**IOSR Journal of Engineering (IOSRJEN)** **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 14, Issue 6, June 2024, ||Series -1|| PP 01-11

# The Role of Misting Systems in Landscape Design: A Case Study of Recreational Parks in Lagos.

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*Received 01 June 2024; Accepted 11 June 2024*

**ABSTRACT**
Using Recreational Parks in Lagos State, Nigeria as a case study, this paper proposes vvv vv. It gives a background to the concept of recreational facilities in Nigeria and misting systems in general. And then, it introduces misting systems: stating the advantages, challenges, and their proposed solutions.
**KEYWORDS**: Recreation, Landscape, Comfort, Humid, Climate, Misting, Thermal.

## I. INTRODUCTION

*1.1. Background*

Located in South–West Nigeria, Lagos State was created on May 27, 1967, and became an administrative entity on April 11, 1968. It is bounded in the North and East by Ogun State, in the West by the Republic of Benin, and stretches over 180 kilometers along the Guinea Coast of the Bight of Benin on the Atlantic Ocean.

Lying approximately on longitude 20 42'E and 32 2'E respectively, and between latitude 60 22'N and 60 2'N, it occupies 0.4% of Nigeria's territorial land mass making it the smallest state in Nigeria. But irrespective of this, it is hailed as the nation's commercial nerve center/capital and financial hub, and it has the highest urban population with a vast array of people from different national and international tribes.

Like the rest of Nigeria, Lagos state enjoys the rich tropical climate with its twin blessings wrapped in the rainy and dry season. Along with the rest of the world, its people are currently experiencing first-hand the negative effects of global warming, Climate change, & Urban Heat Islands. With it, a growing need for landscapers to propose designs that improve thermal comfort for both public and private spaces.

Being the economic capital of the world and known as the land of opportunities Lagosians (as the inhabitants of Lagos are informally called), spend the bulk of their time either in traffic or at work. With such busy schedules comes the quest for recreation, in a fair attempt to balance life and work, hence the need for recreational Facilities. This quest for work-life balance has lead Lagosians to find comfort in the available recreational facilities provided by hotels, shopping malls, and parks.

Recreational facilities are not a new invention, they existed before modern civilization in Nigeria (Babatunde, 2021), and today its relevance is twice as it was back then.

According to LASPARK (Lagos State Parks and Gardens Agency), 212 such recreational parks have been established by the state government but for the purpose of this paper, only 8 of these parks will be discussed. They include:

1. Johnson Jakande Tinubu Park, Alausa, Ikeja
2. The Ndubuisi Kanu Park, Alausa, Ikeja
3. The Infinity Park, Jibowu, Yaba
4. Badagry recreational park, Hospital road, Badagry
5. Rafiu Jafojo Park, Shasha, Alimosho
6. Ikorodu Recreational Park, Ikorodu
7. Muri Okunola Park, Victoria Island, Eti-Osa
8. Dr. Abayomi Finnih Park, Oregun

Their mandate of LASPARK is to mitigate the effect of Climate Change, ensure Environmental Sustainability, and improve Environmental, Social, Economic, Health and Well-being. As well as enhance Environmental Biodiversity, restore the aesthetics of Lagos, enhance Law, order, and the security of highways in the state.

*1.2. Statement of problem*

The absence of improved air quality and thermal comfort systems in the landscape of Recreational Facilities: A case study of Lagos State.

*1.3. Aim of research*

This research is aimed at proposing the adoption of automated misting systems in the landscape to improve thermal comfort in outdoor recreational facilities in Nigeria.

*1.4. Definition of terms*

*1.4.1. Urban Heat Island effect:*

The significant difference in temperature between different parts of an urban area, or between an urban area and its surrounding rural areas due to urbanization, is called Urban Heat Island (Christopher, Poorang, Eric, & Jonathan, 2014).

*1.4.2. Global warming:*

*T*he negative effect of greenhouse gases due to the burning of fossil fuels experienced as a quick rise of the Earth's average surface temperature is called global warming. (Umair, 2015).

