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Sickness and Agricultural productivity: Evidence from Arable-Crop farmers in Southwest, Nigeria.

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ABSTRACT— Literature argued that investments in the health programs for labour to prevent sickness in farming operations enhances agricultural productivity. This paper estimates a stochastic production function using 240 primary data to analyze the relationship between farmers' dietary-pattern, health-status and agricultural production efficiency. Study indicated that workdays lost to sickness influenced poor farm-income and productivity and the effect is considerable. Sound dietary-patterns and health status enhances human productivity and farm-profit levels. Moreover, the incapacitating effects of sickness on farm-labour leads to diminishing effects on farmer's efficiency level. Average value of technical efficiency per-unit of input tends to be higher for healthy farmers than for those affected by sickness. About 79.1% of the respondents spent 85.6% of their farm-proceeds on medical expenses, while 66.8% of the respondents were unable to meet medical expenses from farm-proceeds. Hence, expenditures on health upsets affect the availability of disposable cash income as household financial resources are diverted to pay for medical treatment. Thus, deny farmers inability to procure agricultural inputs that can improve agricultural productivity. Regression results confirm the negative effect of health barriers on farmers' agricultural production-efficiency. Results suggest that one workday lost to sickness increase farmers' inefficiency by 0.4%.

KEYWORDS: Sickness; cost of sickness, economic burden, and agricultural productivity.

1. INTRODUCTION

Past studies argued that health is an important form of human capital [1]. Sound health enhances productivity, increase physical capacities, strength, endurance and mental capacity [28]. Thus, establishes relationship between health and labour productivity [47], [36]. Research in economics has long recognized that health plays an important role in individual and household labour inputs. Literature indicated that sound health interacts with the marginal utility of consumption, leisure, and labor allocation decisions of household members [55]. Study argued that improved investments in health programs in traditional agriculture influenced appreciable economic benefits [43]. [35], [15] contended that improved health programs influenced marginal productivity of farm labour and agricultural production. [37] advocated that improved health in low-income countries have resulted in an increase in the life span of farmers. Thus, more productivity years of participation in the labour force that creates economic incentives.

The literature linking health to labor productivity is built on the concepts of household production theory developed by [7]. In Becker's framework, households are treated also as producers of "commodities" instead of solely consumers of goods and services. This framework was extended by [19] to analyze the demand for health. In Grossman's model, health is viewed as a durable capital stock that yields an output of healthy time. Individuals are endowed with an initial amount of this stock that depreciates over time. By investing in health, households expect to increase the stock of available healthy time, which will increase the amount of time available for earning income or for producing consumables goods. Reviewing traditional agricultural household models, [39] developed a framework that allows the evaluation of the impact of change in health on productivity, labor supply, and overall farmer income. Pitt and Rosenzweig's extension involve incorporation of a health variable into the household's utility function.

Health as a capital good can either improve or reduce households' productive ability [12]. A study of women farmers in mixed cropping systems found that vast majority of women which suffered from intense muscular fatigue, heat exhaustion, and skin disorders, were forced to take days off from attending to farm operations [11]. This resulted to loss of days worked, reduced worker capacity, hence, reducing total output [45], [2]. [54] deduced that sickness and death from HIV/AIDS, malaria, tuberculosis, and other diseases has drastically reduced labour availability for farming operations in developing countries. [26] argued that lack of coordination of policymaking between agriculture and health undermines efforts to overcome ill health among the rural poor. While most research efforts in agriculture have dealt with yield improvements through improved technologies and fertilizers use, the role of human capital and labour productivity have received less attention [30]. Among economists, there appears to be lack of conclusive empirical evidence to indicate whether or not preventable disease caused by malnutrition or poor hygienic have adverse effects on farmer's labor productivity and farm income [4], [29], [52], [42], [25]. This, thus question the effects of deteriorated health on agricultural productivity? [16] reasoned that there is a lack of appropriate health indices that can influenced agricultural productivity.

Agriculture remains fundamental to economic growth, poverty alleviation, improvement in rural livelihood, and environmental sustainability [54]. Past studies contended that sickness of labour reduces labour availability for farm operations influencing poor marginal productivity. This is the construct in which this study was built. The study examines the determinants of sickness, such as dietary pattern and health status of labour and its effects on agricultural productivity, using evidence of farming household from southwest, Nigeria. What then is the direction of this paper; is to examine factors influencing farmers' health status, safety on farms and its effect on farm income The paper is prepared as follows. First section is the introduction, Section two explains the conceptual framework of the linkage between agriculture and health and the empirical findings from preceding and similar studies. Section three presents the methodological approach employed and model assumption. Section four present results and discussions and the last section depicts conclusions and suggests policy inferences.

2. Conceptual construct of the study

2.1 Linkage between agriculture and health

Past studies contended that Farm-labour, agricultural productivity and health are mutually interdependent [40]. Therefore, sound health and the labour-productivity of rural households determine the strength of the farm operations. Policy to mitigate the health threats to farm laborers in agricultural communities is vital in reducing the incidence of disease, strengthening households' labour ability to work productively [5]. Thus, agricultural productivity and labour health influence one another in a bidirectional manner. Figure 1 presents a framework, developed by [21], for understanding the linkages between agriculture and health.

