Heliyon 6 (2020) e05433

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Parametric assessment of household's food intake, agricultural practices and health in rural South West, Nigeria

Abiodun Olusola Omotayo *

Food Security Niche Area, North West University, Mafikeng Campus, South Africa

ARTICLE INFO

Keywords:
Food science
Public health
Nutrition
Agriculture
Analysis
Day(s) of incapacitation
Education
Food intake
Rural development
Self-rated health

ABSTRACT

Food intake and health are important component of agriculture. The contribution of these duo have a lot to say about the productivity of farmers in the nations of the world. The results presented here relied on data collected on households' food intake nutrition and health profile through multistage random sampling of 420 households selected from the Southwest, Nigeria using well-structured questionnaires. Descriptive statistics (percentage, frequency, mean) and inferential statistics (Logistic regression and Negative Binomial). The result shows that the farmers were ageing, given an average of (53 ± 11.44 years). The Logistic regression model of the effect of farming households food intake on health showed that gender of the households' head, marital states of the head, household food security and knowledge of nutrition significantly reduced the probability of reporting good health while the educational year(s) of the farmers, total cost of health and consumption of fruit increased it. In addition, the Negative Binomial Regression model, employed in the assessment of the effect of farming households' nutrition on health indicated that gender, marital status, and consumption of milk and total cost of health significantly increased day(s) incapacitated while the year(s) of education reduced it. It was therefore concluded that diversity of food intake among the farmers was low. Ageing, education and large household size among others, were also identified as major problem among the rural farmers. It was however recommended that considerable investment in human capital should be encouraged since food diversity and nutrition education enhances households' food intake and health status.

1. Introduction

Nigeria's population is expected to rise tremendously in the next decade (2030s') but till then, the structure and capacity to satisfy the growing food demand has remained an issue of great concern (Ikelegbe and Edokpa, 2014). With the national poverty line estimated at 43%, recent empirical studies have revealed that more than 70% of Nigerian poor presently live in the rural settings on less than a US dollar per day (Kolawole and Omobitan, 2014; Obadan and Ighodaro, 2012). This persistent endemic poverty among the rural population is a ripple effect of their extremely low income, which restricts their access to quality and quantity of food which they can purchase and consume for healthy living (Omotola, 2008; Werhane et al., 2020). According to some statistics, more than 50% of the Nigerian population live in severe social deprivation, and many households are nutrition and food insecure (Akinyele, 2009). In Nigeria, "Food deficits of 31% and 20% in the year 1980 and 2000 respectively were recorded" (Okojie et al., 2001).

However, the 9% or about 11 million undernourished Nigerians translate to about 5.4% of the total number of undernourished people in the Sub-Saharan Africa as a whole. Under the condition of rising food prices, the high cost of living accompanied by low per capita income of an average citizen, many Nigerian households have developed increasingly diversified means of access to food. Nigeria is a country among other countries facing serious food-nutrition insecurity problem, and her positions among the most food insecure countries in the last few years remain the 54th in the year 2005, 22nd in 2006, 17th in the year 2007. Furthermore, in the year 2008, Nigeria was the 18th, 15th in 2009 while it was the 13th nation in the year 2010 (Abdullahi et al., 2010; Adebayo, 2011).

In addition, the Global Hunger Index (GHI) ranked Nigeria 40th among 79 countries in 2012, the rising food prices, malnutrition, and death as a result of wide-spread poverty is an indication of the prevalence of food insecurity in the Nigeria. It is also a sign of extreme suffering for millions of poor people (Omotayo, 2020; Von Grebmer et al., 2012).

* Corresponding author.
E-mail address: omotayoabiodun777@gmail.com.

https://doi.org/10.1016/j.heliyon.2020.e05433
Received 25 November 2019; Received in revised form 3 August 2020; Accepted 2 November 2020

According to Global Hunger Index (2015), Nigeria ranked 14th amidst 52 countries with serious GHI between 34.9 and 20 hunger situation (Von Grebmer et al., 2015). Therefore the nutritional status of an average Nigerian remained precarious as the country consistently recorded deficit average per capita calorie intake in previous years.

