IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 13, Issue 7 Ser. I (July 2020), PP 25-33
www.iosrjournals.org

Malnutrition and HIV/AIDS among Rural Families in Nigeria: Implications for Agricultural Livelihoods

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Abstract: *The productivity of countries around the globe is adversely affected by the health-related problems of their labour force. This study examined the effect of the prevalence of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) and the livelihood of the rural farmer in Nigeria, for 26 years (1990–2016). The study employed the instrumental variables and two-stage least squares, simultaneous model. The 2SLS estimator was used in the model because there are multiple endogenous explanatory variables as well as some instruments and exogenous variables.*

The result revealed that the net effect of better education on HIV rate is negative while its net effect on agricultural output is positive. Specifically, a 10% jump in schooling will lower HIV rate by about 6%. While a 1% increase in life expectancy will raise agriculture income by 26.9%. The results show that the most important variables are schooling, the labour-force participation rate and the life expectancy. Education has emerged from this study as the most important policy instrument if the aim is to lower HIV rates and raise agricultural income levels in Nigeria.

Date of Submission: 25-06-2020 Date of Acceptance: 13-07-2020

I. Introduction

The spread of HIV/AIDS infection in the last 30 years posses great impact on health, welfare, employment amongst all social and ethnic groups throughout the world. Since the beginning of the epidemic, 75 million people have been infected and about 32 million people have died of the infection. Globally, 37.9 million [32.7–44.0 million] people were living with HIV at the end of 2018. An estimated 0.8% [0.6-0.9%] of adults aged 15–49 years worldwide were living with the disease, although the burden of the epidemic continues to vary considerably among countries and regions. The WHO established that African region, remained most severely affected, with nearly 1 in every 25 adults (3.9%) living with HIV and accounting for more than two-thirds of the people living with HIV worldwide.

The government of Nigeria indicated a national HIV prevalence in the country at 1.4% among adults aged 15–49years. Previous estimates had indicated a national HIV prevalence of 2.8%. UNAIDS and the National Agency for the Control of AIDS in Nigeria estimated that 1.9 million people were living with HIV in Nigeria, UNAIDS (2019).

Women aged 15–49 years are more than twice as likely to be living with HIV than men(1.9% versus 0.9%.)The difference in HIV prevalence between women and men is greatest among younger adults, with young women aged 20–24 years more than three times as likely to be living with HIV as young men in the same age group. Among children aged 0–14years, HIV prevalence according to the new data is 0.2%. Significant efforts have been made in recent years to stop new HIV infections among children. Notwithstanding the progress in institutional reforms and political commitment to tackle the disease, the country has seen more citizens placed on life-saving medication of active antiretroviral therapy (AART) to increase the survival of such HIV seropositive individuals (National Agency for the Control of AIDS, 2017).

HIV/AIDS is a major public health and development crisis which has evolved into the greatest human tragedy over the last two decades since the first case was diagnosed. The disease is exerting dramatic impact in Sub-Saharan Africa by reducing life expectancy and productivity, disrupting social systems, and increasing poverty. In the ten Sub-Saharan countries with the most advanced HIV/AIDS epidemic, estimates indicate that per capita income growth will be slowed by an average of 0.3% annually between now and 2025 (World Bank, 1996) Nigeria's economy is also under serious threat with the prevalence rates of HIV/AIDS increasing from 1.8%; in 1991 to 5% in 2003 (FMOH, 2004).

Food and Agricultural Organization, FAO (2012) asserts that meeting immediate food, nutrition and other basic needs is essential if HIV/AIDS-affected households are to live with dignity and security.

Rural farm families are a vital part of national economies in many developing countries contributing significantly to national development. Agriculture being their major livelihood, they contribute over 70% of food production in Nigeria. Hence, this study focusing farm-families on whom the national food security depends become very crucial. FAO (1998) highlights the effects of HIV/AIDS on agricultural production" the decimation of household labour; the disruption to traditional social security mechanisms and the forced disposal of productive assets (for example, cost of medical care and funeral); loss of indigenous farming methods, specialized skills, practices and customs.

