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EFFECTIVENESS OF TREE CANOPY IN REDUCING SURFACE TEMPERATURE ALONG PEDESTRIAN WALKWAYS IN HIGHER INSTITUTIONS; CALEB UNIVERSITY AS A CASE STUDY

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Abstract— **Tree canopy is an important landscape element that helps reduce surface temperature and improve outdoor thermal comfort in tropical environments. Urban heat accumulation presents increasing thermal discomfort challenges in outdoor pedestrian environments, particularly within tropical campuses where prolonged sun exposure affects walkability and user experience. This study will evaluate the effectiveness of tree canopy cover in improving pedestrian walkway conditions within Caleb University. Observational data on canopy characteristics such as density, spread, and continuity will be recorded, while structured questionnaires will assess users' comfort perception and walkway preference. The study plans to highlight the role of strategic tree planting as a passive environmental design strategy for enhancing pedestrian comfort and promoting sustainable campus landscape development in tropical climates.**

Keywords— **Passive design, Pedestrian walkway, Surface temperature, Thermal comfort, Tree canopy**

I. INTRODUCTION

Increased surface temperatures in outdoor settings, especially in tropical countries, have been largely caused by rapid urbanization and infrastructure development. Pedestrian mobility and outdoor thermal comfort are impacted by the expansion of impermeable surfaces and the decrease of vegetative cover, which increases heat accumulation (Emmanuel & Krüger, 2018; Gunawardena, Wells, & Kershaw, 2017). By providing shade and evapotranspiration, tree canopy plays a vital role in regulating microclimatic conditions, lowering surface temperatures and enhancing pedestrian comfort (Rahman et al., 2020). In institutional locations such as university campuses, pedestrian pathways serve as main circulation routes, and prolonged exposure to solar radiation can severely influence user comfort, walkability, and overall outdoor experience. The usefulness of tree canopy cover along pedestrian paths on private tropical university campuses has not received much attention, despite the fact that numerous studies have looked at urban heat mitigation techniques. Promoting climate-responsive landscape design requires an understanding of the shading performance and user perception of tree canopy in such situations.

Therefore, by evaluating shade performance and pedestrian comfort levels, this study assesses how well tree canopy cover improves pedestrian pathway conditions at higher institutions using Caleb University.

1.1 PROBLEM DESCRIPTION

Due to intense solar radiation and insufficient shading infrastructure, outdoor pedestrian habitats in tropical countries are becoming more and more vulnerable to heat discomfort. Elevated surface temperatures, decreased walkability, and user discomfort are all consequences of inadequate or nonexistent tree canopy along paths (Lindelöf & Morel, 2020). Inadequate shade can have a detrimental effect on route selection, outdoor activity patterns, and the overall campus experience on university campuses, where employees and students regularly walk between buildings. Even though flora is known to have cooling properties, little empirical research has been done on how well the current tree canopy cover enhances shade and pedestrian comfort in campus-specific settings. The usefulness and sufficiency of the current canopy coverage at Caleb University are called into doubt by differences in the location of trees along pedestrian pathways. Decisions about landscape planning may lack evidence-based guidance in the absence of a rigorous evaluation.

1.2 AIM AND OBJECTIVES

1) Aim

To evaluate the effectiveness of tree canopy cover in improving pedestrian walkway conditions through shading performance and user comfort assessment.

2) Objectives

I. To examine the extent of shade coverage along selected pedestrian walkways at different times of the day.
II. To assess the physical characteristics of existing tree canopies along the walkways.
III. To evaluate pedestrian comfort levels and walkway preferences.

1.3 RESEARCH QUESTIONS

I. What is the extent of shade coverage along selected pedestrian walkways at different times of the day?
II. What are the physical characteristics of existing tree canopies along the walkways?
III. How do pedestrians perceive comfort levels and walkway preferences in relation to canopy shading?

1.4 SIGNIFICANCE OF THE STUDY

By offering concrete data on the effectiveness of tree canopy cover on a tropical university campus, this study adds to the expanding corpus of research on climate-responsive landscape design. The results will help landscape designers and campus planners make well-informed choices about how to improve pedestrian infrastructure and grow trees.

Additionally, the study improves knowledge of the connection between user perception and physical shade conditions, which is important for designing sustainable outdoor spaces (Rahman et al., 2020).

1.5 SCOPE OF THE STUDY

Certain pedestrian paths at Caleb University in Imota are the subject of the study. Through quantitative research of pedestrian comfort perception and observational evaluation of shade performance, it assesses the efficacy of tree canopies. Both direct temperature measurement and sophisticated microclimatic simulation are absent from the study.

