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RELATIONSHIP BETWEEN EFFICIENCY OF FARM PRODUCTION AND HEALTH STATUS OF FARMERS IN SOUTHERN KADUNA, KADUNA STATE, NIGERIA

By

Dr Adama, I. Joseph
Department of Economics,
Ahmadu Bello University, Zaria,
Kaduna State, Nigeria.
E-mail: josephadama2009@yahoo.com

Abstract:
The increasing incidence and spread of HIV/AIDS in Nigeria threatens the supply of labour for agricultural activities. By disrupting economic and social foundations of families, it reduces production capacity, farm production, labour quality and quantity. Therefore, this study attempt to assess the health status of farmers with respect HIV/AIDS on their cropping patterns, incomes and technical efficiency in Southern Kaduna of Kaduna State. Primary data were collected from 154 farm households which consist of 54 HIV/AIDS and associated sicknesses among the contaminated households and 100 non contaminated households. Based on the results, HIV/AIDS has led to low and decline farm production and a tremendous reduction in the variety of crops planted on HIV farms. The level of farm profitability, the average gross revenue (AGR), and average gross margin (AGM) on non-HIV farms were mostly higher than that of the HIV farms. Most important variables that significantly influence the levels of output on both the HIV and non-HIV farms are farm size, hired labour and fertilizer. With a 1 percent level of statistical difference for the two farm groups, non- HIV farms are more technically efficient with a mean of 80.0 as against 0.62 for non-HIV farm. As such, technical inefficiencies of farms in both groups can be improved by increased year of schooling

Keywords: Production Efficiency, HIV/AIDS, Health Status, Farm Households

INTRODUCTION

The HIV/AIDS epidemic is one of the world's greatest health challenges today. In Nigeria, the first case was reported in 1986 and ever since, there has been a consistent increase in HIV prevalence rate, from 1.8 percent in 1993 to 3.8 percent in 1994. The rate increased to 4.5 percent in 1996, 5.4 percent in 1999 and 5.8 percent in 2001 (FMOH, 2005). Though by 2006, it was reported that the prevalence rate has marginally declined to 5%, the target of reducing the number of infected persons remains a major challenge (NACA, 2006). HIV prevalence rate, although, is lower in Nigeria than in some other African countries like Malawi, Zimbabwe, Botswana, Namibia and Zambia (Kambewa et. al., 2006; Mano and Chipfupa, 2006).

The Nigerian economy is predominantly agricultural and the agricultural sector is a major contributor to the country's Gross Domestic Product (GDP). For example, in 2005, the sector contributed about 40 percent to the GDP (CBN, 2008) and it employed over 60 percent of the total labour force in the country. With the increasing incidence and spread of HIV/AIDS in Nigeria, the supply of labour to agriculture may be threatened. Studies show that youths between the ages of 15 and 35 are the most affected. The average rate of infection among the youth population is 5.7 percent, and the rate is as high as 21 percent in some parts of the country (Adeoti and Adeoti, 2008).

The HIV/AIDS epidemic has adverse effects on life expectancy. Mortality rate is rising as a result of HIV/AIDS. It strikes people down in their prime years of productivity. By disrupting economic and social foundations of families, it reduces production capacity, farm production, labour quality and quantity. Labour quality, measured in terms of productivity, is reduced when the HIV-infected person is ill. The supply of such household labour falls when the person dies. Moreover, considerable productive time is devoted by other family members to the care of the sick; all these affect the availability of family labour. Secondly, the availability of cash to the family is affected as household financial reserves would be used for the medical treatment of the sick and for meeting funeral costs in case of death. This reduction in the farm-household's financial resources may lead to a reduction in farm investments, an increase in household food insecurity, deteriorating standards of living and poverty.The executive secretary of Kaduna State AIDS Control Agency disclosed that the 2008 sentinel survey conducted by the FMH revealed the following, while the prevalence rate of HIV/AIDS in the country is put at 4.6%, Kaduna State topped in North West zone (Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa and Kaduna with 2.9, 6,0, 2.1, 2.6,2.2 and 7.0 percents respectively). The prevalence rate of HIV/AIDS in Kaduna State(Kaduna metropolis, Saminaka, Kwoi, Zaria and Kafanchan with 2.3, 2.0, 7.3,3.4, and 17.7 percents respectively.(Akowe, T 2010 Kaduna worried over HIV/AIDS Spread, The NATION 18th April). HIV/AIDS is no longer considered solely as a health problem but rather as a developmental one; which demands a holistic consideration of the problem. In view of this, this paper examines the economic impact of HIV/AIDS and specifically it's effect on the cropping patterns and technical efficiency of farmers in Southern Kaduna State.

