

Economic Burden Of Malaria On Agricultural Gdp In Nigeria

M. G. M. Udouo

G. S. Umoh

Department of Agricultural Economics and Extension,
University of Uyo, Uyo, Akwa Ibom State, Nigeria

A. J. Akpaeti

Department of Agricultural Economics and Extension,
Akwa Ibom State University, Obio Okpa, Akwa Ibom State,
Nigeria

Abstract: *Malaria is a major public health problem in Nigeria with adverse effect on agricultural production. This study examined the effect of malaria morbidity on agricultural Gross Domestic Product (GDP) in Nigeria. Secondary data employed for the study were analyzed using descriptive statistics and production function. Findings from the study revealed that highest percentage change in malaria morbidity and mortality were recorded in 1998 and 1990 respectively. Malaria impacted negatively on agriculture production in the country both in the short and long-run. About ₦142,097.78 million in Agricultural GDP value was lost yearly due to malaria morbidity in the country. The paper recommends that efforts should be directed towards complete extermination of malaria vectors and vaccine production as well as the use of predators as a means of controlling malaria*

Keywords: *Agricultural GDP, economic burden, malaria morbidity and mortality, Nigeria.*

I. INTRODUCTION

Nigeria is one of the most populous countries in Africa with the population of 158 million (World Population Prospects, 2008). The livelihood of the people is mostly agriculture with contribution of about 65 percent to the Gross Domestic product (GDP) of the nation during pre-independence and independence era which had surpassed every other sector in the economy (Federal Republic of Nigeria, 2000). However, this contribution has declined over the years. At present, agriculture accounts for about 35 percent of the real sector, while crude oil accounts for about 17 percent (CBN, 2012). Despite this decline, agriculture is still the dominant economic activity in terms of employment and linkages with the rest of the economy (NNPC, 2004; NBS, 2014). While accounting for one-third of the GDP, it remains the leading employment sector of the vast majority of the Nigerian population as it employs two-third of the labour force (Chigbu, 2005).

Unfortunately, the contribution of agricultural GDP to the nation's growth is being truncated by morbidity (ill-health) of the farmers which reduces labour productivity and at times, leads to death (mortality). As such, the contribution of such

people to the overall growth of the economy is permanently lost. Malaria is a major health problem, particularly in tropical countries accounting for 90% of malaria death in Sub-Saharan Africa [World Health Organization (WHO, 2011)]. According to World Malaria Report (2011), Nigeria, the Democratic Republic of Congo, Burkina Faso, Mozambique, Cote d'Ivoire and Mali - account for 60%, or 390,000, of malaria deaths. Hence, Nigeria is among malaria endemic countries located in the Sub-Saharan Africa. It is estimated that 97% of the countries' population is at risk of malaria while it contributes more than a third of the total African malaria burden. The world Health Organization Rankings for malaria mortality places Nigeria at the 11th position in 2011 out of 192 countries (WHO, 2011). Evidence on Nigeria given by various malaria reports show that malaria incidence throughout the country had been on the increase over the years ranging between 2.25 million by the turn of the millennium 2000 to 2.61 million in 2003 and 4.58 million in 2009. In the cause and effect relationship between malaria and economic growth, it is possible that the severity of malaria leads to poor health outcomes which in turn lead to a low gross national income and poor economic growth (Arrese, 2001).

Empirically, according to Gallup and Sachs (2001), areas with severe malaria are almost all poor and continue to have low economic growth. Using cross country regressions for the 1965–1990 period and taking into account initial poverty, economic policy, tropical location, and life expectancy, among other factors, it was confirmed that countries with intensive malaria grew 1.3% less per person per year, and a 10% reduction in malaria was associated with 0.3% higher growth. Countries with severe malaria in 1965 had much slower economic growth, (amounting to 1.3% lower growth per year), even after other factors such as initial income level, overall health, and tropical location are taken into account.