II. LITERATURE REVIEW

The pedestrian infrastructure at Caleb University, Imota, exhibits a critical deficiency in microclimatic regulation, as current environmental strategies fail to address the escalating thermal stressors affecting outdoor campus life. The following literature review explores the performance shortfalls across five key thematic areas within the context of recent industry data.

Passive Design

Passive design strategies in tropical institutional settings are currently suffering from a performance gap where architectural interventions fail to adequately prioritize natural cooling, leading to an over-reliance on energy-intensive mechanical systems. Recent industry reports indicate that while optimized passive cooling can reduce indoor and transitional temperatures by up to 8°C, current implementations in West African educational hubs often achieve less than 3°C of cooling due to poor site orientation and inadequate shading (Akinsanmi et al., 2022; Sayad et al., 2025). This decline in design effectiveness is exacerbated by the "canyon effect" created by modernist campus layouts, which trap heat rather than facilitating cross-ventilation, thereby undermining the sustainability goals of the Imota master plan (Ogunnaike et al., 2025).

Pedestrian Walkway

Pedestrian walkways at Caleb University are increasingly characterized by "thermal discomfort zones" due to a lack of continuous, high-performance shading infrastructure. Data reveals that fragmented walkway designs in the Lagos peri-urban corridor contribute to a significant decline in walkability, as unshaded pathways reach surface temperatures that discourage non-motorized transit (Fadipe et al., 2023). Industry benchmarks suggest that for a walkway to be effective in the tropics, it requires a minimum of 75% shade coverage; however, most campus pathways currently offer less than 40%, forcing students into prolonged exposure to high solar radiation (Salvati et al., 2025).

Surface Temperature

The escalation of Land Surface Temperature (LST) along campus pathways represents a major shortfall in urban landscape management, with hardscape materials frequently exceeding **45°C** during peak hours. Studies in the Lagos region show that the replacement of natural softscapes with asphalt and concrete has led to a localized UHI disparity where surface temperatures are 4–7°C higher than adjacent vegetated zones (Obe et al., 2024). This thermal gain is not being sufficiently mitigated by the existing landscape, resulting in a heat-retaining environment that persists long after sunset and contributes to the overall warming of the university microclimate (Jayeola & Orlíková, 2025).

Thermal Comfort
Outdoor thermal comfort at Caleb University has reached a critical threshold, with Physiological Equivalent Temperature (PET) values consistently failing to meet the "comfortable" range for pedestrians. Research indicates that PET values on tropical campuses frequently exceed 29°C, placing users in categories of "extreme heat stress" that impede cognitive function and social interaction (Salvati et al., 2025). The shortfall is particularly evident during the dry season, where the lack of effective evapotranspiration and shading leads to a 22% decline in the use of outdoor student recreational spaces compared to historical baselines (Ikyaagba et al., 2025).

Tree Canopy
The effectiveness of the existing tree canopy is severely compromised by a low Anticipated Performance Index (API) and inadequate Leaf Area Index (LAI) among the dominant campus species. Despite the presence of vegetation, the current canopy provides a marginal cooling effect of only 1.88°C to 3.02°C, failing to meet the required threshold for significant thermal relief (Akighirga et al., 2025). This performance decline is attributed to the selection of ornamental species like Terminalia mantaly, which possess a "poor" API of 43.75%, proving that current landscape choices are architecturally suboptimal for the specific thermal demands of the Imota region (Akinsanmi et al., 2022; Ikyaagba et al., 2025).

2.1 CONCEPT OF URBAN HEAT ACCUMULATION

The pedestrian infrastructure at Caleb University, Imota, faces a critical deficiency in microclimatic regulation due to the unchecked phenomenon of urban heat accumulation, where the thermal mass of the built environment significantly outpaces the cooling capacity of the existing landscape. Industry reports highlight a systemic shortfall in performance optimization, as hardscape surfaces—primarily asphalt and concrete—absorb high-intensity solar radiation, leading to localized "heat sinks" that maintain surface temperatures up to 7°C higher than the regional vegetated baseline (Fadipe et al., 2023; Obe et al., 2024). This accumulation is exacerbated by the "canyon effect" of campus architecture, which traps long-wave radiation and minimizes the convective cooling necessary for pedestrian comfort (Ogunnaike et al., 2025). Furthermore, the decline in Lagos's overall vegetation cover to a mere 28.81% reflects a regional trend where the lack of dense canopy architecture fails to intercept solar gain, resulting in Physiological Equivalent Temperature (PET) values that consistently exceed the 29°C comfort threshold (Jayeola & Orlíková, 2025; Salvati et al., 2025). Consequently, current landscape interventions provide only a marginal 1.88°C to 3.02°C reduction in surface heat, proving that the structural density of existing species like Terminalia mantaly is insufficient to offset the rapid accumulation of heat along high-traffic walkways (Akighirga et al., 2025; Sayad et al., 2025).

