Journal of Agriculture and Environment Vol. 12 No. 1, 2016: 35-43
ISSN 1595-465X

ECONOMIC ANALYSIS OF MALARIA AFFECTED FARMING HOUSEHOLDS IN KABBA-BUNNU AREA OF KOGI STATE, NIGERIA

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ABSTRACT

The study examined the incidence of malaria, compared input and output levels of household categories, determined the costs and returns of malaria affected households and identified the palliative measures of malaria morbidity on crop output in the study area. Using structured questionnaire, a cohort of 72 farming households were followed up in order to document malaria incidences and farming activities of the households within the 2012 farming season. Households were categorized into low and high incidence based on the proportion of household's members affected with the malaria. The data collected were analyzed using descriptive statistics, gross margin techniques, t-test and regression analysis. The study revealed that Majority of the households (86.11%) had high malaria incidence while 13.89% had low malaria incidence. There was no variability in the level of variable inputs used by low and high malaria incidence household except for seed. Crop productivity of households with high malaria incidence was about 25% lower than those of households with low malaria incidence ($p < 0.05$). Though the low incidence malaria households spent more on all variable inputs of seeds/seedlings, fertilizer, agrochemicals and labour they recorded higher gross revenue of ₦59,409.75 than the high malaria incidence households with gross revenue of ₦ 175,319.00. High malaria incidence households lost 39.07% of their gross margin to malaria while low malaria incidence households lost 4.72% respectively. The cost of treatment and prevention had significant and positive effect ($P<0.05$) on crop output and by extension on their income level. The study concluded that there is a direct link between malaria incidence and profitability as such preventive measures against malaria needs to be addressed in the study area.

Keywords: Malaria incidence; profitability; gross margin; crop productivity

INTRODUCTION

Health is a major form of human capital and there exists substantial agreement in the literature on the relationship between health and economic development such literatures include the studies like the effect of malaria on agricultural production in Uganda, Farmers' health and agricultural productivity in rural Ethiopia, Effect of Malaria on intensive vegetable production in Cote D'Ivoire, Effect of Malaria on agriculture land use pattern in Kenya, Macroeconomic impact of malaria in Nigeria, Malaria in Children and the Effect of Malaria on Rural Households' Farm Income in Oyo State, Nigeria through its relationship between capability and poverty (Strauss and Thomas 1998) .

It is assumed that improvement in health leads to improvement in life expectancy, which is a robust indicator of human development. A simple channel, through which health affects human development, is by improving living conditions. As living conditions improve, human longevity is expected to improve and vice-versa. Empirical evidence has shown that among poor countries, increase in life expectancy is strongly correlated with increase in productivity and income (Deaton, 2003).

In the agricultural sector, incidence of diseases directly influences earnings. Diseases such as tuberculosis, whooping cough, diarrhea, cholera, Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome, yellow fever, typhoid fever, dysentery and malaria among others are responsible for man-hour losses in agricultural production. (World Bank, 2007)**.** The impact of malaria on the agricultural sector is widely felt in Africa since about 70 percent of Africa's population is engaged in agricultural production.

Malaria is an infectious disease caused by a parasite that is transmitted by the bite of infected mosquitoes. It is common in tropical countries. The disease is characterized by recurring chills and fever (Encarta, 2009). Malaria still constitutes a serious public health problem in Nigeria (Jimoh, 2005; FMH, 2005; Olanrewaju, 2006). According to Olanrewaju (2006) malaria still maintained its status as one of the killer diseases that affects millions of people in Nigeria.

It has adverse effects on the physical, mental and social well-being of the people as well as on the economic development of the nation. Asante (2009) found that people's health affects agricultural production and vice versa; farming could enhance the spread of malaria by creating suitable ecological and climatic conditions for breeding and survival of mosquitoes which transmit the disease. On the other hand, malaria adversely affects agricultural production through decrease in productive time (labor time), loss of farming knowledge and skills in case of death of a farmer and reduction in investments in agriculture due to high expenditures on malaria treatment and prevention (Asante, 2009).

Social scientists, particularly economists, have studied the social and economic impacts of malaria at several scales, examining families and households, looking across communities, and comparing entire nations and continents all come to the conclusion that malaria imposes substantial social and economic costs and impedes economic development through several channels, including but certainly not limited to quality of life, fertility, population growth, savings and investments, worker productivity, premature mortality, and medical costs (Sachs and Malaney 2002, Asante, 2009 and Aheisibwe, 2008).

Information on the effects of malaria on agricultural productivity exists but is largely inadequate. No study in the study area has been carried out to ascertain the incidence of malaria by monitoring farmers in a longitudinal manner and carry out medically certified test to ascertain in reality the occurrence of malaria and make analysis based on that in relation to crop productivity and profitability. This study therefore analyses the economics of malaria affected households in the study area.