However, the government of Nigeria and development partners has responded to the malaria scourge with various interventions. Many malaria prevention programmes and policies had been initiated with a view to preventing malaria and ensure healthy and productive population. This is expected to translate to improved productivity and sustainable economic growth. Some of these programmes include: President's Malaria Initiative (PMI) Strategy, Support to National Malaria Programme (SuNMaP), National Malaria Programme, Malaria Action Program for States (MAPS), Millennium Development Goals and the Measure Demographic and Health Surveys. The core interventions for malaria control in Nigeria include long lasting insecticide-treated net (LLIN) distribution through antenatal care clinics, immunization visits, campaigns, intermittent preventive treatment for pregnant women (IPTp), case management following prompt diagnosis at all levels of health care; and, to an extent, indoor residual spaying (IRS). This intervention has helped to an extent in stemming down malaria illness especially malaria mortality but a large percentage of the agrarian population who are the engine of the economy in terms of food production are still plague by malaria which has reduced their productivity immensely. It is against this backdrop that the study is examining the effect of malaria morbidity on agricultural production in Nigeria vis-a-vis agricultural GDP using production function approach. The specific objectives were to:

- ✓ provide facts on malaria morbidity and mortality in Nigeria;
- ✓ investigate the effect of malaria morbidity on Agricultural Gross Domestic Product in Nigeria;
- ✓ Estimate the cost implications in terms of production loss due to malaria morbidity in Nigeria.

II. MATERIALS AND METHODS

A. DATA COLLECTION

The study employed secondary data obtained from Annual Report and Statements of Account of the Central Bank of Nigeria, (various issues) and publications of National Bureau of Statistics. The data cover the period between 1976 and 2010.

B. METHODS OF DATA ANALYSIS

The data collected were analyzed using descriptive statistics namely percentages as well as graphs. This was used to achieve the first objective while regression model was used for objective two to ascertain the effects of malaria morbidity on Agricultural GDP. Cost implication of malaria morbidity was analyzed using slope coefficient derived from the regression results. The regression model is presented below:

The implicit form of regression equation used is stated as:

$$\ln RAGDP = f(\ln LA, \ln CAS, \ln MI, \ln INF, \ln CRD, U_{it}) \quad (1)$$

The explicit model is:

$$\beta_0 + \beta_1 \ln LA + \beta_2 \ln CAS + \beta_3 \ln MI + \beta_4 \ln INF + \beta_5 \ln CRD + U_{it} \quad (2)$$

Where $\ln RAGDP$ = Real Agric GDP (in Million Naira); $\ln LA$ = labour employed in Agriculture (in Million); $\ln CAS$ = Capital stock employed in Agriculture (in Million Naira); $\ln MI$ = Malaria Index; $\ln INF$ = Inflation or general price changes captured by consumer price index; $\ln CRD$ = credit available for agriculture (in Million Naira); U_{it} = stochastic error term; \ln = natural log; β_0 = intercept; $\beta_0 - \beta_5$ = coefficients of explanatory variables.

A priori, it is expected that as malaria attacks become more prevalent (i.e. as M increases), Y falls. Put more precisely, $f_{LA}, f_{CAS}, f_{CRD} > 0$ and $f_{MI}, f_{INF} < 0$ (3)

C. DATA MEASUREMENT

Labour: Labour employed is measured by the total number of people employed in agriculture in Nigeria. It positively impacts on agricultural output. However, malaria can affect labour through reduced work performance and labour loss in cases of death of the affected person.

Capital stock: Capital is an input into the economy's production function. Increased capital stock employed in agriculture leads to increased economic growth. However, increased malaria incidence affects capital indirectly through the effects on savings which negatively affects investments and ultimately capital needed for agriculture.

Malaria Index: this was measured by the number of reported cases of malaria per 100,000 persons. It is expected to be a good proxy for the intensity of malaria attacks – including cases not reported. It was computed following McCarthy, Wolf and Wu (2000) methodology. This is given as:

$$M = \frac{\text{Total malaria cases reported in the zone}}{\text{Total population of people in the zone}} \times 100,000 \quad (4)$$

Inflation: this was included in the regression to capture economic stability. The variable is captured by consumer price index obtained from various issues of the CBN Annual Report.

Credit: credit is needed for agricultural expansion. It can be used to stimulate agricultural output.

Cost Implication of Malaria Morbidity: This was analysed using Slope coefficient. The slope coefficient indicates the change in the dependent variable (agricultural GDP) associated with a one-unit increase in the independent variable (malaria prevalence) holding constant all the other independent variables in the equation. The coefficient estimated was interpreted as elasticities, that is the percentage

change in agricultural output for a given change in the explanatory variable (in this case malaria index). Slope coefficient or marginal effects parameter was computed following Orem *et al.*, (2012) methodology. This is given as:

$$[(\bar{Q} / Mi) \times \beta_i] \quad (5)$$

where: \bar{Q} is the average of dependent variable, i.e. agricultural GDP (in Million Naira); Mi is the mean of i th independent (explanatory) variable (in this case, malaria index); β_i is the elasticity of the logarithm of a specific independent variable (malaria index). Hence, the cost implication of malaria morbidity was calculated thus: slope coefficient X agricultural GDP (Naira) (6)

