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Full Length Research Paper

A study of the socio-economic factors contributing to malaria risk in Koton Karfe watershed catchment, Nigeria

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This study adopts ground survey and questionnaire administration to determine environmental and socio-economic factors contributing to malaria risk in Koton Karfe watershed catchment. A health facilty-based survey is carried out to assess tbe ratio of population to health facility. The study reveals that poverty is the overriding risk factor determining the high malaria incidence rate which ranges from 40/1000 per annum to 288/1000 per annum across watershed catchment and prevelant among infants and school age children. The nearest neighbour index of 1.48 suggests the randomness in the spatial distribution of health facilities. The increase in the burden of malaria on the populace may deter the attainment of the millennium development goals (MDGs) if urgent measures to control it by the govern-ment and private/donor agencies are not initiated.

Key word: Malaria, incidence rates, burden, watershed ecology, catchment.

INTRODUCTION

Recent publication about watershed catchment areas degradation as a result of anthropogenic activities is reported to be the primary drivers of a range of infectious disease outbreaks and also modifiers of the transmission of endemic infections affecting human health (Patz et al., 2000; Olanrewaju, 2006). These activities include defor-estation for fuel, agricultural encroachment, irrigation, wetland modification and the concentration and expan-sion of settlements. It has been suggested that vector-borne diseases may be one of the major health impact factors that will be affected (Patz and Balbus, 1996; McMichael and Beaglehole, 2000; Haines and Patz, 2004). Among these diseases, Martens et al. (1999) sing-led out malaria as a particularly vulnerable target, as both vectors (mosquitoes of the genus *Anopheles*) and para-sites (*Plasmodium* sp.) affect thousands of people living along wetland areas (coastal and riverine areas) and tropical forest areas.

It was often assumed that the disappearance of rain-forest and use of dichlorodiphenyltrichloroethane (DDT) as a control measure would be accompanied at least by beneficial effects on vector-borne diseases, as the habitat of the vectors would be destroyed, and with this the transmission of infectious malaria disease would be re-duced or even eliminated. However, recent studies have shown that this scenario is untrue. With climate and land-use changes resulting from huge influx of immigrants coupled with changes in socio-economic status of the population and the adaptation of vector to man-made environment, incidence of malaria has increased (Cam-argo et al., 1994; Cardille and Foley, 2003; Souza et al., 2003; Adepoju, 2003; Magnus and Bodmas, 2007). In-deed, this situation has become a classic example of malaria risk and environmental change. In the urban areas malaria is spreading largely as a result of the growth of slums and shantytowns that provide numerous pools of standing water where mosquitoes can breed. Of recent civil conflicts and natural disasters such as floods are other contributors to the malaria spread especially in Africa.

Malaria still constitutes a serious public health problem in Nigeria (Jimoh, 2005; FMOH, 2005; Olanrewaju, 2006; Mawah, 2007). Iyun (1987) posited that in Nigeria, bet-ween 1973 - 1982 malaria consistently maintained the lion share between 55 and 64.7% among 14 top diseases, and malaria was ranked second killer after measles.