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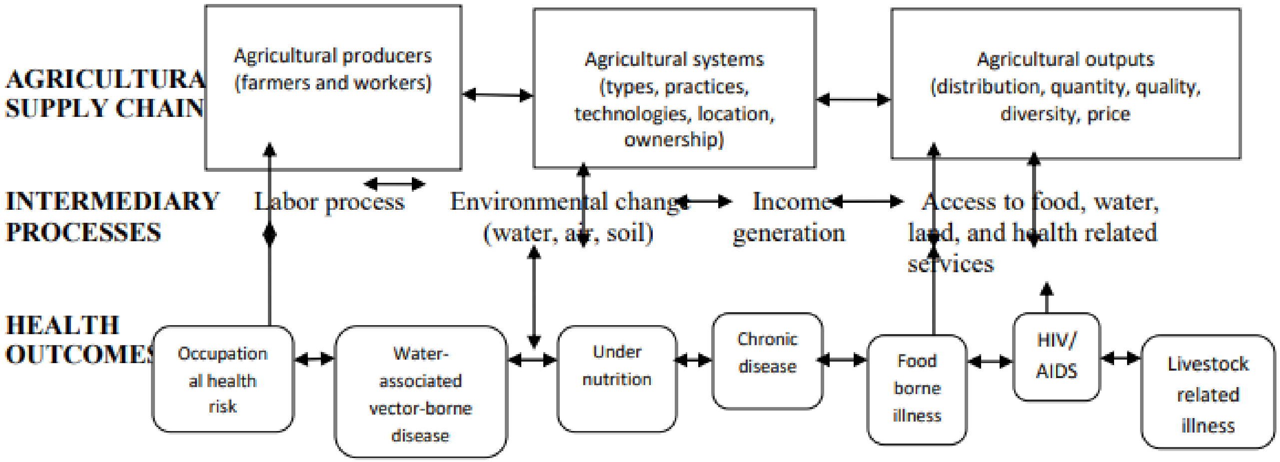
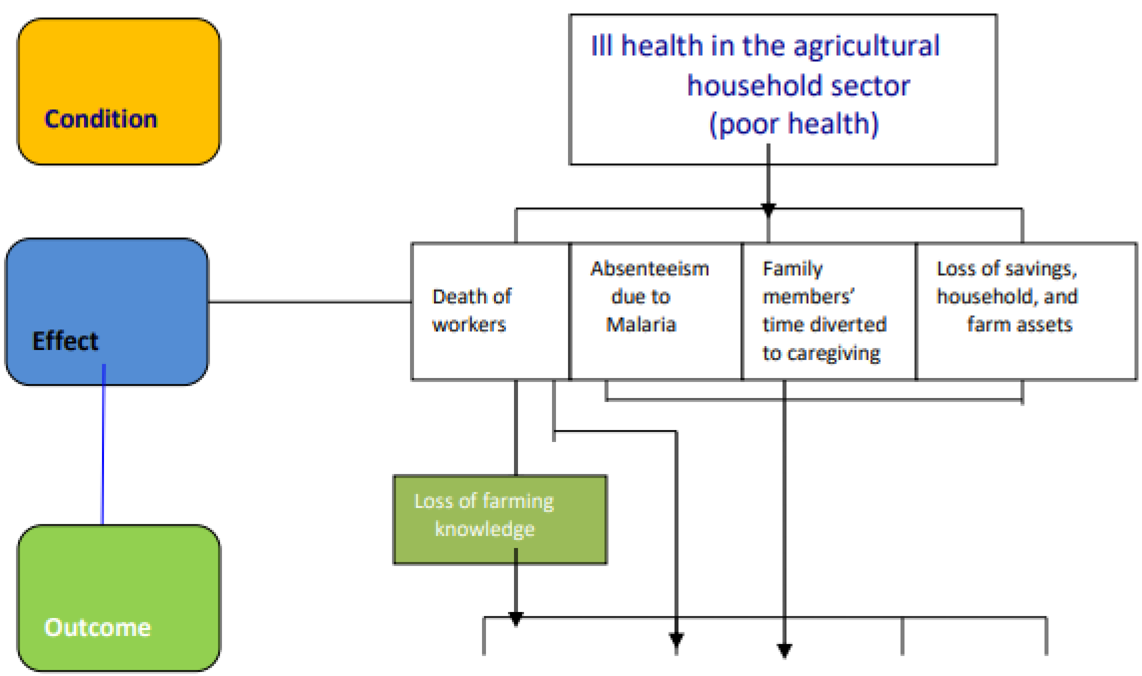


Figure 1—Framework For Linkages Between Agriculture and Health

Source: [21].

Past studies asserted that sound health is an important form of human capital, it enhances workers' productivity, increasing physical capacities, strength, endurance and mental capacities [33]. Health as a capital good can stimulate households' productive ability. Therefore, it is expected to see a positive relationship between sound health and productivity. Literature have deduced that productivity is a measure of output from a production process, per unit of input [32]. Labour productivity is presumed as a ratio of output per labor-hour, an input. Productivity may be conceived of as a metric of the technical or engineering efficiency of production. As such, the emphasis is on quantitative metrics of input, and sometimes output. Productivity is distinct from metrics of allocative efficiency, which take into account both the monetary value (price) of what is produced and the cost of inputs used.



