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Effect of workdays lost to presumptive malaria on food crop production in rural south west Nigeria

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Abstract

Malaria is a major public health problem in Nigeria, having negative effect on economic livelihood of farming households. Therefore, this study examined the effect of workdays lost to presumptive malaria on food crop production in rural South west Nigeria. A four-stage sampling technique was used to randomly select 395 food crop farming households from Oyo and Osun states based on probability proportionate to size. Structured questionnaire was employed in collecting primary data used in the study. Data were analysed using descriptive statistics and ordinary least square regression model at $\alpha_{0.05}$. Age of households' head was 56.41±9.34 years. Male respondents were 88.6%, household size was 7±2 persons and 37.0% had no formal education. Only 45.1%, 24.6%, 37.2% and 7.1% had access to extension services, credit facilities, electricity and mosquito nets, respectively. In a year, the average number of presumptive malaria episodes per household was 17.49± 4.28. Workdays lost to malaria was 73.49±23.87, out of which 69.8% and 30.2% was due to sickness and caregiving, respectively. Household size (β=-1.00), hired labour (β=-0.25) and workdays lost to presumptive malaria (β=-0.12) reduced per capita food crop production while farm size (β= 0.42), fertilizer (β=0.43), herbicides used (β=0.15) and planting materials (β=0.11) increased per capita food crop production. Workdays lost to presumptive malaria had negative influence on household food crop production. Therefore, people in the study area should be encouraged to make proper use of malaria preventive measures, such as mosquito nets, so as to reduce frequency of mosquito bites and malaria attacks. Medication that can reduce the days of incapacitation should be intensified and made available to farmers at affordable prices in order to improve the quality of life and productivity of farming households. Also health education should form a core of educational and extension service delivery to the farmers especially in the rural areas where majority are into farming as means of livelihood.

Keywords: Presumptive malaria**,** Rural farming households, food crop production, southwest Nigeria.

Introduction

The food production role of the agriculture sector depends largely on crops production subsector as all the staples consumed in the nation comes from crop production, 90% of which is accounted for by smallholder farmers (CBN, 2012). In Nigeria, agriculture is characterized by a large number of smallholder farmers with small holdings ranging from 0.05 to 3.0 hectares of land area, low capitalization and low yield per hectare (Ogundari and Ojo, 2007). Nigeria's agriculture is also labour intensive and rain fed, which requires farmers to a well-timed prepare land, plant, weed and harvest to ensure that the crops' growth stages coincide with the most favourable growth conditions. The success of agricultural livelihoods therefore, depends on the health of the workforce.

Nigeria is an agriculturally labour-intensive economy and the protection and utilization of the labour resource to guarantee highest productivity is of immense vitality to the growth of the agricultural sector. Illness and death from malaria, HIV/AIDS, tuberculosis and other diseases reduce agricultural productivity through loss of labour and death of productive adults (World Bank, 2007). About half of adults have at least one episode of malaria each year and at least 50% of the entire population has at least one episode of malaria annually while children that are aged less than 5 years have 2 to 4 attacks per annum (FMoH, 2005; UNICEF, 2014), resulting in high productivity losses.

Malaria is a major public health problem in Nigeria. It impairs the ability of people to work hard by losing productive time during sickness and care-giving activities, while adults with malaria severely compromise household resources as their capacity to work, earn income and save for their families is reduced. An estimated 97% of the country's approximate population of 160 million residents are at risk of malaria. The country accounted for 32% of the global estimate of 655,000 malaria deaths in 2010 (WHO, 2012). It was also reported that Nigeria and Democratic Republic of Congo accounted for more than 35% of global malaria deaths in 2015(WHO, 2016).

Malaria and agriculture are intimately related because agricultural environments provide suitable conditions for breeding of mosquitoes. The peak of malaria transmission has been found to coincide with the peak of planting and harvest seasons when demand for labour is suppose to be high. Malaria is one of the major tropical diseases plaguing the rural populace especially the farmers by affecting their productivity and efficiency (Alaba and Alaba, 2009). According to Ajani and Ugwu (2008), achieving self-sufficiency in food production and the much desired growth in agriculture sector of the economy will continue to elude Nigeria if health issues in agriculture are not properly addressed. Malaria reduces crop production by increasing absenteeism from farm activities, and by reducing work capacity or effort of household members (Laxminarayan, 2004).

