TITLE

ENVIRONMENTAL BENEFITS OF TREES IN URBAN SECONDARY SCHOOLS

GRADE LEVEL: Secondary School (grades 9-12, ages 14 – 18)

REPORT TYPE: International Virtual Science Symposium (IVSS), 2024

THEME: Climate Investigations: Understanding Earth as a System

STUDENTS: Isah Aishat, Nwajiaku Amarachi, Mbachu Chizaram, Osewa Peace, Afolabi-Bakare Goodness, Bamidele Joy, Ojo-Abiodun Darasimi, Adeniyi Faith, Momoh Deborah, Abegunde Ayomide, Lordacquit Peculiar, Ogunsusi Grace, Idachaba Chegbe, Anjorin Fortunate, Olakunori Precious, Idachaba Ojochenemi, Fatorise Faith, Ogunsan Oluwafikayomi, Okeke Faustina, Oluwole Naomi, Olugesin Mercy, Idachaba Uredo.

GLOBE TEACHER: Mrs. Adeyemo Folahan Catherine

CONTRIBUTOR: Mr. Adebayo Adedayo Emmey

SCHOOL: Federal Government Girls' College Akure, Ondo State, Nigeria

DATE: 1st January, 2024

TABLE OF CONTENTS

ABSTRACT

This paper presents a micrometeorological study on the environmental benefits of trees in Federal Government Girls' College Akure, Ondo State, Nigeria. Temperatures under three different surfaces (under trees and among different tree species, bare-ground and asphalted surfaces) within the school were measured. The temperature under commonly planted trees such as Neem (Azadirachta indica), Gmelina (Gmelina arborea) and Mango (Mangifera indica) found on the school compound alongside bare-ground (no vegetal coverage) and asphalted road surfaces were measured in degree Celsius for a period of six weeks. Infrared thermometer and Digital Hygrometer was used to collect surface and air temperatures respectively and their averages calculated. The GLOBE Observer App for trees was used to obtain tree height and circumference and to submit all data collected for the calculated mean average of air and surface temperatures for different surfaces. Data collected were analyzed using frequency, percentage, bar chart, and pie chart. The study showed that there is a temperature variation under different surfaces. Under the trees recorded lowest mean temperature of 23°C followed by bare-ground with 28°C whereas asphalt surface recorded the highest mean temperature of 53°C. The temperature under different tree species shows that trees with bigger crown and broad leaves had lower temperatures. Mean temperature under the Mango tree was 28°C while under the Neem tree, mean temperature was 32°C.

Keywords: Temperatures, Asphalt, Trees, Canopy, Environment, Micrometeorological, Urban.

RESEARCH QUESTION OF THE STUDY:

1. What roles do trees play at reducing air and surface temperatures?

HYPOTHESIS:

H_O: Is there any significant differences between the temperatures on asphalted road, bare ground and under trees?

INTRODUCTION AND LITERATURE REVIEW

The role of trees in the environment, especially as it relates to climate change is one issue that has been emphasized by climate scientist and that is why afforestation is a key component of climate change adaptation. Functions inherent to forests, according to [1] offer solutions to water availability and cooling [1,2,3]. Through evapotranspiration, trees recharge atmospheric moisture, contributing to rainfall locally and in distant locations [1] Cooling is unequivocally entrenched in the capacity of trees to capture and redistribute the sun's energy [4]. Trees enhance soil infiltration and, under suitable conditions, improve groundwater recharge. Precipitation filtered through forested catchments delivers purified ground and surface water [5,6]. Urban vegetation is very important for people's living because it does not only provide visual joy for people, but also influences directly or indirectly, urban environment through its physical characteristics [7]. For example, it influences urban environmental conditions and energy fluxes by selective reflection and absorption of solar radiation and by modulation of evapotranspiration [8]. Thus, a reliable measure of the distribution of urban vegetation is getting more significant.

The benefits of trees are not only well recognized by the academic community, but by municipalities and institutions around the country and the world [23]. However, even when general benefits of trees are understood and desired, it is difficult to manage and maximize their benefits without quantitative information on the direct benefits of an urban forest [24]. Without trees, the world would be bleak, and life as it is known would be impossible. Man is already acquainted with the vast importance of trees to his survival. Primitive people were dependent on trees for food. Fossilized products of trees like coal (carbonized and fossilized wood) supply fuel for the energy need of man. Modern man is no less dependent upon trees, particularly the soaring demand for tree products in the manufacture of newsprint and in the manufacture of papers as well as cardboard and similar packaging including the making of furniture and general construction that requires wood. Trees are not a taxonomic group, but include a variety of plant species that have independently evolved a woody trunk and branches as a way to tower above other plants to compete for sunlight.

