ESTIMATION OF COST OF TREATING MALARIA AMONG ARABLE CROP FARMING HOUSEHOLDS IN NIGER STATE, NIGERIA

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ABSTRACT

This study estimated the economic cost of malaria and determined production and malaria related factors affecting farm revenue. A multi-stage random sampling method was used to select one hundred and twenty eight arable crop farming households from whom data were collected for the study. Data collected were analysed using descriptive statistics, arithmetic indices, t-test of difference of two means and Ordinary Least square (OLS) regression method. The results revealed that an average household had nine members. About 6.5% of sampled households sought health care in the government hospitals, while 30.5 and 20% of the sampled households patronised patent medicines stores and traditional carers respectively. The sum of N7,415.41k was incurred as economic cost of malaria per household per annum in the study area. Farm size, hired labour, combined malaria treatment costs and days lost to malaria attack were significant factors affecting Farm Revenue. The study recommended priority attention to rural areas in malaria control programme; improvement in health care delivery system and incorporation of traditional medical practitioners in the health care system.

Keywords: Malaria, Cost, Arable Crops, Farming Households.

INTRODUCTION

Malaria is one of the world's most serious tropical diseases and it imposes very significant economic costs on some of the poorest nations on earth (Richard, 1998). This disease impairs the living standards of Africans and also prevents improvement of living standards of future generations (Brundtland, 2000). According to Sachs and Malaney (2002), every 49 seconds a child dies of malaria, resulting in a daily loss of more than 2,000 young lives worldwide. These estimates render malaria the pre-eminent tropical parasitic disease and one of the top three killers among communicable diseases. World Economic Forum (2003) reported that the risk of malaria exists throughout Nigeria. This threatens labour availability and efficiency of farm operations. Nwosu (1989) showed various ways in which farm labour supply is affected by disease infection. It was claimed that the 'direct' effect of disease results when a working member of household is prevented from working on the farm due to disease infection. The 'indirect' effect of the disease results when a working member of farming household is prevented from working on the farm when someone

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else is affected by the disease.

Malaria contributes significantly to ill-health in the tropics. Improved health contributes to economic growth in four ways: it reduces production losses caused by worker illness; it permits the use of natural resources that had been totally or nearly inaccessible because of disease; it increases the enrollment of children in schools and makes them better able to learn; and it makes alternative uses of resources that would otherwise have to be spent on treatment (World Bank, 1993). The most obvious sources of gain from healthier workers are savings of workdays, increased productivity, greater better-paying job opportunities, and longer working lives. Health status is often used to explain wages, productivity, school performance, fertility and the demand for medical care.

In Sri Lanka the near-eradication of malaria during 1947-77 is estimated to have raised national income by 9 per cent in 1977. Over the period of three decades, the cumulative cost of such an initiative was $52 million as compared to the cumulative gain in national income of $7.6 billion, implying a spectacular benefit-cost ratio. Areas previously blighted by mosquitoes became attractive for settlement. Migrants moved in and output increased (World Bank, 1993).

In order to study household cost of malaria, Sauerborn *et al.,* (1996) differentiated between financial cost (direct cost) which include out of pocket expenditure for drugs, fees, transport to treatment site, lodging and food for accompanying household members; and the time cost which is the sum of the opportunity costs of wages forgone by the sick individuals due to the illness, and opportunity cost of healthy member's time

spent on treating or attending to the sick person or accompanying them for treatment.

With agriculture providing employment for a great proportion of the Nigerian labour force (Omotesho *et al.,* 1995) and responsible for about 30 percent of national output (Jimoh, 2005), it is to be expected that agricultural sector would bear a substantial fraction of the economic burden of malaria. Paradoxically, the cost of malaria prevention and treatment consumes household resources. The occurrence of such disease could cause morbidity and debilitating effects on labour which affects output especially if the sickness coincides with the peak period of production when labour is in high demand. This study therefore, sought to determine the economic costs of malaria and its effect on farm revenue among arable crop farming households using Niger State as a case study and attempts were made to answer the following research questions:

i.   What is the time and financial costs incurred by arable crop farming households in the study area?
ii. What are the malaria related factors that affect the value of farm revenue?

Findings from the study are expected to bring out the importance of malaria as a disease of national importance in terms of its effect on labour availability and farm income and ultimately provide policy direction aimed at reducing the impact of diseases on farming households and improve farm income.

