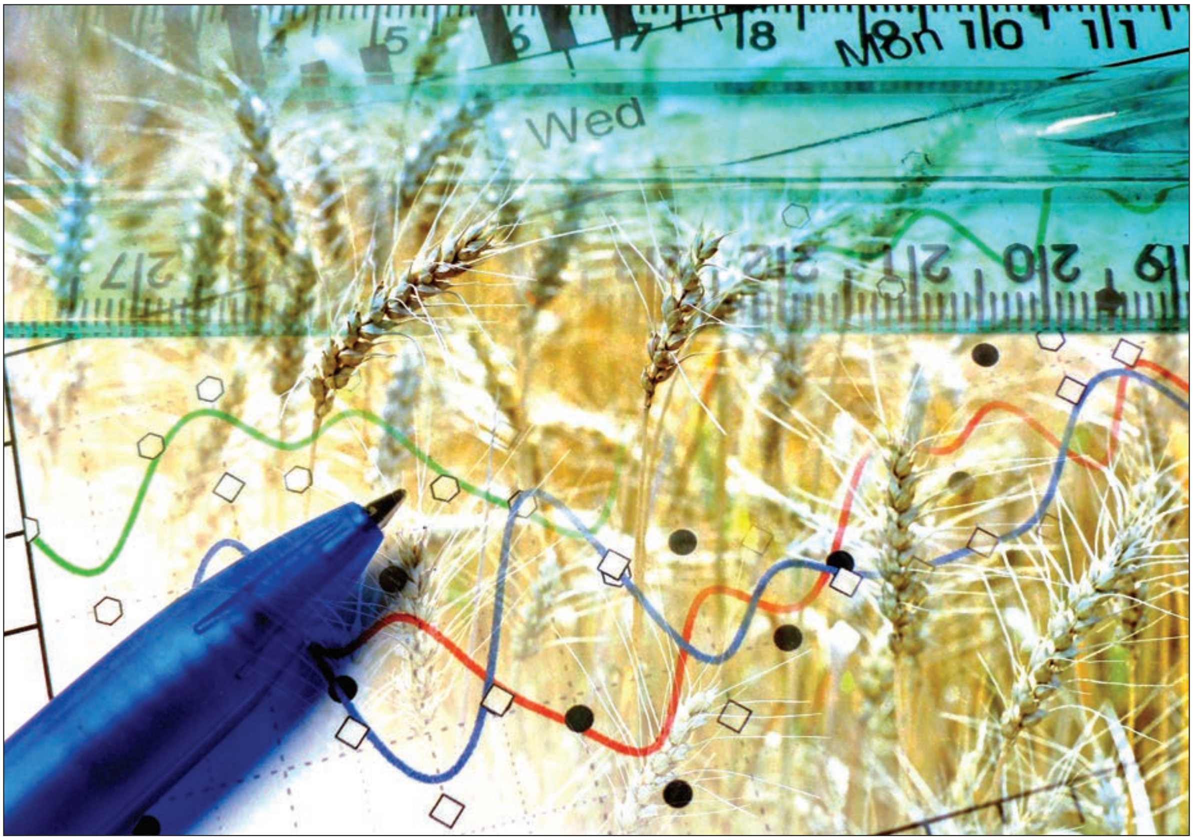

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Impact of Adverse Health on Agricultural Productivity of Farmers in Kainji Basin North-Central Nigeria Using a Stochastic Production Frontier Approach*

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Abstract: This study examined the impact of adverse health on the productivity of farmers in Kainji Lake Basin North Central Nigeria. It made use of Stochastic frontier production model. The technical efficiency of farmers falls in the range of 0.28-0.99 with a mean of 0.85. This implies that the efficiency of farmers can be improved at the available technology by about 15.1% in the short run. With the exception of seed and insecticide, other variables in the efficiency model have positive coefficients with fertilizer having the highest coefficient. This probably suggests an overuse of seed and insecticides relative to other inputs and that fertilizer is an important variable input in the agricultural output of farmers in the study area. It was observed that gamma (a measure of variance of output from the frontier attributed to efficiency) is 0.114. This implies that 0.886 or 88.6% of total variation in output is due to technical inefficiency. The adverse health variable in the inefficiency model has the largest positive coefficient and is statistically significant at $p<0.05$. This implies that health has a greater share in the inefficiency of the farmers and calls for attention of policy makers in Nigeria.