Trees tend to be long-lived, some reaching several thousand years old. Trees have been in existence for 370 million years. It is estimated that there are just over 3 trillion mature trees in the world [26]. Trees help in greening the environment. Greening environment is often used as a catchall term referring to resource protection and practices which emphasize certain core

concepts such as resource efficiency (notably balancing consumption with nature's ability to replenish these resources) and the need to protect the natural systems upon which humans and other species depend [27]. However, deforestation as caused by multiple drivers and pressures, including conversion for agricultural uses, infrastructure development, wood extraction [28,29] agricultural product prices, and a complex set of additional institutional and location-specific factors [30], have led to the loss of trees which can be extremely important in certain localities such as Akure, Ondo state. In Nigeria sites presently occupied by Petrochemicals, Refineries, Fertilizer Companies and Liquified Natural Gas Plants where sometime, naturally occurring forest ecosystems [31].

Trees play important roles in maintaining a virile and sustainable environment. Trees provide the means of paying "carbon debt", this is done as it absorbed carbon IV oxide (CO_2) and gives out oxygen. When most of these trees are destroyed and used as fuel wood, planks for building, etc we have more carbon IV oxide circulating in the air causing more havoc [32]. Too much carbon IV oxide in the atmosphere causes more heat to be trapped within the atmosphere which contributes immensely to global warming and climate change [33,34]. Trees are indicators of a community's ecological health. When trees are large and healthy, the ecological systems – soil, air and water – that support them are also healthy. In turn, healthy trees provide valuable environmental benefits [16]. The greater the tree cover and the less the impervious surface, the more ecosystem services are produced in terms of reducing storm, water runoff, increasing air and water quality, storing and sequestering atmospheric carbon and reducing energy consumption due to direct shading of residential buildings [32].

However, despite these benefits, there are scanty studies on the environmental benefits of trees in Nigeria. Where they exist, they are largely based on observation and perception as only a few are based on micrometeorological measurement. As observed in the city, the benefits of the tree species were categorized as: environmental, medicinal, economic, spiritual and ecological services. There has been a level of confusion as to whether most communities know the values of trees planted or even appreciate them. For instance, in Federal Government Girls' College, Akure (FEGGICOLLA), the trees seen in the school have been the ones planted since the inception of the school. There have not been any plans of planting or replacing the ones that have been cut down in order to erect new structures in the quest of increasing the schools infrastructural facilities.

Trees also serve as screens to secure privacy, to reduce noise and they provide shade, unfortunately, little or no value or priority has been placed on tree planting in FEGGICOLLA and Nigeria as a whole. It is on this basis that the study was embarked on to assess the environmental benefits of trees in the school compound of Federal Government Girls' College Akure, Nigeria.

The Federal Government Girls' College, Akure compound has many buildings of architectural excellence and more are being constructed as the years go by but plans for greening the environment seem not to be in the pipeline as trees are cut down to put up more facilities, student classroom and office blocks. It is on the basis of this that the study accessed the environmental benefits of the few remaining tree stands by measuring temperatures under these trees and on two other surfaces devoid of trees; bare-ground and asphalted surfaces (tarred roads).

RESEARCH METHODS AND MATERIALS

Description and location of Akure city

Akure North Local Government Area of Ondo State is in the South Western part of Nigeria; its headquarters is in the town of Iju/Itaogbolu. It has an area of 660 km² and a population of 131,587 at the 2006 census. It has about 150 towns and villages with Itaogbolu, Iju, Oba-Ile, Ayede-Ogbese and Ilu-Abo as the major towns. The Local Government shares boundaries with Ikere (Ekiti-State) in the North, Owo and Ose Local Government in the West and South West, Ifedore Local government in the East and Akure South Local government in the southern part. Akure city coordinates lies on latitude 7° 4' and 7°25' north of the equator and longitude 5° 5' and 5°30' east of the Greenwich meridian.

Federal Government Girls' College Akure is one of the fastest growing and competitive secondary schools in Nigeria which is situated on a rapidly growing and a sub-urbanized environment that, as of March 2023, contained over 200 trees. Field research teams collected data on location and tree canopy size for 187 trees in the core of the school compound during the first quarter of 2023.
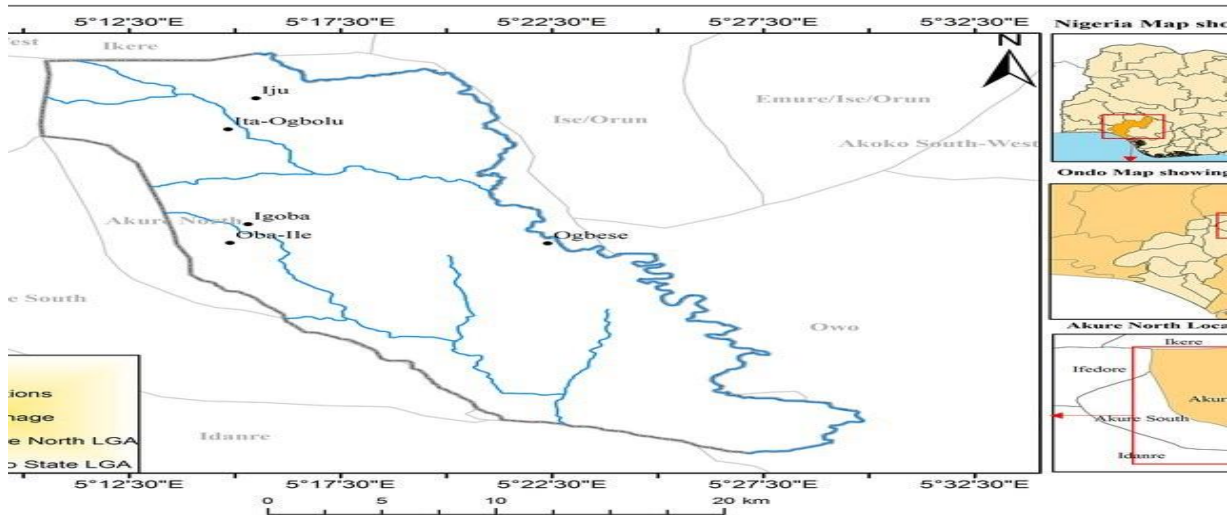
Figure 1: Map of Akure North Local Government area