OBJECTIVES

The main objective of the study as stated in this paper is to determine the impact of HIV/AIDS on the cropping patterns and technical efficiency of farmers in Southern Kaduna State of Nigeria.

The specific objectives are to:

(i) To analyze the cropping patterns in the study area and the changes which have occurred due to HIV/AIDS infection;

(ii) To carry out a comparative analysis of the outputs and incomes of households with and without HIV/AIDS infection.

METHODOLOGY

The Study Area and Sampling Procedure

The study was conducted in Southern Kaduna of Kaduna State, located in the middle belt region of Nigeria. Although the region consisting of eight LGAs, the study focuses on six LGAs: Kachia, Zangon Kataf, Kaura, Jema'a and Jaba. The main tribes include Hausa/Fulani, Bajju, Atya, Kagora, Ham and Asholio among others. With farming as their main occupation, the cultivated crops include yams, maize, soybeans, guinea-corn, millet, etc as well as livestock such as cattle, goats, sheep, pigs and various birds among others. However, only the cultivated crops are selected for this study. The sampling procedure involves multistage sampling.

With a map of HIV incidence overlaid on the cropping system in the region, a vulnerability map for the State reveals Jema'a (Kafanchan) LGA to be relatively more vulnerable to the disease. This may not be unconnected with the high population and relative strategic investments and developments. The last stage involved the selection of farm households with or without HIV/AIDS and related sicknesses with the assistance of agricultural extension workers, widows/widowers who had lost their spouses due to protracted sickness and/or had visible symptoms of HIV/AIDS and Farm families that were persistently spending money and/or disposing of family assets to get medical treatment for their infected members. In all, 155 farm households were interviewed made up of 55 with HIV/AIDS and related sicknesses while 100 were without HIV/AIDS.

Data and Analytical Technique

Primary data were collected on the health status of household members, the types of sicknesses commonly suffered from, and the number of sick days. Other data collected include farm sizes, types of crops grown and the quantities and prices of different farm outputs. The data were analyzed with the aid of descriptive statistics, budgetary analysis and the production frontier function. The budgetary analysis was employed to measure farm incomes. The gross margins are estimated for farm households with and without HIV/AIDS. The total revenue accruing to each farm is calculated from data on outputs and the prices of the outputs. The variable costs incurred in the production of these outputs are also estimated. From these, the gross margin is obtained as:

$$GM = \sum P_i Y_i - C_i \quad \text{.........................(1)}$$

$$(i = 1,2,......,n)$$

Where

GM = Gross Margin

P_i = Farm gate price of i^{th} crop

Y_i = Yield of the i^{th} crop

C_i = Total variable cost of producing the i^{th} crop

n = Number of crops in a farm

The mean gross margins for the two farm household groups are compared to determine the statistical significance of the difference between them. The stochastic frontier production function is applied in this study to determine the technical efficiencies of farms owned by households infected with HIV/AIDS and those not infected. The model was developed by Jondrow *et al* (1982) and has been previously applied in similar analyses by Seyoun *et al* (1998) and Adeoti, et al (2001). Assuming a Cobb-Douglas production function, the stochastic frontier production function applied in this study is specified as follows:

$$\ln Y_{i1} = \ln \beta_0 + \sum_{j=1}^{m} \beta_j \ln X_{ij} + v_i + \mu_i \quad (2)$$

where

Y_i = Farm output for farm i (in grain equivalent)
X_{ij} = Vector of jth inputs used by the ith farm
X_1 = Farm size in hectares
X_2 = Family labour in standard days
X_3 = Hired labour in standard days
X_4 = Quantity of fertilizer used in kilograms
X_5 = Other production costs (seeds, agrochemicals) in Naira.
β = Vector of production function parameters to be estimated
v_i = Random variability in production that cannot be influenced by the farmer
μ_i = Deviation from maximum potential output attributable to technical inefficiency.
i = 1, 2, 3, ... n farms
j =1, 2, 3, ... m inputs.

Direct estimates of the parameters are obtained using the maximum likelihood method. The major feature of the stochastic production frontier model is that the disturbance term is composed of two parts, a symmetric and a one-sided component. The symmetric component, vi , captures the random variability due to measurement error, statistical noise and other non-systemic influences outside the control of the farm. It is assumed to have a normal distribution. The one sided (nonpositive) component μi captures the random variability which is under the control of the farmer. Its distribution is assumed to be halfnormal or exponential. The two error components are assumed to be independent of each other. The technical efficiency index of each individual farm is equal to

$$TE_i = \frac{Y_i}{Y_i^*} = e^{-p} \quad (3)$$

TE_i = technical efficiency of farm i
Y_i = observed output per hectare of farm i
Y_i^* = frontier output per hectare of farm i

The technical efficiency of a farm is in the range of 0 to 1. Maximum efficiency in production has a value of 1.0 and lower values represent less than maximum efficiency in production.