Key words: Adverse health, productivity, inefficiency, impact, Nigeria

INTRODUCTION

The importance of health as a form of human capital can not be over emphasized. Good health and productive agriculture are important in the economy of any nation especially in the fight against poverty. Health enhances work effectiveness and the productivity of an individual through increase in physical and mental capacities.

According to Schultz (1999) and Strauss and Thomas (1998), there is a positive relationship between health and productivity of skilled and unskilled labour. Good health as related to labour output or better production organization (since people of good health generally have better intellectual capacities), can enhance farmer's/household income and economic growth.

The process of agricultural production and the output it generates can contribute to both good and poor health among the producers as well as the entire society. Being an agricultural producer is a determinant of health relative to income and labour (Corinna and Ruel, 2006). Labour equally predisposes producers to a range of occupational health hazards including accidents, strains, diseases and poisoning.

Health affects Agricultural systems by affecting the health of the producers. Poor health will result in loss of work days or decrease worker capacity, decrease innovation ability and ability to explore diverse farming practices and by such makes farmers to capitalize on farm specific knowledge.

Ugwu (2006), Clifford *et al*. (2006), Douald (2006) and Bradley (2002) opined that health capital is affected by a number of preventable diseases: Malaria, musculoskeletal disorders, HIV/AIDS, farminjuries, yellowfever, typhoidfever, Schistosomiasis, Onchocerciasis, Diarrho real diseases

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respiratory diseases and skin disorders, etc. These diseases according to Ngambeki and Ikpi (1982) makes farmers not to utilize fully all inputs at their disposal and debilitates farmer's physical performance and equally impacts negatively on the farm profit levels.

Amidst the alarming report of effects of diseases on farmers, Nigerian subsistent farmers spend as much as 13% of total household expenditure on treatment of malaria alone. This gives enough evidence that the cost of combating diseases and health problems by the farmers are quite enormous, considering the frequency and prevalence of diseases among the Nigerian farmers.

Recent studies estimated the economic cost (both direct and opportunity cost) of a farmer becoming sick once to be N29, 225.53 (Ugwu, 2006). Adewale *et al*. (1997) valued the opportunity cost of Guinea worm infection on the farmer at N9, 566 bags of potential cocoa output lost due to ineffective supervision of farms occasioned by ill health. The farmer loses on the average 22 working days when incapacitated by one sickness or the other per time (Ugwu, 2006; Ashagidigbi, 2004).

Developing country's agriculture is characterized by a widespread productivity decline (Fulginito and Perrin, 1998). Despite concerted efforts by different Nigerian government in terms of human and material input into agricultural system in order to attain self-sufficiency in food production, the rate of productivity decline has persisted (FAO, 1987; Anonymous, 2006; NPC, 2006; Falusi, 1995).

In addition, Nigeria agriculture is labour intensive oriented (Rahji, 2005), implying that labour is indispensable factor of production in Nigeria's agriculture. That not withstanding, recent studies (FAO, 1987) has indicated a declining agricultural labour as well as a decreasing farm size. Agulanna (2006), Schultz (1999) and Strauss and Thomas (1998) opined that there is a correlation between health and productivity of labour or better production organization. Good health enhances work effectiveness and productivity of an individual through increases in Physical and mental capacities. It is therefore extremely difficult to separate agriculture labour supply from the agricultural producer and health stock. The health status of the producer of the agricultural producer determines the output of his labour supply and hence agricultural productivity. The role of health capital on agricultural productivity manifests in the incalculable opportunity cost incurred when the farmers is impaired. It is therefore imperative to reprioritize the relevance and contribution of production input variables to agricultural productivity by all Stakeholders.