III. RESULTS AND DISCUSSION

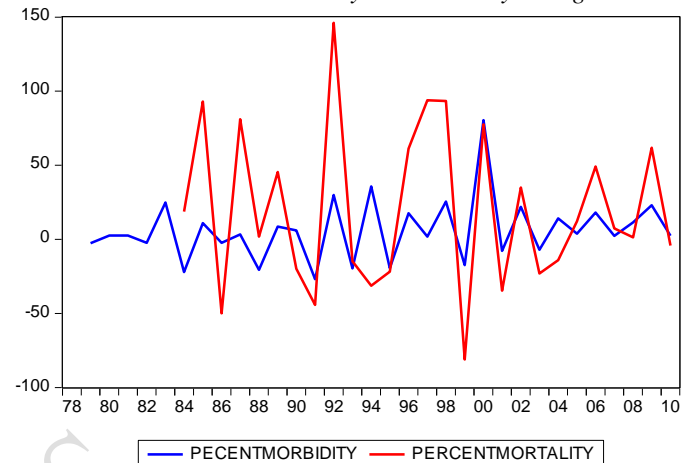
A. RESULTS

✓ **MALARIA SITUATION IN NIGERIA:** Table 01 presents results of the percentage change in Malaria morbidity and mortality in Nigeria. From the results, there were variations in malaria morbidity and mortality in Nigeria throughout the period covered by the study. Malaria morbidity was at its ebb in 1989 but this was followed by a sharp rise the following year. 1998 recorded the highest figure (peak) followed by 1992; however, malaria morbidity experienced a fall towards the last three years covered by the study. This suggests that measures put in place to stem out malaria mortality in Nigeria were effective. On the other hand, malaria mortality recorded the highest figure in 1990 followed by 1983, 1995 and 1996 (See Fig. 01). This was followed by a drastic fall (the lowest) in mortality in 1997. However, the last year of the study (2010) experienced another rise in mortality. If the pattern of decline experienced in 1997 had been maintained, malaria mortality could have been brought under control in Nigeria.

| Year | Malaria Morbidity | Percentage change | Malaria mortality | Percentage change |
|------|-------------------|-------------------|-------------------|-------------------|
| 1976 | 1177726 | - | - | - |
| 1977 | 1147518 | -2.56 | - | - |
| 1978 | 1177518 | 2.61 | - | - |
| 1979 | 1207718 | 2.56 | - | - |
| 1980 | 1178718 | -2.40 | - | - |
| 1981 | 1471651 | 24.85 | 674 | - |
| 1982 | 1147518 | -22.03 | 800 | 18.69 |
| 1983 | 1273090 | 10.94 | 1544 | 93 |
| 1984 | 1242882 | -2.37 | 773 | -49.94 |
| 1985 | 1284403 | 3.34 | 1400 | 81.11 |
| 1986 | 1020071 | -20.58 | 1426 | 1.86 |
| 1987 | 1108421 | 8.66 | 2074 | 45.44 |
| 1988 | 1174633 | 5.97 | 1663 | -19.82 |
| 1989 | 859371 | -26.84 | 928 | -44.20 |
| 1990 | 1116992 | 29.98 | 2284 | 146.12 |
| 1991 | 898230 | -19.58 | 1947 | -14.75 |
| 1992 | 1219348 | 35.75 | 1337 | -31.33 |
| 1993 | 981943 | -19.47 | 1046 | -21.77 |
| 1994 | 1154728 | 17.60 | 1686 | 61.19 |
| 1995 | 1133926 | 1.80 | 3268 | 93.83 |
| 1996 | 1423533 | 25.54 | 6320 | 93.39 |
| 1997 | 1176363 | -17.36 | 3490 | -81.09 |
| 1998 | 2122663 | 80.44 | 6197 | 77.56 |

| | | | | |
|------|---------|--------|-------|--------|
| 1999 | 1958026 | -7.76 | 4048 | -34.68 |
| 2000 | 2388096 | 21.96 | 5465 | 35.00 |
| 2001 | 2220348 | -7.02 | 4207 | -23.02 |
| 2002 | 2535430 | 14.19 | 3616 | -14.05 |
| 2003 | 2631696 | 3.80 | 4057 | 12.20 |
| 2004 | 3109166 | 18.14 | 6052 | 49.17 |
| 2005 | 3183072 | 2.38 | 6495 | 7.32 |
| 2006 | 3547830 | 11.46 | 6586 | 1.40 |
| 2007 | 4366048 | 23.06 | 10662 | 61.89 |
| 2008 | 4471769 | 2.42 | 10219 | -4.15 |
| 2009 | 4577490 | 2.36 | 12490 | 22.22 |
| 2010 | 3837215 | -16.17 | 4308 | 65.51 |

