Journal of Experimental Research

September, 2018, Vol 6 No 3

Email: editorinchief.erjournal@gmail.com
editorialsecretary.erjournal@gmail.com

Received: *December, 2017*
Accepted for Publication: *August, 2018*

Effect of Some Weather Elements on Malaria Prevalence in Agbani, Enugu State, Nigeria

***Okwu-Delunzu VU**

Department of Geography & Meteorology, Faculty of Environmental Science, Enugu State University of Science and Technology, Enugu, Nigeria.

***Author for Correspondence:** virginia.okwu@esut.edu.ng.

Abstract

Climate and weather play significant role in spread of some diseases such as malaria. Global estimates show that about 300 million acute cases of malaria occur every year, resulting in more than one million deaths. Effect of weather elements on malaria prevalence in Agbani, Nkanu West local government area of Enugu state was examined in this study. Climate data of rainfall, temperature and relative humidity (2005 – 2014) were gotten from the ESUT Meteorological Observatory, Ebeano city for a period of ten years, Medical records was obtained from the pathological test register of University of Nigerian Teaching Hospital (UNTH) of different tests for malaria parasite among patients for ten years, well design oral interviews and structured questionnaires were used to get necessary information pertaining to the study. Pearson's product moment correlation and the students't' test for significance was employed to analyze the data to determine the strength of the relationship between weather parameters and frequency of malaria occurrence. Findings indicate that weather element which occurred naturally has a direct effect on malaria prevalence in the study area; findings show positive relationship between rainfall amount and malaria cases; an increase in amount of rainfall led to a decrease in malaria prevalence in the area .The correlation (rp) value of (6.63) between temperature and malaria cases shows that an increase in temperature values led to an increase in the frequency of malaria occurrence. Furthermore, the correlation value of (-4.32) between relative humidity and malaria cases shows that a decrease in relative humidity led to a decrease in malaria causative organism attack thus decrease in malaria occurrence. Based on the findings people are advised to sleep under mosquito treated net during high temperatures, clear stagnant water which are good breeding sites for mosquitoes, take anti-malaria vaccine and incorporate climatological information in urban planning, building designs as well as modernizing of old ones, since weather factors influences malaria incidence.

Keywords: Malaria, rainfall, temperature, relative humidity, prevalence, relationship.

INTRODUCTION

Weather is the state of the atmosphere; explaining the degree of hotness or coldness, wetness or dryness, calm or unstable, clear or cloudy (Glossary of Meteorology 2012). Weather conditions is one of the major determinants of human state of health and causes of diseases .Some Weather elements like temperature, rainfall and relative humidity are important drivers of malaria transmission and are associated with the dynamics of malaria vector populations. The spread of the malaria (disease) has also been noted in the regions lying between latitude 30^0N and 30^0S of the equator as malaria prone regions. Although it is commonly found in most African countries, South American, South East Asia, the Arabian Peninsula and the western Pacific countries (Zulueta 1987; Snow et al. 2005).

WHO estimated in 2015, that there were 214 million new cases of malaria resulting in 438,000 deaths globally, therefore observed that malaria is the third highest environmental health treat globally. One of the most threatening features of contemporary African is the increasing rate of health problems. Studies by some scholars noted that malaria accounts for about 1,144 death cases annually in Nigeria and it is the most predominant health problem in our country.

Malaria is a kind of fever conveyed by mosquito which introduces germs into the blood (Snow and Gilles, 2002), as a disease therefore is a serious impairment to body health. Most malaria protozoa are found mainly in tropical and semitropical part of the world. This is because the vector organisms carrying the orne parasite to man requires the high temperature and humidity of tropical regions in order to survive (Craig et al. 1999). One of the most important vector-borne disease in the tropics is malaria which is associated with one of the four species of parasite called "Plasmodium" and it is transmitted by an infected Anopheles mosquito vectors (Martins et al. 2005), such mosquito are found in almost 211 countries in the tropics and subtropics. Studies indicate that ambient temperature, rainfall and relative humidity favors' the distribution of the vector organism carrying the parasite to man; thus prevalence of malaria in those areas. (National Research Council, 2001; W.H.O 2012).

The deposition and survival of mosquito eggs, their maturation into larvae and then into adults requires aquatic environment, rainfall can create puddles that provide good breeding condition for mosquitoes. In very humid climates, drought may turn river into strings of pools, preferred breeding sites of other types of mosquito (Hay Rogers and Randolph, 2002). The duration through which the parasite would develop within the mosquito saprogenic cycle is dependent also on temperature. The Saprogenic cycle takes about 9 to 10 days at temperature of about 28^0c to 30^0c but stops at temperatures below 16^oc, the daily survival of the vector is also dependent on temperature as well. At temperatures between 16^0c and 36^0c the daily survival is about 90%. This survival drops rapidly at temperature above $36^{0C.}$ The highest proportion of vector surviving the incubation period is observed at temperature between 28^0c and 32^0c the saprogenic cycle. Accordingly Sueur (2009) stated that the effect of minimum temperature on malaria is significant, because at lower temperature, the larval and pupa stage of the mosquitoes takes longer to complete (for example 47 days at 16^0c) and small increase in temperature substantially shortens the duration of these phase (to 37 days at 17^0c). Therefore higher temperatures result in more frequent vector host contact. In the same vain (Bouma and Poveda, 2007) saw weather in the tropics and subtropics as effective in Malaria prevalence through his research because his findings show more *Plasmodium falciparum*" (Malaria parasite) in children during the early rainy season. These data on timing of the mosquito life cycle suggest that malaria cases follow weather at defined intervals; periods of increase temperature and decrease rainfall. These findings indicated that transmission windows (TW) for malaria are predicted to increase with climate change for most vectors malaria, the temperature range of 20^0c-32^0c optimal for development and transmission. A relative humidity higher than 55% is optimal for vector longevity, enabling the successful completion of sporogony. Analysis of average temperature, humidity and precipitation with malaria prevalence indicated that the maximum prevalence occurs in the months of March, April and August when the relative humidity is in the range of >60% and <80% at temperature ranging from 25^0c to 32^0c (National physical laboratory 2014).