The low level of government budgetary allocation to both agriculture (source of subsistent farmers' nutrition) and health is also a clear indication that priority is not placed on activities that have direct links to their nutrition and health status. For instance, national expenditure on health fell from 3.30% in 1995 to 2.92% in the year 2000, while the proportion of government expenditure on agriculture also fell from 6.33% within the year 1995 to 3.33% in 1999 before it was eventually increased to 5.87%. This gives enough evidence that the cost of nutrition, combating diseases, health and other problem by farmers is quite enormous, considering the frequency and prevalence of hunger, malnutrition, diseases and ill health among Nigerian rural farmers.

This study, therefore, seeks to analyze the effect of agricultural households' food intake on health outcomes since food intake and health problems have become one of the greatest problems facing the principal operators of the agricultural sector itself (the small scale farming households). Evidently, Nigeria is facing the challenges of high population growth and food insecurity while the small scale farming households' which the nation rely on as the food producers/supplier are perpetually in the plague of hunger, malnutrition, and ill health. This study therefore determined the socio economic characteristics of the agricultural household; analyze the food intake and health status and assess the effect of the farming households' nutrition on their health. The study thereby leverages this momentum to inform, influence, and catalyze agricultural key actors to better investments in order to sustainably reduce hunger, malnutrition and improve health for these identified world's most vulnerable people.

2. Materials and methods

2.1. Study area, method of data collection, population, sampling procedure, and size

Southwest Nigeria is one of the six geopolitical zones in the country. The zone consists of six different states namely: Ogun, Ekiti, Ondo, Oyo, Lagos, and Osun, Southwest Nigeria (Figure 1). The data collected include demographics characteristics, environment-related issues, consumption expenditures pattern, cost and food compositions, cost and returns of enterprises, nutrition, and health status. A multi-stage sampling procedure was adopted in the selection of respondents in the study (Table 1). Ogun, Oyo, and Osun were purposively selected from the six states in the zone, based on the prominence of agricultural activities in these states.

The second stage was the selection of one Agricultural Development Programme (ADP) zone from each selected state regarded as the food basket of the state. The third stage was a random selection of two (2) Local Government Area in each of the ADP zones. Based on the total household population figure provided by the National Population Commission of 203,631 for the six (6) selected LGA (NPC, 2006), four hundred and fifty (450) households were then randomly selected from 18 villages (3 prominent villages from each LGA) using a proportionate sample of 130, 160, and 130 from Ogun, Oyo and Osun respectively. The proportionate factor utilized is given as $N_s = p/T_p*450$ where N_s = Sample size from the LGA; p = population of selected LGA; T_p = total population of all the selected LGAs and 450 = desired number of respondents for the study (proven sufficient using Raosoft Sample Size Calculator).

2.2. Analytical techniques and methods

A number of analytical tools based on the specific objectives were employed in this study. These consist of descriptive and inferential statistics.

2.3. Indicators of households' food intake and nutritional status

(i) Dietary Diversity Score (DDS)

Dietary diversity can be simply defined as the number of diverse food or food groups consumed within a given reference period of time (FAO, 2013). This is a good indicator used at household and individual level to know their food intake and food security level. It describes the number of food groups consumed, within the number and type of food groups It also provides a broad (wide) indication of households access to foods or individual's consumption of foods. The higher the household's DDS the