Source: NBS- Annual Abstract of Statistics (Various Editions)
Table 1: Malaria morbidity and mortality in Nigeria



Source: NBS- Annual Abstract of Statistics (Various Editions)
Figure 1: Percentage change in Malaria Morbidity and Mortality in Nigeria

✓ **EFFECT OF MALARIA MORBIDITY ON AGRICULTURAL GROSS DOMESTIC PRODUCT:** The result of the stationarity test for the effect of malaria morbidity on agricultural GDP is presented in Table 02. Result in Table 02 indicates that five variables were not stationary at levels: four of these variables Labour (LA), Malaria Index (MI), and Credit (CRD) each became stationary after first differencing at 1% levels and that of Inflation (INF) at 5% level. This indicates that a possible stable relationship can only be obtained at first difference. One variable – Capital Stock employed in agriculture (CAS) became stationary after second differencing at 5% level of significance, indicating that a possible stable relationship can only be obtained at second difference. However, one variable was stationary at levels: Agric. GDP (RAGDP) at 1% level of significance.

| Variables | Augmented Dickey Fuller | | | |
|---------------------|-------------------------|----------------------------|----------------------------|----------------------|
| | At level | 1 st Difference | 2 nd Difference | Order of Integration |
| Agric. GDP (RAGDP) | 3.906*** | - | - | I(0) |
| Labour (LA) | 0.104 | -5.377*** | - | I(1) |
| Capital Stock (CAS) | -2.254 | -0.607 | -3505** | I(2) |
| Malaria Index (MI) | -2.071 | -8.054*** | - | I(1) |
| Inflation (INF) | -1.655 | -5.474** | - | I(1) |
| Credit (CRD) | -1.506 | -10.621*** | - | I(1) |

Note: *** = Significant at 1%; ** = Significant at 5%

Table 2: Summary of stationarity test for effect of malaria morbidity on agricultural GDP

Co-integration test was carried out as a condition for accepting the Error Correction Mechanism (ECM) model. This test is necessary so as to establish whether there is a long-run relationship between the dependent variables and their fundamentals. This was done by running the residuals from the static regression. Appendix 1 shows the result of the co-integration test amongst the first differences of the natural logarithm (Ln) of Real Agricultural GDP. The result of the trace test and max-eigen value test indicate that there is at least one co-integrating equation at 5% level. The result reveals that this variable (Agric. Real GDP) is co-integrated. This means that there is a long-run relationship between it and its respective determining variables, hence, there is the existence of an equilibrium position amongst these variables and they share common trends.

Since the variables are non-stationary at their levels, but stationary after first differencing and also shows co-integration, the next stage is to formulate an error correction model. This is necessary so as to recover the long-run information lost by differencing the variables. The result of parsimonious ECM (see Table 03) shows that variability in Agricultural GDP in Nigeria is significantly explained by its previous year value and its value lagged by two years RAGDP (-1), ARGDP (-2), Capital accumulation in Agriculture (CAS) both at present, in the previous year and lagged by two years. Apart from these variables, Malaria Index (MI (-1)) in the previous year, and availability of Credit both in the previous year and lagged by two years (CRD (-1); CRD (-2)) are also part of the significant explanatory variables that explained the variability in Agric GDP (RAGDP). The coefficients of CAS (-1), and RAGDP (-1) are correct signed at 1%. The coefficients of MI (-1), CRD (-1) and CRD (-2) are correct signed at 5%. This implies that an increase (decrease) in each of these variables significantly increases (decreases) the present value of Agric. GDP.