In Africa, women account for about 70% of agricultural workers and 60-80% of the food producers for household consumption and sale (Todaro, 2000). Taking substantial time off to care for sick adults and especially their children constitutes a threat to food production. Given that over 80% of the continent's population lives in the rural area, the effects of malaria on agriculture, health, and development are widespread. The global impact of malaria on human health, productivity, and general well-being is profound, and Africa has been particularly hard hit (Asenso-Okyere *et al.*, 2011).

Despite its devastating effects, the importance of a malaria-free environment in promoting agricultural development has not been fully appreciated in Nigeria. Hence, this study was carried out to examine the effect of presumptive malaria on food crop production in rural south west Nigeria.

Materials and Methods

Study Area

The study was carried out in South West Nigeria. The zone falls on Latitude 6^0 to the North and Latitude 4^0 to the South. It is marked by Longitude 4^0 to the West and 6^0 to the East. Total population of the area as at 2006 was 27,581,992 (NPC, 2006). The zone is bounded in the North by Kogi and Kwara States, in the East by Edo and Delta States, in the South by Atlantic Ocean, and in the West by Republic of Benin. It composes of six states: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo. The geographical location of South West Nigeria covers about 114, 271 kilometer square, that is, approximately 12% of Nigeria total land mass. There are two distinct seasons, the rainy season, which lasts from April to October and the dry season which starts from November and ends in March. The distribution of rainfall varies from about 1000mm to about 2000mm. Important cash crops such as cocoa, kolanut, citrus, coffee, rubber and oilpalm are grown in the region. Savanna parts of the region produces food crops such as tubers, grains, plantain / banana and vegetables.

Although malaria is endemic throughout Nigeria (Yusuf *et al*., 2010), the choice of South West Nigeria is premised on the fact that, in the zone, the climate is hot and humid which favours the proliferation of the mosquito vectors (Babalola *et al*., 2009). Also, Nigeria Demographic and Health Survey (2013) indicated that South west is the zone with the lowest number of households with at least one Insecticide Treated Nets (ITNs) or Long-lasting Insecticidal nets (LLINs) in Nigeria. Hence, the least in access to malaria preventive measures when compared with the remaining five geo-political zones.

Sampling Procedure

A four-stage sampling technique was used. The first stage was the random selection of Oyo and Osun states from the six states in South west Nigeria. In the second stage, four (4) and three (3) rural Local Government Areas (LGAs) from Oyo and Osun states, respectively were randomly selected based on probability proportionate to size of rural LGAs in each of the states. The third stage was the random selection of five villages from each of the LGAs, making a total of 35 villages in all (i.e. 20 and 15 villages from Oyo and Osun state, respectively). In the fourth stage, a simple random selection of 10% of the food crop farming households in each of the thirty-five (35) villages were carried out. This was achieved by making a list of food crop farming households in each of the selected villages from which a 10% of them were selected for interview. Out of the four hundred and twenty (420) questionnaires administered on the respondents, twenty-five (25) were discarded for incomplete information and inconsistency. Consequently, data from 395 (224 and 171 from Oyo and Osun states, respectively) questionnaires were analyzed for the study.

Method of Data Collection

This study focused on "perceived" or “self-reported’’ malaria. That is, what people perceived to be "malaria" and what health workers typically, presumptively diagnosed as "malaria" and not with the prevalence of malaria as measured by presence of parasites in the blood that are not manifested in illness symptoms.

The primary data used for this study were obtained from the respondents with the aid of structured questionnaire. During the interview, efforts were made to ensure that people reported malaria episodes based on symptoms as close as possible to accepted clinical symptoms. The following symptoms were taken as indicative of malaria: fever, headache, chills/shivering, abdominal pain, diarrhea, nausea (vomiting), altered taste, loss of appetite (anorexia), general body weakness, muscular pain, joints pain and convulsion especially in children (Tangpukdee *et al*., 2009). Appropriate symptoms baselines were set to conclude that the symptoms described justified concluding that the illness is malaria.

The primary data collected from the households include socio-economic and demographic characteristics such as age and sex of household head, household size, level of education, years of farming experience, access to extension services; farming activities such as farm size cultivated, food and cash crops planted, inputs used (quantities and prices), farm outputs (in kg). Malaria related information sought include the number of presumptive malaria cases per household in 2014, number of days of incapacitation per episode of malaria by both the sick and the caregiver, age and sex of the sick and the caregiver.

