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IMPACT OF GREEN SPACES ON URBAN MICROCLIMATE IN RESIDENTIAL AREAS CASE STUDY BEN BADIS SQUARE - BISKRA 720 RESIDENCE

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DEDICATION

In the name of Allah, the Merciful the Great, I dedicate the fruit of my efforts and work to my family and many friends. A special feeling of gratitude to my loving parents, Fadel and Mariam Thamer whose words of encouragement and push for tenacity ring in my ears. My sisters Manar, Sarah, and brother Mondher they have never left my side and are very special. I also dedicate this dissertation to my many friends and family who have supported me throughout the process. I will always appreciate all they have done.

I would like to say thanks to my friends and research colleagues, Slimane Bouabid and others , for their constant encouragement. I express my special thanks. I am extending my thanks to all of my professors for Being an inspiration and an amazing humans and for all their kindness and Encouragement through my years of university.

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I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future. I am very much thankful. My Special thanks go to my friends.

ABSTRACT

The Impact of the urban green spaces in improving the thermal comfort of a residential area through the plantation in a southern Saharan city "Case of the city of Biskra / Algeria Ben Badis square" The open public spaces are for the population meeting, communication, conviviality. So, for these spaces to play their role they must be ruled by a comfortable green physical environment. The optimal use of these spaces deserves detailed knowledge of all the green elements that can improve the climatic conditions of the use of these spaces. The purpose of this research is to study and analyse the role played by vegetation (urban vegetal) in urban external spaces since it is a fundamental component in this latter of which it minimizes and intercepts the solar rays, a very important factor of thermal comfort outside it reduces air temperatures generates shade; absorbs radiated fluxes and in general,

The Saharan population (hot climate and arid zone) seeks shelter from solar rays by all means, especially during the hot summer days. most of people are affected by thermal stress and hot climate, given the lack of green, and shade. This leads them to abandon their public places. and by the insertion of urban vegetation (by simulation) as a mask against solar rays. The results confirm the vital role of urban vegetal in the creation of shade, which has improved the thermal comfort of public places. And adjust the microclimate to suit the quality of urban life. in this research to study the public place of Ben Badis in the city of Biskra / Algeria, (dry climate and arid zone). The technique followed in this work is a combination of measures of the necessary climatic factors and simulation using the software Ray-man then proposing an optimal intervention to make this space a much thermally comfortable place. **Keywords:** urban; green; vegetal; thermal comfort; Ray-Man; Saharan city; public place; open space; heat islands microclimate; simulation.

ملخص

تأثر المساحات الخضراء الحضرية في تحسين الراحة الحرارية لمنطقة سكنية من خلال التشجير في مدينة جنوبية صحراوية "حالة مدينة بسكرة / ساحة بن باديس" تعتبر المساحات العامة و الخضراء المفتوحة مكانا للتجمع السكاني ، والتواصل ، والعيش المشترك. لذلك لكي تلعب هذه المساحات دورها ، يجب أن تحكمها بيئة مادية خضراء مريحة. و يستحق الاستخدام الأمثل لهذه المساحات معرفة مفصلة بجميع العناصر الخضراء التي يمكن أن تحسن الظروف المناخية لاستخدام هذه الغرض من هذا البحث هو دراسة وتحليل الدور الذي يلعبه الغطاء النباتي (نباتي حضري) في المساحات الخارجية الحضرية لأنه مكون أساسي في هذا الأخير حيث يقوم بتقليل الأشعة الشمسية واعتراضها ، وهو عامل مهم جدًا للراحة في الخارج يقلل من درجات حرارة الهواء يولد الظل ؛ وبشكل عام يمتص التدفقات المشعة ،

يبحث سكان المدن الصحراوية (المناخ الحار والمنطقة القاحلة) عن مأوى من أشعة الشمس بكل الوسائل اثناء ممارستهم للانشطتهم اليومية وخاصة في أيام الصيف الحارة. يتاثر معظم الناس بالإجهاد الحراري والمناخ الحار ، نظرا لقلة اللون الأخضر والظل. هذا يقودهم إلى هجر الاماكن العامة. وعن طريق إدخال الغطاء النباتي الحضري (عن طريق المحاكاة) كقناع ضد أشعة الشمس. تؤكد النتائج الدور الحيوي للنباتات الحضرية في خلق الظل ، مما أدى إلى تحسين الراحة الحرارية في الأماكن العامة. وضبط المناخ المحلي ليتناسب مع نوعية الحياة الحضرية. في هذا البحث لدراسة الساحة العامة بن باديس في مدينة بسكرة / الجزائر . التقنية المتبعة في هذا العمل هي مزيج من مقاييس العوامل المناخية الضرورية والمحاكاة باستخدام برنامج (Ray-man) ثم اقتراح التدخل الأمثل لجعل هذه المساحة مكانًا مريحًا.

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GENERAL INTRODUCTION

The process of global urbanization accelerates population growth in cities, causing changes in the urban microclimate, and ultimately affects people's daily lives. Although thermal comfort and urban warming are constantly improved by urban green spaces. the underlying mechanisms and quantitative effects on the microclimate and human perceptions are still poorly understood. In this study, we summarized the benefits and effects that possibly influence the performance of microclimate to regulate by urban green spaces, which are vegetation characteristics (quality and quantity, plant) vertical (distribution of vegetation), and weather conditions. these factors affect the vegetation's performance on microclimate regulation.

Generally, Vegetation cover has a positive impact on regulating the urban microclimate and mitigating the Urban Heat Island (UHI). it can lower the outdoor temperatures. It is assumed that a tree has a projection area of shading and a reduction of sky view factor, in the air surrounding a tree always has high humidity due to tree irrigations system. The surrounding open spaces between trees are well protected from solar radiation and the surrounding air is usually saturated with humidity, which can impact directly the outdoor temperature. This paper studies the impact of the urban trees on microclimate in dry arid and semi-arid zones, and Biskra is considered a city of the south and this study aims to contribute to the creation and scientific planning and management of urban green spaces in dry hot areas through the intervention on a public space.

1. Statement of the problem

Urban green spaces provide cities with ecosystem benefits ranging from maintenance of biodiversity to the regulation of urban climate. Humanity is increasingly urban but continues to depend on nature for its survival, therefore cities are dependent and benefit from internal urban ecosystems. But in our current reality, the urban environment has become chaotic and not suitable to the requirements of the population, it Needs a new methodology to deal with urban green spaces and view them as a necessary unit, not as an accessory, to provide a better life for the residents of the city.

The city of Biskra, like the rest of southern Algerian cities, is also suffering from the deterioration, harsh hot and dry climate and the lack of green spaces and its poor management and preservation, especially in public spaces in residential neighbourhoods, so we will shed light in our study on one of the public spaces that have an important location in the city but lacks a proper green cover (Ben Badis square), also known as the 720 square, to remedy the existing deficiency on its green cover.

By answering the following question: What is the Impact that green spaces can do regarding the quality of living for people or on the environment and the microclimate for these urban residential areas.

2. Aim of the study

The study aims to show the fact of not having enough green spaces in the region, and prove what that can do to the microclimate of urban areas and the study is in a major city in the southern area of Algeria “Biskra”, there is a negligence of the environment in the structural urban schemes in Biskra. Through the study, the absence of green spaces was identified and surveyed,

and the environmental aspect of reason for the marginalization in the region. The importance of the study is that it is being examined in an area that has not taken its right to previous studies, like most areas in Biskra. To address some of the issues that concern for the place, the green spaces are the right of all members of society to reach and access them and enjoy the comfort it provides. Some approaches have been used to achieve the objectives of the study, to study the variability of green spaces through the structural schemes that available for the study area, and the delineation of its green spaces in it, and knowing how far the inhabitants have experienced comfort in these areas.

3. Research questions

Main question

- How can urban green spaces impact the urban microclimate in residential areas?

Secondary question

- What are the benefits the presence of green spaces in cities have in relation with urban microclimate?

4. Research hypotheses

-Vegetation can help to reduce the urban heat island effect that most cities suffer from.

-Green spaces help to ease the issue of heat also by providing a building free space in which air currents can circulate and consequently alleviate the heat in this area.

-These green spaces, along with the vegetation that usually accompanies them, can help improve the thermal comfort in the city.

- The presence of this vegetation can also improve air quality.

5. Significance of the study

The importance of the study lays in highlighting its competence to determine the green areas and explain its importance and its great impact on the urban environment and in particular residential areas. It is considered to be of new content, especially for the study area, thus adding valuable information for the urban planning community. The Green Field Survey.

The study talks about the reality of green spaces in the study area. And highlights the importance of providing and preserving the environment and natural resources as a result of the increasing population and an increase in population, Urban sprawl, ensuring sustainable development that meets the needs and requirements of the present without affecting the next generations.

it has a role in assessing the environmental importance within the planning stage, by showing the importance of green spaces in structural plans and the necessity of including them within an integrated planning system.

The study provides a database, which makes it an important reference for subsequent studies on other aspects not covered in this study in future research.

The findings and recommendations of the study have an important role in determining the importance of the green spaces and its necessity preservation, and how to increase green areas in the study area city.

6. Research methodology

The research study will be based on the qualitative design as an approach to gathering and analyses data. As far as I am concerned, the topic of my present research is considered to be a fresh subject matter. Therefore, data in this work are intended to be collected from different sources. I intend to use structured Data gathering methods to seek information and semi-structured interviews for gathering teachers' opinions. Then run or study a simulation to farther prove my point. Finally, the results will be stated after analysing the collected information. And a design proposition will be included.

7. Structure of the dissertation

The research is divided into three main chapters. Both of the first and second chapters are devoted to the literature review and the third chapter is concerned with the fieldwork the case study project. This dissertation starts with a general introduction that deals with the statement of the problem and the aim of the study. It includes also the research questions, hypotheses, and the significance of the study.

The first chapter provides an informative background of green spaces and urban microclimate and highlights different perspectives and aspects of these concepts.

The second part of the research deals with the real impact that the green spaces left on urban areas. In this chapter we dive into the effects of green spaces on urban microclimate, I provide simulations and scientific information and previous studies regarding this subject.

The last chapter is devoted to the analysis of data gathered from the research tools. It contains a detailed description and analysis of the city climate and the area “field of study”. In this chapter, I answered the research questions and checked the results, and provide the proposed management and plan for the project plus a 3D concept design, and in the end, I put forward some practical recommendations.

8. Research Limitation

• It is predicted that it may be difficult to get accurate data from the part of learners and teachers when they are given the questionnaire.

• Limitation of time. And resources.

• the absent of any previous local studies and master thesis about the research subject specially in English.

• This research is limited to the students of master at Biskra University with no outside help.

• This research investigates the most difficult skills which are writing and reading.

Chapter I: Overview and concepts on urban green spaces and the microclimate

Introduction :

Urban green spaces, vegetation, is such a vast subject and difficult to encompass in a single approach, given the interference of green spaces with multiple dimensions of the city in general and the urban space in particular the (social, aesthetic, technical, landscape… etc). this chapter In addition to identifying green spaces, the role, utility, and function of urban vegetation. Green spaces in the city deserves analysis and deep knowledge of it and of all its types, forms, so that it can be used correctly and adequately. This chapter also deals with the urban microclimate, residential areas. Passing through the "exterior comfort" term to the thermal comfort while looking for the parameters which affect it. Urban green spaces are ecosystems of vital importance in enhancing the quality of life and comfort in an urban environment.

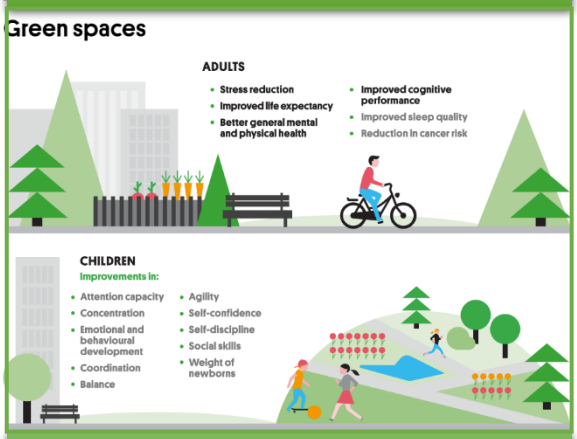
1 -Definition of urban green spaces

In this brief urban green space is defined as all urban land covered by vegetation of any kind. This covers vegetation on private and public grounds, irrespective of size and function, and can also include small water bodies such as ponds, lakes or streams (“blue spaces”). (World health organization. (2017))

1-1- Green space in a city

Green spaces such as parks and sports fields as well as woods and natural meadows, wetlands or other ecosystems, represent a fundamental component of any urban ecosystem. Green urban areas facilitate physical activity and relaxation, and form a refuge from noise. Trees produce oxygen, and help filter out harmful air pollution, including airborne particulate matter. Water spots, from lakes to rivers and fountains, moderate temperatures.

Figure 01- Green spaces



(source : www.isglobal.org)

Urban parks and gardens play a critical role in cooling cities, and also provide safe routes for walking and cycling for transport purposes as well as sites for physical activity, social interaction and for recreation. Recent estimates show that physical inactivity, linked to poor walkability and lack of access to recreational areas, accounts for 3.3% of global deaths.

Green spaces also are important to mental health. Having access to green spaces can reduce health inequalities, improve well-being, and aid in treatment of mental illness. Some analysis suggests that physical activity in a natural environment can help remedy mild depression and reduce physiological stress indicators. (Lisa Templeton (2019))

1-2- Open Space/Green Space

Open space is any open piece of land that is undeveloped (has no buildings or other built structures) and is accessible to the public. Open space can include:

- Green space (land that is partly or completely covered with grass, trees, shrubs, or other vegetation). Green space includes parks, community gardens, and cemeteries.
- Schoolyards
- Playgrounds
- Public seating areas
- Public plazas
- Vacant lots

Figure 02- Open space Green spaces

(source : naturesacred.org)

Open space provides recreational areas for residents and helps to enhance the beauty and environmental quality of neighborhoods. But with this broad range of recreational sites comes an equally broad range of environmental issues. Just as in any other land uses, the way parks are managed can have good or bad environmental impacts, from pesticide runoff, siltation from overused hiking and logging trails, and destruction of habitat.

Lack of community and public access to safe open and green space is a critical area of concern for urban residents in New England. (Grants & Projects. (2006))

1-3- Urban green

Urban greening, or green infrastructure, refers to all forms of vegetation such as street trees, open parks and gardens, shrubs, green walls, green roofs, lawn and pervious soils. NAGA's Adaptation in the North strategy has identified the importance of urban greening to reduce the impacts of climate change, particularly the combined impacts of the urban heat island effect and increasing temperatures. Research also shows that establishing greener infrastructure, including enhancing tree canopy throughout the north could lead to many co-benefits such as:

- Interception of stormwater runoff and improved water management
- Lower cooling demand for electricity
- Carbon sequestration
- Wildlife habitat
- Increased property value
- Improved amenity
- Improved health and wellbeing
- Reduced asset damage
- Improved air quality (NAGA Northern alliances (2020))

1-4- Vegetation

Vegetation contributes to sun protection. It provides shade and creates a microclimate by evapotranspiration. The choice of the species is important because the quality of the shade of a tree depends on its density. Thus, the foliage of a tree can filter out 60 to 90% of the solar radiation and a carpet of vegetation also reduces the solar radiation reflected by the ground.

Vegetation is an effective tool for sun protection and radiation control. It stabilizes the air temperature by retention of water in its leaves and by evaporation of water on their surface. When water is in contact with hot unsaturated air, two phenomena occur: on the one hand, heat exchange takes place between water and air; on the other hand, evaporation lowers the temperature of the air by drawing the energy necessary for its evaporation. It prevents the night temperature from dropping rapidly and keeps the daytime temperature lower than that of the atmosphere. In the dry tropical zone, the vegetation creates a microclimate with lower temperatures and a higher degree of hygrometry. This brings the level of comfort closer. Vegetation acts on air quality. By capturing carbon by the phenomenon of photosynthesis, it transforms Co into oxygen. Vegetation prevents the warming of the soil and its evaporation. It allows the control of soil erosion, reduces surrounding noise and regulates the circulation of wind around buildings. The plantations create zones of low and high pressure favoring the flow of air through the buildings. Trees that act as sun protection should have a slender trunk so as not to slow down the flow of the wind. In a humid climate, the overabundance of vegetation on the ground often poses a problem of maintenance of the surroundings of the construction. On the other hand, on a laterite soil often bare by the rains, the vegetation grows with difficulty.(Alain Liebard, André De Herde. (2015)).

2 -Definition of A microclimate:

A microclimate is a smaller area within a general climate zone that has its own unique climate. (Wendy McDougal . (2016))

2-1- Microclimate Factors:

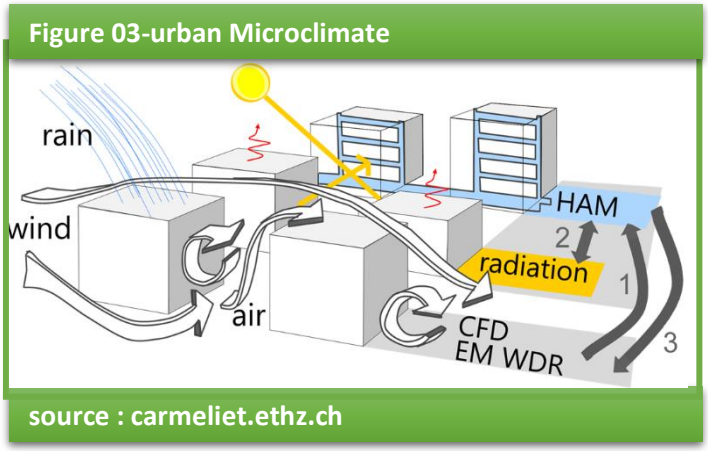


Figure 03-urban Microclimate

source : carmeliet.ethz.ch

The climate of an area or region is dependent on a multitude of factors. Some of these include geographic location, elevation, latitude, and topography. We know that cities located on the coast of the Pacific Ocean tend to have fairly temperate climates. Areas in the desert Southwest are very dry and hot, and the Midwest experiences many extremes. So with a basic knowledge of the climate in which we live, we can prepare accordingly and go about our business . (Wendy McDougal . (2016)).

2-1-1- Definition of air temperature:

Air temperature is a measure of how hot or cold the air is. It is the most commonly measured weather parameter. More specifically, temperature describes the kinetic energy, or energy of motion, of the gases that make up air. As gas molecules move more quickly, air temperature increases.

Importance of Air Temperature

Air temperature affects the growth and reproduction of plants and animals, with warmer temperatures promoting biological growth. Air temperature also affects nearly all other weather parameters. For instance, air temperature affects:

- the rate of evaporation
- relative humidity
- wind speed and direction

- precipitation patterns and types, such as whether it will rain, snow, or sleet. (Fondriest Staff, (2010)).

2-1-2- Definition of wind speed:

Wind speed describes how fast the air is moving past a certain point. This may be an averaged over a given unit of time, such as miles per hour, or an instantaneous speed, which is reported as a peak wind speed, wind gust or squall. Wind direction describes the direction on a compass from which the wind emanates, for instance, from the North or from the West.

Wind Speed and Direction Technology:

The measurement of wind speed is usually done using a cup or propeller anemometer, which is an instrument with three cups or propellers on a vertical axis. The force of the wind causes the cups or propellers to spin. The spinning rate is proportional to the wind speed Wind direction is measured by a wind vane that aligns itself with the direction of the wind. (Fondriest Staff, (2010)).

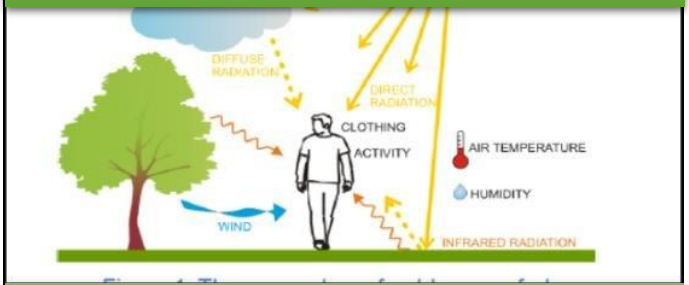
2-1-3- Relative humidity:

Relative humidity is a measure of how close the air is to reaching saturation. Saturation is the point when the air can hold no more water vapor and is essentially full. Think of it as a water balloon being filled with water. At some point the balloon can hold no more water before bursting, the same is true of air. The air reaches a point when it can hold no more water vapor and must release it, not by bursting, but as liquid water (rain, snow, sleet, hail, dew, frost, or fog). (Dominic Corsini. (2015)).

3 -Definition of The exterior thermal comfort:

In order to reduce individual vulnerability and ensure a state of satisfaction with thermal environment, ambient temperatures should be neither too low nor too high. Body temperature, around 37 ° C, is maintained thanks to the contributions of calories from food and heat exchange with the environment immediate according to these mechanisms:

Figure 04- The Parameters of outdoor thermal comfort



(source: researchgate.net)

• convection, which promotes exchanges between the skin and the ambient air, which are accentuated by air speed;

• conduction, either exchanges by direct contact with the skin and a warmer body or colder (example: walking barefoot on a cold floor);

• radiation, or exchanges between the skin and the solid elements of the environment (examples: walls, ceiling, floor and heat sources);

• sweating, which is a loss of heat by evaporating sweat, which is more effective when relative humidity is low (Salomon and Aubert, (2003)).

Thermal comfort is therefore specific to everyone and it is impossible to define a type thermal environment that meets everyone's requirements. However, it is possible to specify an acceptable temperature range for a high percentage of people. This interval would be between 20 and 27 ° C with an optimal humidity rate ranging from 35 to 60% (Fanger, P.O. (1982)).

3-1- Definition of The sky view factor (SVF):

The sky view factor (SVF) is a parameter widely used in several research fields, applied research and planning. It is of crucial importance concerning the energy budget of a certain location. Many methods for calculating the SVF have been developed. In the present study, a selection of methods and models is analyzed in order to find out about possible improvements. Also, a new method using GIS software is introduced. In the city of Szeged fisheye pictures were taken along transects and evaluated. For the images' coordinates, SVF was calculated by numerical models which use a 3D-building database as input. Also, a set of artificial fisheye pictures was created and used for validating the applied methods. The calculations were performed with the models SkyHelios (Matuschek and Matzarakis (2010)) .

3-2- Definition of Physiological Equivalent temperature (PET):

Physiological Equivalent temperature (PET) is defined as the physiological equivalent temperature at any given place (outdoors or indoors) and is equivalent to the air temperature at which, in a typical indoor setting, the heat balance of the human body (work metabolism 80 W of light activity, added to basic metabolism; heat resistance of clothing 0.9 clo) is maintained with core and skin temperatures equal to those under the conditions being assessed. (Peter Höppe. (1999)).

3-3- Definition of Predicted mean vote (PMV):

The predicted mean vote (PMV) was developed by Povl Ole Fanger at Kansas State University and the Technical University of Denmark as an empirical fit to the human sensation of thermal comfort. It was later adopted as an ISO standard. It predicts the average vote of a large group of people on the a seven-point thermal sensation scale where:

+3 = hot

+2 = warm

+1 = slightly warm

0 = neutral

-1 = slightly cool

-2 = cool

-3 = cold (www.designingbuildings.co.uk. (2020)).

3-4- Definition of Mean radiant temperature (MRT)

All bodies exchange thermal radiation with their surroundings, depending on the difference in their surface temperatures and their emissivity. This radiant exchange is an important component of the thermal comfort that will be experienced by a person, particularly in places where there may be significant differences in radiant and air temperatures, for example, near a large window.

Other factors that influence thermal comfort include: environmental factors, such as air temperature, air velocity, relative humidity and the uniformity of conditions, as well as personal factors such as clothing, metabolic heat, acclimatisation, state of health, expectations, and even access to food and drink. (www.designingbuildings.co.uk. (2020)).

4 -Definition of residential areas:

A residential area is a land use in which housing predominates, as opposed to industrial and commercial areas. Housing may vary significantly between, and through, residential areas. These include single-family housing, multi-family residential,. Zoning for residential use may permit some services or work opportunities or may totally exclude business and industry. It may permit high

density land use or only permit low density uses. Residential zoning usually includes a smaller FAR than business, commercial or industrial/manufacturing zoning. The area may be large or small. (Definitions.net .(2020)) .

4-1- Green Space Factor in residential Area:

Residential green space is not only the main outdoor activity space for residents, but also a space being most widely distributed with highest using rates in urban green system. In the living environment, no element could replace of it. Green often exists as the edges of site and landscape background or a part of sites. In residential areas, the green is everywhere, such as the green groups between buildings, the border between different functional areas, the green plaza and the green around water. Although these greens are separated, it still keeps as a whole for the space environment. It plays a positive role for regulation of the psychology and the spiritual relaxation. It could also adjust microclimate to some extent. From my point of views, green is an indispensable factor in the environment of outdoor living space. (Ye Jienan. (2009))

5 -Definition of Urban Heat Island:

As a result of the Micro-Climate in Urban areas the Term Urban Heat Island was coined. By Definition: An urban heat island (UHI) is a metropolitan area that is significantly warmer than its surrounding rural areas due to human activities. The temperature different is usually larger at night than in the day and recorded when wind is minimal.

The formation of a heat island is the result of the interaction of the following factors:

- ✓ the release (and reflection) of heat from industrial and domestic buildings;

- ✓ the absorption by concrete, brick and tarmac of heat during the day, and its release into the lower atmosphere at;
- ✓ the reflection of solar radiation by glass buildings and windows. The central business districts of some urban areas can therefore have quite high albedo rates (proportion of light reflected);
- ✓ the emission of hygroscopic pollutants from cars and heavy industry act as
- ✓ condensation nuclei, leading to the formation of cloud and smog, which can trap radiation. In some cases, a pollution dome can also build up;
- ✓ recent research on London's heat island has shown that the pollution domes can also filter incoming solar radiation, thereby reducing the build up of heat during the day. At night, the dome may trap some of the heat from the day, so these domes might be reducing the sharp differences between urban and rural areas;
- ✓ the relative absence of water in urban areas means that less energy is used for evapo-transpiration and more is available to heat the lower atmosphere;
- ✓ the absence of strong winds to both disperse the heat and bring in cooler air from rural and suburban areas. Indeed, urban heat islands are often most clearly defined on calm summer evenings, often under blocking anticyclones. (Tyler Tonna. (2014)).

