

## Climate Variability And Physiological Comfort Measurement In Ado Ekiti, Ekiti State, Nigeria.

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### ABSTRACT

The research study focuses on the variations of temperatures and thermal comfort in Ado-Ekiti an urban centre. It highlights the usefulness of trees incorporated into building designs. The data used for this research work was collected using maximum and minimum thermometers. One set of these instruments were placed at the centre of a selected vegetative canopy that lies within an urban settlements at a height of about 1.5 metres above the ground surface, while another set of the instruments were placed in an open space about 500metres away from the nearest vegetative canopy. The main weather elements measured was the air temperature. Measurements were made at both sides on an hourly interval starting from 8.00am (7.00GMT) through 6.00pm (17.00GMT). A total of one hundred and fifty four (154) measurements were taken.

It was established that Effective Temperature values were higher in open space than under canopy cover.

### INTRODUCTION

Climate, a basic environmental factor, is often referred to as the average weather conditions of a place over a long period of time, (Ojo et al, 2001). However this widely accepted concept assumes that climate can be taken for granted and this has been the case for decades. Recent events all over the world have shown that climate cannot and should not be regarded as constant and that for all practical purposes the statistics required to specify climate comprises not only the averages but also extremes and frequencies of occurrence of the various characteristics that are of interest to mankind (Adebayo,1999; Adebayo and Owolabi; 2004). Thus, in defining climate, the total experience of weather at any place over some specific period of time must be considered. Climate is therefore the synthesis of weather at a given location over a period of about 30-35 years. Therefore, climate refers to the characteristic condition of the atmosphere deduced from repeated observations of weather over a long period. Thus, in reality, climate is far from being average of weather condition; it is always changing on a variety of time scales (Adebayo, 1999, 2010). It includes considerations of departures from averages, that is, variabilities extreme conditions and the probabilities of frequencies of occurrences of given weather conditions.

Temperature as one of the variables of climate affects human activities and human lives (Adebayo 2010). Variation of temperature, therefore, should be of interest to the people. Temperature can be simply defined as the degree of hotness or coldness of a body. It is one of the most talked about weather element after precipitation. Temperature can be defined in terms of movement of molecules such that the more rapid the movement the higher the temperature. It is usually explained in relative terms on the basis of the degree of heat the body has (Adebayo, 1993, 1999, 2010).

Temperature variations and Thermal comfort should be of interest to both Government and individuals, since it affects the comfort and productivity of the society. People wear light clothes, spend money in buying fans and air conditions for homes and offices in hot weather while in chilly weather, people warm themselves up with heaters or fire places. It is of importance therefore to study what affects men and their lives.

Physiological reactions to the atmospheric environment are complicated by differences in tolerance exhibited by individuals or contain ethnic group and by adaptation achieved through prolonged acclimatization. Human health, energy and comfort are affected more by climate than by any other elements of the physical environment (Adebayo, 1997). He further opined that, the physiological function of the human body respond to the changes in weather. Human physical vigour is influenced by temperature, humidity and wind. High temperature and humidity tends to decrease physical and mental vigour as well as dry air or extremely low temperature may also impair physical vigour and adversely affect attitudes to mental work.

This research study is interested in the variations of temperature and thermal comfort in Ado Ekiti - an urban centre.

### CONCEPT OF THERMAL COMFORT

The atmospheric environment- air movement, humidity and radiation are the major elements that influence the human body and its functions. The elements affect the ease with which heat produced by the body is lost to the surroundings (Adebayo, 2007). The amount of metabolic heat productivity varies with factors such as the type of activity, age, sex, weight and height. The maintenance of the body temperature however requires a balance to be attained between heat loss and heat gain.

Heat gain occurs through nasal processes, absorption from the surrounding air, if it is above skin temperature. Heat loss takes place through radiation, conduction, convection and evaporation of moisture from the skin surface. If more heat is lost than is gained, the body temperature will rise.

For a constant human body temperature to be maintained, the following equation must prevail:

$$M+R+C-E=O \text{ ----- (i)}$$

Where M is the metabolic heat created chemically within the human body.

R is the heat gained or lost by Radiation.

C is the heat gained or lost by Convection.

E is the heat lost by Evaporation.

It could be further explained that, to maintained thermal equilibrium the metabolic heat created chemically within the human body together with the heat gained or lost by radiation and convection and the heat lost by evaporation must add up to zero. If otherwise, a number of physiologic responses will occur (Oliver 1981).

Cold condition like what is experienced during many nights in the harmattan season in northern parts of Nigeria causes vasoconstriction, that is, the body, react to cold condition by constricting the peripheral parts of the body conserves heat and keep up the core temperature of the body. The reduced blood flow to these extremities can have adverse effect. Under extreme condition, frost bite can occur, resulting in frozen tissues and cell destruction (Ojo, 1977; Oliver, 1981).

Excessive heat load on the body initially leads to a rise in skin temperature. It also cause sweating, a cooling mechanism which also cause loss of water and cell from the body (Life minor, April 1989). Physical exertion in a hot humid environment can result in heat stroke, a condition caused by cessation of sweating and consequent rise in core temperature of the body (Oliver, 1981).

### THE STUDY AREA

Ado-Ekiti, the study area is situated at about 48 kilometres north of Akure, Ondo state capital, about 344 kilometres north of Lagos (Nigeria) and about 750 kilometres south west of Abuja, the Federal Capital Territory (FCT). Ado –Ekiti is the Capital city of Ekiti State and also serves as a Local Government Headquarter in one of the sixteen Local Government Areas in Ekiti state. Ado-Ekiti, lies within Latitude 7°10' and 7°45' north of the Equator and Longitudes 5°10' and 5°28' east of the Greenwich meridian.

