

Effects of local trees on the environmental climate of urban outdoor spaces in arid and semi-arid regions

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Abstract – The purpose of this study is to assess actual and potential environmental aspects related to the impact of local tree areas on local climate control and to assess external thermal comfort. This has allowed us to assess its sustainability in the light of achievable environmental benefits. Sustainability can be defined as the property of a material or product that indicates how well it meets current requirements for a particular application. These demands affect the well-being and health of city dwellers. We approach this study with an ecological approach, focusing on the effects of native trees (palms and olive trees) and exotic trees (*Ficus letesa*). Adjust the microclimate of the city. The study highlights the positive effects of plants on urban outdoor spaces in the city of Biskra during July and August, the hottest months of the year when temperatures can reach values above 50 degrees Celsius. I made it A green strategy is an essential element in improving the external local climate, especially in dry climates. The main criteria we relied on in this study included vegetation density, tree placement and orientation, and country albedo. Based on these three criteria, we have achieved very important results in terms of improving and adjusting the urban microclimate.

- Selection of the components of the regional urban forest model that have the greatest impact on regional climate and cooling effects. In addition to these factors, the impact of urban forests on local climate also emphasizes permeability, tree abundance, sky visibility, leaf area index, and distance between trees. -Urban green spaces, especially olive and palm trees, have a positive impact on the outdoor microclimate, reduce the urban heat island effect in the summer in the shade of tall trees and shrubs, attenuate solar radiation, Being able to block the flow of heat from the sky, thereby increasing the comfort of the microclimate and change. In addition, evaporation and transpiration from plants reduce temperature and increase humidity.

Keywords – Urban Outdoor Space, Microclimate, Plant Cover, Outdoor Thermal Comfort, Dry Climate

I. INTRODUCTION

Over the past few decades, several studies have shown that urban greenery, especially trees, can positively impact outdoor microclimates“Ref. [1]” and mitigate the effects of urban summer heat islands. The shadows of tall trees and shrubs dampen the sun's rays and impede the flow of heat from the ground to the sky at night, altering local climates and comfort levels. Evaporation and transpiration of plants lowers the temperature and

increases the water content. Trees reduce wind speed and reduce heat convection. “Ref. [2]” Furthermore, little is known about the effects of climate on tree mediation. The purpose of this study is to improve our understanding of the role of trees in the microclimate. We continuously measured the temperature and humidity in the city of Biskra in the summer. In most cities in southern Algeria, the temperature in the center is higher than in the suburbs. “Ref. [3]” One of the main causes of rising

temperatures and changing behavior in southern cities is the lack of urban green space development. These impacts have undesirable consequences such as reduced thermal comfort and increased health risks for urban dwellers. We noticed spatial differences in temperature and humidity due to the distribution of trees in this area“Ref. [4]”and “Ref. [5]”. Furthermore, by classifying the actual weather conditions during the observation period, we can determine the cooling effect of trees under different weather conditions“Ref. [6]”.

A. Goals and methodology

The purpose of this study is to assess actual and potential environmental aspects related to the impact of green space on microclimate regulation and outdoor thermal comfort ratings. This allows us to assess sustainability based on achievable environmental benefits. Durability can be defined as a property of a material or product that indicates how well existing requirements are met in a particular application. These requirements affect the well-being and health of city dwellers. We approach this study from an ecological approach, focusing on the impact of local trees (palm trees, olive trees) and exotic trees (city tree *Ficus letesa*) on urban microclimate control. I worked on it. This case study highlights the positive impact the plant has on the urban space of Biskra in the hottest months of the year, July and August, when temperatures in the city can exceed 50 degrees Did.A green strategy is one of the key factors for improving the external microclimate, especially in dry climates. Canopy density, tree position and orientation, and ground albedo. Based on these three parameters, very important results were obtained in terms of optimizing and tuning the urban microclimate.

II. MATERIALS AND METHOD

A. Case study

The background of the research is the city of Biskra, located in the sub-Saharan region, 450 km from Wilaya in Algiers. It is 88 meters above sea level. The city is characterized by a hot and dry Saharan climate. Day and night temperatures vary greatly. summer and winter. The study was conducted in a public garden (Jennan Bayrek) and a district street (Darnooni) in the city of Biskra, Algeria.

B. instrument used

"Testo 480", thermal imager "Testo 875", and "infrared thermometer" were used for the measurement.