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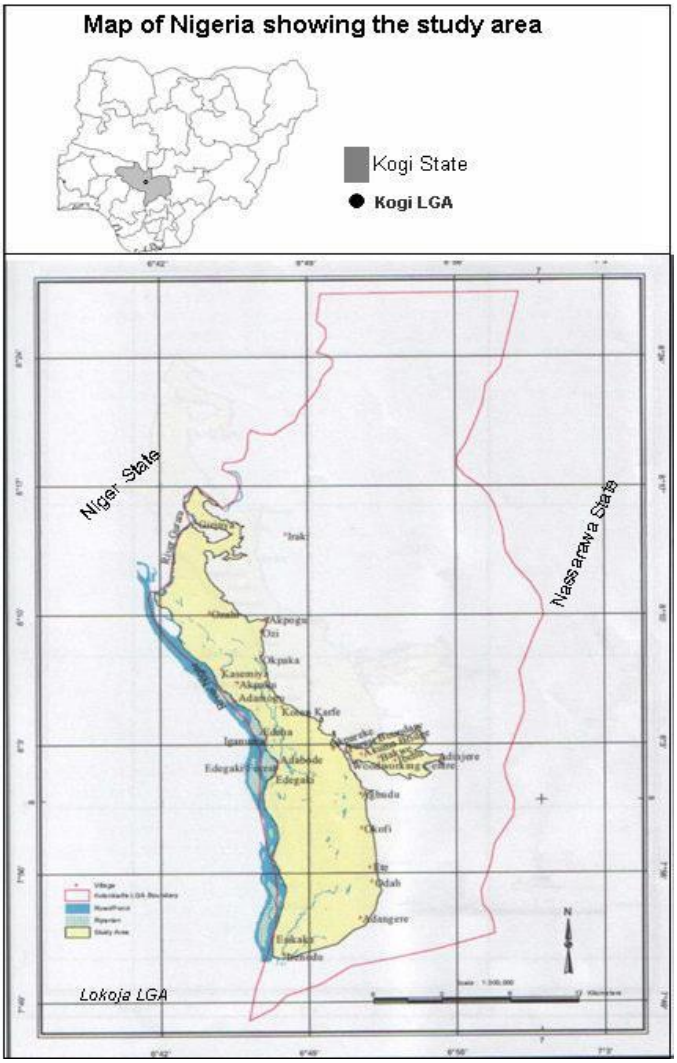

Figure 1. Koton Karfe watershed catchment.
Source: Geodata and Envial Ltd, 2007.

Olanrewaju (2006) declared that between 2000 and 2001, malaria still maintained its status as one of the killer diseases that is affecting millions of people in Nigeria. The 16% growth in malaria cases annually (World Health Organization, 2000) made effect of malaria to be more devastating.

Malaria in Nigeria is currently confined to all parts of the country but with varying incidence and prevalence rate across the nation. Areas such as coastal, riverine, forested and urban areas are endemic areas. The contributing factors include: abject poverty; large-scale deforestation (about 400,000 ha of vegetation cover is lost annually to mineral exploitation, infrastructure development; fuelwood extraction and expansion of settlement); increase in urban agriculture and irrigation farming; increase in urban and watershed flooding due to interferance with water ways; presence of surface water bodies and open water storage facilities; indiscriminate dumping of refuse and the spatial pattern of health care facilities and infrastucture (Adesina et al., 1999; Adesina, 2005; Laah and Zubairu, 2008).

The risk of malaria infection varies widely according to geographic region, season, environment and socio-economic status of individuals. The burden of malaria in Koton Karfe watershed catchment, like any other part of sub-saharan Africa has been a major public concern. The effective control of this major killer of children and adults requires the understanding of the various variables that determine its risk.

This study assessed the current situation of malaria risk in the Koton Karfe watershed catchment and the effects of the environment on malaria with emphasis on the watershed as source for the elucidation of factors that now and in the future might determine malaria risk in this area. Potential mitigating factors to reverse the emergence of risk factors are discussed.

The study area

Koton Karfe watershed catchment is located in Kogi Local Government of Kogi State in North Central Nigeria. It lies between Latitude 7^{O} 51'N and 8^{O} 17'N and between Longitude 6^{O} 42'E and 6^{O} 57'E (Figure 1). The watershed area falls within the crystalline basement complex rock and is also associated with some sedimentary lowland alluviums that are underlain by some tertiary sediment of the plain sands and cretaceous sandstones.

The area lies in close proximity to the western littoral hydrological landscape of the country and within the Niger central hydrological area. The major rivers within the area are tributaries to River Niger. The elevation is within the range of 36.27 to 211.53 m above sea level. The major soil types are Alluvial deposits, ferrisols and ferruginous soils.