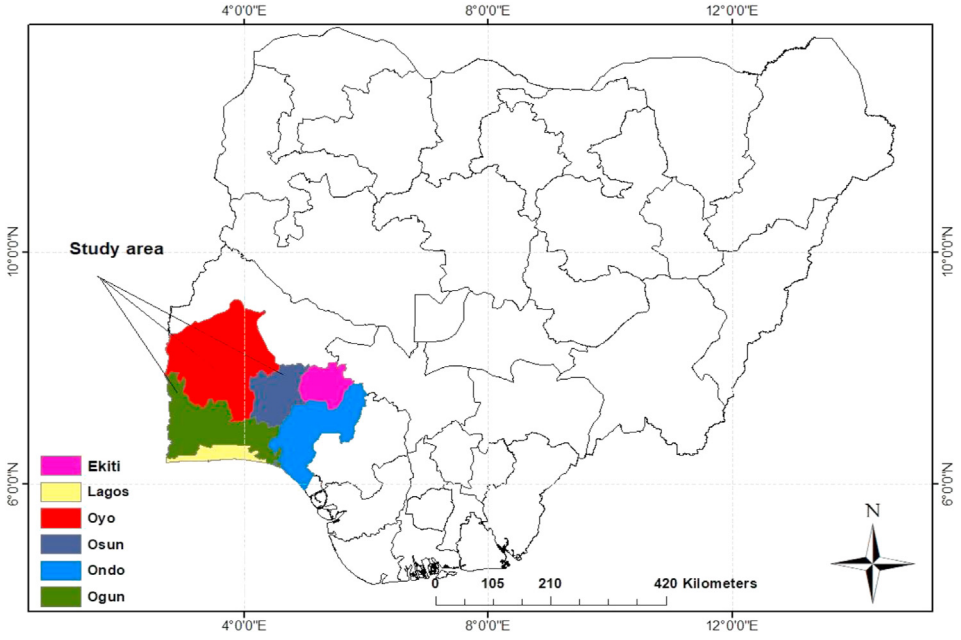

Figure 1. Map of Nigeria showing the selected South West States.

Table 1. Distribution of respondents across the selected villages.

State	Selected ADP Zone	Local Government Areas (LGAs')	Selected Villages	Administered number of Questionnaires	Retrieved and Completely Filled
Ogun	Ijebu	Odogbolu	Odo-Jobore, Idowa & Ososa	65	60
		Ijebu-Ode	Ishiwo, Okeako & Molipa	65	60
Osun	Iwo	Ejigbo	Ilawo, Masifa & Esundunri	65	59
		Iwo	Olomu, Agorro & Elemo	65	61
Oyo	Ogbomoso	Ogooluwa	Ajaowa, Otamokun&Osupa Ile	95	92
		Iseyin	Alayin, Abugaga & Abalagogo	95	88
Total			**18**	**450**	**420**

better their nutritional status. However, DDS represents the sum total of all the food groups consumed by an individual.

The values for the dietary diversity variable was derived by adding all 16 food groups into 12 main groups based on similarities pattern of (Arimond et al., 2010; Kennedy et al., 2007; Ruel et al., 2004; Savy et al., 2005; Steyn et al., 2006). For this research, Household Dietary Diversity Score (HDDS) was calculated as the number of food groups consumed during the diet-recording period. The recall period of 24 h recommended by FAO was adopted, because it is less cumbersome for the respondent, less subject to recall error and also conforms to the recall time period used in many dietary diversity studies (Arimond et al., 2010; Kennedy et al., 2007; Ruel et al., 2004; Savy et al., 2005; Steyn et al., 2006).

The approach for collecting information on HDDS was in a qualitative 24-hour recall of all the foods and drinks consumed by the respondent and/or any other household member. Following the lead of FAO (2011), the mean score was used as the cut-off point in terms of a number of food groups to show adequate or inadequate dietary diversity for the HDDS or distribution of scores for the purpose of analysis and to set research goals or targets. The mean distribution score of 6 derived in this study was used as the cut-off point in terms of a number of food groups to show adequate or inadequate dietary diversity for the HDDS distribution of scores for the purpose of analysis and to set research goals/targets.

(ii) Coping/fall back strategies or mechanisms

These are remedial actions undertaken by people whose survival and livelihood are compromised or threatened (Dryland et al., 2020; Hamenoo et al., 2018). Households with food shortage are almost by definition nutritionally unsustainable, and are likely to be economically and environmentally unsustainable as well (Kirkland et al., 2013; Tefera, 2012). Coping Strategies Index (CSI), is a food intake behavior that counts the frequency and severity of behaviors in which people engage when they do not have enough food or enough money to buy food (Maxwell and Caldwell, 2008). Nevertheless, even though coping strategies are an indication of shortage and severity of hunger, the distinction between "coping" and "failure to cope" is an important distinction to note in the famine literature (Maxwell, 1996).

