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# Assessment of Malaria Prevalence Rate in Kogi State, Nigeria

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**ABSTRACT**

*Malaria remains a significant public health concern in sub-Saharan Africa, with Nigeria bearing the highest burden globally. This study assesses the spatial pattern of malaria prevalence and its associated socio-environmental determinants in Kogi West Senatorial District, Kogi state, Nigeria. A survey design involving 400 respondents from seven Local Government Areas was employed, with data analyzed using descriptive statistics and Geographic Information Systems (GIS). Findings indicate that 60% of the region, notably Lokoja and Kogi LGAs, is at high risk of malaria transmission. Major contributing factors include poor waste disposal, inadequate drainage, low household income, and suboptimal use of insecticide-treated nets. Vulnerability mapping via ArcGIS revealed four risk categories ranging from low to very high. Respondents suggested interventions such as improved sanitation, free distribution of ITNs, better drainage infrastructure, and enhanced access to healthcare. This study highlights the value of GIS in understanding disease patterns and guiding effective, location-specific public health strategies.*

***Keywords:*** *Malaria prevalence, Geographic Information Systems (GIS), Kogi State, spatial analysis, vector-borne disease, vulnerability mapping*

## Introduction

Malaria remains a serious vector-borne disease affecting a significant portion of the tropical world's population. It is a life-threatening disease caused by infection with Plasmodium parasites, primarily Plasmodium falciparum in sub-Saharan Africa (World Health Organization [WHO], 2023a). Nigeria continues to be one of the countries most vulnerable to malaria epidemics and its extensive health and socioeconomic consequences.

According to WHO (2023a), Nigeria accounted for 26.8% of global malaria cases and 31.3% of global malaria deaths in 2022, indicating the country's disproportionate burden. Malaria remains a leading health concern, with seasonal transmission peaking during the rainy season between July and November. Approximately 97% of the Nigerian population lives in areas with stable malaria transmission (Nigeria Malaria Elimination Programme [NMEP], 2023). The dominant species responsible for malaria in Nigeria remain Plasmodium falciparum and Plasmodium vivax, although P. falciparum causes over 90% of the cases. The environmental factors contributing to the spread include stagnant water bodies, poor drainage systems, and climate-related changes such as rising temperatures and increased humidity (WHO, 2023b).

Infrastructure development, while essential for economic growth and improved living standards, can sometimes lead to adverse health effects if not carefully managed. Large-scale dam projects and water impoundments have historically been linked to increased malaria transmission due to the creation of new mosquito breeding habitats (Keiser, Castro, Maltese, Bos, Tanner, Singer & Utzinger, 2020). Despite years of control efforts, including the use of insecticide-treated nets (ITNs), indoor residual spraying (IRS), and seasonal malaria chemoprevention (SMC), malaria morbidity and mortality remain high. WHO (2023a) highlights that economic losses due to malaria cost African countries an estimated US $12 billion annually in lost productivity and healthcare costs. Globally, children under five years old remain the most vulnerable group. In 2022, they accounted for about 80% of all malaria deaths in the WHO African Region (WHO, 2023a). This underlines the need for robust surveillance, prevention, and treatment strategies.

Geographic Information Systems (GIS) provide a valuable tool for malaria monitoring and control. GIS helps in mapping disease distribution, analyzing spatial patterns, and integrating various data types, including topography, climate, socioeconomics, and health statistics to support decision-making (Macharia, Giorgi, Noor & Snow, 2023). GIS platforms facilitate visualization of high-risk areas, optimize resource allocation, and assist public health officials in designing targeted interventions.

In Kogi State, Nigeria, malaria prevalence remains significant. However, the spatial distribution of cases is less understood. The deployment of geo-information technologies like GIS can reveal patterns and correlations between malaria incidence and environmental factors. This spatial understanding is crucial for targeted interventions, monitoring, and reducing disease burden.