The pandemic creates significant economic stress on households and communities, affecting the nutritional status and long-term food security. The synergy between HIV/AIDS, nutrition and livelihood security are becoming increasingly entwined in a vicious cycle. Livelihood insecurity threatens nutritional status and thus increases susceptibility to HIV infection; HIV/AIDS, in turn, increases household vulnerability to nutritional insecurity through its impact on livelihood activities. On the other hand, good nutrition has been discovered to have the greatest impact at the early stages of the diseases, because it enhances the capacity of the body's immune system to fight opportunistic infections, thus delaying disease progression.

The operational implications of nutrition and infection interactions apply to health programmes specifically, and to the fact that interventions to improve nutrition will often be an effective way of preventing ill health. Nutritional care and support interventions will, therefore, mitigate the disease's impact on food utilization by strengthening the biological use of food to manage symptoms and strengthen immune function, thereby enhancing the livelihood capability of the affected household. To achieve this, there is the need to understand this synergy through a well-articulated interdisciplinary research approach, management and intervention. Findings of this research would provide information for policies and actions to enhance the nutritional status and better quality of life for rural farm-families especially those living with HIV/AIDS.

II. HIV/AIDS in Nigeria: An Overview

The first two AIDS cases in Nigeria was diagnosed in 1985 and reported in 1986 in Lagos one of which was a young female sex worker aged 13 years from one of the West African countries (Nasidi and Harry, 2006). In 2018, 1 900 000 people were living with HIV. HIV incidence per 1000 uninfected—the number of new HIV infections among the uninfected population over one year—among all people of all ages was 0.65. HIV prevalence—the percentage of people living with HIV—among adults (15–49 years) was 1.5%. Of all adults aged 15 years and over living with HIV, 55% were on treatment, while only 35% of children aged 0–14 years living with HIV were on treatment.

Forty-four per cent of pregnant women living with HIV accessed antiretroviral medicine to prevent transmission of the virus to their baby, preventing 7200 new HIV infections among newborns. Early infant diagnosis—the percentage of HIV-exposed infants tested for HIV before eight weeks of age—stood at 18% in 2018.

Women are disproportionally affected by HIV in Nigeria: of the 1 900 000 adults living with HIV, 1 000 000 (55.56%) were women. New HIV infections among young women aged 15–24 years were less than double those among young men: 26 000 new infections among young women, compared to 15 000 among young men. HIV treatment was higher among women than men, however, with 68% of adult women living with HIV on treatment, compared to 37% of adult men.

Only 28.86% of women and men 15–24 years old correctly identified ways of preventing the sexual transmission of HIV. In 2017, the percentage of people living with HIV and tuberculosis who were being treated for both diseases was 19.7%, up from 16.3% in 2015.

III. Literature-Agriculture, Health and Productivity

The well-being of individuals in a community is a good and broad indicator of human development. Precisely, in an agrarian community, the state of health at the individual level cumulatively determines the health of the community, which in turn reflects the well-being of the state or nation. Agriculture and health have direct impacts on one another, although not many of previous analyses in many developing counties have explored the impact of health status on agricultural productivity. However, the recent emergence of health problems like HIV/AIDS and malaria has examined the linkage between agriculture, health and productivity of farm households important (Abamu and Nwaze, 2003).

Health also affects agricultural output, particularly its demand. Malnutrition and disease patterns influence market demand for food quantity, quality, diversity, and the price people are able or willing to pay. Nutrition affects people's health and is an important factor in farm labour productivity. Past nutritional status predicts the probability of developing chronic diseases and consequently influences labour force participation (Sur and Senauer, 1999). The nutrition and health status of adults affect the duration of labour force participation and the intensity of work effort. Poor health will result in a loss of days worked or in reduced work capacity and is likely to reduce output (Antle and Pingali, 1994). Limited access to food may occur in a household if individuals are too ill or overburdened to produce or earn money to buy food (Keverenge-Ettyang, Neumann, and Ernst, 2010).

Common mechanism households adapt to cope with the burden of high medical costs is reducing consumption of basic needs, including food (Pitayanon, Kongsin, and Janjaroen, 1997). If consumption reduction is substantial, this can lead to malnutrition which increases susceptibility to opportunistic diseases for AIDS patients. Malnutrition weakens the immune system, increasing the risk of ill-health, which in turn can aggravate malnutrition. The World Health Organization identifies malnutrition as "the single most important risk factor for the disease." In developing countries, poor nutrition is a massive problem making people more susceptible to diseases.