2.4. Indicators of households' health status

(i) Self-Rated/Self Assessed Health Status

This is another technique commonly used to assess the health status of adults. Self-Rated health approach was used to rate respondents health status as "good, very good, moderate, bad, very bad" (Alawode and Lawal, 2014; Ghatak, 2010) According to Alawode and Lawal (2014), "self-rated health refers to a survey procedure that is commonly utilized in medical research in which participants are invited to assess different aspects of their own health status by answering a series of questions". At the individual level, it has been established that richer people have better health because they can afford better goods and services, better food, nutrition, medical care, sanitation and good housing that promote health. At low-income levels, people are more likely to fall sick as a result of malnutrition, inability to attend schools and therefore, will be less able to work (Alawode and Lawal, 2014).

(ii) Day of Incapacitation due to Sickness

An incapacitating illness or injury is one in which one is hospitalized, under medical care for a short term condition, or otherwise sufficiently debilitated as to be unable to perform basic livelihood activities (Szasz, 2009; Omotayo 2016a; Ajith and Ghosh, 2019; Omotayo and Oyekale, 2013). It is a very good indicator of health at individual and population level (Omotayo 2016a; Omotayo and Oyekale, 2013).

2.5. Logistic regression model (LRM) of the effect of households' food intake on health

This binary logistic regression model was employed to determine the effect of farming households' food intake on health. The binary logistic regression model is stated as:

$$Yi = \beta 0 + \beta 1X1 + \beta 2X2 \ldots . + \beta nXn \quad (1)$$

Yi is the binary variable with value 1 if respondents re-categorized self-rated health status was good and 0 otherwise that serves as a proxy for health status.$\beta 0$ is the intercept (constant), and β1, β2, to βn are the regression coefficients of the predictor variables, X_1, X_2, and Xn. Logistic regression model is widely used to analyze data with dichotomous dependent variables. Hence, it was considered a suitable model to use in this research because the dependent variable was dichotomous in nature. In addition, it was necessary to create dummy variables (Table 2) to use the selected socio-economic, nutritional, and environmental and health and enabling variables of this study in the logistic regression model.

2.6. Poisson regression model (PRM) of the effect of nutrition on day(s) incapacitated

Poisson regression model was used to analyze the effects of farming household's nutrition on health status. This is due to the fact that the dependent variable in this case is a count variable i.e respondent's day(s) of incapacitation due to sickness(s). The count index (days of incapacitation) is discrete and small and hence the appropriateness of the Poisson maximum likelihood regression (Eq. (2)). The model takes the form of

$$Dk = \beta 0 + \beta 1Ak + \beta 2Ck + vk \quad (2)$$

Dk = Count Index (day(s) of incapacitation to sickness).

Ak = Socioeconomic characteristics e.g. Gender, marital status, household size.

Ck = Nutritional components such as vegetable, cereal, legume, fruits (See Table 3).

Vk = Error Term.

Table 2. Variables used to analyze the effect of farming household's food intake on health.

Independent Variable	Description
Household Heads' Gender	Dummy; 1 if Head is male and 0 if otherwise
Marital Status of the Head	Dummy; 1 if Head is married,0 otherwise
Households Size	Number of members of the household (Continuous)
Age of the Household Head	Number of years (Continuous)
Educational Year	Number of years of academic education (Continuous)
Dependency Ratio	The ratio of the dependent population to the total productive population within the households (Continuous)
Availability of Medications	Dummy, 1 if good, 0 if otherwise
Household Food Security	Dummy, 1 if secured, 0 otherwise
Total Cost of Health	Total value in Naira (Continuous)
Absence of Ill Health	Dummy, 1 if yes, 0 if otherwise
Respondents' Use of Treated Net	Dummy, 1 if yes, 0 if otherwise
Financial Source	1 = Personal saving,0 = Otherwise
Working Hour	Number in Hours (Count)
Consumption of Fruit	Dummy, 1 if yes, 0 if otherwise
Consumption of Cereal	Dummy, 1 if yes, 0 if otherwise
Vegetable Consumption	Dummy, 1 if yes, 0 if otherwise
Root and Tuber Consumption	Dummy, 1 if yes, 0 if otherwise
Legume Consumption	Dummy, 1 if yes, 0 if otherwise
Households Possession of Transport Means	Dummy, 1 if yes, 0 if otherwise
Knowledge of Nutrition	Dummy, 1 if yes, 0 if otherwise

2.7. Negative Binomial Regression model (NBRM)

In the *negative binomial* model, the number of observations (yi) is assumed to follow a Poisson distribution with a mean (λi) but the dispersion is assumed to follow a Gamma distribution (Cameron and Trivedi, 1998). Poisson regression uses Maximum Likelihood Estimation (MLE) due to violation of homoscedasticity assumption (Figure 2).