An increase in Capital Accumulation for Agriculture both at present and lagged by two years [CAS, CAS (-2)] will reduce Agricultural GDP by ₦ 1.193 and ₦ 1.799 respectively. This implies underutilization of capital both at present and in the past but Capital accumulation in the previous year [CAS (-1)] will increase Agricultural GDP by ₦ 1.800. The coefficient of Malaria Index being -0.762 implies that for every one reported case of malaria per 100,000 persons in the country, while holding other explanatory variables constant, Agric. GDP will reduce by ₦ 0.762 per year. Availability of Credit impacts positively on Agricultural GDP implying that a million naira increase in Credit (both in the previous year and lagged by two years) will increase agricultural GDP by ₦ 0.551 and ₦ 0.309 respectively. This suggests that as more loans are made available for agriculture, the more the growth in Agricultural GDP. The lagged error correction term ECM (-1) is negative and statistically significant at 5%; which confirms that long run equilibrium relationship (co-integration) exists amongst the variables. The adjusted R-squared of the estimated model shows that about 87.1 per cent of the variation in Agric. GDP was explained by the combined effects of the explanatory variables, while the F-statistic shows that the overall regression was significant at 1 per cent level.

| Variable | Coefficient | Standard Error | t- Statistics |
|---------------------|-------------|-------------------------|---------------|
| D(LnCAS) | -1.193*** | 0.320 | -3.724 |
| D(LnCAS(-1)) | 1.800*** | 0.239 | 7.528 |
| D(LnCAS(-2)) | -1.799*** | 0.461 | -3.902 |
| D(LnMI(-1)) | -0.762** | 0.330 | -2.305 |
| D(LnCRD(-1)) | 0.551** | 0.216 | 2.549 |
| D(LnCRD(-2)) | 0.309** | 0.127 | 2.443 |
| D(LnRAGDP(-1)) | 0.59*** | 0.180 | 3.294 |
| D(LnRAGDP(-2)) | -0.22* | 0.11 | -1.98 |
| ECM(-1) | -0.613** | 0.248 | -2.466 |
| R-squared | 0.871 | Mean dependent variable | 0.119 |
| Adjusted R-squared | 0.743 | S.D. dependent variable | 0.377 |
| Durbin-Watson stat. | 2.198 | S.E. of regression | 0.191 |
| F-statistic | 6.779*** | Sum squared residual | 0.584 |

Note: ***=Significant at 1% level; **= Significant at 5% level; *= Significant at 10% level

Table 3: The parsimonious error correction model for the effect of malaria morbidity on agricultural GDP

✓ **PRODUCTION LOSS DUE TO MALARIA MORBIDITY IN NIGERIA:** The result of estimation of the impacts of malaria on agricultural GDP is presented in Table 04. From Table 04, slope coefficient (or marginal effect) for malaria index (MI) of -0.44786 indicates that when malaria morbidity increases by one unit, while holding all other explanatory variables constant, per capita Agric. GDP decreases by ₦ 0.44786 per year (i.e. the burden of malaria on per capita Agric. GDP). For instance, the real Agric. GDP in 2010 was ₦ 317281.7 million. The reduction in per capita Agric. GDP due to malaria morbidity for 2010 translates into a total of ₦ 142,097.78 million (that is 0.44786 x ₦ 317,281.7 million). This is equivalent to US\$721.31. From this result, it is clear that the economic burden of malaria in terms of loss of agricultural output is great, considering an agrarian economy like Nigeria. This supports the work of Jimoh (2005) that the economic burden of malaria in terms of lost agricultural output may be as high as ₦ 3.953 million for every reported case of malaria per 100,000 persons.

| Variable | Mean of | Regression Coefficient | Slope Coefficient |
|-------------------------|---------|------------------------|-------------------|
| Variable (Elasticities) | | | |
| Per Capita Agric. GDP | 1101.58 | - | - |
| Malaria Index | 1874.25 | -0.762 | -0.44786 |

Source: Authors' Computation

Table 4: Burden of malaria morbidity on agricultural GDP

B. DISCUSSIONS

✓ **MALARIA SITUATION IN NIGERIA:** The burden of malaria is a challenge to human development. In Nigeria, malaria is number one cause of morbidity accounting for about 50 percent of out-patient consultation, 15 per cent of hospital admission. It is the prime among the top three causes of death in the country (National Malaria Control Programme (NMCP), 2005). It is also the leading cause of mortality in children under five years and pregnant women, especially, the first three months of pregnancy. It is a significant cause of adult morbidity. The results of the fact on malaria morbidity in the country show that Nigeria experienced fluctuations in percentage change in malaria morbidity and mortality from one period to another as covered by this study. The highest percentage change in

malaria morbidity and mortality were recorded in 1998 and 1990 respectively. All the years in which very high percentage change in malaria morbidity and mortality were obtained were before the Millennium Declaration (which was in year 2000). This implies that activities of Roll Back Malaria Initiative which started in 1998 and other malaria control programmes might have helped to stem out malaria in Nigeria. However, the fact that malaria mortality increased towards the last two years covered by the study reveals that more measures still need to be put in place to reduce future death due to malaria.