- **The urban heat island**

The urban heat island (UHI) phenomenon means that cities often have higher air temperature than their surrounding rural areas (OKE, T. R. 1982). The value of this temperature difference is defined by urban geometry, surface characteristics, urban extent, intensity of anthropo-genic activity

and further regional climate factors (KIRCSI, A. et al. 2005; MCCARTHY, M. P. et al. (2010)).

6 -The relevance of urban green spaces:

Urbanization results in an increasing proportion of the population living in cities. In Europe it is expected that around three quarters of the population will live in urban settings by 2020. Urban living limits access to nature and can increase exposure to certain environmental hazards, such as air and noise pollution. Many urban areas face increasing pressure from expanding populations, limited resources and growing impacts of climate change. These challenges must be addressed in order for cities to provide healthy and sustainable living environments.

Green spaces and other nature-based solutions offer innovative approaches to increase the quality of urban settings, enhance local resilience and promote sustainable lifestyles, improving both the health and the well-being of urban residents. Parks, playgrounds or vegetation in public and private places are a central component of these approaches and can help to ensure that. (World health organization. (2017))

- urban residents have adequate opportunities for exposure to nature;
- urban biodiversity is maintained and protected;
- environmental hazards such as air pollution or noise are reduced;
- the impacts of extreme weather events (heatwaves, extreme rainfall or flooding) are mitigated;
- the quality of urban living is enhanced;
- the health and well-being of residents is improved.

7 -Urban green space interventions and the benefits they provide

Urban green space interventions are defined as actions that significantly modify the quality, quantity and accessibility of urban green space. This can be done by establishing new urban green spaces or by changing the characteristics and functions of existing ones.

7-1- Green intervention types

A broad spectrum of intervention types can be implemented at different scales in private or public spaces. These include:

Picture 1: roadside greenery and vegetation barriers along streets or rail tracks;

Picture 2: small urban green spaces (such as gardens or pocket parks) and playgrounds;

Picture 3: green roofs and facades;

Picture 4: parks and urban meadows;

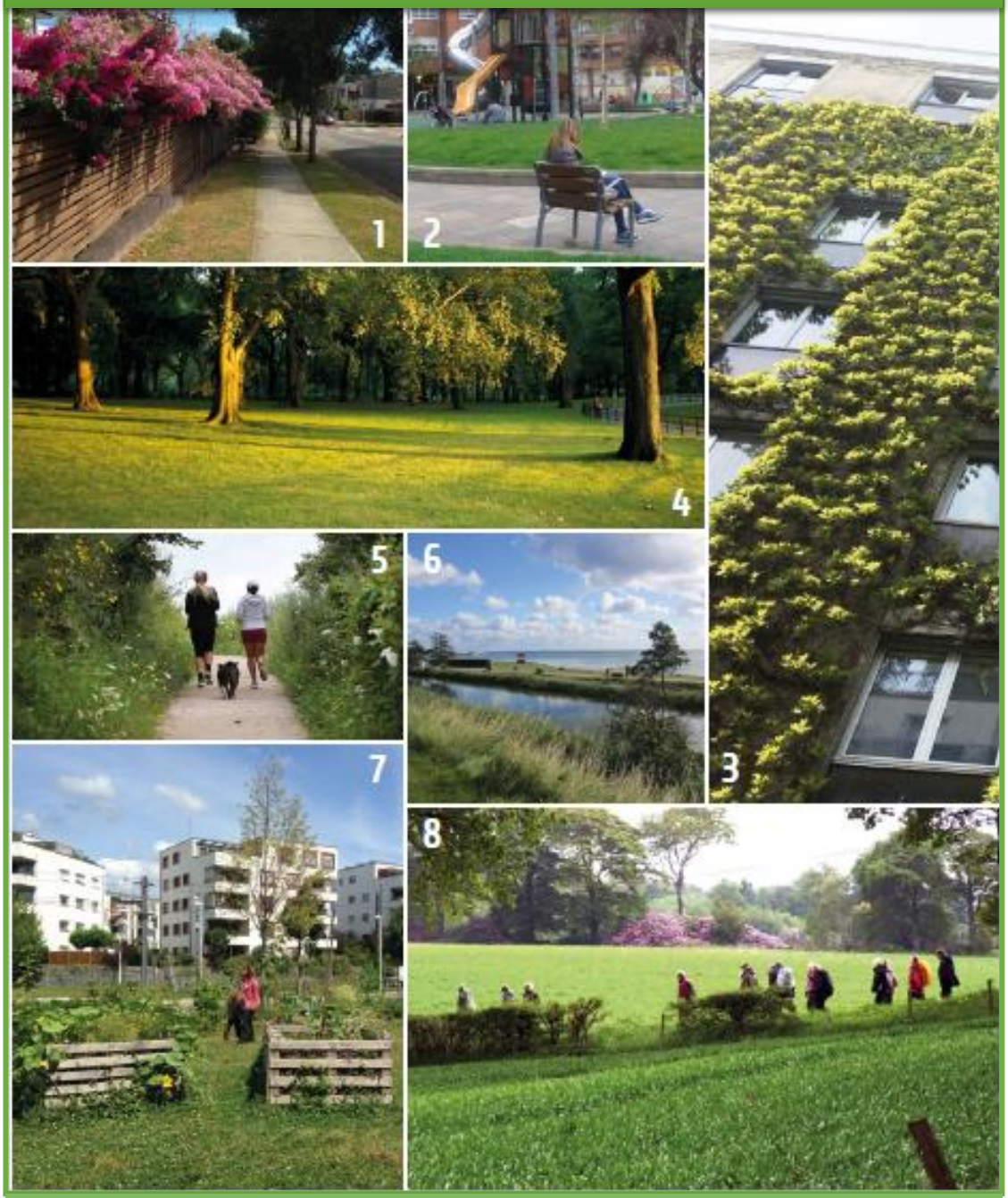
Picture 5: greenways and corridors (such as green trails for walking/cycling);

Picture 6: coastal, riverside or lakeside trails, linking green with blue spaces;

Picture 7: recreational and urban gardening facilities (such as community gardens, sport and play areas and school grounds).

Picture 8: facilitated access to urban woodlands, and natural wildlife areas.

Figure 05- intervention types .



Source: world health organization.2017

7-2- Opportunities:

Opportunities to involve urban green space interventions in urban planning include:

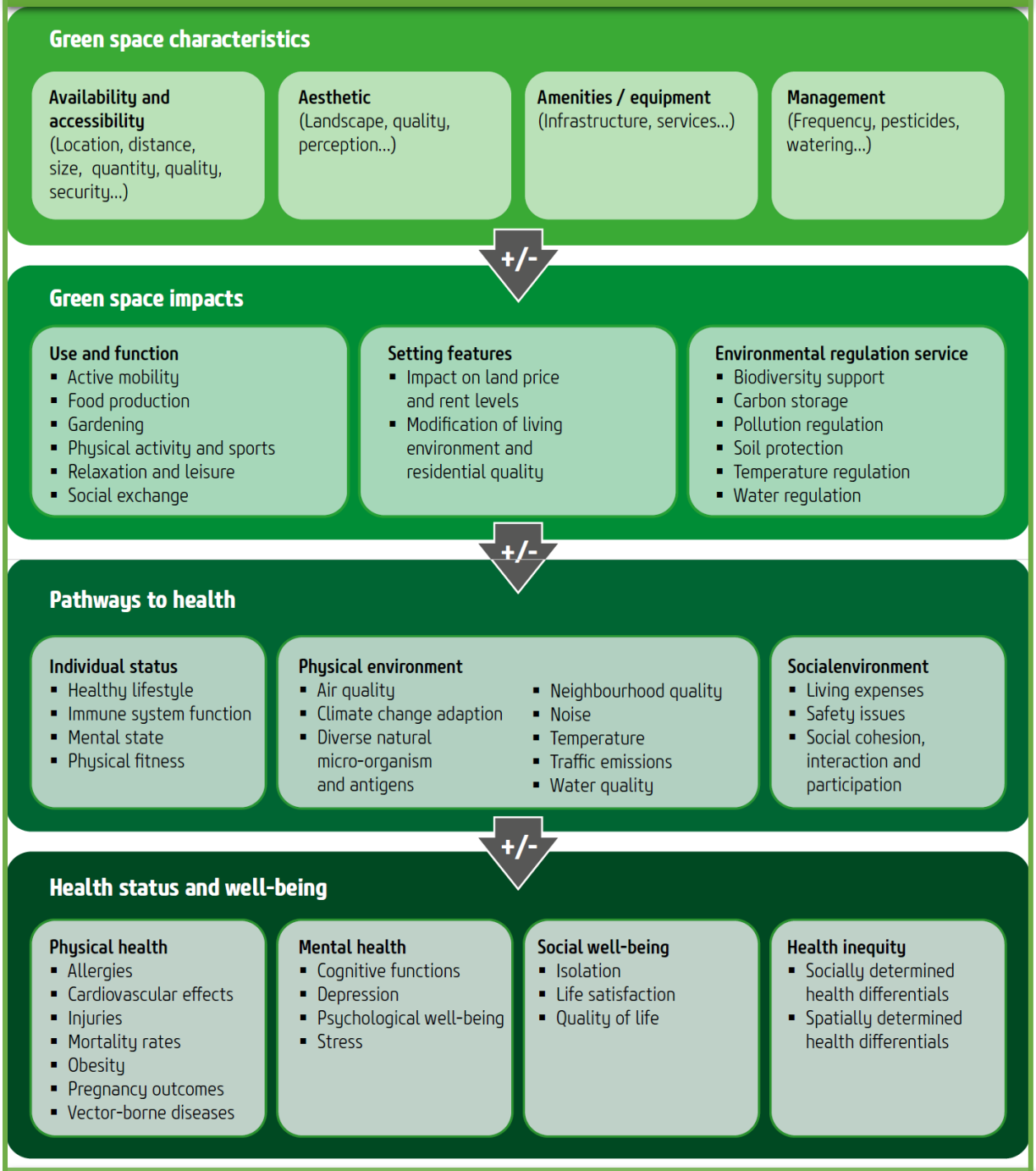
- development of new residential neighbourhoods, community facilities, business parks or transport infrastructure projects;
- regeneration projects and urban renewal initiatives;
- brownfield development and rehabilitation of industrial areas;
- urban gardening/agriculture projects;
- initiatives to enhance biodiversity.

7-3- Benefits:

Through improved air and water quality, buffering of noise pollution and mitigation of impacts from extreme events, urban green spaces can reduce environmental health risks associated with urban living. In addition, they support and facilitate health and well-being by enabling stress alleviation and relaxation, physical activity, improved social interaction and community cohesiveness. Health benefits include improved levels of mental health, physical fitness and cognitive and immune function, as well as lower mortality rates in general and also reduce hot temperature and harsh climate.

Everyone can benefit from urban green space interventions, but they can be of particular relevance for socially disadvantaged or underserved community groups, which often have least access to high-quality green spaces”). (World health organization. (2017)).

Figure 06- A causal model of the impacts of urban green spaces on health and well-being



Source: developed from a figure created by A. Roué-Le Gall in Milvoy & Roué-Le Gall (2015).

8 -How to approach the planning of urban green spaces:

Experiences with urban green space interventions at the local level have identified a few general aspects to be considered within the urban planning process. This section suggests approaches for urban policy-makers and practitioners to consider during the process.

Be clear about the objectives of green space planning:

- What type and size of urban green space is being planned?
- What are its main functions to be?
- Which population groups are expected to make use of it?
- Who is responsible for its maintenance and management?
- Might the planned urban green space be a way to upgrade a deprived area?

Make use of the urban/local planning context and frameworks. These will ensure that planners:

- create a long-term vision of a green city within the local authority;
- integrate urban green space infrastructure needs in urban masterplans;
- consider green spaces within infrastructural projects (housing, transport, business parks, community and health facilities) and urban rehabilitation approaches;
- consider regional planning frameworks such as green corridors and networks;
- engage the local community as part of the local planning process.

Have a long-term perspective and remain flexible:

- Green spaces are a long-term investment: they may need some time to establish before they are fully usable, and they require long-term maintenance.
- The benefits of urban green spaces may only become apparent over time.

- Urban green spaces should be planned and designed in a flexible way, making functional adjustments possible to adapt to changing future demands.

Consider green space projects to be a public health and social investment:

- Providing green spaces in urban settings is an investment in health, well-being and quality of life, creating places for relaxation, recreation and social interaction.

Urban green spaces are valuable settings for community organizations to host cultural or recreational events or provide space for (intercultural) gardening. (World health organization. (2017)).

9 -How to design urban green spaces:

Urban policy-makers and practitioners are advised to consider four practical implications for the planning and

design of urban green spaces identified from the review of evidence and practice.

Put the green space close to people:

- Establish street greenery, urban gardens and green trails in close vicinity to urban residents, and use public open spaces for greenery.
- As a rule of thumb, urban residents should be able to access public green spaces of at least 0.5–1 hectare within 300 metres' linear distance (around 5 minutes' walk) of their homes.
- Ensure access to urban green space of sufficient quality for all population groups and users (universal access).
- Use greening opportunities in other sectors and projects (greening of schools, business areas, shopping areas, housing estates and similar) and promote private green areas.

Plan for a diversity of urban green space types, responding to diverse demands:

- Consider various types of urban green space – street greening, small and large parks, greenways, nature playgrounds and so on – to satisfy different needs.
- Make use of biodiversity, using different plants to create diverse settings.
- Do not over-design urban green spaces to support only very specific functions or attract only specific users – they should facilitate activities by all population groups.

Consider simple design features to improve the comfort of urban green space use:

- Establish clearly visible entrance or access areas.
- Use signing within parks or for greenways and trails.
- Prepare for different seasons (lighting, drainage, materials).
- Consider safety issues (lighting, visibility, accessibility).
- Supply infrastructural features such as benches, waste bins, toilets and so on.

Think of the maintenance needs of the urban green space:

- Regular maintenance is necessary so that end users perceive the urban green space as safe, clean and cared for.
- Combat signs of vandalism and antisocial behaviour quickly.
- Use maintenance-friendly designs, avoiding the need for expensive and/or complex maintenance requirements.
- Use plant species with no or small allergic potential – especially native species with fewer maintenance needs.

Apply ecological maintenance practices and avoid potential health risks. (World health organization. (2017)).

10 - Benefits of urban green spaces:

Figure 07- Benefits of urban green spaces

(Source: blogs.ntu.edu.sg by Isabelle Lim.2019)

10-1- Economic benefits:

Urban green space can have long-term positive effects on the economy but can also generate more direct economic benefits and values through e.g. increased property value, willingness-to-pay for goods, urban agriculture and city branding.

Increased property values in the proximity of urban green spaces show the attractiveness of such locations. studies indicate a 20% increase in property values close to parks.

10-2- Health benefits:

10-2-1- Benefits for human health: Urban green spaces provide a number of benefits for human health, including longevity, physical and mental well-being, brain power and child development, all important for social and economic sustainable development.

Today, physical inactivity is a major global health issue, annually causing disease and around 1.9 million premature deaths (WHO, 2002) as people living close to green spaces with high recreation values spend more time in physical activity than others (Björk, et al., 2008). The amount of park near the home is connected to levels of physical activity, particularly for women and young people (Kaczynski, et al., 2009). Overall, people are healthier when living in urban areas with access to much green space, even healthier than in rural areas (de Vries, et al., 2003), with less sick-leave (Maas, et al., 2009). People also consider themselves healthier the more green space they can access near the home (Maas, et al., 2006).

10-2-2- Educational values: Urban green space has developmental and educational values which can be used in school teaching (Dyment and Reid, 2005). School ground gardening has many positive effects on children and their behaviour, including educational results (Blair, 2009). Schools with large windows facing environments with trees and shrubs have a higher proportion of pupils with good study results and plans for higher education than other schools (Matsuoka, 2010). Viewing vegetation from the home is associated with increased cognitive abilities among children in low-income families (Wells, 2000). Children often use natural vegetation close to housing, since children's mobility is limited unless in organised groups or similar (Florgård and Forsberg, 2006). Access to vegetation makes children more creative (Taylor, et al., 1998) and supports children with difficulties in concentrating (Kuo and Taylor, 2004).

10-2-3- Mental illness : often connected to stress, is a global problem creating high costs (WHO, 2004). In Europe alone, 33 million people suffer from severe depression (WHO, 2003). Proximity to urban green space is important for reducing mental illness, particularly stress-related forms (Stigsdotter, et al.,

2010), as the frequency of use becomes limited at distances above 100–300 metres (Grahn and Stigsdotter, 2003; Nielsen and Hansen, 2006). Living more than one kilometre from the closest large green space is associated with poorer self-reported health and life quality (Stigsdotter, et al., 2010). Viewing natural elements such as trees and water from a window or, even better, walking in such environments reduces blood pressure and stress (Hartig, et al., 2003). Urban green elements are important for individual mental recovery (van den Berg, Hartig and Staats, 2007),

10-3- Quality of life benefits:

10-3-1- Increase the attractiveness: Green spaces can increase the attractiveness of urban areas for residents and visitors, providing possibilities for increased quality of life in terms of e.g. safety, participation, social interaction and attractive living and working environments.

10-3-2- Safer society : Green city elements can contribute to a safer society with less negative social behaviour and higher perceived personal safety (Kuo, et al., 1998). People living in multi-family housing with much surrounding greenery such as trees and grass report less mental fatigue, aggressive behaviour and violence and better neighbourliness and safety than others (Kuo, 2003; Kuo and Sullivan, 2001a). Vegetation in urban areas is even associated with lower levels of property and violence crime (Kuo and Sullivan, 2001b; Wolfe and Mennis, 2012).

10-3-3- Reducing car transport: Urban green spaces can play a role in reducing car transport. In areas with much green space, bicycle transport is somewhat more used than elsewhere (Maas, et al., 2008). Besides, children gain larger independent mobility in urban areas with mixed land use and many street trees (Larsen, et al., 2009). Transport in green urban environments, in particular past

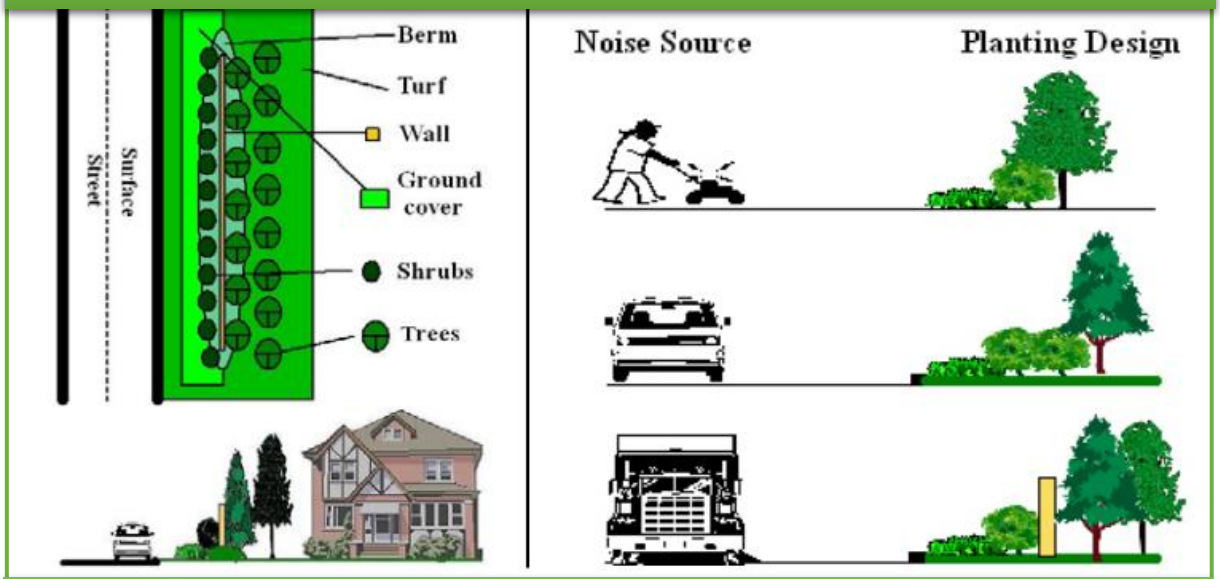
street trees and flowers, is considered aesthetically attractive and good for mental well-being (Todorova, Asakawa and Aikoh, 2004).

10-4- Sustainable ecological benefits:

10-4-1- Ecological benefits: from urban green spaces include e.g. regulating services, noise and pollution reduction, local climate regulation and reduction of global warming. High biodiversity of species results in stable ecosystems that can provide many ecosystem services for ecological and other benefits. Urban environments can be important in providing scope for conservation of species in the city (Dearborn and Kark, 2010). Planners therefore have a role in developing the possibilities for biodiversity on different scales (Alvey, 2006) through green spaces of high quality, sufficient size and coherence (Millard, 2008).

10-4-2- Noise-reducing: Vegetation has some noise-reducing effects depending on its design (Fang and Ling, 2005), which can serve to reduce the risk of high blood pressure (Bodin, et al., 2009) and cardiovascular diseases caused by traffic noise (Babisch, 2008). Green spaces function as health-supporting quiet zones

Figure 08-urban noises and trees



(Source: Ar. Navin Gupta. 2017)

(Gidlöf-Gunnarsson and Öhrström, 2007), particularly if the ecological quality is high (Irvine, et al., 2009). Green roofs can absorb sound waves before they reach the indoor environment (Dunnett and Kingsbury, 2004).

10-4-3- Generation of pleasant sounds: In 2009, Irvine et al. studied the soundscapes of three green spaces in Sheffield, UK with psychological, ecological and acoustical approaches. They interviewed seventy park users, measured habitats and recorded sound levels. Species rich bird communities were demonstrated to directly impact the quality of the soundscape in urban parks. In addition, the sound of rustling leaves was also considered as being pleasant (Matsui et al. 2009). Research in this particular field has thus far not received much scientific attention.

10-4-4- Global warming: global warming gives rise to immense economic costs and can cause disturbances in ecosystem services, soil quality and water supply and lead to fires (Schröter, et al., 2005). Urban green elements such as trees, parks and green roofs can contribute to reducing global warming (Gill, et al., 2007) by lowering the local temperature (Wong and Yu, 2005) and by storing carbon dioxide (McPherson, et al., 1997; Yang, et al., 2005). Green spaces with city trees can, through evapotranspiration and reduced wind speed, diminish the amount of carbon dioxide emitted to the atmosphere (Jo and McPherson, 2001). One single tree can diminish the amount by 18 kilograms per year or even more if it is standing in a group of trees. (Jansson, M. (2014)).

10-4-5- Protections solarise

In addition to the vegetation which, as previously stated, is a great way to protect the building envelope from direct sunlight, other solutions exist to limit the heat input from solar radiation. These are sun protection for

glazing and building. Sunscreens are devices that are installed outside, around windows or on them to block the entry of summer solar radiation, while allowing light (unlike interior protections). Various types of sun protection. The use of fixed solar masks requires precise sizing so as not to lose the benefits of sunshine in the winter season (avoid installing a sun visor too long which will block the entry of solar radiation in winter, when the sun is more low). Although they are much less effective in protecting the interior of the building from summer overheating, interior protections such as blackout fabrics or blinds should be clear and cover the entire surface of the window (Oliva and Courgey, (2006)).

10-4-6- Ventilation

Ventilation can be provided by natural means (natural ventilation) or mechanical (supply or extract ventilation). For an occupant to feel comfortable when temperatures are not high, the air speed should be of about 0.2 m / s. If temperatures get hotter and wetter, it could increase in order to relieve the occupant. Indeed, the speed of the air influences the exchange of heat by convection and allows evaporation from the surface of the skin (Watkins et Kolokotroni, (2007)).

11- Green spaces in cities:

Green spaces have had a part in urban planning for many centuries (Flores-Xolocotzi, R., et al., 2010). Nevertheless, their relationship has been changing, in continuous evolution, following different trends and tendencies that have occurred through the years (Groenewegen et al., 2012; Maheswaran, 2010; Jansson, 2014; James et al., 2009). Therefore, these spaces also could be used to express contemporary values, cultural trends, tendencies, and beliefs of urban societies (James et al., 2009; Jansson, 2014). Green spaces represent both the culture in which they were designed and the communities that make use of

them, since different populations value differently the contact with nature. This means, the role these areas have differ from one country to another, and can also differ within the city, in regards of different social groups (James et al., 2009).

Nowadays there are multiple factors and developments that are forcing experts to re-examine the way a city is designed, planned and experienced (James et al., 2009). In their article,(James et al. (2009)) highlight that, despite the fact that the functions these green spaces fulfil are becoming more well-known now than ever ,also supported by (Jansson, 2014), there's still the need to redesign the integration in planning of these areas, in order to maximize their services and benefits (Andersson et al., 2014), as well as the need to design new approaches to support the decision-making process related to these areas (James et al., 2009), and therefore gain a more prominent role in spatial planning practices (Jansson, 2014; de Vries et al., 2003), so that the role they provide is not undervalued (Jansson, 2014). Maintaining both quantity and quality of these green spaces should be a priority issue in planning practices globally (Fuller et al., 2009; Jansson, 2014), so that the services provided by these areas can not only be maintained, but even increased (Jansson, 2014). Some tendencies, at global, European and national level have started to work towards a better management of these spaces. This is for example the case of the European Commission (1996), that stated that the importance of this kind of spaces were as important as buildings and physical infrastructure (Madrid Mónica. (2017)).

12- Challenges to green spaces in cities:

The benefits provided by green spaces according to the ecosystem services perspective are endangered by human actions, such as urbanization (Niemelä et al.2012). As the development of new policies focuses on managing this

increasing growth, such as policies aiming for the densification of cities in order to combat urban sprawl and its problems, (Fuller et al., 2009; Jansson, 2014; James et al., 2009; Sandström, 2002; Niemelä et al., 2012). causing the development of a heterogenic area that hinders these areas to provide ecosystem services to their maximum capacity (Andersson et al., 2014). This might also result in more pressure on existing green spaces, as they are demanded to have a multifunctionality that endangers the ecosystem services they provide with multiple objectives, conflicting interests and meanings (Andesson et al., 2014).Various authors point towards these green spaces as mechanisms to fight the negative effects of this intense urbanization (Fuller et al., 2009; Jansson, 2014; Maheswaran, 2010), as it has been mentioned above. It is in this context that appears the necessity to study the way in which a city is managing these green spaces. We need to fully understand the role these green spaces play, and the role they will have in the future; and to understand how different cities have approached this issue. (Madrid Mónica. (2017)).