More so, the goodness of fit was evaluated from statistical significance of deviance statistics. However, the Assumption of Poisson distribution was rejected from its statistical significance ($p < 0.05$) in this section. Therefore, Negative Binomial regression was employed and its superiority over Poisson regression was evaluated from likelihood ratio test statistics of alpha equal to zero. Table 3 highlights the independent variables employed in the model.

Table 3. Variable used for Poisson Regression of effect of nutrition on days incapacitated.

Independent variable	Description
Gender of the Households' Head	Dummy; 1 if head is male,0 if female
Marital Status of the Head	Dummy; 1 if Married,0 otherwise
Households Size	Number of Members (Continuous)
Year of Education of the Head	Number of Educational Years (Continuous)
Possession of other Occupation	Dummy, 1 if yes, 0 if otherwise
Knowledge about Food	Dummy, 1 if yes, 0 if otherwise
Eating Outside Family Food plan	Dummy, 1 if yes, 0 if otherwise
Cereal Consumption	Dummy, 1 if yes, 0 if otherwise
Root and Tuber Consumption	Dummy, 1 if yes, 0 if otherwise
Fruits Consumption	Dummy, 1 if yes, 0 if otherwise
Consumption of Egg	Dummy, 1 if yes, 0 if otherwise
Vegetable Consumption	Dummy, 1 if yes, 0 if otherwise
Consumption of Milk	Dummy, 1 if yes, 0 if otherwise
Legume Consumption	Dummy, 1 if yes, 0 if otherwise
Total Cost of Health	Total value in Naira (Continuous)
Total Cost of Production	Total value in Naira (Continuous)
Total Cost of Feeding	Total value in Naira (Continuous)
Total Revenue	Total value in Naira (Continuous)

3. Result and discussion

3.1. Respondents' socio economic characteristics

Table 4 reveals that majority of the respondent fall into the age intervals of 40 < 60 years with the average age of household heads in the pooled data set and standard deviation (in parenthesis) of 53 years (11.44). Age of the household's head is an important variable as it reveals whether the households benefit from the past farming experience or such farmer has to base his/her decisions on the risk of seeking advice from more experienced farmers. The study indicates that farming households were ageing evidenced through the highest mean age of 54.6 years in Oyo state, which confirms previous findings (Daud et al., 2017; Ijatuyi et al., 2018; Nkonki-Mandleni et al., 2019; Omotayo, 2016a). More so, 81.19% of the respondents were male while the others (18.81%) were female. This finding is in line with the traditional belief that farming is predominantly a male oriented and dominated enterprise while women are mostly known to be involved in processing and marketing of farm produce. This finding could also be linked to the laborious nature of small scale farming as it is being practiced in the study area.

The result further shows that majority (74.52%) of the respondents were married. This can positively influence farming households' nutrition, health and hence agricultural outcomes as the wife(s) and children could help in cooking activities thereby enhancing the farmer's devotion to his farming activities. The distributions of household size indicates that larger (88.57%) percentage of the respondents have less than 10 household member. Large household size could lead to correspondingly poor food intake and health in the study area (Omotayo, 2017; Gebrehiwot and van der Veen, 2014). In addition, the FAO/WFP (2014) suggested that larger household size exacerbates poverty levels. More so, the educational status of the farming households' head shows that 43.10% of the pooled respondents have secondary education with mean years of education of 9.28 years. The implication of these results is that higher number educational year could have a positive influence on the ability of the farmers to know their nutrition composition of food and the need for diversity (Omotayo, 2016b).