***Statement of the Research problem/ Justification***

Malaria continues to be an economic burden and a great threat to global health delivery and eradication has been a serious challenge. This global frustration has been that Malaria vectors have become more resistant to insecticides and the parasites that cause the disease are becoming resistant to anti-malarial drugs and other preventive measures. This is making prevention and treatment increasingly more difficult and costly. This may also be associated with the fact that about 40% of the world's population lives in regions where malaria transmission is endemic, especially in the tropical and sub-tropical regions. Thus, malaria is the major cause of death in Nigeria. The number of children who die before their fifth birthday as a result of malaria disease is alarming. It also claims the lives of many pregnant women (Nigeria Malaria Indicator Survey, 2015). Malaria and mosquito control challenges operate at a wide spatial scale. Prevalence of malaria is also known at a limited number of specific sample locations. The pattern and variation of risk cannot be accounted for by only the known covariates.

Kogi state has over time experienced a growing rise in the scourge of vector-borne diseases. It is therefore necessary for a study such as this to be carried out in Kogi state to find out the predisposing factors to areas vulnerable to malaria in order to avoid the inherent problems of its prevalence as well as suggest intervention measures that emphasize species-specific and cost-effective approach rather than waste resource for its control.

***Objectives of the Study***

The aim is to analyse malaria prevalence rate and its implication on the health of the residents of Kogi state. The specific objectives of the study are:

i. Identify the factors influencing prevalence of malaria in Kogi state.
ii. Analyse the spatial pattern of malaria prevalence in Kogi state.
iii. Examine various measures to mitigate malaria prevalence in Kogi state.

***Research Questions***

i. What are the factors influencing malaria prevalence in Kogi state?
ii. Where are the areas vulnerable to malaria prevalence in Kogi state?
iii. How can malaria prevalence be mitigated in Kogi state?

## Methodology

The research methodology was guided by the needs for time efficient and cost-efficient instrument in achieving a reliable data.

**Research Design**

The research method that was adopted is quantitative research method, particularly the survey design. Survey research design is commonly used for collecting information about a population of interest that is a large in number. The survey design is considered appropriate in this study as it allows for the use of questionnaire as a data collection instrument and because of the low cost and easy accessibility of information from respondents. This design helped the researcher to obtain general result the sample

**Population of the Study**

A population is the entire class or group to be investigated (Tayie, 2005). The study area for this research is Local Government Areas in Kogi West, which includes Kabba/Bunu, Kogi, Mopa-muro, Ijumu, Yagba East, Yagba West and Lokoja. However, since it is not be possible to investigate all the respondents in Kogi West because of its estimated high population of 1,221,400 people (National Bureau of statistics, 2022) and due to time prohibition, the study sample which is described as a subset of the entire population was taken to represent the entire population.

**Sampling Technique and Sample Size**

Stratified random sampling technique was employed to get the required data for the study. According to Nzeneri (2002), the technique is unbiased since each respondent is given equal opportunities of being selected for the study. Furthermore, samples were drawn from population in the study area which made the sampling unbiased. Data was sourced from different categories of people that made up of the population of the study area.

The area of study was further sub-divided into smaller sampling units or strata. Since the study intends to cover Kogi West as a whole, the study used existing Local government areas in Kogi West as its sampling frame. Kogi West is made up of Seven (7) LGAs which include Kabba/Bunu, Kogi, Mopa-muro, Ijumu, Yagba East, Yagba West and Lokoja. Each of these LGA represents sub-units from which respondents for the study was drawn. The sample size of the study was drawn in proportion to the total population in each LGA (strata) in order to have a proportional representation such that the LGA with higher population had larger sample and vice versa

The study sample for this research was drawn from the target population using the Taro Yamane Formula (1967) to determine sample size. The Yamane, (1967) sampling formula ($n = \frac{N}{1+N(e)^2}$) for sample size determination was used to determine the sample size for this study;

$n = \frac{N}{1+N(e)^2}$

Where n = sample size

N = total population (1,221,400)

e = signifies the margin error (0.05)