A study on the effect of nutrition on labour productivity in rural Sierra Leone was one of the first attempts to test the nutrition-productivity relationship using total farm output as the measure of productivity. A Cobb-Douglas production function was estimated to test the hypothesis that farm output is influenced by effective family and hired labour hours, variable non-labour inputs, fixed capital, and land. It was found that calorie intake had a significant positive effect on farm labour productivity with a calorie-output elasticity of 0.34 at the sample mean (Strauss, 1986).

Re-examining the nutrition-productivity relationship considering seasonal variability using data from India, Behrman and Deolalikar (1989) found that calorie intake is an important determinant of wages in peak seasons, while weight-for-height is a more important determinant during lean months. During peak seasons energy is required to carry out strenuous and time-consuming work and so calorie intake becomes very important. Examining the link between nutrition and productivity in the Philippines with height as the predictor of long-term nutritional status, Haddad and Bouis (1991) found that while height is a significant determinant of wages, energy intake as determined from a 24-hour food recall survey was not a significant predictor of wages.

Research carried out in Ethiopia estimated the impact of health and nutritional status on the efficiency and productivity of cereal growing farmers (Croppenstedt and Muller, 2000). Results showed that the distance to the source of water as well as nutrition and morbidity status affects agricultural productivity. Ulimwengu (2009) used a stochastic production function to analyze the relationship between farmers' health impediments and agricultural production efficiency in Ethiopia. Healthy farmers were found to produce more per unit of inputs, earn more income, and supply more labour than farmers affected by sickness. As expected, the model results show that production inefficiency increases significantly with the number of days lost to sickness.

Ajani and Ugwu (2008) examined the impact of health conditions on farmers' productivity in north-central Nigeria and found that a one per cent improvement in a farmer's health condition led to a 31 per cent increase inefficiency. Using a quasi-experimental design along with a generalized linear model (GLM) for longitudinal data, Audibert and Etard (2003) estimated the worker productivity benefits of health in Mali. They assumed that the family members and the hired labour who are working in the fields are imperfect substitutes because of the cost of hired labour and the low agricultural yield. Results showed an increase of 26 per cent in the production per family labour person-day in the experimental group who received treatment for schistosomiasis relative to the control group who received a placebo. Unlike other studies which looked at health indicators related to past and time-invariant health (e.g., such as height due to investment during childhood), current health and changes in health caused by unexpected illness or external input were considered in their study.

The African region remains the most heavily affected region in the global HIV/AIDS epidemic. In 2011, an estimated 23.5 million people living with the virus resided in Africa, which represents 60% of the global HIV burden (UNAIDS, 2012). Quinn (1996) reported the global burden of the HIV pandemic and noted that Africa and Asia were at the top of the list compared with the rest of the world. These findings were consistent with Corrigan et al. (2005), who investigated the relation between the AIDS crisis and growth in Sub-Saharan Africa using the general equilibrium model. They found that the macroeconomic consequences of the AIDS epidemic are quite large.

Different econometric methods and models have been employed by several authors and researchers to investigate the effect of the prevalence of HIV/AIDS on economic indicators, and the effect/impact of the former is not always in favour of the latter in the region. For example, Dixon et al. (2001) reported that the prevalence of the epidemic has a very large negative effect on life expectancy and economic growth in Africa. A two-least-square

(2SLS) model was used by Garima Malik (2006) to examine the relationship between health and economic growth in India and the results indicated a negative relationship between HIV/AIDS and the GDP per capita growth rate in the country within the reporting period.

McDonald and Roberts (2006) employed an augmented Solow model, a human capital approach, to estimate the elasticity of AIDS in relation to economic growth, and the result revealed that HIV/AIDS has a negative impact on the income per capita in Africa, with an estimated coefficient of -0.59. This means that with a 1% increase in the epidemic (AIDS), the income per capita decreases by 0.59%.

The literature reviewed indicated that the elasticity of the prevalence of HIV/AIDS is inelastic, implying that the percentage increase in HIV/AIDS is greater than the percentage decrease in economic growth due to the fact that the prevalence is increasing globally and diseases have no geographical boundary; as such, AIDS accounts for a greater fraction of the global distribution of communicable diseases. Africa is at the top of the list, with more than 16 million individual carriers of the disease, almost 3% of the population of the entire sub-continent (Quinn, 1996). However, this figure rose to 23.5 million people living with the virus in Africa, representing 60% of the global HIV burden (UNAIDS, 2012).