METHODOLOGY
The Study Area
The study was conducted in Niger State, Nigeria which is located between latitudes $9^{0}18'N$ and $11^{0}30'N$ and longitudes $5^{0}03'E$

and 8⁰30'E within the Northern Guinea savanna vegetation zone and covers a total land area of 4240 sq km (8 million hectare). The vegetation of the state is within the southern guinea savannah ecological zone. It experiences distinct dry and wet seasons with annual rainfall varying from 1,100mm in the North to 1,600mm in the South. Duration of dry season commences in October and the humidity could be 140 percent in December and February.

The estimated population of the state is 3,950,249 (National Population Commission 2006). Farming is the pre-occupation of about 47.2 percent of the state's population, while others engage in white collar jobs, businesses, crafts and arts. The climate, soil and hydrological condition permit the cultivation of most Nigeria staple crops such as rice, maize, beans, as well as yam and still leave ample scope for grazing, fresh water for fishing and forestry. This climate also favours the breeding of mosquito, hence the preponderance of malaria disease.

Methods of Data Collection and Sampling Technique

Data were collected with the aid of well structured questionnaires which were administered to the selected households. Data were collected on the malaria illness episodes, days lost to illness, cost of illness, treatment methods, coping strategies, farm inputs, outputs and prices. This study adopted a multi-stage sampling technique. The first stage involved selection of two out of the three Agricultural Development Projects (ADP) zones through purposive sampling technique based on the Niger state monthly Epidemiological reports (2005). The second stage was a simple random sampling of 70 respondents from each of the two zones using the State ADP's village

and farmers list as sampling frame. This gave a total of 140 respondents. However, only data obtained from a total of one hundred and twenty eight (128) samples (representing a 91.4% return rate) were adjudged valid based on completeness of information provided for onward analysis.

Analytical techniques

Descriptive statistics involving the use of frequency tables and percentages was used to describe the socio-economic characteristics of arable crop farming households. The Cost of Illness was calculated following Sauerborn (1996) arithmetic indices procedure. Gross margin analysis was also used to assess the return to arable crop farming and t-test was to compare the values between high and low malaria episode households. Ordinary Least Square (OLS) regression analysis was used to obtain estimates of parameters of production inputs and malaria related factors affecting farm revenue. Linear, Semi-Logarithm and Double Logarithm functional forms were estimated in order to give room for the selection of the best fit functional form.

Direct and Indirect Cost of Malaria Aversion by households in the study area

A modified arithmetic index following Sauerborn (1996) was used to capture the direct and indirect costs incurred in malaria aversion.

Direct (Financial costs of healthcare for the last farming season (N)

$$F = F_t + F_e + F_0 \text{ -------------------------------- (4)}$$

where

F = total financial cost of treatment of malaria in the last season (N)

F_t = cost incurred in traditional treatment methods (N)

F_e = cost incurred on conventional treatment methods (N)

F_0 = other cost such as transportation, sub-

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stitutes etc incurred on malaria treatment (N)

Direct (Prevention) cost of malaria:

$$P = P_m + P_{mr} + P_{nt} P_s + P_{st} \text{----------------------------} (5)$$

where

P = Prevention cost of malaria by household (N)

P_m = Costs incurred on mosquito coil (N)

P_{mr} = Cost incurred on mosquito repellents (N)

P_{nt} = Cost incurred on bed-net (N)

P_s = Cost incurred on Sunday –Sunday 'agbo' (herbal mixture) medicine (N)

P_{st} = Cost incurred on sanitation (N)

Indirect (time) cost of malaria:

$$T = (T_s * a_s * w) + (T_c * a_c * w) \text{-----------} (6)$$

where,

T = Opportunity cost of time due to days of work lost during sickness (days of forgone production)

T_s = time lost by the sick person (days of forgone production)

T_c = Time lost of the caretakers (days of forgone production)

a = productivity coefficient/male adult equivalent

w = daily wage rate

s = related to the sick individual

c = related to the carer (s)

$*$ = multiplication sign

Economic cost of malaria:

$$E = \Sigma (F + P + T) \text{------------------------} (7)$$

where

E = Economic costs of malaria in each household

F = Total financial cost of healthcare in the last season (N)

P = Prevention cost of malaria by house hold (N)

T = Opportunity cost of time due to days of work-lost during sickness (days of forgone production

Gross Margin Analysis

Gross margin analysis was also used to assess the return to arable crop farming

$$GM_i = TR_i - TVC_i \text{--------------------------} 2.$$

where

GM = Gross Margin in naira per hectare

TR = Total revenue which (farm gate value of the output)

TVC = Total variable cost

Difference of Two Means

This was used to test the hypothesis that no significant difference exists in the Gross Margin between low (2 episodes or less) and high (more than 2) malaria episode households.

$$T = \frac{\overline{X_i} - \overline{X_j}}{\sqrt{\dfrac{S_i^2}{n_i} + \dfrac{S_j^2}{n_j}}}$$

where

$\overline{X_i}$ = the mean gross margin per hectare of household that had less than two malaria episode per year.

