

## Global Climate Changes and Effects on Urban Climate of Urban Green Spaces

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### Abstract

Global climate change and drought are major threats of our age. The future of earth ecosystems is increasingly dependent on the patterns of urban growth because cities are growing rapidly worldwide. Urban ecosystems differ from natural or rural ones in many obvious ways and are also often of poorer quality than their rural equivalents. Human activities, such as building, traffic, or industrial production affect the quality of air, water, and soil which impacts ecosystems in many ways and the activities is causing global climate changes. Green space is an important part of complex urban ecosystems and provides significant ecosystem services. There are positive contributions on a properly designed and implemented a green spaces for bio-climatic environment creation, micro-air-climate creation, climate control to provide increase of oxygen decrease of pollution amount and dust reduction, energy savings provision, reduce the negative effects of rainfall, some benefits on city climate. In this study, on global warming and climate changes important threats of our era and effect on the environmental damage will be highlighted. Creation of the green spaces and the positive contribution to climate in the city will be described.

**Keywords:** *Global climate change, urban ecology, urban green spaces.*

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### 1. Introduction

The world is becoming an increasingly urban place. About 65 % of the world's population is expected to live in urban areas by the year 2025 [1]. Due to the rapid pace of urbanization, natural ecosystems are increasingly replaced by cities [2]. Urbanization promotes rapid social and economic development, but at the same time, leads to many problems, such as concentration of the population, traffic jams, housing shortages, resource shortages, biodiversity reductions, "heat island" effects, noise, and air and water pollution [3,4].

In this century, the most important subject is climate and climate changes problems and the precautions of depend on this condition in the near future. Each sector evaluates to climate change in their view on and it has been trying to predict the future. In addition to this prediction, it has been trying to develop new strategies for future.

In this paper global climate change, urban ecology, urban green spaces and the importance of these areas of the city for global climate change, climate and explained the positive contributions, given some suggestions.

### 2. Global Climate Change

All text must be in a two-column format. The total allowable width of the text area is 17.1 cm wide by 24.4 cm high. Columns are 8.1 wide, with a 0.9 cm space between them. The main text is in 9-point Times New Roman. Do not use double-spacing. All paragraphs should be indented and fully justified in the column. Please do not place any additional blank lines between paragraphs. Global climate change, climate elements such as the last 20 years has changed within a short time ecological process. Potential effects of this process, everywhere in the world has not yet been fully configured by the computer model is based on the initial data through is not difficult to see approaching danger [5]. Climate change, the United Nations Framework Climate Change Convention that are defined as: "a comparable time period observed in natural climate change, in addition to, directly or indirectly, the composition of global atmosphere and disrupts human activities as a result of climate change [6].

When the CO<sub>2</sub> cycle of the earth in last 400,000 years studied, it will be seen that CO<sub>2</sub> gas amount in the atmosphere peaks in every 80,000th or 100,000th year and then decreases again. In

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the same way, the air temperature increases and decreases in parallel to CO<sub>2</sub> gas amount. In the last 400,000 years the maximum amount of the CO<sub>2</sub> was 320 ppm and the maximum air temperature at that time was 18.5°C. The current relationship between the CO<sub>2</sub> and air temperature is somewhat different than it was in the past. The CO<sub>2</sub> amount in the atmosphere is about 385 ppm but average air temperature is 14.5 °C today [7].

It's commonly agreed by all circles that human activities cause some changes in climate. In the last report prepared by The Intergovernmental Panel on Climate Change (IPCC) it has been cited that in the ratio of %90 of the reason of the global climate change is human activities. Basically, as a result of various human activities such as combustion of fossil fuels, industrial processes, land-use changes and deforestation, etc., atmospheric concentrations of main greenhouse gases have been significantly increasing since the industrial revolution, and natural greenhouse effect has been strengthening. The most significant and clearest impact of increased greenhouse effect is to cause an additional positive radioactive forcing over energy balance of the Earth and thus to warm the Earth's climate. Observed increase in globally averaged annual mean surface temperatures is about 0.74 °C for the period 1906-2005. Increased atmospheric concentrations of greenhouse gases are projected to cause regional and global changes in the variables, such as temperature, precipitation, humidity and wind. The most developed climate models estimate that the global average surface warming is likely to be in the range 2 to 4.5 °C with a best estimate of about 3 °C for the period 1990-2100 [8].