13- New global trend towards 'sustainability' and green spaces:

On the other hand, recentideas about sustainability have stressed the necessity of the presence of green spaces in the city due to their role as regulating spaces, and the importance of a healthy relationship between humans and nature (Fuller et al., 2009; Harting et al., 2014; Jansson, 2014). Following global trends towards a 'sustainable urban environment', the importance of these areas have been increasing in recent years (Jansson, 2014; Sandström, 2002). To the benefits and functions these areas have mentioned above, new benefits in a global and economic context can be found (James et al., 2009; Jansson, 2014). It has been proven that cities with more, well maintained green spaces are able to attract more investment, both national and international, as companies lately

have been focusing on being related with the 'green wave' of sustainability that's becoming increasingly relevant globally (Jansson, 2014; James et al., 2009). Green spaces can also be used towards the 'branding' of the city, attracting investment, qualified workers, and increase tourism (Jansson, 2014; Niemelä et al., 2012). Centres of research and innovation also tend to establish in areas in were green spaces are present, providing a modern, environmental friendly, and clean image. This is for example the case of research centres such as Universities, or technological parks, such as Parque Teconológico de Tres Cantos, in Madrid. Finally, green spaces also help to increase property value of its surroundings (Jansson, 2014) by attracting population. (Madrid Mónica. (2017)).

Conclusion :

The world is rapidly urbanizing. More people live in cities than ever before and this number will grow. All these citizens need an inclusive, healthy, resilient, safe and sustainable living environment. The Urban Green Spaces is a concept which helps address these needs. That's why the city needs a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services and comfort. It incorporates (urban) green spaces and other physical features. Green spaces provides benefits to people such as clean air, protection from flooding, a cooler city during summer, enhance the thermal comfort level for the citizens, or simply to enjoy nature in the city.

Chapter II: Analytic study of the impact of green spaces on urban areas

Introduction:

The positive role and impact of vegetated open spaces in regulating the urban climate and mitigating the Urban Heat Island have been well documented by various studies. Urban parks are able to reduce ambient air temperatures and can even generate a 'cool aura' that can be felt at small distances usually at their leeward side. The present study attempts to answer the following questions: What is the impact of Green space of a given fixed area of tree-planted open space on the microclimate? And if there's an optimal size and distribution of green spaces (urban trees) that achieves a maximum cooling effect.

1- Cooling effect of particular urban green spaces with known specifications :

This section discusses the articles where the location and characteristics (size and shape) of the studied UGSs are specifically mentioned. To enable more accurate examination of the cooling effect of green spaces, the articles in this category are further divided into three subcategories based on the size and type of the case studied: large-scale urban parks with areas of more than 20 ha, medium-sized urban parks with areas of between 0.1 and 12 hectares; and local and small parks with areas of less than 0.1 hectares.

1-1- Large-sized urban parks

Research in this subcategory has studied large urban parks mostly located in city centers. The cooling effect of large urban parks has long been of paramount interest to urban planners (Almendros Coca, 1992; Ca et al., 1998). Thanks to their vast area and location in the heart of the city, these parks often have a significant impact on the temperature of urban spaces (Jauregui, 1990). The cooling effect of these parks is closely associated with their CED and CEI, which depends on several factors, including park size and shape, type and amount of vegetation cover, and regional climate. A study conducted by (Hamada and Ohta (2010) in Nagoya) found that during summers, areas adjacent to Heiwa Park (147 ha) had up to 1.9 C lower temperature than other areas. They reported that in summers, this park had a CED of 200e300 meters during night hours and 300e500 meters during day hours. In another study (Doick et al., 2014), the average night-time CED of Kensington Gardens (111 ha) in London over the period between August and December (5 months) was found to vary between 20 and 440 meters. According to this study, this park reduces the summer nighttime temperatures by an average of 1.1 C and a maximum of 4 C.

to measure the cooling effect of green spaces. A study conducted in Shanghai, China, showed that on a hot sunny day (August 21st, 2:00 pm), the Yuan Dynasty Relics Park (102 ha) decreased the PET by an average of 2 °C and a maximum of 15.6 C (Sun et al., 2017). Another study conducted in Shanghai (Chen et al., 2015) reported that the cooling effect created by Zhongshan Park (21.42 ha) located in the city center resulted in a PET of 15-29 °C during winter. In a similar study by Mahmoud (2011), it was shown that during the hot months of summer, the cooling effect of Cairo's central Park (26.01 ha) results in a daytime PET of 22e30 °C and a nighttime PET of 21e29 °C.

And we can take the Botanical Garden Hamma – Algeria as an example The Test Garden of Hamma), (French: Jardin d'Essai du Hamma) is a 32-hectare (79-acre) botanical garden (38 hectares (94 acres) of gardens and 20 hectares (49 acres) of arboretum) located in the Mohamed Belouizdad (formerly Hamma-Anassers) district of Algiers. It was established in 1832. (Wikipedia (2020)).)

Figure 09- The Test Garden of Hamma- Algeria-Algiers

(source: Wikipedia.com)

1-2- Medium-sized urban parks:

studies showed that green spaces with areas of 0.5e2 ha can only cause up to 0.3 °C temperature reduction over 40m distance, but the temperature reduction caused by green spaces with areas of 3e5 ha can extend over a 70-120 m distance and reach as low as 0.7 °C. It was also reported that larger green spaces with areas of up to 12.1 ha can decrease temperature by 1°C over 180/330 m distances. In a study conducted in Tel Aviv (Cohen et al., 2012), the cooling effects of 10 urban parks with different sizes (0.2-0.36 ha) and different vegetation quality and diversity were compared. This study found that parks with dense vegetation cover have the greatest effectiveness in terms of cooling and thermal comfort. The greatest cooling effect was observed in summer, when the parks managed to reduce the temperature by up to 3.8 °C, resulting in a PET of 18 °C. In comparison, a smaller effect was observed in winter, when temperature reduction was 2 °C and the resulting PET was 10 °C.

And we can take the July 5th Garden – Biskra Algeria as an example, It was created by the cooperation between Defourd, Albert Landon between 1848

Figure 10- July 5th Garden – Biskra Algeria (4.02 Ha)

(source: author, Biskra, 2020)

and 1890, The works lasted more than 40 years. It is part of the national and international heritage; it must be preserved as it is. The garden is located in the city center in the colonial checkerboard district, limited to the north by a barracks which remains functional to this day, it encompasses the old Catholic church, now transformed into an Islamic cultural center. (Belkacemi Hadjer .2018)).

1-3- Small parks:

Besides large and medium-sized parks, small parks can also play a role in creating a cooling effect. Generally, studies on the cooling effect of UGSs are more focused on large and medium-sized green spaces; however, among the articles in this area, in a study, the role of small parks is also mentioned. According to this study conducted by Park et al. (2017) in Seoul, small green spaces with an area of 300 m2 can result in 1 °C temperature reduction and slightly larger parks with an area of 650 m2 can reduce the temperature by up to 2 °C. This study found that the CEI of a park correlates with its size, and accurately predicted that a 1500 m2 green space would reduce the temperature by up to 3.6 °C. This study also showed that polygonal lands with combined vegetation cover can reduce the temperature by up to 4 °C. (Farshid Aram.o and AL. (2019)).

And we can take the 20th of August 1955 Garden – Biskra Algeria as an example It was created by Defourd since 1858, Where he was the reason for creating this garden is his son's birthday, and it covers an area of 0.15 Ha.

The garden August 20, 1955 located at Boulevard Hamouda Ahmed Ben Abderahmane Dit (Si El Haoues), next to the large post office. This garden is characterized by a varied vegetation, where there are several rare tree species brought from five continents. (Belkacemi Hadjer .(2018)).

Figure 11- 20th of August 1955 Garden – Biskra Algeria(0.15 Ha)

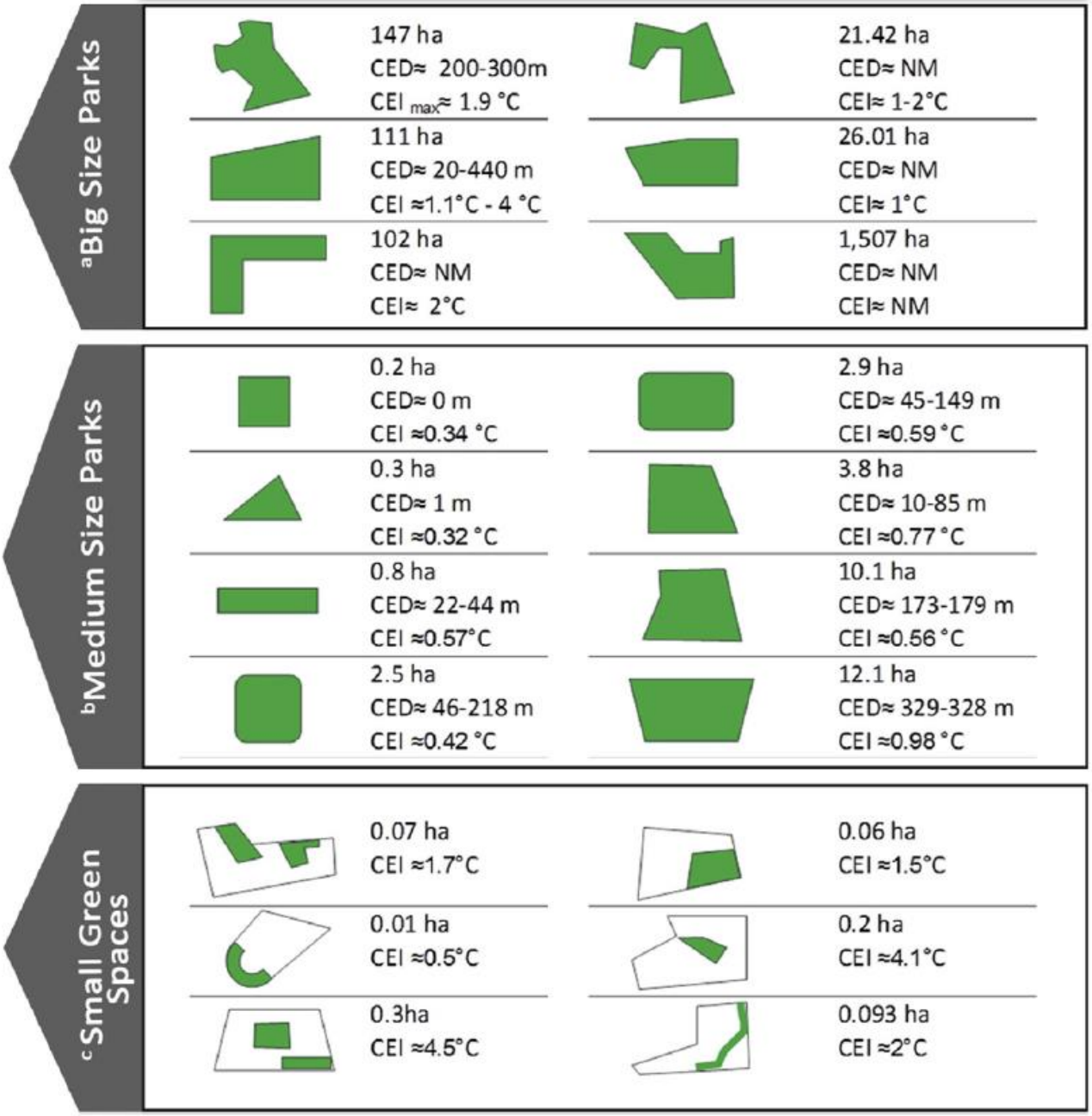
(source: Belkacemi- Hadjer.2018)

Table 01 - summary of studies investigating the cooling effects of particular green spaces with known specifications

Size	General features
Big Size Parks	• Mature and tall trees with high percent of canopy • Water body • Different zones and landscapes with various vegetation types
Medium Size Parks	• Different size of trees (medium and high) • various vegetation types • small water body
Small Green Spaces	• Low tree diversity • Low vegetation diversity • Has an enclosure space

(source: Farshid Aram.2019)

Figure 12 - Parks Scale that were investigated in the cooling experiment



(source: Farshid Aram.2019)

2- Cooling effect predicted in computer:

The digital simulation tools developed and evolved over time have enabled us the modeling of projects and architectural works or even urban fabrics and the simulation of climatic factors, sunshine, shade, etc. like the realization a fine analysis of atmosphere and micro-climatology either for a street or a building, just like at the block or neighborhood level. As already announced to the problem, this work consists of two parts, a work 'In situ' and 'simulation' work. one will try among others to sweep the models of modeling and simulations, then identified the numerical model meeting the objective of our simulation. Also in this chapter, we will touch on the choice of the measuring device, the tap points of measurements

for the place, the progress of the measurement campaigns, the days and measurement moments and the graphic representation of the measured parameters… etc. (HANAFI ABDELHAKIM . (2018)).

Table 02 - Urban climatology research models

Research in climatology urban	**Modeles**	**Reading and comparison**	**is based on data and parameter measurements climatological.**
		Reading and interpretation	**is based on results numerical simulations.**

(source: Farshid Aram.2019)

3- Choice of the digital modeling tool:

The choice of the numerical modeling tool was on the 'RayMan' model for its peculiarity compared to other available software and compared to our research.

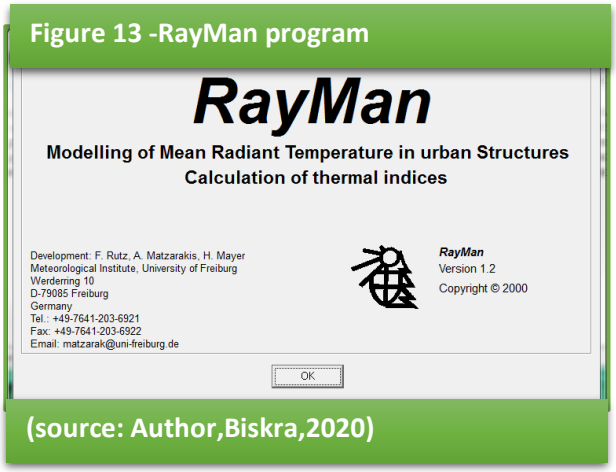


Figure 13 -RayMan program

(source: Author,Biskra,2020)

- Respond to the objectives of our research.
- Available, of which it is free to download.
- Rapidity in the work, of which it takes only a few seconds to establish the simulation.
- Advantages presented by RayMan: various data in the form of tables, graphs or drawings… etc. relating to the climate, the sun, the shade of buildings and trees.
- Quick and easy determination of microclimate changes in different environments urban.
- Simple input data to establish a simulation.
- Use and validate by several studies since 2000

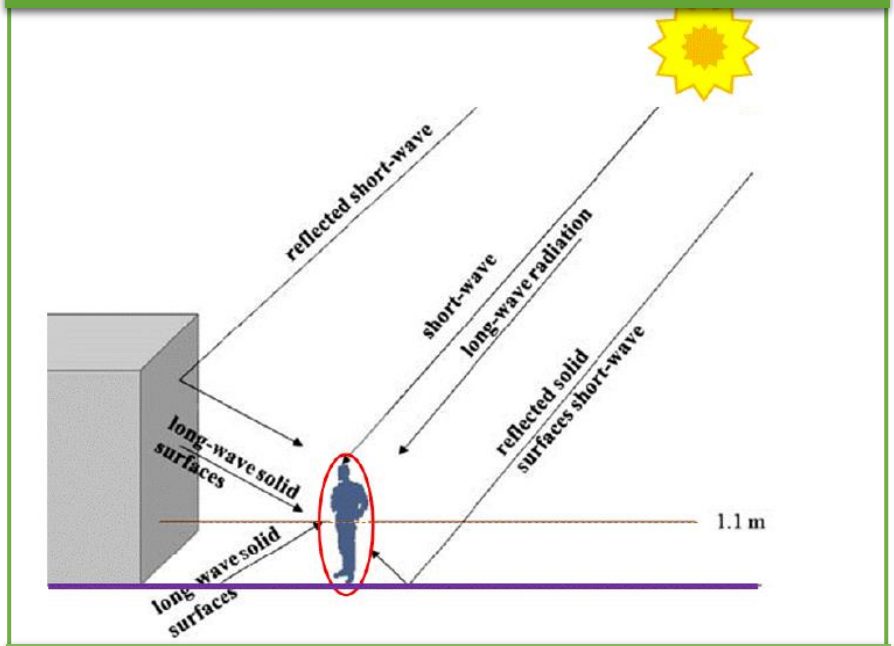
3-1- Presentation of the modeling / simulation software: RayMan:

The 'RayMan' model is available free of charge from the website: http: //www.mif.unifreiburg.by / rayman. Note that it is compatible with 'Windows'. This 3d software (means, to structure three-dimensional) is well suited for urban space with a simple or complex character. (MATZARAKIS, A et al; (2002)) Since the year 2000 those responsible for this software have been developing it each time; version 1.1, 1.2, 1.3 arriving at RayMan Professional.

Use of the results obtained by the 'RayMan' model in applied sciences gives a lot more to the latter. Of which it offers good simulation and it is designed to calculate:

- Solar radiation incident on the human body of short and long wavelength; as it estimates global, direct, diffuse and reflected solar radiation.
- The soil temperature (TS)
- The mean radiant temperature (Tmrt): to determine this lastly, the "RayMan" software takes into consideration all types of radiation.

Figure 14- strong solar radiation for temperature determination radiant mean (Tmrt).



Source: MATZARAKIS, A et al.2010

3-2- Calculation mode of the "RayMan" model:

For the calculation of these parameters the ‘RayMan 'software requires the necessary data related to the energy balance human or its environment.

- air temperature (Tair)
- air speed (Vair)
- relative humidity (RH%)

- vapor pressure (VP)
- average radiant temperature measured In addition: thermo-physiological data:
- clothing.

and the activity. (HANAFI ABDELHAKIM . (2018)).

- **4- The impact of green space distribution on the microclimate of idealized urban grids:**

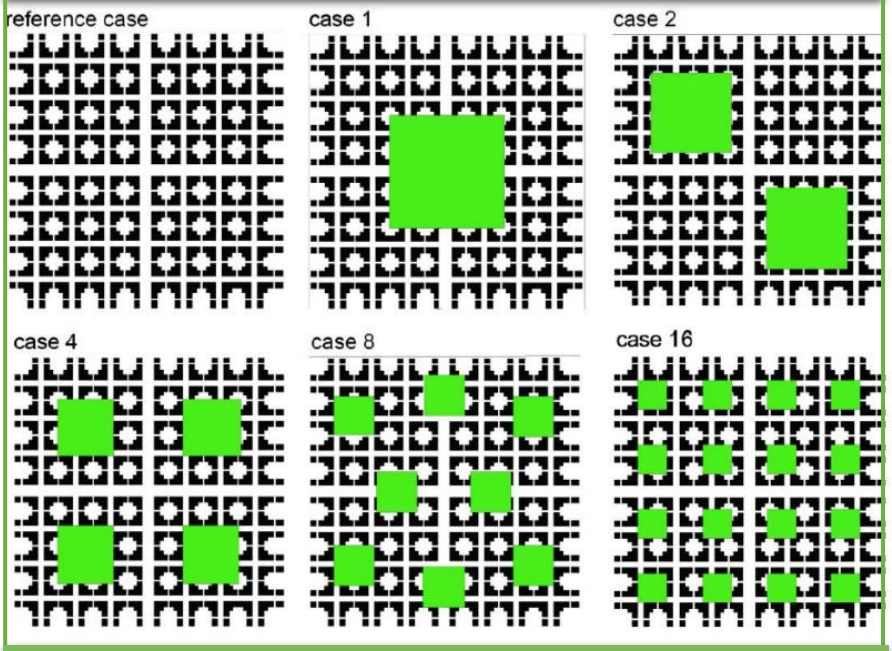
The positive role of vegetated open spaces in regulating the urban climate and mitigating the Urban Heat Island (UHI) is well documented (Bowler et al., 2010). Urban parks are able to reduce ambient air temperatures and can even generate a 'cool aura' that can be felt at small distances usually at their leeward side. The present study attempts to answer the following questions: What is the influence of different spatial distributions of a given fixed area of tree-planted open space on the microclimate of an idealised urban grid? Is there an optimal size and distribution of green spaces that achieves a maximum cooling effect? The study focuses on the city of Thessaloniki which has a typical Mediterranean climate to produce simple green-space distribution guidelines that can be used in the development and regeneration of settlements.

4-1- conducting a simulation using ENVI-met:

The simulations are conducted using ENVI-met V3.1 (Bruse, 1999; 2004), a three-dimensional computational fluid dynamics model that simulates micro-scale interactions of air, surfaces and plants. ENVI-met is supplemented by BioMet, from where the Potentially Equivalent Temperature (PET) thermal comfort index can be calculated. For the case study city of (Thessaloniki, Greece) the accuracy of the model has been validated in previous open space studies and the differences between observations and simulations typically do not exceed 15% (Chatzidimitriou et al., 2013). A limitation of ENVI-met V3.1 is that

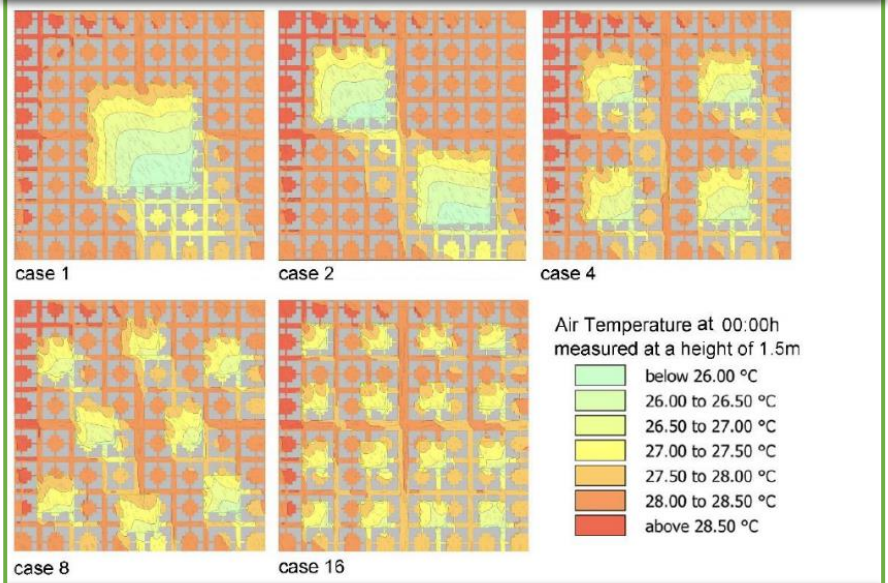
it does not fully simulate heat storage in buildings and as a result the nocturnal UHI is not accurately represented (Yahia and Johansson, 2013).

Figure 15- The examined green space layaout



Source: Aristotelis Vartholomaios.2015

Figure 16 - Distribution of air temperature in the five examined cases at midnight.



Source: Aristotelis Vartholomaios.2015)

4-2- Analysis of the Results:

A noticeable drop in air temperature can be observed in all cases during the nocturnal period. The intensity of this effect is proportional to the size of the

park. This effect ranges from 1.3K inside the smaller parks (case 16) to 2.7K inside the largest park (case 1). During the morning and early afternoon this effect is reduced and is almost nullified when maximum air temperatures are observed at 15:00 (local time). This can be partially attributed to the 'cool oasis' phenomenon created by the urban canyons, mostly through shading, which reduces the air temperature differences and the mixing of cool and hot air masses inside the parks as the city heats up after noon. In smaller parks, the enclosure created by neighboring buildings creates additional shade and traps cool air masses. In contrast, a greater movement of air masses under the canopy of trees is observed in larger parks.

Parks also generate a 'cooling aura' at their leeward side that can reach several tens of meters in length. This effect is mostly observable during the nocturnal period . On one hand larger parks produce cooler air masses which dissipate over longer distances, but a relatively small area is actually influenced. A reduction of air temperature

4-3- Conclusions about this study:

The study has demonstrated a simple method for determining the influence of green space distribution and size on the urban climate through microclimatic modelling. The results of this method are easy to interpret and can inform the urban planning and design processes. A larger sample of green space configurations simulated under different climatic conditions and a validation of findings with in-situ measurements could provide a deeper insight on the underlying microclimatic mechanisms. Future research could focus on these aspects which could not be examined within the limits of this preliminary study. (Aristotelis Vartholomaios. (2015)).

5- Effects, functions and uses of the urban tree:

Table 03 - Effects, functions and uses of the urban tree

Effects and functions	Designations
Aesthetic functions and landscaped.	Protection against nuisance sound and visual.
Climate improvement and air.	- lowering the temperature. - Increase in humidity. - Air circulation and movement. - Production of water vapor. - CO2 reduction - Dust and particle filtration.
Social functions.	- Psychic and relaxing action. - educational and pedagogical role.
Ecological functions.	- Energy saving. - Shading in summer and transparency in winter.

source: GILLIG,C.M et al ; 2008 translated and edited by author,Biskra,2020 .

In our topic we will look at the thermal role of vegetation in general and the tree in particular Of which "the trees help to refresh the air in cities and to limit certain types of pollution such as dust ; they increase the humidity level and generally lower the temperature following production of water vapor… In addition, plants breathe and release water vapor what is called the phenomenon evapotranspiration7; One of its main consequences is the cooling effect. And we note that "the temperature of a field covered with grass can be up to 10 ° C lower than asphalt. (HANAFI ABDELHAKIM . (2018)).

6- Thermal Impact of vegetation. (HANAFI ABDELHAKIM . (2018)).

