CONFLUENCE JOURNAL OF ENVIRONMENTAL STUDIES

Volume 1, Number 2, 2006

ISSN: 1597-5827

KNOWLEDGE FOR SELF RELIANCE

Published by:

THE DEPARTMENT OF GEOGRAPHY AND PLANNING

KOGI STATE UNIVERSITY, ANYIGBA

E-mail: geoksuanyigba @yahoo.com

CONFLUENCE JOURNAL OF ENVIRONMENTAL STUDIES

VOLUME 1, NUMBER 2, 2006

Contents **Page**

CLIMATE AND MALARIA: A GEOGRAPHER'S VIEW POINT

OLANREWAJU, R.M.
GEOGRAPHY DEPARTMENT
UNIVERSITY OF ILORIN

ABSTRACT

Malaria menace has become an economic burden in the tropical countries. No single measure of control through the use of drugs seems effective. This paper identified the most crucial climatic parameters that are responsible for the outbreak of malaria in the tropical city of Ilorin Kwara State. Reports of weather pattern and occurrences of malaria diseases were examined during the period 1991-2000. Climatic data (rainfall, relative humidity, maximum temperature, minimum temperature, evaporation and wind) were grouped into two dry season period (November - April) and rainy season period (May - October). Monthly means of climatic variables and outbreak of malaria were calculated for the study period (1991-2000). Simple regression analysis and correlation were employed to investigate the relationship. The result of the analyses showed seasonal variation in outbreak severity. Mean malaria occurrence was 96.5 during the dry season and 154.0 during the wet season. Based on the results of correlation analysis, rainfall displayed the strongest positive relationship of 0.737 while maximum temperature showed strongest negative relationship of – 0.789.

INTRODUCTION

Health, water and food are the major basic needs of man. However, resurgence of infectious diseases poses threats to both food security and economic development of man. Malaria is the most common serious infectious disease worldwide (Eugene et al., 1998). Although the problem is world wide, Africa is most endemic of all other continents. For instance study shows that between 1 million – 1.5 million malaria deaths recorded per year world wide, 80% of the cases were from Africa (Bradley, 1996). Malaria menace has become an economic burden in tropical Africa (BBC 2003). According to the report of the American Association for the Advancement of Science (AAAS) Washington, D.C 1991 on Malaria and Development in Africa, pregnant women and children under the age of five are at high risk of malaria morbidity and mortality.

In Nigeria, between 1973-1982 malaria consistently maintained the lion share between 55% and 64.7% among 14 top diseases, and malaria was ranked second killer diseases after measles (Iyun, 1987). Between 2000-2001 malaria still maintained its status as one of the killer diseases that is affecting millions of people in Nigeria. The effect is becoming more devastating as the World Health Organisation (WHO) (2000) forecast an increase of 16% growth in malaria cases annually. Hence malaria has been identified as one of the leading health threats for the 21st century as it kills in one year what AIDS killed in fifteen years.

The most worrisome aspect of it is that no single measure of control through the use of drugs seems effective. The chief means of controlling malaria infections are through the use of antibodies and insecticides. Reports show that some mosquitoes have become immune to the application of insecticides while some malaria parasites have also developed resistance to most anti-malaria drugs. This resistance to drugs and insecticides are wide-spread and there are no operational vaccines, nor any foreseen in the near future (Epstein, 1977). Based on the above report, Scott et al (2000) advised that health should be pursued not just focusing on the curative measures alone but as well as preventive measures which should include examination of vulnerability and risk factors as well as environmental factors. Thus, this present study aimed at discussing climate and incidence of malaria outbreak in Ilorin, Kwara state Nigeria for effective control of the malaria outbreak.

CLIMATE AND MALARIA

The relationship between climate and ill health characteristics cannot be over emphasized. Human malaria is caused by a protozoa of genus plasmodium. There are four species of them namely P. vivax, P. falciparum, P. malariae and P. ovale. Malaria is transmitted by female anopheles mosquito (Kakkilaya, 2000).

Tropical regions have ideal environments for the transmission of many deadly diseases. Based on this, Scott (2000) ascribed 90% of health problem caused by malaria to environmental conditions. To corroborate this, Epstein (1997) emphasized the role of temperature on the range development, timing and intensity of malaria outbreak. He described mosquito as hot weather insects that have fixed thresholds for survival. For instance, Anopheles mosquito and falciparium malaria transmission are sustained only where the winter temperature is kept above 16^0C (61^0F). A shift in the geographical limit of equal isotherms that accompany global warming may extend transmission range. In the same vein, Jonathan et al (1996) attributed the spread of malaria disease to an increased weather variability and global warming emanating from global climate change.