This study focuses on the principal farm operator and his productivity conditioned on his health. The study seeks to answer the following research questions: Do health status affect the productivity of the farmer? What is the share of adverse health to farmers' efficiency? Would an improvement in the health status of the farmer pay off in terms of higher productivity? The Stochastic Frontier approach was employed to separate the impact of adverse health on principal farmer's productivity as well as measure the level of technical inefficiency caused by adverse health alongside other socioeconomic factors.

This study is an attempt to assess the impact of adverse health on the technical efficiency of the principal farm operators, with a view to determine adequate response, that will address health issues in agriculture.

MATERIALS AND METHODS

The study area Kainji lake Basin North-Central Nigeria has a population of 102, 370 (NPC, 2006) scattered in 60 communities that are purely agrarians.

A multistage random sampling procedure was adopted to collect the data with respect to farm specialty of communities. A total of twenty farming communities were selected for the study, while six respondents were purposively selected for interview from each of the twenty communities chosen. The data was collected through well-structured questiounaires in the early months of year 2006. A total of 120 respondents were surveyed.

Analytical Technique

The study made use of the Stochastic production function, in particular, the translog functional form. The choice of this model is because this model allows for the presence of technical inefficiency while accepting that random shocks (weather or disease) beyond the control of the farmer can affect output. The model specifies output (Y) as a function of input (x) and a disturbance term (e_i). That is;

$$Y_i = f(X_i, \beta) + e_i \tag{1}$$

Where:

Y_i = Output of the ith farm,
X_i = Vector of actual input quantities used by the ith farm,
β = Vector of parameter to be estimated,
e_i = Composite error term denoted as Coelli and Batesse (1996).

$$e_i = V_i\text{-}U_i \tag{2}$$

Where:

V_i = Decomposed error term measuring technical efficiency of the ith farm,
U_i = The inefficiency component of the error term.

The symmetric component (V_i) represent the variation in output due to factors (weather or disease attack) beyond the farmer's control. This symmetric component of the error term is independently and normally distributed as N (O, δv^2). A one sided component (U_i>O) shows technical inefficiency relative to the Stochastic frontier. Hence, if $U_i = 0$, production lies below the frontier and U_i is assumed to be independently and identically distributed and truncated at zero with the variance δu^2 (N 0, δv^2).

The parameter estimators (β) and the variance parameters were obtained by the maximum likelihood estimation method.

$$\delta^2 = \delta v^2 + \delta u^2 \tag{3}$$

$$\gamma = \frac{\delta u^2}{\delta^2} \tag{4}$$

Where:

I-γ = Inefficiency,
γ = The variance ratio parameter (Gamma) and by Batesse and Corra (1997), $\gamma = (o \leq \gamma \leq I)$.

The variance ratio parameter (γ) has two important characteristics:

- When δv^2 tends to zero, it is the predominant error term in Eq. 1 implying that the output of the sample farmers differs from the maximum output mainly because of the difference in technical efficiency.
- When δv^2 tends to zero, v is the predominant error term in Eq. 1 and so γ tends to zero, thus differences between farmers output and the efficient output can be determine based on the value of γ (Kalirajan, 1981).

The empirical model of the translog Stochastic production frontier function is specified as follows:

$$LnYi = \beta_0 + \beta_1 \ Inx_1 + \beta_2 \ Inx_2 + \beta_3 \ Inx_3 + \beta_4 \ Inx_4 + \beta_5 \ Inx_5 + V_i - U_i \quad (5)$$

Where:

Y_i = Value of output of ith farm in kg,
x_i = Land area cultivated measured in hectares,
x_2 = Labour used measured in total hours worked in the farm by main farm operator,
x_3 = Quantity of fertilizer used in kg,
x_4 = Quantity of seed used in kg,
x_5 = Quantity of insecticides used in litres,
V_i-U_i = As defined above,
β_O-β_1 = Parameter estimates,
i = 1,2,3 ----------n, farms.