Figure 17 - Diagram of the thermal role of vegetation and trees. Processed by the author ,Biskra,2020

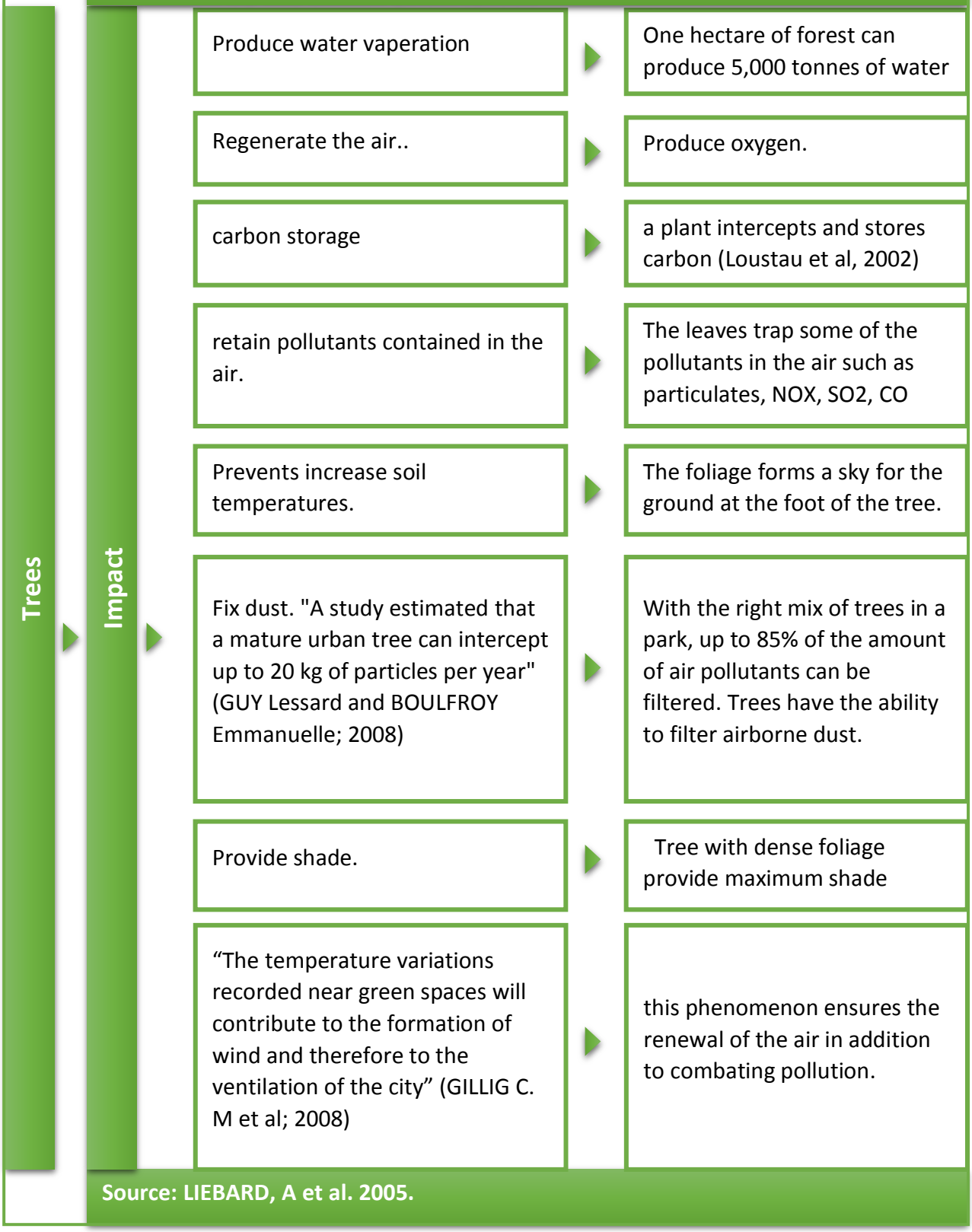
Vegetation with all its types

The decline of air temperature and surfaces by the effects shade and evapotranspiration (Akbari; 2002)	For example : - shading of trees above car parks lower the temperatures inside vehicles of 25 ° C (Scott et al; 1999). - peri-urban areas with trees old trees, its temperatures lower than those of the zones peri-urban without trees (Simpson; 1998) - the planting of deciduous trees along facades, there are reductions in consumptions of up to 50% for The air conditioning. (Akbari et al; 1992)
a difference from 1 to 5 ° C, measured under the tree cover.	For example : - studies prove that there are gaps 1 to 2 ° C between the temperatures of a grassed sports field and others surfaces. - According to a model made by TAHA et al; (1999) the combined effect of trees in new york city would reduce the urban temperature by 1 ° C, in summer at 2:00 p.m.
Interception rays solar	- a tree intercepts the radiation solar which provides shade protective. In addition, the alignment of its temperature and that of air.
humidity Modification	- a deciduous tree can emit up to 400 liters of water per day. - The presence of a large number trees or a park, its influence by evapotranspiration can cool down the region by lowering from 1 to 5 ° C of its temperature (McPherson, E.G ; 1994)
Noise attenuation	- The vegetation acts to concealment sources of noise. (SIAQ; 1995)

Source: BOUTEFEU, E. 2011.

7- Impact of urban vegetation (urban tree): (HANAFI ABDELHAKIM . (2018)).

Figure 18 - diagram relating to the role of the urban plant (the urban tree). Processed by the author ,Biskra,2020



Source: LIEBARD, A et al. 2005.

8- Impact of urban plants (trees) in public spaces:

Figure 19 - diagram relating to the effects of urban vegetation (the tree) in public spaces. Processed by the author Biskra,2020

Vegetation with all types: ground cover (grass), beds, bushes, shrubs or trees.

Improvement quality of life	thanks to its bioclimatic regulation, to the beautification of the places it generates and to the reminder of the cycle of the seasons. Per year.
Oxygen Production	150 m² of leaf area would meet the oxygen requirements for one person for a year. (Peck et al; 1999) A mature tree could provide four (04) people with their daily ration of oxygen. (Montreal Tree Policy. 2005)
pollution limitation air.	by the role of dust filter and its CO2 absorption.
The urban tree has a role of air purification	Urban tree foliage absorbs: carbon dioxide, ozone and sulfur dioxide. (SIAQ; 1995)
Interception of particles atmospheric	It is reported that in the air of the streets without trees, from 10,000 to 12,000 particles per liter of air on the other hand in the tree-lined streets, we only 3000 particles per liter of air.
The interception of noise	The presence of vegetation would absorb and dissipate sound waves. (KANE, R; 2004)
Improvement of the water cycle.	by absorbing rainwater which limits runoff.
Improvement of biodiversity.	by serving as shelter and food for animals and plants as well

source: REITER, S. 2007.

It should be noted that the role of vegetation is essentially through the reflection of rays solar including (JOHNSTON. J et al; (2004) report that "The effect of vegetation on islets heat is therefore produced directly by the reflection in the atmosphere of part of the solar radiation as well as by the shadow it casts on surrounding surfaces. The reflection and radiation emitted by streets and buildings are also partially intercepted by trees, which reinforces their role if they are planted close to buildings " (JOHNSTON. J et al; (2004)) In addition to the albedo of an area covered by trees equal to 0.15 to 0.18, and an area grass is 0.25 to 0.30, on the other hand an asphalt surface it is 0.05 to 0.20. (HANAFI ABDELHAKIM . (2018)).

9- The arrangement of urban vegetation (the urban tree) in public space:

"Plants, even defoliated, constitute volumes comparable to structures architectural… The foliage constitutes vaults which define spaces interiors with sometimes very architectural characteristics… Plant boundaries and patterns participate in the structure of urban space. They can introduce continuity, underline a built order, link disparate volumes or structure spaces

Figure 20 - (a) and (b) presence of trees in urban areas.

Source: LARUE, D.1996

disorganized. They confront and clarify the urban patterns ... The plant environment which almost always accompanies architecture ensures the transition with its environment. When the building and its immediate decor

have a precious character, the vegetation constitutes a setting… A tree or a group of plants, remarkable for their size, their architecture, their flowering contributes to orientation and location ... Climbing vegetation or suspended significantly transforms the appearance of buildings, especially if the conditions necessary for their growth were integrated into the architectural process. "(STEFULESCO, C; 1993) . (HANAFI ABDELHAKIM . (2018)).

10- Impacts of Green spaces:

Recent studies have been developed in relation with green spaces, that seek to understand the positive effects green spaces have on both the population around them and the city as a whole. The effects these areas provide are numerous, and relate to a wide range of different aspects of the city. The effects depend on the landscape qualities of the green space, such as the size, the shape, the placement and the content of the area (de la Barrera et al., 2015; Jansson, 2014). They affect the city differently, at several levels at the same time.

10-1- Regulate the ecosystem:

The regulating servicesis the services that regulate the ecosystem, and formulate the essential background for the development of other ecosystem services (Niemelä et al., 2010). These regulating services can be seen in for example the presence of green spaces that has helped to improve the 'health' of the city (Hartig et al., 2014; Jansson, 2014; James et al., 2009; Fuller et al., 2009). These green spaces, along with the vegetation that usually accompanies them, can help reduce noise levels in the city, and depending on the vegetation used, it can absorb or soften noise generated from different sources, such as traffic or the development of other activities within the city, such as industries (Jansson, 2014; Niemelä et al., 2010). The presence of this vegetation can also

improve air quality, as the plants will filter the air and reduce the amount of certain pollutants present in it .

10-2- Reduce the urban heat:

Vegetation can also help to reduce the urban heat island effect that most cities suffer from, i.e. a rise of temperature in comparison to their surrounding areas, as a result of the development and concentration of human activities in the area. Vegetation can reduce heat islands by providing shadow, and therefore also reduce energy demand (Hartig et al., 2014; James et al., 2009; Jansson, 2014; Niemelä et al., 2012). Green spaces, especially those with a certain dimension, help to ease theissue also by providing a buildingfree space in which air currents can circulate and consequently alleviate the heat in this areas (Jansson, 2014). The impact on these aspects depends on the constitution of the green spaces, since their effects vary depending on the vegetation density, the vegetation species used, etc. (Hartig et al., 2014; Jansson, 2014). As Jansson (2014) mentions, the differences in temperature generated by a green space can vary between a reduction of 1 - 4 ºC.

10-3- Ease the negative impacts urbanization:

Some authors argue that green spaces help to ease the negative impacts urbanization has in both the population and the environment (Maheswaran, 2010; Niemelä et al., 2010). In addition, in an increasingly dense city, these areas can sometimes act as a second living space for residents (Stockholm City Council, 2010). It could also be said that the presence of these areas can determine the sustainability of an urban development in the long term (Stockholm City Council, 2010). To be able to fully.

benefit from these effects, green spaces must be carefully planned, as well as a studied use of the vegetation planted in them.

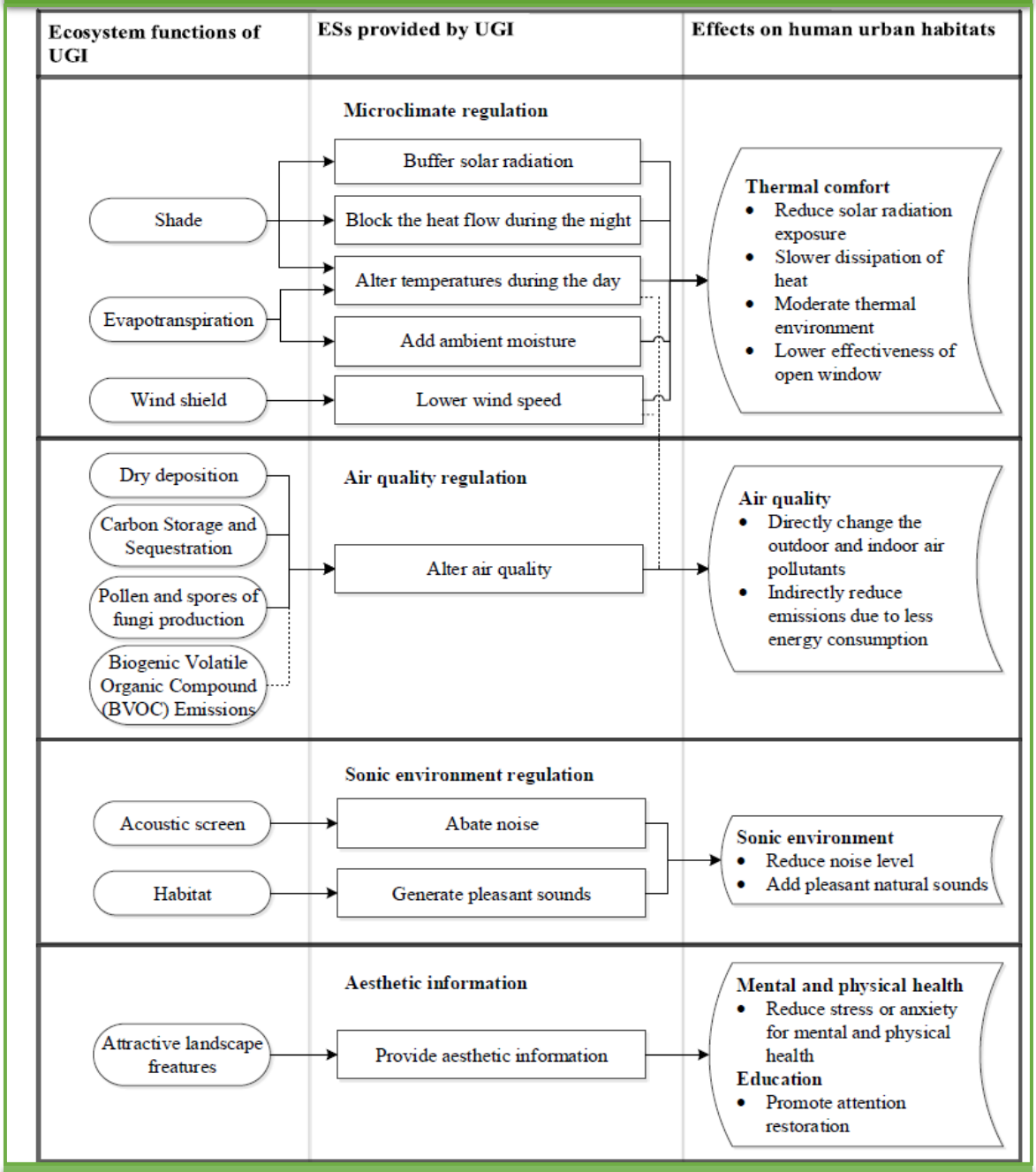
10-4- Impact of green spaces on air quality:

Vegetation positively affects urban air quality through three ecosystem functions: removing air pollutants through dry deposition processes (Bolund and Hunhammar 1999, Nowak 1994, Thornes et al. 2010), storing and sequestrating carbon through photosynthesis (McPherson and Simpson 1999), and slowing down smog formation process by cooling the ambient temperature (Konopacki and Akbari 2000, Taha et al. 1997). On the other hand, UGI also has negative effects on the air quality. For example, BVOC emissions from vegetation can contribute to the formation of O3 through a photochemical reaction with NOx (Akbari 2002), the formation of secondary organic aerosols (SOA) through photo oxidation process (Fu and Liao 2012) and the formation of carbon through oxidation or reduction processes (Bouvier-Brown et al. 2012). Also, human allergic response to pollen and fungi spores is an environmental health issue (Townsend et al. 2003). In addition, UGI may also increase air pollution inside buildings by reducing the air ventilation. Inadequate air ventilation due to the shield of trees reduced the dilution effects of outdoor air on emissions of indoor sources, and lowered the transfer rate of indoor air pollutants when the inside pollution concentration is higher than outside. (Madrid Mónica. (2017)).

11- Establishing the relation between UGI and urban habitats:

the established relations between urban green infostructure (UGI), Ecosystems (ESs) and human urban habitats. The main ecosystem functions associated with each service provided by UGI were used to classify the selected papers. (Yafei Wang. (2015)).

Figure 21 - The ESs provided by Urban Green Infrastructure (UGI) to human urban habitats. Solid line and dash lines correspond to direct and indirect effects, respectively.



Source: Yafei Wang.2015

12- Main factors influencing the service performance of UGI:

In the previous sections, the effects of UGI on human urban habitats in outdoor and indoor environment were reviewed. Table 2.2 summarizes the main factors, and sub-factors that are important in the relationship between UGI and human urban habitats.

+ have influence; /? may have influence with unknown extent; and 0 no information from the reviewed papers. (Yafei Wang. (2015)).

Table 04 - Main factors influencing ESs generation by UGI on human urban habitats.

Main factors	Microclimate regulation	Air quality regulation	Sonic environment	Aesthetic information
Local morphology				
Configuration of building and vegetation	+	+	+	+
Orientation of building and vegetation	+	0	0/?	0
Geographical conditions				
Ground property (e.g. soil types, surface mulching)	+	+	0/?	0
Local climate and weather condition	+	+	0	0/?
Vegetation characteristics				
Vegetation quality and quantity	+	+	+	+
PAI or LAI & Structure (height, width and crown property)	+	+	+	0/?
Vegetation species (especially for deciduous or evergreen plants)	+	+	+	0/?
Building characteristics				
Façade property (e.g. material, isolation, construction)	+	0	0/?	0/?
Air ventilation and infiltration rate	+	+	0	0

Source: Yafei Wang.2015

13- Study area example (Ghardaia):

Figure 22 - Weather station in Palme trees zone at low level.

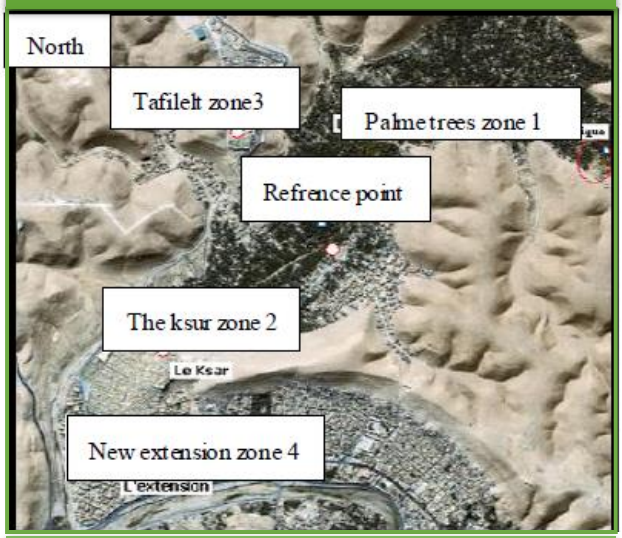
Source: Hamida bencheikh.2012

Figure 23 - Weather station in the street of the old ksur Beni Ezgen .

Source: Hamida bencheikh.2012

Ghardaia is located in the south of Algeria, which is well known by its hot arid climate, its ksurs (dense old buildings), its river, and its detached houses surrounded by Palme trees as shown in Photos The climate of Ghardaia is characterized by a very hot dry summer, the mean summer temperature in July is 36.8℃ and the maximum absolute temperature is 46℃. The outdoor temperatures were recorded in four different sites in addition to the reference point; shows the different sites where field measurements were recorded. The reference point is situated at the frontier of Palme trees site on the top of the local radio building and the first site, detached houses in Palme trees (Oasis) is situated at the bottom of the valley. The second site called Beni Ezgen ksur, the old part of the city (high density buildings and partially covered narrow streets) The third site the new city extension called Tafilalt and the forth site is the new detached houses in open area without vegetations.

Figure 24 - The different zones where field measurements were recorded



Source: Hamida bencheikh.2012.

Figure 25 - Weather station on the top of houses roof in the old ksur Beni Ezgen

Source: Hamida bencheikh.2012.

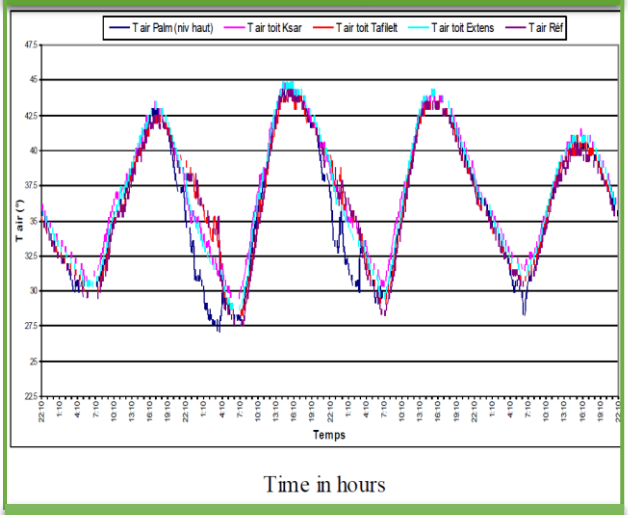
13-1- Study Results and Discussion

Ghardaia a hot arid city situated in the south of Algeria, the outdoor temperatures were recorded by fixed weather stations at two level points, street level and canopies level (roof of building and bottom of building) for the four mentioned sites and the reference weather station site. Figure (6) presents the outdoor temperature variation at building roof level in the four sites in comparison with the outdoor reference site. Figure (7) presents the outdoor temperature variation for the same sites at street level. Figures(6, 7) show that the high diference in outdoor temperatures between sites were recorded during night time at canopies level in palm trees site. The outdoor air temperatures during day Time in Palme trees site were lower by, 2°C than the reference weather

station, 3°C to 4°C than the ones in Beni Ezgen site, and by 5°C to 8°C, lower than Tafilelt, and the open site houses). During night time the outdoor temperatures in Palme trees site were lower by 5°C to 8°C than the

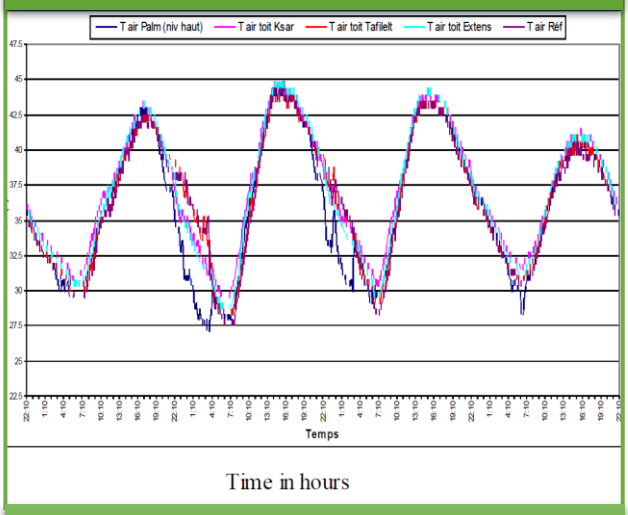
Beni Ezgen site , and by 10°C lower than Tafilelt, and the open site houses

Figure 26 - Out door temperature recorded in different zones at canopies.



Source: Hamida bencheikh.2012.

Figure 27 - Out door temperature recorded in different zones at street level .



Source: Hamida bencheikh.2012.

13-2- Study Conclusions:

The study shows that the outdoor temperatures in center of Palme trees site were lower by 5° to10°C in comparison to the other studied sites. The old ksur characterized by its compact buildings with narrow streets and its surrounding ramparts was designed to offer a good thermal comfort and security from enemies , however in our days the security problems does not exist. A second ksur called tafilelt was designed in 1990 in the same shape as the old one but with larger streets, for cars and technique equipments to get inside, but our study shows that the outdoor temperatures in the ksur of tafilelet were greater than the outdoor temperatures in Palme trees site. Therfore we suggest a new urbanization method, which gives the vegetations (Palme trees) great space in all buildings design. For further studies it is rec-ommended to find the optimum vegetation surface percent-age in the new extension of Ghardaia city. The existence of Palme trees surrounding houses offer a better microclimate, protection for hot wind, sand and also Palme trees fruits (dates) for the inhabitants. (Hamida bencheikh, Ameur Rchid. (2012)).

Conclusion :

The study and information in this chapter has demonstrated a simple method for determining the influence of green space distribution and size on the urban climate through microclimatic modelling. The results of this method are easy to interpret and can inform the urban planning and design processes. A larger sample of green space configurations studied under different climatic conditions and a validation of findings with measurements could provide a deeper insight on the underlying on the impact of green spaces on microclimatic mechanisms and the urban space in general.

Chapter III: Analyzing the Study area and design proposition / interventions

Introduction

The city of Biskra like most southern Algerian cities These days has lost its identity and its geo-climatic specificities. This has created a poor environment that lacks green spaces, according to the analysis we concluded from different studies and site observations the abandonment of these spaces is due to the lack of comfort thermal, which forces people to leave these spaces or to frequent them occasionally. This paper and chapter is an attempt to spot the light on the real impact of green space and the thermal comfort that it can offer to a public square and therefor its users, and make it sustainable, within existing urban outdoor green spaces, and the very open spaces, to play their roles well. by studying the field climatic characteristic and running a simulation through the Ray-man software then proposing a concept design as we see suitable. And eventually, improve the urban living environment of the population of the city of Biskra.

1- General data:

1-1 Presentation of the wilaya of Biskra:

Before going to the city of Biskra it is obvious to know the wilaya of Biskra The wilaya of Biskra is classified by the Algerian state as a wilaya of the south, although it is located between north and south and this gave it the name "the gateway to the desert".

Table 05 – general information about Biskra-Algeria

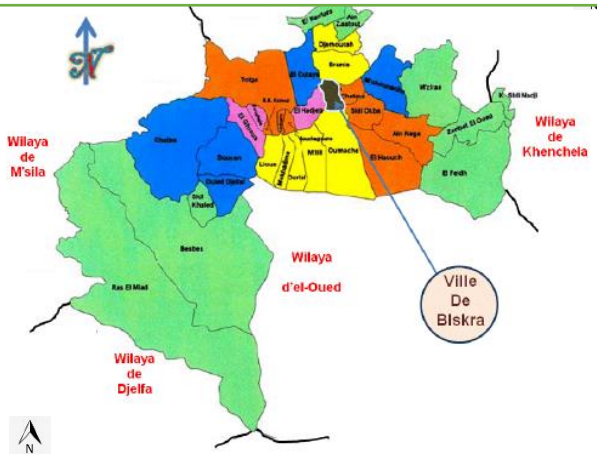
population	area	location	average density	density variation	wilaya of Biskra
735,921 inhabitants in 2005	21509.80 Km².	-425 km southeast of Algiers, -243 km south of Constantine, -220 km north de Touggourtet -113 km east of Bou Saada.	34 inhabitants / square kilometer	the main city reaches up to 1650 Inhabitants / Km² on the other hand to the town of El Besbes does not exceed 3 Inhabitants / Km².	contains 12 daïra enveloping 33 communes.

source : DPAT of Biskra. Cited in: SRITI, L; 2012, D.P.A.T from Biskra.

Surrounded By:

- North the wilaya of Batna.
- South by the wilaya of El-oued.
- North east by the wilaya of Khenchela.
- North oust by the wilaya of Msila.
- Southwest by the wilaya of Djelfa.