Malaria epidemics due to *Plasmodium falciparum* are reported frequently in the east African highlands. The Ethiopian highlands experience 2 moderate transmission seasons every year (after rains in March through April). Epidemics occur in 5- to 8-year cycles; >1 million cases and 150,000 deaths in Ethiopia were recorded in 1998 due to malaria (World Health Organization/UNICEF, 2003).

Also Craig et al. (1999) stated that on the desert and high land fringes of malaria area, rainfall, humidity and temperature with other critical parameters for disease transmission is unstable and the population lacks protective immunity. Thus when weather conditions favor transmission, serious epidemics may occur. In some high land regions, higher temperatures possibly linked to E1 Nino may increase malaria transmission. This has been shown to occur in higher attitude parts of Asia, such as North Pakistan, at the beginning of this century, periodic epidemic of malaria flared up in Punjab region (North-East Pakistan and North-West India) after excessive monsoon rainfall (Bouma and Poveda, 2007). Reports have also shown that from 1921, forecasts of malaria epidemics in Punjab were based on established relationship between rainfall and malaria mortality creation, probably the first malaria warning system (Conner and Thompson, 2008).

Malaria is found in many regions of the

word, but human plasmodia are not uniformly distributed. Malaria is more prevalent than was once suppose, particularly in West Africa (Bruce-Chwatt, 2003). It has been established that in the early 1850's, the total annual number of cases of human malaria throughout the world was about 250 million, with a mean fatality rate of 1%. The estimated global incidence of malaria lies within the next 20years to less than half of the previous figure, but this disease is still one of the most prevalent affections of the tropical worlds. Thanks to the introduction of residual insecticides and anti-malaria drugs, malaria control activities have been gently expanded and the probability of global malaria eradication has been hoped for the World Health Organization (WHO) since 1955, By the end of 1975, eradication of malaria was achieved in some countries and territories inhibited by 824 million people, over 800 million others live in areas where malaria eradication programs is still on course. Two thirds of the last figure lives in Africa where the progress has been slow, because of administrative, financial and some technical difficulties (Bruce-chwart, 2003). Thus Malaria is an entirely preventable and treatable mosquito borne illness. Notwithstanding the malaria control programs, malaria spread by the water breeding Anopheles mosquito, still kills some 5 million people a year. More than half of the world population lives at some risk of the diseases with 200-400 million new cases annually. Malaria is now a major economic and social threat in many tropical and subtropical countries (World resources, 2014).

In 2012, malaria killed an estimated 482,000 children less than five years of age. That is 1300 children every day or one child almost every minute. Between 2000 and 2012, the scale-up of interventions helped to reduce malaria incidence rates by 25% globally and by 31% in the WHO (World Health Organization) African region. The global malaria mortality rate was reduced by 42% during the same period, while the decrease in WHO African region was 49%, between 2000 and 2012; a scale up of malaria intervention saved an estimated 3.3 million lives. 90% or 3million of these are in the under five age group in sub-Saharan African. In many parts of Africa where malaria have long been highly endemic, people are infected so frequently that they develop a degree of acquired immunity and many become “asymptomatic” carriers of the infection. This is reflected in the estimated number of people infected (267 million) compare with the estimated number of clinical case of malaria which is 107million per year (WHO, 2014). According to the World health organization (W.H.O) some 200 million persons are affected by the disease including one-fourth of the adult population on the continent of Africa. Resistance of the vector to insecticides however can make present day control programmers more difficult. According to Conner and Thompson (2008), malaria has taken a heavy toll on the population of Africa,

In Nigeria studies have shown that weather elements and malaria prevalence has been studied; some effort in Nigeria today has been directed towards providing medical facilities needed to improve health conditions. But these health programme have been only too often biased towards over sophisticated “corrective” treatment rather than mare basic widespread “preventive” treatment (Gerald, 2010). Similarly there is an urgent need for the development of malaria early warning systems with adequate lead – time to target scarce resource for preventive activities; this is recently done by Nigerian Meteorological Agency, with their seasonal rainfall prediction annual bulletin (NIMET SRP, 2015). This is important because unusual meteorological conditions, such as very low rainfall and high temperature are often cited retrospectively as the precipitating factors for epidemics. There have also been formal attempts to predict epidemics by the use of local weather or global climatic variable that are predictors of vector abundance and therefore of transmission potential. As much as this diseases “Malaria” is still highly prevalent in our communities causing physical and socio-economic burden it is however preventable. Malaria causes several problems, however the lack of understanding of the situation of malaria risk, its severity and fundamental perspectives of where (distribution) why (environmental determinations) how (transmission intensity) and when (seasonality) malaria occur are very limited. As the weather becomes warmer, it may be expected that these vector will increased in their geographical range (Longstreth and Wilseman, 2004). Since weather affects the health of Nigeria population in such a way that it encourages the spread of disease to man.