The technical efficiency for individual farm is computed as an index and the average technical efficiency for the production system determined.

Based on a number of socio-economic factors identified to be influencing the technical efficiency of the farms, the Coelli and Battese (1996) inefficiency model was employed to estimate the parameters of the variables. The model assumes that the inefficiency effect (ui) is independently distributed with mean Ui and variance δ^2.

The model is specified as:

$$u = \delta_0 + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \delta_4 z_4 + \delta_5 z_5 + \delta_6 z_6 \ e_i \quad (6)$$

Where:

U_i = Inefficiency effect,
z_1 = Dummy variable representing the primary occupation of respondents,
z_2 = Dummy variable denoting level of education,
z_3 = Dummy variable denoting the sex of the respondents,
z_4 = Actual age of respondents in years,
z_5 = Health status of respondent,
z_6 = Farming experience measure in years,
δ_0-δ_6 = Parameter estimates,
e_i = A random disturbance following half normal distribution.

β, δ, δ^2 and γ are unknown parameters to be estimated. δ^2 and γ = coefficients are diagnostic statistics that indicates the relevance of use of the Stochastic production frontier function and the correctness of the assumptions of the disturbance of the error term. The gamma (γ) indicates that the symmetric influence, the are not explained by the production function are the dominant sources of random errors. The statistical significance of gamma shows that in the specified model, there is the presence of a one-sided error component (v_i). This implies that the traditional OLS response function cannot adequately represent the data and hence the use of stochastic production frontier function estimated by the maximum likelihood estimation method is most appropriate. The computer programme frontier version 4.1 (Coelli, 1994) was used to run the maximum likelihood analysis.

RESULTS AND DISCUSSION

The maximum likelihood estimates of parameters which reflect the best practice farm at the existing level of technology is shown in Table 1. From the table; signia squared $\delta_s^2 = \delta v^2 + \delta u^2 = 0.369$,

Table 1: Maximum likelihood estimate and the inefficiency function

	Variables			
Production inputs	β	Coefficients	Standard error	t-ratio
Constant	β_0	0.108	0.258	0.419
Land area (ha)	β_1	0.106	0.168	0.633
Labour (hours worked)	β_2	0.251	0.323	0.778
Fertilizer used (kg)	β_3	0.405	0.345	1.174
Seed used (kg)	β_4	-0.163	0.985	-0.166
Insecticides (L)	β_5	-0.153	0.546	-0.280
Inefficient model				
Intercept	δ_0	0.193	0.832	0.232
Occupation	δ_1	-0.299	0.368	-0.813
Education	δ_2	0.416	0.219	1.899**
Sex	δ_3	-0.524	0.258	-2.031
Age	δ_4	0.144	0.172	0.837
Health	δ_5	0.305	0.116	2.629**
Experience	δ_6	-0.443	0.216	-2.0809
Diagnostic statistics				
Sigma squared	δ^2	0.369	0.653	0.565
Gamma	γ	0.114	0.135	1.067
Log likelihood		-0.10489		
Ave-technical efficiency		0.849		
LR test		0.224		

Source: Computer Print Out, 2006; No. of periods = 1; No. of observation = 120; No. of iterations = 27; Values in the table has been corrected to three significant figures; ** = Statistically significant at 5%

with a t-ratio of 0.565. This is the ratio of performance of the farm specific efficiency indices to the total variation in output due to technical inefficiency. Batesse and Corra (1977) defined gamma (γ) as the total variation of output from frontier which can be attributed to technical efficiency. It indicates the estimate of the Stochastic frontier, which show the best practice performance i.e., efficient use of available technology. It can be observed that the estimate of g = 0.114. This implies (1-0.114) = 0.886 or 88.6% of the total variance in output of the farmers is due technical in efficiency. Thus, on the average, the farmer's are just realizing about 11.4% of their potential output feasible in the prevailing socio-economic physical and health environment. In other words, the observed differential output is resulting from farm specific performance and not just statistical random variability. This therefore, requires attention of policy makers.