MATERIALS AND METHODS

Study Area

The study was carried out in Kabba/Bunnu Local Government Area of Kogi State. The local government area is located in the western part of the State which falls between latitude 7^0N and 31^0N of the equator and longitude 5^0 41'E and 6^0 15'E, with an estimated population of 3,278,427 (NPC, 2006).

The study area is known to have a tropical savannah climate with distinct wet and dry season. The wet season range from the Month of April to October while the dry season is between November and March. The annual temperature varies between 27^0C and 37^0C with relative humidity between 30% and 40% in January and rises between 70% and 80% in July to August. Malaria transmission, based on climatic parameters occurred between (May and October). (www malaria consortium.org) About six and half months of rainy season are responsible for malaria transmission in the study area.as evident from stagnant water and dampness. The soil in the study area is predominantly sandy loam in texture. The indigenes are farmers engaging in crop production, rearing of livestock and fish. Kabba-Bunnu is blessed with suitable ecological and climatic conditions which make it possible to produce various agricultural products such as yam, cassava, cocoyam, maize, millet, rice guinea corn, palm produce, cowpea and others. (Http:ilen.wikipediaorg/wiki/Kabba/Bunu).

Data Collection

Primary data were used for this study. The primary data were obtained between the months of May to December 2012. The structured questionnaires were designed in two different forms. The first was designed to monitor the occurrence of malaria in the households on a weekly basis through the assistance of well-trained health workers using Rapid Diagnostic Test kit (RDT). While the second form of the administered questionnaire were used in collecting information on farming activities per month. For proper accountability Information were collected on agricultural production, malaria occurrences in the households, numbers of days absent from farm due to malaria episodes and cost of treatment, prevention and care giving among others

Sampling Techniques

Sampling was based on a cohort longitudinal study. A multi- stage sampling technique was employed in selection of sample for this study. In the first stage 12 villages were randomly selected from the Local Government Area. The second stage involved a random selection of six farming households from each selected village. Thus a total of 72 households were used for the study.

Data analysis and Model Specification

The analytical tools employed for this study are descriptive statistics, gross margin, t- test and multiple regression analysis.

Gross Margin (GM): This is employed to determine the cost and return on farming activities of malaria affected households. GM is the difference between gross income and total variable cost

$$GM = TR - TVC$$

Where;

GM = Represents the gross margin per hectare

TR = Total value of yield per hectare (₦)

TVC = Total variable cost of production per hectare (₦)

The value of family labour was obtained by assuming its opportunity cost as equal to the prevailing wage rate in the study area.

T- Test for Test of Significance between two Means

T-test analysis was used in comparing the input and output levels as well as the gross margin of the malaria affected households. Four levels of malaria endemicity are depicted viz 100 or more cases per 1000 population per year; 1 or more cases per 1000 population per year, and less than 100 cases; Less than 1 case per 1000 population per year but less than zero; and zero recorded cases representing; high, moderate, low and zero malaria incidence respectively (World Malaria Report, 2008 and 2012). However, for this study farming household were categorized into two based on the proportion of household members with malaria. Households with proportion of less than 0.2 were categorized as low malaria incidence household, while households with proportion greater than 0.2 were categorized as high malaria incidence households. This study compares the gross margin among the two groups of malaria infected households to identify if there is any significant difference in the levels of input/output in the two groups.

Multiple Regression Analysis

Regression analysis was used to test weather cost of treatment, cost of prevention and care giving have a significant effect on output. The advantage of regression analysis is that other variables that are assumed to influence output may also be included. Use of mosquito net is assumed to affect output and is therefore included as control variables. For this analysis The major crops cultivated in the study area: Maize seed (kg), pepper seed (kg), sorghum seed (kg), yam sets (kg) and cassava bundles (kg) were converted to grain equivalent weight for homogeneity so as to create a basis for comparison of the households. The conversion was made using a standard conversion factor 3600 kcal which is the energy content of 1kg of grain.

Grain equivalent Weight = calorie content of the crops multiplied by its quantity in kilogram's divided by maize grain equivalent which is 3600 kcal (Deville, Seaman and Geifer, 1978)

Output in grain equivalent was fitted with the regression analysis using four functional models.

The model of multiple regressions that was used is given by
Y = F (X_1, X2, X3, X4, U)
Where
Y = Crops output (GEW)
X_1 = Cost of treatment of Malaria incidence (₦)
X_2 = Cost of prevention of Malaria incidence (₦)
X_3 = Cost of care giving on Malaria incidence (₦)
X_4 = Number of times slept under a mosquito net
U= Stochastic term

RESULTS AND DISCUSSION

Proportion of Malaria in the Farming Household

Table1 presents the classification of malaria households based on the proportion of households with malaria. Households were categorized into two; High malaria incidence households and Low malaria incidence households.