**2.1. Urban Ecology**

Urban ecology is the subfield of ecology which deals with the interaction of plants, animals and humans with each other and with their environment in urban or urbanizing settings. Analysis of urban settings in the context of ecosystem ecology (looking at the cycling of matter and the flow of energy through the ecosystem) may ultimately help us to design healthier, better managed communities. Urban ecology also involves the study of the effects of urban development patterns on ecological conditions. Emphasis may be placed on planning

communities via design and building materials in order to promote a healthy and biodiverse urban ecosystem.

In general, urban climate compared to the exposed countryside experiences higher temperature, weak winds and an amount of sunshine that varies according to the degree of pollution. Average change of climatic parameters in built-up areas is follow:

- Air pollution: Gaseous pollution 5-25 times more
- Solar radiation: Global solar radiation 15-20% less, Ultraviolet radiation 15-20% less,
- Duration of bright sunshine 5-15% less
- Air temperature: Annual mean average 0.5-1.5°C higher, on clear days 2-6°C higher
- Wind speed: Annual mean average 15-20% less, Calm days 5-20% more
- Relative humidity: Winter 2% less, Summer 8-10% less
- Clouds: Overcast 5-10% more
- Precipitation: total rainfall 5-10% more [9].

Such as reduction of green areas in cities and evaporation surface; increasing concrete and asphalt coated surfaces, structural areas increased changing meteorological parameters, the local and regional scale climate change is causing to be came large cities as their unique climate and the places. These climatic differentiations in urban areas are described as "urban heat island".

In contemporary metropolitan cities, as a result of lessening green areas and evaporation surfaces, increasing asphalted surfaces and built areas meteorological parameters change and cause local and regional climate changes which makes the cities unhealthy places that have their own climatic properties. This differentiation between urban areas and surrounding semi-rural and rural areas is as 'urban heat island' determined.

Almost every city in the world today is usually between 1 to 4 °C (2 to 8 °F) hotter than its surrounding area; this clearly shows that cities function as "heat islands" [10]. Urban heat islands are isolated pockets of increased temperatures located over cities and urban areas (Figure 1), and they have been intensifying throughout this century [11].

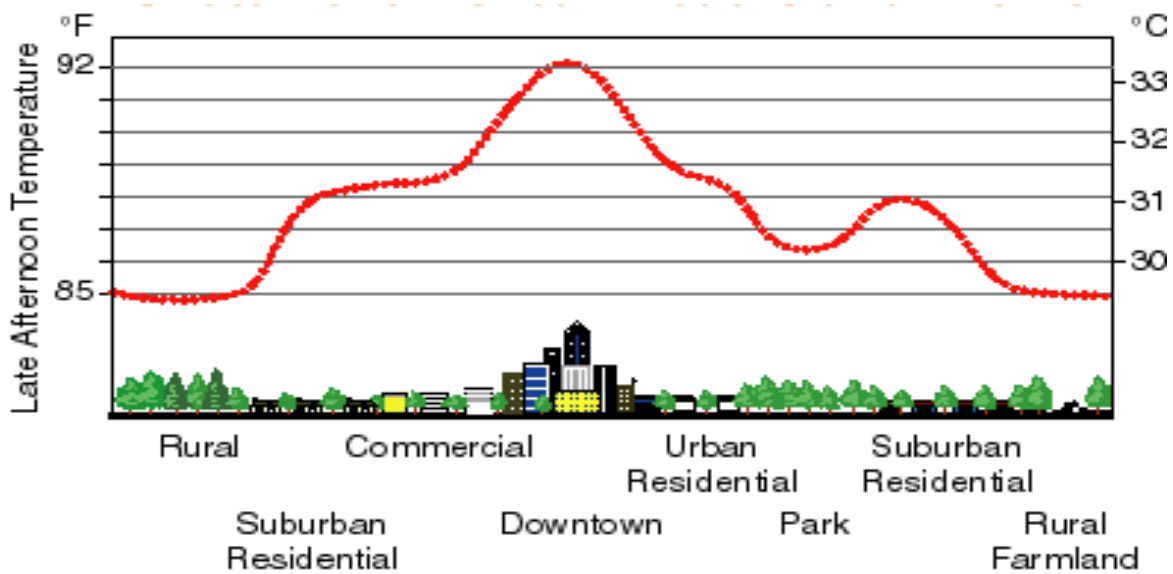


Fig.1. Sketch of an Urban Heat Island Profile [12]

The causes of this phenomenon are:

- The urban heat island effect in summary results from heat absorption by building roofs and walls, as well as by pavement and from a substantial lack of vegetation. Buildings and pavement absorb the solar radiation instead of reflecting it, causing the temperature of the surfaces and their environment to rise. Due to the surface temperature of urban structures become 10 to 20 °C (50 to 70 °F) higher than the ambient air temperatures [13].
- There are fewer trees, shrubs, and other plants to shade buildings, intercept solar radiation, and cool the air by "evapotranspiration"
- The effect of the urban heat island is that the annual mean temperature of cities is several degrees warmer than their surrounding area – in some small open spaces up to 10°C. During the day, wide streets, squares and non-planted areas are the hottest parts of a town. At night, the narrow streets have higher temperatures than the rest of the city. [14] summarized as follows;
- The number of hot days per year increases.
- The urban heat has negative effects on the wellbeing of people. During hot months a heat island creates considerable discomfort and stress. Extreme heat is held responsible for more deaths than violent weather events such as tornadoes, blizzards, or floods. E.g., in an extreme case, Chicago in 1995, the indoor heat killed 700 elderly people.
- The additional temperature always has the damaging consequences of increasing demand for electricity (e.g. increasing air conditioning loads) and therefore economic costs.
- Increased electricity generation by power plants leads to higher emissions of sulfur dioxide, carbon monoxide, nitrous oxides, and suspended particulates, as well as carbon dioxide, a greenhouse gas known to contribute to global warming and climate change.
- Finally, summer heat islands often accelerate the formation of harmful smog, as ozone precursors such as nitrous oxides (NO<sub>x</sub>) and volatile organic compounds (VOCs) combine photo chemically to produce ground level ozone. Research shows that for every degree of increased heat, electricity generation rises by 2% to 4 %, and smog production increases by 4% to 10%.

## 2.2. Important of Urban Green Spaces

Urban green spaces play a key role in improving the environmental quality, liveability, and sustainability of our towns and cities. They provide a range of benefits at both the national and the local levels and offer many useful opportunities to people in different ways. They also provide many contributions to social and economic life, and to the local ecological and planning systems, and as a whole, to the urban quality of life. They contribute positively to some of the key agendas in urban areas including social inclusion, health, sustainability, and urban renewal. Many previous studies have highlighted the contributions of urban green spaces from several perspectives including social, economic, ecological, or planning dimensions [14].

A research project, is Benefits of Urban Green Space Period (BUGS), been completed between March 2001 - February 2004. The project supported by the Fifth Framework Programme and contributing to the implementation of the Key Action "City of Tomorrow and Cultural Heritage" within the Energy, Environment and Sustainable Development [16]. Benefits of Urban Green Space (BUGS) is an EU research project aiming at developing a methodology to assess the impact of green space and settlement patterns on urban environmental quality and social well-being and to formulate recommendations regarding the use of green space as a design tool in urban planning strategies.

Another project, Development of Urban Greenspaces to Improve the Quality of Life in Cities and Urban Regions (URGE), supported by the European Commission between 2001-2004. The aim of the URGE project is to improve the provision of cities with green spaces, both qualitatively and quantitatively, thus enhancing the quality of life of the urban population and contributing to the sustainable development of European cities. The project includes the elaboration and testing of an interdisciplinary catalogue of methods and measures, based on experience from various European cities. This catalogue is comprised of criteria with which to evaluate ecological, sociological, economical and planning issues [17]. Assessments criteria of urban green spaces are grouped under four headings are social, planning, economic, ecological criteria in the project.

## 2.3. Important Urban Green Spaces Toward to Global Warming Threat

Urban green spaces contribute to the maintenance of a healthy urban environment by providing clean air, water, and soil; maintain the balance of the city's natural urban environment and a certain degree of humidity in the atmosphere; regulate rainfall; moderate temperature; curb soil erosion [18, 19].

Most of concentrated of greenhouse gasses are be seen in urban areas and their environment. And also urban areas are life spaces more threaten than rural areas. Therefore action plan should be applied for solution of these problems urgently. In nowadays, urban green spaces rehabilitation as concept, first approach to consider in C sequestration or decrease of CO<sub>2</sub> emission and rehabilitation of urban ecosystem.