Figure 28 – Biskra city Surrounds



source: D.P.A.T de Biskra

1-2 Presentation of the city of Biskra:

1-2-1 Geographical location:

The city of Biskra is located in the southeastern side of the country, under the slopes of the Aurès mountain mass, which is a natural separation between it and the north. With its location, Biskra is considered the gateway to the desert, and a link between north and south. It is characterized by good connectivity through the various national roads it penetrates, including the national road No. 03, the natinal road No. 46 and the national road No. 83.

Figure 29- image by satellite of Biskra.

Source Google Earth

Biskra is also located in the southern foothills of the Saharan Atlas (Aurès), which gives it an arid climate: cold in winter and very hot in summer. These particular aspects of geo-climatic and topographical factors have played an essential role in the development of the region in general and the city in particular.

1-2-2 Site and location :

A . The situation :

The city of Biskra is located in a hinge zone between the Tell and the Sahara, it is the main city of the wilaya and occupies an area of 127.55 km2, it is limited:

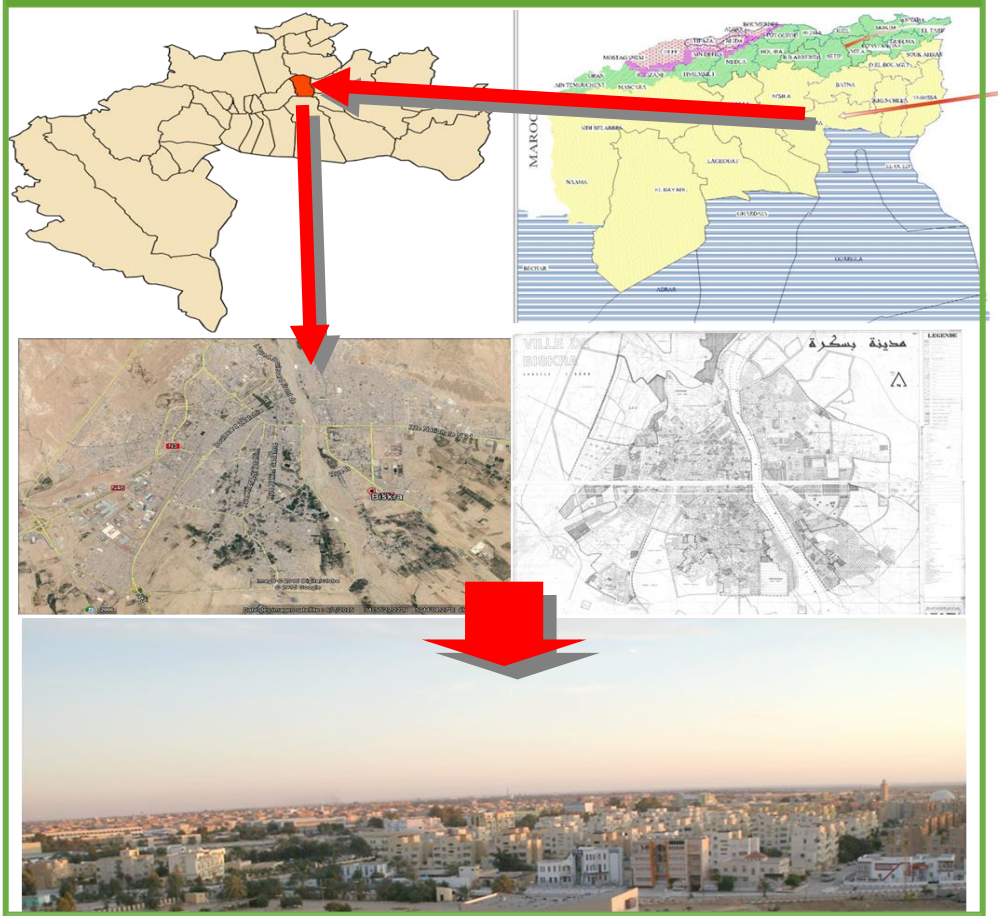
- In the North by the municipalities of Branis and El Outaya.
- In the East by the commune of Chetma.
- In the South by the municipalities of Oumache and Sidi Oqba.
- To the West by the commune of El Hadjeb.

B. the site :

The city of Biskra is located at the foot of Jebel Boughezel and is crossed from north to south by wadi Biskra (wadi Sidi Zarzour), a huge wadi which origin

ates in the Aures mountains. The site on which the city was founded is established on a huge area of plains which represents about 80% of the total

Figure 30 – Biskra location and site.



source: Google Maps Earth,PDAU-Biskra.

area of municipal. North of the city, we find an area with very rugged relief which occupies about 10% of the municipal area.

C - Administrative data:

Biskra appeared as a municipality under the decision of May 1878 subject to the decision of the Senate of April 9, 1889; After that, the administrative division

was as follows: Biskra was a department of the state of Aures until 1974, after which it was promoted to a state according to Law No. 04-84 of 04/02/1984 and beyond.

1-2-3 The importance of the location of the city of Biskra:

Several main axes

- The city of Biskra has several main axes linking it with the rest of the cities, and the importance of these axes has increased significantly, and they are these axes, including the south of the national road No. 3, the axis east of the west of the national road No. 46, in addition to the national roads with numbers 83,87,31 Its presence at the intersection of the main axis connecting the north and the south was the cause of the urban growth of the city.

Railway / Airport

- In addition to the land axes, there is a railway line and an international air line.

Strategic location

- It has a strategic location between the various states, which distinguishes it with high polarization.

Oasis

- Biskra is the most important oasis in Algeria, as it is characterized by its abundant production of high-quality dates. The hot mineral sources, including the Al-Salihin bath, the Sidi Hajj bath, and others

Good living conditions

- (availability of housing, availability of service equipment) was behind the rapid displacement of the population, which created chaotic neighborhoods

The industrial development

- that the city witnessed through the presence of many factories that brought labor from all states.

Tourism

- The mineral complex, Hammam al-Saleheen, which attracts residents for medical treatment and tourism.

1-2-4 History of the city of Biskra:

Urbanization of The contemporary city:

- Born as an intra-palm plantation city, Biskra developed during the colonial era as built-up area in the open countryside, garrison town, checkerboard layout, characterless architectural. The popular and dense suburbs have formed on its fringe south, wedged between colonial core and palm grove. These limited spaces were not on the scale of the great expansion of recent decades. This first involved a thrust to the west which, crossing the railway, created the western habitat zone and the zone industrial. Then, the topography quickly limiting the possibilities in this direction, a push more recent led to cross the Biskra wadi and to create on the left bank the area of habitat East, the University, various equipment. four bridges allow today to cross the wadi, 500 meters wide.

Architecture and city planning of Biskra the contemporary city:

- At present, the transitional management phase on a national scale due to the new Algerian legislation, the city of Biskra experienced a controlled spatial occupation and rational (by the presence of urban management tools and control instruments such as: P.D.A.U and P.O.S on an urban scale and building permits on an architectural scale).

(HANAFI ABDELHAKIM . (2018)).

2 - Natural data:

2-1 Position:

Position is the Placement and its defined as the land on which a city is built and the area occupied by its built up mass. The city of Biskra is located at the confluence of the Aures and Zab mountains , on an altitude of 128 meters above sea level. It is located on a surface capable of reconstruction in most of it in an area slightly domed and tilted towards the south, open to the desert.

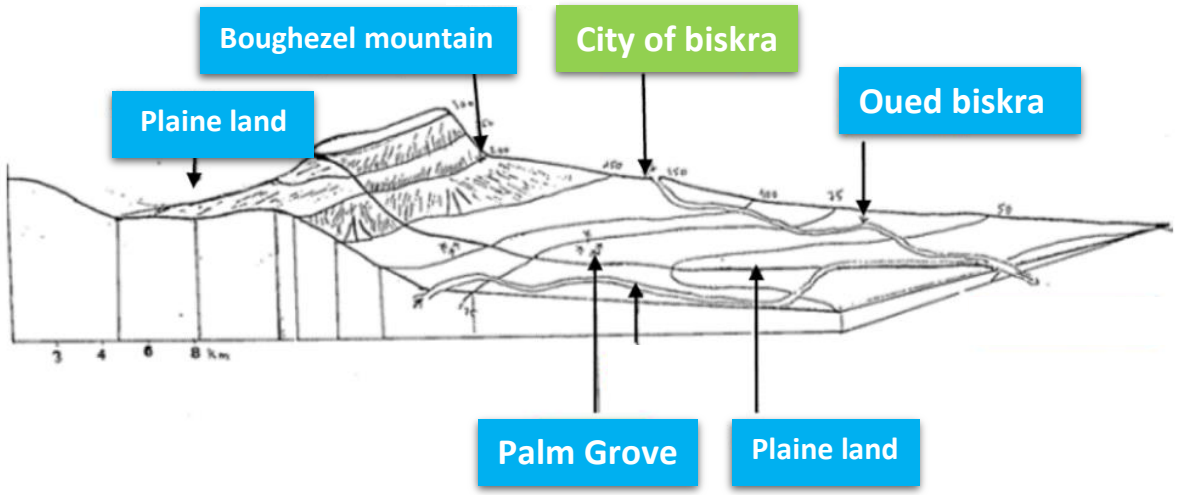
In altitude, it is located in the north, where it reaches a height of 150 meters above sea level, while its lowest land is located in the south, where its height is less than 95 meters above sea level. The valley of Biskra passes through the city,

which is characterized by its sudden floods, where its width ranges between 400 and 500 meters.

2-2 Topography and morphology of the area and regressions:

The slopes enable us to identify areas that must be avoided when building and that constitute an obstacle to signing the networks and cost a lot of money to prepare and use these lands. the slope is (0-2)% which is the characteristic category of the city area, with a very weak slope represented in completely flat lands that do not require large costs in the preparation operations as they are characterized by easy connection to the networks and their weak drainage of rainwater, but their ability to build may be Not large due to its exposure to floods and the sensitivity of the land below.

Figure 31 - Topographic section of the city of Biskra .



Source: topography map of Biskra BOUZAHZAH.F.2015

2-3 Climatic characteristics:

Figure 32 – meteoblue logo

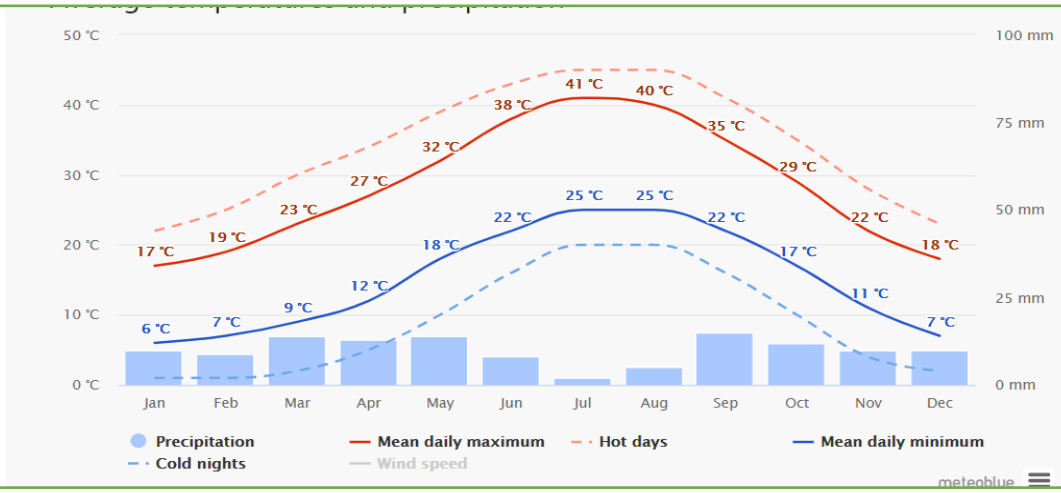
Source: meteoblue.com

General information: Since 2007 meteoblue has archived weather model data. In 2014 it began calculating weather models with historical data from 1985 onwards, and produced a 30-year continuous global archive of hourly weather data. Climate charts are the first simulated climate data publicly available on the Internet. The city of Biskra climate is semi-arid to arid, the summer is characterized by hot and drought, and the winters are cold and dry as well.

2-3-1 Average temperatures and precipitation:

The "mean daily maximum" (solid red line) shows the maximum temperature of an average day for every month for Biskra. Likewise, "mean daily minimum" (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average of the hottest day and

Figure 33 – Average temperatures and precipitation .



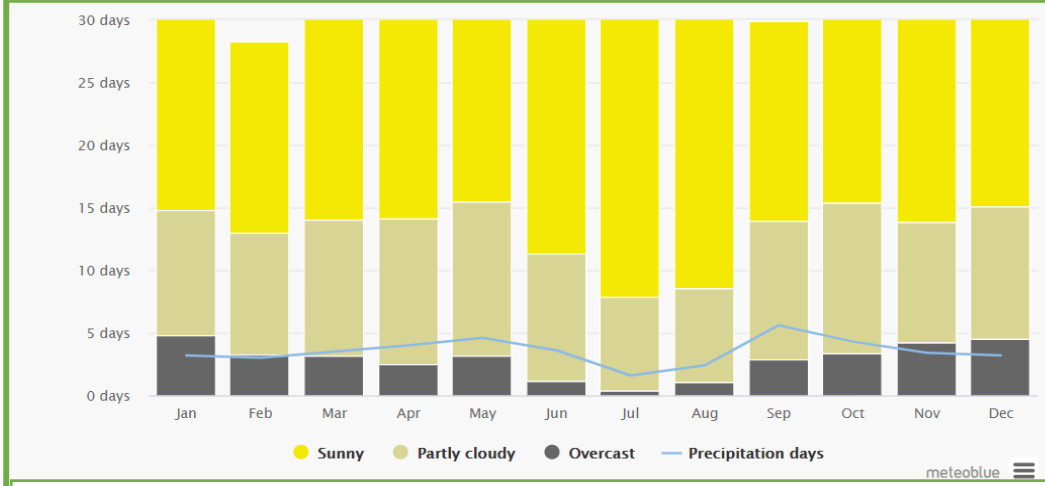
source: meteoblue.com

coldest night of each month of the last 30 years, you can expect the mean temperatures, and be prepared for hotter and colder days.

2-3-2 Cloudy, sunny, and precipitation days:

The graph shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast.

Figure 34 – Cloudy, sunny, and precipitation days

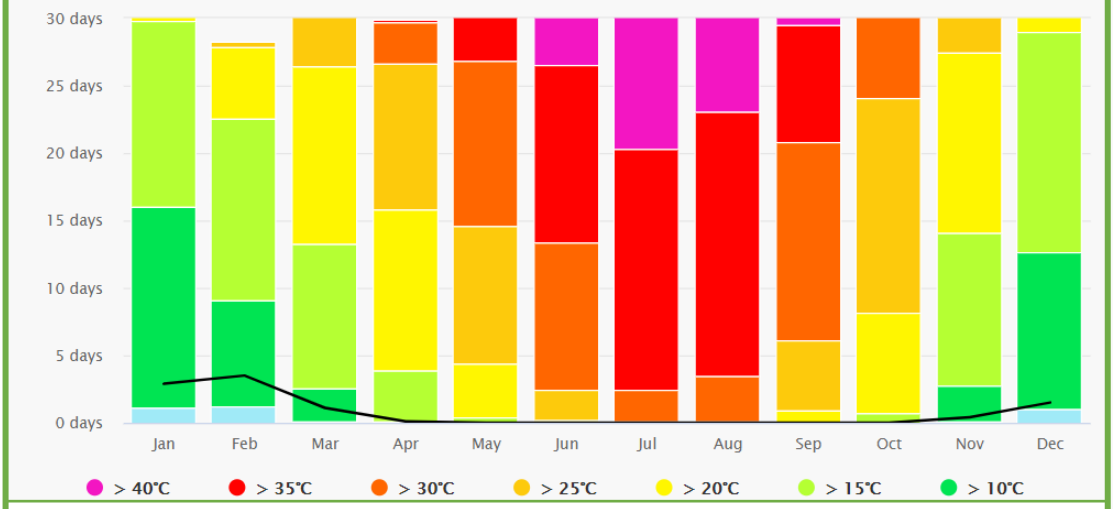


source: meteoblue.com

2-3-3 Maximum temperatures:

The maximum temperature diagram for Biskra displays how many days per month reach certain temperatures.

Figure 35 – Maximum temperatures (source: meteoblue.com)



source: meteoblue.com

2-3-4 Precipitation amounts:

The precipitation diagram for Biskra shows on how many days per month, certain precipitation amounts are reached. In tropical and monsoon climates, the amounts may be underestimated.

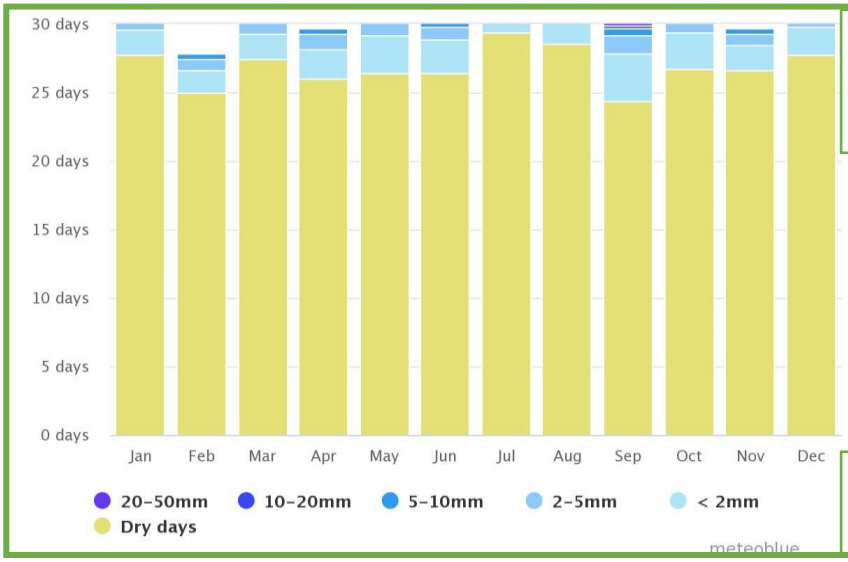


Figure 36 – Precipitation amounts

source: meteoblue.com

2-3-5 Wind speed:

The diagram for Biskra shows the days per month, during which the wind reaches a certain speed. An interesting example is the Tibetan Plateau, where the monsoon creates steady strong winds from December to April, and calm winds from June to October. Wind speed units can be changed in the preferences (top right).

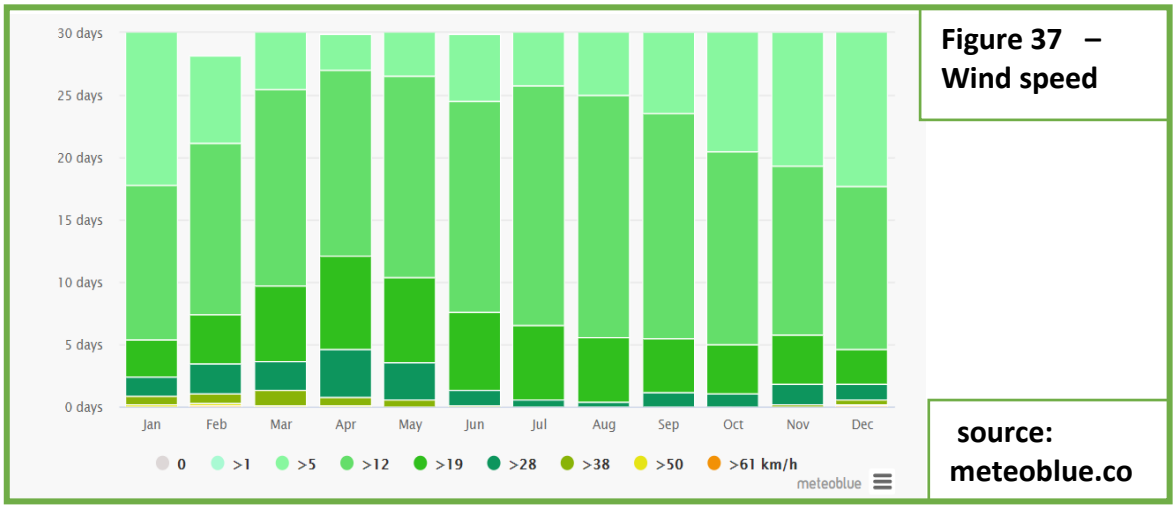


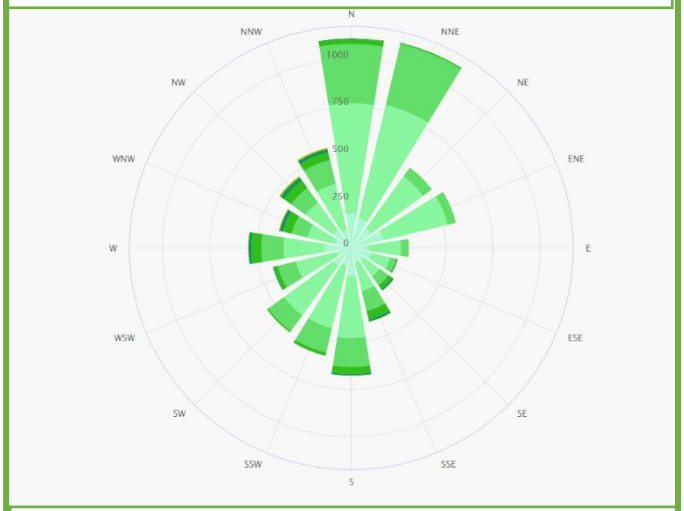
Figure 37 – Wind speed

source: meteoblue.co

The wind rose:

The wind rose for Biskra shows how many hours per year the wind blows from the indicated direction. Winds in arid climates vary gradually over the same day, rather weak at the start of the day and peak in the afternoon, warm winds dominate these regions and are often laden with dust. The diagram shows the means

Figure 38 – wind rose



source: meteoblue.com

(meteoblue.com.(2014)).

2-4 Biskra's climat data:

Air temperature:

- In hot and dry regions, there are large daily amplitudes of air temperatures, but also annual amplitudes are also important The maximum daily average In Biskra, at the edge of the northernmost of the desert, the average maximum temperatures are 41-42 ° C in July - August with, however, peaks of 48 ° C - 52 ° C during invasions of superheated air that comes from the south.

Solar diagram:

- July is the most important month hot of the year. January is the coldest month of the year (Berghout B, 2012). The average temperature is 11.8 ° C during this period. The heat record is of 48 ° C recorded on Friday July 13, 2012 and the cold record of -5 ° C recorded Sunday January 25, 1976

Relative humidity:

- The Biskra region was considered an arid zone, as its name suggests hot climate is characterized by very low relative humidity, between 10 and 50%. It is all it's normal to see relatively low humidity percentages. According to data from Still 10 years of observation (1990-2000) (fr.climate-data.org), we found that the humidity level of the city of Biskra remains low and therefore considered dry: it is around 41.54%.

The precipitations:

- A day of precipitation is a day during which we observe an accumulation of water, measured at least 1.00 millimeter of water. Probability of precipitation days in Biskra varies throughout the year, with a higher probability of daily precipitation 8 %. The drier season lasts 2.4 months, from June 10 to August 23. The probability of the lowest precipitation is 2% on July 10 .The Biskra precipitation diagram shows small amounts of precipitation of 2 mm July (the driest month of the year). In September, the precipitation is the largest of the year with an average of 23.6 mm.

Solar radiation:

- In these so-called arid regions, the sun's radiation is very intense, especially in summer. The surfaces in these environments are heated by the sun's rays during the day and will cool overnight. The length of the day in Biskra varies significantly over the course of the year. The shortest day is December 21, with 9 hours and 49 minutes of daylight; the most day long is June 21, with 14 hours and 30 minutes of daylight. Incident solar radiationreaching the ground surface in a large area, taking full account of variations seasonal length of day, the height of the Sun above the horizon, absorption by clouds and other atmospheric components.

(Guedouh Marouane Samir. (2018)).

2-5 Biskra to a contemporary Saharan city (today):

Biskra (gate of the desert), (Queen of Ziban), of the names given to this city, by its oasis status, its strategic position and its geographic location at the gates of the desert Algerian. Biskra has experienced a development of a new dimension, in addition to a quick mutation; especially after the administrative division of 1974, where she was promoted to wilaya. From now on this city has not known how to preserve its urban and architectural specificity than it possessed; the tertiary and service sectors take the place of the primary sector. Or we count that a palm tree for 10 inhabitants in the year 2000, while it was 7 palm trees for each inhabitant in 1962. And it ends by a modernist society which replaces traditional customary society. (ADAD, M.C. et al ; 2002) All these and other factors in interference resulted in the Saharan city contemporary (of today) of Biskra; where the latter from a green Saharan city to a city in the Sahara. (HANAFI ABDELHAKIM . (2018)).

2-6 Vegetation in Biskra:

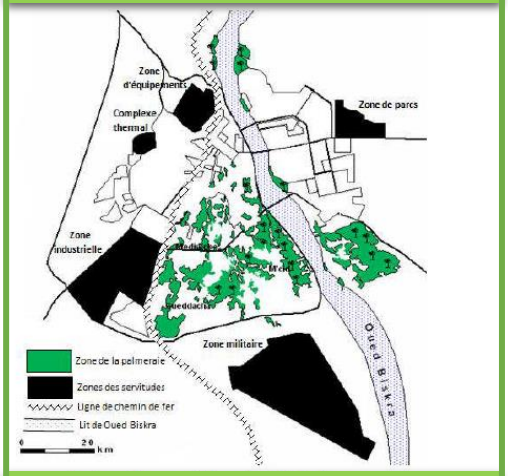
The city of Biskra lost during its growth its green cover (the palm grove) and whose urban expansion was at the expense of the latter. With vegetation (green cover, palm grove), 'the Biskris' were able to adapt to their physical environments, where the context was respected, despite the austere climate in this region. Note that the number of palm trees compared to the number of

inhabitants decreases over time, where we recorded 24 palm trees / person in 1904. However, it decreased to 01 palm trees / person in 2009, what does it mean, a deficit of 23 palm trees since 1904 to 2009 per person. (HANAFI ABDELHAKIM . (2018)).

Figure 39 -vegetation The city of biskra .

source: google earth .2006

Figure 40 - The city of biskra green cover .



source: google earth .2013

2-7 The plants / the trees, in the city of Biskra:

We are not going to talk here about the palm tree and its types in the city of Biskra since it knew by same better quality of dates but it is obvious to know the other types of plants existing in this city. So it should be noted that the garden July 05, London garden, square August 20, Mohamed Zidane garden, Bachir Ben Nacer garden, November 1 garden and others of the city of Biskra were home to multiple plants from all over the world.