$\overline{X_j}$ = the mean gross margin per hectare of households that had more than two malaria episode.

S_i^2 = the sample variance for household that had less than two malaria episodes

S_j^2 = the sample variance for households that had more than two malaria episodes

N_i = the number of household that had less than two malaria episode per year

N_j = the number of households that had greater than two malaria episode per year.

Model specification:

$Q = f(X_1, X_2, X_3, X_4, X_5, X_6,)$ ------------ (1)

where

Q = Farm Revenue (N)
X_1 = Land size (hectare)
X_2 = Family labour (N)
X_3 = Hired labour (N)
X_4 = other costs (cost of fertilizer, seeds, insecticide (N)
X_5 = Combined malaria treatment and time cost (N)
X_6 = prevention cost (N)
X_7 = Days lost to malaria attack
e = error term

The regression coefficients of the variables were expected to come up with positive sign implying positive contribution to the farm revenue, except variable X_5 (Treatment cost) and X_7 (days lost to malaria attack) that are expected to have a negative signs, implying a negative contribution to the farm revenue. Thus the *a priori* expectations of the signs and magnitudes of the estimated parameters are:

$b_1 > 0$, $b_2 > 0$, $b_3 > 0$, $b_4 > 0$, $b_5 < 0$, $b_6 > 0$ and $b_7 < 0$

RESULTS AND DISCUSSION

Table 1 shows the summary statistics of various socio-economic and production variables that are of importance and considered in this study. The analysis revealed that average farmer realizes a Gross margin of N32,675 with household size of nine and average years of arable crop farming experience of 21 years. The mean age of house-

Economic cost of malaria

Table 2 shows that malaria afflicted household incurred N217.50 for traditional methods of treatment, N342.00 for orthodox methods of treatment and N82.26 as transportation cost to the treatment site per episode. Similarly, N817.15 was expended on preventive measures, while time cost of sick person and carer totalled N2,657.37 per malaria episode. Generally, the financial cost for treatment was N1,283.52 constituting 17.31% of the total cost of malaria treatment. Time cost was N5,314.74 representing 71.67% per year per household. Financial cost of malaria treatment depletes the household income and may have negative effect on the household budget for farm inputs. This is because the scarce household resources may eventually be diverted to healthcare, thereby reducing purchasing capacity which would eventually lead to reduced agricultural productivity. Also, time cost, which indicates the opportunity cost by the affected household members and the carers ramifies the economic loss of members' time rendered unavailable for farm activities as a result of malaria attack. This may have a negative effect on the farm output especially if the attack occurred at peak farming period. It can also delay farm operations and/or create a 'shadow effect' situation, where a specialized function that had to be performed by male household members may be transferred to the women folk, thus implying less efficiency of labour contribution across age and gender.

Gross Margin and Test of Difference of Two Means

The hypothesis tested as shown in Table 3 indicated that a significant difference exist in the gross margin among households based on the frequency of occurrence of malaria in the study area. Households with two or less

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malaria episodes had a higher gross margin per hectare (N35,609.66) while those that had more than two malaria episodes had a lower gross margin (N29,966.06). This may be interpreted to mean that malaria epi-sodes play a major role in lowering profit accruable to arable crop farming households and hence reduces the potential of farmers to improve their means of livelihood.