*1.4.3. Climate change:*

The effect of unsustainable human activities on the weather conditions of an area over a long period of time is called Climate change (Santos and Bakhshoodeh, 2021).

*1.4.4. Thermal comfort:*

Classified in relation to environment type, thermal comfort is the state of mind, which expresses satisfaction with the thermal environment (Joost, Mitja & Jan. 2010).

## II. LITERATURE REVIEW

Misting systems are evaporative cooling technologies that discharge extremely fine water droplets from atomization nozzles. These water droplets, when they make contact with the airflow, absorb heat from the air to produce a cooling effect(Xie, Sun, Zhu, Zhao, Wang, and Zhai, 2024).

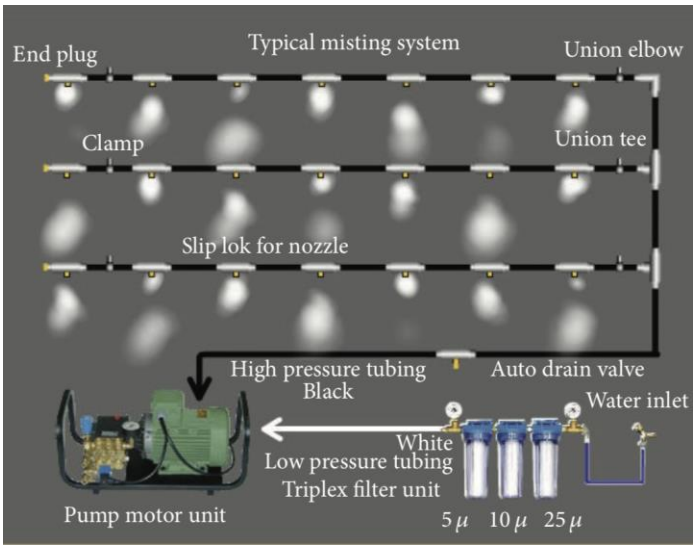


**FIGURE 1:** Typical Representation of Misting Systems

*Culled from Hikmet and Omer (2015). Investigation of Photovoltaic Assisted Misting System Application for Arbor Refreshment.*

This technology is a temperature-based control solution that produces quick evaporating, ultra-small water droplets that cool the air without leaving any wet feeling on the human skin (Zheng, Yuan, Wong, and Cen. 2019).

Misting systems utilize water in their operation and their usage can be traced to their application in vernacular Architecture during the Islamic era as far back as 1000 years ago (Mahmoud, 2015). And since water is known to produce a cooling effect, it has helped landscapers achieve thermal stability and comfort (Belkayalia and Ayanb, 2017).

Despite the potential of these misting systems, they must be introduced sustainably into the landscape design to ensure that they maximize alternative energy and water without further contributing to global warming.

***2.1. Benefits of misting systems on landscape***

a) They are efficient, adaptable, and environmentally friendly;

b) They provide uniform cooling and comfort all through the outdoor space thus encouraging outdoor living and community participation;

c) They support biodiversity and the growth of greenery, and they create a healthy ecosystem;

d) They improve air quality, thus impacting the well-being of their users;
e) They can be used in conjunction with other eco-friendly materials and technologies to achieve sustainability.

***2.2. General application of misting systems in outdoor***

The use of misting systems are not only restricted to recreational facilities alone, they can be applied in a wide range of facilities such as:

*2.2.1. Indoor spaces to achieve thermal comfort;*

*2.2.2. Sports Arena's and stadiums:* thermal comfort will make the experience more enjoyable for sports fans, as well as improve the performance of the players;

*2.2.3. Large outdoor public gatherings:* from religious crusades, through afrobeat concerts, to political rallies, the causes for large gatherings in Nigeria are many. Misting systems will ensure that participants of these gatherings will have cleaner and safer air quality;

*2.2.4. Agricultural use:* misting systems can be used in greenhouses and other agricultural facilities either to achieve thermal comfort for livestock, or to administer nutrients for plant growth in areas with relatively low air humidity (Romero-Gámez, Suárez-Rey,& María, 2012) or to fumigate against pests (Bukłaha, Wieczorek, Majewski, Iwaniuk, Sacha, Tryniszewska, and Wieczorek, 2022);

*2.2.5. Medical use:* misting systems can be used by professionals to administer disinfectants to spaces in what is also called ultrasonic misting (Naidu, Kahraman, and Feng, 2022).