Therefore this research is aimed at assessing the effect of weather on malaria prevalence in Agbani Nkanu West Local Government Area Enugu with the following objectives (1) Investigation of malaria frequency and it's occurrence in Agbani area (2) Assessing the relationship between weather elements (temperature, relative humidity and rainfall) and incidences of malaria in Agbani area . Thereafter recommend means of preventing and reducing malaria occurrence in Agbani area.

MATERIALS AND METHOD

Study Area

Agbani is located in Nkanu West local government, Figure 1.1. Nkanu west local Government of Enugu state has a population 146, 693 with 74, 367 females and 72,326 male (NPC 2006). Agbani is the headquarters of Nkanu West Local government, is located at latitude 06^{0} 21' to 06^{0}30 N and longitude 07^{0}25' to 07^{0}45'E . Figure 1.2 below shows the map of Nkanu West Local government and Agbani the study area.

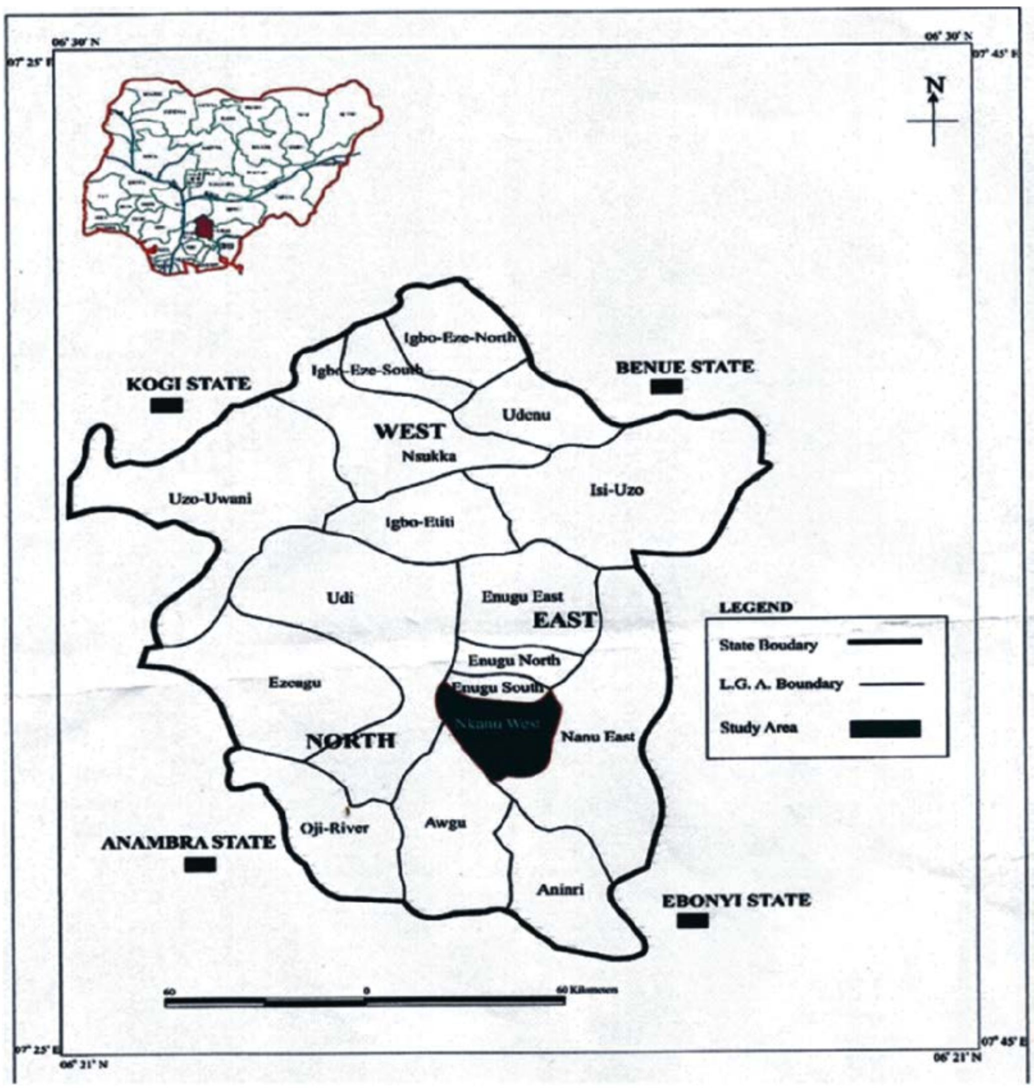

Figure 1: Map of Nigeria above showing Enugu State and Map of Enugu State Showing the Location of the Study area Nkanu West local Government Area.
(Source: Ministry of Lands and Survey, Enugu, 2014)

Agbani is bounded in the Northwest by Akpugo and in the Northeast by Umueze while Southwest by Amuri and Southeast by Ugboka. The town comprises of various villages which are Mgbogodo, Ogbeke, Amakpu, Ojiagu, Amiyi, Ukwa, Obeagu, Amafor, Isiagwe, Ndiagu-Amaforamakatanga and Mgbenu (Fieldwork, 2015) Amafor called station which is the new developing area where there market is located have been overcrowded. Housing while other villages has dispersed and linear settlement whereby in some area bush separate one building another.