Study area:

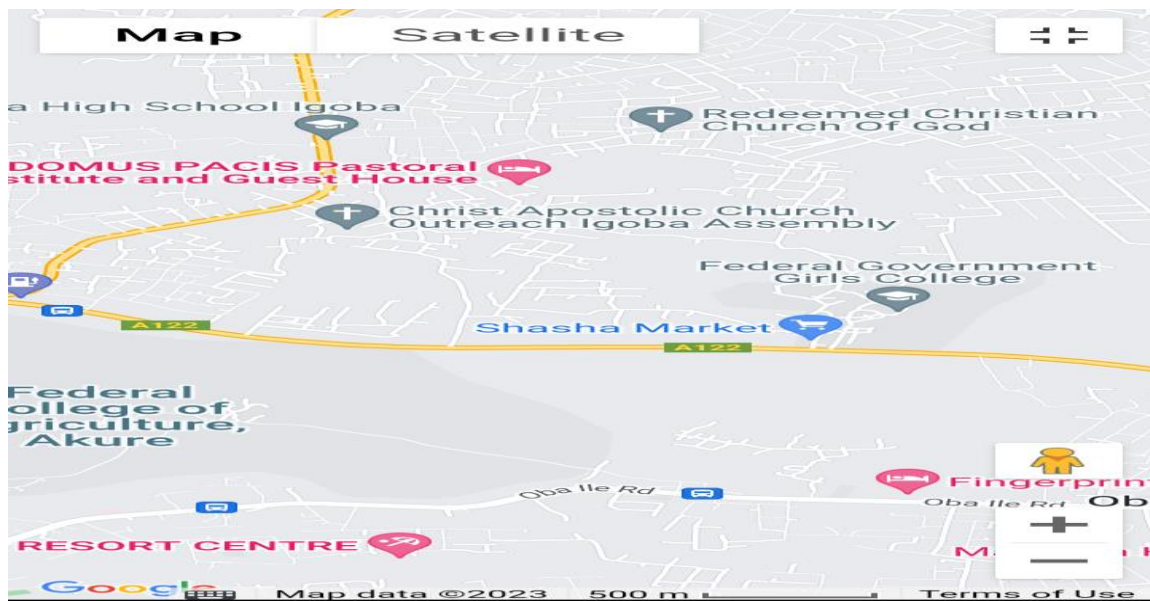The study was conducted in Federal Government Girls College Akure, Ondo State, Nigeria.

Figure 2: GLOBE Observer app showing the location of Federal Government Girls College Akure

Methods:

The research was carried out using GLOBE Observer Tree App to get the accurate tree height measurements, Measuring tape for measuring tree diameter and circumference, a hand held Infrared Thermometer to measure surface temperatures and Digital Hygrometer to measure the air temperatures under three different surfaces which include under trees, bare ground and asphalted surface for a period of six weeks covering all days of the week except Sunday because Sunday, was a worship day and active school activities takes place on that day. The

measurements were made between 12:35pm to 1:35pm local time for the period of study. Additionally, measurements were also made under different tree species such as Gmelaina (Gmalaina aborea), Mango (Mangifera indica) within the school compound. The trees sampled are located around the Sport Complex, hostels, PTA office area, Mosque area, Multipurpose Hall/Assembly ground area and Chapel area of the school. The entire observations was carried out during the peak period of both the dry and raining season with the dry season readings taken during the peak of the dry season around November-December and that of the raining season taken during the peak of the raining season around March-April thus affording us the opportunity to take our observations and readings in the two major weather conditions so as to get optimum results that will not be solely based on a period of time or a particular weather condition. The temperature measurements were taken and instantly recorded in a field note. The measurement was submitted through the GLOBE Observer App and later transferred to the computer for analysis.

