Dutse Journal of Pure and Applied Sciences (DUJOPAS) Vol. 3 No. 2 December 2017

ASSESSMENT OF SUMMER HEAT STRESS CONDITION FOR TOURISM DEVELOPMENT IN RIRUWAI RING-COMPLEX, DOGUWA LOCAL GOVERNMENT, KANO STATE

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Abstract

The paper focuses on the assessment of heat stress condition for sustainable tourism development in Riruwai Town. Data was collected through the field measurements of temperature and humidity using thermometer and hygrometer. The data were subjected to Yoram (2006) Discomfort Index (DI) model for calculating the status of comfort for potential tourism development. The diurnal DI Values for indoor were 21.8,22.5 26.2, 27, 26, 25, 24 , 22.7 for 6am, 9am, 12 noon, 3 pm, 6 pm, 9 pm, 12 mid night, and 3 am, respectively. While for outdoor the DI values were 21.7, 24.4, 27.3, 29.6, 28.7, 26, 25.9 and 21.6 for 6am, 9am, 12 noon, 3pm, 6pm, 9pm, 12 mid night, and 3am respectively. The result has revealed a promising hope for establishing tourism industry. The outcome of the diurnal heat stress condition analysis revealed general summer heat stress condition exposure which ranges from mild to moderate level. This result indicated that with little technological modifications of the study area with its spectacular ring-complex landforms, old mining ditches, vegetation and drainage features will be potentially good for the intended socio-economic land use. It is also recommended that, more trees should be planted around the settlements and in the deforested area for maintaining an eco-friendly habitat. This will pave way for sustainable tourism economy as a means of diversifying the existing oil-economy for sustainable income and employment opportunities to its people and Governments.

Key words: *Orographic Weather, Heat Stress, Tourism, Discomfort index, Ring complex, Ecotourism, Community*

Background of the Study

Tourism is an important source of economic growth in an area, indeed is one of the most important industrial sectors in various countries. It is often said that one essential thing for people is not "living", but "travel". Tourism is one of the most dynamic economic sectors in most countries and one of the noblest of human occupation; tourism is one of promising industries of this century (Ahn, 2009). On one hand, tourism wields tremendous economic positive outcomes; it is one of the most significant sources of economic outcomes and employment. Tourism is identified as an effective way to revitalize the economy of any destination as noted by Long (2002) and widely acknowledged as one of the fastest growing industries globally (Basu, 2003; Ozgen, 2003; Dorcas and Ayeni, 2012).

Climate is an important predetermining factor which affects the physiological, morphological and even social wellbeing of human and other various activities. In fact, climate is a determining factor of tourism development in a given area and is counted as the fundamental or complementary factor. According to Hooshmand (2013), tourism is mainly influenced by weather and climate. For instance, fair weather and knowledge about destination of tourists play a key role in tourism industry.

When the body's cooling mechanisms work well, core temperature drops or stabilizes at a safe level (37^0C). But if too much sweat is lost through heavy labour or working under hot, humid conditions, the body doesn't have enough water left to cool itself. The result is dehydration and core temperature rises above 38^0C and possibility of heat related illness or heat stress disorders may subsequently develop. George (2008), and Bowles (2009) in Alhaji, (2015) lament the same. While according to Saricovalt (2008), if the body temperature exceeds 39^0C heat stroke may developed and a temperature of 40.6^0C is life threatening. He further states that before these serious health effects occur, at lower heat exposures a worker may be subjected to diminished work ability , diminished mental task ability and increased accident risk which eventually lead to overall reduced work ability and lower labour productivity. This shows that, reduced work ability is a function of environmental humidity radiant heat, air movement and ambient temperature.

Decline in agricultural cultivation and mining economies of Riruwai due to land degradation and over dependency on oil by Nigerian Governments and subsequent general universal economic meltdowns which characterize: unemployment and job dissatisfaction, social vices, there is need for Nigeria to look for alternative economic diversifications. Thus, tourism can be regarded as an answer for national and regional development, bringing employment, exchange earnings and importance infrastructural developments benefiting local and visitors same way.