Importance of urban green spaces toward to global warming threat can be analyzed in two groups;

### 2.3. 1. Impacts on Urban Climate

The positive climate on the city green field's contributions can be explained as follows:

- Coolness and Temperature Effect: Plants balanced the temperature in the urban environment through the air to control of the sun's rays. They provide temperature falls during the summer the, the rise in winter temperatures below is 5-8 ° C higher than average at open space in urban environment at night compared to tree [20]. The vegetation cover reduced 17 ° C of hard-surface temperature [21]. In addition, plants reduce heat loss by changing the direction the flow of wind and snow-type by preventing air or and save fuel consumption by up to 8-12%. Their shades create the sensation of coolness within the building in summer [22]. Green areas at surrounding the building reduce the need for heating and

air conditions. Thus, it will reduce electricity usage and fuel consumption for heating and reduce CO<sub>2</sub> emissions

- The Effect on Relative Air Humidity: Vegetation decrease water loss keeping the sun rays, wind speed to cut through the soil and reducing evaporation, and give water their transpiration and environment. For example, a tree 21 m tall leafy shade type reveals about 400 lt of water a day [23].
- Effect on Wind: Wind direction, speed and the cutting or increasing regulation of urban air movement can be provided with suitable planting. Appropriate 20 km per hour wind speed was reduce to 5 km / hour, with twice as long as plant height distance by planting around the building [24].
- Radiation on Effect: Tree leaves prevent human skin reducing very harmful to causing human cancer absorbing 96% of ultraviolet rays to prevent the harmful effects [25].

### 2.3. 2. Impacts on Air Quality

Plants produce nutrient using water, sunlight and with the soil elements and atmosphere as CO<sub>2</sub>. The effects of plants on air quality can be classified under two groups.

CO<sub>2</sub> and O<sub>2</sub> balance: it is very important for living things makes the O<sub>2</sub> gas absorbing atmospheric CO<sub>2</sub> and other gases. It is vital for the world ecosystem under control keeping the balance of carbon dioxide and oxygen arising from fossil fuels [26].

Dust filtration: Plants filter harmful contaminants for humans and other living organisms (dust, ash, pollen, smoke, etc.) to increase the air quality [27].

McPherson [28] reported that, approximately 304000 tons of atmospheric carbon dioxide, 12000 tons of ozone and 9000 tons particulate matter has emerged holding by 6000000 trees. The measurements in different regions of Frankfurt obtained from showed that the dust grains were measured in the unit in litter of air was 18370 in the city centre, 17640 unit in Frankfurt station, 11490 treeless street, 3830 in the street with trees, 1140 in park [29].

According to a study [30], the trees leaves shed 30% of dust in the atmosphere (rural) and 27% (urban), trees needle-leaf reduce the rate has emerged the dust in the atmosphere by 42% (rural) and 38% (urban).

In a survey study done in Beijing city, China showed that trees in the city centre absorbed 1261.4 tons of airborne pollutants, and 0.2 million tons of CO<sub>2</sub> [31].

Produced oxygen amount form leaves is followed 1.76 g/dm<sup>2</sup>/h Fagus sp.; 2.53 g/dm<sup>2</sup>/h, Betula sp.; 1.53 g/dm<sup>2</sup>/h Quercus sp.; 1.70 g/dm<sup>2</sup>/h, Larix sp.; 1.20 g/dm<sup>2</sup>/h, Pinus sp.; 1.15 g/dm<sup>2</sup>/h, Picea sp.; 1.12 g/dm<sup>2</sup>/h, Pseudotsuga sp. [32].

### 3. Conclusion

The first action strategy is in the struggle against global warming recognized for reducing CO<sub>2</sub> emissions emerging as the most important greenhouse gas. Fossil fuels and cement production are shown two main sources of CO<sub>2</sub> emissions released into the atmosphere. For this purpose, the maximum release of greenhouse gases (about 70-80% produced) should

be established urgently action programs in urban areas and around.

World scale and the possible negative consequences of global warming and ways of preventing or reducing the urban scale and the necessary measures can be applied to implementing possible solutions. Increase of the green areas the quality and quantity as the most important basic component of nature should be the basic goal in urban areas for resulting heat island effects to reduce of CO<sub>2</sub> production and current CO<sub>2</sub> emission.

The importance of urban green spaces in our communities is taking on greater significance as we learn more about their potential to improve quality of life. Environmental concern about global warming, urban heat islands, and air pollution has brought attention to the potential of green spaces to ameliorate climate and conserve energy.

For this purpose, it must be sensitive and conscious for establishment of urban green space, planning and management.

Implementation maintenance and design of urban green areas are in the responsibility of municipalities.

The design of green space and control must be absolutely done by expert people.

Application of green space and planting works needs to be done by experts and educated people within the programs.

Maintenance and repair works for sustainability of green space must be fulfilled scrupulously. These areas inventories should be maintenance and repair work management plan should be prepared by local governments.

Local governments and the media have an important role to increase plant affection and interest of people. Exhibitions of the people should be informed about. People must be conscious for the importance of plants, care and protection with the seminars, books, brochures, radio and TV programs etc.

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