However, the findings of Hay et al (2002) refutes that of Epstein (1997) on the effect of altitude on the outbreak of malaria. Hay et al (2000) examined the role of climate change on the resurgence of malaria in the East African Highlands. He observed that P. falciparum transmission was limited by low temperature in areas of high altitude while the transmission of P. falciparum depends on a combination of temperature and rainfall conditions. In his own study, Epstein (1997) discovered that malaria outbreak occurred in higher-elevations of Central Africa and could threaten cities such as Nairobi, Kenya (at about 5000ft or the altitude of Denver, Colorado) as freezing levels have shifted higher in the mountains.

The influence of daily temperature fluctuation on mortality rate through malaria infection was emphasised by Kalkstein and Davis (1989). They discovered a more regular influence on mortality during a day when temperature hovers near 35^0C than when temperature approaches 40^0C but rapidly falls to more tolerable levels.

The affliction of malaria on its victims can be grouped into direct and indirect effects. The physical and psychological pains of malaria which result in either morbidity or mortality represent the direct burden. This in turn leads to economic burden due to loss of economic output resulted from the ill health. Jimoh (2005) studied the effect of malaria illness on agricultural output in Nigeria. For every one reported case of malaria per 100,000 persons, the loss in real agricultural output is about N3.953m for the long-run estimates while the loss stood at about N2.078m for the short run.

THE STUDY AREA

Ilorin the capital of Kwara State lies within latitude 08^0 30'N and longitude 04^0 35' East (Fig. 1). Ilorin has the tropical wet-and-dry climate which supports tall grasses and vegetation that interspersed with short trees. Rain is not established until the month of May with a mean of 1318mm per annum. Temperature is high throughout the year. Such climatic conditions enhance rapid development of malaria parasite. Farming and weaving constitute the major economic activities of the people.

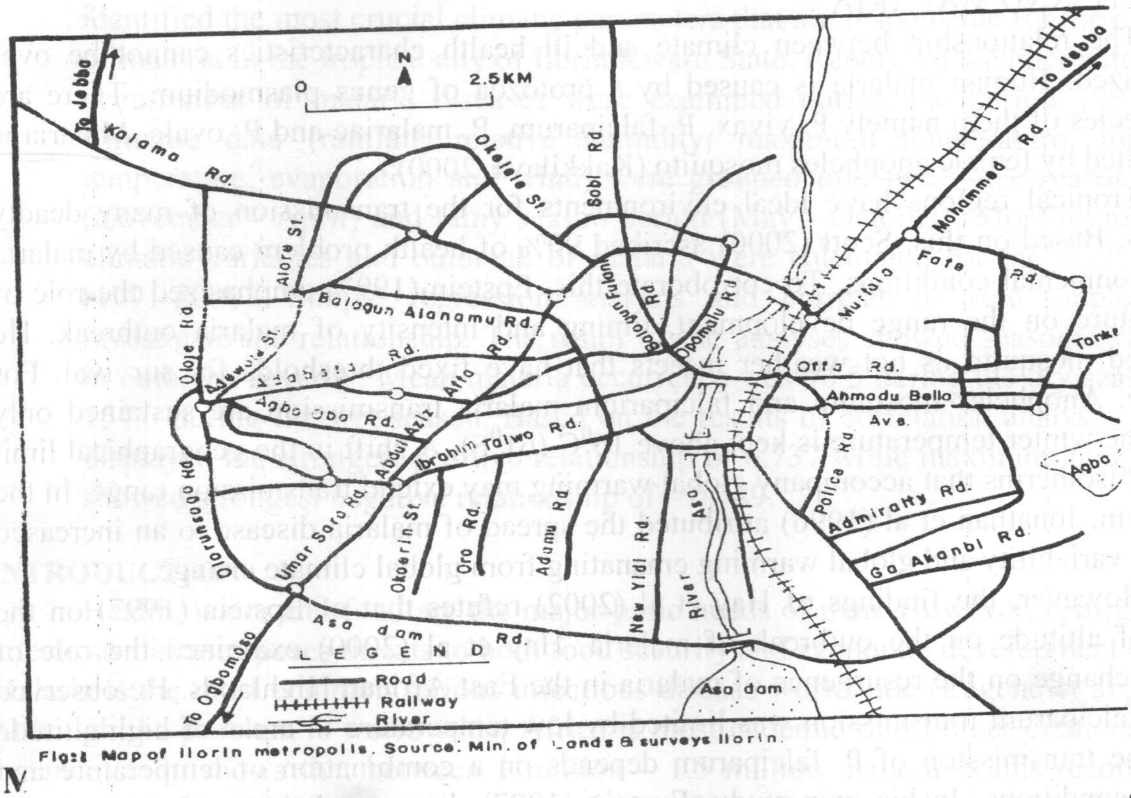


Fig.1 Map of Ilorin metropolis. Source: Min. of Lands & surveys Ilorin.