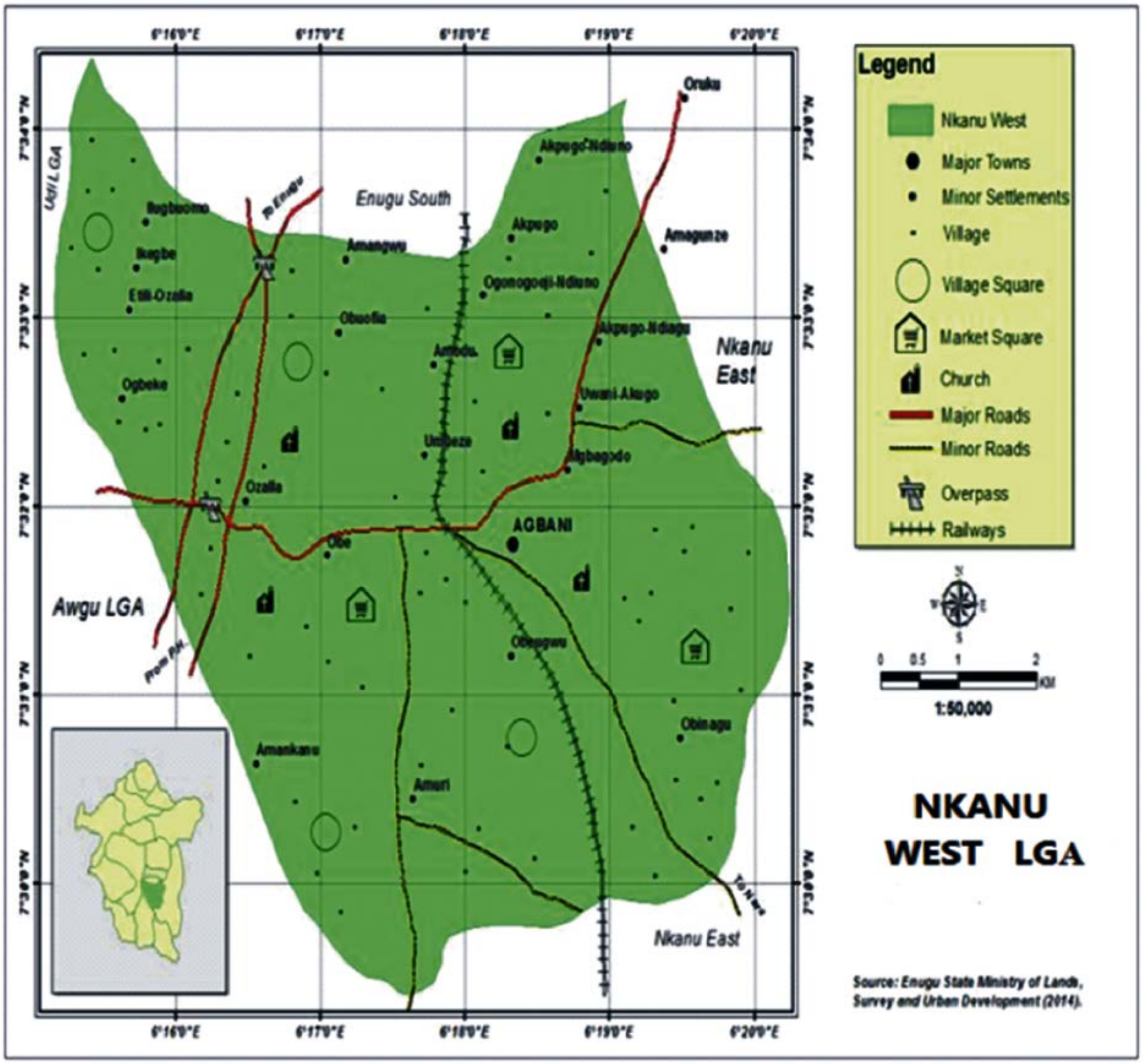

Figure 2: Map of Nkanu West L.G.A, Enugu

Source: Enugu State Ministry of Lands Survey and Urban Development (2014)

The relief of Agbani is dominated by plains under 230m above sea level. To the East of Agbani are more elevated plans while in the northern part it is lower relief system. According to (Ofomata 2002), the plain forms the dominant feature in the certain Nigeria landscape and resulted from alternating denudation activities. The major rivers which drain Agbani are Umuekwu in Amafor and Ekwu stream at Ojiagu, there is Umumba and Umunneche, Umunwation and Umuakparakwu. They exhibit dentritic pattern drainage system which is characterized by irregular branching of tributaries.

Climate and Vegetation

Agbani like the rest of other place in Enugu State has the tropical savanna type of climate, according to Koppen (2012) climate classification, the two air masses that influence the climate of the area, are the warm tropical maritime air mass which originates from the South Atlantic ocean and the dry dusty tropical continental air masses associated with dry rainy season experienced in the area.