The town is situated on a fairly high level with about 390 meters above sea level in the south eastern part of Ireje stream and about 540 meters above sea level in the north eastern limits of the town. The landscape is dotted with rounded inselbergs and steep sided hills with gradients ranging from 33° to 44°.

The climatic condition of Ado-Ekiti is similar to the general climate of the South Western Nigeria characterized by seasonal wet and dry seasons with double maxima rainfall occurring in July and September. The onset and cessation of the rainy season are often marked by severe thunderstorms which are mainly experienced in the afternoons and occasionally at night (Adebayo, 1993).

Temperature in the region is, however, more uniform throughout the year with very little deviation from an annual mean of about 27° C and a range of 3.7° C between the month of highest temperature- February and the month of lowest temperature-August. The climatic conditions of Ado-Ekiti favours tree cultivation coupled with indoor and outdoor all-year-round recreation activities.

### DATA COLLECTION

The basic instruments used for data collection were the minimum and maximum thermometer. One set of these thermometers was placed at the centre of an identified and selected vegetative canopy that lies within an urban settlement at a height of about 1.5 meters above the ground surface. Teak is the major species of the trees making up the vegetative canopy with some mango trees and acacia. The average height of the trees in the

canopy is about 38.5 meters. The second set of the minimum and maximum thermometers was placed in an open space about 500 meters away from the vegetative canopy.

The main weather elements measured was the air temperature. The minimum and maximum temperatures were measured at both sites on an hourly interval starting from 8.00am (7.00GMT) through 6.00pm (17.00 GMT). For each day, eleven (11) measurements were taken and for the whole period a total of one hundred and fifty-four (154) measurement were taken.

These were considered to be adequate for a research of this nature.

### DISCUSSION OF THE RESULTS

The physiological temperature is the temperature experienced by a living organism including man. It depends on the air temperature as well as the rate of heat loss from that organism. The physiological temperature varies with individuals depending on their characteristics such as general build and weight, type of clothing, physical activities or job engaged in, diet, state of health, age, sex, emotional state and the degree of adjustment to the prevailing climatic conditions (Ayoade, 1988. Adebayo, 2007).

The Effective Temperature Index (ET) formula  $ET = 0.4(T_d + T_w) + 4.8$  (ii); was used to calculate the Discomfort index. Where ET is the Effective Temperature.  $T_d$  and  $T_w$  were the dry bulb and wet bulb temperatures measured in °C. An ET value of 18.9° C or below ( $ET \leq 18.9^\circ C$ ) indicates an uncomfortable condition arising from cold stress. While an ET value of 25.6°c or above ( $ET \geq 25.6^\circ c$ ) indicates heat stress (Ayoade, 1988; Adebayo, 1998). This implies that an ET value between 18.9° C and 25.6° C are conducive for man.

**TABLE 1: SUMMARY OF AVERAGE TEMPERATURE IN ADO-EKITI**

TIME		8.00	9.00	10.00	11.00	12.00	1.00	2.00	3.00	4.00	5.00	6.00
Under Canopy	$T_d$ (°C)	22.5	23.0	23.6	24.0	24.5	24.9	25.1	25.6	25.6	25.3	25.0
	$T_w$ (°C)	11.8	12.3	12.8	13.4	13.9	14.1	11.6	14.9	14.9	14.5	13.9
	ET (°C)	18.5	18.9	19.4	19.8	20.2	20.4	20.7	21.0	21.0	20.7	20.4
Open Space	$T_d$ (°C)	28.5	28.0	29.0	30.01	31.5	32.8	33.2	33.7	33.8	33.3	32.4
	$T_w$ (°C)	13.8	15.3	16.8	17.9	18.8	19.7	20.0	20.5	20.3	19.5	18.8
	ET (°C)	21.3	22.1	23.1	24.0	24.9	25.8	26.0	26.5	26.4	25.9	25.3

### Field Survey 2013.

Table 1 shows clearly the different ET values from temperatures under canopy and open space. It could be observed from the results that under the canopy, it was only at 8.00am (7.00 GMT) that the ET value was less than 18.9° C (18.5° C) and there was no period of the day when the ET value was higher than 21.0° C. This shows that the effective temperature of places under canopy cover were always more conducive throughout the day without heat or cold stress.

Temperature records for open space had conducive ET between the hours of 8.00am (7.00GMT) to 12.00pm (11.00GMT) and 6.00pm (17.00GMT) because their effective temperatures (ET) values were less than 25.6° C, while between the hours of 1.00pm (12.00GMT) and 5.00pm (16.00GMT) there was heat stress (see table 1). This showed that areas that had no tree cover were always experiencing heat stress at least five hours daily in Ado – Ekiti, Nigeria.

The implication of this analysis is that there is always a relationship between tree cover and physiological comfort of human beings. It also re-affirm that the presence of trees in an area definitely lead to the reduction in the Effective Temperature Index (discomfort index). This agreed with Heisler (1977,1978,

Huang et al (1987),Owolabi (1999), Adebayo (1997), and Owolabi (2004), Adebayo (2010) in their researches that urban heat island were always created in the urban centers partly due to the nearly absence of vegetation covers.

## CONCLUSION

From the foregoing, we have established the fact that Effective Temperature values were higher in open space than under canopy cover. Therefore to make the urban environment conducive for living during the afternoon hours, trees should be inter-planted within buildings. At times, it could be vegetated lawns that should be planted within the urban buildings. Trees and grasses should be planted within the city to provide beautiful scenery.

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