RESULTS AND DISCUSSION

Health Status and the Cropping Patterns

Table1 gives the details of the types of sickness of the respondents that had HIV/AIDS and related sicknesses. As shown in table 1, tuberculosis, protracted illnesses and HIV/AIDS caused 36%, 32% and 24% of morbidity among the respondents respectively. As the major causes of morbidity, these three types of sickness caused 92% of morbidity among the respondents. Similarly, malaria fever, HIV/AIDS and pneumonia were the three major causes of mortality, responsible for 23%, 20% and 20% of mortality among the respondents respectively. In all, protracted illnesses, HIV/AIDS and tuberculosis represent the major causes of morbidity and mortality among the respondents.

Table 1: Number of Respondents Whose Relatives died or were sick due to HIV/AIDS and Related Sicknesses

Types of Sicknesses	Morbidity		Mortality		Pooled Data	
	Freq.	%	Freq.	%	Freq.	%
Typhoid Fever	---	---	3	10.00	3	5.45
Malaria	2	8.00	7	23.33	9	16.36
Pneumonia	---	---	6	20.00	6	10.91
Tuberculosis	9	36.00	3	10.00	11	21.82
HIV/AIDS	6	24.00	6	20.00	12	21.82
Protracted Illness(not diagnosed)	8	32.00	5	16.67	13	23.64
Total	25	100.00	30	100.00	54	100.00

Source: Field survey data, 2012

Table2 shows the various crop combinations planted by farmers in the study area. The cropping patterns observed in the study area comprise both sole and mixed cropping patterns. However, mixed cropping is the predominant cropping pattern. The table shows that sole maize, sole guinea corn, sole ginger and maize/soya beans farms comprise of about 76.40 percent of all HIV farms, while 27.00 percent of non-HIV farms are solely cultivated to the four farms' crops. In both farm groups, other farm households cultivate two or more crops in mixtures. However, the cultivation of maize is included in all mixtures. This indicates the predominance of maize cultivation in the study area. In HIV farms, 38.10 percent of them cultivate two crops in mixtures. About 3.60 percent of HIV farm households cultivate three crops in mixtures. Farms that cultivate sole and two crops in mixtures have commendable percentage; implying advantage of specializtion.

In non-HIV farms, 17.0 percent cultivate two crops in mixtures, 22 percent cultivate three crops in mixtures while 47 percent cultivate more than three crops in mixtures. Farms that cultivate more than two crops in mixtures represent the largest percentage among non-HIV farms with 47.00 percent relative to HIV farms with 3.60 percent only. Overall, the result shows that non-diversification in HIV farms are fewer than in non-HIV farms. However, irrespective of farmer's health status, maize cultivation is the most prevalent.

Table 2: Distribution of Respondents According to Types of Crops Cultivated

Crop Combination	HIV Farm		Non-HIV Farm		Pooled Data	
	Freq.	%	Freq.	%	Freq.	%
Sole Yam	3	5.50	4	4.00	7	4.50
Sole Maize	11	20.00	10	10.00	21	3.60
Sole Ginger	8	14.60	3	3.00	11	7.10
Sole Guinea Corn	10	18.20	8	8.00	18	11.60
Maize/Soya Beans	13	23.60	6	6.00	19	12.30
Yam/Maize	1	1.80	10	10.00	11	7.10
Maize/Guionea Corn	2	3.60	5	5.00	7	4.50
Maize/Ground Nut	4	9.10	7	7.00	11	7.70
Maize/Millet/Soya Beans	2	3.60	24	24.00	26	16.80
Maize/Guinea Corn/Soya Beans	---	---	23	23.00	23	14.80
Total	54	100.00	100	100.00	154	100.00

Source: Field survey data, 2012

Analysis of the Outputs and Incomes of Households

The budgetary technique is used to assess the profitability of the farm enterprises. It is carried out on both per-farm and per-hectare basis for the HIV and non-HIV farms. It shows the cost and the returns on the per-hectare basis. The results are summarized in **Table 3**. Here, the average gross revenue(AGR) on HIV farms is N38, 012.61 per hectare while the average gross margin(AGM) is N17, 219.37 per hectare. The AGR on non-HIV farms is N54, 518.27 per hectare while the AGM is N26, 370.92 per hectare.