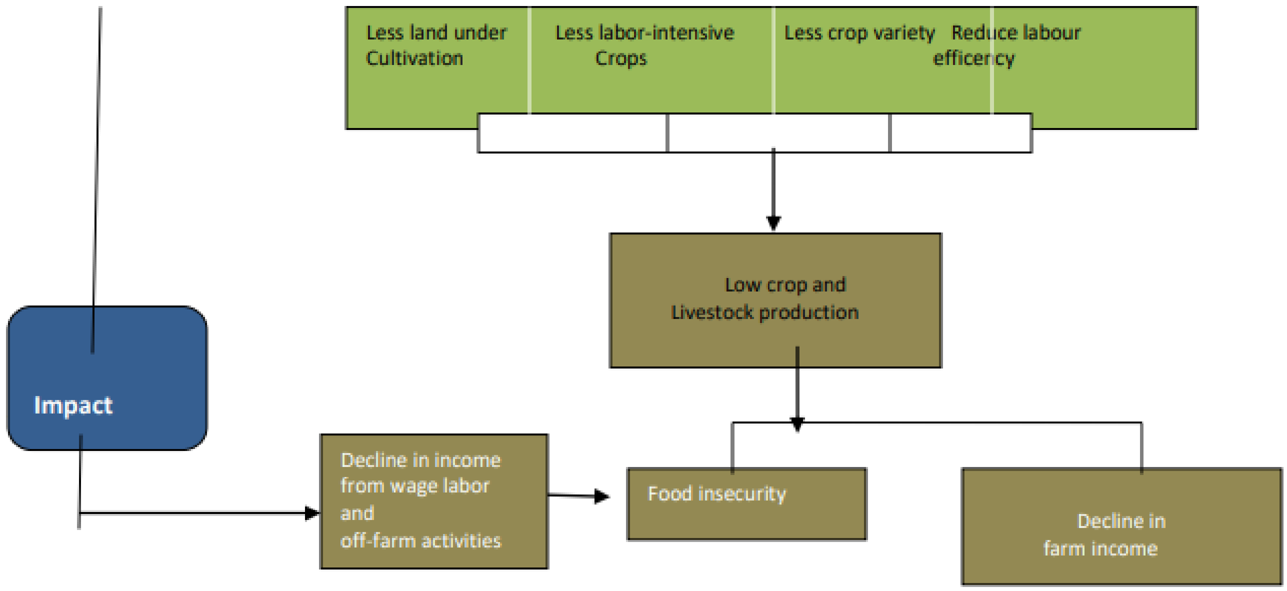


Figure 2 —Conceptual framework for the impact of illness/disease on agriculture

Source: Adapted from [3].

Figure 2 shows the conceptual framework for analyzing the effects of sickness (health status) on agriculture. The figure indicated that poor health (from whatever cause) can inflict great hardships on households, including debilitation, substantial monetary expenditures, loss of labor, and sometimes death. Past studies contended that the health and nutritional status of adults affects their ability to work, and thus underpins the welfare of the household, including the children's development [20]. Evidence indicated that weak labor productivity is a distinguishing characteristic of developing-country. Past studies revealed that labor productivity (measured in terms of agriculture value-added per worker) is quite low in low-income or developing countries, as compared to high and middle-income countries, which rely more on farm machinery than labor (Berazneva and Byker 2017).

2.2 Empirical review on the linkage between health and agricultural productivity

Literature contended the significance role health played in the promotion of economic development through sound mind of labour [41]. Advancement of labour through sound health programs can influence productivity. Evidence abound in literature that progress made in industrialized countries was associated with significantly increased in sound health care programs provided to the people [18]. Moreover, sound health relates positively with schooling that enhances sound learning [8], [31]. Also, enhancement in the levels of human capital influences the rate of return to value-added in human capital, thereby increase the life expectancy of people. Past study posited that declines in maternal mortality health program have influenced likelihood of dying in childbirth as evidenced in the report of Sri Lankan project [23]. Evidence also abounds of the empirical evidence on the link between health and Productivity of the agricultural household [39]. [21], deduced that in agricultural community's, poor health diminishes income and productivity, and thus, shrinks' people's ability to address health problems.

[46] deduced healthy labour is a significant input in farming operations. [13] found evidence of a significant link between health and nutritional status and agricultural productivity in their study in Ethiopia. Their results show that the distance to the source of water as well as nutrition and morbidity status affect agricultural productivity. [49] deduced in his study of the relationship between farmers' health drawbacks and agricultural production efficiency using econometric tools of a stochastic production to estimate household survey data.

Their finding suggests that investing in the health sector programs in the rural areas influenced agricultural productivity as well as farmer's income generation. The study concluded that healthy farmers produce more per unit of outputs, earn more income than unhealthy farmers. [14], engaged an interdisciplinary method to elucidate the association between health and agricultural productivity in rural Nigeria. The results revealed that poor agricultural productivity was influenced by poor health status, while a huge expenditure was used to take-care of the sick person.

[38] indicated that workdays lost to sickness influenced poor agricultural productivity. The paper argued that preventive healthcare interventions policies were not put in place that addressed health concern of those engaged in agricultural livelihood. [50] study, assessed the economic burden of ill-health on household productivity using the cost of illness approach to evaluate the burden of malaria, typhoid fever and malnutrition which are considered as the major infections in the study area. The results showed that about 95% of household income were used to take care of sick household's members. Moreover, the study indicated that household's member that is sick cannot provide labour for farming purposes and thereby reducing labour availability for farm operations. The study concluded that there is a long-term negative relationship between ill-health and agricultural productivity.

From the foregoing, there is evidence of relationship between sickness/ill-health of labour and agricultural productivity. The conceptual construct of this paper is that healthy labour /farmers produce more per unit of inputs, earn more income and supply more labor than farmers affected by sickness.

3. Methodology

The study area covers the agricultural zones of Ekiti, Osun and Ogun states, Southwest Nigeria respectively. There are three agricultural zones in the states identified. Selection of the agricultural zones was influenced from past studies and literature. In addition, the identified communities have very large and vast agricultural activities, where majority derives their livelihood. The southwest zone, Nigeria is one of the six zones in the country. Southwest region lies between longitude 20 31 and 60 001 East and latitude 60 21 and 80 371 N with a total land area of 77,818 km2. National Bureau of Statistics, (2019) reported that 27 511 892 people lived (14 049 594 males and 13 462 298 females) in Southwest, Nigeria. It has two different seasons which are: rainy season (April-October) and dry season (November-March). The temperature zone runs between 21 and 28 degrees centigrade (0C) with high humidity of 77 percent. Hence, crops and livestock production are done with little hitches in the area. The major occupation of the people is agriculture. The additional occupations include trading, driving, carpentry, etc. The official language is English, while the main informal language for communication in this region is Yoruba with different dialects.

3.1 Sampling Procedure and Data collection

The study adopted multistage sampling technique for data collection. The first stage entails a random selection of two blocks out of the 3 blocks in each of the agricultural zones in each of the identified state to give 6 blocks. Second stage entails selection of three communities in each block (6 communities in each state) to give 18 communities. In the third stage, 20 respondents were selected in each of the community identified to give a total respondent of 360. However, 240 respondent's data (66.7% response rate) were useful for data analysis. The 240 respondent's data have the sufficient information to help achieve the objectives of the study. The rest of the unused questionnaires were discarded due to insufficient information, improper filled, missing information and lost in transit.