Table 06 - types of plants existing in the city of Biskra-Algeria.

Brazilian yuccas (Yucca Boscii),	**Carolina (Yucca brevifolia)**	**Texas (yucca (rigida)**	**mimosas**
Farnese acacias (Acacia farnesiana),	**latan trees (Latania lontaroides),**	**fragrant gum trees**	**false pepper trees (Schinus molle)**
royal (Roystonea regia)	Java (Corypha elata)	coconut palms (Cocos nucifera)	roses, carnations

lilacs Saharan	blood oranges	mandarin trees	Ficus Opuntia ficus-indica)
indian fig trees (and pagodas (Ficus religiosa)	cypress, tamarisk, red hibiscus	purple lianas bougainvilleas	blackcurrant-gum trees

source: MAAOUI, M.2014

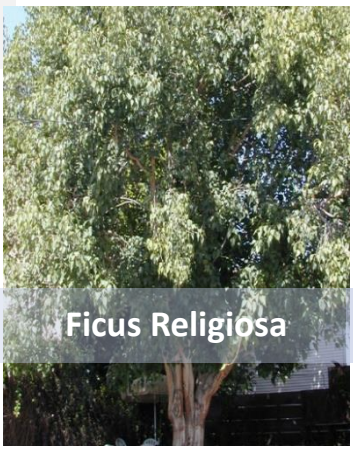
Recalling that our study aims to produce shade by inserting urban vegetation (the tree urban). The tree chosen was indeed the "ficus". Species, Ficus retusa; family, moraceae; his common name, ficus. It is of the tree category of tropical origin; of the persistent type; dense erect habit; rapid growth. In addition, its been in the city of Biskra for a long time and it resists its climate. (HANAFI ABDELHAKIM . (2018)).

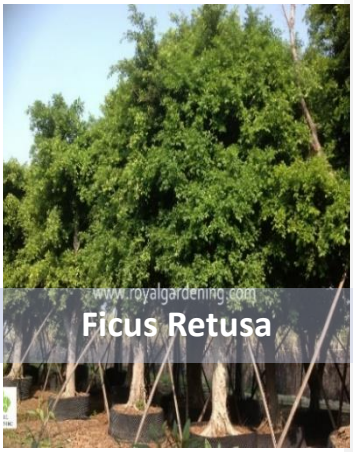
Figure 41- Types of ficus tress

Fig tree Sycamore from Central Africa, height up to 20 m high and 6 m wide, persistent type, pretty crown shape dense, spreading habit and rapid growth

Caoutchouc origin tropical Asia, height 3 m, persistent type, Irregular shape, and rapid growth

Pagoda fig tree origin India and Asia from the south-east, height 3 m to 6 m ,Caduc type, open crown shape, and rapid growth





Ficus tropical origin, height 3 m and 6 m large, persistent type, shape Dense and erect habit, very long service life And rapid growth

source : : HANAFI ABDELHAKIM.2018

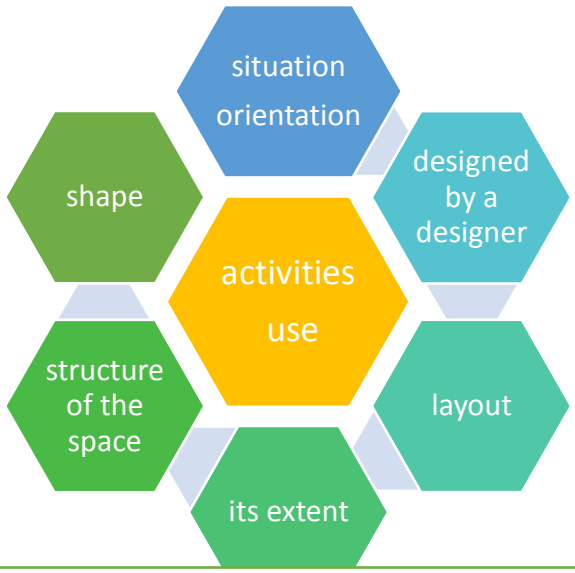
3- Field-of-study analysis

3-1 Choice of place for study:

The selection of the place for analysis and study was based on a classification which meets the objectives of our research then selected by (graph 42)

The city of Biskra contains several public places and lots, we chose according to criteria cited above Ben Badis square.

Figure 42 - Choice criteria

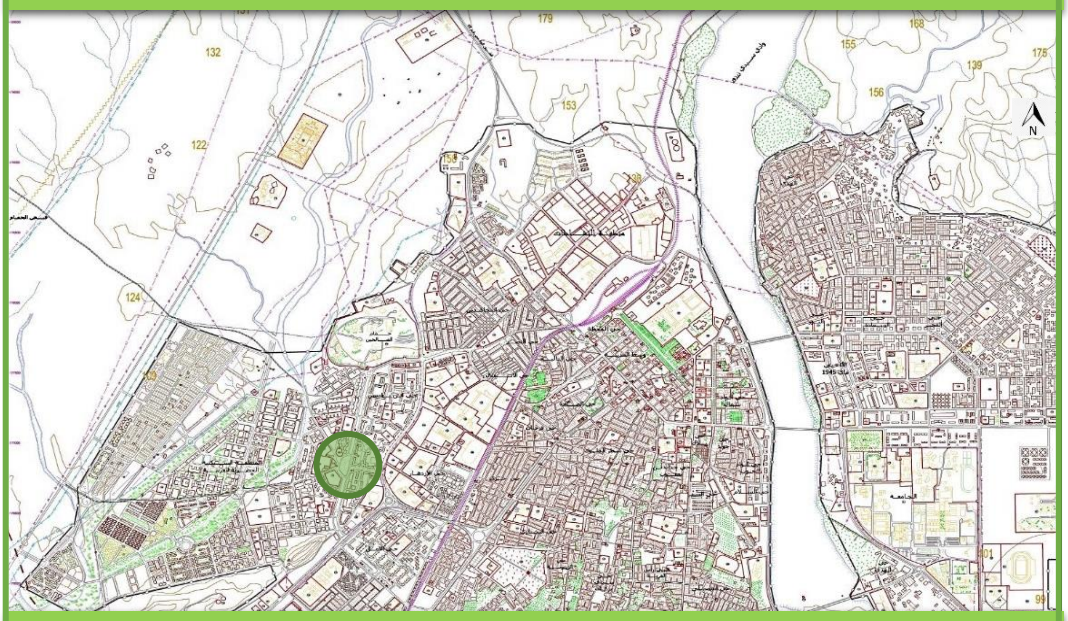


source: Author,Biskra,2020

3-2 Ben Badis / Biskra square:

Place Ben Badis (in the Ben Badis city from which it takes its name), is located in the West, where it is part of the Seddik Ben Yahia alleys Biskra . Its layout designed by the architect: ZERNAJI chérif (architect at DUE / APC Biskra) and the development work was completed in: 2001. Ben Badis square is trapezoidal .

Figure 43- Ben Badis / Biskra square location .

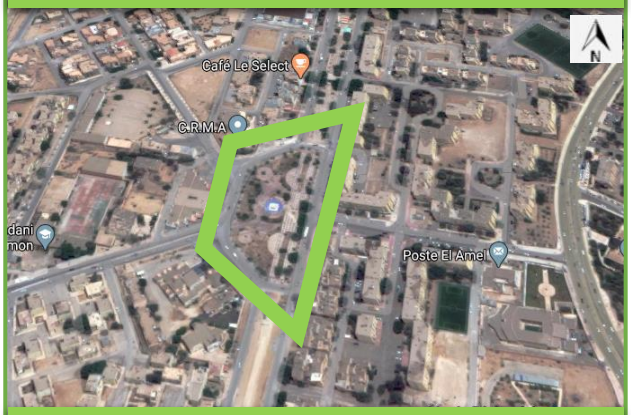


source: PDAU Biskra.2014

3-3 Position (Typo-morphological analysis of Ben Badis / Biskra square):

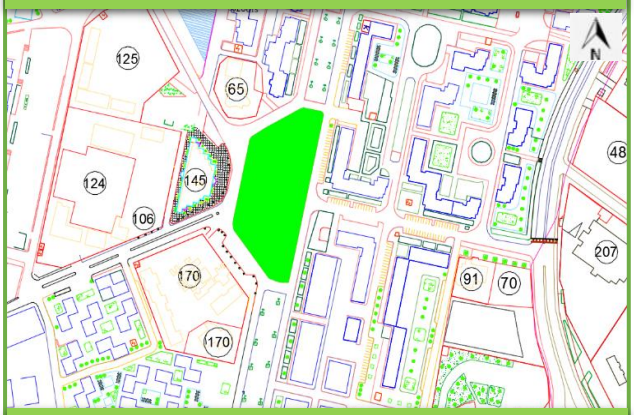
The place takes place within a city (collective housing type) surrounded by administrative establishments OPGI, a civil status office, the bank C.R.M.A, a clinic and others. They are only minorities compared to the residential activity where it dominance. these activities hardly influence the animation and the frequentation of the place, since it is used as a passage most of the time .

Figure 44- Ben Badis / Biskra square



source: google maps. 2020

Figure 45- Ben Badis / Biskra square



source: PDAU BISKRA. 2014

its limited to:

Figure 46-North Regional Fund for Agricultural Cooperation N65

source: Author,Biskra,2020

Figure 47- South Heath centre N170

source: Author,Biskra,2020

Figure 48- West Commercial shops N145

source: Author,Biskra,2020

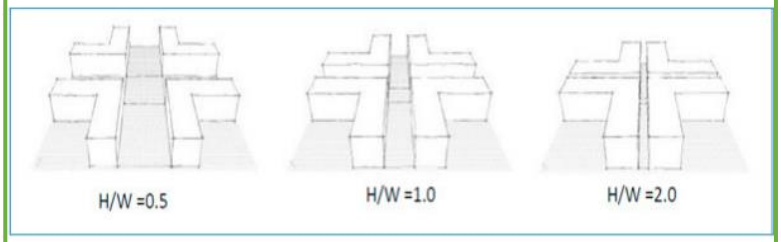
- East: Hai Ben badis (720 residence.)

The place of Ben Badis square before being developed and whose boundaries have hardly changed. was an asphalt surface considered as a street pavement, intended for parking of city residents' vehicles during the night and the exposure of goods from the weekly market on Thursday.

3-4 Urban typology and the green spaces of Ben Badis / Biskra square:

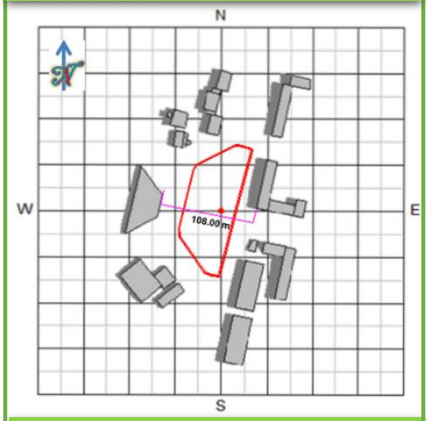
Recalling different classes of urban typology , the free space H = 0.25W. So the Ben Badis public square is classified as a cleared (cleared) urban public space since H of buildings = 6 m and W = 108.00 m.

Figure 49-The relationship between the architecture facade and the section of the street in three geometric patterns .(H≥2W, H=W, H≤0.5W)-.(Open Street, dihedral street, Canyon street)



source: khaled authmaina

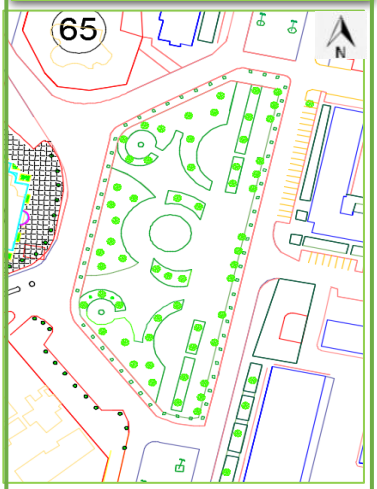
Figure 50-Ben Badis square ground plan



source: RayMan, A. Hanafi.2018

The place is determined by an orthogonal layout of which it has a regular shape, in as a whole it is limited by public streets in all its sides what allows the access to the place from different directions. The layout of the place seems like passages between a green space. A total surface of: 6479.00 m² including 2277.25 m² green space and 4201.75 m² paved space. (HANAFI ABDELHAKIM . (2018)).

Figure 51-Ben Badis square green spaces



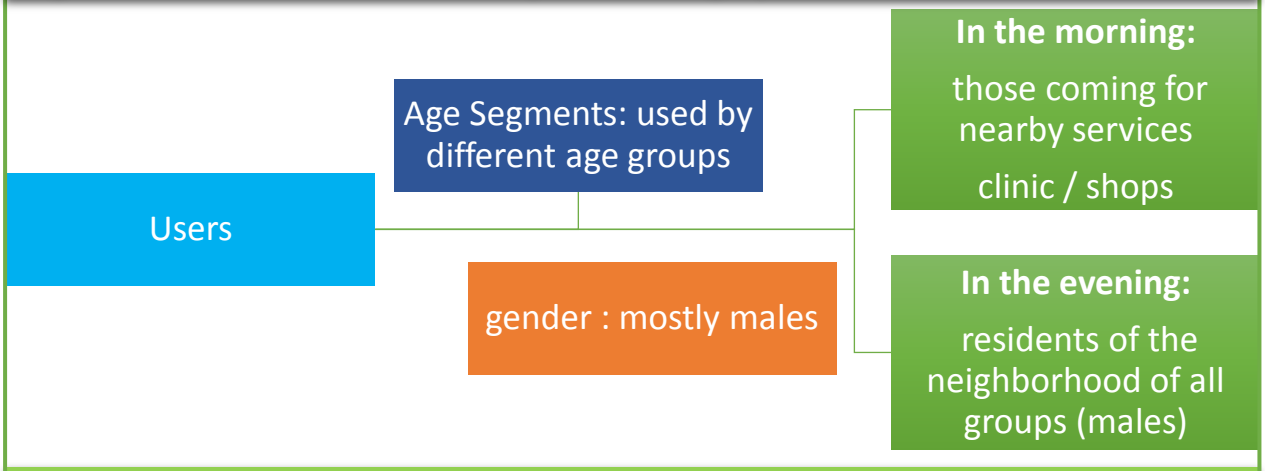
source: PDAU-Biskra 2014

3-5 The structure of the square users:

We can approach the demographic data in its utilization context, because one cannot imagine a preservation of a natural space without one ability to perceive its usefulness its advantages and its necessity in an urban environment.

An approach in this direction is expressed quite simply, by means of a representation of the structure of the users of the space according to the Observation of the author , Biskra, 2020. We can note that its used by the neighborhood residents from all ages but only by the male gender , and the administrative / health / commercial establishments (OPGI, a civil status office, the bank C.R.M.A, a clinic) and others. They are only minorities compared to the residential activity coming from the neighborhood residents.

Figure 52- The structure of the square users graph



(source: Author,Biskra,2020)

There is a strong link between the nature of people who use the space and the quality of life in an urban environment In other words, in general they can cause a real major impact on the urban space mode and life style, a principle of causality.

3-6 The state of the place:

We note the abandonment and total neglect of either the green space or the monument central which is unfinished since the reception of the place in 2001.

Figure 53- Lack of shadows

source: Author,Biskra,2020

Figure 54- Poor green spaces

source: Author,Biskra,2020

Figure 55- Empty planters

source: Author,Biskra,2020

Figure 56- Tranches uncovered

source: Author,Biskra,2020

Figure 57- Empty spaces

source: Author,Biskra,2020

Figure 58-Unfonctional wet-area

source: Author,Biskra,2020

As we can see in the following pictures how neglected the space is . broken floors , planters , lack of green spaces , garbage everywhere , water leaks , poor shading uncared for plants , over grown grass up to 1.00 m in Hight …

Figure 59- Empty spaces

source: Author,Biskra,2020

Figure 60- garbage everywhere

source: Author,Biskra,2020

Figure 61- unmanaged borders

source: Author,Biskra,2020

Figure 62- uncontrolled grass

source: Author,Biskra,2020

Figure **63- wild grass**

source: Author,Biskra,2020

Figure **64- broken planters**

source: Author,Biskra,2020

Figure **65- dead grass**

source: Author,Biskra,2020

Figure 66- - Large open uncovered spaces

source: Author,Biskra,2020

Figure 67- The lack of trees

source: Author,Biskra,2020

Figure 68- No shade

source: Author,Biskra,2020

Figure 69- Dead green spaces

source: Author,Biskra,2020

Figure 70- Dead hot spaces

source: Author,Biskra,2020

Figure 71- Unshaded seating areas

source: Author,Biskra,2020

Different photos of the space The space main problems that impact the thermal comfort

3-7 The importance of the location:

The public square of Ben Badis is characterized by an important location for the city. The reason for its importance is due to the availability of its location on several advantages and Important elements, namely:
• It is located on the centre of a wide variety of main roads that surround the space.
• Next to a very important locations such as administrative establishments OPGI, a civil status office, the bank C.R.M.A, a clinic, Shops area and others .
• It has a positive effect on the the city .
• A meeting point for the residence of the area .

4- Investigation:

The approach followed in this work aims to highlight the role of vegetation (urban vegetation), on the thermal comfort of the public square We will see the degree of influence of the vegetation on the reduction of the factor opening to the sky (SVF), Mean radiant temperature (MRT). We calculated the thermal comfort index (PET), the index (PMV), and ran these factors through a simulation by Rayman software .

4-1 Methodology:

Our case of study is The public square of Ben Badis plays a very important role of identification and orientation, it constitutes a particular space, especially by the inclusion of different types of daily, weekly and occasional activities, this The public square is poor in vegetation except the existence of some palms that offer shade in some times of the day. This public square is very crowded during almost the whole year except for the hot summer days for the lack of shade and water elements . In order to evaluate the effect of vegetation on outdoor

thermal comfort into this public square, a series of measurements were collected; the measurements were performed in summer during the very hot season in the month of July 2016. The simulation will be done by the software RayMan Pro; the software can analyze complex urban structures and other environments (building and tree). It requires.

only basic meteorological data (air temperature, air humidity, type of sky and wind speed) for the calculation of radiation fluxes, soil temperature and common thermal indices **(PMV, PET, (MRT), and SVF).** It is taken into consideration the geographical coordinates of the site studied .

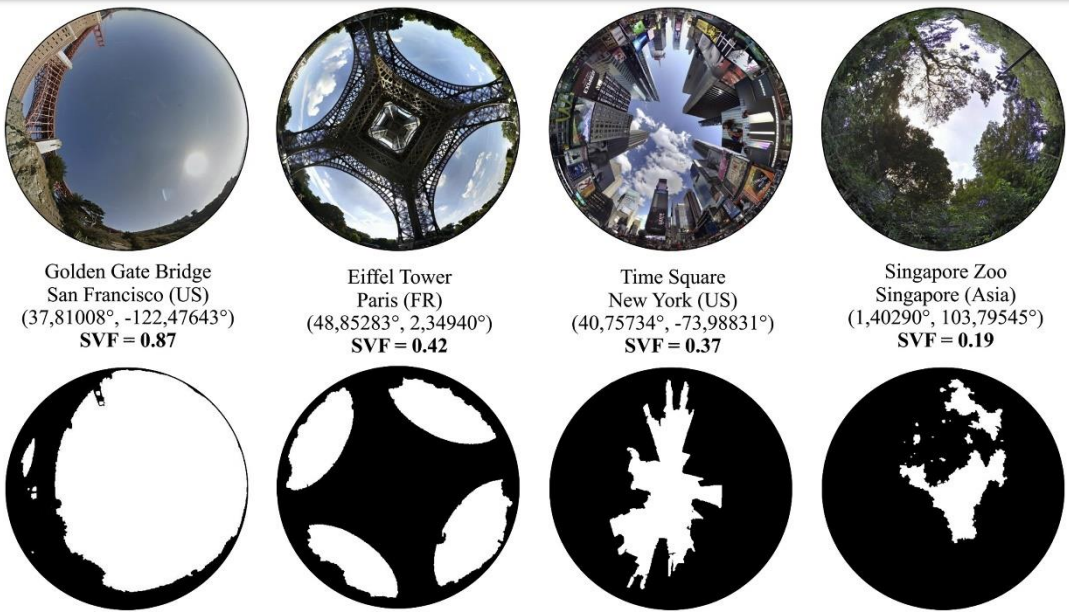
The first step: is to simulate the current state of the public square in other words to calculate the global radiation, soil temperature, PMV, PET, MRT, and SVF and the shadow during the day.

The second step: is to propose a type of vegetation useful for our case ; the choice is based on the maturity of the tree, its height, the size of crown, the density of foliage and its adaptability to the plaza (soil temperature and humidity). Note that the large crown size of the tree ensures more shade, especially at noon when the sun is at the azimuth state .

4-2 Sky view factor (SVF):

The SVF factor (Sky view factor), allows researchers to evaluate the exchanges of heat by radiation between the studied space and the sky. The latter can be obtained by calculation (formula) or by simulation. Its value is between 0 and 1. If the value of the SVF = 1, so the studied space is isolated; and if the value of SVF <1, means that space is blocked. This factor is considered a morphological factor important and essential in the impact on the microclimate.

Figure 72- Fisheye photographs generated from Google Street View



source: Matthias Demuzere

4-3 Mean Radiant Temperature (Mrt):

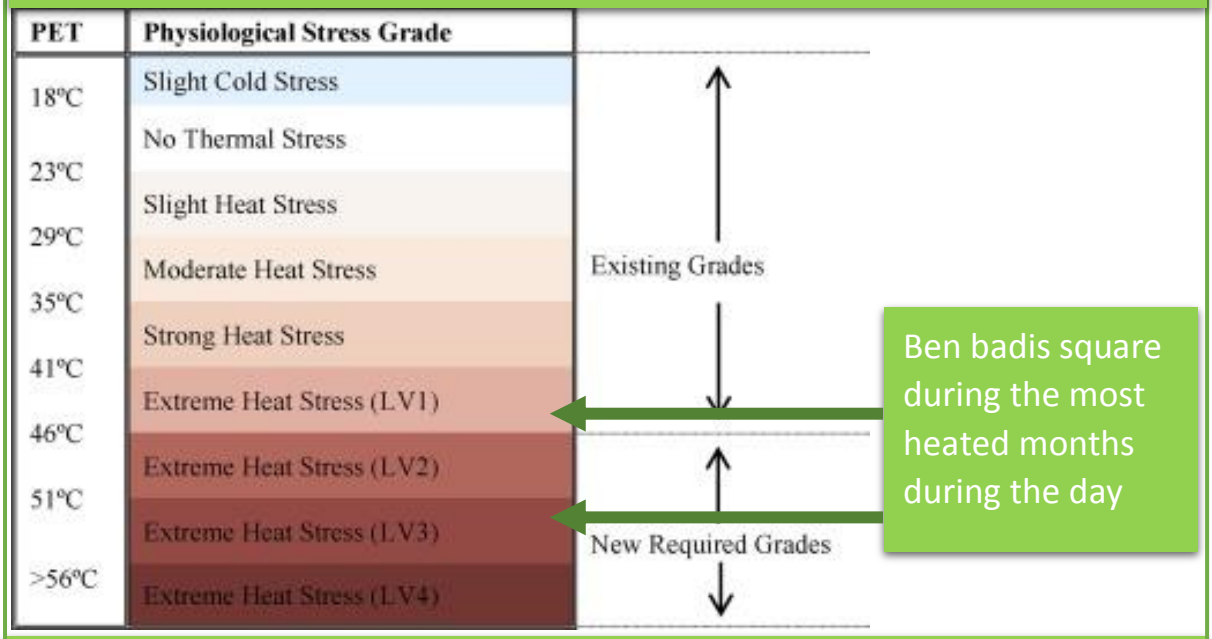
The mean radiant temperature is considered to be an indicator thermal, integrating several exchange systems. Mrt is an important variable in the evaluation of thermal comfort in outdoor spaces and in sunny weather. We can have the Mrt by measuring the surface temperatures, or by calculation at through a simulation. The radiative balance is linked to the nature of the soil surface. It depends indeed of its albedo, (emissivity, thermal conductivity and evaporation) and of the air speed.

4-4 Physiological Equivalent temperature (PET):

To assess thermal comfort, several researchers use this index (PET) since it is the most useful medium for different climates. They consider it as an indicator of climate impacts. And they can intervene with this clue, for thermal comfort, either interior or exterior space.

Table 07- Physiological stress grade.

PET	Physiological Stress Grade
18°C	Slight Cold Stress
23°C	No Thermal Stress
29°C	Slight Heat Stress
35°C	Moderate Heat Stress
41°C	Strong Heat Stress
46°C	Extreme Heat Stress (LV1)
51°C	Extreme Heat Stress (LV2)
>56°C	Extreme Heat Stress (LV3)
	Extreme Heat Stress (LV4)



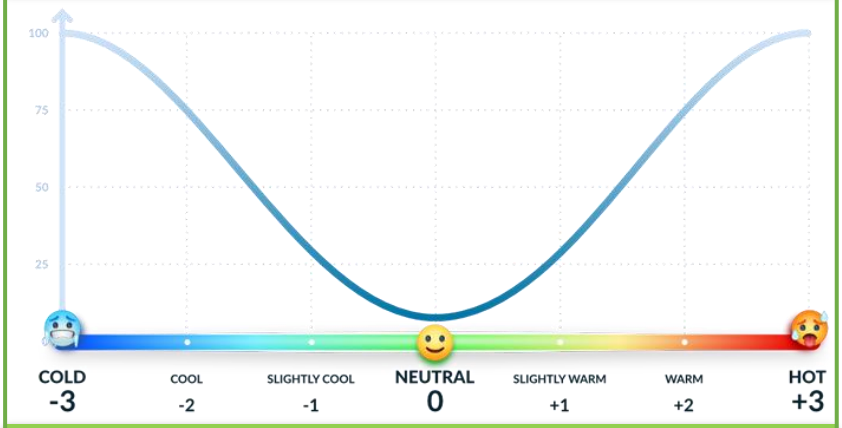
source: A. Santos Nouri 2018

PET is defined as the air temperature at which, in a typical indoor setting (without wind and solar radiation), the heat budget of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions to be assessed. This way PET enables a layperson to compare the integral effects of complex thermal conditions outside with his or her own experience indoors. On hot summer days, for example with direct solar irradiation the PET value may be more than 20 K higher than the air temperature, on a windy day in winter up to 15 K lower.

