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OJOTE SAMSIDEEN.

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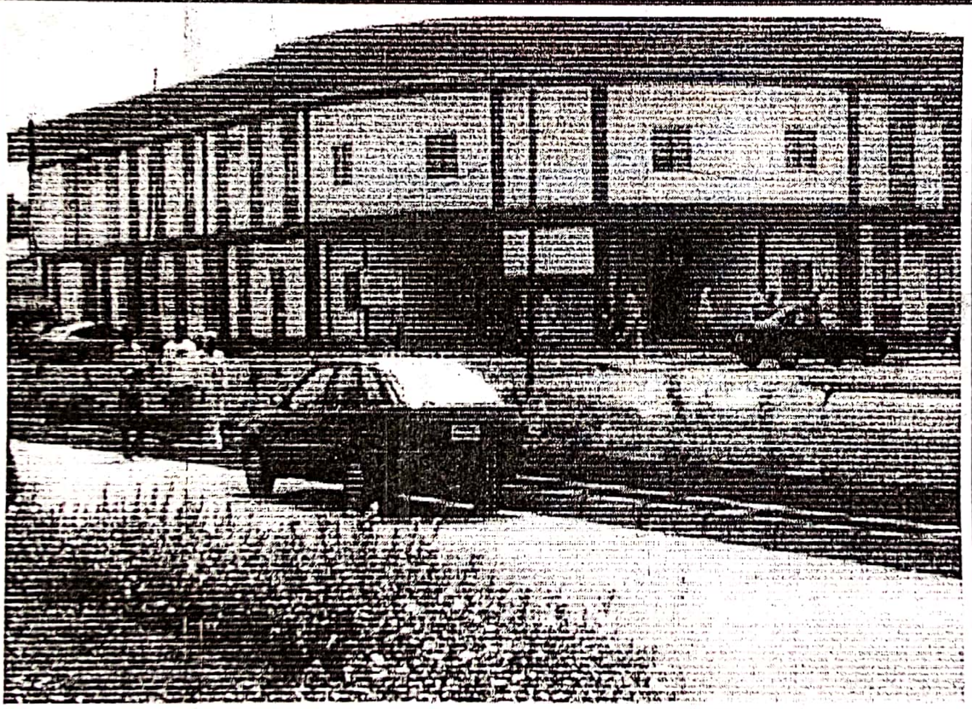

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PERFACE

The effect of science are not felt if it is not put into practical use or not communicated to those who will benefit from the knowledge. School of Science and Science Education Federal University of Technology, Minna has identified that valuable research findings are often left to rot away in our laboratories. The break through do not have to be big but it should be sufficient for somebody to improve upon for a change Science\scholars are often ignorant of the results of research laboratories. This affect the speed of scientific and technological development.

Institutions of higher learning especially the university of technology etc., are burdened with task of developing new techniques, fabrication of equipments and manufacturing. It is important for scientist and technologist to understand those colleagues of their who are working in their own areas of interest. They could easily get the information from research publications.

There are only few Journals of Science and Technology in circulation and the cost of subscribing with journal outside is very high. Nigeria is increasing and are not sufficiently circulated. The School of Science and Science Education has started the publication of Journal of Science Education and Technology as her contribution to knowledge with the hope that papers in the journal will stimulate researches for eventually break through in various fields of science and technology education in Nigeria and the Africa continent at large.

Professor H.T Sa'ad
Vice chancellor.

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EDITORIAL COMMENTS

Science publication in the from of journals are geared towards giving scientists and non scientists alike trends of scientific break throughs in our research institutions, similar institutions of higher learning and organizations. In civilized nations such publications are held in high esteem and regular production is guaranteed through funding and article contributions.

The School of Science and Science Educations school board in 2006 took a bold step by reviving the publication of defunct Journal of Science Education and Technology. The Journal is inter disciplinary in nature covering a wide area of researches in Science, Technology and Education. During the last year the editorial board worked very hard to develop a system that will ensure a continuous publication of this journal. Efforts have been made to encourage faster peer review, provide the enabling environment for authors to track the progress of their manuscripts, increase the efficiency of manuscripts handling and allow for better coordination across the editorial board team.

I thank the management of Federal University of Technology for the support received for the take off, I wish to express my sincere thanks to Professor H.T Sa'ad the Vice Chancellor of F.U.T Minna for his encouragement and advice.

I thank the entire staff of School of Science and Science Education, particularly the chairman of the Journal Committee Dr (Mrs.) I.N Mogbo and her team for their hard and well coordinated work. I thank the various contributors for their articles and the reviewers for prompt completion of the review process.