The study uses both primary and secondary data for analysis. Primary data were collected through the use of an efficient administration of well-structured tested questionnaire to respondents in the study area. Also, data were sourced through participatory observation, focus group discussions and key informants' interview. Information collected were on respondents' socio-economic variables, environmental and health data, production data, farm income, family expenditure, as well as cost of medical treatment of the sick. Also, information was sought from the respondents on amount spent on hired labour, and morbidity data. Source of secondary data includes ministries of health, hospitals and clinics, annual statistical bulletins and reports, and other research institution with relevant information. However, secondary data were used to augment the primary data where necessary.

Table 1: Selection of respondents in the identified communities of the study area.

		State			
		Ekiti	Osun	Ogun	Total
Town	Alajo/Itaore	16	0	0	16
	Araromi	12	0	0	12
	Aaye Ilawe	16	0	0	16
	Ifakin	12	0	0	12
	Ikole ara	12	0	0	12
	Ijesa isu	12	0	0	12
	Abiri ogudu	0	12	0	12
	Ayesan	0	16	0	16
	Igbogi	0	12	0	12
	Ilaje	0	16	0	16
	Isale oba	0	12	0	12
	Molete	0	12	0	12
	Abuleoloni/Lantoro	0	0	16	16
	Ijaiye	0	0	12	12
	Ajebandele	0	0	16	16
	Imushin	0	0	12	12
	Ayede/Lomiro	0	0	12	12
	Ilushin/Lokugbe	0	0	12	12
Total		80	80	80	240

3.2 Method of Data Analysis

Data were analyzed through the use of descriptive statistics and stochastic production function model. Descriptive statistics such as frequencies, percentage, and averages and was used to itemize and compare the nutritional patterns of farmers, use of the healthy days for farming, and activity by location. Also, included in this analysis is the comparison of expenditure patterns, treatment of the sickness among others etc. stochastic production function was used to modelled the causal effects of sickness on farmer's efficiency.

3.3 Modeling the effects of farmer's health on efficiency

The study modelled the farmer's health through labour contribution to agricultural productivity by appraising efficiency. The study takes a cue from the work of [44] that modelled a recursive analytical model of profit and utility. Hence, this model will help to account for the successive nature of agricultural households' decision-making process and its maximizing components of income generation. This study modelled that each farmer is assumed to maximize a utility function through the following form:

$$U = U(C_a, C_m, C_I) \quad (1)$$

Where Ca = Agricultural staple commodities
Cm = Market-purchased commodities
Ci = Leisure

Hence, Utility is maximized subject to a cash income constraint:

$$P_m\, C_m = \; P_a\, (Q_a - \; C_a) - S\; (\, L - \; L^w) + \; S_x\, X + Err \qquad (2)$$

Where Pm = Price of the market-purchased commodity
Cm = Price of the staple
Pa = Price of the agricultural-based commodities
Qa = Production of the staple;
S = Market Salary;
L = *Labour*
$L^f = Family\ laboiur$ if (*L* - *LW*) is positive
$L^f = Hired\ laboiur$ if (*L* - *LW*) is negative
X = variable input
S_x = market price
Err = any non-labor, non-farm income such as remittance not accounted for.

It is argued that every farmer also faces a time constraint: hence, he can only assign for instance, time to leisure and forgone other activities. Past study argued that farmers' management ability should be replicated in both the allocative efficiency of input and technical efficiency of the production process [53]. Past studies deduced that the total stock of farmers' time available for farm production (*Lf*) is divided between management *M* and work *W* [9], [2]. These studies conceptualized effective management input in the production process and is given as:

$$M_g^{\mathfrak{G}}\left(I_H\, M_g\,\right) = m\,(I_H)\, M_g\, \frac{d_{mg}}{d_{IH}}\; < 0 \qquad (3)$$

where *I* is the index of health impairment (Sickness). Similarly, effective family labor (f) input is given by

$$F^{\mathfrak{G}}\,(I_H\, F) = F\,(I_H)F, \frac{df}{dI}\; < 0 \qquad (4)$$

Hypothetically, decrease in production is due to abridged effective management input and operative family labor input. However, the comparative static effects of sickness I on actual family labor inputs (FLI) and on other contributions are not forthright [2]. Literature argued that the influence of lesser productivity may be partly compensated by the substitution of hired labor or other inputs. In addition, distribution of family labour to management and hired labor depends on the comparative marginal productivities of hired labor. Thus, the influence of the comparative effects of labour sickness on farming operations inferred management decision. Consequently, the study argued that production performance is dependent on the sound health of farmers through effective management decisions. Also, the effect of healthy environment and healthy farmers' influenced utility function [39].

From the above deduction, the study assumed empirically, a stochastic production frontier of the following form taking a cue from the work on [6], [24]: The model form is deduced as:

$$Q_i = F(X_i\,, \beta)\; \in_I, \exp(V_i) \qquad (5)$$

In log form, equation (5) can be written as

$$InQ_i = \; \beta_0 + \sum_{j=1}^{k-1} \beta_j\; InXij + In \in_i + \; V_i \qquad (6)$$

Let Ui = - $In \in_i$, it then follows that

$$InQ_i = \beta_0 + \sum_{j=1}^{k-1} \beta_j \, InXij - U_i + V_i \quad (7)$$

$$Where\ U_i \sim N^+ (\theta, \sigma_u^2), and\ \lambda = \sigma_{U\ /\ \sigma_v}$$

Subsequently, variables that influencing agricultural efficiency ($\in_i$) can also influence agricultural production (Qi). Modelling this relationship (eqn.7) is taking from the methodological approach of [51], [27]. Hence, equation (7) is rewritten as follows:

$$InQ_i = \beta_0 + \sum_{j=1}^{k-1} \beta_j \, InXij - U_i + V_i \ (Z_i, \theta) \qquad Where\ U_i(Z_i, \theta) \geq 0 \quad (8)$$