Therefore, $n = \frac{1,221,400}{1+1,221,400(0.05)^2} = 400$

The sampling frame for this research is depicted below:

| S/N | LOCAL GOVERNMENT AREA | TOTAL POPULATION | SAMPLE SIZE |
|---|---|---|---|
| 1 | Kabba/Bunu | 194,900 | 64 |
| 2 | Kogi | 155,100 | 51 |
| 3 | Mopa-muro | 59,000 | 19 |
| 4 | Ijumu | 159,800 | 52 |
| 5 | Yagba East | 199,000 | 64 |
| 6 | Yagba West | 188,600 | 62 |
| 7 | Lokoja | 265,000 | 87 |
| **TOTAL** | **11** | **1,221,400** | **400** |

**Source: National Bureau of Statistics (2022)**

**Techniques of Data Analysis**

The data collected from the field was analysed using descriptive statistics of simple percentage, frequency count and charts. This was further presented in tables. This method was adopted because of their simplicity and easy understanding.

**Malaria and Vulnerability map**

The basic spatial analysis employed in this work was done using ArcGIS 10.8 software. Vulnerability surface modeling was carried out using the Geo-statistical Analyst extension tool. Classification and reclassification operation was performed to classify the risk into four classes.

Mapping of Malaria vulnerable areas over the entire study area was done by Hotspot analysis using the Shook's law formula (R = H×E×V) Where R is risk, H hazard, E the degree of exposure and V vulnerability. Environmental factors such as altitude, distance from natural drainage, land use and land cover types was selected and used to generate malaria risk map for the study area.

**Results & Discussion**

**Demographic and Socio-Economic characteristics of Respondents**

This section presents the demographic and socio-economic characteristics of the respondents. The demographic and socio-economic characteristics examined include age, sex, education, occupation, income (see Table1) and out of the 400 questionnaire administered, 10 was returned invalid.

Out of the 390 respondents sampled, 53.33% of the respondents were males, while 46.67% were females. The males are slightly more than females; therefore, the sample is a representation of the whole population by sex. In this research, sex was considered not just as a variable in spatial sample representation, but has a relationship with malaria prevalence and infection. Researches in the past have concluded that women, more especially the pregnant ones were the most vulnerable to malaria morbidity and mortality (Gabrielli, Bellina, Milardi, Katende, Totino, 2016).

13.59% of respondents fell within the age bracket of 61 years and above, 16.41% fall in the range of 41-60, 70% fall within ≤ 40. A further cursory look at the table implies that majority of the respondents were young people who are conscious of their health and are more likely to seek for care on infection of malaria.

**Table 1: Demographic and Socio-economic Characteristics of the Respondents**

| Variable | Frequency | Percentage (%) |
|---|---|---|
| **Sex** | | |
| Male | 208 | 53.33 |
| Female | 182 | 46.67 |

| | | |
|---|---|---|
| **Age (Years)** | | |
| ≤ 40 | 273 | 70.00 |
| 41-60 | 64 | 16.41 |
| 61 and above | 53 | 13.59 |
| **Marital Status** | | |
| Single | 161 | 41.28 |
| Married | 229 | 58.72 |
| **Ethnic Group** | | |
| Okun | 197 | 50.51 |
| Igala | 89 | 22.82 |
| Ebira | 75 | 19.23 |
| Others | 29 | 7.44 |
| **Highest Educational Level** | | |
| None | 62 | 15.90 |
| Primary | 58 | 14.87 |
| Secondary | 157 | 40.26 |
| Tertiary | 92 | 23.59 |
| Adult Education | 21 | 5.38 |
| **Occupation** | | |
| Farmer | 213 | 54.62 |
| Business | 65 | 16.66 |
| Civil Servant | 73 | 18.72 |
| Others | 39 | 10.00 |
| **Monthly Income (Naira)** | | |
| Less than 50,000 | 246 | 63.08 |
| 50,001-100,000 | 102 | 26.15 |
| 100,001-150,000 | 27 | 6.92 |
| 150,001-200,000 | 8 | 2.05 |
| 200,001-250,000 | 4 | 1.03 |
| 250,001-300,000 | 2 | 0.51 |
| 300,001 and above | 1 | 0.26 |

**Source: Field work, 2024**

Married respondents (58.72%) populated the study area and 41.28 % were not married, which simply implies that majority of the respondents are matured enough to know about malaria prevention and mitigation.