At this point, it is my hope that the editorial board shall continue to enjoy the support of the school and the university to ensure biannual regular publication of this journal.

Any constructive suggestion for further improvement of the journal would be accepted.

Thanks

Professor G.D Momoh
Editor in chief

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Climate Change and Health: An Appraisal on Implications for Research, Monitoring and Policy.

O., Samsideen and T. I., Yahaya
Department of Geography Federal University of Technology, Minna

Abstract.
The impact of climate change on the various sectors was appraised and the findings showed that climate stress on agriculture may mean up to 300 million additional victims of malnutrition world-wide each year(Ojoye, 2006). Extreme floods and drought are projected to become more severe as global warming worsens. These extremes were found to be responsible for the non availability and supply of safe drinking water. Diseases associated with flooding, could affects millions more people every year. Extreme weather events, like the abnormal storms and flooding that have devastated many communities' across the country in recent times. The world's leading authority on global warming, the intergovernmental panel on climate change (IPCC) has concluded that unchecked global warming will cause a significant increase in human mortality due to extreme weather and infectious disease. Malaria could become even more common as global warming worsens, it was projected that a warmer temperatures spread north and south from the tropics, and to higher elevations, malaria carrying mosquitoes will spread with them.

Introduction.

Global warming and climate change in Perspectives

Global warming and climate change refer to an increase in average global temperatures. Natural events and human activities are believed to be contributing to an increase in average global temperatures. This is caused primarily by increases in "greenhouse" gases such as Carbon Dioxide (CO_2).

What is the Greenhouse Effect?

The term *greenhouse* is used in conjunction with the phenomenon known as the *greenhouse effect*.

- Energy from the sun drives the earth's weather and climate, and heats the earth's surface;
- In turn, the earth radiates energy back into space;
- Some atmospheric gases (water vapor, carbon dioxide, and other gases) trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse;
- These gases are therefore known as greenhouse gases;
- The greenhouse effect is the rise in temperature on Earth as certain gases in the atmosphere trap energy.

Six main gases considered to be contributing to global climate change are carbon dioxide (CO_2), methane (CH_4) (which is 20 times as potent a greenhouse gas as carbon dioxide) and nitrous oxide (N_2O), plus three fluorinated industrial gases: hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF6). Water vapor is also considered a greenhouse gas.

Many of these greenhouse gases are actually life enabling, for without them, heat would escape back into space and the Earth's average temperature would be a lot colder. However, if the greenhouse effect becomes stronger, then more heat gets trapped than needed, and the Earth might become less habitable for humans, plants and animals.

Climate change and human health.

In environmental health there is a close relation between epidemiological research and those monitoring activities, which seek evidence of changes in the environmental or health status of populations. A distinction is usually made between monitoring and surveillance, the latter being the continuing standardized recording of the occurrence of disease. In the context of climate change and health, however, both monitoring and surveillance are needed to:

- Identify important changes in disease incidence, health risk indicators, or health status;
- Determine whether these changes are likely to be the result of local, regional, or global environmental changes;
- To help develop countermeasures and assess their effectiveness; and
- To develop hypotheses about the potential health effects of climate change. Monitoring should also help in the detection of unexpected events

The Research Challenge.

Since there is uncertainty about the profile and rate of future climate change it is necessary to estimate effects on health in relation to specified probable climate scenarios. This process differs in several important ways from the more familiar empirical procedure of quantitative risk assessment. The latter is usually conducted in relation to some existing index of environmental exposure for which there is prior empirical evidence of direct (usually toxicological) health risks across an exposure range which includes the index exposure.

The three main approaches to health risk assessment based on scenarios are extrapolation based on specific (historical) analogue situations for some aspects of climate change; formal integrated mathematical modeling; and generalized assessments drawing on expert judgment of the range of health consequences (physical, microbiological, and psychological) of diffuse and complex demographic, social, and economic disruption.

Summarily entails on.

- Health risk assessment based on scenarios encompasses extrapolation, integrated mathematical modeling, and generalized assessments of the consequences of demographic, social, and economic disruption
- Uncertainty is unavoidable because of such factors as the unpredictability of future industrial activities, and differences in sensitivity of disease systems and vulnerability of populations to climate change
- Monitoring of health indicators and disease surveillance activities must be integrated with global observing systems currently being developed for climate change and its impact
- The potentially serious effects of climate change on health heighten the urgent need for policies to limit greenhouse gas emissions

Historical Analogues

Historical analogues probably come from recent times, although earlier documented experiences may also be informative. Most useful are those situations, which seem to simulate aspects of future climate change. For example, epidemiologists have begun to study the regional health consequences of the worldwide climatic fluctuations associated by "teleconnection" (remote linkages) with the El Niño southern oscillation.