The rainy season normally starts from late march and ends in October. But the rainfall is not continuous during this period. There is a break in rainfall in August and as a result the area experiences two maximum rainfall peak in a year (June/July and September/October) the dry season are experienced in November to early March. The annual rainfall is between 1500mm to 2000mm, the mean monthly rainfall is about 1400mm (NIMET 2015)

The monthly temperature ranges from 25^0c to 32^0c and the mean annual temperature is 27^0c, Agbani lies within the guinea savannah zone of Nigeria it has some of the few characteristics of the rain forest zone, but due to human activities in the area (e.g farming, construction of road and building of houses) the natural rain forest has been destroyed. The area is now filled with secondary vegetation and derived savanna (Chukwudelunzu 2002).The vegetation aid in the soil formation and soil type while the climate acts as an agent of weathering which are transported during rainfall along the stream channels of the streams found in Agbani.

The study area with land area of about 160,222 square kilometers is one of the major sub-urban areas in the state due to the presence of Higher education industry like the State University and others. In the recent population census of 2006, the study area had a population of 146,693 and based on an annual population growth of 1.37%.

Data Collection

The data used for this study were collected from both Primary and Secondary sources, Medical reports from the pathological test register, obtained from the pathology unit of UNTH revealed different tests for malaria parasite in patients for the ten years under study (2005-2014). Positive and Negative test for malaria parasites, the months of high occurrence and low occurrence was duly noted. Also Climate Data (temperature, rainfall and Relative humidity) were gotten from the ESUT Meteorological observatory. At the time of investigation information from well-designed oral interviews personal observation, as well as the use of questionnaires were used. Oral interviews were directed to professionals (doctors, nurse and primary health officers) in the medical and health sectors on malaria and weather. The researcher made proper observation of the study area to identify favorable mosquito breeding conditions. A simple constructed questionnaire, well blended questions were employed to obtain reliable information, regarding the contribution of weather on malaria prevalence from the populace of the study area. 100 copies of questionnaires were distributed randomly by hand to the populace of Agbani Area.

Data Analysis

In analyzing the data for this research work, the Pearson moment correlation and the "t" test for significance were utilized. Also, the "t" test for significance was used because the sample size was not large.

The formula for the Pearson product moment correlation used is

$$rp = \frac{\sum xy - (\sum x^2) - (\sum y^2) - (\sum y)}{n}$$

$$\sqrt{(\sum x^2 - (\sum x^2) - (\sum y)^2 - (\sum y)^2)}$$

Where: rp is the correlation

$\sum$ is the summation of values

X is the mean positive malaria cases

Y is the total mean monthly weather elements (temperature, rainfall, relative humidity) in H_1

n is the sample size

The formula for the 't' Test for significance is

$T = r\sqrt{n2/1-r^2}$

Where t test for significance

r = Pearson product moment correlation

n = sample size.

Furthermore, the use of hypotheses subject to the coefficient of (rp) test for significant (t) and percentage (%) were also employed, to determine the dependency of malaria incidence on weather phenomena (Rainfall, temperature and relative humidity), as to make inferences on the contribution of weather phenomena on malaria prevalence in the area.

RESULTS AND DISCUSSION

Characteristic features of weather elements in the study area.

The charts show characteristic features of weather elements under review. Observation in Figures 3 and 4 indicates that Agbani areas experiences a fairly high percentage of relative humidity, with the month of September having fairly higher relative Humidity than other months while year 2009 also had highest

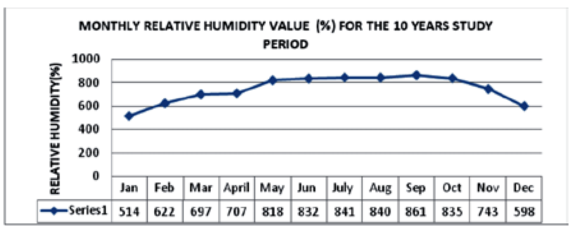

Figure 3: Annual monthly Relative Humidity (%) during the ten year study period

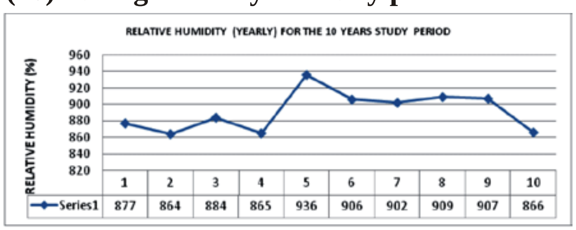

Figure 4: Annual Relative Humidity (%) during the ten year Study period

Source: Meteorological Observatory, Department of Geography and Meteorology, ESUT, Agbani 2015.