Koton Karfe has a population of 37,826 people made up of 49% males and 51% females. Agriculture is the mainstay of the people employing over 75% of the people. Most people combine farming and fishing and are thus farmers and fishermen

MATERIALS AND METHODS

To estimate the incidence rate of malaria a health facility-based fever survey was carried out. The facility-based fever surveys focused on the age and gender specific fraction of malaria attri-butable fevers. This methodology is aimed at identifying the poten-tial risk factors. One primary healthcare centre in each settlement was cho-sen for indepth study. Also as part of the study a total of 180 questionnaires were administered to 18 settlements in the Koton Karfe Catchment identified within 1.5 km radius of the flight of mosquitoes from the various breeding cites. A total of 163 ques-tionnaire were valid for analysis given a success rate of 90.1%. The data were analysed and presented in form of charts and simple Tables.

RESULTS AND DISCUSSION

Malaria risk profiles

The two broad domain of risk profiles condition identified

Table 1. Percentage distribution of respondents by risk profile

Risk Profiles			Responses	
			Yes (%)	No (%)
Environmental factors	a. Housing characteristics	Quality of roof (corrugated sheets)	129 (79.1)	34 (20.9)
		Quality of walls (cemented bricks)	41 (25.2)	122 (74.8)
		House Ceiling (Covered)	39 (23.9)	124 (76.1)
		Screens (Nettings)	23 (14.1)	140 (85.9)
	b. Proximity to forest fringe		163 (100.0)	0 (0.0)
	c. Proximity to water bodies		163 (100.0)	0 (0.0)
	d. Crop area (irrigated and wet season)		163 (100.0)	0 (0.0)

		Degree of Responses		
		High (%)	Moderate (%)	Low (%)
Socio-economic factors	a. Literacy level of household head	8	27	65
	b. Hosehold Size	56	34	10
	c. Number of rooms per household	13	34	53

are environmental and socio-economic as shown in Table 1. The environmental risk profiles reflect the exposure of the population to mosquito bite. The housing characteristics such as the quality of roofing (79.1%), quality of the walls (25.2%), effectiveness of the housing ceiling (23.9%) and screens (14.1%) indicate that the majority of the population is exposed to mosquito bite as their respective houses are not protected from mosquito incursion and subsequent breeding. This vulnerability to mosquito bite is enhanced as houses (100%) are within the fringes of forest, water bodies, and farming areas, as well as within the flight distance of the mosquitoes from their respective breeding habitats .

The socio-economic conditions shows the risk of acquiring malaria and the capacity of households to protect themselves from mosquito bite. The literacy level of the settlers was low with 65% of the population having only primary/koranic education. This low level puts the population at a high risk of acquiring malaria as the awareness of preventive measures could be low. The household size is not directly related to the number of rooms per household. The distribution shows that 56% of the population has an average household size of 7, with 53% having access to 2 rooms accommodation. This implies that the household size in Koton Karfe catchment area is more than the national avearge of 5 persons per household (National Population Commission, 2004). This invariably means that people in ioton Karfe catchment area are living in crowded accommodation, puting them at risk of mosquito bite and acquiring malaria.

Malaria incidence rates

Table 2 shows the incidence rates of malaria in the population of the watershed catchment area. Three thousand four hundred and fourteen (3,414) malaria cases were reported as both in-patient and out-patient in the various health facilities within the study area in the study year. The incidence rate of malaria was 90/1000 per annum; with 8 settlements having higher than 90/1000 per annum. These settlements are Adangere (287/1000 per annum), Ozahi (239/1000 per annum), Adingere (192/1000 per annum), Ozi (165/1000 per annum), Akpaku (142/1000 per annum), Edeha (136/1000 per annum), Iraki (125/1000 per annum) and Odah (106/1000 per annum).

Figure 2 shows that the incidence rates vary throughout the year, with a maximum in the month of October (141/1000 per annum). The high incidence rate during the month of October could be attributed to the climax of rainfall regime, crops growth and thick vegetation cover during this period (Ifatimehin, 2008; Patz et al, 2004). It is worth noting that the mosquito breeds well at temperatures approximately 70 to 90 degrees Fahrenheit and a relative humidity of about 60%. These conditions are characteristic of the month of October in the tropical areas of Africa (Carrington, 2001). The seasonal pattern indicates the gradual rise in the incidence rate from the month of May to October and declines rapidly to a rate as low as 50/1000 per annum in the month of December. This trend is corroborated by Laah and Zubairu (2008) and Olarenwaju (2006).