El Niño events—partial analogues for future climate change?

- The El Niño southern oscillation is a large, irregular, unstable atmosphere-ocean system, which produces relatively short-term climate changes over the Pacific region.

- Events related to the El Niño southern oscillation (that is, El Niño warm events and La Niña cold events) strongly influence climate variability between years and are associated with regional land and sea surface warming, changes in precipitation and in the occurrence of tropical cyclones.
- These anomalies impinge primarily on countries bordering the Pacific and Indian Oceans but also affect other continents.
- El Niño events can affect human health—epidemics of malaria and dengue fever are more likely to occur in the year of an El Niño event or in the year following; the occurrence and distribution of harmful coastal algal blooms is also associated with El Niño events.
- Weather disasters are twice as frequent worldwide during the year of an El Niño event.

These studies can be useful in assessing the vulnerability of populations to climate change, although the relatively short time scale makes direct extrapolation to the effects of global warming on health difficult.

Dealing with uncertainty.

As with all forecasting, assessing the impacts of global climate change entails unavoidable uncertainties. These uncertainties arise from the intrinsic unknown element in future trends in human industrial, demographic, and trading behaviour; from the nature of the non-linear and interactive relations within the various complex natural systems; and from the variable (and population specific) sensitivity of the health outcome to the change in climate and environment. Uncertainty also arises from the stochastic nature of the biophysical systems being modeled.

Differences in vulnerability between populations are another source of variability. These occur because of the heterogeneity and changeability of human culture, social relations, and behaviour. As Balbus and Patz state: "While a given disease system may be particularly *sensitive* to the effects of climate change based on biological or physiological characteristics, the ultimate *vulnerability* of a given population to that disease may be considerably lessened by adaptive responses." Some populations and geographical regions will be particularly vulnerable. For example, populations whose food supplies are insecure are vulnerable to downturns in agricultural productivity caused by climatic factors, and people living on the edge of regions where infectious diseases borne by vector organisms are endemic are most likely to experience the early extensions in range of these diseases.

Another dimension of complexity in the assessment task results from the interplay of several environmental stresses that are coexistent. Interaction between local environmental degradation and changes on a larger scale—climate change, population growth, and loss of biodiversity—may significantly influence the effects on health. For example, local deforestation caused by increased population pressure may directly change the distribution of vector borne diseases while also causing a local increase in temperature (in addition to its contribution to a global temperature increase by depleting one of the biosphere's great carbon dioxide "sinks").

Major Research Needs.

Important research needs include the following:

- Improvements in mathematical models for predicting the impact of climate change on health, including higher resolution to enable local and regional impact assessments to be made with more emphasis for further studies to;

(a) Distinguish more clearly between the effects on health of climate and of air pollution;

(b) Determine the extent to which, in different regions, a reduction in mortality related to cold might offset the impact of more frequent heat waves; and

(c) Assess the longer term health effects, if any, on populations living in locations with different climates;

- Analysis of infectious disease epidemics associated with recent regional changes in climate, using these as analogues of future climate change. For example, a systematic examination of vector borne outbreaks in regions affected by climatic events related to the El Niño southern oscillation would improve our understanding of the relations between climate and health;
- For vector borne diseases, there is a need for basic laboratory and field investigations of arthropod vector ecology and pathogen infectivity at raised temperatures and varying humidity and ecological studies on the climate sensitivity of diseases in locations at the margins of endemic areas;
- Assessment of how changes in food production—as a result of climate and weather changes, increased ultraviolet irradiation, sea level rise, changes in pest ecology, and socioeconomic shifts in land use practices—could affect human health and nutrition;
- Study of the association of extreme climatic events with global warming and the occurrence of disasters affecting large human populations;
- Modeling studies of the potential public health implications of forced migration from climatically vulnerable regions;
- Ecological studies of the range of possible public health impacts of reductions in biodiversity related to the climate;
- Assessment of the potential health impacts of strategies to mitigate greenhouse gas emissions (for example, the health risks of biomass fuels).

Monitoring for changes in health related indices.