Empirical evaluation of morbidity impacts on individual labour productivity has been limited to a few diseases. As quantity and quality of labour are affected during the duration of illness, the capacity to produce agricultural output often is reduced, resulting in lower labour productivity. As suggested by theoretical literature, household farm production will decline (and shift to less labour-intensive crops) because of loss of productive labour due to illness. While numerous studies have focused more on estimating the economic burden of illnesses (direct and indirect costs), the available empirical literature evaluating the effect of morbidity on agricultural production has shown varying results.

Attempts have been made to estimate the extent of rural labour loss due to HIV/AIDS mortality. The U.S. Department of Agriculture has estimated that the reduction in numbers of agricultural labourers in Southern Africa will reduce agricultural labour productivity by 12 per cent per year, which will result in a 3.3 per cent loss in grain output (ILO, 2004). Moreover, FAO (2004) using epidemiological data, projected that by 2020 the nine most severely hit Sub-Saharan African countries would lose from 13 to 26 per cent of their agricultural labour force to HIV and AIDS.

A survey in Zambia found that heads of HIV-affected households reduced their cultivated land area by 53 per cent, resulting in reduced crop production (ILO, 2000). A study in western Kenya that examined the impact of HIV and AIDS on labour productivity found that HIV-positive workers plucked 4 to 8 kg/day less tea in the last year and a half before they died compared to HIV-negative workers (Fox et al., 2004). Absenteeism also occurs as a result of time reallocated to care for an ill household member, including children. A household impact study of HIV and AIDS on families in the Free State province of South Africa found that household members spend 7.5 hours a day or about 2700 hours per year which is equivalent to 113 person-days a year taking care of the ill (Booysen and Bachman, 2002). In rural Zimbabwe, the average time spent in taking care of bed-bound AIDS patients is 38.5 hours per week or about 2,000 hours per year which is equivalent to 83 person-days a year (Woelk, 1996). A study in Rwanda indicated that reduced labour time as a result of HIV-related illness among women and increased time women devote to caregiving to members living with AIDS resulted in a decline in production of beer bananas (a cash crop), a source of income for women (Donovan and Bailey, 2006).

Malaria. Compared to HIV infection, which generally causes steadily deteriorating health, lost labour time due to malaria is lesser, because malaria affects children more than adults, whereas it is the opposite for HIV. Studies have shown that per malarial attack, depending on the severity, typically entail a loss of four working days, followed by additional days with reduced capacity for about four episodes per year (Brohult et al., 1981; Picard and Mills, 1992). This means about 16 working days are lost in a year. Another study found that about of non-fatal malaria will typically last for 10–14 days, including 4–6 days of total incapacitation with the remainder characterized by headaches, fatigue and nausea (Hempel and Najera, 1996). In Oyo State of Nigeria, the estimated average number of workdays lost per malaria episode by productive adults in agrarian households was 16 days for an average of 4 bouts per year which is about 64 days per year (Alaba and Alaba, 2009).

Investment in workers has had a track record of creating better employment conditions in economies throughout the world. If employment is improving (which could be the aftermath of health and education of the citizenry), consumer spending rises, leading to increased revenue for companies and additional business investment. As a result, employment is a key indicator or metric for determining how GDP growth may perform.

This is why OECD routinely analyzes the impact of education level on employment and ultimately, economic growth.

Similarly, across the world, there has not been single research debunking the interconnectivity between Agriculture Education and sound public health. Instead, many scholarly articles have corroborated their complementarily.

IV. Materials and Methods

The augmented Solow model, which is rooted in the neoclassical growth theory, and specified as two-stages simultaneous model was used for this study. The model uses 3 inputs (capital, labour, and knowledge/effectiveness of labour) into the production process, with which output is attained. It assumes constant returns to scale and diminishing returns to each input.

What makes the Solow model unique is the incorporation of knowledge variable, which captures human capital, the variable which is completely absent in the classical growth model. Also, it assumes technological progress, which is assumed to be exogenous. Technological progress explains the long-run growth in an economy, which cannot be accounted for by physical capital accumulation.