Illustrations:

Figure 3-14: Air temperature measurement on asphalted road, sample of mango tree, tree circumference measurement using measuring tape, surface temperature measurement under mango tree, air temperature measurement under tree, tree diameter measurement using measuring tape, surface temperature measurement on asphalted road, air temperature measurement under tree, sample of gmelina tree, cloud measurement taken, surface temperature measurement on bare ground and air temperature measurement on bare ground.

GLOBE Protocols used:

1. Atmosphere: Cloud, Air temperature, Surface temperature.

2. Biosphere: Biometry.

Materials used:

Infrared Thermometer, Digital Hygrometer, Measuring tape, GLOBE Clouds Chart and GLOBE Observer App Data entry.
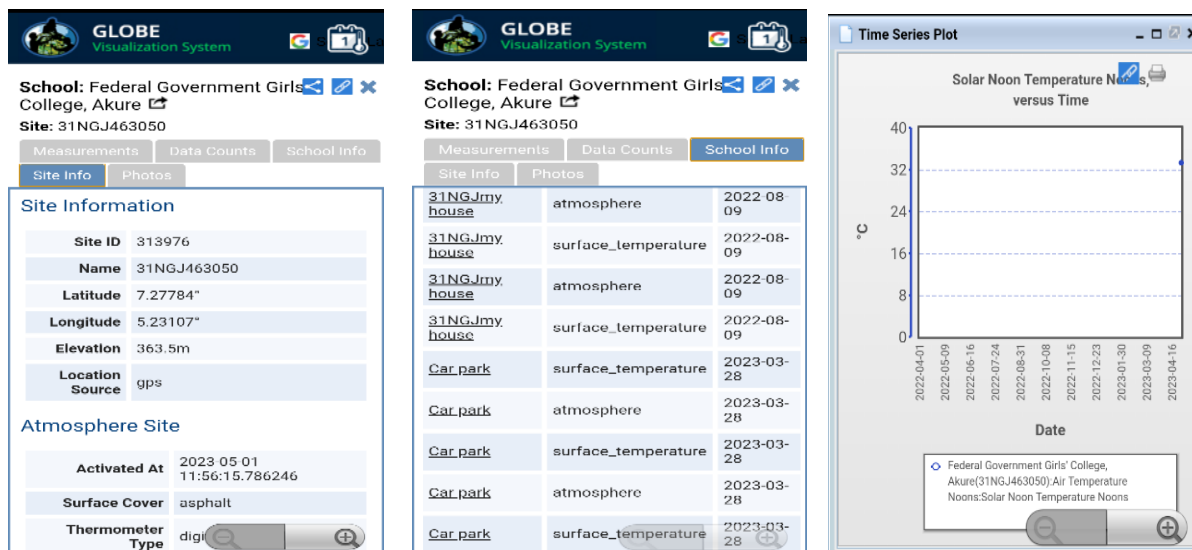
Data entries through the GLOBE Observer App:

Figure 15-20:Tree circumference measurement, gmelina tree, cloud cover, air temperature, surface temperature and air temperature and solar noon temperature versus time graph.

RESULT

Table 1: Tree species in Federal Government Girls College Akure, Ondo State.

S/N	Common Names	Scientific Names
1	Gmelina	Gmelina aborea
2	Oil Palm	Elaeis guineensis
3	Mango	Mangifera indica
4	Cashew	Anacadium accidetali
5	Sand Paper Tree	Ficus exasperata
6	Quick stick	Gliricidia sepium
7	Moringa Tree/ Drum Stick	Moringa oleifera
8	Pawpaw	Carica papaya
9	Neem Tree (Dogonyaro)	Azadirachta indica
10	Trema	Trema orientale
11	Red Bird of Paradise	Caesalpinia pulcherima
12	Flambouyant Tree	Delonix regia

Source: Field Survey, 2023

Table 2: Rate of Occurrence of Trees(Frequency and Percentage)