***2.3. Previous Research on Misting Systems***

*2.3.1.* In his publication on the "Experimental Study to Evaluate Mist System Performance", Mahmoud (2015), identified 7 researchers who have investigated Misting Systems in different applications. They include:

a) O. Amer, et al - 2015
b) J. R. Camargo et.al. - 2005
c) Mu'azu Musa - 2008
d) Samaan et.al - 1980
e) Bucklin et al - 2008
f) Roy - 1989
g) El-Dessouky et al, - 2000
h) J. R. Camargo, C. D. Ebinuma and S. Cardoso - 2003

*2.3.2. Research focus:* all the researchers investigated the effect of misting systems on the thermal comfort of various spaces.

*2.3.3. Result:* all the researchers recorded a positive outcome with a conclusion that this system offered an energy-efficient and environmentally friendly solution to enhancing the thermal comfort of both interior and external spaces.

***2.4. Classifications of misting systems***

Misting Systems can be classified based on the pressure force at which mist is pumped out of the nozzle, and according to their uses. These classifications include,

***2.4.1. High-Pressure Misting Systems:*** ideal for use in commercial or residential spaces, these systems produce a fine mist when high-pressure pumps force water(most) out through their nozzles (Babcock, 2021);

***2.4.2. Low-Pressure Misting Systems:*** ideal for use in residential decks, patios, and pools, these systems produce fine mist with lower pressure. Their cooling performance and price are less than of the high-pressure misting systems (Li and Willits, 2008);

***2.4.3. Industrial Misting Systems:*** ideal for use in industrial settings, these systems eradicate dust, eliminate stench, and regulate the temperature of high-use, heavy-duty machines like computer processors and recycling plants;

***2.4.5. Specialized Misting Systems:*** ideal for use in medical facilities, they can be used to disinfect spaces against contamination.

## III. CASE STUDY REVIEW

### *3.1. Johnson Jakande Tinubu (JJT) Park, Alausa, Ikeja*

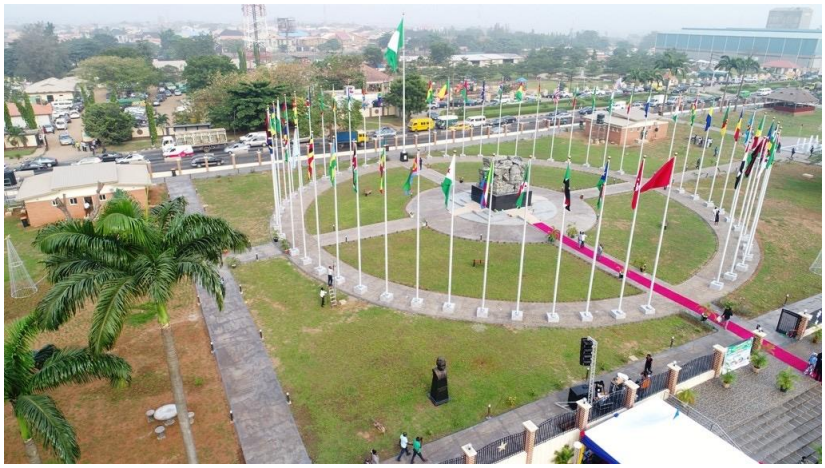

*FIGURE 2: LASPARK. [Picture of Johnson Jakande Tinubu (JJT) Park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.1.2. Basic Details*
Commission date: Dec 13, 2017
People capacity: 4,000
*3.1.3. Landscape features*
Trees
24 toilets
Children playground
Parking area
Food court
Lounge huts
Aviary
Pergola
Gigantic chessboard
Perimeter fence
Pedestrian walk ways
Lawn
Gazebos
Water Fountain
National monuments (statues of Lagos heroes)
Flags
Park benches