3.4 Estimation procedure

The empirical models used for this research consist of a stochastic frontier model, taking a cue from the works of [10] the following model was adopted:

$$Q_n = \alpha_0 + \alpha_1 LnX_1 \ldots . \alpha_n LnX_n + (v_i + u_j) \quad (9)$$

Where $v_i - N(0, \sigma^2)$

Where Ln = Natural Logarithms

Q = Agricultural output of the ith arable crops
$X_{1\text{-}n}$ = Explanatory variables
X_1 = Family labour in man-days
X_2 = Hired Labour in man-days
X_3 = Seeds planted (kg)
X_4 = Cultivated land area (acre)
X_5 = Fertilizer input (kg)
X_6 = Access to extension services
X_7 = Access to credit facilities
X_8 = Dietary pattern
X_9 = Household size
X_{10} = Age
X_{11} = Workdays lost by farmers due to sickness
X_{12} = Education
X_{13} = Access to basic health facilities
X_{14} = Production pattern
X_{15} = Classes of food taken
X_{16} = occupational health hazard
v_1 = Symmetry error
ui = Inefficiency

The inefficiency model is stated as:

$$|u_i| = \beta_0 + \beta_1 HS + \beta_2 Age + \beta_3 HHS + \beta_4 Class + \beta_5 DP + \beta_6 AH + \beta_7 EA + \beta_8 PT + \beta_9 WS + e_i$$
(10)

Where: ui = Stochastic inefficiency estimate

HS = Health status dummy (where if being sick = 1 and otherwise 0)
HHS = Household size
Class = Class of food taken
DP = Dietary pattern
AH = Access to basic health facilities
EA = Extension access

PT = Production pattern
WS = Workdays lost to sickness

Equation (10) was estimated using the one-step maximum likelihood estimation (MLE) procedure, where health variables and selected demographics were employed as explanatory variables of agricultural productivity. This methodology was adopted to achieve both efficiency and consistency level. Hence, the frontier function and the inefficiency segment are equally estimated using the marginal effect of Zi on production (Qi) and efficiency (ui) and is given by

$$\partial / \left\{ \in \left(\frac{Q_i}{X_i Z_i} \right) \right\} \ / \ \partial Z_{ik} = \partial / \left\{ \in \left(\frac{-U_i}{X_i Z_i} \right) \right\} \ / \ \partial Z_{ik} \qquad (11)$$

Thus, equation (11) signifies the semi-elasticity of output (efficiency) with regard to exogenous factors, i.e. the percentage change in the expected output (efficiency) when there is an increases by one unit.

4. Results and Discussions

4.1 Descriptions of the Selected Demographics variables of the respondents

This section presents the demographic characteristics of the respondents used in the study area. From Table 2, male house heads (66.7%) dominated agricultural activities and in their active working age group (31-50 years) with mean age of 44 years. Also, majority of the household heads were married (63.3%), while majority (58.4 %) of the respondents had moderate farm sizes between 5-8 acres with mean of 7.47 acres. Moreover, 78.3% of the respondents have at least secondary education and 11.7% University education. This is a fairly literate population where information dissemination can easily be processed and use (Table 2). Table 2 indicated that Cassava (56.3%) and Yam (20.0%) are the dominant mixed cropping farm enterprises with a reasonable farm experience of 10-17 years and mean of 15 years. Also, labour used for farming operations were jointly supplied by both the family and hired labour respectively. Similarly, mean household size of 6.73 (Table 2). Results revealed that in the last six months, days worked in a week has been between 5-6 days (64.6%), however, 1-2 days (91.3%) lost to labour-sickness or labour taking care of the sick (Table 2).

Table 2: Descriptions of the Selected Demographics variables of the respondents

Description	Frequency (%)	Mean
Sex: Male	160 (66.7)	
Female	80 (33.3)	
Marital Status: Single	20 (8.3)	
Married	152 (63.3)	
Divorced/Separated	52 (21.7)	
Widowed	16 (6.7)	
Education: Primary	52 (21.7)	
Secondary	92 (38.3)	
Post-secondary	68 (28.3)	
University	28 (11.7)	
Age-grouping: 21-30	16 (6.7)	44.27 years
31-40	72 (30.0)	
41-50	88 (36.7)	
51-60	48 (20.0)	
61-70	16 (6.7)	
Farm size grouping (Acres): 1-3	8 (3.3)	7.47
3.1 – 5	88 (36.7)	
5.1 – 7	52 (21.7)	

7.1 – 10	48 (20.0)	
10.1 – 15	40 (16.7)	
15.1 – 20	4 (1.7)	
Farm experience (Years): 1 – 5	4 (1.7)	15.37
6 – 10	60 (25.0)	
11 – 15	96 (40.0)	
16 – 20	12 (5.0)	
21 – 30	56 (23.3)	
31 – 40	12 (5.0)	
Household size (No.)1 – 3	20 (8.3)	6.73
4 – 6	104 (43.3)	
7 – 9	76 (31.7)	
10 – 12	36 (15.0)	
13 – 15	4 (1.7)	
Farm enterprise: Cassava	128 (53.3)	
Yam	48 (20.0)	
Maize	24 (10.0)	
Vegetable	40 (16.7)	
Production pattern: Monocropping	16 (6.7)	
Mixed cropping	184 (76.7)	
Mixed farming	40 (16.6)	
Labour supply to farming through		
1. Family labour	40 (16.7)	
2. Hired labour	40 (16.7)	
3. Family labour (75%), Hired Labour (25%)	44 (18.2)	
4. Family labour (25%), Hired Labour (75%)	40 (16.7)	
5. Family labour (50%), Hired Labour (50%)	76 (31.7)	
Access to Fund for farming purposes thru		
1. Personal savings	32 (13.3)	
2. Friends and relations	32 (13.3)	
3. Micro-finance bank	80 (33.3)	
4. Commercial bank	44 (18.3)	
5. Cooperative	52 (21.8)	
Extension services access is		
1. Regular (Monthly visit)	56 (23.3)	
2. Moderate (Quarterly visit)	100 (41.7)	
3. Poor (Once in six months)	68 (28.3)	
4. No access	16 (6.7)	
Common Sickness treated at the Medical centers		
1. Malaria	60 (25.0)	
2. Non-communicable diseases	28 (11.7)	
3. Influenza	20 (8.3)	
4. Yellow fever	16 (6.7)	
5. Tuberculosis	16 (6.7)	
6. Headaches/general body pains	16 (6.7)	
7. Typhoid	16 (6.7)	
8. Ulcer	16 (6.7)	
9. Onchocerciasis	12 (5.0)	
10. Diarrhea	12 (5.0)	
11. Measles	8 (3.3)	
12. Cholera	8 (3.3)	
13. Rheumatism/Arthritis	8 (3.3)	
14. Asthma	4 (1.6)	
Place visit for Medical attention		