- Global observation systems

The monitoring of health effects should be integrated with global observation systems that are currently under development. The Global Climate Observing System is a joint initiative of the World Meteorological Organisation and other international agencies and will encourage the development of coordinated climate observations by national and international organizations. Its coverage will exceed that of current monitoring programmes, such as Global Atmosphere Watch and World Weather Watch, which comprise a network of satellites, telecommunications and data processing facilities. The Global Ocean Observing System, operated by the Intergovernmental Oceanographic Commission of UNESCO, includes monitoring of sea level rise, sea surface temperature and, eventually, biological measures such as the phytoplankton concentration. The Global Terrestrial Observing System is being established under the auspices of the United Nations Environment Programme (UNEP) and other international agencies. It will be used to detect and monitor response of terrestrial ecosystems to global change including new patterns of land use and climate change.

Ecosystem monitoring

It has been increasingly recognised that ecosystems have important influences on human health—for example, through changes in key indicator species such as insects and rodents, this may have both direct and indirect effects. Algal blooms in marine ecosystems can act as reservoirs for certain pathogens including *Vibrio cholerae*. Monitoring indicator species could help our understanding of important links between climate change and its effects on health.

Remote sensing

Remote sensing, particularly by satellites, can be used to monitor a range of variables relevant to climate change, including sea surface temperatures, algal blooms and changes in terrestrial ecosystems. For example, vegetation indices produced by high-resolution radiometry have been correlated with mortality and the population density of tsetse flies. Data from remote sensing may need to be validated by local data on the vector organisms and diseases of interest. The table summarises a framework for the development of monitoring systems for the health impacts of climate change

General and specific policies to reduce climate change or its impacts

Agriculture

- Reduced land conversion through improved farming techniques
- Improved tillage to reduce fossil fuel combustion
- Improved feed use for ruminants to reduce methane emissions
- Reduced biomass burning

Forestry

- Reduced deforestation with concurrent improvement in agricultural productivity (tropical forests have maximal potential for sequestering carbon)
- Regeneration of degraded lands for reforestation

Human settlements

- Buildings with improved thermal integrity
- Condensing furnaces and heat exchangers
- Solar water heaters and insulated water storage
- Financial incentives for energy conservation
- Building codes and utility regulations
- Planting shade trees to reduce "heat islands"

Energy supply

- More efficient power generation
- Natural gas turbines in place of oil or coal
- Gasification of fossil fuels before combustion
- Alternative energy sources (solar, wind, geothermal energy, etc)

Industry

- Cogeneration and steam recovery
- Alternative materials (e.g., replace concrete with wood)

Transportation

- Improved public transport
- Facilitation of cycling and walking
- Urban traffic control for shorter transit times
- Use of ethanol and methanol fuels

Policy Implications:

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The implications of climate change for public policy are wide ranging. Mitigation options aim to reduce greenhouse gas emissions. or to increase carbon dioxide sinks—for example, by promoting reforestation. Some options directly affect health, such as the promotion of bicycling, which would increase fitness and lower cardiovascular risk while helping to reduce carbon dioxide emissions. Renewable energy sources should be assessed for their impact on health since some may have adverse consequences. Hydroelectric dams for example may cause population displacement and social disintegration.

Population growth is an important driving force of climate change. It is estimated that half of the increase in carbon dioxide emission between 1992 and 2022 will be a result of population growth. Although most will occur in developing countries, any growth in developed countries is an important contributor because of the much higher per capita consumption of fossil fuels. Currently only around 1% of international donor aid is spent on family planning, whereas just 2-3% would give worldwide access to contraception. Policies such as these, which meet short-term local needs as well as long-term environmental goals, should be priorities for implementation.

Tension between the priorities of conventional economics and environmental Protection has led to the development of "environmental economics." This attempt to assign a market value to the otherwise uncounted costs of the adverse impact of environmental degradation. "Ecological economics" seeks to incorporate the concept of sustainability and thus to avoid compromising the health and survival of future generations. There is clearly a need for greater public and professional debate about the long-term consequences of climate change and the balance between the immediate economic impact of mitigation strategies and their potential to reduce the impact on health and well being in the future.

Finally, global environmental hazards to health should feature in school curricula since much of the anticipated impact on health would occur within the coming decades. Meanwhile, in the spirit of primary prevention, health professionals should advocate to policy makers early application of strategies to minimize climate change in order to limit the anticipated impact on health. That impact, mediated through disruption to life supporting biophysical systems, has unprecedented importance for the sustainability of human health.

Conclusion.

Regional climate stress on agriculture may mean up to 300 million additional victims of malnutrition world-wide each year. Extreme floods and drought are projected to become more severe as global warming worsens. These extremes may threaten the availability and supply of safe drinking water. Diseases associated with flooding, could affects millions more people every year. Extreme weather events, like the abnormal storms and flooding that have devastated many communities' across the country in recent times.