Most of the respondents were Okun (50.51%) by ethnicity, 22.82% were Igala, 19.23% were Ebira by tribe. Tribal differences can influence malaria treatment behaviour because various ethnic groups may have different ways of treating the disease aside other treatment.

Sichande, Michelo, Halwindi and Miller (2014), on the other hand argue that there is a significant association between formal educational attainment and the individuals' health outcomes. As revealed in Table 1, 15.90% of the respondents had no form of formal education, 14.87% attained primary education,

40.26% attained secondary education, and 23.59% reached tertiary educational level, while 5.38% have acquired adult education. Thus, respondents are well educated enough to have better knowledge about malaria prevalence and these findings concur with a study conducted in Bangladesh which reveals that the level of education was related to prevalence of malaria (Bashar, Al-min, Reza, Islam, Asaduzzaman, Ahmed, 2012).

Occupation is synonymously used to mean livelihood. Farming appeared to be the primary occupation (54.62%) of most people in the study area, although other respondents are involved in various businesses (16.66%), while 10% of the respondents are civil servants (Table 1). It is notable that all respondents are vulnerable to malaria infection irrespective of their occupation (Cochran and Williams, 2013) and this was confirmed in the study because victims of malaria were irrespective of their occupation. The assessment of household income indicates that 63.08% of the respondents earn less than N50, 000 monthly, while about 36.92% earned above N50, 000 monthly and this may be because majority of the respondents are farmers. The seemingly low income level among respondents is indicative of their occupation and educational level. Following the passage of the minimum wage bill into law in the year 2019, the minimum wage recommended by the Nigerian government was thirty-thousand Naira per month. Going by the United Nations poverty line, anyone that earns less than one dollar ninety cents per day live in internationally agreed poverty line (United Nation, 2019). This implies that a greater percentage of respondents in Kogi West are poor, and poor populations are at higher risk of suffering from malaria as the disease has been found to impose financial hardship on poor households (United Nations [UN], 2019). During the field survey, the position was affirmed as personal expenditures on malaria prevention methods such as bed nets or insecticides are materials luxury to a large proportion of the poor population in Kogi West while those in higher socio-economic groups are more likely to pursue a good healthy lifestyle. Hence, low income earning is one of the contributory factors to malaria prevalence in Kogi West since low income earners are more in numbers than high income earners.

**Identifying the factors influencing Prevalence of Malaria**

Table 2 shows there is inadequate waste disposal bins and sites in the study area as 51.79% of the respondents mainly dispose their wastes on refuse dumps which are small open dogged spaces located around their houses, which have been a regular practice over the years. If these open spaces around the household are not disposed off promptly, they decay and become breeding spaces for mosquito larva which leads to the spread of malaria. Furthermore, other means of waste disposal are farmlands (21.54%) which the respondents perceive serve as manure to increase soil nutrients, on the streets (8.97%), waterways (10.26%) etc. Furthermore, 44.61 % of the respondents reported that they have a good drainage system near their houses, while 55.39% do not have good drainage systems near their houses, which therefore give room for stagnant water and breeding avenue for mosquitoes.