1. Community clinic	84 (35.0)	
2. Government hospitals	76 (31.7)	
3. Traditional homes	44 (18.3)	
4. Private hospitals	36 (15.0)	
Weekly visits by household members for medical attention		
1. 1 – 2 Visits	16 (6.7)	
2. 3 – 4 Visits	76 (31.7)	4.52
3. 5 – 6 Visits	124 (51.6)	
4. 7 – 8 Visits	24 (10.0)	
Dietary pattern (how many times food taken daily)		
1. Once daily	28 (11.7)	1.86
2. Twice daily	132 (55.0)	
3. Thrice daily	80 (33.3)	
Food taken is from		
1. Proceed from the farm (100%)	36 (15.0)	
2. Proceed from the farm (75%), Market (25%)	92 (38.3)	
3. Proceed from the farm (50%), Market (50%)	82 (34.2)	
4. Proceed from the farm (25%), Market (75%)	10 (4.2)	
5. Market	20 (8.3)	
Classes of Food taken by household members		
1. Carbohydrate (75%), Protein (15%) Fat and oils (10%)	48 (20.0%)	
2. Carbohydrate (50%), Protein (25%) Fat and oils (25%)	40 (16.7%)	
3. Carbohydrate (65%), Protein (25%) Fat and oils (10%)	48 (20.0%)	
4. Carbohydrate (85%), Protein (10%) Fat and oils (5%)	104 (43.3)	
Days worked in a week		
1. 3 days	19 (7.8)	5.12
2. 4 days	45 (18.8)	
3. 5 days	86 (35.8)	
4. 6 days	69 (28.8)	
5. 7 days	21 (8.8)	
Days lost to sickness in a week		
1. 1 day	99 (41.3)	1.68
2. 2 days	120 (50.0)	
3. 3 days	21 (8.8)	

Source: Results from Field Survey and Data Analysis 2022.

4.2 Respondent's dietary pattern, health status and labour-sickness.

Past studies argued that sound dietary pattern improves health status. This, thus enhances human productivity [1]. This paper assesses the importance of sound dietary pattern on health status of the respondents in the area of study. The results revealed that majority (36.7%) takes more carbohydrate than protein (10.5%) and fat and oils (7.5%). These classes were not adequate in their daily feeding ration and majority (55.0%) took often 2 times daily instead of the requirement of 3-times daily (Table 2). Moreover, the average protein intake in the study areas was less than the FAO minimum requirement of 65gm daily requirement. The study finds out that in all the study areas except in Ogun state average of 61gm of daily intake recorded. Hence, index of the variability of protein intake is lower in Osun and Ekiti states respectively. In addition, results of the calcium intake were 387gm for all the states covered. The intake is lower that the 500gm required daily for adequate body activities [34]. None of the communities covered met with the requirements for adequate body activities. Results of iron and phosphorus intake analysis revealed that average iron intakes in all communities covered were observed to be higher than the 10gm daily intake that are required for proper body activities. The index of the variability of iron intakes in Ekiti, Osun and Ogun states were 55.84%, 76.15% and 84.83% respectively. Also, the intake of phosphorus was higher among respondents in Ogun states as compared to others respondents in both Ekiti and Osun States. However, average intake of this nutrient by respondents in the study areas was much higher than the minimum requirement of 880gms daily intake [34]. The index of variability in phosphorus intake were 45% in Ekiti, 52% in Osun and 66.16% in Ogun states respectively.

In Ogun state, in the last six months, 25.1% of the arable-crop farmers have fallen sick and need to visit the medical center for health concern. Also, in Ekiti state, there were 11.3% and Osun State 17.8% of the farmers who have fallen sick in the last six months and visited the medical center for health concern. Malaria has the highest prevalence among the arable-crop farmers in the area of study with about 25% (Table 2). Malaria is dominant in Ekiti state (53.3%), while Influenzas in Osun State (33.3%) and Rheumatisms/Arthritics and general body pain dominant in Ogun state. Factors attributed to these diseases are poor sanitation (24.6%), poor nutrition (20.4%), mosquito bites (18.8%), stress (13.8%) while 11.3% of the respondents could not ascertain the principal cause of their sickness (Table 2).

Respondents also indicated that sickness affected their daily farming activities thus, making their productivity level decline to about 35% capacities. Hence, Farmers could not do normal farming activities for some days due to sickness. Results from this analysis revealed that in the last six months, days lost to sickness or taking care of a loved ones who are sick are, 32, 56 and 48 days for Ekiti, Osun and Ogun states respectively. Hence, this translate to about 33.3% in Osun, 21.8% in Ekiti and 16.6% in Ogun state days lost to sickness. This category of people could not work nor perform normal farming activities, which include planting, weeding, heaping, harvesting, processing and marketing among others in the last six months.