The world's leading authority on global warming, the intergovernmental panel on climate change (IPCC) has concluded that unchecked global warming will cause a significant increase in human mortality due to extreme weather and infectious disease. Malaria could become even more common as global warming worsens, it was projected that a warmer temperatures spread north and south from the tropics, and to higher elevations, malaria carrying mosquitoes will spread with them.

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Lastly, Global warming will have numerous damaging impacts on human health, spreading infectious diseases, longer and hotter heat waves and extreme weather will all claim thousands of additional lives nationwide each year. If global warming continues unabated, both we and our children will pay a terrible price.

We simply cannot afford to ignore the global warming problem

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Microclimatic Analysis and its Effect on Human Comfort: A Case Study of Minna, Niger State.

O. Shemsudeen and T. I.Yahaya

Department of Geography, Federal University of Technology, Minna

Abstract.

One major pre-occupation of human climatology is to understand the effect of a given set of climatic conditions on the comfort level of individual. The modification of natural environment such as construction of buildings, roads and provision of open spaces are referred to as urban surfaces. All these coupled with human activities and industries, transportation and waste disposal have influence on the climate of the immediate environment to constitute city climate. City climates therefore provide the most extreme micro-climatic modifications which man has created. Looking at the present rate of urbanization and high rate of population explosion in tropical cities / urban centers, it is pertinent to study the relationship between human health and comfort and the various microclimatic parameters to determine the level of comfort ability or otherwise of these cities. The wide range of external and internal factors influences comfort of individuals and what is comfortable at one time to an individual may not be comfortable at a later time to the same individual. The paper made an attempt to determine the range of comfort in human beings who are exposed to different environmental conditions. Data used were collected from practical exercise on field study which was stretched from 7.00am to 7.00pm. Dry and wet bulb thermometers were used to collect air temperature from six (6) selected sampling areas within the city and 90 people of different sex, age, height and weights were interviewed to know their thermal sensation during the period covered. The data were computed using Effective Temperature (ET) and Relative Strain Index (RSI). The analysis of the result and responses showed that the environment was generally comfortable in the morning and towards the evening but hot and warm and not comfortable during the afternoon- though the level of comfort ability varies from one location to the other within the study area. Also, the study reveals that micro-climatic parameters like humidity, wind and temperature are more important in determining the comfort level of a given environment

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Introduction

The term climate refers to atmospheric conditions over long time periods, such as seasons, years, or decades, whereas the term weather conditions refers to shorter periods of time, such as hours, days or weeks. Climate depends in part on precipitation and temperature, both of which show tremendous variability on a global scale. The simplest classification of climate is by latitude, tropical, subtropical, midlatitudinal (continental), sub arctic and arctic. It is important to recognize the significance of potential climatic variability in determining the kinds of organism that lives where.

On a regional scale, air masses that cross oceans and continents can have a profound influence on seasonal patterns of precipitation and temperature. On a local scale, climatic conditions can also vary considerably and produce a local effect reoffered to a micro-climate.

Micro climate is the variations in the climatic conditions of a small area say few, few square kilometers. The vertical zone of the area is assumed to extend as far as the level reached by the tallest plants above the ground and below ground as far as the depth of the air penetrating into the ground (Ojo,1977).Various activities of man such as cooking, heating, factories and vehicular movements make a city to generate greater heat. A more extreme modification of micro-climates is that resulting from the building of cities. The varieties of shapes and orientation of the city building which composed mainly of rocky materials alter the natural landscape. Since shelter is one of the essentials of life and climate dependent, erecting buildings are essentials so as to create artificial indoor climates that are comfortable for people to live and work in (Ayoade 1988, Wahab 1995). One major pre-occupation of human climatology is to understand the effect of a given set of climatic conditions," the climate on the comfort of the individuals". The main climatic elements that affect human comfort are radiation, air temperature, humidity, sunshine hours and wind. Complete assessment of human comfort also requires information such as thermal conductivity of clothing, vapour pressure of the skin and metabolic heat rate due to activity of the human body (Hobbs, 1980)

There is considerable literature on the comfort, discomfort and thermal stress indices in relation to the climatic environment conditions (Landsberg 1990, Lafleur, 1991). The general principles underlying the evaluation of these indices to is to recognize that human health and comfort depend upon maintenance of a stable internal body temperature of 37oC and skin temperature at 33oC.To maintain these, heat gains must balance hat losses between man and his environment and these depend on the nature of the environment.