Table1: Proportion of malaria in the farming household

Incidence	Frequency	Percentage
High malaria	62	86.11
Low malaria	10	13.89
Total	72	100

Majority of the households (86.11%) had high malaria incidence. Less than 15% fell within the low malaria household category (13. 89%).

Input and Output Levels of High and Low Malaria Incidence Households

Results of the test of significance of input levels of household's malaria incidence are presented in Table 2

Table 2: Results of t-test analysis comparing the input levels of household categories

Variables	High	Low	T value	P value
Farm Size (Ha)	1.78(1.20)	2.12(1.10)	0.90	0.384
Family Labour (Mandays)	96.30(66.10)	118.40(60.30)	1.06	0.309
Hired Labour (Mandays)	13.60(10.20)	12.68(9.40)	0.28	0.78
Seed (GEW)	1082.22(102.00)	975.00(279.00)	6.94	0.000**
Chemicals (Litres)	1.13(1.85)	1.90(2.73)	0.86	0.408
Fertilizer (Kg)	18.50(31.70)	15.00(24.20)	0.41	0.687

Values in parenthesis are standard deviations, ** significant ($P<0.05$)

Result revealed that the total area of the land cultivated by households with high malaria incidence is 1.78 hectares with a minimum and maximum farm size of 0.35 and 6 hectares respectively. The estimated mean labour used by high malaria incidence household was 96.30 mandays of family labour and 13.60 mandays of hired labour giving a total labour of 109.90 mandays per hectare. The average planting material (seed), used by high malaria incidence households was 1,082.22 grain equivalent weight (GEW). A typical household with high malaria incidence used an average 1.13 liters of chemical on their farm and an average of 18.50kg of fertilizer. Households with low malaria incidence cultivated an average of 2.12 hectares of land with a minimum of 1 hectare and maximum of 3.6 hectares. Household used an estimated mean labour of 118.42 mandays of family labour and employed 12.68 mandays of hired labour on their farm. Result further revealed that average of 975.79 GEW of planting material was used for their production. The minimum and maximum quantities of planting materials used by low malaria incidence household were 276.19 GEW and 1659.16 GEW respectively. The household also used an average of 1.9 litres of chemicals and 15kg of fertilizer respectively. As expected, households with low malaria incidence used more family labour (118.43 mandays) than households with high (96.30 mandays) malaria incidences. More land (2.12 hectares) and chemicals (1.9 litres) were used compared with those used by high malaria incidence households respectively. These levels of inputs utilization together with the low level of malaria incidence could explain the higher output realized. This conforms with the findings of Alves, Andrade and Macedo (2003). Where healthy individuals possess a higher level of human capital and are more productive than those with poor health and also in line with the findings of Ulimwengu (2009) study in rural Ethiopia on the relationship between farmers' health status and agricultural production found out that, the average value of agricultural production per unit of input tends to be higher for healthy farmers than for those affected by illness

T-Test comparing the input of malaria morbidity households revealed that all the inputs used in production, land, family labour, hired labour, chemical and fertilizer were not statistically significant at 5% level except seed. This implies that there was no variability in the level of variable inputs used by low and high malaria incidence household in the study area.

Table 3: T-test comparing the output level of high and low malaria household

Malaria Incidence	Mean	T-value	P-value
High	12,623(6131)	1.97^{**}	0.041
Low	16,900.47(6865)		

Values in parenthesis are standard deviations, ** significant (P<0.05)

Table 3 presents the test of significance of output levels of high and low malaria incidence households**.** Analysis revealed a total yield of 951,638.70 grain equivalent weight/ha of which the low malaria incidence household obtained an average yield of 16,900.47 grain equivalent per hectare compared with high malaria incidence households with average yields of 12, 623 grain equivalent respectively. Crop productivity of households with high malaria incidence was about 25% lower than those of households with low malaria incidence. Result further shows that there was significant difference in the levels of output of the malaria household categories at 5 % implying a high variability in output level. Thus this finding implies that decreased malaria incidence among households increases their level of out output compared to households with high malaria incidence. This finding collaborates that of Aheisibwe (2008). The study revealed that the agricultural crop production of the households that were negatively affected by malaria illness had 23.7 % less agricultural outputs than those who did not report any malaria incidence.