The raining months recorded about 76% of the reported malaria cases. These rates are greater than the global malaria incidence rates of 23.6/1000 per annum for a settlement (Caldas de castro et al., 2006). This is an indication that the Koton Karfe watershed catchment is wi-thin the malaria high risk area of Nigeria. The results also confirm that malaria transmisssion in the watershed is

Table 2. Incidence rate of malaria in Koton Karfe watershed.

S/N	Settlement	Male Popn	Female Popn	Total	Cases of Malaria													
					J	F	M	A	M	J	J	A	S	O	N	D	Total	Incidence Rate
1	Adangere	300	448	748	12	9	8	11	15	12	14	29	45	28	17	15	215	287.433155
2	Adingere	334	420	754	8	4	6	9	11	9	16	16	14	31	11	10	145	192.307692
3	Akpaku	666	642	1308	14	11	12	9	8	17	18	12	21	41	10	13	186	142.201835
4	Akpogu	1372	1668	3040	9	9	21	6	37	23	12	11	23	29	26	19	225	74.0131579
5	Edgaki	258	254	512	0	0	0	2	5	1	2	11	3	2	6	3	35	68.359375
6	Edeha	538	548	1086	0	0	6	10	11	17	18	9	21	17	31	8	148	136.279926
7	Ette	328	362	690	0	7	1	3	2	0	2	2	4	6	1	0	28	40.5797101
8	Girinya	2336	2344	4680	14	13	10	23	21	31	15	34	31	19	17	9	237	50.6410256
9	Iganuma	336	332	668	0	3	5	1	2	0	6	8	9	2	4	1	41	61.3772455
10	Iraki	354	462	816	7	5	4	3	12	17	10	8	19	7	5	5	102	125
11	Irenodu	646	526	1172	5	6	2	4	11	8	7	12	10	5	6	7	83	70.8191126
12	Kasemiya	376	400	776	0	2	1	4	7	8	9	6	5	9	3	1	55	70.8762887
13	Koton karfe	7276	7462	14738	67	54	23	21	65	73	97	119	132	231	309	57	1248	84.6790609
14	Odah	430	478	908	12	10	2	3	6	9	0	21	13	11	4	5	96	105.726872
15	Okofi	446	512	958	5	4	11	21	9	3	6	10	12	2	1	0	84	87.6826722
16	Okpareke	1812	1570	3382	15	21	9	6	3	27	21	18	16	13	9	10	168	49.6747487
17	Ozahi	378	372	750	4	3	9	10	54	3	1	51	32	12	0	0	179	238.666667
18	Ozi	366	474	840	8	11	7	5	6	21	17	11	23	16	8	6	139	165.47619
	Total	**18552**	**19274**	**37826**	**180**	**172**	**137**	**151**	**285**	**279**	**271**	**388**	**433**	**481**	**468**	**169**	**3414**	***90.2***
	Monthly Incidence Rate (cases/1000 per yr)				**52.7**	**50.4**	**40.1**	**42.2**	**83.5**	**81.7**	**79.4**	**113.6**	**126.8**	**140.9**	**137.1**	**49.5**		