Also, the reaction of man to his environment has been a subject of interest to researchers who are concerned with thermal comfort for many years. Consequently, the term "comfort zone" was introduced between 1913 and 1923 by Hill (1993).Also, an American society of heating, refrigeration and air conditioning engineers (ASHRAE) carried out an experiment which led to the development of comfort chart. It was also in 1923 that temperature and humidity were combined into an index of thermal comfort called "Effective temperature (ET)", (Houghton, 1993). It is in line with these studies that this research paper has been undertaken and the aim is to determine the range of comfort in some selected areas in Niger State. Though, comfortability of a building depends upon the orientation of the building, the position of the rooms, the arrangement of the windows in relation to wind direction and atmospheric condition to which the people dwelling in the rooms are exposed to. The significance of this study will show the reactions of different combinations of climatic conditions by a number of human subjects of different ages and sexes and the way they are being exposed to both indoor and outdoor. Also, the study reflects how human body responses to temperature and how wind exerts influence largely on human beings through its effect on skin temperature and body moisture. The willingness of planners to establish a building in relation to micro-climatic parameters of the environments of great significance.

Study Area.

The study was conducted in Minna, the capital city of Niger State, which is located approximately on longitude 40001 East and latitude 70001 North. It is found in the middle belt of the country. The drainage system of the entire state is divided into six major sub-catchment basins of river Niger. The division is based on the size of the basin, rivers draining into the river Niger which is the main river in the state. Rainfall distribution has a trough in August. Temperatures are about 280C on the average and this shows very little variation throughout the year. The relative humidity is up to 56% and usually higher in summer than in the winter owing to the prevalence of ocean and hence moisture laden wind blowing across Niger State from March to October(Nweke, 1988). The soils and the vegetation of the communities occupy an important position in her development. The soils in the state were derived from

The hydromorphic and organic soils developed on alluvial and fluvial deposits of variable texture, notable along the river flood plains, and

The ferrasols, developed especially on sedimentary rocks.

Methodology.

The data used were collected from practical exercise of field study carried out which was stretch from 7.00am to 7.00pm each day within the selected areas of the town 90 people of different ages, sexes and weights were interviewed through the questionnaire to show their thermal sensation with the environment.

Dry bulb (Td) and wet bulb (Tw) temperatures measured in degrees Celsius were used for the temperature of the selected areas. A widely used measure of comfort of thermal sensation, probably the most commonly employed for determining thermal sensation is the effective temperature (ET) index which is calculated from an empirical formula.

$$ET = 0.4\,(Td + Tw) + 4.8 \quad \text{--- (i)}$$

Where Td and Tw are dry and wet bulb temperature respectively in oC The resulting values are related to a subjective scale on sensation of people within the areas covered.

Another measure of comfort in relative strain index (RSI) which was devised by Lee and Herschel (1966) was to account for insulating effects of the body. The fomular for relative strain index is given as:

$$RSI = \frac{10.7 + 0.7(Ta - 35)}{44 - ea} \quad \text{---- (ii)}$$

Where Ta is the dry bulb temperature and ea is the vapour pressure of the air. The vapour pressure VP is calculated thus:

$$VP = \frac{RH \times SVP}{100} \quad \text{------------- (iii)}$$

Where RH is the Relative humidity (%) and SVP is the saturated vapour pressure

For a healthy person, the scale of sensation indicates comfortability conditions for the people when RSI is less than 0.2, discomfortable conditions when RS is more than 0.3, distress conditions when RS is more than 0.4 and complete failure when RS is more than 0.5 Hobbs (1980) stated that when body temperature exceeds 400C and ET is above 330C with RS of 0.3, a critical point of discomfortability is observed.

Results and Discussion

Equations (i) and (ii) were computed and analyzed in the diagrams below for the six selected areas in the town, which were representatives of measures to examine the relationships between human health and comfort, and the physiological climatic environment. These areas include (i) Bosso (ii) Gidan Kwano (iii) Chanchaga (iv) Bosso Low Cost area (v) Tunga (vi) Kpakungu.

As can be noted from the table and the diagrams in figure 2.0, both the ET and RS values indicate that conditions were uncomfortable for most parts of the area during the periods most especially between the hours of 1.00 pm and 4.00 pm, these periods are characterized by physiological stresses and discomfort.

The ET values varied between approximately 270C and 290C over Bosso area, 260C and 290C at Gidan Kwano area, 270C and 290C at Tunga area, Chanchaga was 260C and 280C, Bosso low cost between 270C and 300C and Kpankungu is between 27.60C. and 290C.Generally, the relative high values occur visually in all the locations reflecting the significance of transportation pollution and poor waste disposal system, other contributing factors as observed from this research finding are the levels of human activities, poor ventilation of the buildings and overcrowding of human population. For example, at Kpakungu area with high population density and bus stop for both intra and inter-urban traffic movement reflect the significance of transportation within the area.