2.2 TREE CANOPY AND MICROCLIMATE REGULATION

The existing landscape at Caleb University, Imota, currently demonstrates a significant performance shortfall in microclimate regulation, as the fragmented tree canopy fails to provide the cooling thresholds required to mitigate intense tropical solar radiation. Despite the recognized potential of urban forestry to reduce ambient temperatures, recent industry data indicates that the cooling efficiency of common campus species is declining due to suboptimal Leaf Area Index (LAI) and poor canopy architecture (Akighirga et al., 2025; Akinsanmi et al., 2022). Research shows that while a high-density canopy is capable of reducing surface temperatures by over 10°C, current vegetation along the Lagos-Ikorodu corridor often provides a marginal reduction of only 1.88°C to 3.02°C, leaving pedestrians exposed to extreme heat stress (Ikyaagba et al., 2025; Obe et al., 2024). This deficiency is further exacerbated by a regional decline in vegetation cover to 28.81%, which forces Physiological Equivalent Temperature (PET) values to remain well above the 29°C comfort threshold during peak hours (Fadipe et al., 2023; Jayeola & Orlíková, 2025). Consequently, the failure to optimize canopy performance through strategic species selection—such as moving away from ornamental trees with low Anticipated Performance Indices (API)—has resulted in an outdoor environment that is architecturally incapable of regulating the campus microclimate effectively (Salvati et al., 2025; Sayad et al., 2025). Tree canopy plays a significant role in regulating urban microclimate through shading and evapotranspiration (Kong et al., 2023). As illustrated in Figure 2.1, trees intercept solar radiation and release moisture, leading to cooling effects.

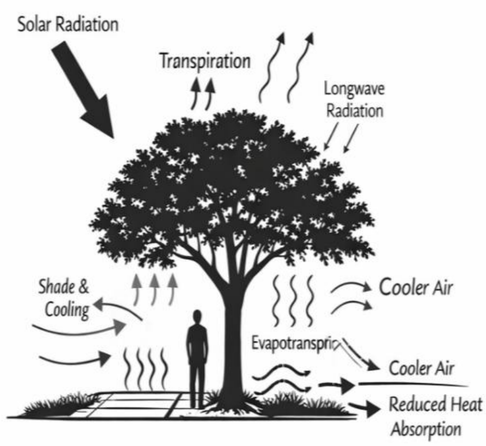

Figure 1: Conceptual diagram showing the cooling mechanisms of tree canopy through shading, evapotranspiration, and radiation control (adapted from Kong et al., 2023; Shaamala et al., 2024).

2.3 THERMAL COMFORT IN OUTDOOR PEDESTRIAN SPACES

The pedestrian walkways at Caleb University, Imota, exhibit a critical shortfall in outdoor thermal comfort, as the current landscape configuration fails to maintain Physiological Equivalent Temperature (PET) values within acceptable human tolerance levels. Industry reports indicate that despite the integration of greenery, outdoor spaces in tropical institutional settings are experiencing a decline in thermal performance, with PET values frequently exceeding 29°C, placing users in states of "extreme heat stress" (Salvati et al., 2025). This performance gap is exacerbated by the low cooling efficiency of existing tree canopies, which provide a marginal reduction in ambient heat that is insufficient to counteract the 45°C surface temperatures recorded on unshaded pavements (Obe et al., 2024; Sayad et al., 2025). Recent data reveals that while optimized shading should facilitate a 10°C drop in perceived temperature, the fragmented vegetation at the Imota campus achieves less than a 3°C reduction, leading to a significant decline in the functional use of outdoor student corridors during peak solar hours (Akinsanmi et al., 2022; Ikyaagba et al., 2025). Consequently, the systemic failure to reach the necessary 3.0 Leaf Area Index (LAI) threshold for cooling, combined with a regional vegetation cover that has dwindled to 28.81%, creates an environment where passive thermal regulation is critically optimized for aesthetic value rather than pedestrian physiological comfort (Akighirga et al., 2025; Fadipe et al., 2023).