Empirical Model Specification

Two variants of growth models were specified in this study. The first incorporated HIV/AIDS variables into the growth model while the second model contained agricultural output measure through which HIV/AIDS affects growth.

Model 1

$\ln HIV/AIDS_t = \beta_0 + \beta_1 \ln Agr_t + \beta_2 \ln CBR_t + \beta_3 \ln MAL_t + \beta_4 \ln LE_t + \beta_5 \ln HIV/AIDS_{t-1+}\ \beta_6 \ln LBFt + \mu_i$ (1)

Model 2

$\ln Agr_t = \lambda_0 + \lambda_1 \ln Agr_{t-1} + \lambda_2 \ln HIV/AIDS_t + \lambda_3 \ln MAL_t + \lambda_4 \ln SCH_t + \lambda_5 \ln LBFg_t$
$+\lambda_6 \ln GFC_t + \mu_i$

Theoretically, $\beta_1 > 0$; $\beta_2 \ldots \beta_4 < 0$; while $\beta_5 \ldots \beta_6 > 0$ (2)

Theoretically, $\lambda_1 + 0$; $\lambda_2 \ldots \lambda_3 < 0$ while $\lambda_4 \ldots \lambda_6 > 0$.

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μ_i represents the stochastic disturbance term, which is assumed to be normally distributed and has a zero mean with constant variance. The implication symbolically is that $\mu_i \sim IID\ (0;\ \sigma^2\mu\ )$.

AGR = growth rate of per capita GDP measured in PPP. G*FC* = Gross fixed/physical capital. *SCH* = human capital variable, measured with life expectancy and primary school enrolment. Other variables with which the models were augmented include; *MAL* represents reported and confirmed cases of malaria while HIV/AIDS is measured with incidence and prevalence of HIV as well as several people per thousand population living with HIV/AIDS, and AIDS-related deaths. *LBF* = labor force and CBR = Crude birth rate, LE = Life expectancy.

V. Empirical Results and Discussion

Table 1 Descriptive Statistics

	AGIC	HIV	LABOUR	GFC	LIFE	PRY	CBR	MALARIA
Mean	6.88E+12	1266667.	71955304	5.03E+12	48.29990	21452189	42.29583	1465346.
Median	4.42E+12	1350000.	69736512	2.90E+12	47.03229	21873751	42.95000	1165544.
Maximum	2.15E+13	1800000.	98866698	1.12E+13	53.70000	26158376	44.00000	4481725.
Minimum	1.23E+11	480000.0	50958653	2.02E+12	45.83971	13776854	38.90000	281.5000
Std. Dev.	7.16E+12	369437.5	14841450	3.40E+12	2.753291	3688936.	1.511256	1336981.
Skewness	0.783651	-0.624050	0.334091	0.828250	0.705393	-0.512294	-0.932627	0.484807
Kurtosis	2.111700	2.481789	1.886849	1.911245	1.933177	2.232185	2.588570	2.227757
Jarque-Bera	3.245510	1.826298	1.685571	3.929382	3.128426	1.639322	3.648450	1.536512
Probability	0.197354	0.401259	0.430510	0.140199	0.209253	0.440581	0.161343	0.463821

From table 1, AGRIC averaged 688.0 billion nairas during the observed period and it varied between a minimum of 123.0 billion nairas and a maximum of 215.0 trillion nairas. Crude birth rate from 1990 to 2016 stood at an average of 42.29583 per thousand ranging between the lowest value of 38.9 per thousands and the highest of 44 per thousands. The same pattern could also be observed in the average value of gross fixed capital formation which remained at an average of 5.03 billion nairas and ranged between a maximum value of 1.12 trillion nairas and a minimum of 2.02 billion nairas from 1990 to 2016. People living with Hiv/AIDS averaged 1,266,667 million ranging from 480,000 thousand people minimum to 1.8 million people maximum. Infant mortality had an average value of 110.2564 between 40 years with a minimum of 80.0 and a maximum of 129.0 infant deaths per 1000 live births. The Nigerian Life expectancy had a mean of 48.30 years with the minimum year of 45.83 and maximum of 53.7 years within the period under consideration. The labour force averaged 71955304 people with a minimum of 50958653 and maximum of 98866698 people.