Figures 5 and 6 show a high amount of rainfall from the month April to November, during the years under study, September (339.3mm) recorded the highest rainfall amount in the period of ten years in line with month of high relative humidity above, followed by June (286.76mm), July (274.27mm), May (270.79mm), then a decrease in rainfall from November . February recorded 108mm of rainfall which happens to be the least in amount and corresponds with period of high malaria prevalence because of high temperature and low rainfall. Agbani experiences two maximum rainfall peaks in June-July and September. While the remaining months of the year October, May and August experience average or little rainfall amount. The year 2009 had highest rainfall within the study period

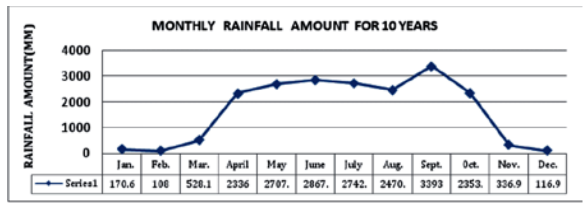

Figure 5: Mean Annual Monthly Rainfall (mm) for the study period

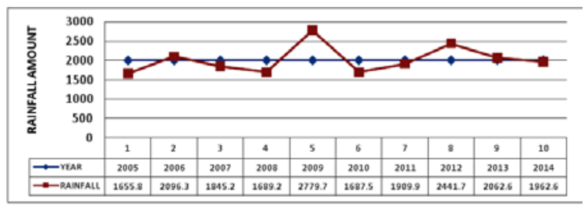

Figure 6: Annual Monthly Rainfall (mm) for the Study period

Source: Meteorological Observatory Department of GEO &MET ESUT Agbani, 2015.

Figure 7 shows the study area has maximum temperatures in months of February, March, November and December. February March also corresponds to period of high Malaria prevalence from literature and findings

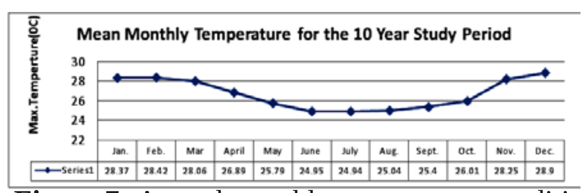

Figure 7: Annual monthly temperature condition for the ten years study period

Source: Meteorological Observatory, Department of GEO &MET ESUT Agbani, 2015.

Malaria frequency in the study area from the number of questionnaires distributed.

The findings from table 1 show that 87 respondents had suffered from malaria between 2005-2014, while 3 respondents had not suffered from malaria for the past ten years. Hence about 97 percent of the population in Agbani, area at one time or the other suffered from malaria, within the past ten years. While about 6 percent of the people have not had malaria fever during this same time or period.

Table 1 : Presented below 90 respondents

Responses	No of respondents who suffers Malaria	Percentage (%)
Yes	87	97
No	3	3
Total	90	100

Source: (Field work 2015).

Table 2 shows that 65 respondents which is 72.2% suffered from malaria very often, while 22 respondents suffer from malaria on a rare occasions also 3 respondents has not suffered from malaria in the past 10 years.

Table 2: Detail: How often do you suffer from malaria?

Responses	No of respondents	Percentage (%)
Very often	65	72.2
Not often	22	24.4
Not at all	3	3
Total	**90**	**100**

Source :(Field work 2015)

Table 3 shows highest number of positive malaria parasite test (MP+) in the months of March about 411.1 positive malaria cases which corresponds to period of highest temperature value. August has a mean total of 399.6 cases. The remaining months of the year experiences fairly high positive malaria cases with mean total of about 104.2-107.2. However November had the least Malaria attack which corresponds to period of low rainfall, Relative Humidity and Temperature.

Table 3: Number of cases positive to malaria Test (MP+)

Month	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total	Mean Total
Jan.	100	120	101	100	102	110	101	103	105	100	1024	104.2
Feb.	217	197	200	213	204	198	210	205	115	200	1959	195.9
March	400	402	402	400	450	403	420	409	410	415	4111	411.1
April	200	210	201	211	220	215	200	201	210	212	2080	208.0
May	195	119	112	162	190	120	110	153	162	120	1443	144.3
June	200	211	213	207	202	212	214	208	209	201	2434	233.4
July	200	210	205	211	218	208	207	201	197	162	2019	201.9
Aug.	400	414	411	413	401	398	410	362	400	387	3996	399.6
Sept.	201	200	206	212	199	182	200	204	209	220	2033	203.3
Oct.	212	211	213	200	215	218	200	218	200	192	2079	207.9
Nov.	100	115	110	115	87	72	98	78	87	99	961	96.1
Dec.	118	100	110	101	120	99	100	105	104	115	1072	107.2

Source: (Pathology Unit, UNTH. ItukuOzalla, 2015.)

The table 4 shows that 60 respondents that is 66.7% believed mosquito to be the major causes of malaria fever in human, 15 believed that dirty environment is the major cause of malaria fever to human while 7 respondent considered it to be too much rainfall and 8 respondent believed it is

Table 4: Detail what do you think is the major cause of malaria fever to human?

Causes	No of respondents	Percentage (%)
Mosquito	60	66.7
Dirty environment	15	16.7
Poor housing	-	-
High temperature	-	-
Much Rainfall	7	7.8
All of the above	8	8.8
Total	90	100

Source: (Field work 2015)

Table 5 shows that 21 respondents believed that malaria can be prevented and wiped off from Agbani while 45 respondents do not agree that it is possible to prevent and completely wipe off malaria from Agbani.

Table 5: Do you agree that malaria can be prevented and wiped off from Agbani area.

Responses	No of respondents	Percentage (%)
Yes	21	23
No	45	47
Not sure	24	30
Total	90	100

Source: (Field work 2015).