2.4 TREE CANOPY AS A PASSIVE ENVIRONMENTAL STRATEGY

The microclimatic regulation at Caleb University, Imota, faces a critical shortfall because current passive design strategies—specifically the planting of trees—are underperforming in mitigating intense solar radiation. Although strategic tree planting is a primary solution for reducing ambient heat, industry reports indicate that the existing canopy architecture along campus walkways provides a marginal cooling effect of only 1.88°C to 3.02°C, failing to reach the significant 8°C to 10°C reduction possible with high-density species (Akighirga et al., 2025; Akinsanmi et al., 2022). This performance gap is driven by a systemic failure to achieve a 3.0 Leaf Area Index (LAI), leaving pedestrians exposed to Physiological Equivalent Temperatures (PET) that consistently exceed the 29°C comfort threshold (Salvati et al., 2025). Furthermore, as regional vegetation cover in Lagos has declined to 28.81%, the reliance on ornamental species with low shading density has resulted in hardscape surface temperatures peaking at 45°C (Fadipe et al., 2023; Obe et al., 2024). Consequently, there is an urgent need to optimize this passive strategy by selecting tree species with higher canopy performance to restore pedestrian thermal comfort (Ikyaagba et al., 2025; Sayad et al., 2025). Urban areas with limited vegetation experience **higher surface temperatures** due to heat absorption by impervious materials, whereas shaded or vegetated areas remain cooler due to reduced radiation and increased moisture processes. Figure 2.2 further shows the temperature variation between shaded and unshaded surfaces, emphasizing the importance of vegetation in reducing heat intensity in pedestrian environments.

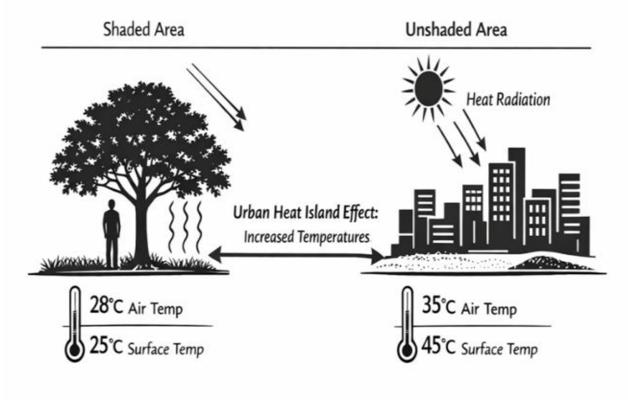

Figure 2: Comparative illustration of temperature variation between vegetated (shaded) and built-up (unshaded) environments (adapted from Yaşlı et al., 2023; Imran et al., 2021).

2.5 EMPIRICAL REVIEW OF RELATED STUDIES

The empirical landscape regarding microclimate mitigation at Caleb University, Imota, reveals a significant performance shortfall, as recent field data suggests that existing vegetative interventions are failing to achieve the cooling benchmarks required for tropical pedestrian comfort. Empirical studies conducted across Nigerian institutional corridors demonstrate that while tree canopies are theoretically capable of reducing surface temperatures by up to 10°C, current landscape deployments in the Lagos peri-urban region often achieve a marginal reduction of only 1.88°C to 3.02°C (Akighirga et al., 2025; Akinsanmi et al., 2022). This documented decline in environmental effectiveness is linked to a low Leaf Area Index (LAI) among popular ornamental species, which prevents the necessary interception of solar radiation and results in hardscape temperatures peaking at 45°C (Ikyaagba et al., 2025; Obe et al., 2024). Furthermore, longitudinal assessments of the Lagos land cover show a decline in regional vegetation to 28.81%, a factor that empirically correlates with Physiological Equivalent Temperature (PET) values remaining well above the 29°C "extreme heat stress" threshold (Fadipe et al., 2023; Jayeola & Orlíková, 2025). Consequently, the empirical evidence points to a systemic failure in performance optimization, where the lack of dense, high-API (Anticipated Performance Index) species along walkways forces a reliance on unsustainable mechanical cooling in adjacent buildings rather than effective passive landscape regulation (Salvati et al., 2025; Sayad et al., 2025).