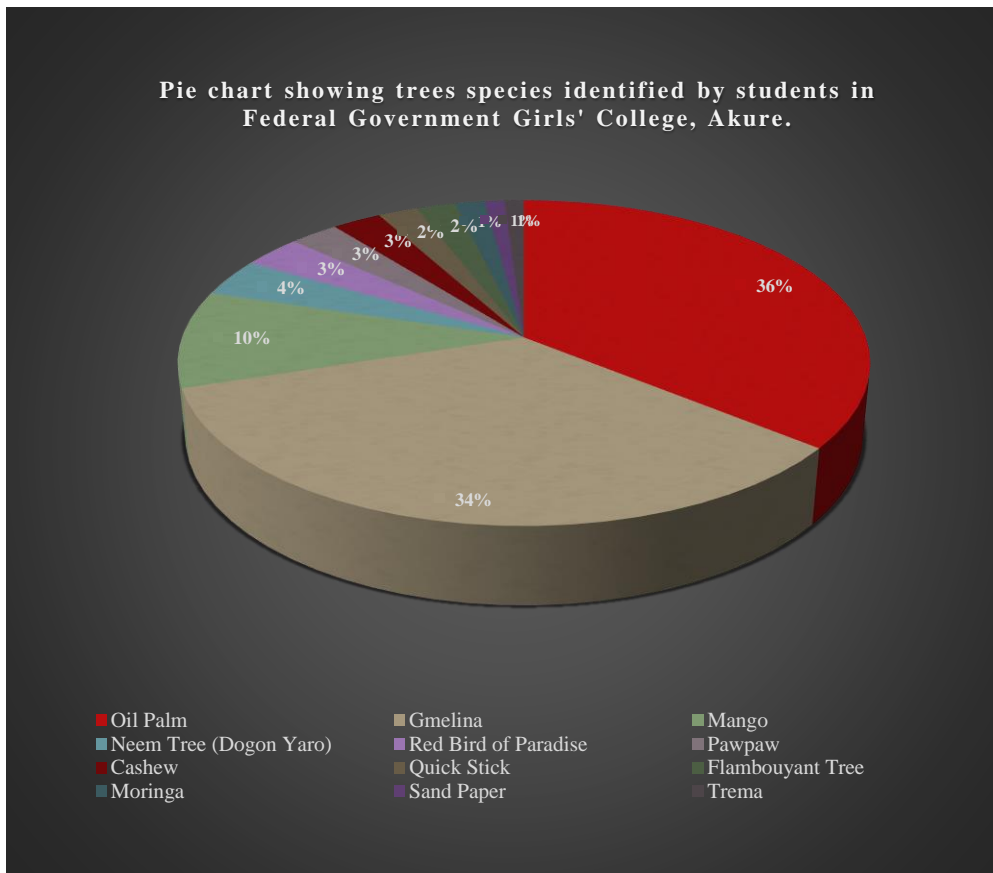| Trees	Frequency	Percentage (%)
Oil Palm	67	35.83
Gmelina	64	34.23
Mango	18	9.63
Neem Tree (Dogonyaro)	7	3.74
Red Bird of Paradise	6	3.21
Pawpaw	5	2.67
Cashew	5	2.67
Quick Stick	4	2.14
Flambouyant Tree	4	2.14
Moringa	3	1.6
Sand Paper	2	1.07
Trema	2	1.07
TOTAL	**187**	**100**

Source: Field Work, 2023

Chart 1: *Pie Chart showing the rate of occurrence of Trees on the FEGGICOLLA compound in Percentage.*

The average values of the two climatic factors (Surface temperature and Air temperature) obtained during the period of the study from the three different surfaces are shown in the table below.

Table 3: Daily temperature record for bare ground, under tree and asphalted road

DAYS	BARE GROUND (℃)	UNDER TREE (℃)	ASPHALTED (℃)
WEEK ONE			
Monday	31.1	29	44.1
Tuesday	31.8	30	40
Wednesday	32.5	26.7	35
Thursday	30.3	27	36.8
Friday	30.5	29.4	30.6
Saturday	31	26	33

WEEK TWO			
Monday	32.8	26	52.7
Tuesday	31.4	25.4	53
Wednesday	30	28	47.7
Thursday	31.6	27.3	42
Friday	33.1	30	44
Saturday	32	29.7	41
WEEK THREE			
Monday	31	29	40
Tuesday	30	29	35
Wednesday	32.5	30	33
Thursday	30	23	33
Friday	32	28.8	40
Saturday	32.5	29.3	37.5
WEEK FOUR			
Monday	35	30	48
Tuesday	30	34	49
Wednesday	29	23	31
Thursday	30	23	33
Friday	28	25	30
Saturday	32	30	40
WEEK FIVE			
Monday	30	31.3	40
Tuesday	32.5	29.5	38
Wednesday	40	37	49
Thursday	35.7	30.8	48
Friday	32	29.7	39.5
Saturday	38.6	32	45
WEEK SIX			
Monday	37.2	30.4	40.7
Tuesday	38	32.9	43
Wednesday	33	31.4	34