Table 2: Result of unit Roots Tests using Augmented Dickey-Fuller(ADF)and PP-Fisher

Series	ADF	Critical value @ 5%	PP	Critical value @ 5%	Order of Integration
LAGRIC	-3.172580	-2.981038	-3.412968	-2.981038	1(0)
LCBR	7.59540	-2.981038	5.782385	-2.981038	1(0)
LGFC	-10.34768	-2.998064	0.351927	-2.981038	1(1)
LLABOUR	-3.647354	-3.020686	-6.012798	-2.991878	1(1)

LLIFE	-4.433097	-3.004861	2.691424	-2.981038	1(0)
LHIV	-9.806257	-2.981038	-10.85047	-2.981038	1(0)
LSCH	-5.388406	-2.991878	-7.266622	-2.986225	1(1)
LMALARIA	1.221304	3.144920	2.715451	-3.004861	1(0)

It is always desirable in time series variables to examine their properties to ensure the robustness of the analysis and estimation. This is so because most time series variables are not stationary and the outcome of the classical econometric analysis is always based on the assumption that variables employed are stationary. If they are, their mean values and variances would not vary systematically over time and the result of our analysis will be valid. To avoid the situation of spurious regression, there is the need to carry out unit root tests on the variables and determine the order of their integration. Phillips-Perron (PP) Tests for unit roots were conducted for all the variables used in the study. The results are shown in the table above.

From the results, agriculture, crude birth rate (CBR), Hiv/aids, malaria and life expectancy which were stationary at a level, all other variables became stationary at their first difference. Also, the test results revealed that the series were integrated of order I(1) and order I(0). The result necessitated the cointegration test since virtually all the variables became stationary at their first difference and are of the same order.

Table 3:Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.972438	293.4049	125.6154	0.0000
At most 1 *	0.886102	203.6223	95.75366	0.0000
At most 2 *	0.876465	149.3110	69.81889	0.0000
At most 3 *	0.804530	97.03023	47.85613	0.0000
At most 4 *	0.700615	56.22146	29.79707	0.0000
At most 5 *	0.572380	26.07087	15.49471	0.0009
At most 6 *	0.175778	4.832872	3.841466	0.0279

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4:Unrestricted Cointegration Rank Test (Trace)

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At most 1 *	0.886102	203.6223	95.75366	0.0000
At most 2 *	0.876465	149.3110	69.81889	0.0000
At most 3 *	0.804530	97.03023	47.85613	0.0000
At most 4 *	0.700615	56.22146	29.79707	0.0000
At most 5 *	0.572380	26.07087	15.49471	0.0009
At most 6 *	0.175778	4.832872	3.841466	0.0279

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
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**MacKinnon-Haug-Michelis (1999) p-values

Johansen Co-integration Test and Results

The literature affirms that if the series are integrated of the same order, then there is the need to test whether they are cointegrated. The results of the analysis revealed seven cointegrating equations as can be seen from the Trace statistic and the Maximum Eigenvalue in the tables above. This implies that there exists a long-run relationship between agriculture and the other explanatory variables in the model, and so, the explanatory variables can confidently predict the behaviour of the dependent variables (Hiv) and (Agric) in the specified model.

Interpretation of Simultaneous Equations Models

The two-stage least squares estimator was utilized

Table 5: Dependent Variable: LHIV

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAGR	-0.037003	0.024752	-1.494979	0.1571
LLBF	-0.250810	0.762501	-0.328931	0.7471
LCDR	0.177412	0.732240	0.242287	0.8121
LHIV(-1)	0.946413	0.205398	4.607707	0.0004
LLF	-0.481589	0.232732	-2.069285	0.0577
R-squared	0.982018			
Adjusted R-squared	0.975595			
F-statistic	14.947066			

Table 6.Dependent Variable: LAGRIC.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LHIV	-5.654443	2.253263	-2.509446	0.0232
LGFC	-0.257650	0.228591	-1.127121	0.2763
LLBF	4.997492	1.596006	3.131249	0.0064
LSCH	0.136387	0.660161	0.206597	0.8389
LAGR(-1)	0.827848	0.227662	3.636311	0.0022
R-squared	0.986147			
Adjusted R-squared	0.981818			
F-statistic	17.057080			