Findings in table 6 show that 50% of the respondents believe clearing of drainage system will eradicate mosquito breeding places; thereby reduce malaria prevalence in the area.

Table 6: Detail of what measures can help in eradicate mosquito?

Measures	No of respondents	Percentage (%)
Sand filling of stagnant water	15	16.7
Clearing of drainage system	45	50
Clearing of vegetation around houses	30	33.3
Total	90	100

Source :(Field work 2015)

The relationship between weather elements and malaria prevalence in the study area.

Table 7 shows 72 respondents believed that rainfall favor malaria prevalence, while 18 respondents do not agree that rainfall favors the prevalence of malaria.

Table 7: Does rainfall favor malaria prevalence?

Response	No of respondent	Percentage (%)
Yes	72	80
No	18	20
Total	90	100

Source: (Field work 2015).

Source: (Field work 2015).

From table 8 it was seen that 40 respondent which is 44% see temperature as a major causes of malaria while 50 respondents which is 56% do not agree that temperature causes malaria in Agbani.

Table 8: Does temperature influence the frequency of malaria prevalence?

Response	No of respondent	Percentage (%)
Yes	40	44
No	50	56
Total	90	100

Source: (Field work 2015).

Table 9 shows that 76 respondent think that relative humidity affects the prevalence of malaria while 14 of the respondents do not think that relative humidity actually influences malaria prevalence in Agbani area.

Table 9: Do you think relative humidity influence the frequency malaria prevalence?

Response	No of respondent	Percentage (%)
Yes	76	84.4
No	14	15.6
Total	90	100

Source: (Field work 2015)

With reference to table 10, 50 respondents believed that season of malaria attack is mainly during rainy season June July and August, which is not correct, and therefore enlightenment programme is important, 20 respondent believes season of malaria attack is during dry season March, April and May which is correct while 12 respondent experienced malaria during the rainy season retreat between September, October and November and 8 respondents were believes malaria attacks more during dry season, between December, January February.

Table 10: Season of malaria attack

Season	No of respondent	Percentage (%)
Raining season (peak) June, July, august	50	55.6
Dry Season March, April And May	20	22.2
Retreat or end of rainy season September, October November	12	13.3
Proper dry season December, January February	8	8.9
Total	90	100

Source: (Field work 2015).

Hypothesis was tested between relative humidity and malaria prevalence. Correlation value of rp (-4.32) is greater than +0.73, which shows a very strong negative relationship between relative humidity (RH) and malaria cases. This negative relationship means that an increase in RH will lead to a decrease in malaria cases, and vice versa. And since the calculated value of t =(0.69) is less than 1.81 we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1) which states there is significant negative relationship between relative humidity (RH) and malaria prevalence. Further still correlation between Temperature (^{0}c) and Malaria Prevalence indicates the value of rp (6.63) is greater than +0.74 and less than +1, which shows a very strong positive relationship between temperature and malaria cases. This positive relationship means that an increase in temperature lead to a increase in malaria prevalence, and since the calculated value of t = (-0.49) is less than 1.81 we reject the null hypothesis (H_0) and conclude that there is a significant relationship between temperature and malaria prevalence. On Correlation between Rainfall and Malaria Prevalence, the value of rp (8.9) is greater than +0.74 and greater than +1, it shows a positive relationship between rainfall amount and malaria cases. This means that an increase in amount of rainfall will lead to a decrease in malaria prevalence, and vice versa. This is true, since temperature values are low during this period,it does not favour growth of mosquito larva. Again, the fallen rains flushes away the mosquito breeding places, therefore leaving less agent of Malaria during the period, we conclude that there is significant relationship between relative rainfall amount and malaria prevalence.

CONCLUSION

The findings of this research work implicate climate and weather in the health sector particularly the issue of malaria prevalence in Agbani area. The study discovered that cases of malaria attack are quite high in Agbani. As it can be seen from the distributed questionnaire 96.6% of the populace in Agbani have at one time or the other suffered from malaria this is in line with findings of W.H.O 2012, Craig et al (1999) and National Research council, 2001 indicating Malaria as prevalence in tropical area because of the weather in the area. It was also discovered that majority of these malaria cases occurred in March when the temperature are high, and few ponds created by false rainfall onset.

On the relationship between malaria prevalence and temperature, it was discovered that there is a relationship between malaria and low temperature; malaria cases tend to be on the decrease, especially during the month of November during period of low temperature, but malaria cases tend to be on the increase during the months of high temperature.

On the relationship between rainfall amount and malaria prevalence; it was deduced that there is a significant relationship which is positive between malaria prevalence and rainfall amount which means that an increase in the amount of rainfall will lead to an decrease in cases of malaria in Agbani, especially during the months of June and September. This is also in line with Bouma and Poveda (2007) findings when he noted that weather in the tropics and subtropics as effective in Malaria prevalence through his research because his findings show more plasmodium falciparum" (Malaria parasite) in children during the early rainy season and following Elino events.

Findings also discovered that there is a very weak relationship between relative humidity and malaria prevalence, with a correlation coefficient value of 4.32., that periods of low humidity do not favors the breading of mosquitoes, which determine the rates of malaria prevalence on the people of Agbani. It was also discovered that these periods which experiences high rainfall amount and high relative humidity, have low recorded temperatures, as a result of the availability of rain clouds, which affects the amount of insulation that get to the earth surface.