***3.2. The Ndubuisi Kanu Park Alausa, Ikeja***

*FIGURE 3: LASPARK. [Picture of Ndubuisi Kanu Park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.2.1. Basic Details*
Commission date: 12th of June, 2014
*People capacity: 2500*
*3.2.2. Landscape features:*
Rotunda Stand
Artwork monument
18 toilets
Children's playground
Gazebos
Car park
Vendor stand
Security presence
Park benches
Trees
Lawn

***3.3.Badagry Recreational Park, Idale-Topo, Badagry***.

*FIGURE 4: LASPARK. [Picture of Badagry Recreational Park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.3.1. Basic Details*
People capacity: 3000
*3.3.2. Landscape features:*
Conference room
Lawn Tennis court
Basketball courts

5-a-side football pitch
4 toilets
Seating area
Trees
Lawn

***3.4. The Jibowu Park (The Infinity Park)***

*FIGURE 5: LASPARK. [Picture of Infinity park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.4.1. Basic Detail*
Commission date: 18th of October 2018
People Capacity: 200
*3.4.2. Landscape features:*
Gazebo
Minizoo
6 toilets
Water fountain
Monument
Seating area
Trees
Lawn

***3.5. Rafiu Jafojo Park, Shasha, Alimosho***

*FIGURE 6: LASPARK. [Picture of Rafiu Jafojo Park] [JPG]. LASPARK GALLERY. Retrieved on Febrary 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.5.1. Basic Details*
Commission date: 14th December 2017
People capacity: 3000
*3.5.2. Landscape features:*
Children's play area
Food stall
Parking space
Rotunda
Basketball court
Water fountain
18 toilets
Minizoo
Park benches
Trees
Lawn

***3.6. Ikorodu Recreational Center, Ikorodu***

*FIGURE 7: LASPARK. [Picture of Ikorodu Recreational center] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.6.1. Basic Details*
People capacity: 3000
*3.6.2. Landscape features:*
Children's play area
Food stall
Parking space
Security presence
Five-a-side football pitch
Basketball court
Water fountain
8 toilets
Seating area
Trees
Lawn

***3.7. Muri Okunola Park, Adeyemo Alakija Street, Victoria Island***

*FIGURE 8: LASPARK. [Picture of Muri Okunola Park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.7.1. Basic Details*
Commission date: 18th Dec. 2008
People capacity: 3000
*3.7.2. Landscape features:*
Parking space
Security presence
Water fountain
8 toilets
Trees, lawns, park benches, walkways, monuments.

***3.8. The Dr. Abayomi Finnih Park, Oregun, Ikeja,***

*FIGURE9: LASPARK. [Dr. Abayomi Finnih Park] [JPG]. LASPARK GALLERY. Retrieved on February 9th, 2024 from https://lasparkportal.lagosstate.gov.ng/parks-gardens/*

*3.8.1. Basic Details*
Commission date: 31st August 2019
People capacity: 1000
*3.8.2. Landscape features*
Children's play area
Vendor stand

Parking space
Security presence
Water fountain
18 toilets
Roofed pavilion
Elevated platform
Library
Basketball court

***3.9. Case Study Landscape: Appraisal***

*3.1.5. Merits*

a) *Location:* accessible and in close proximity to their prospective users;
b) Fairly affordable entry fees;
c) They have lawns and trees that promote environmental health;
d) They have economic and social impact - they create job opportunity.

*3.1.6. Demerits*

Aesthetically, the landscape of the parks do not mirror the reputation of the State as the "commercial nerve center/capital and financial hub";
Available facilities are poorly maintained;
Insufficient greenery to serve as a shading device and improve air quality;
Acoustic measures were not incorporated into the landscape;
The inability of existing landscape features (water bodies and trees) to provide optimal thermal comfort.