N

The secondary data used were climatic data and cases of malaria disease reported. The climatic parameters used were rainfall, temperatures (maxi and mini), relative humidity, evaporation and wind. They were collected from Nigerian Meteorological Society (NMS) Ilorin Air Port for the period of ten years (1991-2000). The incidences of malaria disease were collected from University of Ilorin Teaching Hospital (UITH) for the same period.

DATA PROCESSING

Climatic data and incidences of malaria reported were computed on monthly basis. This will help examine the general pattern of outbreak of malaria with climatic pattern. Both climatic and incidences of malaria disease were further grouped into two seasons of wet and dry to enable us isolate the season of the year in which man is more prone to malaria attack in Ilorin, Kwara State. Correlation and simple regression analysis were used to know those climatic parameters critical for the outbreak of malaria.

RESULTS AND DISCUSSION

Table 1 and figure II show weather pattern and cases of malaria disease during the period 1991-2000. All the climatic variables considered are important to the outbreak of malaria disease in the tropical city of Ilorin. For instance it appear high rainfall and high relative humidity encourage the outbreak of malaria disease as outbreak seems to increase with rainfall amount. The only months that deviate from this general pattern are the months of April and July. During the month of April, an increased rainfall did not result in corresponding increased in outbreak of malaria disease. Also in July when a decline in rainfall is observed, outbreak of malaria is high. Although a drop in rainfall amount is observed during the month of July, relative humidity is on the increase. Again, for the month of April there is a sharp decline in evaporation to 5.9mm/hr from 8.5mm/hr observed in March. These findings plus some other environmental factors might not be unconnected with the deviations observed during these months.

Similarly, temporal variations exist in the relationship between malaria outbreak and temperature. During the months of February-March when temperature hovered between 34.0^{0}C and 35.7^{0}C the outbreak of malaria diseases was mild. However, between the months of June-November when temperature range was put at 25^{0}C – 31.1^{0}C the outbreak of malaria was severe.

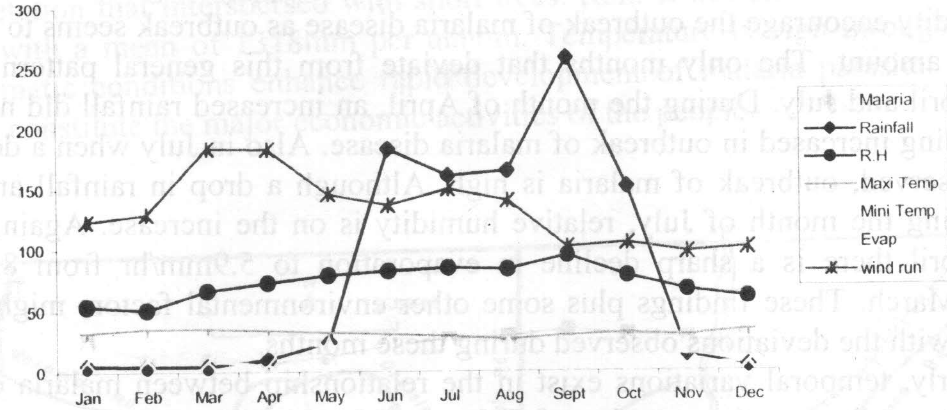
Evaporation was high with mild outbreak of malaria except for the month of January when high evaporation (8.7) coincides with high incidence of malaria disease (24.3). The months of May – November with low evaporation which ranged between 2.4mm/hr-5.3mm/hr experienced severity in the outbreak of malaria disease.