RECOMMENDATION

The basic reasons for this research work is to highlight the contribution of weather on malaria prevalence and from the findings of this work, it was found out that the people in Agbani are not totally aware about the weather influence on malaria prevalence and its effect on the occurrence of the malaria outbreak. Based on findings from this research work the public could be educated or informed; emphasizing on the importance of incorporating climatological information in urban planning, building designs as well as modernizing of old ones, since weather factors influences malaria incidence, building designers should incorporate mosquito preventive measures such as, proper drainage channels, door and window nets even to the smallest opening and the newly introduced mosquito repellent bulbs because mosquito is the targeted vector carrier of malaria parasite to man. Formal and informal education and training are necessary to create awareness of the scale of the problem and the times of the year when Malaria attacks is more prevalent. Research work findings should be published and made public; the larger public can be reached by enforcing environmental sanitation standards, developing the culture of environmental compliance.

REFERENCES

Bouma MJ, Poveda G.(2007). Predicting high risk year for malaria in Colombia using parameters of Ei Nino Southern Oscillation. The Medical Health Encyclopedia J.G Ferguson publishing co Chicago Illinois. pp: 19-323.

Bruce-Chwatt RM. (2003). Epidemic common in West Africa. Kochar's Concise Textbook of Medicine, Fourth Edition York Lodge, York Road, Richmond, Surrey, TW10 6DR, UK Lippincott, Williams and Wilson, Baltimore, USA, 2003

Chukwudelunzu VU. (2002). Implications of Rainfall Characteristics on Agriculture in Enugu State of Southeastern Nigeria Unpublished M.Tech.,Project; Federal University of Technology, Minna Niger State.

Conner SJ, Thompson ML. (2008). Environmental information systems in malaria risk mapping and epidemic forecasting. Journal of the Tropical Medicine and Hygiene. 51:160-165.

Craig MH, Snow RW, Le Sueur D. (1999). A Climate-Based Distribution Model of Malaria Transmission in Sub-Saharan Africa. Trends in Parasitology, 15, 105-111.

De Zulueta J. (1987). Changes in the geographical distribution of malaria throughout history. Parassitologia. 29;(2-3):193-205.

Glossary of Meteorology. Troposphere. Archived 28 September 2012 at the Wayback Machine. Retrieved on 27 June 2008.

Hay SI, Rogers DJ, Randolph SE (2002). Hot topic or hot air? Climate change and malaria resurgence in East African highlands. Trends Parasitol. 2002;18:530–34.

Koppen WP. (1987). Regional Climatic Pattern in Ojo O. (1977) (Ed) Climate of West Africa. Henin Publishers. Ibadan. pp: 131

Longstreth JD, Wiseman J. (2004). The potential impact of climate change on patterns of infectious diseases in United state. U.S environmental protection agency Washington D.C.

Martin RE, Henry RI, Abbey JL, Clements JD, Kirk K (2005). The 'permeome' of the malaria parasite: an overview of the membrane transport proteins of *Plasmodium falciparum*. *Genome Biology.* 2005: 6:R26,

Najera NH, Hay S. (2001). Weather climate and human settlement W.M.O No448 World Meteorology Organization, Geneva. pp: 45.

National Research Council (2001). Tropical disease spatial programme for research and training in tropical disease TDR (W.H.O) Geneva,Switzerland.

National physical laboratory (2014) Temprature dependent development and survival rate of anopheles mosquitoes in journal of biometeorology vol11 pg119-127.

NPC (National Population Commission) (2006) Census Review Pp 3.

Nigerian Meteorological Agency (NiMET). (2015). Seasonal Rainfall Prediction March 2015 pp: 38-42

Ofomata GEK. (2002). A Survey of Igbo Nations. Africana first publishers Ltd. pp: 75.

Snow RW, Gilles HM. (2002) The epidemiology of malaria. In: Warrell DA, Gilles HM, editors. Essential malariology. 4th edn Arnold; London: 2002. pp. 85–106.

Snow RW, Guerra C, Noor A, Myint H, Hay S. (2005). The global distribution of clinical episodes of *Plasmodium falciparum* malaria. Nature. 434: 214–217.

Sueur (2009). Temperature dependent variation in anopheles larval head capsule width and adult wing length the Macmillan press ltd,London.

Wagmen TA. (2009). Weather climate and health Rome, World Meteorological Organization W.M.O No892.

World resources (2014) An assessment of the resources base that support the global economy basic books,inc New York.

World Health Organization/UNICEF (2003). The Africa malaria report 2003. Geneva: WHO/Roll Back Malaria; 2003. Available from http://www.unicef.org/publications/index_7936.html

WHO (2014). World Malaria Report 2014. Geneva, Switzerland: World Health Organization. pp. 32–42. ISBN 978-92-4-156483-0.

WHO (2002). Worldwide malaria distribution in 2002. Public Health Mapping Group, World Health Organization; Geneva: 2003

World Health Organization (2015). World Malaria Report 2015. ISBN 978-92-4-156515-8. December 2015.

Zhou, A.T, Oaks, S.C and Mictchel, V.S (2004) the parasite rate in the high altitude malaria; journal of tropical medicine and hygiene vol.51 pg160-165.