The impacts of the aforementioned factors also reflect on the temperature of the selected areas. For example the Td temperature of chanchaga range between 260C and 280C all is reflecting the high rate of temperature in the areas.

The relative strain index values (RSI) show greater contrasting condition over the selected areas than the ET values. Over Bosso area the RS values varied between 0.1 and 0.7 at Bosso low cost area between 0.1 and 0.6 , Tunga area between 0.2 and 0.5 indicating a relative high values. The low values were experienced at Chanchaga and Gidan Kwano which is the out sketch of the town with less concentration of human population and activities, compared with Kpakungu and Bosso areas.

The terms of thermal sensation with the use of ET scale, the ET diagram indicated that none of the areas selected was thermally comfortable during the study period and people were exposed to physiological stresses and discomfort especially during the day.

Based on the subjective reactions of the people interviewed, it appears that the RS index gives a more accurate assessment of the sensation during the study period. The afternoon and evening periods were relatively cool and comfortable for most people and generally uncomfortable conditions which occurred over most part of the town for example Chanchaga and part of Gidan Kwano areas as indicated by RS value reflect that the effects of the geographical locations located at the outsketch of the town occupied by modern houses with good ventilation system and less population density within the area.

From the RS values, Kpakungu area and part of Bosso which are important bus stops with high population concentration provide the "heat islands" of the town which relatively open spaces such as the outsketch of Gidan- Kwano and chanchaga areas provide the 'Cool Spots'. Thus in relative terms the influence of transportation pollution, population concentration, urban waste generation and adjusted and arrangement of the buildings provide the major factors between the heat islands and the cool spots in town.

Observatory Areas within Federal University of Technology, Minna.

Table 1.0 FUT Bosso Campus

Time

Td (oC)

Tw(oC)

RH (%)

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VP(mb)
ET
RS

7.00	28.0	26.5	87	32.5	26.6	0.1
8.00	28.0	26.5	87	32.5	26.6	0.1
9.00	28.5	26.0	81	31.2	26.6	0.2
10.00	28.5	26.0	81	31.5	26.6	0.2
11.00	29.0	27.0	84	33.49	27.2	0.3
12.00	30.0	27.0	81	34.37	27.6	0.4
1.00	30.0	27.5	81	34.32	27.6	0.4
2.00	31.0	27.5	78	35.24	27.8	0.6
3.00	32.0	27.5	78	36.48	28.6	0.7
4.00	30.0	26.5	73	31.00	27.2	0.3
5.00	28.5	26.5	81	31.15	26.8	0.2
6.00	28.5	26.0	83	31.01	26.4	0.2
7.00	28.0	26.5	87.	33.46	26.6	0.1

Table 2.0 Gidan Kwano

Time	Td (oC)	Tw(oC)	RH (%)	VP(mb)	ET	RS
7.00	30.0	27.5	81	34.37	27.8	0.3
8.00	30.0	27.0	81	34.37	27.6	0.3
9.00	30.0	27.0	81	34.37	27.6	0.4
10.00	30.5	27.5	74	35.57	28.0	0.4
11.00	31.0	27.0	71	33.43	28.0	0.4
12.00	31.5	27.0	71	33.19	28.2	0.4
1.00	31.5	27.0	71	35.59	28.2	0.4
2.00	32.0	28.0	68	33.83	29.2	0.5
3.00	33.0	28.0	71	34.14	28.2	0.5
4.00	32.0	27.5	74	34.60	28.6	0.5
5.00	31.5	27.5	81	36.60	28.4	0.5
6.00	30.0	28.0	81	34.60	28.4	0.5
7.00	30.0	27.5	81	34.37	27.8	0.3

Table 3.0 Tunga area

Time	Td (°C)	Tw(°C)	RH (%)	VP(mb)	ET	RS
7.00	28.5	26.0	81	31.15	26.6	0.2
8.00	29.0	26.0	81	32.25	26.6	0.2
9.00	29.0	27.0	84	33.49	27.2	0.3
10.00	30.0	26.0	73	31.00	27.2	0.3
11.00	30.0	26.0	73	31.00	27.2	0.3
12.00	30.5	26.5	74	32.49	27.6	0.4
1.00	31.0	27.0	71	33.43	28.0	0.4
2.00	31.5	27.0	71	33.59	28.2	0.4
3.00	32.0	28.0	68	33.83	29.2	0.5
4.00	32.0	27.5	74	34.60	28.6	0.5
5.00	30.0	27.5	81	34.37	27.8	0.4
6.00	29.0	27.0	84	33.48	27.2	0.3
7.00	28.5	26.5	81	32.25	26.8	0.2