Table I: Average Climatic Pattern and Outbreak of Malaria in Ilorin Kwara State During 1991-2000

Month	*Malaria	Rainfall (mm)	Relative Humidity (%)	Maxi temp (^{0}C)	Mini temp(^{0}C)	Evap. Mm/hr	Wind run (km)
Jan.	24.3	5.3	54.0	32.6	20.0	8.7	123.0
Feb.	10.6	4.6	51.1	35.7	21.8	9.8	129.2
Mar.	9.2	4.3	66.4	35.4	23.4	8.5	183.8
Apr.	7.2	9.8	72.6	34.0	23.2	5.9	183.3
May.	12.0	23.9	78.5	32.2	22.2	4.0	145.4
Jun.	21.9	183.2	82.0	30.5	22.0	3.2	136.3
Jul.	26.6	160.9	84.3	29.1	21.3	2.9	149.6
Aug.	28.9	164.5	83.0	25.8	20.8	2.6	139.7
Sept.	34.6	257.9	94.1	29.4	20.9	2.4	100.9
Oct.	30.0	151.1	77.5	31.1	21.3	2.5	104.2
Nov.	27.0	12.8	66.2	29.8	20.0	5.3	96.8
Dec.	18.2	4.2	60.2	33.8	20.1	7.2	100.5

Sources: (1)*UITH Ilorin (2) Author's Computation 2004

FIG II: AVERAGE CLIMATIC PATTERN AND OUTBREAK OF MALARIA IN ILORIN KWARA STATE DURING 1991-2000



Source: Author's Computation, 2004

Based on table 1 and figure I, wind run and malaria exhibit no regular pattern of relationship. The results of our findings show that high temperature coupled with low rainfall and low relative humidity with high evaporation discourage outbreak of malaria diseases. However, high infection of malaria diseases requires low temperature, high rainfall, high relative humidity but low evaporation.

SEASONAL PATTERN OF MALARIA OCCURRENCE

Table II and III reflect the seasonal patterns in the outbreak of malaria.

Table II: Climatic Pattern of Malaria Occurrence During the Dry Season

Month	*Malaria	Rainfall (mm)	R.H. (%)	Maxi temp (^{0}C)	Mini temp(^{0}C)	Evap. Mm/hr	Wind run (km)
Nov.	27.0	12.8	66.2	29.8	20.0	5.3	96.8
Dec.	18.2	4.2	60.2	33.8	20.1	7.2	100.5
Jan.	24.3	5.3	54.0	32.6	20.0	8.7	123.0
Feb.	10.6	4.6	51.1	35.7	21.8	9.8	129.2
Mar.	9.2	4.3	66.4	35.4	23.4	8.5	129.2
Apr.	7.2	9.8	72.6	34.0	23.2	5.9	183.3
Total	96.5						

Sources: (1)*UITH Ilorin

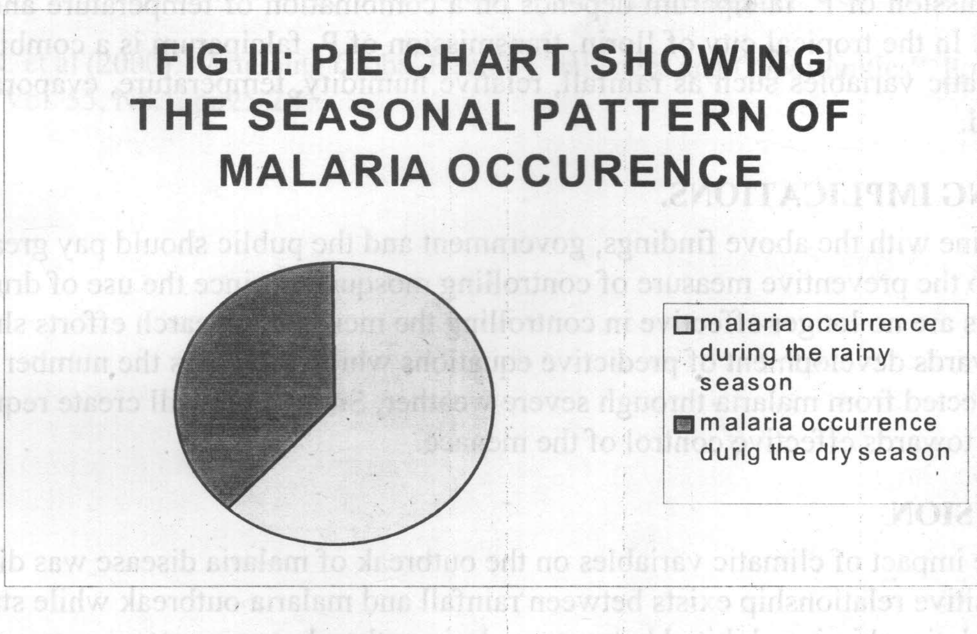
(2) Author's Computation 2004

Table III: Climatic pattern of Malaria Occurrence during the Rainy Season

Month	*Malaria	Rainfall (mm)	R.H. (%)	Maxi temp (^{0}C)	Mini temp(^{0}C)	Evap. Mm/hr	Wind run (km)
May.	12.0	23.9	78.5	32.2	22.2	4.0	145.4
Jun.	21.9	183.2	82.0	30.5	22.0	3.2	136.3
Jul.	26.6	160.9	84.3	29.1	21.3	2.9	149.6
Aug.	28.9	164.5	83.0	25.8	20.8	2.6	139.7
Sept.	34.6	257.9	94.1	29.4	20.9	2.4	100.9
Oct.	30.0	151.1	77.5	31.1	21.3	2.5	104.2
Total	154.0						