Table 1: Summary Statistics of Socio-economic and Some Production Variables

Variables	Mean	Minimum	Maximum	Std. Dev
Gross margin	32675	17900	64025	4561.3
Hired Labour	42.7	14	117	13.7
Family Labour	85.1	30	115	21.2
Household Size	9	3	37	6.6
Experience	21.3	4	65	10.4
Farm Size (ha)	4.18	0.64	10.00	1.28
Other cost	4780	2500	10,680	1206
Age of head	43.5	27	78	12.2

Source: Computed from field survey data (2006)

Table 2: Summary of Economic cost of malaria treatment per year in the study area

Type of cost	Amount (N)	Percentage
Financial cost of malaria treatment per episode		
Cost incurred in traditional method of treatment	217.5	33.89
Cost incurred in orthodox treatment method	342.0	53.29
Cost incurred in transportation to location of treatment	82.26	12.82
Total	**641.76**	**100.00**
Prevention cost of malaria per household		
Cost incurred on mosquito coil.	150	18.36
Cost incurred on mosquito repellents	57.15	6.99
Cost incurred on bed net	450	55.07
Cost incurred on weekly (herb) medicine	110	13.46
Cost incurred in sanitation	50	6.12
	817.15	**100.00**
Time cost of malaria per episode		
Time cost of sick person(s)	151.50	57.14
Time cost of carer(s)	1138.87	42.86
Total	**2657.37**	**100.00**
Total cost of malaria illness per year		
Financial cost	1283.52	17.31
Prevention costs	817.15	11.02
Time costs	5314.78	71.67
Total	**7415.41**	**100.00**

Source: Computed from field survey data (2006)

Table 3: T-test of Difference of means in Farm Revenue according to malaria episodes per year in the study area

Malaria episode	Mean GM/ha (N)	t-statistic	Remark
1 to 2	35, 609.66	2.072	0.05 level)
Greater than 2	29, 966.06		

Source: Computed from field survey data, 2006

Factors affecting farm revenue in the study area

Based on factors like the signs of the parameter estimates vis-a-vis the *a priori* expectations; the significance of the estimates as revealed by the t-values; the coefficients of multiple determination (R^2) and F-values, the linear functional form was selected as the lead equation to explain the relationship between farm revenue and factors affecting it (including malaria related factors). (Table 4).

The empirical result indicated that land size (X_1) significantly ($\alpha_{0.01}$) and positively affect farm revenue. The implication is that *ceteris paribus*, a unit increase in the hectare of land cultivated will cause the output value to increase by N12, 494. This result is consistent with the findings of Amara *et al.* (1999), that the larger the farm size, the higher the revenue.

Table 4: Factors affecting farm revenue in the study area

Variable name	Parameter	Coefficient	t - value
Constant	b0	16636*	2.875
Land size	b1	12494**	4.307
Family labour	b2	0.957	1.440
Hired labour	b3	2.182**	3.534
Other costs	b4	1.958	1.476
Treatment cost	b5	-1.179*	-1.983
Prevention cost	b6	3.108	1.259
Days lost due to illness	b7	-165.4*	2.151
Adjusted R2	0.778		
F value	64.57		

**: Significant at $\alpha_{0.01}$ percent level, *Significant at $\alpha_{0.05}$ percent level
Source: Computed from field survey data

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Hired labour (X_3) was significant ($\alpha_{0.01}$) and positively related to the value of output. This implies that a naira increase in the cost of hiring labour by the household will cause revenue to increase by 2.182 units. This corroborates Meir, (1989) findings, that a positive relationship exists between the output and labour if labour is limited in supply. This may therefore implies shortage of labour supply. It may also be interpreted to mean that arable crop farmers were operating in the stage I of the production surface which is a stage of increasing return to scale. In this stage, marginal revenue is greater than marginal cost as shown by this result.

Treatment costs (X_5), is significant ($\alpha_{0.05}$) and negatively related to output value. This implies that an increase in the treatment expenditure of a household by 1 naira will lead to a decrease in farm output by N1.19. The implication of this is that malaria has significant effect on the crop output and consequently on the level of revenue accruing to arable crop farming households in the study area. Furthermore, days lost to malaria infection (X_7) had a negative and significant ($\alpha_{0.05}$) relationship with farm revenue. This implies that as members of arable crop farming households lose workdays to malaria, farm revenue decreases. The coefficient value of -165.4 means that farming households lose N165.40 to malaria episode.

CONCLUSION AND RECOMMENDATION

Based on the results obtained, the economic cost of malaria was estimated at N7, 415.41 per household per year and this was 22% of the average gross margin of the surveyed farmers. There was significant difference in the gross margin per hectare at different levels of malaria episodes. The study established that malaria affliction in households has negative effect on income due to attendance loss of valuable manpower and reduced productivity. This study therefore recommends that government at the various administrative levels should give more priority attention to malaria control programmes and improvement in healthcare delivery system, especially in the rural areas.

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(Manuscript received: 4th May, 2010; accepted: 24th March, 2011).