Method of Data Analysis

Statistical tools used in data analysis are descriptive analysis and Ordinary Least Square Regression model**.** The descriptive statistics included frequency, means, percentages and standard deviation. These were used to profile the socio-economic characteristics of the households. The Ordinary Least Square Regression model was used to examine the influence of workdays lost to presumptive malaria and other variables on per capita food crop production.

Ethical considerations

Written informed consent was obtained from all the heads of the households participated in the data collection (interview) and assurance given to them that all information received would be handled confidentially. Participants were informed that participation is voluntary. The respondents were also assured of their right to withdraw from the interview at any time they would wish during the interview. The survey was also anonymised so that household or individual information is not identifiable. Ethical clearance for the study was obtained from the Osun State Specialist Hospital Osogbo Health Research Ethics Committee (Clearance number: HREC/27/04/2015/SSHO/027).

Econometric specification

Ordinary Least Square Regression model

Given that the main focus of this study is to estimate the effect of workdays lost to presumptive malaria on food crop production, the study adopted the analytical technique of Ordinary Least Square regression model as used by Fosu and Nwabu (2007) and Aheisibwe (2011) in estimating the effect of malaria on agricultural production in Kenya and Uganda, respectively. The general functional form of the production function used is specified as follows:

$Q = f(K, L, Z, X, M,)$ ……………………………………………………………..(1)

Where
Q = Quantity of food crop produced by households in a given crop season in kg (grain equivalent)
K= Household farm size cultivated (hectare)
L = Labour inputs contributed by household members (mandays)
Z = Vector of quantities of physical inputs such as fertilizers, planting materials, etc.
X = A vector of other factors affecting production such as socio-economic characteristics of the households (e.g. Age, marital status, education level etc.)
M= Vector of Malaria prevalence at household level (e.g., presence or absence of malaria, number of malaria episodes, days of incapacitation due to malaria incidence, etc).

Equation 1 shows the effect of malaria (M) on output (Q), holding constant the effect of other relevant variables (K, L, X and Z). Different specifications of equation 1 have been used to estimate the effect of malaria on farm production, economic growth and on the level of gross domestic product in Africa (Aheisibwe, 2011; Ibrahim *et al*., 2010; Fosu and Nwabu, 2007; Gallup and Sachs, 2000; McCarthy *et al.*, 2000). The effect of M on output in the literature so far has been shown to be negative (Fosu and Nwabu, 2007; Aheisibwe, 2011; Gallup and Sachs, 2000). It is for this reason that malaria is said to be a burden on the economy.

The equation 1 shows that for a given levels of K, L, X and Z, M captures output-reducing effects of malaria such as diminished work capacity, work absenteeism, and low stocks of human capital (deficiencies in cognitive ability, literacy and numeracy skills due to malaria).

Implementing the production function approach started with a linear specification of the production function and proceeded to estimate a double-log form of the model (Orem *et al*., 2012).

Given the production function as :
$Q=f(Ag, Hs, Ed, Fe, Ex, Fs, Fl, Hl, Ft, Hb, Cp, M, \varepsilon i)$……………………………………(2)
Equation 2 presents the general functional form of food crop production.

According to Orem *et al*. (2012), if the standard linearity assumption between explanatory variables in a regression is violated; equation 2 can be expressed in its Cobb-Douglas production function form as:

$$Q = \beta_0\, Ag^{\beta 1}\, Hs^{\beta 2}\, Ed^{\beta 3}\, Fe^{\beta 4}\, Ex^{\beta 5}\, Fs^{\beta 6}\, Fl^{\beta 7}\, Hl^{\beta 8} Ft^{\beta 9} Hb^{\beta 10}\, Cp^{\beta 11}\, M^{\beta 12}\, \varepsilon i \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Following Orem *et al*. (2012); Gujarati and Porter (2009), equation 3 can be transformed into its double-log functional form as:

$$\ln Q = \beta_0 + \beta_1 \ln Ag + \beta_2 \ln Hs + \beta_3 \ln Ed + \beta_4 \ln Fe + \beta_5 \ln Ex + \beta_6 \ln Fs + \beta_7 \ln Fl + \beta_8 \ln Hl + \beta_9 \ln Ft + \beta_{10} \ln Hb + \beta_{11} \ln Cp - \beta_{12} \ln M + \varepsilon_i \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:

Q = Quantity of food crop output (per capita output) in kg (grain equivalent)
Ag=Age of the Household Head (Number of Years)
Hs= Household size (in number)
Ed= Household's head level of education (Years of schooling)
Fe =Farming experience (Number of Years)
Ex= Access to Extension service (Dummy; 1=access, 0=no access)
Fs= Household farm size cultivated (hectare)
Fl= Family labour input (manday)
Hl= Hired Labour utilized (manday)
Ft =Quantity of fertilizer used (kg)
Hb=Quantity of Herbicides used (Litres)
Cp =Cost of Planting materials used (Naira)
M= Malaria (estimated as workdays lost to presumptive malaria by households in 2014 (manday)
ε_i is the usual error term
β_0 is the multiplicative constant or intercept of the production plane.
β_s are the effect of each of the explanatory variables on food crop output, and
ln= natural logarithm.