Table 4.0 Chanchaga area

Time	Td (°C)	Tw(°C)	RH (%)	VP(mb)	ET	RS
7.00	28.9	26.5	83.4	32.97	27.0	0.2
8.00	29.0	26.4	82.4	32.94	26.96	0.3
9.00	29.3	26.6	81.6	32.73	27.16	0.3
10.00	29.7	26.6	77.6	33.06	27.28	0.4
11.00	30.0	26.9	78.2	33.39	27.88	0.5
12.00	30.7	27.0	74.8	34.6	28.00	0.5
1.00	31.0	27.1	74.4	34.36	28.4	0.5
2.00	31.5	27.4	72.6	34.04	28.18	0.5
3.00	32.2	27.8	71.2	34.28	28.68	0.6
4.00	31.2	27.1	73.2	33.6	28.40	0.5
5.00	30.1	26.6	77.2	32.25	27.48	0.4
6.00	29.4	26.6	80.8	33.20	27.24	0.3
7.00	29.2	26.6	81.6	33.20	27.12	0.3

Table 5.0 Bosso Low-cost area

Time	Td (°C)	Tw(°C)	RH (%)	VP(mb)	ET	RS
7.00	28	25.5	81	32.5	26.2	0.1
8.00	28	25.4	81	32.5	26.6	0.1
9.00	28.5	26.4	81	32.3	26.8	0.2
10.00	28.5	26.0	84	32.15	26.6	0.2
11.00	29.0	26.0	81	32.25	26.8	0.2
12.00	30.0	26.6	81	36.69	27.4	0.6
1.00	31.0	27.0	77	35.24	28.0	0.6
2.00	31.0	27.0	78	35.24	28.0	0.6
3.00	31.5	27.5	78	34.6	28.4	0.6
4.00	31.0	26.0	74	33.6	28.2	0.5
5.00	29.0	26.5	74	32.25	26.8	0.2
6.00	29.5	26.5	81	33.2	27.2	0.3
7.00	29.5	26.5	81	33.2	27.2	0.3

Table 6.0 Kpakungu area

Time	Td (°C)	Tw(°C)	RH (%)	VP(mb)	ET	RS
7.00	28.9	26.5	83.4	32.97	27.00	0.2
8.00	29.0	26.4	82.4	32.94	26.96	0.3
9.00	29.3	26.6	81.6	32.73	27.16	0.3
10.00	29.7	26.6	77.6	33.06	27.28	0.4
11.00	30.0	26.9	78.2	33.39	27.88	0.5
12.00	30.7	27.0	74.8	34.60	28.00	0.5
1.00	31.0	27.1	74.4	34.36	28.04	0.5
2.00	31.5	27.4	72.6	34.04	28.18	0.5
3.00	32.2	27.8	71.2	34.28	28.68	0.6
4.00	31.2	27.1	73.2	33.78	28.40	0.5
5.00	30.1	26.6	77.2	32.71	27.48	0.4
6.00	29.4	26.6	80.8	32.83	27.24	0.3
7.00	29.2	26.6	81.6	33.05	27.12	0.3

Conclusion

This study has been able to look into how climate parameters affect human being in an environment. The behavior of different climate parameters like temperature Td, Tw and ET and relative humidity (RH) in relation to time of the day was clearly demonstrated However, the influence of these parameters on the orientation of buildings, human activities, ventilation and general housing conditions were able to reveal the comfort level of human population in an environment. These equally provide the significance between the heat islands and cool spots in an environment.

Generally, temperature were high during the period of studies .Dry bulb temperature (Td) ranges between 28°C 32 °C and wet bulb (Tw) range between 25.5°C and 28°C respectively in all the six selected areas but judged from a subjective reactions of people interviwed, the RSI values give a more accurate assessment of the level of comfortability of the people during the period of study. The minimum RSI value of 0.1 was observed in Bosso Low cost.

In summary, this reveals the fact that micro-climatic parameters like temperature, humidity and winds are more important in determining comfort level of individuals in urban environment as indicated in the selected areas of Minna.Other related factors such as human activities resulting to pollution and waste disposal problems, and orientation of buildings are significant factors.

A more significant aspect of the study in that it can be used to provide information for proper re-designing of urban expansion and renewal, thus the influence of heat load within an urban environment must be a greater concern of city planners as there is very little emphasis placed on the need to reduce head loads to a comfortable level in planning or re-designing of old cities mostly in Africa in general and Nigeria in particular.

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