For both gross revenue and gross margin per hectare, the average estimates are lower for HIV farms than non-HIV farms. The average variable costs and average fixed costs follow the same pattern. The amounts invested on the average are, lower on HIV farms than on non-HIV farms. Consequently, the profit realized from HIV farms are lower relative to non-HIV farms. The average farm profit for an HIV farm is N7,480.39 per hectare as against N14, 116.28 per hectare for an average non-HIV farm. This difference in the profit per hectare between HIV and non-HIV farms is 47 percent. This difference is probably not unrelated to the higher productivity of labour and other inputs used on non-HIV farms.

Table 3: Cost and Returns per hectare of HIV and Non-HIV Farms

Items	HIV (₦)	Non-HIV (₦)
Gross Revenue	38,011.51	53,508.93
VARIABLE COSTS		
Hired Labour at ₦300/std day	13,252.29	13,307.93
Fertilizer at ₦ 1,200/50kg bag	3,567.29	6,282.22
Herbicide	931.97	2,203.89
Pesticide	1,283.31	5,348.85
Planting Material	717.77	893.45
Total Variable Costs	20,693.23	28,136.34
Gross Margin	17,217.36	26,360.82
FIXED COSTS		
Depreciation	287.33	416.34
Family labour at ₦300/std day	7,941.65	10,335.30
Land Rent at ₦1,400/hectare	1,400.00	1,400.00
Total Fixed Costs	9,737.96	12,244.64
Farm Profit	7,460.39	14,114.28

Source: Computed from field survey data

Production Frontier Analysis of Farms' Technical Efficiencies

The maximum likelihood estimates of the parameters of the frontier models and the variance parameters for the two groups of farms are presented in **equations 4a, 4b, 5a and 5b.**

$$HIV = \underset{0.252^{***}}{3.636} X_0 + \underset{0.081^{**}}{0.146} X_1 + \underset{0.063}{0.042} X_2 + \underset{0.082^{***}}{0.844} X_3 + \underset{0.043^{***}}{0.198} X_4 - \underset{0.046^{***}}{0.411} X_5 ....(4a)$$

$$\delta^2 = \underset{0.070^{***}}{0.259}$$

$$\gamma = \underset{0.248^{***}}{0.896}$$

$$NonHIV = \underset{0.382^{***}}{2.372} X_0 + \underset{0.087^{**}}{0.431} X_1 + \underset{0.166^{***}}{1.050} X_2 + \underset{0.090}{0.052} X_3 + \underset{0.087^{***}}{0.278} X_4 - \underset{0.048^{***}}{0.215} X_5 ....(4b)$$

$$\delta^2 = \underset{0.039^{***}}{0.217}$$

$$\gamma = \underset{0.000^{***}}{0.929}$$

Where

X_0, X_1, X_2, X_3, X_4 and X_5 in **equation 4** above represent the intercept, farm size, family labour, Hired Labour, Fertilizer and Other costs respectively.

While Q_0, Q_1, Q_2 and Q_3 in **equation 5** below represent the intercept, age, years of schooling and years of farming respectively.

Inefficiency Model

$$HIV = \underset{0.320}{1.721}^{***} Q_0 - \underset{0.009}{0.028}^{***} Q_1 - \underset{0.011}{0.328}^{***} Q_2 + \underset{0.023}{0.034} Q_3 \ldots\ldots(5a)$$

$$NonHIV = -\underset{0.453}{0.186} Q_0 - \underset{0.016}{0.023} Q_1 - \underset{0.015}{0.039}^{***} Q_2 - \underset{0.012}{0.061}^{***} Q_3 \ldots\ldots(5b)$$

The variance parameters are represented by sigma squared(δ^2) and gamma(γ). The sigma squared indicates the goodness of fit and the correctness of the distributional form assumed for the composite error term. The gamma indicates the systemic influences that are unexplained by the production function, which are the sources of random errors. The significance of the estimates of the sigma squared indicates that the distributional forms of the error terms are well specified. The statistical significance of the gamma estimate implies that the inefficiency effects make significant contribution to the technical inefficiencies of farms. It justifies the inclusion of the μi error term in the function.