Tourism and Heat stress condition

Glosson *et al.,* (1995) in Sulaiman (2013) defines tourism as "any short-term movement of people, either individual or groups , undertaken for leisure, sport, business, study, military, medical, religion, family, meeting or seeking benefit from a particular service or activity outside ones normal place of living and work for a period greater than one day and less than one year". Tourism is a known affair in human life. It has been an industry of vast dimensions and eventually supports economic and

social growth. World Travel and Tourism Council has succinctly pointed out that, tourism worldwide has experienced phenomenal growth. With more than 600 million people travelling annually, tourism is the world's largest industry, with revenues of about half a trillion dollars a year, and averaging 5% annual growth as at 2010 despite a 4% decline in 2009 due to global economic and financial meltdown (WTTC,2012). However, according to their latest annual research shows that Travel & Tourism's contribution to world GDP grew for the fifth consecutive year in 2014, rising to a total of 9.8% of the World GDP generating US $7.6 trillion(10% of global GDP) and 277 million jobs (1 in 11 jobs) to the global economy in 2014. They further suggested that, its expansion in 2015 will continue at a stronger rate than last year (WTTC, 2015).

Heat stress is a physiological condition of a living body, which occurs when one's body gains heat faster than it loses. When this condition persists without relief, there is the danger that worker can experience heat discomfort. Thus human health is complicated by heat stress simply by forcing the body to continue functioning as it tries to maintain core temperatures.

A person's tolerance to high temperature may be limited if he or she cannot: sense temperature, lose heat by regulatory sweating and move heat by blood flow from the body core to the skin surface where cooling can occur. It is reported from Alhaji (2015) that the human body function best within a narrow range of internal temperature. This core temperature varies from 36^0C to 38^0C. To get rid of excess heat and keep internal temperature below 38^0C, the body has to adopt two cooling mechanisms: The heart rate increases to move blood and heat from heart, lungs and other vital organs to the skin. While Sweating increases to help cool blood and body evaporate water, which is the most important way the body gets rid of the excess heat.

In a study of spatio-temporal air heat stress condition in Kano Metropolis, Alhaji (2015) revealed that heat stress exposure of both indoor and outdoor condition range from 0 to severe per annum and mild to severe during the summer period in the Metropolis rural periphery. This indicates that at the moment the atmospheric condition is not conducive for tourism industry, except with invention of technology. Also the mean maximum diurnal air temperature of the metropolis reached up to 38^0C.

The local communities and Kano state governments in general have not made serious commitment towards identifying, assessing, and mapping tourism resources in the local government. Therefore, it's based on these facts that the researcher is prompted to undertake this research to ascertain the level of tourism resources (Climate resources) in the local government in order to develop appropriate strategies to manage and maintain its potential effects.

This study tries to investigate the highland micro-climate status based on the metrological measures (that is Heat stress condition) for tourism development in the study area.

The aim is planned to be achieved through the following objectives.

i. To identify and calculate the mean temperature and humidity variables for determining the heat stress condition.
ii. To establish the level of the indoor and outdoor heat stress condition for assessing the suitability of Riruwai locality for tourism industry.
iii. Recommends some strategies for improving the environment for tourism economy.

Study Area

Riruwai as Doguwa local government headquarters is located at the extreme southern tip of Kano state, and it is also called foot slope of Jos plateau. It lies between latitude 10^0 43′ 97″N - 10^0 45′ 01″N and longitude 8^0 43′ 3″E - 8^0 45′ 86″E . In the north and east Riruwai borders with Zainabi ward, Doguwa ward in the north and east, Ragada ward in the west and Dariye shere in the south.

In terms of relief, Riruwai has an outstanding elevation in the whole Kano region. It is the highest point above the sea level in the region rising up to about 1230 meters, but the average height is 1100meters. While the geology of the area is describe as basement complex consisting of both olden and younger granite and believed to have intruded into the basement complex some 165ma in Jurassic period (Olofin, 2006)

The climate of Riruwai town is described as Aw climate by Koppen's classification also known as tropical continental climate which lies between forest and desert. it's characterized by wet & dry season, the rainfall receive in an area is around 1100mm and the mean temperature is 23^0c and also the type of rainfall in the area is orographic & conventional rainfall the area have a very nice prevailing wind condition. The natural vegetation of Riruwai and its surrounding is guinea savannah characterize by denser and taller forest youth. Riruwai is one of the potential sites in Kano state noted famous in terms of heritage potentials with beautiful sites and sites both natural and man-made. These are associated with its endowed natural (physical) features such as mighty Falgore game reserves with some wild lives, waterfalls and cataracts features, caves, aesthetic and spectacular landscapes, well-rounded hills, rolling topography with intermountain plateau, dissected hills, ridges and spurs Orographic weather and availability of surface water (green table water).