Parameter estimates for equation (4) will be obtained using the Ordinary Least Squares analytical technique as used by Fosu and Nwabu (2007). Specifically, the loss in food crop output due to number of workdays lost as a result of presumptive malaria can be computed from equation 4 above, provided both Q and M are in natural logarithm, λ which is the loss in food crop output in kilograms per household due to presumptive malaria can then be computed as:

$$\lambda = (\partial Q / \partial M) = (Q / M)\, \beta_{12} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where:

β_{12} is the elasticity of food crop output (Q) with respect to workdays lost to presumptive malaria (M). The economic loss in levels λ is the reduction in the household food crop output resulting from a unit increase in workdays lost to presumptive malaria at household level. The parameter λ is expressed in kilograms per household.

From equation (5), the elasticity term $\beta_{12} = \lambda\,(M/Q)$.
β_{12} is known from regression results, M and Q are got from the sample means.
The effect of other factors, other than workdays lost to presumptive malaria, on food crop output is also determined using equation (4) above.

For this study, days of incapacitation due to malaria illness for any household member(s) who is/are less than 18 years old, especially school children, were not computed as part of workdays lost in line with ILO (2010) and Akazili (2000), except if adult caregiver lost workdays in the course of such a malaria episode. Per capita food crop output was used because the focus is on labour productivity rather than land productivity (quantity produced per hectare) and since malaria affects humans and not the land, this is in line with Cunguara and Kelly (2009b).

Results and Discussion

Socio-economic Characteristics of the Respondents

The result of the descriptive analysis shows that 88.6% of the households' head were male, age was 56.41±9.34 years, 88.4% were married, household size was 7±2 persons. Years of schooling was 4.80±4.65 which is far below the universal basic education of at least 6 years (primary school) with 37.0% of them had no formal education. Years of farming experience was 29.53±10.78. Average farm size cultivated was 1.72±0.56 and the annual farm income was estimated to be ₦452,711.70±153,704.70 (equivalent to ₦37,725.97 per month). All these were illustrated in tables 1.

Table 1: Socio-Economic Characteristics of food crop Farming households

Variables	Frequency	Percentage	Mean	S.D
Sex of the household head				
Male	350	88.6		
Female	45	11.4		
Age of Household head (years)				
Less than 45	49	12.4		
45-54	106	26.8		
55-64	152	38.5	56.41	9.34
Above 64	88	22.3		
Marital status of household head				
Married	349	88.4		
Widow/Widower	45	11.4		
Single	1	0.3		
Household size				
2-5	111	28.1		
6-9	266	67.3	6.518	1.63

Above 9	18	4.6		
Household head's years of Schooling				
0 (No formal education)	146	37.0		
1-6	142	36.0		
7-12	100	25.3	4.80	4.65
Above 12	7	1.8		
Farming experience (years)				
1-10	11	2.8		
11-20	96	24.3		
21-30	93	23.5	29.53	10.78
31-40	142	36.0		
Above 40	53	13.4		
Farm size (Hectares) cultivated				
Less than 1	13	3.3		
1-1.5	120	30.4		
1.6-2.0	193	48.9	1.722	0.5569
2.1-3.0	57	14.4		
Above 3	12	3.0		
Household's farm income (₦ / Annum)				
Less than 200,000	8	2.0		
200,000-299,999	58	14.7		
300,000-399,999	97	24.6		
400,000-499,999	100	25.3	452711.7	153704.7
500,000-599,999	68	17.2		
600,000-699,999	35	8.9		
700,000 and above	29	7.3		

Source: Field survey, 2015.

Estimation of Workdays Lost to Malaria

Table 2 indicated that the average workdays lost to presumptive malaria per household per year in the study area was 73.49±23.87. The actual workdays lost by the sick was 51.28±19.92, while the workdays lost to care-giving was 22.21±13.48 days. This implies that the bulk (69.8%) of the workdays lost is actually due to malaria sickness of the adults and older children who provides source of family labour on the farm while the remaining 30.2% is attributable to care-giving alone.