**Table 2: Waste disposal method and Drainage**

| Variable | Frequency | Percentage (%) |
|---|---|---|
| **Waste disposal method** | | |
| Refuse Dump | 202 | 51.79 |
| Farmland | 84 | 21.54 |
| Street | 35 | 8.97 |
| Waterways | 40 | 10.26 |
| Others | 29 | 7.44 |
| **Drainage** | | |
| Yes | 174 | 44.61 |
| No | 216 | 55.39 |

**Source: Field work, 2024**

In figure 1, 47.6% respondents agreed that the government supplied them with ITN, 39.49% respondents agreed that they buy Insecticide Treated Net (ITN), while 12.8% of the respondents do not have ITN, which agrees with the practical and effective means of preventing malaria in Africa (Federal Ministry of Health [FMOH], 2014). But during the field survey, it was discovered that most respondents do not use the ITNs adequately, thereby increasing malaria prevalence in Kogi West.

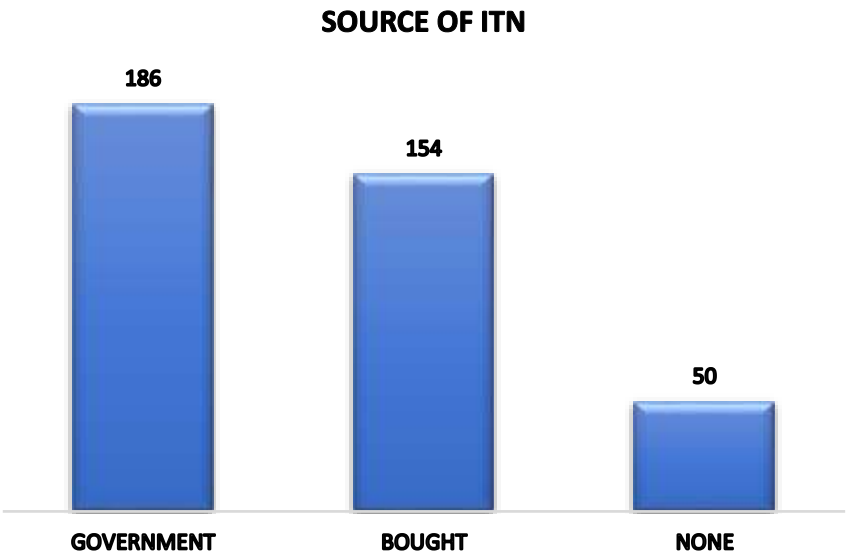


**Figure 1: Source of Insecticide Treated Net**

**Source: Field work, 2024**

**Spatial pattern of Malaria Prevalence**

Malaria vulnerable areas is depicted in Figure 2, this shows the probability that malaria would spread in the population and the expected degree of loss due to malaria infection. The outcome showed that most of the people in the study area are at risk of malaria, with a majority of Lokoja and Kogi LGA subject to high risk of malaria. Four areas with different levels of malaria risk were found, that is Very high (36%); High (24%); Moderate (17%): low (23%). Hence, it can be concluded that the great majority of Kogi West (around 60%) is at high risk for malaria.