- ✓ **EFFECT OF MALARIA MORBIDITY ON AGRICULTURAL GROSS DOMESTIC PRODUCT:** Malaria has negative impact on economic growth and development. This is because its direct impact is felt by the labour force; but the wealth of a nation is the health of its people. Hence, any negative impact of malaria on availability of labour in a country will definitely affect the growth and wealth of such country. In an agriculturally labor-intensive economy like Nigeria, where agriculture occupies one-third of the GDP and employs two-third of the labour force, the debilitating effect of malaria on Agricultural GDP cannot be overemphasized. This study reveals that malaria morbidity has negative effect on agricultural GDP in Nigeria. For every one reported case of malaria per 100,000 persons in the country while holding other explanatory variables constant, agricultural GDP will reduce by ₦ 0.762 per year. In a populated country like Nigeria, this has severe effect on food production and food security of the populace. The high burden of malaria in the country can lead to decreased long-term economic growth, and works against poverty eradication efforts and socioeconomic development of the country. It can also frustrate the Millennium Development Goals, because eradication of malaria will help to improve maternal health, reduce child mortality, reduce poverty and serve as booster towards achievement of universal primary education.

The coefficient of capital stock in Table 03 suggests that one million naira increase in agricultural capital stock (in constant prices) leads to about 1.8 million naira increase in agricultural output measured in constant prices on the short run but will reduce agricultural output by 1.2 million naira and 1.8 million naira at the present and in the future. This may be due to depreciation of capital. Hence, efforts need to be made to improve capital accumulation in agriculture both at present and in the future. Availability of credit for agriculture had positive impact on Agricultural GDP. Credit is needed for expansion of agricultural enterprise and for other running expenses in the farm. When this is made available to farmers at the right time, it will encourage more production. As production increases, there will be steady growth in agricultural sector, hence, growth in Agricultural GDP. A million naira increase in credit made available for agriculture would stimulate agricultural output by ₦ 0.551 and ₦ 0.309 at the short run and long run respectively. However, the long run effect is smaller than the short run effect. Hence, loans made available for agriculture need to be properly supervised so that the

positive effect of such loan can span productively into the future.

- ✓ **PRODUCTION LOSS DUE TO MALARIA MORBIDITY IN NIGERIA:** Considering the cost implication of malaria morbidity in Nigeria, it is evident that when malaria morbidity increases, substantial amount of production is lost. From this study, about ₦142, 097.78 million (US\$721.31) (based on 2010 real Agricultural GDP) of agricultural GDP is lost per year for every one reported case of malaria per 100,000 persons while holding other explanatory variables constant. This collaborates with the findings of Kwadwo and Asante (2003), Jimoh, (2005), and Orem *et al.*, (2012), which reported malaria has negative effect on the value of agricultural GDP.

IV. CONCLUSIONS

This study has shown that malaria morbidity and mortality experienced inter-annual fluctuations. Malaria mortality recorded higher percentage rise than malaria morbidity. Malaria has negative effect on agricultural GDP. As malaria incidence increases, agricultural GDP falls considerably. Also, the production loss due to malaria morbidity in Nigeria and has led to millions of naira being lost annually. If this debilitating effect of malaria is not checked, there will be reduction in food production in the future. This may lead to food shortages, increase importation of food at the expense of food exportation, low Gross Domestic Product, poverty and food insecurity (at both micro level and macro level) as well as retarded economic growth. Considering the predicted figures of malaria morbidity and mortality in Nigeria, it is obvious that there is an urgent need to take proactive steps towards eliminating malaria in the country. Early diagnosis and treatment of malaria need to be carried out to reduce mortality. This is important so as to prevent future production loss emanating from both malaria morbidity and mortality (especially mortality). This study thus recommends that government and development partners should seek measures towards complete extermination of malaria vectors in Nigeria. There should be more funding for researches in the use of predators (e.g. predator-mosquitocidal fungi) as a means of controlling malaria as well as in the development of vaccine. This will help in total eradication of malaria in Nigeria.

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