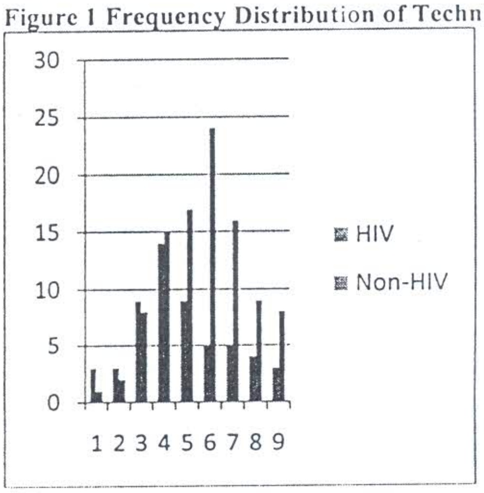
In HIV farm, the sigma squared is estimated as 0.259 while the gamma estimate is 0.896. The estimates are statistically significant at 1 percent level. In non-HIV farm, the sigma squared estimate is 0.217 and the gamma estimate is 0.929. Both estimates are statistically significant at 1 percent level. The gamma estimate shows that the amount of variation in output which results from technical inefficiency of the sampled farms is high. The estimated parameters have varying signs for both farm household groups; with most of them being statistically significant at the 5 percent level. In HIV farms, the coefficients for farm size, hired labour and fertilizer are positively signed and are statistically significant at the percent level. The positive relationship signifies that an increase in any of these variables will lead to an increase in output levels. The coefficient of other cost is negative and statistically significant at 1 percent level. This shows that an increase in costs of other inputs will lead to a decrease in output level. The coefficients obtained for the estimated parameters gives the elasticities of the explanatory variables as is typical of the Cobb-Douglas production function. The magnitude of the coefficients is 0.146 for farm size, 0.844 for hired labour, 0.198 for fertilizer and 0.411 for other costs. The magnitude of the coefficients indicates the degree of elasticities of the variables with respect to the level of output. All the four variables are inelastic to output levels with farm size and fertilizer being highly inelastic.

In non-HIV farms, the coefficients of farm size, family labour and fertilizer have positive relationship with the level of output; and are statistically significant at the 5 percent level. The coefficient of other costs is negatively signed but statistically significant at 1 percent level. The magnitude of the coefficients is 0.431 for farm size, 1.050 for family labour, 0.278 for fertilizer and 0.215 for other costs. This implies that family labour is elastic with respect to output level while farm size, fertilizer and other costs are inelastic.

These results show that in HIV farm hired labour is statistically significant than the family labour while in non-HIV farm family labour is statistically significant than the hired labour. The inefficiency model reveals the sources of inefficiencies among individual farms. For the HIV farms, the estimated parameters for age and years of schooling are negative and statistically significant at the 1 percent level. This shows that increase in these variables will reduce the farm's inefficiency. The coefficient for the years of farming is positive and is not statistically significant. In non-HIV farm, years of schooling and years of farming are negatively signed and are statistically significant. Increase in years of schooling or farming will decrease farm's inefficiency. The coefficient for the age of respondents is not statistically significant. This result shows that the years of farming are not significant in reducing farm's inefficiency if the farm household is infected with HIV. This may be due to loss of skilled labour either as a result of morbidity and/or mortality. In non-HIV farm, years of farming will reduce the level of farm's technical inefficiency; as the skill and experience acquired over years will be available for the household's farming activities. As stated earlier, the specification of the stochastic frontier production function has an error term with two components. One is to account for random effects due to non-systemic influences on production and the other to account for technical inefficiency in production. An important characteristic of this model is its ability to estimate individual, farm-specific technical efficiencies.

The frequency distribution for the two farm groups are presented in Figure 1. The result shows a wide variation in the technical efficiencies of farms in the two groups. For the HIV farms, the mean technical efficiency is 0.52; showing that, with maximum efficiency in resource allocation, farm output can be increased by 48 percent on an average farm. About 47.28percent of the farms have indices above 0.50. The variation in the levels of individual farms' indices shows that the potential for increasing farm output varies across farms. The gap between the most efficient (0.91) and the least efficient (0.12) shows a high inter-farm variation in technical efficiency. For the non-HIV farm, the mean technical efficiency is 0.70. About 74 percent have technical efficiencies over 0.50 but also with a wide inter-farm variation. The least efficient is 0.18 while the most efficient is 0.97. None of the farms has a perfect efficiency rating of 1.00, but non-HIV farms generally have higher performance indices than HIV farms.

Figure 1 Frequency Distribution of Technical Efficiencies of HIV and Non-HIV Farm



CONCLUSION

The study shows that Non- HIV farm households cultivate a wider variety of crops in mixtures and they make more income than HIV farms. On both group of farms, output levels are affected by farm size and the quantity of fertilizer used. Family labor affects output levels on non-HIV farms while hired labor affects output level on HIV farms. Therefore, non-HIV farms are more technically efficient than HIV farms; and thus, increased years of schooling will increase technical efficiency in both groups of farms.

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