4.3 Labour-Sickness and Agricultural Productivity

Table 2 indicated respondents' insight of their health-related socioeconomic status. Results indicated that all the respondents had access to health-care facilities in varying degrees. The results further indicated that 51.7% of the respondents have access to health facilities, while about 31.7% had access to health-care facilities through community clinic and government hospitals. Although, there were concern about poor accessible to health personnel and facilities. These are grossly inadequate to cater for all their health care needs. Moreover, the results indicated that in the last six months, Malaria had influenced labour sickness more and had been dominant (25%). Malaria influenced labour-sickness to prompt for medical attention to about 1-2 days' weekly. The study also showed that Onchocerciasis and non-communicable diseases attracted more weekly visit to health care facilities. The implication of the finding is that, for the past six months, 62.2% of the households have had at least one sick household member visit medical centre. In addition, about 8 farm labour hours per week were lost in caring for the sick persons. Past studies argued that Labour hour losses by the caregiver are often only a fraction of the labour hours loss by the sick persons themselves. Past studies argued that adult male farmers down with guinea worm disease were estimated to lost a total of 35 days a year (3.9 person months) [3].

[47] deduced that labour-sickness influenced poor labour productivity. Also, sick labour cannot provide labour to farming operations and thus result to loss of farm production time. Results from the profit analysis indicated that respondents from Ogun state made more (about 15% made above 150, 000 Naira in the last six months), while Ekiti state respondents made the least. The results indicated 41.6% in this category made less than 100,000 Naira. In addition, the study deduced that about 79.1% of the respondents spent 85.6% of their farm-proceeds on medical expenses. However, on medical expenses, Ogun state respondents spent more (13% difference) than other states considered. However, Osun state spent the least (14.8% difference). These results further confirmed that sickness has significantly affected farm-proceeds negatively and taking care of a sick member has taking substantial amount of household income and time.

The study revealed that 41.7% of the respondents made profit of N20,000-N35000 from farming activities, while 16.7% made over N50, 000 in the past six months. Results further revealed that about 66.8% of the respondents were unable to meet medical expenses from their farm-proceeds but had to look for other sources to augment. This extra cost spends on medical cost often influence households' inability to procure agricultural inputs such as seeds, fertilizers tools, among others and hence decreased farming operations. In addition, these medical expresses would have been ploughed back in farming operations. The study shown that 75. 6% of the households suffered direct cost of treating sick persons and about 18.3% of them spent between N25, 000 – N40,000 naira to treat sickness within the last six months. The study deduced that majority (85.6%) exhausted their farm-income in taking care of sick household members. Hence, what are the coping strategies the respondents employed to meet with the extra medical expenses spent on health issues?

Results for this analysis indicated that household heads have devised several means to cope such as selling food reserves (12.1%), use of personal saving (19.2%), selling of livestock or crops on the field (16.3%) take loans (12.5%) among others to pay for medical expenses of loved ones (Table 2). This is a case in point for low agricultural productivity as productive asset and financing sources are diverted for medical purposes. Hence, valuable resources are now used to cater for medical expenses. Past studies argued that labour-sickness minimizes farmers' ability to modernize, invest in and maneuvering positive changes in agricultural systems. Also, prohibiting changes that enhances sound health, and thereby expanding inefficiencies in agricultural production [17]. Past studies argued that poor health conditions in developing countries hurt the productivity of adults, thus diminishing agricultural productivity [48]. [48] observed that a large part of the consequence of health on influencing earnings is due to productivity differences. [49] argued that healthy farmers supply more labor than farmers affected by sickness and thus enhanced productivity. Study involved 500 cocoa farmers in Ondo state, Nigeria that are infected with guinea worm revealed that cocoa farmer affected with guinea worm disease lost 19 bags of possible harvest. According to the report, this loss was valued at about 4,884 naira in 1997 (about US$64 in present value terms, year 2022) [22]. This loss is significant, value of the potential loss, 9,566 bags were valued at 2,442,000 naira (US$31,845).

4.4 Sickness and Farmer's Technical Efficiencies

Stochastic frontier model stated in equation 9 was estimated by Maximum Likelihood Estimates (MLE) and results were presented from Table 3. The description of the inefficiency relationship was also expressed in equation 10 and results presented from Table 3. Results form the diagnostic statistics indicated that the efficiency effects were mutually estimated with the frontier function. Gamma (γ) is the ratio of the errors as specified in eqn. 10. Hence, if (γ) = 0, then, efficiency is absent, and if (γ) > 0 then presence of inefficiency. Results from this analysis indicated that gamma (γ) of 0.8524. This result is significant as it is different from zero. This thus established that arable-crop farmers in the area of study are exceptionally inefficient. Though, the sigma square (σ^2) result of 0.6517 is statistically significant at 5% while gamma (γ) is statistically significant at 1%. Hence, the results of both gamma (γ) and sigma square (σ^2) indicated that the model generated a good fit for the data.

Moreover, in the computation of the elasticity coefficient, the results of the estimates indicated that education, dietary pattern, family labour, and access to basic health facilities were significant at 1% level ($p < 0.01$). Also, occupational health hazard, Fertilizer, access to extension and credit facilities were significant at 5% level ($p < 0.05$) (Table 3). Also, production pattern and classes of food taken were significant at 10% level ($p < 0.10$) (Table 3). However, workdays lost to sickness was significant at 1% level ($p < 0.01$) but negative. Therefore, the coefficients of education (0.5023) had the topmost elasticity follow by dietary pattern (0.4726) family labour (0.3216) and access to medical facilities (0,3018). Thus, a percentage unit increase in education attainment, dietary pattern, family labour, occupational health and medical facilities access would increase output by 0.50%, 0.47%, 0.32%, 0.41 and 0.30% respectively. However, a unit increase in the workdays lost to sickness (elasticity coefficient 0.2681) would lead to decrease in agricultural productivity by 0.27%.