The result indicates that the output of the farmers are affected not ouly by the traditional input variables: land, labour and capital (fertilizer, seed and insecticide) but equally by socio-economic factors: age, experience and health as well as series of dummy variables such as sex, education and type of primary occupation. The signs of the estimated coefficients were as expected. Thus, the elasticity's of land, labour and fertilizer are positive while seed and insecticides are negative. This implies that increasing the quantities of any of these inputs will increase output except for seed and insecticide which were inversely related to output. Fertilizer has the largest coefficient (elasticity = 0.405) meaning that fertilizer has the largest impact on the output of the farmers in the study area. If additional quantity of fertilizer is used on the farm, output will increase appreciably. Land and labour were not significant because all the farmers have access to land and land is not a problem in the study area. All the farmers source family labour, so there is no significant difference in the amount of labour supplied. Seed and insecticides were inversely related to output which implies that increasing their quantities will results in decrease output. This follows theory, that there is a limit to increasing quantity of variable input relative to fixed inputs in production, which if not obeyed will at a point cause output to decline. Suggesting probably an over utilization of resources on fixed factor of production.

Table 2: Estimate of technical efficiency for the principal farm operators

Class interval	Frequency	%
0.20-0.29	1	0.83
0.30-0.39	5	4.17
0.40-0.49	0	0.00
0.50-0.59	7	5.83
0.60-0.69	7	5.83
0.70-0.79	4	3.33
0.80-0.89	24	20.00
0.90-0.99	72	60.00
Total	120	100.00

Source: Calculation from Computer Print Out, 2006

In the inefficiency model, the negative sign of the parameters indicates that associated variables have a positive effect and vice versa. All variables carry the expected signs. Health, education and age have positive coefficients implying that these variables decrease efficiency of the principal farm operator while occupation, sex and experience carry negative coefficients implying positive effects on the efficiency.

The positive sign of age follows a prior expectation, since productivity decreases with old age. Education has a positive sign and decreases efficiency because of high level of illiteracy of the principal farm operators in the study area. The health variable which is measured as average days lost to incapacitation i.e., periods of sickness when the farmer could not attend to his farm due to sickness multiplied by frequency of occurrence of that sickness, thus reflecting adverse health. Health has a positive coefficient in the model and is statistically significant at 5%. This follows a prior expectation that adverse health impacts negatively on the productivity of farmers. The coefficient of health is large (0.31) i.e., 31% implying that one percent improvement on the health condition of the farmer will lead to 31% increase in the efficiency of the farmer. Of all the variables in inefficiency model, health has the largest impact on the efficiency of farmers. The individual farmer's technical efficiency obtained from the estimated stochastic frontier is presented in the frequency distribution (Table 2). The predicted technical efficiency differs substantially among the farmers as it ranges from 0.28-0.99 with a mean technical efficiency of 0.85. This implies that there is a potential of about 15% to improve the output of the farmers.

Out of the entire variables specified in the inefficiency model, health has the largest coefficient and is statistically significant at 5%. This implies that the greater part of the inefficiency of the farmer is as a result of adverse health. Put another way, it means that improvement of the health condition of the farmer will improve efficiency greatly.

CONCLUSIONS

The present study is an empirical investigation on the impact of health on agricultural productivity. The research findings bring to light the importance of health capital as an indispensable production input in agriculture and the economic development of the nation as a whole.