Fig. 1 Measurement devices used for the monitoring

III. MEASUREMENT OF ENVIRONMENTAL PARAMETERS AND DISCUSSION OF RESULTS

Microclimate and instantaneous scales were employed to analyze the extent of local effects on individual trees due to attenuation of temperature, ambient temperature, relative humidity, infrared radiation and wind speed. Species selection was based on a search for independently isolated adult plant species with different crown sizes and shapes and plant height classes. All trees were physically described by measuring height, crown diameter, branch length, crown length, and crown width.

- Data were recorded every 30 minutes from 7:00 to 19:00 for 12 hours at different distances (stem, 5 m, 10 m) and outdoors, 1 m above the ground, from each of the selected plant species. rice field.
- Stem discomfort index was not significantly different between 5 m and 10 m, but there were specific differences between different plant species.
 - Characteristics of the tree species analyzed, such as crown structure and density, leaf size, shape and color, a geand growth
 - Canopy temperature is an indicator of the energy balance between the leaf interior and the environment. Some of the solar radiation that leaves absorb is used for biochemical reactions such as photosynthesis, but most of it is converted into heat energy by the leaves.
 - Canopy temperature is primarily determined by ambient temperature, but is also controlled by leaf physical properties and transpiration rate. When

plants are exposed to thermal conditions, reflection and movement reduce the amount of radiation, and excess heat is released through radiative emission, convective heat.

Trees and palm trees are always used in the design of outdoor spaces in hot climates because of their dense foliage and green color, which cover large areas of the ground. During the hottest months, vegetation increases the cooling effect and lowers the average surface temperature. The cooling effect near green spaces during hot periods varies with vegetation density and type, leading to a temperature drop of 5°C to 10°C during the hottest part of the day. 2 pm We can infer that:



Fig. 2 Treatments of different plants

In the summer of 2022, the trees (Urban Ficus Retesa) degraded and died from the heat, while the palm and olive trees withstood the heat see Fig. 2 .

Example

Calculation of heat transfer by conductivity

$$\Phi_{1-2} = \lambda S (T_1 - T_2) / e = (T_1 - T_2) / R_{th} \quad (1)$$

We will replace T_1 by

$$T_1 = (T_{a.out.} - \Delta T) \quad (4)$$

$T_{a.out.}$: Average outside temperature.

Calculation of heat transfer by conductivity “Ref. [7]”

It can be seen that the operating temperature decreases as the vegetation density changes.

recommendation

To be able to use plant species for the heat transfer laws, we need to calculate various constants ΔT and create a table of plant species “Ref. [7]”.

IV. CONCLUSION

The results of this study show that green spaces have a positive impact on reducing outdoor ambient temperatures. It can greatly improve the thermal environment.

-In urban green spaces, different types of plants have different abilities to improve thermal comfort, reduce temperature, and control relative humidity to improve people's quality of life. The tree species selected are important factors that contribute to thermal comfort by attenuating radiation and regulating wind speed. The microclimate of a tree depends on tree anatomy (leaf mass, size, shape, angle, reflection), physiological (incoming energy, temperature, wind) and physiological (transpiration).

- Native trees and palms with long canopies tend to provide more shade and thermal comfort than urban ornamental tree species.

- The diverse influence of plant species on the urban microclimate can be effectively exploited to improve thermal comfort in urban green spaces in arid and semi-arid regions. Investigating tree temperature regulation strategies in a variety of local plant species will enhance our understanding of the design and organization of outdoor spaces and of plant adaptations to different ecological functions.

Results show that broad and dense tree structures can improve plant cooling capacity by increasing

transpiration capacity and synergistic physical properties. Because planting trees is a viable and cheap solution. Species used for urban cultivation

(1) must be carefully selected to have dense foliage and to block as much solar radiation as possible.

- When designing outdoor spaces, as mentioned above, do not rely on imported ornamental trees that are unsuitable for the environment, as they will die quickly in the heat of summer.

- -Selection of components of regional urban forest patterns that have the greatest impact on regional climate and cooling effects. In addition to these factors, permeability, tree cover, sky visibility, leaf area index, and distance between trees can also be emphasized for the impact of urban forests on local climate.

-Urban green spaces, especially olive and palm trees, have a positive impact on the outdoor microclimate and reduce the urban heat island effect in summer. The shade of tall trees and shrubs moderates solar radiation and impedes heat flow from urban soils. Adjusts the sky to reduce microclimate and comfort changes. Additionally, evaporation and transpiration from plants lowers temperatures and increases humidity levels.

- Green space is related to the environmental conditions, the design quality of the city's outdoor spaces and their organization. There is a close relationship between microclimate conditions and types of open space use

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