Thursday	30	29.1	35
Friday	32	30	37
Saturday	30	23	33

Source: Field work, 2023

Bar chart showing the temperature on bare ground, under trees and asphalted road
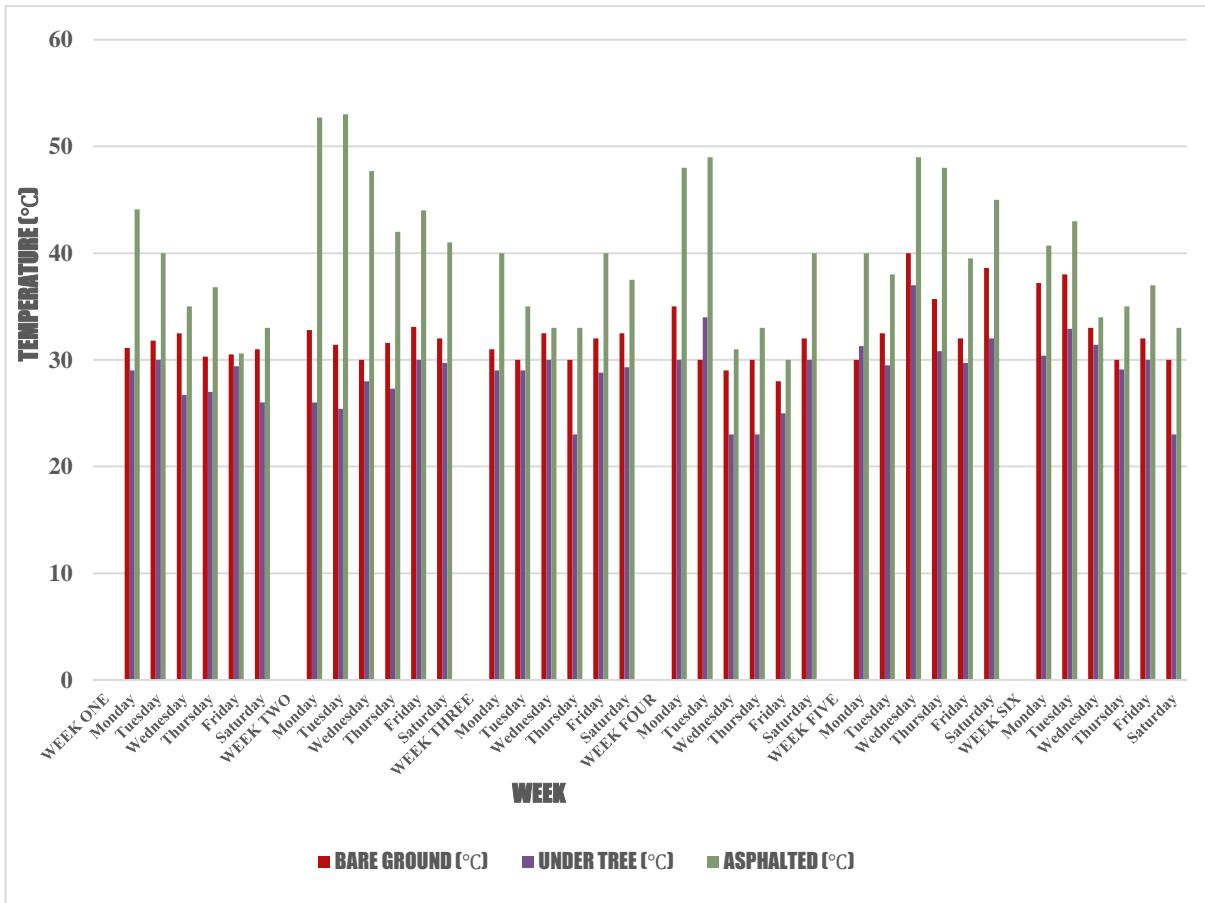

Chart 2: *Bar chart showing daily temperature record under different surfaces*

DISCUSSION

Tree Species Found in FEGGICOLLA Compound

Table 1 presents the various species of trees in Federal Government Girls' College Akure Compound. It recorded trees that are dominant in the different locations. The study recorded 12 different species of trees that are found in the FEGGICOLLA compound. The study observed that the trees are sparsely distributed in these locations and with little to no orderliness in their arrangement. This could be the result that the trees were largely inherited at the inception of the school.

Table 2 shows that there are 187 trees within the FEGGICOLLA compound. These trees play diverse role in providing shade which is vital in maintaining the temperature of the environment. More so, these trees in the School environment serves as wind breakers which prevent buildings and other valuable infrastructures from being damaged by wind storm which is a popular weather phenomenon that occurs during the rainy season each year. It was observed that areas with few trees received greater impacts of wind storms while those with much trees had minimal impacts of the wind storm. It therefore be said that trees around the school play a significant role in the environmental protection.

Chart 1 shows the species of trees that were identified in the school environment and their respective rate of occurrence on a pie chart on a scale of 100%. The tree with most population is Oil Palm with an occurrence percentage of 36%, followed closely by Gmelina which makes up about 34% of all tree species within the school compound and the distant third is the Mango tree which made up 9.63% of all trees.

The trees with the littlest representation are Flambouyant Tree and Moringa at 2% respectively, Sandpaper and Trema which occur at 1% respectively. This result shows that Oil Palm and Gmelina were identified as the most common tree species in the school.

Temperature Difference under Different Surfaces

Table 3 and Chart 2 shows the average temperature (surface and air) in the school compound based on three parameters which are the temperature on bare ground, under the different tree species and on asphalted ground. This measurements further showed that Week 2 recorded the highest temperature on Asphalted ground which was on Tuesday of Week 2 at 53°C and the lowest temperature on asphalted ground occurring at 30°C on Friday Week 4.