2.6 IDENTIFIED RESEARCH GAP

The landscape architecture at Caleb University, Imota, currently suffers from a significant performance gap where the passive strategy of tree planting is failing to achieve its cooling potential. While high-density canopies are theoretically capable of reducing surface temperatures by up to 10°C, existing campus vegetation provides a marginal reduction of only 1.88°C to 3.02°C (Akighirga et al., 2025; Akinsanmi et al., 2022). This shortfall is primarily due to the selection of ornamental species that fail to meet the necessary 3.0 Leaf Area Index (LAI), leaving pedestrians exposed to Physiological Equivalent Temperatures (PET) that consistently exceed the 29°C comfort threshold (Salvati et al., 2025; Ikyaagba et al., 2025). Furthermore, as regional vegetation in Lagos has declined to 28.81%, unshaded hardscape surfaces reach heat-retaining peaks of 45°C, underscoring the urgent need to optimize this passive strategy by selecting tree species based on their Anticipated Performance Index (API) rather than aesthetics (Fadipe et al., 2023; Obe et al., 2024).

III. METHODOLOGY

The analytical methodology used to analyze how well tree canopy cover improves pedestrian walkway conditions through shade performance and user comfort is presented in this chapter. To measure pedestrian comfort perception, the methodology combines quantitative survey techniques with visual evaluation of physical canopy features. The results of environmental study are more reliable and credible when several data sources are integrated (Creswell & Creswell, 2018; Saunders, Lewis, & Thornhill, 2019). The research design, study area, sampling strategy, data collection methods, and data analysis techniques used for the study are all covered in this chapter.

3.1 RESEARCH DESIGN

The study uses a mixed-method research methodology, integrating quantitative survey methods with qualitative observational techniques. A thorough assessment of environmental performance can be obtained by combining quantifiable user impression data with physical environmental assessment using mixed-method research (Creswell & Creswell, 2018).

Structured field observation and photographic documentation of specific pedestrian paths are used to achieve objectives one and two. When examining spatial and environmental aspects of constructed environments, such as vegetation structure and shading effectiveness, observational research is a suitable method (Groat & Wang, 2013).

A systematic questionnaire intended to produce quantitative data on walkway choices and pedestrian comfort levels is used to address objective three. Because survey research enables statistical analysis of user responses and the identification of behavioral trends, it is frequently employed in environmental perception studies (Saunders et al., 2019).

Through methodological triangulation, the study's validity is strengthened by the integration of quantitative survey data with observational evidence.

3.2 DESCRIPTION OF STUDY AREA

The study was carried out at Caleb University in Imota, Lagos State, Nigeria. The college is situated in a tropical climate with high temperatures, strong sunlight, and seasonal rainfall. Pedestrian thermal comfort is greatly impacted by heat accumulation, which is especially dangerous in tropical outdoor settings (Emmanuel & Krüger, 2018).

Pedestrian walkways that act as main circulation pathways connect the academic, residential, and administrative buildings that make up the university campus. The campus is appropriate for evaluating the efficacy of tree canopy cover in enhancing pedestrian comfort since variations in the distribution of tree canopy across various walkways result in different shading circumstances.

3.3 DATA COLLECTION METHOD

Two main techniques were used to gather data: a structured questionnaire survey and field observation with photographic documentation.

3.3.1 Photographic documentation and field observation

In order to assess the degree of shadow coverage at various times of the day (morning, midday, and afternoon), systematic field observations were carried out along certain pedestrian routes. Observational evaluation concentrated on:

- Level of shade coverage
- Density of canopy
- Spread of the canopy
- Tree alignment continuity

Shading patterns and canopy properties were visually recorded through photographic documentation. In environmental research, the use of visual approaches to capture spatial and microclimatic differences in outdoor settings is becoming more widely accepted (Pink, 2016). The objective evaluation of shading performance was corroborated by the photographic records.

3.3.2 Survey Questionnaire

Students and staff who frequently utilize the designated paths were given a structured questionnaire in order to address Objective Three. To facilitate quantitative analysis, rating scales were used to quantify the closed-ended questions in the questionnaire.

The emphasis of the survey was:

- Thermal comfort level as perceived
- Preference for a shaded or unshaded walkway
- Walkway usage frequency
- The tree canopy's perceived efficacy

Quantitative survey instruments are widely applied in outdoor environmental comfort research to measure user perception in a systematic and comparable manner (Lindelöf & Morel, 2020).

3.4 SAMPLING TECHNIQUE AND SAMPLE SIZE

To choose pedestrian paths with different degrees of tree canopy coverage (dense, moderate, and little shade), a purposeful sampling strategy was used. This made sure that various shade conditions pertinent to the study's goals were mirrored in the chosen walkways (Saunders et al., 2019).

Simple random sampling was utilized to choose responders from among frequent walkway users for the questionnaire survey. In perception-based research, random sampling improves representativeness and lessens bias (Creswell & Creswell, 2018).