## IV. RECOMMENDATION:

While the existing landscape features(trees, gazebos, grasses/lawns, etc.) have their impact on the air quality, misting systems have the potential to do more. To optimally improve the thermal comfort in these recreational centers, the use of automatic, thermal sensor-fitted, solar energy-powered, misting systems are recommended.

***4.1. Justification***

*4.1.1 Automatic* - automation schedules misting times thus reducing the park operator's stress factor and workload, providing consistency in the execution of a task, as well as reducing the likelihood of mechanical faults (in the solar systems, the misting systems, or thermal sensors) due to human errors (Richard &, Éloi. 2003). They are equipped with timers and remote control to improve their ease of use.

*4.1.2. Solar energy powered* - by utilising renewable energy, this system saves cost. They can be neatly installed on existing rooftops, they are eco-friendly, and getting it powered is by sunlight which we have an abundance of in Nigeria;

*4.1.3. Thermal sensor:* this device measures the degree of coldness or hotness of the recreational center and automatically activates misting during peak periods with high temperature.

***4.2. Benefits of the misting systems in recreational facilities in Lagos, Nigeria***

*4.2.1*. Strategically installed in the lawns, misting systems will improve the aesthetic of the park, creating a fine (almost enchanting) mist that evaporates quickly, thus lowering the high temperature, and making the park more comfortable for patrons.

*4.2.2*. They maintain optimal humidity within the park, thus positively impacting the overall health of the park's vegetation (trees, shrubs, flowers, lawn grass).

4.2.3. They increase patronage: the aim of parks is to create experiences and memories in a conducive atmosphere with thermal comfort. Misting systems can create an enabling atmosphere to achieve these at all times and despite the weather.

*4.2.3*. Installed creatively (by adding lights or in accompaniment of music, poetry, or drama), misting systems create a side attraction for visitors serving as a unique selling point, and improving the park's revenue.

*4.2.4*. At peak periods, increased crowds and high activities from patrons leave the park air quality dusty, and polluted by odors. Air mists systems ensure a safer, cleaner, and more pleasant air quality

*4.2.5*. They can be used to fumigate against pests (Bukłaha, et Al, 2022) like wild ants.

*4.2.6*. They can be used to administer disinfectants in the park after events (Naidu et Al, 2022).

### *4.3. Misting Systems in Recreational Landscape: Challenges and Solutions*

*4.3.1. Cost:*

The issue of cost is often a cause for concern when adopting smart, technology-based solutions. While the initial cost of misting system can be overbearing, it can be recouped over time by a slight increase in entry fees which the public will be ready to pay in exchange for the thermal comfort and visual appeal that the systems offer.

*4.3.2. Energy efficiency:*

the use of water as the primary cooling agent in the fans guarantees environmental sustainability and promotion of biodiversity.

*4.3.3. Water conservation:*

Water Consumption by misting systems has attracted a backlash owing to their ability to consume water. These Water-efficient practices must be adopted to avoid wastage:

i) the use of water-efficient misting nozzles that supply an adequate amount of mist per spray

ii) the use of properly recycled gray or runoff water.

## V. CONCLUSION

The concept of misting systems as a sustainable landscape solution to achieve thermal comfort has been studied and proven to be efficient by many researchers (Mahmoud, 2015). When adopting these systems, water conservation measures, energy efficiency, plant needs, spatial requirements, and maintenance schedules must be considered appropriately. Also, stakeholders must be educated on the best practices to ensure that the proper functioning of the misting systems throughout their service life.

Standard procedures like regular inspections of its component parts (pumps, filters, tubing, fittings, and nozzles) to prevent corrosion, clogging, and all forms of degradation, must not be neglected. This reduces the chances of clogging in the nozzles of the misting systems due to debris or mineral buildup). It also helps prevent potential leakages in the pumps, thus avoiding leakages or wastage.

Scheduled maintenance should be prioritized and performed by trusted professionals to ensure optimal performance of the systems throughout their service life. This also also helps us to avoid unnecessary expense on avoidable repairs.

If adopted by LASPARK for the state-controlled recreational Facilities, it will help them achieve their mandate, as well as increase the value of their facilities, increasing patronage and annual revenue.

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