Table 3: Maximum Likelihood Estimates of Efficiency Determinants

Variables	Coefficient	Standard error
Maximum likelihood estimates		
Constant	9.8315***	0.4725
Family labour	0.3216***	0.0528
Hired Labour	0.0062	0.0914
Seeds planted (kg)	0.0071	0.0062
Cultivated land area (acre)	0.0193	0.0672
Fertilizer input (kg)	0.1137**	0.1382
Access to extension services	0.1062**	0.3416
Access to credit facilities	0.1026**	0.0417
Dietary pattern	0.4786***	0.0281
Household size	0.0953	0.2642
Age	0.0762	0.0346
Workdays lost due to sickness	-0.2681)***	0.5172
Education	0.5023***	0.6319
Access to basic health facilities	0.3018	0.0831
Production pattern	0.0997*	0.0731
Classes of food taken	0.0975*	00336
Occupational health hazard	0.0418**	0.0184
Gamma (γ)	0.8524**	0.3391
Sigma square (σ^2)	0.6517***	0.0061
Estimates of Inefficiency model		
Constant	0.7941*	7.9642
Health status	0.3782**	0.0681
Age	0.0841	0.0012
Household size	-0.1152*	0.0741
Class of food taken	0.2195*	0.0862
Dietary pattern	0.3416**	0.0851
Access to basic health facilities	0.3115**	0.9512
Extension access	0.0725	0.0846
Production pattern	0.0843	0.1105
Workdays lost to sickness	-0.2951**	0.0272
# Observations 240		
Wald statistic 139.6; p-value:0.00		
Log-likelihood -1016.8		

Source:
*, **, *** signify significance at 10%, 5% and 1% levels, respectively.

Evidence from the results of the inefficiency model revealed that the health status, dietary pattern, access to basic health facilities and workdays lost to sickness were statistically significant at 5% level ($p < 0.05$), while the coefficient of age, household size and class of food taken were statistically significant at 10% level ($p < 0.10$). These results suggest that the significance of farmer's health status enhances productivity, that is healthy farmers are more efficient than the sick farmers. This is further corroborated with the statistically significant of workdays lost to sickness ($p < 0.05$) which carries negative sign. However, the significance of household size with negative sign indicated that as household size increases the farmer's efficiency diminishes.

Health status used as a variable is number of days' farmers could not work because of sickness. Hence, the results imply that one more day lost due to illness enhances farmers' inefficiency by 0.4% (Table 3). Though the significance of the effect is high and highly remarkable. It can be argued from this result that farmers may have amassed some technical and managerial skills that cannot be easily interchangeable or transferrable through either labor market or family and any other social link. Hence, limiting their ability to do agricultural activities because of sickness, which influences overall efficiency. Indeed, as farmers lose more days because of illness, their efficiency is expected to decline.

Generally, it is a known fact that healthy farmers are more efficient than those affected by sickness; though, the results from this study suggest the existence of state heterogeneity (Table 4). Results indicated that across the states, the highest efficiency is seen among the respondents from Ogun state (0.672), with those affected by sickness (0.468). Also, respondents from Ekiti state have the lowest (0.428) (Table 4).

Table 4: Efficiency and sickness by states

States	**Number affected by illness**	**Number not affected by illness**
Ekiti	0.428	0.615
Ogun	0.468	0.672
Osun	0.481	0.592

Source: Field survey, 2022

5. Conclusions and implication of findings

The study indicated that sickness affected farm proceeds and productivity and the effect is considerable. The study deduced that dietary patterns and health status enhances human productivity and farm profit levels. Moreover, the incapacitating effects of sickness on farm labour influence diminishing effects on farmer's efficiency level thus inspires poor productivity. Moreover, the average value of technical efficiency per unit of input tends to be higher for healthy farmers than those affected by sickness. The difference in input productivity is also observed in income generated from farm proceeds. The study deduced that the variance in income ranges from N100,000 to N150,000 naira. where healthy farmers earn about N100,000 more under the time reviewed (of 6 months) than those affected by sickness. This implies that sickness reduce supply of working time to farming operations and thus decrease income.

The study deduced that about 79.1% of the respondents spent 85.6% of their proceeds from the farm on medical expenses, while 66.8% of the respondents were unable to meet medical expenses. Hence, expenditures on health upsets affect the availability of disposable cash income as household financial resources are diverted to pay for medical treatment. Thus, deny farmers to procure agricultural inputs to improve agricultural productivity. For severe sick household members that require huge finances and when such finances cannot be provided, household heads devised means to cope such as selling food reserves (12.1%), use of personal saving (19.2), selling of livestock or crops on the field (16.3%) take loans (12.5%) among others to pay for medical expenses of loved ones.

Regression results confirm the negative impact of health impediments on farmers' agricultural efficiency by some variables. These variables are education, dietary pattern, family labour, and access to basic health facilities. However, a unit increase in the workdays lost to sickness (elasticity coefficient 0.2681) would lead to decrease in agricultural productivity by 0.27%. Indeed, inefficiency is found to be significantly influenced by the number of days lost to sickness. The results suggest that one more day lost because of sickness will increase farmers' inefficiency by 0.4%; this implies that substitution of farmers' time through either labor market or family and other social link may not be perfect. Results from the communities revealed that weak health services and poor dietary pattern influences farmers' income and efficiency poorly. Hence, investing in improving access to health sector and improved dietary pattern of arable-crop farmers will improve efficiency and income. Also, the rate of return on other investments such as education and extension services will be progressed.

This study revealed that the insufficiency of some vital nutrients in the dietary pattern influences certain infectious diseases and sickness. Sickness thus influences loss of working days contributing to poor productivity. in addition, access to quality health facilities is still very poor in the areas of study, but majority still visit government and community clinic for health concern. Hence, there is a dire need to develop comprehensive nutritional programme, health strategies and sensitization of infectious and diseases control mechanism. These health strategies; provision of quality health instruments such as prevention, health protection and health education. These strategies must be tailored to boost health status of farmers and their working efficiency. Much researches have been on measuring the effects of health upsets on farming operations but there is comparatively little empirical evidence. Thus, giving inconsequential agricultural; health policies that can inculcate access to quality health facility. This study evidenced that while promoting agricultural productivity, policy of complementary and comprehensive access to quality health facility and education on less occupational health hazard must go in line too. The deductive from this study is to safeguard labour contribution to farming operations from being less productive. Also, safeguarding the health status of arable crop farmers and creating a platform where nutritional education can easily be effective and improved. The study suggests a dire need to develop comprehensive nutritional programme, health strategies and sensitization of infectious and diseases control mechanism among the farming population.

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