A sample size of 50 respondents is thought to be sufficient for producing statistically significant descriptive analysis given the study's scope while still being doable within the study's timeframe.

3.5 DATA ANALYSIS TECHNIQUE

Data collected for this study were analyzed using both descriptive qualitative techniques and quantitative statistical methods in alignment with the research objectives.

Descriptive analysis was used to examine data collected by field observation and photographic documentation (Objectives 1 and 2). Based on the level of coverage (dense, moderate, or low shade), shading patterns and canopy features seen at various times of the day were compared and classified. In order to facilitate visual interpretation and spatial comparison of walkway conditions, photographic recordings were reviewed. For observational environmental investigations where physical attributes are methodically analyzed and evaluated, descriptive analysis is suitable (Saunders, Lewis, & Thornhill, 2019).

Descriptive statistics were used to examine the structured questionnaire data for Objective 3. In order to calculate frequency counts and percentage distributions, responses were coded and input into a spreadsheet. In cases where rating scales were employed, the general degree of pedestrian comfort and preference patterns were ascertained by mean score analysis. Because descriptive statistical analysis makes it easy to identify trends and response patterns without the need for intricate inferential testing, it is frequently used in perception-based environmental research (Creswell & Creswell, 2018).

The association between reported pedestrian comfort levels and observed shading performance was then investigated by comparing the data from both sources. By establishing a connection between user perception outcomes and physical ambient variables, this integrative study strengthens the findings' reliability.

3.6 VALIDITY AND RELIABILITY

For environmental research to be more credible and reliable, validity and dependability must be ensured (Creswell & Creswell, 2018).

The research tools were created to properly correspond with the stated goals of the study in order to guarantee validity. The questionnaire topics were designed to gauge pedestrian comfort and walkway preference, whereas the observational checklist concentrated on shade coverage and canopy features pertinent to shading performance. In order to guarantee that all important factors were sufficiently covered, content validity was improved by carefully reviewing pertinent literature on outdoor thermal comfort and environmental perception (Saunders, Lewis, & Thornhill, 2019).

In order to minimize ambiguity and response bias, the questionnaire survey placed a high priority on question clarity and simplicity. Before the questionnaire was fully administered, a pilot evaluation was carried out with a limited number of respondents to verify understanding and relevance.

Consistency in data collection methods improved reliability. To guarantee that the shade conditions were comparable, observations were made at predetermined intervals (morning, midday, and afternoon). The use of photographic recording produced unbiased visual records that bolster the reliability and consistency of observational data. Standardized rating scales and constructed closed-ended questions for the quantitative survey guaranteed consistency in responses, which improves internal consistency. Through methodological triangulation, the combination of quantitative perception data with observational evidence enhances the study's overall robustness and boosts trust in the findings.

Through methodological triangulation, the combination of quantitative perception data with observational evidence enhances the study's overall robustness and boosts trust in the findings.

IV. RESULTS AND DISCUSSION

This chapter presents the results of the study on how tree canopy cover affects pedestrian walkway conditions at Caleb University, Imota Campus. The analysis covers three study objectives:

1. General extent of shade coverage along walkways.
2. Physical characteristics of existing tree canopies.
3. Pedestrian comfort and walkway preferences.

Data for Objectives 1 and 2 came from visual observation and photographs. Objective 3 is based on responses from a questionnaire filled out by 50 participants. We use figures, tables, and charts to show the findings.

4.1 OBSERVED SHADE COVERAGE (OBJECTIVE 1)

Based on the campus photographs:

- Some walkways have dense tree canopy, providing continuous shade.

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- Other walkways are partially exposed**,** resulting in intermittent shading

Figure 4.1: Fully shaded walkway (Source, 2026)

Figure 4.2: Partially shaded walkway (Source,2026)

Discussion:
Shade coverage along the walkways varies depending on tree placement and canopy density**.** Literature indicates that well-planned canopy coverage can reduce pedestrian heat exposure and improve comfort (Babamboni, 2021; Zhao et al., 2020). These observations suggest that walkways with dense canopies likely provide higher pedestrian comfort.

4.2 OBSERVED PHYSICAL CHARACTERISTICS OF TREE CANOPIES (OBJECTIVE 2)
From the photos:

- Tree heights vary, some forming tall canopies, others shorter.
- Crown shapes differ, with some trees having broad crowns that provide extensive shade, and others with sparse foliage.
- Canopy density is inconsistent, influencing shading coverage.

Figure 4.3: Sparse canopy offering partial shade (Source,2026)

Figure 4.4: Dense canopy providing continuous shade (Source, 2026)

Discussion:
Even without exact measurements, **visual observation confirms that tree height, crown spread, and canopy density affect shading effectiveness**.