Table 3: Average workdays lost to malaria sickness and care-giving

Forms of Workdays lost	Workdays lost	Std dev.	As % of total workdays lost to malaria	Minimum	Maximum

Workdays lost by the sick persons	51.28	19.92	69.8	11	112
Workdays lost by the care-givers	22.21	13.48	30.2	0	70
Total workdays lost	**73.49**	**23.87**	**100**		

Source: Field survey, 2015.

Determinants of Food Crop Output

Table 3 presents the estimates of the OLS regression. The overall fit of the model is very good with the coefficient of determination (Adjusted R^2) of 0.7388, implying that 73.9% of the variation in log of per capita food crop output is explained by the regression equation. This means that all the factors combined significantly influence per capita food crop output of farming households. F-value for the model was statistically significant at 1%, implying that the model is well fitted to the data, and the results are reliable.

The coefficient of presumptive malaria (defined in term of workdays lost to presumptive malaria) was negative and statistically significant at 10%. This implies that households' per capita food crop output is negatively affected by workdays lost to presumptive malaria.

The coefficient for workdays lost to presumptive malaria (M) of -0.1154 indicates that when workdays lost to presumptive malaria increases by 1%, *ceteris paribus*, per capita food crop output decreases by 0.1154% (estimated to be 3.68Kg grain equivalent in adult equivalent, given the per capita food crop output of 2342.67kg), which is the burden of malaria on per capita food crop output. The study has proved that the workdays lost to presumptive malaria result in a statistically significant decline in household per capita food crop output; this implies reduced labour productivity. These findings concur with Ochi *et al*.(2015), Aheisibwe (2011), Alaba and Alaba (2009) that malaria illness will lead to reduction in crop production.

The coefficient of household size was found to be negative and significant at 1 percent level. This implies that there is an inverse relationship between household size and the per capita food crop output. The coefficient of -1.0040 indicates that when household size increased by 1%, per capita food crop output decreased by 1.00%. The coefficient of hired labour was negative and significant at 1%. The coefficient of -0.2499 indicates that when hired labour utilized increased by 1%, per capita food crop output decreased by 0.2499%. The inverse relationship between hired labour and per capita food crop output is a pointer to the fact that hired labour involvement is above the cost-effective point such that it therefore affects household per capita food crop output negatively. However, the coefficients of farm size cultivated by the household, fertilizer used, herbicides used and planting materials used had positive coefficients and were significant at 1%. Precisely, 1% increase in each of these variables, holding other factors constant, would lead to 0.4181%, 0.429%, 0.1503% and 0.1130% increase in per capita food crop output, respectively. These findings agree with Umoh (2006).

These findings of this study are closely related to Aheisibwe (2011), Asante (2009), and Ajani and Ashagidigbi (2008). Asante (2009) noted that malaria impacted negatively on agriculture in terms of; causing loss of probable active adult labour in addition to decline in labour quality; time diverted from farming towards taking care of the sick and reduction in funds available to hire seasonal casual workers.

Table 3: Effects of Presumptive Malaria on Food Crop Output

Dependent variable: Log of per capita food crop output (Log Q)				
Independent Variables	Coefficient	Std error	t-value	P > | t |
Constant	2.2008***	0.3339	6.59	0.000
Log Age of household head	0.0714	0. 1396	0.51	0.609

Log Household size	-1.0040***	0.0505	-19.89	0.000
Log Household head's years of schooling	0.0268	0.0181	1.48	0.140
Log farm experience in years	0.0310	0.0522	0.59	0.553
Log Access to extension	0.1799	0.2324	0.77	0.439
Log Farm size cultivated	0.4181***	0.0631	6.63	0.000
Log Family labour utilized	-0.0358	0.0482	-0.74	0.458
Log Hired labour utilized	-0.2499***	0.0612	-4.09	0.000
Log Fertilizer used in kg	0.4269***	0.0960	4.45	0.000
Log Herbicides used in litres	0.1503***	0.0412	3.65	0.000
Log Cost of planting materials used	0.1130***	0.0236	4.78	0.000
Log Workdays lost to presumptive malaria.	-0.1154*	0.0590	-1.96	0.051
F(12, 382) =	86.72			
Prob > F =	0.0000			
R-squared =	0.7474			
Adj R-Square =	0.7388			
Root MSE =	0.0812			
No of Obs. =	395			

Source: Field survey, 2015. *** Significant at 1%, and ** Significant at 5% .
Figures in parentheses are the standard errors.