4-5 Predictable Mean Vote (PMV):

The value of the thermal comfort index PMV, which is an estimate of the expected average vote of a panel of evaluators for a given thermal environment, is calculated by the method developed by Fanger (1972). He established a model of correlation between the subjective human perception, expressed through the vote of comfort on a scale ranging from -3 (very cold) to +3 (very hot), and the difference between the heat generated and the heat released by the human body.

Graph 01- The PMV chart



source: www.simscale.com

The methodology consists, on a series of physical measurements of the parameters climatic (air temperature, relative air humidity, wind speed and coverage of the sky), the thermal, hygrothermal and aerodynamic effect, which directly affect the exterior space studied (the public square, Ben Badis / Biskra). (HANAFI ABDELHAKIM . (2018)).

Figure 73- Environmental and personal factors that influence thermal comfort

source : www.simscale.com

5- Simulation:

It is carried out by the software 'RayMan, 1.2'. This 3D software calculates the radiation (global, direct and diffuse), the ground temperature, PMV, PET, MRT. It takes into consideration the geographic coordinates of the studied site, climatic parameters (air temperature, wind speed, relative humidity and type of sky), the physical environment, simple or complex (buildings and trees) .

The simulation, already mentioned above, was carried out to find out the role of vegetation on thermal comfort. The latter was carried out for three situations in the public square Ben Badis, Biskra.

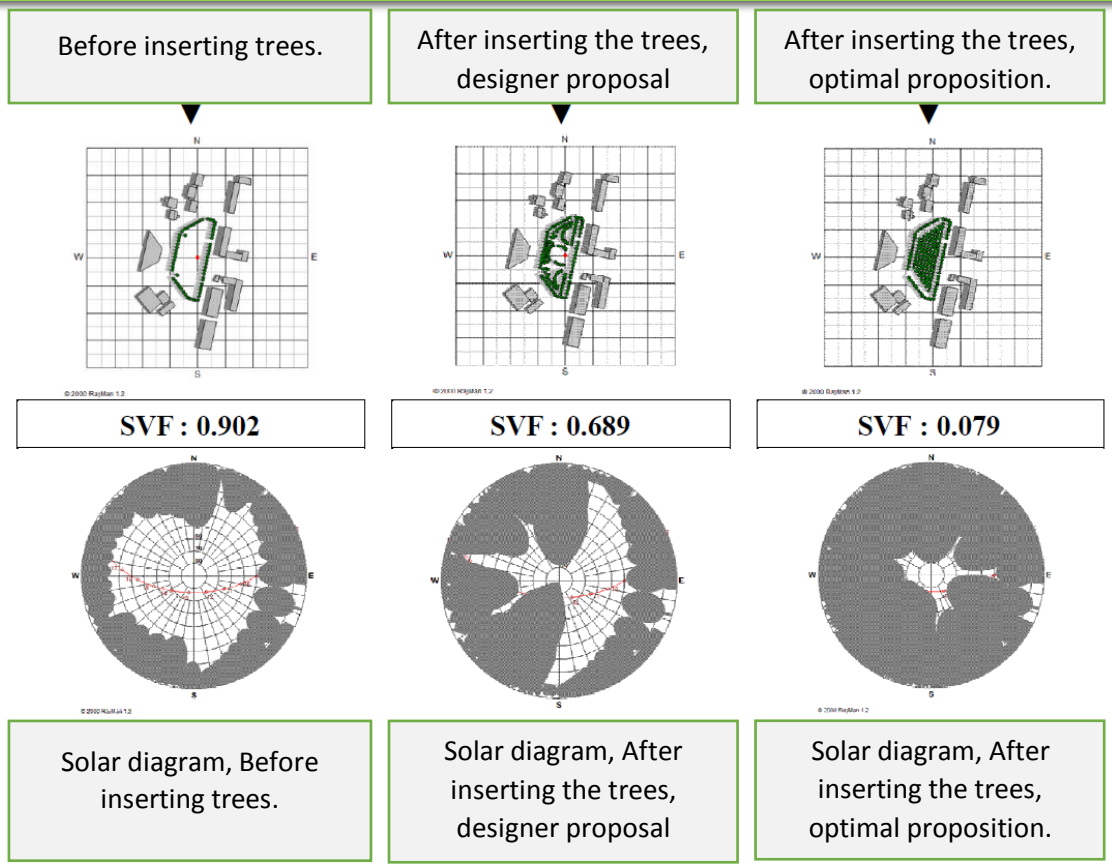
- The first situation in the square, before the trees are inserted, (actual condition).

- The second situation, after the insertion of trees, the designer's proposal. Based on the idea of embellishing the square with rows of trees.

- The third situation of the square, after the insertion of trees is the optimal proposition, to improve the thermal comfort of the public square Ben Badis, Biskra, Algeria.

Using the 'RayMan' software, the shadow was drawn for each period of the day and the SVF was determined.

Figure 74- Diagram relating to the Place Ben Badis / Biskra simulation for different situations.



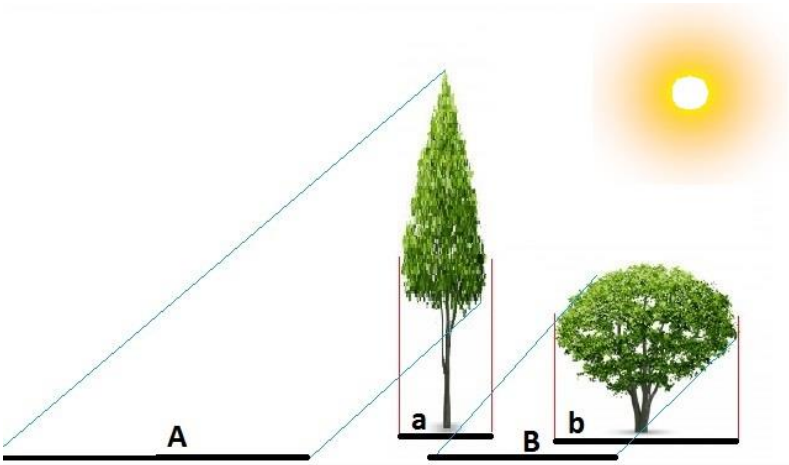
source: RayMan .A. Hanafi.2018

5-1 Choice of the type of urban tree to introduce:

According to the study made by Chatzidimiriou, 2006, there is no tangible difference in soil temperature, between land under tree cover or some other type of cover, at least after 5 pm. Displaying the public square whose objective is to create a mask against the sun's rays would be an adequate solution. The choice of the type of tree useful for this task is based on: the maturity of the tree, its height, the size of its crown, the density of its foliage and its ability to adapt to the location (soil, temperature, humidity).

It should be noted that the large size of the crown of the tree provides more shadows, especially at midday when the sun is in midsky (azimuth. Kotzenn, 200,) confirms that trees with a large crown perform well in arid areas, since it offers a large shaded area.

Figure 75- Comparison of quantity shade created by a large tree crown and another long crown.

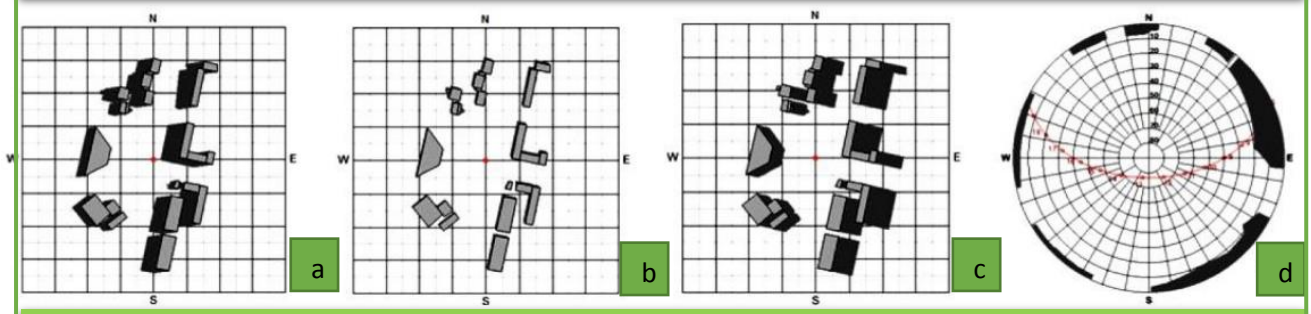


(source: author,Biskra,2020)

Recalling that our study aims to produce shade by inserting vegetation: the urban tree, within the Ben Badis square, Biskra. Indeed the role that the green cover play is sun protection in hot summer days . The choice of tree is the 'ficus'. Species, ficus retusa and Family, moraceae. Its common name is ficus. Its rapid growth. In addition it has existed in the city of Biskra for a long time and it is of tropical origin, of the evergreen type, and of dense erect habit form and harsh climate resistant.

Figure 76- Location of the square before the trees are inserted actual condition:
(a) Shadow path at 8.00 a.m .; (b) Shadow path at 12.00 p.m .

(c) Shadow path at 6.00 p.m .; (d) Polar diagram; SVF = 0.902.

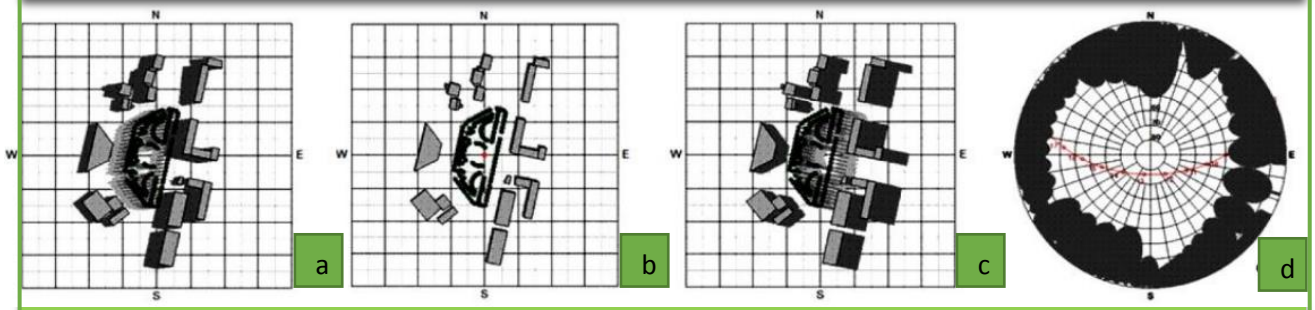


(source: simulation by RayMan A. Hanafi .2018)

Figure 77- Location of the square, after the insertion of trees, proposal from the designer; Based on the idea of embellishing the square, by aligning trees.

(a) Shadow path at 8.00 a.m .; (b) Shadow path at 12.00 p.m .

(c) Plot of shade at 6.00 p.m .; (d) Polar diagram where SVF = 0.508.



(source: simulation by RayMan A. Hanafi.2018)

5-2 Design (rationale):

The figure below presents the optimal proposal of a 'vegetation design', which has given conclusive results, compared to the other cases of vegetation design of the place, with variations.

The designed vegetation is based on two essential parameters:

The first parameter The first is not to vegetate the entire surface of the square. The goal is to leave an area uncovered for users who love the sun. In addition, it is recommended to ensure vegetation with a 60/40 vegetation / built-up space ratio . In our design, we arrived at 65% of vegetated space of the total surface of the place.

The second parameter The second is to meet the criterion of thermal comfort by creating a mask or a natural blanket against the sun's rays.

Figure 78- The establishment of trees doesn't allow the passage of solar rays a real solar mask and what was adopted in our design shows the quality of the shade.

(source: author,Biskra,2020)

'The ficus' provides denser shade, in addition to the type of vegetation design, either by alignment or by mesh .

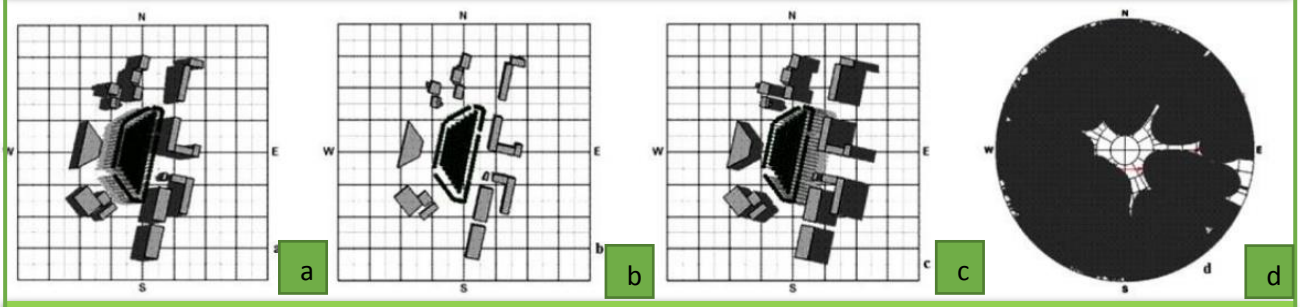
Figure 79- example for trees with

source: www.Grove.com

Figure 80- denser shade mesh

source: cityofpoughkeepsie.com

Figure 81- Situation of the square, after insertion of trees, optimal proposal to improve the thermal comfort of this seat.
(a) Shadow path at 8.00 a.m .; (b) Shadow path at 12.00 p.m .;
(c) Plot of shade at 6.00 p.m .; (d) Polar diagram where SVF = 0.079.



source: A.Hanafi.2018

We see the situation of the place, before the insertion of the trees (real state), with a SVF = 0.902, we see the situation, after the insertion of the trees, the designer's proposal, with an SVF = 0.508. And after inserting trees optimal proposition the SVF is equal to 0.079.

We see that in the third situation (optimal proposition), we were able to considerably reduce the SVF by the insertion of the vegetation and by the way in which it was arranged (green cover). This in turn attenuated the direct and global radiation.

The vegetation has played the role of the mask and protection against solar rays perfectly, where we can see the almost total absence of 'Act direct radiation' throughout the day, except at noon when the sun is at the 'azimuth.

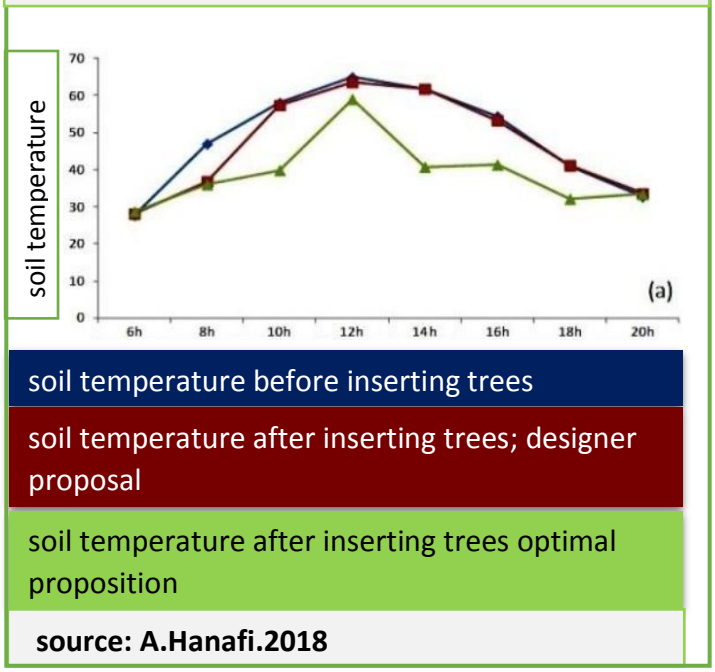
5-3 Act global radiation:

is the total short-wave radiation from the sky falling onto a horizontal surface on the ground. It includes both the direct solar radiation and the diffuse radiation resulting from reflected or scattered sunlight. mean annual variability.

We note that 'Act global radiation' has decreased considerably compared to other situations (before the insertion of trees, the real state and after the

insertion of trees, proposal of the designer) of the urban space studied (public square)

Graph 02- The Predicted Mean Vote (PMV) graph

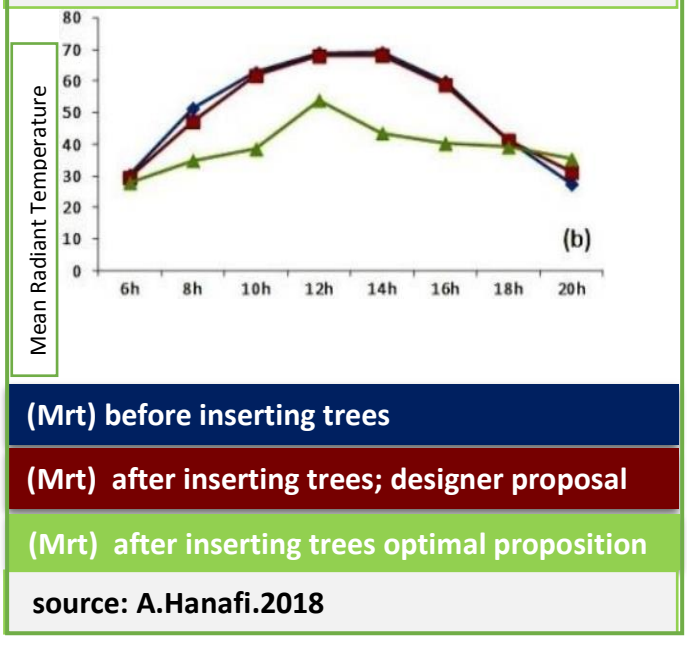


- In the first situation, the ground temperature begins with 27.7 ° C at 8.00 am to reach 64.8 ° C at noon and then drops to 32.7 ° C towards sunset, since the space is exposed to the sun.

- For the second situation, no change, where almost the same temperatures are recorded.

- On the other hand, in the third situation, the difference was palpable, thanks to the presence of the green cover (vegetation). The difference is 20 ° C at 10.00 a.m. and 2.00 p.m. It should be noted that at noon, the difference is minimal, since the sun is in azimuth.

Graph 03- The mean radiant temperature (Mrt) Graph)

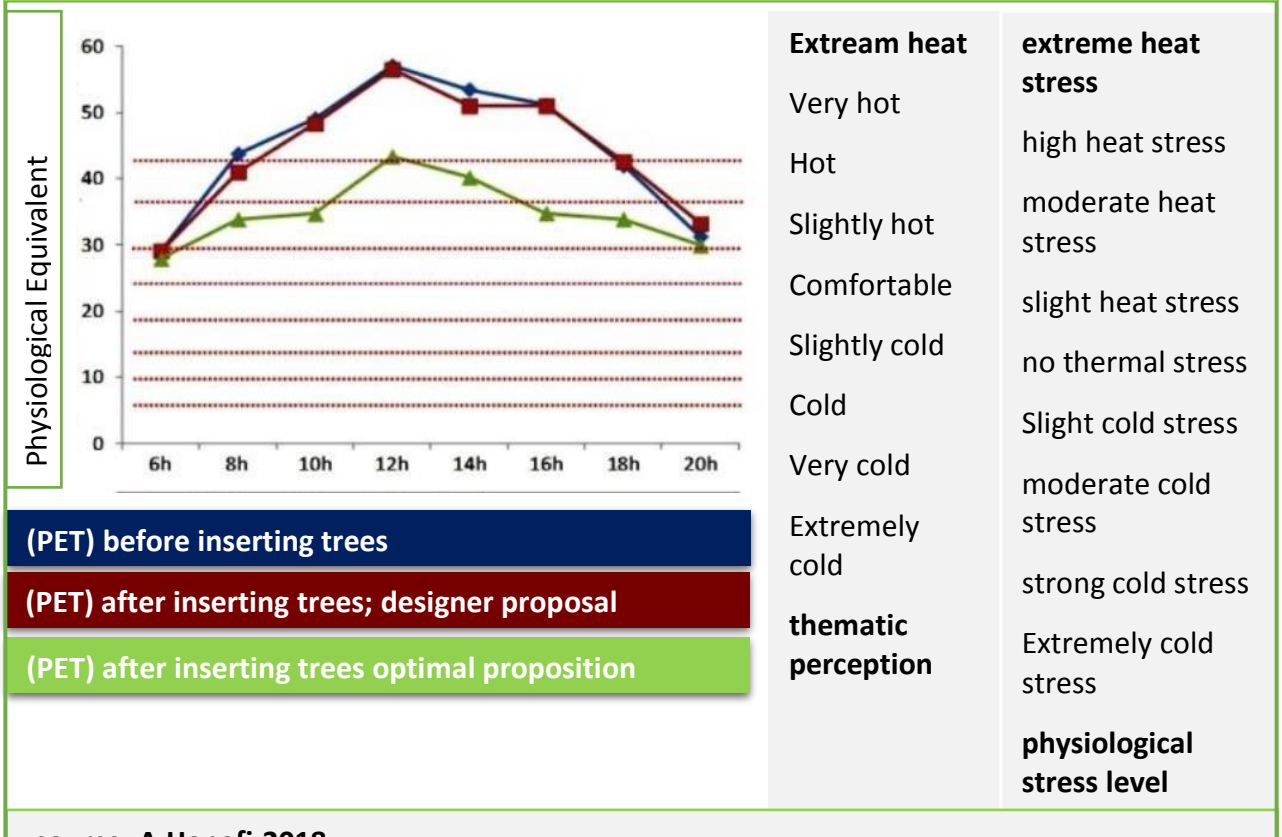


* Regarding the mean radiant temperature in the third situation (after the insertion of trees, optimal proposition), it did not exceed the average of 33 ° C all day except at noon when it was 54.1 ° C.

On the other hand, for the two other situations (before the insertion of the trees and after the

insertion of the trees, proposal of the designer), we note an evolution from sunrise until noon, where we mark 69.0 C°.

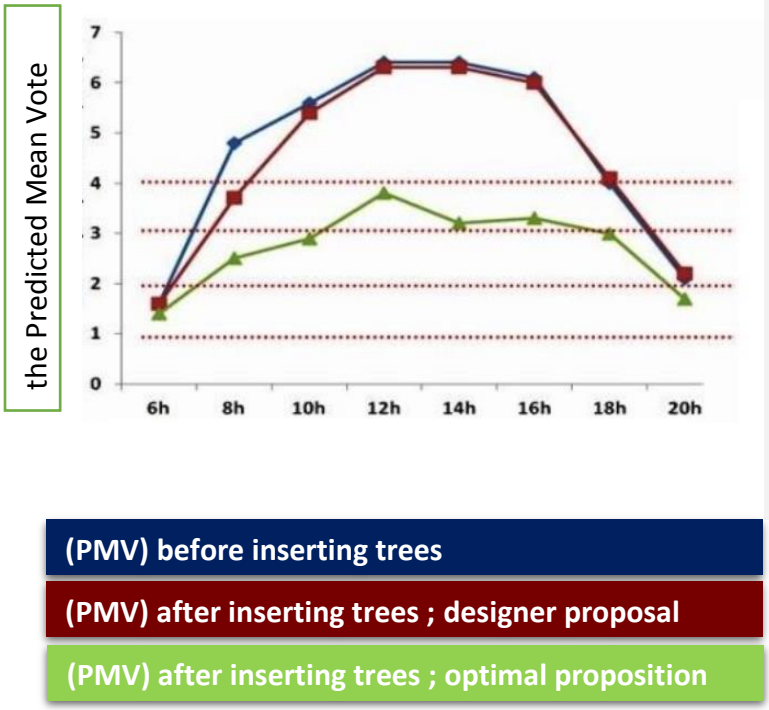
Graph 04- Physiological Equivalent Temperature (PET) Graph



source: A.Hanafi.2018

For PET (physiological equivalent temperature), the results obtained for the third situation (after the insertion of the trees, optimal proposition) show a significant attenuation compared to the results obtained in the other situations (before the insertion of the trees and after the insertion. trees, designer's proposal), the maximum PET is 43.4 ° C at noon, and 40.2 ° C at 2.00 am The rest of the day the PET does not access the hot strip (moderate heat stress), (see table 03) .

Graph 05- The Predicted Mean Vote (PMV) graph



source: A.Hanafi.2018

The PMV (predicted mean vote) obtained for the third situation (after the insertion of trees, optimal proposition) shows a significant reduction compared to those obtained in the other situations (before the insertion of the trees and after the insertion of the trees, proposition designer). The maximum PMV is 3.8 at noon, the rest of the day it does not reach the limit of the hot feeling.

In other situations, however, the PMV moves from the hot zone to the very hot zone from 8.00 a.m. in the morning until 18.00 p.m. (HANAFI ABDELHAKIM . (2018)).

5 – 4 - Results and Discussion:

5 - 4 -1 - Before the Intervention:

The study simulation shows the square with the software RayMan pro.

The SVF of the square **0.902** which is so high this is why people in this space always feel uncomfortable. In some other words it is due to the high rate of solar radiation. The Ben Badis square is exposed to sunlight almost all day except in the evening by blessing the shade provided by the few trees that already exist in the space.

5 - 4 - 2 - After the Intervention:

After the Simulation the results shows the optimum proposal of design of the vegetation, which it gave the best results compared to current situations of the square. The conception of the vegetation was based on two essential parameters: first, do not plant the entire surface of the square except the parts of sitting most used by the inhabitants of this square to protect them from solar radiation. The second to use two types of vegetation **(Ficus Religiosa)** a deciduous tree, very used in Algerian south and north that resists the aridity of our area . The second type is coniferous tree **(Ficus Retusa)** very used too in Algeria . It is of category tree of tropical origin of the persistent type of dense port shape erected, rapid growth. In addition it has been in the city of Biskra for a long time and it resists its climate . These two types were chosen in order to protect inhabitants in summer from solar radiation and allow the penetration of solar rays through the deciduous trees in winter.

SVF

- It is noticed that the SVF is decreased after the insertion of the vegetation (SVF=0.079) which will mitigate the penetration of radiation, especially in the hottest times of the day.

MRT

- Concerning MRT, in the first situation without vegetation, we measure 42.9°C at 8.00 am and it reaches 52.9°C at noon but it decreases at 18.00 pm until 45.8°C. in the third situation((Mrt) after inserting trees optimal proposition) with the vegetation we measure 35.7 ° C at 8.00 am, it reaches 43.5 ° C at noon and decreases to 36.5 at 18.00 pm, shows the global radiation before and after the insertion of the vegetation.