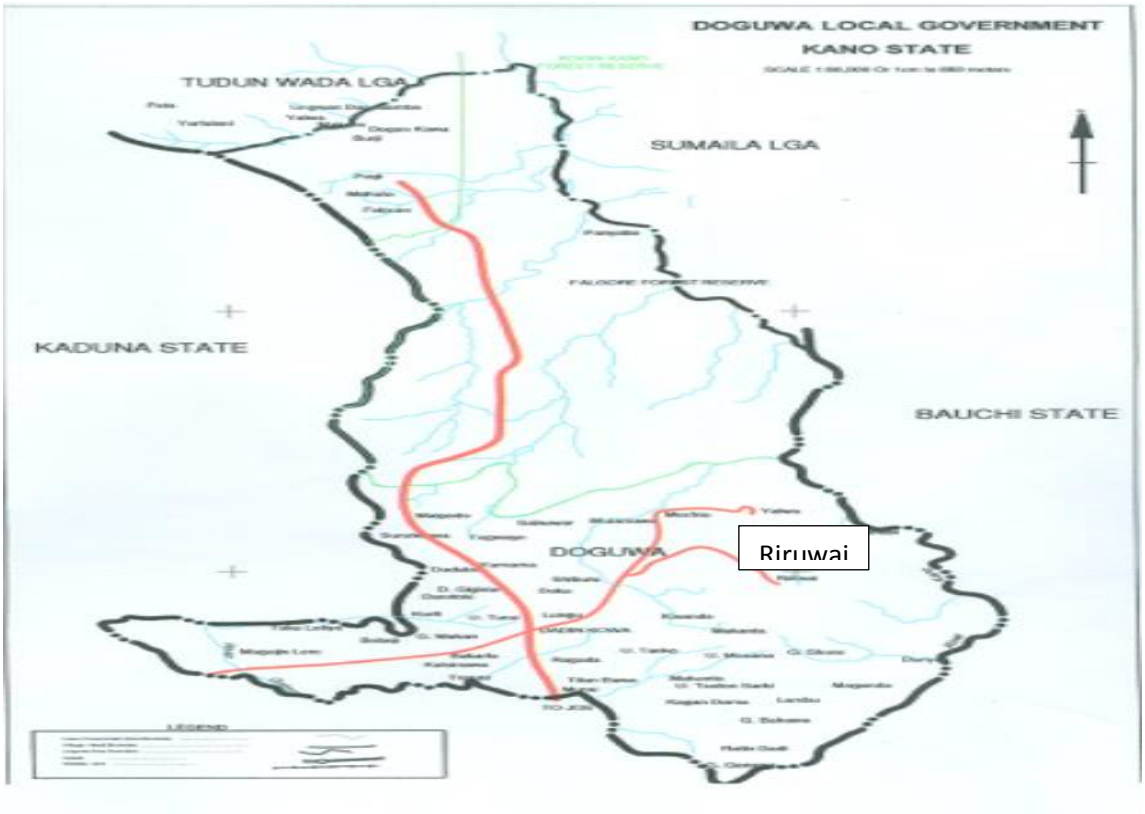

Figure 1: Doguwa Local Government Area

Methods of Data collection

The data for this study were collected from the primary source through measurement and observation of climatic variables (temperature and humidity) and physical observations on physiological and hydrological features. It includes the measures of dry bulb (Ta) and wet bulb (Tw) temperature at different periods of the day for a week interval in a summer season month (April), 2014. The data were obtained using hygrometer and thermometer instruments; the values of the temperature and humidity were recorded by 6:00am, 9:00am, 12:00Noon, 3:00pm, 6:00pm, 9:00pm, 12:00Mid N, and 3:00am. The measurements were conducted in the residential areas of Riruwai located on the intermountain plateau surrounded by Ring-complex during the month of April when the entire Northern Nigeria experiences its maximum diurnal temperature in the year. Both in-door and out-door conditions were measured and recorded.

The result of the values taken at different periods and locations were subjected to means and discomfort index formula is given below

DI = 0.5tw + 0.5ta .....Eq 1

The formular is adopted by Yoram (2006) as discomfort index standard.

Where by Tw = means wet bulb temperature

Ta = Dry bulb temperature value.

The calculated values are subjected to the ranges provided in the

(DI) index below.

- DI value of 22 units: Means no heat stress encounter
- DI value of 23-24 units: Means mild sensational of heat

- DI value of 25 – 28 units: means moderate heavy heat load, people feel very hot, physical work may be performed with some difficulties.
- DI value of above 28: Indicate several heat loads.

Data Analysis

Finally, the results were subjected to Analysis of Variance and t-test for assessing differences between diurnal hours on one hand and between in-door and out-door on the other hand.