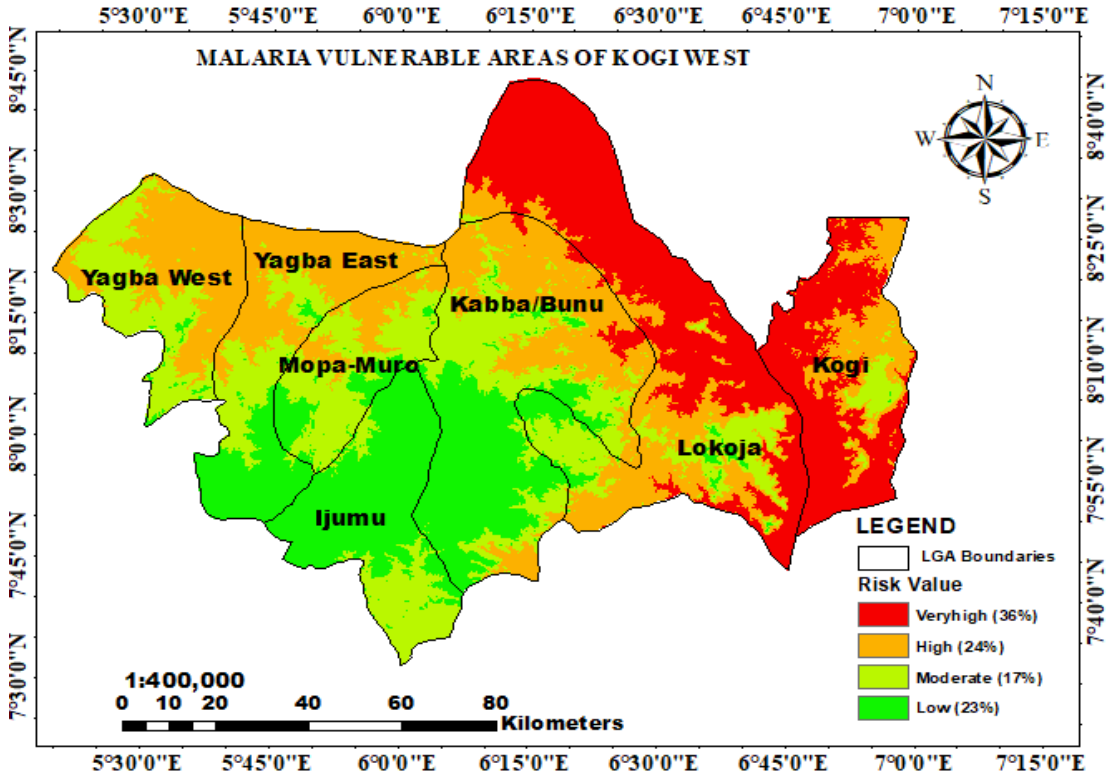


**Figure 2: Malaria Vulnerable areas of Kogi West**

**Source: Authors analysis (2024)**

**Measures for mitigation of Malaria Prevalence**

As a way of mitigating or ameliorating the menace of malaria within Kogi West, the study inquired from respondents the measures to be implemented and figure 3 present the result. Several measures were put forward by the respondents of which sanitation occupied the highest position with 17.69%. The reason why sanitation in Kogi West is important is as a result of solid wastes being indiscriminately disposed in open spaces into drainage channels, with heaps of waste lying on roads within the study area. Asides being an eye sore, wastes are natural habitats for mosquito to thrive. Distribution of free mosquito net was next with 15.38%. This is also very important as several studies on the efficacy of the use of Insecticide Treated Nets (ITNs) have shown it to be up to 90% efficient when appropriately used. Respondents also revealed that proper drainage channels are needed within the study area (13.85%). This is a very important measure as most drainage channels in Kogi West are open and filled with stagnant water which helps to breed mosquito larva. Other respondents (10.77%) suggested that more health facilities be provided within the study area. This is also not surprising because the population of Kogi West has been growing astronomically, but the number of health centers remains almost stagnant and unevenly distributed thereby creating a deficit. Some respondents (10.26%) are advocating for free malaria treatment and 9.49% are seeking reduction in price of malaria medication. This call is very necessary because most of the inhabitants of Kogi West are poor and earn low wages or salaries, hence being unable to match their income level with malaria management needs. Few respondents (8.46%) advocated for better housing conditions in order to mitigate the occurrence of malaria in the study area. Some respondents also opined that the Ministry of Health should organize routine aerial fumigation exercises as they believe that most of their preventive strategies seem not to be effective due to high mosquito infestation in the area. Little percentage of the respondents (6.40%) did not provide any suggestions that could be implemented in the area to mitigate malaria prevalence due to individual reasons. The fraction of the total respondents in the non-response cartegory is too insignificant to affect the result of this research.