Wednesday, week 5 recorded the highest temperature on bare ground at 40°C and the lowest temperature on bare ground at 28°C on Friday of Week 4. Finally, the day with the highest temperature under tree was Wednesday week 5 at 37°C and lowest temperature occurring under the tree at 23°C on Wednesday and Thursday of week 4 which showed a constant temperature on two consecutive days. This temperature variation is associated with rainfall and overall weather and atmospheric conditions. The days that had rainfall including days following the day it rained indicates low temperatures, but days that are sunny and dry had high temperatures except the locations or environments that were around trees and vegetation which exhibited lower temperatures compared to other locations and it also goes on to prove that trees will always be useful in the environment in alleviating heat and exposure to the direct ultraviolet rays of the sun.

The result is a proof of the environmental benefit of trees in the school environment especially during the dry season months of November to April. During this period, one could feel the heat directly from asphalted surfaces during the day. The trend of temperature is similar throughout the course of the study. There is a consistency of higher temperature on asphalted surfaces over bare ground and under trees. This indicates that asphalted surfaces have higher temperature because of heat absorption of the tar. Albedo level for asphalted surface is 0.05-0.20 as it is a black surface which all have albedo levels close to Zero. Albedo is the fraction of solar radiation (light) reflected by a surface or an object. Albedo is measured on a scale from zero (0) to one (1), where 0 reflects no light and 1 reflects all light. It plays an important role in the thermal behaviour of pavements and other ground surfaces and their resultant impacts on humans and the environment.

CONCLUSION

The study was conducted to evaluate the environmental benefits of trees in an urban secondary schools using Federal Government Girls' College Akure as a case study. The objectives were to examine temperature differences under three (3) different surfaces which include: under trees, bare ground and asphalted surfaces. In addition, we evaluated temperature differences under different tree species in our school such as: Gmelina, Mango and Neem trees. The study shows that there is temperature variation between the three variables measured which were bare grounds, under tree and on asphalt surface. It was observed that temperatures under trees were lower compared to bare grounds and asphalt

surfaces. This was expressed from the means of temperature collected for six weeks. The work also covered the benefits of tree planting in our school, and it was shown that the benefits include the following: Furniture making, firewood and provision of timber for building constructions and serving as wind break which is capable of protecting houses and properties from being wrecked by wind storm. Other benefits include provision of food, shade and for research purposes.

RECOMMENDATIONS

The following recommendations were made among others;

1. Creation of awareness for tree planting among the students, staff of the Federal Government Girls' College Akure and people living around the school should be intensified,
2. Students should be encouraged to plant by incentisizing the process to encourage students to engage in planting trees in the School,
3. Seedlings of trees and water should also be made available in order to maintain the planting and maintenance of trees,
4. The environment should utilize the environmental day to demonstrate practical tree planting in the school.

ACKNOWLEDGEMENT

BADGES DESCRIPTION

I Am a Collaborator:

During the development of the research, students were grouped, (Nwajiaku Amarachi, Mbachu Chizaram, Osewa Peace and Afolabi-Bakare Goodness) engaged in taking solar noon daily air and surface temperature measurements of different surfaces (asphalt, under tree and bare ground), (Bamidele Joy, Ojo-Abiodun Darasimi, Adeniyi Faith, Momoh Deborah and Abegunde Ayomide) engaged in taking different tree species height and circumference measurements, (Olakunori Precious, Idachaba Ojochenemi, Fatorise Faith, and Ogunsan Oluwafikayomi) engaged in taking cloud measurement, (Lordacquit Peculiar, Ogunsusi Grace, Idachaba Chegbe, Olugesin Mercy, Oluwole Naomi, Okeke Faustina and Anjorin Fortunate) engaged in collating the field data collected during the course of the study and (Isah Aishat, Bamidele Joy, Momoh Deborah, Adeniyi Faith, Abegunde Ayomide, Idachaba Ojochegbe and Idachaba Uredo) were involved in the video presentation of the project, all the students worked together to provide a qualitative research work.

I Am a Stem Storyteller:

Story about our research work was shared on *you-tube* and also included in the research presentation submitted to GLOBE International Virtual Science Symposium, so that others can also learn from our creative research work. Students engaged in the video blogs include; Isah Aishat, Bamidele Joy, Momoh Deborah, Adeniyi Faith, Abegunde Ayomide, Idachaba Ojochegbe, Idachaba Uredo.

I Am a Data Scientist:

During the study, it was observed that there was an increase in air and surface temperature, through the data collected and infered to the previous year data. One of the reasons is the deforestation of trees going on in the school compound just to use them as fuel and also to erect more buildings.

I Make an Impact

Our school compound has many buildings of architectural excellence and more are being constructed as the years go by but plans for greening the environment seem not to be in the pipeline as trees are cut down to put up more facilities, student classrooms and office blocks. It is on the basis of this that we accessed the environmental benefits of the few remaining tree stands by measuring temperatures under these trees and on two other surfaces devoid of trees; bare-ground and asphalted surfaces. We recommend that creation of awareness for tree planting in our community should be intensified, Students should be encouraged to plant by incentisizing the process to encourage students to engage in planting trees in the School, Seedlings of trees and water should also be made available in order to maintain the planting and maintenance of trees.