Results and Discussions

Mean Diurnal Heat Stress Condition in an in-door Condition

Table 1 revealed the diurnal patterns of indoor physiologic condition (heat stress condition) during the summer season for the 24 hours at the interval of 3 hours. Initially the dry bulb and wet bulb temperature were displayed and finally computed into heat stress condition using Discomfort index. The result indicated three categories of heat stress: no heat stress around 6:00am, mild heat stress around (9:00am and 12:00 mid night) and moderate heat stress (between 12:00noon and 9:00pm). This indicates no severe heat stress condition. The general analysis of the mean diurnal D.I values shows Mild heat sensation for shelter, indoor-domestic activities.

Table1: Indoor mean diurnal value of discomfort index (DI) values.

Time	Mean Ta	0.5x Ta	Mea Tw	0.5x Tw	DI	Heat stress exposure
6:00am	23.5	11.75	20	10	21.8	No heat stress encounter
9.00am	24	12	21	10.5	22.5	Mild sensation of heat
12:00noon	28	14	24.3	12.2	26.2	Moderate heavy heat
3.00pm,	27.2	13.6	26.8	13.4	27	
6.00pm	27	13.5	25	12.5	26	
9.00pm	27.8	13.9	24	12	25	
12:00mid n	26	13	22	11	24	Mild sensation of heat
3:00am	24.4	12.2	21	10.5	22.7	
Total					195.2	
Mean daily (DI)					24.4	Mild sensation of heat

Source: Field work, 2014

Mean Diurnal Heat Stress Condition in an out-door Condition

Table 2 display the mean diurnal heat stress condition of an outdoor condition. The result reveals four diurnal patterns throughout the day. From about 3:00am to about 9:00am the condition is free from Heat stress menace. While around 9:00am the condition reflects mild heat sensation, during the noon hours the exposure to heat was moderate. The extreme exposure has coincides with period between 3:00pm to around 6:00pm when the D.I.value indicates severe heat sensation. The general analysis of the mean diurnal D.I values shows Moderate heat sensation for out-door socio-cultural activities: leisure, hunting, excursion among others.

Table 2: Outdoor mean diurnal values of Discomfort index (DI) values.

Time	Mean Ta	0.5x Ta	Mea Tw	0.5 x Tw	DI	Heat stress exposure
6:00am	26.0	13	17.3	8.7	21.7	No heat stress encounter
9.00am	26.8	13.4	22.0	11.0	24.4	Mild heat stress
12:00noon	29.5	14.8	25	12.5	27.3	Moderate heavy heat
3.00pm,	32.4	16.2	26.8	13.4	29.6	Severe heat stress
6.00pm	31.4	15.7	26	13	28.7	
9.00pm	29.8	14.9	22.2	11.1	26	Moderate heavy heat load
12:00mid n	28.0	14.0	23.7	11.9	25.9	
3:00am	26.6	13.3	16.6	8.3	21.6	No heat stress encounter
Total					205.2	
Mean daily (DI)					25.7	Moderate heat stress

Source: Field work, 2014

Discussions

The outcome of the heat stress analysis reveals moderate to mild heat sensation with few diurnal hours escalating to the critical risk exposure of the heat stress (3:00pm to 6:00pm). When the dry bulb temperature is observed, none of the temperature value reaches over 32^0C. The value of the dry bulb is lower than that recorded at Kano Metropolis periphery (38^0C) as was revealed by Alhaji (2015). Likewise the heat stress vulnerability is lower than that discovered at the Kano urban periphery which clearly ranges from mild to severe condition. However, looking at the study area ecological biomass diversity and the astonishing landscape and its associated drainage features around the study built-up, the magnitude of the heat stress vulnerability is likely to be lower and much favorable for tourists than that of the town ship location. The findings reveals a favorable results which Hooshmand (2013) in his paper on tourism noted that tourism is heavily dependent upon favorable weather and Climate. You may refer to figure II for the ranges of the heat stress condition.

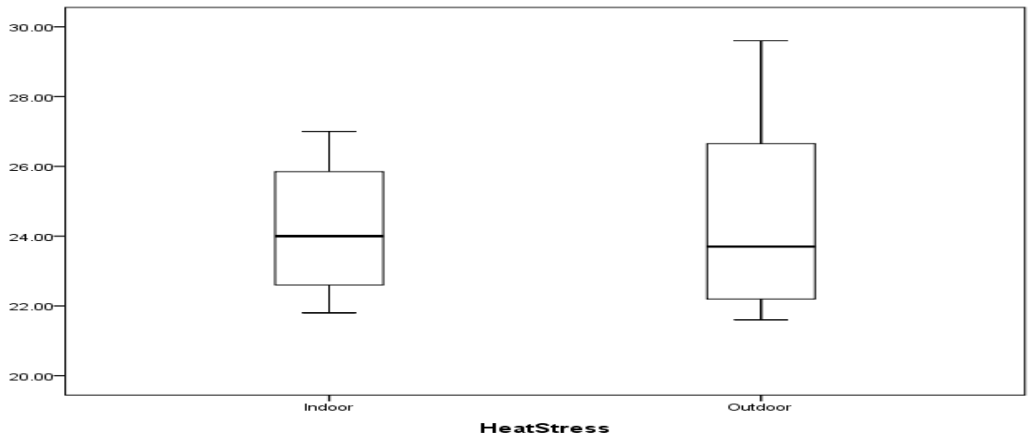

Figure II showing the mean summer heat stress condition range in in-door and out-door