Computation of the loss in food crop production

The loss in food crop output due to number of workdays lost to presumptive malaria is computed as follows:

$$\lambda = (Q/M)\,\beta_{12}$$

$$\lambda = \frac{2342.68}{73.49} * -0.1154$$

$$\lambda = -3.68\text{Kg (grain equivalent)}$$

* multiplicative sign.

Diagnostic Tests

A number of tests were undertaken to validate the regression results. The results obtained by the OLS method was subjected to the heteroscedasticity hettest, omitted variable and the model specification linktest. The respective null hypotheses are that the residuals are homoskedastic, the model has no omitted variables and that there is no specification error. Heteroskedasticity test was conducted using Breusch-Pagan / Cook-Weisberg test. Results indicated that the residuals were homoskedastic (constant variance). Similarly, Omitted variable test result indicated that there were no omitted variables. Also, the results from linktest for model specification revealed that there is no specification error in the model since the P-value of hat squared was not significant at 1% level of significance. Hence, the model is correctly specified. In addition, tests for multicollinearity was carried out using the Variance Inflation Factor (VIF). The result indicated that multicollinearity is not a serious problem in the model with mean vif of 9.33

Conclusion and Recommendations

The findings of this study showed that workdays lost to presumptive malaria illness reduced households' per capita food crop output. The loss in crop output is largely explained by loss of productive time by the sick household member and the time spent by household members taking care of the sick ones and therefore has little time to engage in active farming. The situation is worsened when a household experiences multiple bouts of malaria infections at a point in time or repeated bouts in a year.

On average, farming households lost 73.49 workdays to malaria in the study area. This has negative impact on their farm output. It is therefore recommended, among others, that the people in the study area should be encouraged to make proper use of preventive measures, such as mosquito nets (ITNs or LLINs), so as to reduce frequency of mosquito bites and malaria attacks. Medication that can reduce the days of incapacitation should be intensified and made available to farmers at affordable prices in order to improve the quality of life and productivity of farming households. Adoption of Artemisinin-based Combination Therapy (ACTs) as the first line malaria treatment should be intensified. Also health education should form a core of educational and extension service delivery to the farmers to assist them make proper use of malaria preventive measure specially in the rural areas where majority are into farming as means of livelihood.

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Appendices

Diagnostic Tests for the OLS Model

1) Diagnostic Results for Heteroskedasticity in OLS Regression

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of logpercapitaoutput

chi2(1) = 0.94

Prob > chi2 = 0.3315

The Breusch–Pagan test tests for conditional heteroskedasticity. It is a chi-squared test: It tests the null hypothesis of homoskedasticity.

2) Omitted variables tests

Ramsey RESET test using powers of the fitted values of logpercapitaoutput

Ho: model has no omitted variables

F(3, 378) = 0.51 Prob > F = 0.6753

3) Specification error tests

linktest

Source	SS	df	MS
Model	7.44064348	2	3.72032174
Residual	2.50723886	392	.006396018
Total	9.94788234	394	.025248432

Number of obs = 395

F(2, 392) = 581.66

Prob > F = 0.0000

R-squared = 0.7480

Adj R-squared = 0.7467

Root MSE = 0.0799

logyield	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
_hat	1.888241	.9477943	1.99	0.047	-1.560967	3.772713
_hatsq	-.1479881	.1578345	-0.94	0.349	-.3660624	.3380998
_cons	-1.330035	1.421248	-0.94	0.350	-5.247155	4.846755

The null hypothesis is that there is no specification error. If the p-value of _hatsq is not significant then we conclude that our model is correctly specified. Hence, we accept the null hyphotesis.

4) Test of Multicollinearity

Variable	VIF	1/VIF
Logfertilizer	42.79	0.023368
Loghire labour	38.07	0.026267

logage	6.69	0.149565
Logfarm experience	5.77	0.173272
Logworkdays lost to malaria	4.56	0.219258
logfamsize	4.52	0.221378
Logyears of schooling	3.75	0.266589
Logherbicide used	3.24	0.308673
Logfamily labour	1.97	0.506330
Loghousehold size	1.67	0.598933
Logcost of planting materials	1.60	0.624295
Logextension access	1.37	0.728722
Mean VIF	**9.33**	