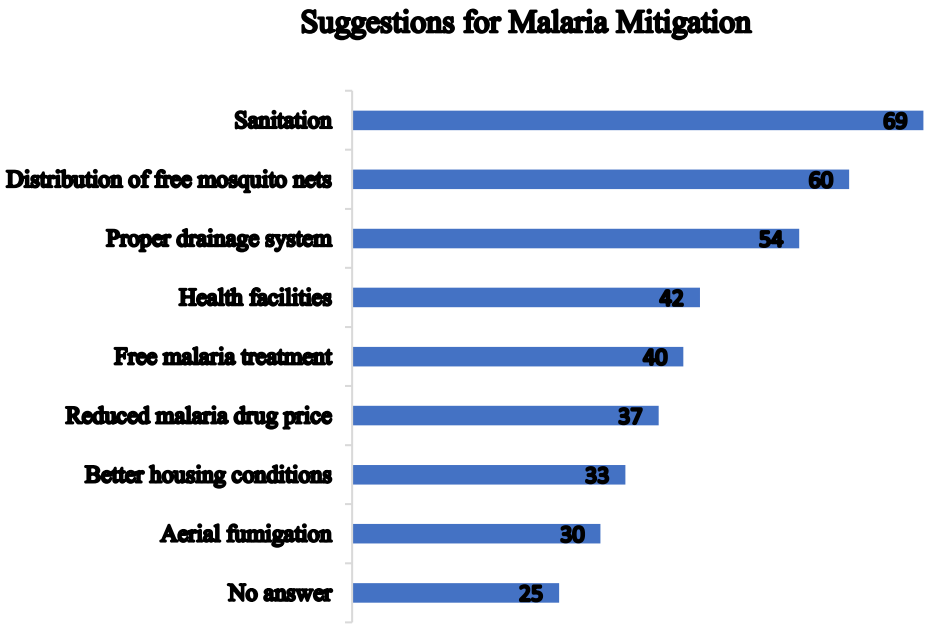


**Figure 3: Measures for Mitigation of Malaria Prevalence**

**Source: Field work, 2024**

## Conclusion

The study is embarked on to identify the factors influencing the prevalence of malaria. The finding showed that the major factor influencing the prevalence of malaria is inadequate waste disposal bins, which shows about 51.79% of the respondents dispose their wastes using refuse dumps which are small open dugged spaces located around their houses, which have been a regular practice over the years.

Secondly, is to map out the spatial pattern of malaria prevalence. The outcome showed that most of the study area are at risk of malaria, but high risk are in areas like Lokoja and Kogi LGAs. Four areas with different levels of malaria risk were found, that is Very high (36%); High (24%); Moderate (17%): low (23%). Hence, it can be concluded that the great majority of Kogi West (around 60%) is at high risk for malaria.

Lastly, was to identify various measures to mitigate malaria prevalence. Several suggestions were put forward by the respondents of which sanitation occupied a lofty position of 17.69%. The desire for sanitation in the study area is not surprising as a result of solid wastes being thrown into drainage channels, with heaps of waste lying on roads within the study area. Asides being an eye sore, they are natural habitats for mosquito to thrive. Distribution of free mosquito net was next with 15.38%.

## Recommendations

Malaria is a serious, infectious disease spread by certain mosquito usually the Anopheles. Malaria ranks among the major health and development challenges facing the world.

To reduce the problem of malaria in the study area, the researcher made the following recommendations:

i. Since this study has highlighted the prevalence of malaria in almost 60% of Kogi West, it is recommended that all wards that fall within the very high and high categories should be given higher priorities than those within the lower categories.

ii. There is the need for a strong collaboration among major stakeholders including the Government, and Non- Governmental Organizations to sensitize the communities on malaria as a disease as well as developing the holistic and effective methods for prevention and control of the disease.

iii. Efforts must be seriously made by the major stakeholders such as Ministry of Health, World Health Organisation in the health sector to make the Insecticide Treated Nets (ITN) and Malaria drugs readily available and affordable in the communities of the study area.

iv. In order to improve timeliness of treatment, the service consequently needs to be closer to the communities especially those found in the remote and malarious endemic areas like Lokoja and Kogi LGA.

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