Gross margin analysis

Table 4 presents the costs and return of low and high incidence malaria households. The table further presents the loss intensity in the study area. Results revealed that low malaria incidence households have higher gross revenue of ₦59,409.75 than the high malaria incidence households. The low incidence malaria households also spent more on all variable inputs of seeds/seedlings, fertilizer, agrochemicals and labour. Though, there is no significant difference in the farm sizes of both categories, the gross margin of the low malaria incidence households (₦202,679.25) is higher than that of high malaria incidence households (₦ 153,119.36). Further analysis shows that high malaria incidence households lost 39.07% of their gross margin to malaria while low malaria incidence households lost 4.72%. This is similar to the finding of Omotayo and Oyekale (2013) where households lost ₦ 26,694.17 of their income to malaria.

Table 4: Costs and return analysis of malaria affected farming households

	Malaria Incidence	
Variables	High	Low
Gross Revenue	175,319.00	234,728.75
Cost of Seed/Seedlings (₦)	1452.00	1823.60
Cost of Fertilizer (₦)	1044.35	4,625
Cost of Agrochemical (₦)	1460.11	2061.32
Cost of Labour (₦)	18,243.18	23,539.58
Total Variable Cost	22,199.64	32,049.5
Equals GM	153,119.36	202,679.25
Less imputed cost of day loss	49,083	7,830
Less cost of treatment	7,332.60	1,182.67
Less cost of prevention	2,542.66	410.49
Less cost of care giving	862.30	139.09
Equals loss	59,820.56	9,562.25
Loss (%)	39.07	4.72

Average wage rate per day= ₦1500

Regression Analysis

Double log function was chosen as the lead equation for study based on the significance of the individual explanatory variable as expressed by their t-value, the appropriateness of the sign of the regression coefficients based on a priori expectation of the magnitude of the coefficient of determination (R^2).

R^2 of the lead equation (double log function) is 0.79. This is good and implies that the explanatory variable shows 99% of the total variation in output. The coefficient of cost of treatment by the household is negative which is in conformity with *apriori* expectation while the coefficients of other variables were positive. The negative sign of the coefficient of the cost of treatment implies that as more money is spent on treatment, there is the likelihood of procuring less input (fertilizer, chemical and hired labour) which could decrease the level of output. The result also revealed that cost of treatment is significant at 5% level. The costs of treatment are an indication of the prevalence of malaria episodes. Households with higher incidence of malaria episodes spend more money on medical care. Cost of malaria prevention through the use of various protective devices was found to be directly associated with output at 1% level of significance. This implies that a household that uses protective device to prevent malaria produces 1.17% more crop output holding other factors constant. This finding collaborates that of Audiberts (1986) who calculated the elasticity of output of rice with respect to malaria prevalence. He found that elasticity varied from 0 to 0.5%, implying that a 1 % rise in malaria index will result into 1.5%vreduction in the units of rice

Cost of care given was significant at 10% level. The non-significance of the use of mosquito net was against *apriori* expectation. This may be probably due to the fact that most of the farming household did not use mosquito net in the study area.

Table 5: Multiple regression results of palliative measures of malaria morbidity on output

Functional Forms	Constant	Regression Coefficient				
		Cost of treatment (X_1)	Cost of prevention (X_2)	Cost of care giving (X_3)	Times Used net (X_4)	R^2
Linear	10814.74	-1.634	1.3191	0.609	82.821	0.7433
	(5.50)	(-2.43)***	(3.26) ***	(0.28)	(3.48)***	
Semi log	-1266.181	-584.889	1523.355	1538.443	280.425	0.093
	(-0.11)	(-0.89)	(1.02)	(2.05)**	(0.75)	
Double log	8.223	-0.157	1.1667	6.170	0.691	0.7933
	(7.67)	(-1.95)**	(24.64) ***	(1.77)*	(1.44)	
Exp.	9.057	-0.000	8.43e-06	0.000	0.003	0.0663
	(48.63)	(-0.27)	(0.20)	(0.20)	(1.91)*	

Values in parenthesis are absolute values of t-ratio, (*) significant at 10%, (**) significant at 5%, (***) significant at 1%

CONCLUSION

It is worth nothing that this study actually ascertains malaria incidence in the study area. Malaria test were actually carried out. As such this study established that there was great variation in the crop output produced among malaria affected households which was statistically significant even though there were no variations in the level of input used by households. The cost of treatment and prevention had significant and positive effects on crop output. Given the labour intensive nature of small scale agricultural production in the study area and the fact that rural farmers are prone to high malaria incidence, small scale farmers in the study area would continue to suffer loss and operate at lower levels of productivity and profitability except efforts are made to address issues bordering on malaria incidence.

A zero tolerance malaria programme in the study area would decrease household incidence of malaria and increase agricultural production considerably thereby ensuring increase profitability. Efforts should be aimed at facilitating early detection of malaria through the use of Rapid Diagnostic Test (RDT) for effective treatment. Strengthening malaria control in the study area by use of insecticide treated net and other control measures.

Awareness should be created on the use of mosquito nets. The area should be targeted for free net distribution and training on utilization.

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