Sources: (1)*UITH Ilorin
(2) Author's Computation 2004

Dry season with low rainfall amount and high temperature has lower report of malaria cases of 96.5 while rainy season has a higher incidence of 154 (Fig. III).



Source: Author's Field Survey, 2004

However, to further confirm the above findings and to find out whether there are other climatic factors beside rainfall crucial to malaria outbreak in Ilorin a correlation analysis was conducted and the result presented in table IV.

Table IV: Correlation Coefficient Between Incidences of Malaria Diseases and some Climatic Variables.

Rainfall (mm)	R.H. (%)	Maxi Temp (^0C)	Mini Temp (^0C)	Evap mm/hr	Wind run (km)
0.737	0.504	- 0.789	- 0.641	- 0.641	- 0.680

Source: Authors Computation, 2004.

Rainfall displayed a strong positive relationship with outbreak of malaria diseases while relative humidity showed a mild positive relationship. The implication of this is that as rainfall and relative humidity increase, outbreak of malaria disease also increases. The explanation to this might be as a result of pools of stagnant water found around during rainy season which serve as breeding places for anopheles mosquitoes. Again rainy season supports rapid growth of vegetation (grasses in particular) where mosquitoes breed. Every other climatic factors considered (temperature, evaporation and wind speed) exhibit a strong negative relationship with outbreak of malaria disease in Ilorin Kwara state. As these climatic variables increased the outbreak of malaria decreased.

The result of the findings has slightly modified the conclusion of Epstein (1997) that transmission of P. falciparum depends on a combination of temperature and rainfall conditions. In the tropical city of Ilorin, transmission of P. falciparum is a combination of many climatic variables such as rainfall, relative humidity, temperature, evaporation and wind speed.

PLANNING IMPLICATIONS.

In line with the above findings, government and the public should pay greater attention to the preventive measure of controlling mosquitoes since the use of drugs and insecticides are no longer effective in controlling the menace. Research efforts should be geared towards development of predictive equations which estimates the number of deaths expected from malaria through severe weather. Such move will create required awareness towards effective control of the menace.

CONCLUSION

The impact of climatic variables on the outbreak of malaria disease was discussed. Strong positive relationship exists between rainfall and malaria outbreak while strong negative relationship is exhibited between malaria outbreak, temperature, evaporation and wind speed. Man is more vulnerable to malaria attack during the rainy season than during the dry season. Hence, greater efforts should be geared towards controlling the malaria attack during the rainy season.

REFERENCES

American Association for the Advancement of Science (AAAS), Washington, DC. 1991.

BBC-360 Environmental control of mosquitoes to abate malaria pp. 1-5 Wed 13/8/03.

Eugene W. et al. (1998): Microbiology: A Human Perspective WCB/Mc Graw Hill pp. 688-692.

Hay I.S., Cox J., Rogers, D.J., Randolphs S., Stern, D.I., Shanks, G.D., Myers, M.F and Snow, R.W. (2002): "Climate Change and the Resurgence of Malaria in the East Africa Highland" Nature vol. 415, pp21.

Iyun B.F., (1987): "Ecology and Disease in Nigeria" Geographia medica, Vol. 17, pp85-128.

Jimoh, A. (2005): "The Malaria Burden and Agricultural Output in Nigeria": A seminar paper presented at the Faculty of Business and Socio Sciences, University of Ilorin.

Jonathan A.P. et al (1996): "Global Climate Change: Health Effect" Journal of American Medical Association 275, pp 217-223.

Kakkilaya B.S. (2000): "What is Malaria?" Dr. B.S. Kakkilaya's Malaria Web site.

Laurence S.K. and Robert E.D (1989): "Weather and Human Mortality: An Evaluation of Demographic and interregional Responses in the United States. Center for Climatic Research, No. 44, pp 44-63.

Paul R.E (1997): "Climate, Ecology and Human Health" Consequence: Vol. 3, No. 2.

Scott C.R. et al (2000): "Attaining Global Health: Challenges and Opportunities" Population Bulletin. Vol. 55, No.1, pp25-28.