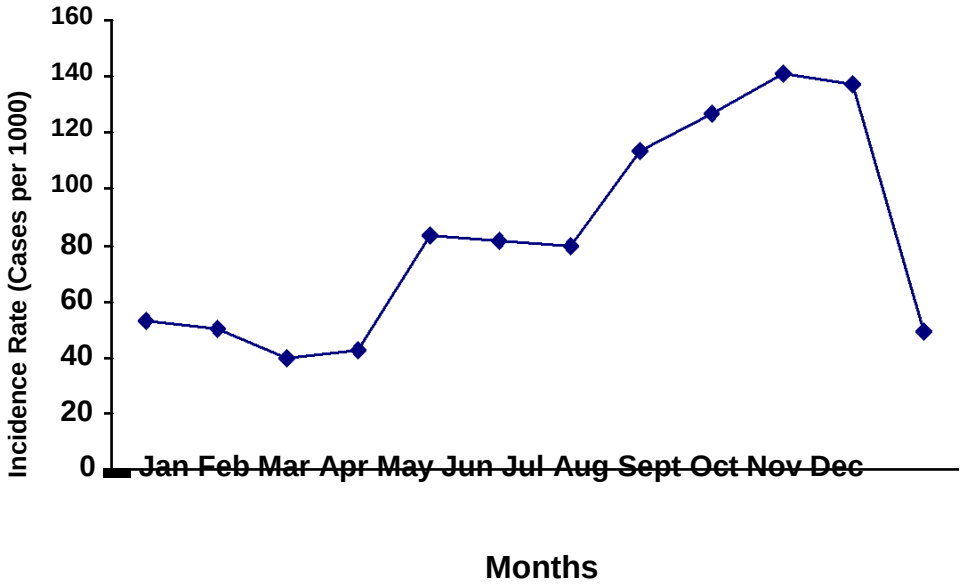

Figure 2. Monthly malaria incidence rate.

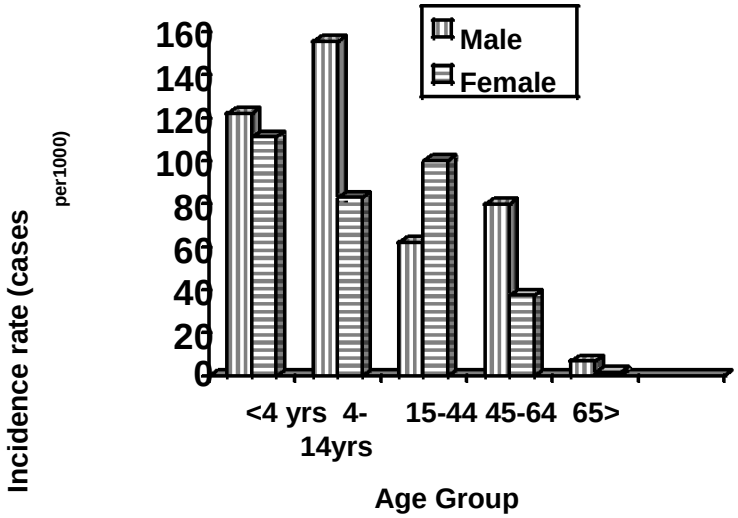

Figure 3. Malaria incidence rate by gender.

characteristerized by substantial inter-monthly variation. Incidence rates show a rising, albeit fluctuating trend with reported cases remaining relatively high (Figure 2).

The malaria incidence rate was higher among population below the age 14 years (117/1000 per annum) than other age group (64/1000 per annum). This implies that school age children are the most vulnerable group to malaria infections in the watershed area and confirms what is already known on the age pattern of malaria transmission in Nigeria (NPC, 2004) . The incidence rate was higher among the males in the various age groups than the females, but with an exception in the age group 15 – 44 years (Figure 3), as their reproductive health makes them more vulnerable to illnesses like malaria and anemia among others (Falade et al., 2008; Onwujekwe et al., 2004; Nosten et al., Dicko et al., 2002; Campbell et al., 1980). The high incidence rate of malaria may also be due to high poverty (National Bureau of Statistics, 2007) and low use of insecticide treated nets (ITNs) (NPC, 2004).

Distribution of health facilities

Table 3 shows the coverage of public health systems in the Koton Karfe watershed catchment area. The entire watershed has a ratio of one health facility to a population of about 1351 people. The ratio of health facility to population however, varies among the various settlements in

Table 3. Distribution of health facilties by settlements.

