1 hour timeframe to prevent temperature differences caused by time delays between measurement points. The due to distances between mobile measurement points of Atatürk Forest Farm had been long, measurements had been made according to the points seen in Figure 5 (Bilgili 2009).

It is drawn temperature map of measurement points Figure 6. Cooling effect decreased from center of the Atatürk Forest Farm to outside.

---

**Figure 4.** Plant density map of Atatürk Forest Farm

**Figure 5.** Measurement points of mobile temperature
Conclusions:

Temperature data which had been achieved from pointal measurements are converted to spatial data. It is apparent that park is cooler than the surrounding areas according to the maps achieved from the midday temperature measurements. Temperature is increasing through the north direction if gone away. In general, it's seen that the cooling effect of the park is decreased if gone far away from the park border. There is a distance of 1.5 km between the cool point and the hottest point of the park. Green zones add a lot of contribution to city ecosystems. One of these contributions are decreasing of the formation of urban heat islands.

References