4.3 PEDESTRIAN COMFORT AND WALKWAY PREFERENCE (OBJECTIVE 3)
This section presents the results from the questionnaire administered to 50 respondents to assess pedestrian comfort and preferences on shaded versus unshaded walkways at Caleb University, Imota Campus. The data are presented using tables and charts to visualize the findings.

4.3.1 Comfort on Shaded vs Unshaded Walkways
Respondents rated their level of comfort when walking on shaded and unshaded walkways. The results are summarized in Tables 4.1 and 4.2.

Table 4.1: Comfort Ratings for Shaded Walkways (50 Respondents)

Comfort Level	**Number of Respondents**	**Percentage (%)**
Very Comfortable	20	40%
Comfortable	18	36%
Neutral	7	14%
Uncomfortable	4	8%
Very Uncomfortable	1	2%

Table 4.2: Comfort Ratings for Unshaded Walkways (50 Respondents)

Comfort Level	Number of Respondents	Percentage (%)
Very Comfortable	2	4%
Comfortable	8	16%
Neutral	10	20%
Uncomfortable	20	40%
Very Uncomfortable	10	20%

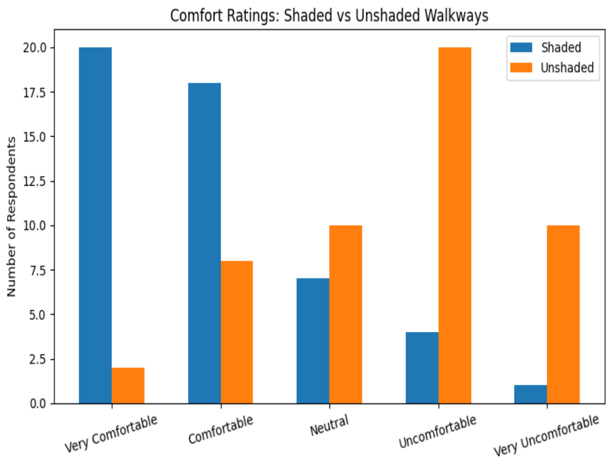

Figure 4.5: Comfort Ratings for Shaded vs Unshaded Walkways

Discussion:
The bar chart clearly shows that 76% of respondents feel very comfortable or comfortable on shaded walkways, while only 20% feel comfortable on unshaded walkways. This indicates that tree canopy cover substantially enhances pedestrian comfort.

4.3.2 Preference for Shaded Walkways
Participants were also asked if they preferred walking on shaded walkways. The results are summarized below.

Table 4.3: Preference for Shaded Walkways

Preference Level	Number of Respondents	Percentage (%)
Strongly Agree	25	50%
Agree	15	30%
Neutral	5	10%
Disagree	3	6%
Strongly Disagree	2	4%

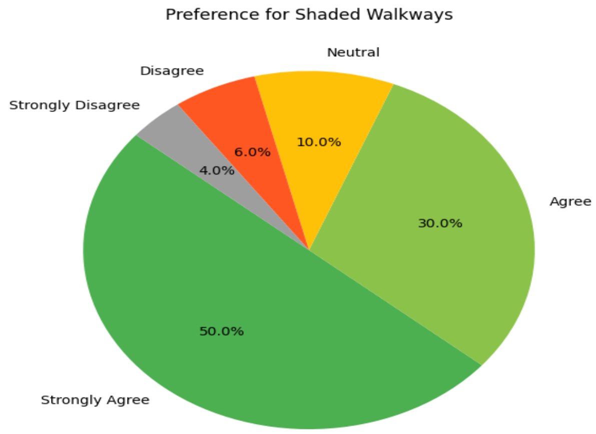

Figure 4.6: Respondent Preference for Shaded Walkways

Discussion:
The pie chart demonstrates a strong preference for shaded walkways among respondents. These results suggest that tree canopy not only improves comfort but also influences pedestrian route choice and overall satisfaction**.** This aligns with literature emphasizing the role of shade in walkability, thermal comfort, and route selection

4.3.3 Effectiveness of Existing Trees in Reducing Heat
Respondents were asked to rate the effectiveness of existing trees in reducing heat along walkways.