S/N	Settlement	No of Health Facilities				Population Per Health Facility	Nearest Neighbour Distance (Km)
		General Hospital	Primary Health care center (PHC)	Private clinic	Total		
1	Adangere		1		1	748	1.78
2	Adingere		1		1	754	1.21
3	Akpaku		1		1	1308	0.87
4	Akpogu		2		2	1520	2.54
5	Edgaki		1		1	512	2.41
6	Edeha		1		1	1086	2.78
7	Ette		1		1	690	1.76
8	Girinya		2	1	3	1560	2.21
9	Iganuma		1		1	668	0.67
10	Iraki		1		1	816	0.94
11	Irenodu		1		1	1172	1.07
12	Kasemiya		1		1	776	0.56
13	Koton karfe		3	3	7	2105	2.24
14	Odah		1		1	908	2.1
15	Okofi		1		1	958	0.78
16	Okpareke		2		2	1691	2.96
17	Ozahi		1		1	750	1.54
18	Ozi		1		1	840	1.94
	Total		**23**	**4**	**28**	**1351**	**30.36**
						Rn Index	**1.48**

the study area. Akpogu (1520), Girinya (1560), Koton Karfe (2105) and Okpareke (1691) have ratios greater than the area's average. This high ratio is indicative of the scarcity of health facilities in the area. The scarcity of health facilities has contributed to the prevalence of malaria infection among the population of Koton Karfe watershed catchment area.

The distribution of health facilties in the Koton Karfe watershed catchment, although tending towards a regular distribution, is essentially random as the calculated nearest neighbour index (Rn) is 1.48. This randomness of the health facilities suggests that residents of Koton Karfe do not have easy access to them, which could invariably contribute to the burden of malaria. There are only 28 health facilities in Koton Karfe watershed catchment area this implies an average of 1.5 health facility per settlement.

Conclusion

The identified risk profiles such as environmental fac-tors, socio-economic factors and health infrastructure are the contributing factors of malaria burden on the population in Koton Karfe watershed catchment. The proximity of unprotected houses to the forest fringes, water bodies and irrigation fields play major a role in determining malaria risk. However, poverty is responsible for the high malaria incidence rate of 90/1000 per annum in the watershed catchment with children (0 - 14 years) most vulnerable to malaria. The contribution of inadequate distribution of health facilties in the watershed catchment is also enormous. As its spatial distribution limits accessibility by populace thereby augmenting disease burden of the population.

The implications of above findings will surely affect government efforts towards achieving the Millenium Development Goals (MDGs) as consistent disease bur -den on the population contributes to persistent hunger and poverty, maternal and child mortality as well as decrease in child literacy level. Therefore, government and the private/donor agencies should pay greater attention to the preventive measure of controlling mosquitoes in this water-shed cacthment area as livelihood is directly sourced from the environment which is the highest contributing factor to malaria.

Remediation efforts such as environmental education, use of insecticide treated nets (ITN), provision of equipped health facilities and drugs should be provided by government and international donour agencies to-wards controlling malaria incidences in the watershed catchment.

REFERENCES

Adepoju GKA (2003). The spatial Pattern of Health Facilities in the Nigerian Environment. InJimoh, H.I. (ed), Techniques in Environmental Studies, Nathadex Publishers, Ilorin, pp. 191-198.

Adesina FA (2005). Geoinformation and Natural Resources exploitation in Africa; United Nations Economic and Social Council Paper delivered in Fourth meeting of the committee on Development Information, Addis Ababa on 23 – 28 April.

Adesina FA, Siyanbola WO, Oketola FO, Palermo DA, Ojo LO, Adegbulugbe AO (1999). Potentials of agroforestry for climate change mitigation in Nigeria, some preliminary estimates; Global Ecology and Biogeography Letters. l8: 163 – 173.

Camargo LM, Ferreira MU, Krieger H (1994). Unstable Hypoendemic Malaria in Rondonia (Western Amazon region): Epidemic Outbreaks and Work -associated Incidence in an Agro-industrial Rural Settlement. Am. J. Trop. Med. Hyg. 51(1): 16-25.

Campbell CC, Martinez JM, Collins WE (1980). Seroepidemiology Studies of Malaria in Pregnant Women and New Borns from Coastal El Salvador. Am. J. Trop. Med. Hyg. 29(2): 151-157

Cardille JA, Foley JA (2003). Agricultural Land use Change in Brazilian Amazonia between 1980 and 1995: Evidence from Integrated Satellite and Census data. Remote Sensing of Environment, 87(4): 551-562.