PET

- For the PET, the results obtained for the third situation ((PET) after inserting trees optimal proposition) we observe a significant attenuation compared to the resultsobtained in the first situations, the maximum PET is at 2.00pm with 57.1 °C very hot, the minimum PET is at 8.00am we measure 35°C. it decreased to the maximum PET is at 2.00pm with 42 °C, the minimum PET is at 8.00am we measure 35°C .

PMV

- For the PMV obtained in the third situation, we observe a significant reduction compared to those obtained in the first and second situation, the maximum PMV is 3.8 at 12.00 pm.

6- Student intervention and design on the project floor:

6-1 - The project floor:

The project is considered a redesign (Replantation and Afforestation) of the public square Ben badis from scratch the project which have a location that gives the area importance and attractiveness And vitality by creating places for rest , culture and entertainment while taking into account the different aspects of the study area .

With the aim of reorganizing and preparing the field, this after knowing the problems and shortcomings to give an appropriate picture of the area and the city.

6-2 - Summary of key points for The objectives of the intervention:

Summary of key points for The objectives of the intervention
the need for a southern urban green study of perceptions and preferences of urban greenspaces to inform future planners and designers.
embedding Greenspaces projects in the city landscape, ecological and social context this varies from place to place and so locally relevant knowledge needs to be developed.
the aim by this Greenspace design to enhance the ecological functions of greenspace habitats.
To prove that Different models can be adopted and tools are potentially available to help evaluate how well they function.
Make a real impact on the microclimate of the area by inserting the proprt vegetation and trees.
Create a green cover over the space that provides shade and comfort to the users of all types .

Create a thermal comfort level that allows the usability of the space during hot summer days and all year long .
aim to produce spaces which are attractive and accessible to people; guidance on how best to do this with the appropriate tools.
Integration of the district with the city as a whole.
Reviving it and making it an attractive area for residents even from outside by giving it a dynamic space .
To consolidate its basic role as a meeting, rest and entertainment area.
Recreation of public spaces in the area.
Giving an aesthetic view of the area and a visual comfort for residents and passers-by.
Creating cultural places so that there is functional diversity in the region.
Create recreational places so that the area is attractive to all segments of society.
Reviving the street, highlighting its importance and considering it as an example for rehabilitating other streets.
Not to waste real estate by keeping pace with modern urban development and underground construction.
Create a green dynamic and identifier space.
Improving the urban image of the region.
Introduce the concept of sustainability into the design and preserve the space for many generations to com by integrating new technologies such as solar power usage and greenery as a key factor in urban planning

6-3 - The inspiration behind this intervention on the project:

London garden - Biskra Algeria

Figure 82- green cover and trees placements pathways

source: vitaminedz.com

Figure 83- organic pathways

source: itaminedz.com

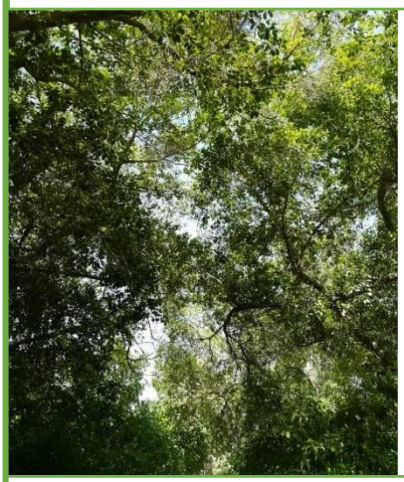
Figure 84- Water features -

(source:Midsphotography2013)

Figure 85 - Covered Shaded path-ways by trees (source: author)

source: author,Biskra,2020

Figure 86- The SVF (Sky View Factor) for the Garden



author,Biskra,2020

July 5th Garden – Biskra Algeria

- **The City Tree**

London is to benefit from a revolutionary new technology – the City Tree – which harnesses the power of nature to remove harmful particulate matter and nitrogen dioxide from the air and make an impact on the thermal comfort. (Green City Solutions.com / article).

Figure 87- Green-City Solutions_CityTree

Source: urbannext.net

The ficus Tree is the most famous tree in Biskra almost as palm level which we plant in our houses ,in our gardens, by alignment in the circulation routes, we can even say that there is not a street in Biskra that does not contain a ficus type tree given its climatic, aesthetic, ornamental role, etc. the latter he adapts to the region of Biskra and its climate. The presence of this type of tree in Biskra dates back to the colonial period. There are trees that date before independence and

Figure 88- Ficus tree in the city of Biskra .

Source: author,Biskra,2020

they remain to this day. There are several species and qualities of the tree the ficus; the Photos(58-59-60) shows us the Ficus tree that exist in the city of Biskra.

6 – 4 – Interventions:

Interventions:

- Recreation, RePlantation and Afforestation and furnishing of the public square (chairs, public lighting, seating benches, containers ,Garbage, ...) until it regains its true function, and this is through Equiping it with various requirements, necessary and vital elements , toilet, stalls, ...).
- Providing security by establishing security cameras and office for the guard.
- Create a green wall in front of the shops.
- Creating an organic pathways linking the various parts of the public areas.
- Realization of the water distribution network and creating new modern water elements .
- Create an infographic.
- Creating it with green spaces, and diversifying and coordinating them according to: the areas designated for grass, strips Greenery, ornamental trees.
- Putting different types pergolas to protect from the sun and rain.
- Equiping it with Solar Powered overhead lighting
- providing a handycape and speasial needs ramps and pathways
- creat shaded and secured Playgrounds for kids
- An exhibition introducing the green and comfort of the city.

6-5 The intervention Concept design and renderings:

- **Before intervention**

Figure 89-Ben Badis square plan before intervention

source: PDAU-Biskra.2014

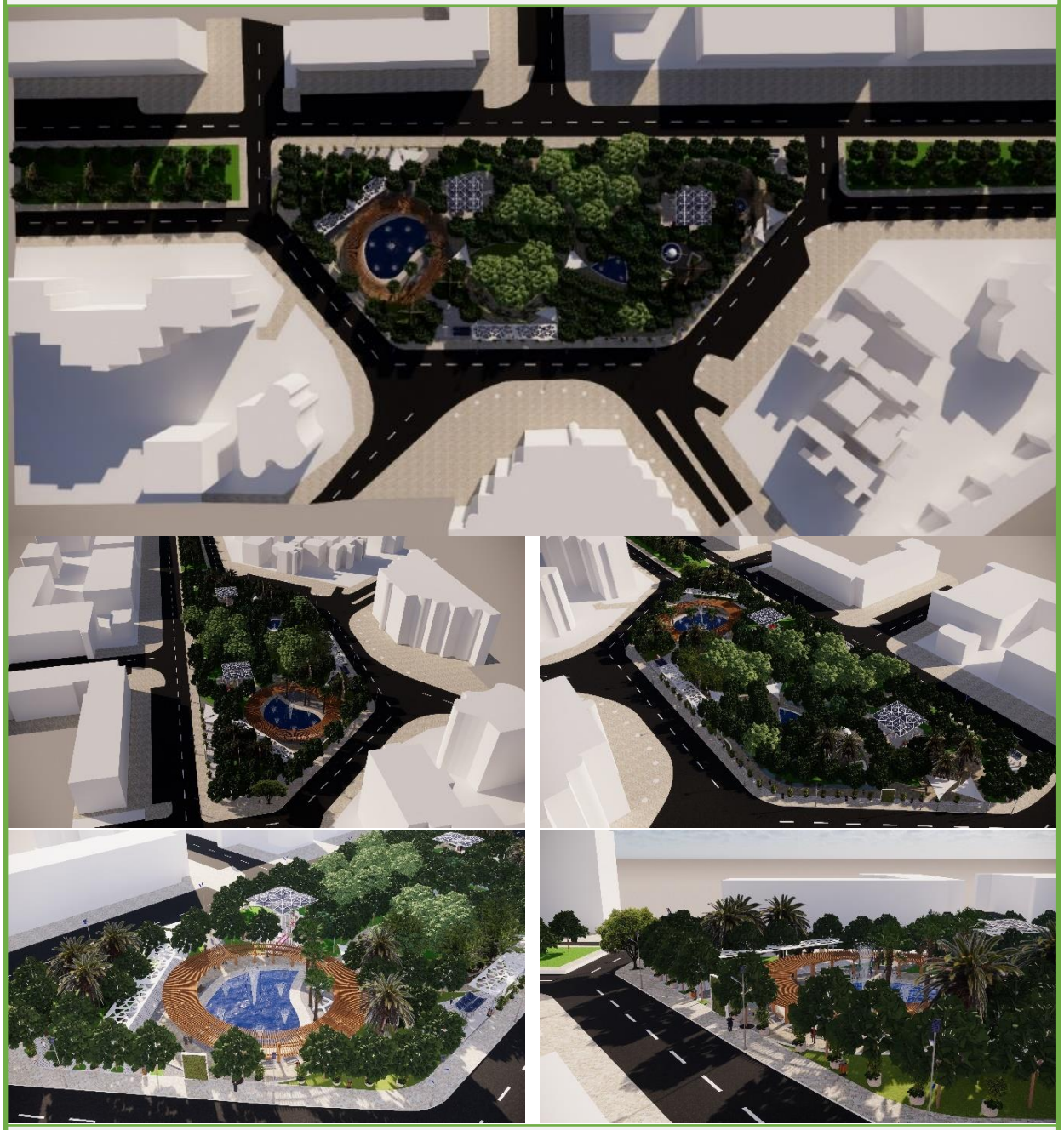
- **After intervention**

Figure 90-Ben Badis square after intervention

Source: author,Biskra,2020

6 - 5 -1 Plantation and Afforestation: That the planted trees be of the species that bear the environmental conditions of the area and are resistant to infection With diseases, harmful insects and environmental pollution factors(ficus tree).Trees are planted in dimensional pits in an organic mesh grid.The trees are durable, sun-proof and easy to maintain, and allow some light to go through.

Figure 91- Ben Badis Square concept design views.



Source: author,Biskra,2020

6-5-2 The proposed urban furnishing in the project: Urban furniture is the most important complement to public spaces, so its type and location must be determined Its position and measures are as follows:

Figure 92 -Ben Badis Square concept design main urban elements

Playgrounds with solar powered pergolas

Fountains and aesthetic water models

Bike-pargings

Source: author,Biskra,2020

6-5-3 Seating:

It should be easy to clean, resistant to dust and made of materials that can withstand high temperatures. The height of the seats must be about 45 cm off the ground in order to achieve comfort for their users And to be placed in places such that they do not constitute an obstacle to pedestrians.

Figure 93- different Seating designs concepts inside the space

Source: author,Biskra,2020

6-5-4 Solar Powered overhead lighting:

The amount of spacing between the lighting poles must be respected according to the approved standards and the characteristics of the area. It is necessary to provide periodic maintenance for the solar panels on these lighting poles for most sectors of the city to achieve its durability and fulfill its role in the field.

Figure 94- solar-power lighting

Source: author,Biskra,2020

6-5-5 Garbage containers:

To be within reach of young and old so that it is placed at an appropriate height in the appropriate location. It should be one of the types that have a cover that conceals what is inside and prevents rain water from escaping. And the arrival of the insects to it. It is desirable that they have a certain color for ease of identification and are placed on road sidewalks.

Figure 95-Garbage-containers inside and around the space

Source: author,Biskra,2020

6-5-6 Fountains and aesthetic water models:

To have a specific location and consistent size without causing obstruction to the movement of the two men on the sidewalk or path. No two men. The size and height of the object must be proportional to the size of the vacuum in which

Figure 96- Fountains and aesthetic water models inside the space

Source: author,Biskra,2020

it will be placed and it must be preserved. From rust if it is made of metal. It must be certain of the architectural and urban character of the area.

6-5-7 Bike-parking:

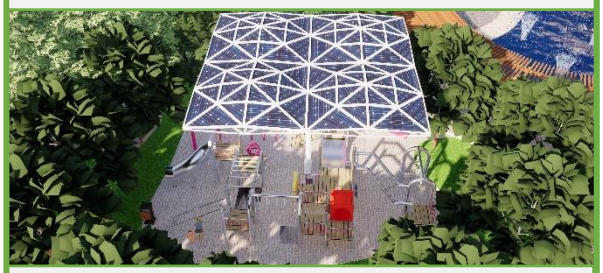
Figure 97- Bike-parkings on the edges of the space

Source: author,Biskra,2020

Increase Parking Capacity & Space – A wall of bike racks can accommodate more customers. It also provides a convenient place for bikes to be stored. Adequate bike parking will also ensure that bikes aren't in the way of pedestrians or passersby.

6-5-8 Playgrounds:

Figure 98-playground with a solar-power pergola(



Source: author,Biskra,2020

We included two separate playgrounds on both sides , one dedicated to the residences of the area on the far north and one dedicated to the health center and shops users , we equipped both of the playgrounds with a wide custom made pergola for maximal shade with a solar powered roof to collect energy and store it for night-time use .

Figure 99- Playgrounds on both sides of the space

Source: author,Biskra,2020

6-5-9 Pathways:

We designed the green space to flow in an organic form , its been done in hot areas sinse ancient times and been used in algeria and spacialy in southern areas with hot climate . the organic form have many benefits we mention :

- It deflects the hot wind and therefore help cool it
- Makes the space more enjoyable to walk in and chill
- Allows for more trees to be placed in different and random pattern wich creats more shade and green areas

Figure 100- the organic Pathways that shape the insides the space

Source: author,Biskra,2020

6-5-10 Pergolas:

We used three types of pergolas (triangles shaped , square organic shaped pergolas , round wooden pergola around the water feature)

Figure 101-triangle shaped pergolas

Source: author,Biskra,2020

Benefits To Having A Pergolas

-Decorative Value. Pillars in pergolas can be used as support while providing shade in the hot months of summer.

-Pergolas Provide A Defined Open Space.

-Weather Protection.

-You Can Work With Angles.

-Block Unwanted Sun light .

-They Are Fairly Easy To Install.

-Pergolas Can Help Plants and people.

Figure 102-different types of pergolas inside the space

Source: author,Biskra,2020

6-5-11 Communication and Media Furniture: It should be along the road side , where the driver can pay attention to it, as well as at level The broad sidewalks are where the spaces for rest and walking with feet Services. It should be located at every entrance and next to where people park.

Figure 103- Communication and Media Furniture **(Source: author)**

Figure 103- Communication and Media Furniture **(Source: author)**

6-5-12 Handicapped and special needs usability

It can be viewed as the “ability to access” and benefit from some system or entity. And focuses on people with disabilities or special needs and their right of access, enabling the use of the Ben Badis space .

Figure 104- special needs access points

Source: author,Biskra,2020

6-5-13 The sky view factor for the designed Ben Badis space (SVF) :

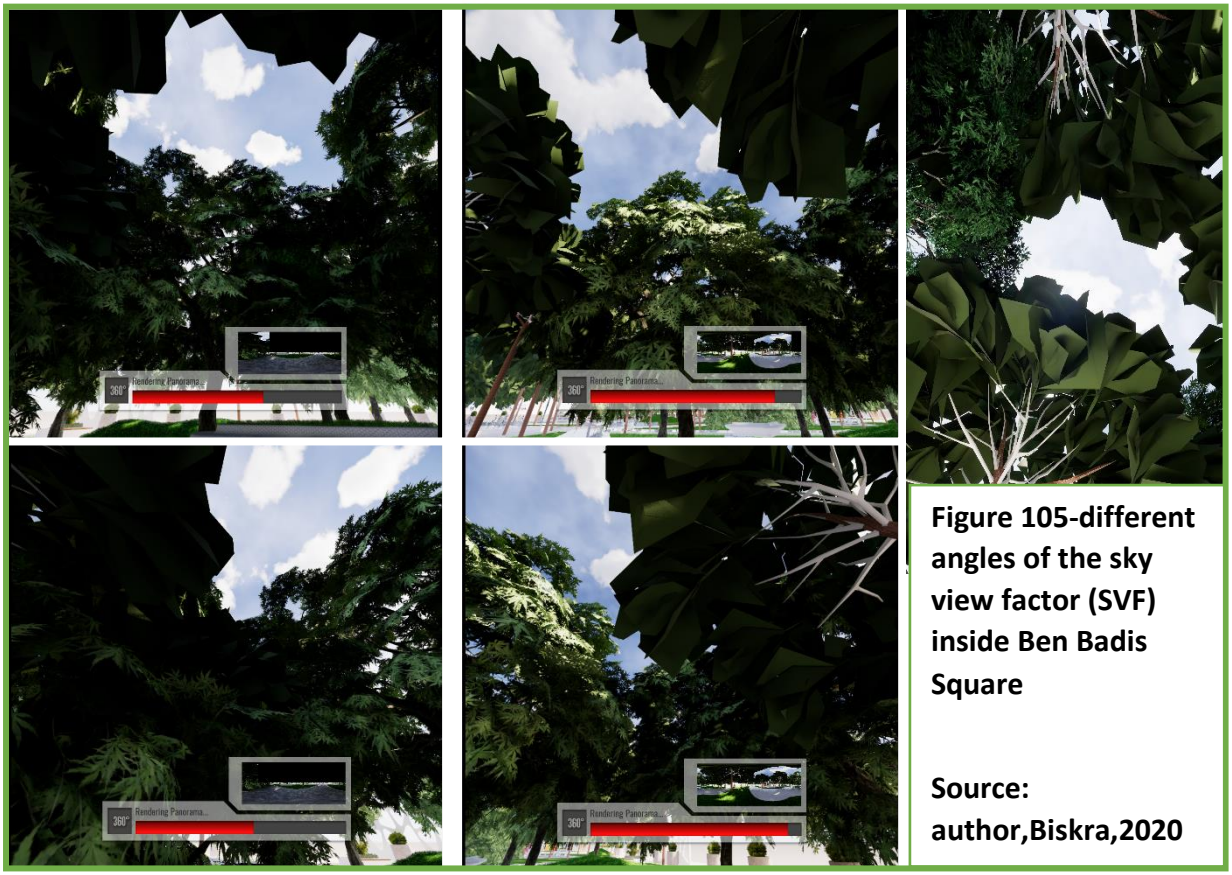


Figure 105-different angles of the sky view factor (SVF) inside Ben Badis Square

Source: author,Biskra,2020

We can the trees covering the sky and unwanted sun light/rays

Letting just enough of it to enjoy the space and not disturb the comfort of the different space users

- In the end we tried to reach the optimal intervention and possibly drop the temperature to a comfortable level to this space users plus provide an easy comfortable place for people to use and set an example to what an urban green space in a southern city should be like.

Figure 106- Ben Badis Square green Design Biskra-Algeria

Source: author,Biskra,2020

Conclusion:

Vegetation can affect the microclimate in many ways it reduces air temperature, while providing shade. Vegetation brings aesthetic improvements to an environment otherwise dominated by asphalt and concrete. The main object of this research is to improve the impact of vegetation on outdoor thermal comfort, the two types of trees introduced into the area of study have given good results and wide variations in climatic parameters and indices. The Sky view factor (SVF) reduced from 0.902 in the situation without vegetation to 0.079 after the insertion of vegetation. For the global radiation decreased drastically after the insertion of vegetation. For the PMV showed a significant reduction compared to those obtained in the other situations (before the insertion of the trees) The maximum PMV is 3.8 at noon, the rest of the day it does not reach the limit of the hot feeling, the mean radiant temperature was changed from 69.0 C°.to 54.1 °C. So vegetation is often an important component of the open outdoor space, which contributes greatly to the quality of its development. Generally, trees provide significant improvements in thermal comfort mainly at noon and in the early afternoon as they provide shading, and attenuate solar radiation. In addition, trees increase the environmental quality of outdoor space and the thermal and visual comfort felt in the southern climate.

GENERAL CONCLUSION

Our study in this thesis shows that the outdoor temperatures in areas of green spaces with trees were lower by 5° to 10℃ in comparison to areas that don't have any. The old square of Ben Badis characterized by its wide open empty spaces that don't have any forms of shade with surrounding buildings with wide streets and its surrounding ramparts was not designed to offer a good thermal comfort and security from solar radiations .This study shows that the outdoor temperatures in the Ben Badis Square of Biskra were greater than the outdoor temperatures in other green spaces that are considered comfortable for the average human . Therefore, we suggest a new plantation method, which gives the vegetations (Ficus-tree and similar trees) great space in all of the space design.

the presence of green spaces made important contributions to the regulation of the area climate, and green spaces increased humidity in the air and decreased the temperature, thus improving the air quality of surrounding urban microclimates. The important role played by green space as a temperature mitigating element is found. So, an urban climatic factor is a necessity to be considered as standards to perform sustainable development, as well as to mitigate urban heat island effects in the urban environment to provide better quality of life for urban residents. In addition, landscaping vegetation in an urban region will support to beautify the city environments and transform urban microclimates to make it suitable and comfortable for urban dwellers.

After a thorough examination of this project, we will propose the following recommendations:

- To use a category of trees of the persistent type, dense erect habit, rapid growth, and with qualities such as large crown.

- In addition, it's better that the trees and plantations already exist in the city of Biskra for a long time, it gives it better opportunities in resisting its climate.

- avoid complex and expensive shapes, designs and not environmentally friendly.

- The use of advanced technology to facilitate the integration of developed countries and the improvement of architecture and urbanism.

- Study the needs and requirements of users and the nature of the space and climate for each design according to its function and characteristics.

-contract various climate and plantation organizations and work with them to establish a solid logical study that would be possible to translate in reality as an actual project.

In the end we find the necessity of integrating green spaces and urban trees in future urban planning, as a vital part of the city which would decrease the level thermal stress and temperature. create shade and a barrier of leaf's from the solar radiations, clean city air and ventilate the climate which improve the thermal comfort. And adjust the microclimate to suit a much better quality of urban life inside the city.

REFERENCES

Books

Alain Liebard, André De Herde. (2015) , traité d'architecture et d'urbanisme bioclimatique, Paris 368p**.**

Fanger, P.O.(1982) , Thermal comfort: analysis and applications in environmental engineering. R.E. Krieger Publishing company, Malabar, Florida, 244 p.

KIRCSI, A. and Al. (2005) , The relationship between built-up areas and the spatial development of the mean maximum urban heat island in Debrecen, Hungary. Wiley Online Library [Online]. Interna-tional Journal of Climatology, pp. 405–418.

Oliva, J.P., Courgey, S. (2006) , La conception bio confortables en neuf et en réhabilitation. Terre vivante, 240p.

Salomon, T, Aubert, C. (2004) , La fraîcheur sans clim. Terre Vivante, Paris,160p.

Watkins, R. and Al. (2007) , Increased temperature and intensification of the urban heat island: implications for human comfort and urban design, Built Environment, Vol. 33 pp. 85-96.

Thesis and dissertations

Belkacemi Hadjer. (2019) , L'espace vert public à Biskra entre la planification et l'application. Masters thesis, Université Mohamed Khider – Biskra, 220 p.

Ar. Navin Gupta . and Al. (2017) ,Evergreen Buffers as Screens in Landscapes, School of Architecture & Landscape Design, SMVDU, J&K, India STA, School of Architecture & Landscape Design, SMVDU, J&K, India, Volume: 04 pp . 340-343.

Guedouh Marouane Samir. (2018) , Impact du bâtiment à patio sur l'environnement thermique et lumineux adjacent, Département d'Architecture, Université Mohamed Khider – Biskra, 330 p .

HANAFI ABDELHAKIM . (2018) , Le végétal urbain générateur de confort thermique dans les villes sahariennes contemporaines. «Cas des places publiques de la ville de Biskra / Algérie » Doctorat en sciences en : Architecture Option : Architecture en milieux arides et semi-arides Université Mohamed Khider Biskra, 356 p.

Jansson, M. (2014) , Green space in compact cities: the benefits and values of urban ecosystem services in planning. Nordic Journal of Architectural Research 2, 160 p.

Madrid Mónica. (2017) ,Green spaces in cities? Analysis and comparison of green spaces in Stockholm Verduras ,Department of Human Geography Stockholm University SE Stockholm Sweden, 62 p.

Reports and articles

Aristotelis Vartholomaios. (2015) , The impact of green space distribution on the microclimate of idealized urban grids, Aristotle University of Thessaloniki, University Campus, 54006, Thessaloniki, Greece 18 May 2015, 05 p.

Dominic Corsini. (2015) , "What is Relative Humidity? - Definition, Equation & Calculation." Study.com, 20 July 2015, study.com/academy/lesson/what-is-relative-humidity-definition-equation-calculation.html.

Fondriest Staff, (2010) , Wind Speed and Direction on August 12, 2010, at www.fondriest.com.

Grants & Projects. (2006) , United States Environmental Protection Agency https://www3.epa.gov/region1/eco/uep/openspace.html.

Hamida bencheikh, Ameur Rchid. (2012) , The Effects of Green Spaces (Palme Trees) on the Microclimate in Arid Zones, Case Study: Ghardaia , Algeria Depatement of architecture Amar Telidji University Laghouat Algeria , 05 p.

Lisa Templeton. (2019) , Green spaces in cities can help people live longer , medicalnewstoday.com Website .

Mansournia . (2019) , Urban green space cooling effect in cities , Universidad Politecnica de Madrid-UPM, Madrid, 28040, Spain, 31 p .

NAGA Northern alliances. (2020) CLIMATE ADAPTATION > URBAN GREENING https://www.naga.org.au/urban-greening.html .

Peter Höppe. (1999) , The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment , Int J Biometeorol (1999) 43:71–75.

Tyler Tonna. (2014) , Micro-Climate of an urban area , Lesson 4, 27 p

Wendy McDougal. (2016) , Microclimate: Definition, Factors & Examples. Study.com, 8 July 2016, study.com/academy/lesson/microclimate-definition-factors-examples.html.

World health organization. (2017) , Urban green spaces: a brief for action, UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark , 22 p .

Yafei Wang. (2015) , The effect of urban green infrastructure on local microclimate and human thermal comfort, Wageningen University - 14 p .

Ye Jienan. (2009) , RESEARCH OF LANDSCAPE DESIGN IN RESIDENTIAL AREA, Blekinge Institute of Technology The European Spatial Planning Programme, Karlskrona, Sweden , 60 p .

Websites:

www.isglobal.org/

www.meteoblue.com/

www.Grove.com/

www.cityofpoughkeepsie.com/

www.urbannext.net/

avarth@arch.auth.gr

naturesacred.org/

http: //www.mif.unifreiburg.by /.

https://www.definitions.net/definition/residential+area

Wikipedia.com

www.designingbuildings.co.uk/