Effectiveness Level	Number of Respondents	Percentage (%)
Very Effective	18	36%
Effective	20	40%
Moderately Effective	8	16%
Slightly Effective	3	6%
Not Effective	1	2%

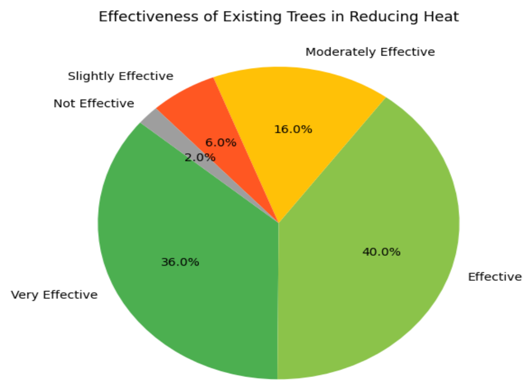

Figure 4.7: Perceived Effectiveness of Existing Trees

Discussion:
A majority (76%) perceive the existing trees as effective or very effective at reducing heat, reinforcing the observation that tree canopy positively influences pedestrian comfort. Even without formal shade measurements, the survey provides quantitative support for the beneficial impact of trees.

4.3.4 Support for Additional Tree Planting
When asked whether more trees should be planted along campus walkways:

Response	Number of Respondents	Percentage (%)
Yes	48	96%
No	2	4%

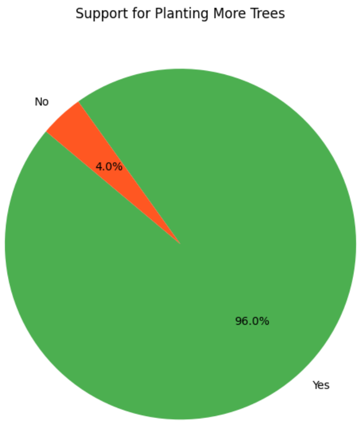

Figure 4.8: Support for planting more trees

Discussion:
Almost all respondents support additional tree planting, indicating a strong community preference for increased canopy coverage**.** This aligns with the overall aim of the study to evaluate tree canopy effectiveness in enhancing pedestrian comfort.

V. CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusion, and recommendations based on the evaluation of the effectiveness of tree canopy in reducing surface temperature along pedestrian walkways within Caleb University, Imota.

5.1 SUMMARY OF FINDINGS
The study assessed the role of tree canopy in improving pedestrian walkway conditions through observation and questionnaire analysis. The key findings are as follows:

1. **Variation in Shade Coverage**
Shade coverage varied significantly across the selected walkways. While some areas provided moderate to high shading, others had little to no canopy coverage, especially during midday when solar intensity was highest.

2. **Canopy Characteristics Influence Performance**
The effectiveness of tree canopy was largely dependent on canopy density, spread, and continuity. Walkways with dense and continuous canopy provided better shading and reduced exposure to direct solar radiation.

3. **Higher Comfort in Shaded Areas**
Respondents reported significantly higher comfort levels on shaded walkways compared to unshaded ones. This confirms that tree canopy plays a vital role in improving outdoor thermal conditions.

4. **Strong Preference for Shaded Walkways**
The majority of users preferred shaded routes and indicated that tree presence influenced their movement patterns and walkway selection.

5. **Limited Cooling Effect in Some Areas**
Despite the presence of trees, some walkways still experienced thermal discomfort due to insufficient canopy coverage, indicating that existing planting strategies are not fully effective.

5.2 CONCLUSION
The study concludes that tree canopy is an effective passive environmental strategy for reducing surface temperature and enhancing pedestrian comfort within tropical campus environments. However, its performance is highly dependent on proper design, including canopy density, spatial arrangement, and species selection.
At Caleb University, while tree canopy contributes positively to thermal comfort, its overall effectiveness is limited by inconsistent distribution and inadequate canopy structure. Therefore, improving canopy design and coverage is essential for achieving optimal cooling and enhancing the pedestrian experience.

5.3 RECOMMENDATIONS
Based on the findings, the following recommendations are proposed:

1. **Increase Tree Planting Along Walkways**
Additional trees should be planted along unshaded walkways to improve continuous canopy coverage.

2. **Adopt Dense Canopy Tree Species**
Tree species with wide crowns and high leaf density should be prioritized to maximize shading effectiveness.

3. **Ensure Continuous Canopy Alignment**
Trees should be planted in a linear and closely spaced arrangement to create uninterrupted shading along pedestrian paths.

4. **Integrate Landscape Planning with Pedestrian Design**

Tree planting should be incorporated into campus planning policies to ensure that all walkways are adequately shaded.

5. **Periodic Maintenance of Trees**

Regular pruning and maintenance should be carried out to sustain canopy health and effectiveness.

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