Falade CO, Olayemi O, Dada-Adegbola HO, Aimaku OG, Salako LA. (2008). Prevalence of Malaria at Booking Among Antenatal Clents in a Secondary health care Facility in Ibadan, Nigeria. Afr. J. Reprod. Health. 12(2): 141-152

Carrignton A (2001). Malaria: Its Impact, Challenges, and Control Strategies in Nigeria. Harvard health Policy Review, 2(2).

Dicko A, Mante C, Thera MA, Doumbia S, Diallo M, Diakite, Sagara I, Doumbo OK (2003). Risk Factors for Malaria Infection and Anemia for Pregnant Women in the sahel Area of Bandiagara, Mali. Acta. Trop. 89:17-23.

Federal Ministry of Health (2005). National Malaria Control Programme in Nigeria. Annual Report. Abuja.

Haines A, Patz JA (2004). Health Effects of Climate Change, Jama: J. Am. Med. Assoc. 291(1): 731-750.

Ifatimehin OO (2008). Integrating Science and Local Knowledge in Identifying Factors Associated with Malaria Risk in Koton Karfe, Nigeria. In Akoh, A. D., Taiga, A. And Akpata, D. F. (Eds) Indigenous Science for Development and Social Mobilization, Foladave Nig. Ltd. Akure, Nigeria, pp. 165-175.

Iyun BF (1987). Ecology and Disease in Nigeria. Geogr. Med. 17: 85-128.

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

Laah JG, Zubairu M (2008). An Examination of the Trend and Seasonal Variation in the Incidence of Malaria in Gwagwalada, Nigeria. in Bisong, F. E. (Ed), Geography and the Millenium Development Goals: Translating Vision into Reality in Nigeria. Index Books Publishers, Calabar, pp. 537-541.

Magnus OO, Bodmas AA (2007). Public Healthcare Facilities and Problems of Medical Equipment: A Spatial Study of General Hospitals in Edo North, Edo State. Confluence. J Environ. Stud. 2(1): 53-62.

Mawah IK (2006). Spatial Analysis of Malaria infection in Idah, Kogi State. Unpublished B.Sc. Project. Department of Geography and Planning, Kogi State University, Anyigba.

Martens P, Kovats RS, Nijhof S (1999). Climate change and Future Populations at Risk of Malaria. Global Environment Change, Part A.

McMicheal AJ, Beaglehole R (2000). The Changing Global Context of Public Health, Lancet 356(9228): 495-499.

National Bureau of Statistics (2007). Core Welfare Indicator Questionnaire Survey, Nigeria, 2006. Abuja.

National Population Commission (2004). Nigeria Demography and Health Survey, 2003. Abuja.

Nosten F, Rogerson SJ, beeson JG, McGready R, Mutabingwe TK, Brabin B (2004). Malaria in Pregnancy and the Endemicity Spectrum: What Can We Learn? Trends. Parasitol. 30(9): 425-432.

Olanrewaju RM (2006). Climate and Malaria: A Geographer's View Point. Confluence. J. Environ. Stud. 1(2): 90-97.

Onwujekwe O, Henson K, Fox-Rushby J (2004). Inequalities in purchase of Mosquito nets and willingness to pay for Insecticides Treated Nets in Nigeria: Challenges for Malaria Control Intervention. Malar. J. 3(6): 1-8

Patz JA, Balbus JM (1996). Methods for Assessing Public Health Vulnerability to Global Climate Change. Clim. Res. 6(2):113-125.

Patz J, Daszak P, Tabor GM, Aguire A, Pearl M, Epstein J, Wolfe ND, Kitpatrick AM, Foufopoulos J, Molyneux D, Bradley DJ (2004). Unhealthy Lanscapes: Policy Recommendation on Land Use Change and Infectious Disease Emergencies. Environ. Health. Perspect.122(10): 1092-1098.

Souza C, Firestone L, Silva LM (2003). Mapping Forest degrdation in the eastern Amazon from SPOT 4 through Spectral mixture models. Remote Sensing of Environment 87(4): 494-506.

World Health Organization (2000). The African Summit on Roll Back Malaria, Abuja Nigeria. www.rbm.who.int/docs/abuja_declaration.pdf.