. As a supplement to the weather attributes, plates I, II and III have revealed the spectacular outlook of the Riruwai Geo-ecotourism and Geo-heritages potentials with beautiful sites and sights both natural and man-made. These are reflections of potential sites for tourists' attraction

Plate I: Geo-heritage potentials of (A) Riruwai aerial view and its (B) Central Mosque

PLATE II (A) Green Water Reservoir and (B) Zainabi Water fall Captured during Data Collection

PLATE III A AND B:The Eco-Tourism Potentials in Riruwai Ring Complex

Analysis of variance and t-test results

Table 3: ANOVA for Heat stress Condition

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	75.230	7	10.747	11.080	.001
Within Groups	7.760	8	.970		
Total	82.990	15			

Table 3 indicates that the analysis of variance shows strong significance between the diurnal hours because the significance difference value is less than 0.05. Thus, null-hypothesis is rejected.

Table 4: Heat Stress Condition

Tukey HSD[a]

Time	N	Subset for alpha = 0.05			
		1	2	3	4
6 am	2	21.7000			
3 am	2	22.1500	22.1500		
12 Midnight	2	23.4000	23.4000	23.4000	
9 am	2	23.4500	23.4500	23.4500	
9 pm	2	23.5000	23.5000	23.5000	
6 pm	2		25.7500	25.7500	25.7500
12 noon	2			26.7500	26.7500
3 pm	2				28.3000
Sig.		.622	.073	.102	.281

Table 4 indicates Means, for groups homogeneity and heterogeneity among the variables. It indicates that strong heterogeneity between the subsets, while, homogeneity within each subset is reading above 0.05.

Table 5: shows the t-test analysis indicating no significant differences between in-door and out-door heat stress conditions. The 2 tails values (0.793 and 0.794) have exceeds 0.05. Thus, the similarity of indoor and out-door conditions is attributed to the sparsely population and highland nature of the climate in the study area.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
DIV	Equal variances assumed	1.728	.21	-.268	14	.793	-.325	1.21	-2.92	2.27
	Equal variances not assumed			-.268	12.02	.794	-.325	1.21	-2.97	2.32

Summary and Recommendation

Summary

The study has revealed promising results. The general weather conditions both indoor and outdoor range from mild heat stress in indoor and moderate heat stress condition in Riruwai. This has indicated that with little technological modifications on Orographic weather, the study area atmosphere plus its spectacular ring-complex landforms, old mining ditches, vegetation and drainage features will be potentially good for the intended socio-economic land use.

Riruwai can be a very good area for tourism based on the micro climate analysis of the area, vegetation, topography and other important tourist attraction sites. The microclimate is potential for the tourism industry and can be supplemented by afforestation of the open vegetated land, provision of social amenities and infrastructural facilities. These among many initiatives will boost the socio-economic status of the study area and also serve as the alternative sources of income and an ultimate economic diversification.

Recommendation

Following recommendations were made for future improvement of the area towards the intending tourism sector.

i. Governments are advice to invest and harness available resources in Riruwai as an alternative source of income to the governments and Riruwai people as practice in some other countries like Kenya.
ii. At the same time governments and nongovernmental organizations in collaboration with the community leaders should propagate an eco-tourism industry as an economic diversification
iii. There should be an establishment of low cost houses, sporting facilities, parking spaces, good public and private healthcare units, conference rooms, banks, theatres and tourism institution in the area.
iv. Avoid establishing industries and other anthropogenic heat sources for they are agents of pollution.
v. There should be an improvement of security in the area which will encourage tourists to settle safely.
vi. It was also recommended that, more trees should be planted around the settlements and in the deforested area for maintaining an eco-friendly habitat. This will pave way for sustainable tourism economy as a means of diversifying the existing oil-economy for sustainable income and employment opportunities to its people and Governments.
vii. Building structures should be built with white Marbles or painted white for improving heat reflectance.
viii. Conservation of geo-ethics and cultural and moral values of the indigenous populace.

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