BIBLIOGRAPHY/CITATIONS

1. Ellison D, Cindy E.M, Locatellie B, Sheil D, Cohen J, Murdiyarso D, Gutierrez V, van Noordwijk M, Creed .IF, Pokorny J, Gaveau D, Spracklen D.V, Tobella AB, Ilstedt U, Teuling A.J, Gebrehiwot GS, Sands D.C, Muyst B, Verbist B, Springgay E, Sugandi Y, Sullivan CA. Trees, forests and water: Cool insights for a hot world. Global Environmental Change. 2017(43):51–61.

2. Hesslerová P, Pokorný J, Brom J, Rejšková–Procházková A. Daily dynamics of radiation surface temperature of different land cover types in a temperate cultural landscape: Consequences for the local climate. Ecol. Eng. 2013;54:145-154. DOI: 10.1016/j.ecoleng.2013.01.036.

3. Syktus J.I, McAlpine CA. More than carbon sequestration: Biophysical climate benefits of restored savanna woodlands. Sci. Rep. 2016;6:291-94.

4. Pokorný J, Brom J, Cermák J, Hesslerová P. Solar energy dissipation and temperature control by water and plants. Int. J. Water. 2010;5:311-336. DOI: 10.1504/IJW.2010.038726.

5. Calder I.R. Blue revolution: Integrated land and water resource management: Integrated land and water resources management (2nd Edition). Earth scan, London; Sterling, VA; 2005.

6. Neary D.G, Ice GG, Jackson C.R. Linkages between forest soils and water quality and quantity. For. Ecol. Manage. 2009;258:2269-2281. DOI: 10.1016/j.foreco.2009.05.027.

7. Zhang X, Feng Z. Detecting urban vegetation from Ikonos data using an object oriented approach. A Sponsored Research by Jiangsu Province Natural Foundation, China; 2005.

8. Small C. Estimation of urban vegetation abundance by spectral mixture analysis. International Journal of Remote Sensing. 2001;22:1305-1334.

9. Owolabi J.T, Adebayo W.O. Economic and environmental benefit of trees in an urban centre. IOSR Journal of Applied Chemistry. 2012;3(2):33-35.

10. Seamans G.N.S. Main streaming the environmental benefits of street trees. Urban Forest Greening. 2013;2–11.

11. Nowak D.J, Dwyer J.F. Understanding the benefits and costs of urban forest ecosystems. Urban and Community Forestry in the Northeast. 2007;25-46.

12. Crowther T.W, Glick H.B, Covey K.R, Bettigole C, Maynard D.S, Thomas S.M, Smith J.R, Hintler G, Duguid M.C. Mapping tree density at a global scale. Nature. Advance Online Publication. 2015;7568:201–205.

13. Kandari L.S, Bisht V.K, Bhardwaj M. Conservation and management of sacred groves, myths and beliefs of tribal communities: A case study from north India. Environ Syst Res. 2014;3:16. DOI:https://doi.org/10.1186/s40068-014- 0016-8.

14. Geist H, Lambin E. Proximate causes and underlying driving forces of tropical 439 deforestation tropical forests are disappearing as the result of many pressures, both local and 440 regional, acting in various combinations in different geographical locations. Bio-Science. 2002;52(143): 441-150.

15. Fearnside P.M. Mitigation of climate change in the Amazon, Pp 353-75 in W.F Laurance & C.A Peres, Eds, Emerging Threats to Tropical Forests, University of Chicago Press, Chicago, Illinois. 2006;1- 563.

16. United Nations Framework Convention on Climate Change (UNFCCC). Climate Change Impact, Vulnerabilities and Adaptation in Developing Countries, UNFCCC Secretariat, Martin Luther – King Street, Bonn Germany. 2006;13.

17. Ogunwale A.O. Deforestation and greening the Nigerian environment. International Conference on African Development Issues (CU-ICADI): Renewable Energy Track; 2015. Ojeh et al.; JSRR, 26(6): 59-75, 2020; Article no. JSRR.59071 75.

18. Adebayo W.O, Owolabi JT. Micro climate relationships of open space and vegetative canopy in an urban environment. Journal of the Social Sciences. 2004;3(1):41-47.

19. Adebayo W.O. The human environment: Something to everyone. University of Ado Ekiti, the Twenty Ninth Inaugural Lecture. 2010;1-75.

20. Ayoade J.O. Climate change: A synopsis of its nature, causes, effects and management. Ibadan, Vintage Publishers Ltd.; 2003.

21. Garba H.A, Ojeh V.N, Elijah E, Ayeni B.E. The use of GIS and Google Earth images for mapping of Taraba State University Campus. Asian Journal of Geographical Research. 2018;1(1):1-16. Article no.AJGR.40306.