The coefficient associated with health variable of the principal farm operator in the model is positive, large and statistically significant; thus, the study proposes that, achieving self-sufficiency in food production and the much desired growth in agricultural sector of the economy, will continue to elude Nigeria, if health issues in agriculture are not properly addressed.

Policy actions to train farmers in work related risk reduction geared at curbing infections and incapacitations occasioned by diseases, accident and strains, may impact farmers health and agricultural productivity much as past policies, that improved farmers access to inputs (like machinery, land etc.). Health capital expenditure is a justified basis of promoting development through large increases in productivity.

REFERENCES

Adewale, B., M.A. Mafe and M.A. Sulyman, 1997. Impact of guinea worm disease on agricultural productivity in owo local government area, ondo state Nigeria. Public Health Division, Nigerian Institute of Medical Research, Yaba Lagos.

Agulanna, F.T., 2006. Health an Labour Productivity among Female Farmers in Imo State. Nigeria. A post Mid-Term Paper Submitted to Idachaba Foundation for Research Scholarship, Ibadan.

Anonymous, 2006. Back Note, Federal Republic of Nigeria, Nigeria

Ashagidigbi, W.M., 2004. Effect of malaria on rural household productivity in ido local government area of oyo state. M.Sc. Project, (Unpublished) University of Ibadan, Ibadan Nigeria.

Batesse, G.E. and G.S. Corra, 1977. Estimation of production frontier model with application to pastoral zone of Eastern Australian. J. Agric. Econ., 21: 167-179.

Bradley, K.R., 2002. Health Hazards in Agriculture: An Emerging Issue. A Publication of NASD, Department of Agriculture, United States.

Clifford, M.M., M. McCarney and E. Boelee, 2006. Understanding the links between Agriculture and Health Agriculture Malaria Water Associated Diseases. Brief 6 of 16.

Coelli, T.J., 1994. A guide to frontier version 4.2. A computer programme for stochastic frontier production and cost function estimation. Department of Economics University of New England, Armidale.

Coelli, T.J. and G. Battese, 1996. Identification of factors which influence the technical inefficiency of Indian farmers. Aust. J. Agric. Econ., 40: 103-128.

Corinna, H. and M.T. Ruel, 2006. Understanding the Links Between Agriculture and Health. Published by International Food Policy Research Institute, Brief 1 of 16.

Donald, C., 2006. Understanding the links between agriculture and health food, agriculture and the environment. Occupational health hazards of Agriculture. Focus 13, Brief 8 of 16.

Falusi, A.O., 1995. An overview of Nigeria's rural economy. Status, Problems and Potentials Paper Presented at the National Workshop on Rural Development NCEMA.

FAO (Food and Agricultural Organization), 1987. Report on FAO identification mission on integrated dairy development, Nigeria. FAO, Rome.

Fulginito, L.E. and R.K. Perrin, 1998. Agricultural Productivity in Developing Countries. Agric. Econ., 19: 45-57.

Kalirajan, K., 1981. Econometric analysis of yield variability in Paddy production. Can. J. Agric. Econ., 29: 283-293.

Ngambeki, D.S. and A.E. Ikpi, 1982. Rural farmer productivity in the tropics. The Nigeria Experience Can. J. Agric. Econ., 30: 297-318.

NPC (National Population Commission), 2006. Population Facts, Abuja.

Rahji, M.A.Y., 2005. A utility function Analysis of formal credit allocation in Dichotomised Nigerian Economy between 1970 and 1999. J. Rural Econ. Dev., 14: 56-57.

Schultz, P., 1999. Productive Benefit of improving Health: Evidence from low income countries. Mimeo, Yale University.

Strauss, J. and D. Thomas, 1998. Health, Nutrition and Economic Development. J. Econ. Literature, 36: 766-817.

Ugwu, P.C., 2006. Effect of farmers health on the agricultural productivity of the principal farm operator in borgu lga of niger state. M.Sc. Project, (Unpublished) University of Ibadan, Ibadan, Nigeria.