From table (5): With only five explanatory variables, it explained over 97% of the country health status and agricultural impact in Nigeria. The F-value is significant; the hypothesis of log-linear coefficients have the expected signs. However, the coefficient of agriculture is significant at the 10 per cent level. As expected, the lagged HIV variable is highly significant and the crude birth rate and labour force participation rate are not significant. Also, the remaining variable life expectancy is significant. Now consider table(6) which is even better than the table (5). With the six variables employed, the model can explain over 98% of the country's agriculture contribution during the period under review. The F-value is highly significant and all the coefficients have the expected signs excepts gross fixed capital. As expected, lagged agriculture is highly significant; and so the number of people with HIV and labour force, are significant at the 5 per cent level. The school enrolment coefficient is not significantly different from zero at the 10% level.

Steady – State Elasticity – Multiplier Coefficients

To make further headway in the analysis of the regression results, more calculations must be done. The first step is to obtain steady-state or long-run coefficients to get these, let the value of the endogenous variables be stationary (that is, set **HIV* = HIV*** $_{-1}$ and **AGR* = AGR*** $_{-1}$). Solving, we obtain

HIV* =- .691AGR * -4.680LBF* + 3.310CDR* - 8.987.LF* **(1)**

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AGR* = -3.00 HIV* - 1.497 GFC* + .5.794LBF* + .792 SCH* **(2)**

In (1a) and (2a), we have added tildes (~) to HIV* and AGR* to indicate steady-state values. Since the variables are in logarithms, the coefficients are elasticities. But these elasticities measure only direct effects. For example, from equation (1), we know that a 1% increase in life expectancy will lower HIV rates by 8.9%. the only problem with this statement in that it ignores indirect effects. When the life expectancy rises, this affects agriculture (raises it) which is return effects HIV rates (reduces it). Hence, the indirect effect of a rising life expectancy is a reduction in the HIV rate. To find out the net effect of life expectancy on the life expectancy rate, we must add together the direct and indirect effects of changes in life expectancy on mortality. The best way to do this is to calculate 'elasticity-multiplier' Coefficients which measure both the direct impacts of the exogenous variables on the endogenous ones. The three exogenous variables that have the greatest net impact on the endogenous ones are the life expectancy, Schooling, and the total labour force participation rate. The steady-state elasticity-multiplier coefficients for these variables have been calculated and are reported in Table 7.

Table 7: Steady-State Elasticity-multiplier Coefficients

	LBF	LF	SCH
HIV	**-8.684**	**- 8.987**	**-.547**
AGRIC	**19.834**	**26.961**	**.792**

The results show that the net effect of better education on HIV rate is negative while its net effect on agriculture is positive. However, the net reduction on HIV rate arising from increasing education is less than the direct effect. Specifically, a 10% jump in schooling will lower HIV rate by about 6%. The highest elasticity multiplier in the table is that of agriculture concerning the life expectancy. A 1% increase in life expectancy will raise agriculture income by 26.9%. The results show that the most important variables are schooling, the labour-force participation rate and the life expectancy. Of these, education and the labour force participation rate qualify as policy variables. Education has a positive effect on agriculture income and a negative one on HIV. Since lowering HIV rates and rising agriculture income are the main goals of governments in Nigeria, it is clear that education is a critical policy tool. As for a rising labour-force participation rate, it raises the desirable agricultural income but also reduces HIV rates which are desirable. All in all, education has emerged from this study as the most important policy instrument if the aim is to lower HIV rates and raise agricultural income levels in Nigeria.

VI. Conclusion

In this study, eight variables employed the three exogenous variables that have the greatest net impact on the endogenous ones are the life expectancy, Schooling, and the total labour force participation rate. Of these, education and the labour force participation rate qualify as policy variables. Education has a positive effect on agriculture income and a negative one on HIV. Since lowering HIV rates and rising agriculture income are the main goals of governments in Nigeria, it is clear that education is a critical policy tool.

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Ogunbadejo Hussain Kehinde, et. al. "Malnutrition and HIV/AIDS among Rural Families in Nigeria: Implications for Agricultural Livelihoods." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 13(7), 2020, pp. 25-33.