Furthermore, farm size distribution of the respondents reveals that majority (95.24%) cultivate less than 4ha. This is in line with the previous finding that explained that Nigeria's food security depends mainly on food production by small-scale farmers who are cultivating not more

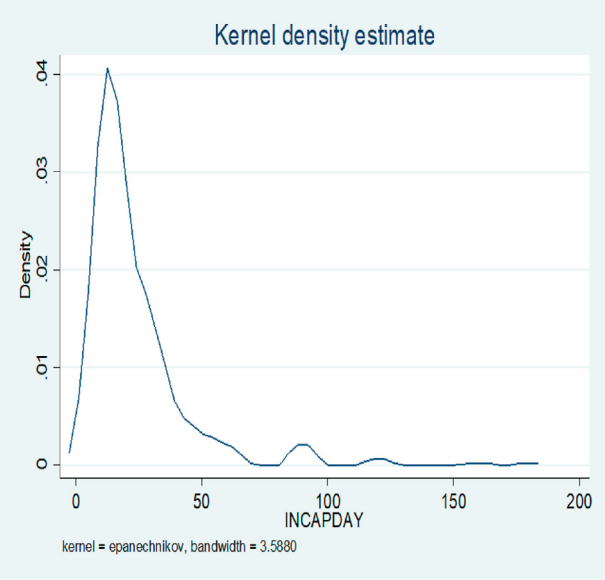

Figure 2. Kernel density graph of respondent's day(s) of incapacitation.

than 2.5 ha of land (Matemilola, 2017; Omotayo and Oladejo, 2016). Year of farming experience is presented below with 40.00%, 39.20 and 35.80% of the respondents from Oyo, Ogun and Osun states respectively having less than 10 years of experience in farming and mean of 17.80 years, 17.40 years and 19.57 years of experience in Oyo state, Ogun state and Osun states respectively.

3.2. Respondents food intake and nutrition

(i) Respondents daily frequency of food intake across the selected states

Table 5 shows the farming household's distribution according to daily food intake. A larger percentage of the farming households i.e. 40.56% in Oyo state and 45.00 % in Osun state eat twice daily while their counterpart from Ogun state reported that they eat thrice daily. The disparity in the number of meal taken daily could be due to lack of adequate nutritional knowledge or due to poverty status of the households (Babatunde et al., 2007).

(ii) Households' dietary diversity score across the selected states

Tables 6 and 7 shows the dietary diversity scores of respondents. Households' Dietary diversity score (HDDS) as earlier mentioned, was based on 12 food groups earlier mentioned in section 2.3. The mean score recorded across the selected states were 5.20, 5.10 and 4.31 from Oyo, Ogun and Osun states as against the mean cut-off point of 5 which was set according to FAO (2011) recommendation based on their study in Mozambique where HDDS was stratified using a wealth scale, while the mean HDDS in the highest wealth tertile was 5. Therefore, this indicates an adequate household dietary diversity score (HDDS) in Oyo, Ogun but inadequate HDDS in Osun state. This is in line with existing literature. It has been shown in previous studies that increase in dietary diversity (food intake) is connected with households' food security status (i.e. households' energy availability) and socio-economic status (World health Organisation (WHO), 2000).

(iii) Respondents coping mechanism for food shortage across the selected states

Table 8 explains that large percentage of the farming households adopt adjustment of food intake in Oyo and Ogun state with 38.89 % and 34.17% respectively while borrowing was the most accepted coping mechanism of respondents from Osun state (45.00%) whenever they run out of food in their respective households.

3.3. Respondents health indicators

(i) Self-rated health status of respondents across the selected states

Table 9 presents the result of farmers' self–rated health status. The finding does not corroborate with farmers' income in the sense that it reveals that the poor revenue farming households (See Table 9) mostly have very good, good and moderate health status across the three states. However, the farming households could probably mention their health state based on their traditional knowledge. In addition, this is consistent with literature as poor individuals tend to under report ill health (Ahmed et al., 2000).

(ii) Respondents days of incapacitation due to ill health across the selected states

Table 10 presents the average days of incapacitation as a result of illnesses among farming households' in Southwest Nigeria. The average days of incapacitation across Oyo, Ogun and Osun states were 25.27days, 22.44 days and 21.60 days respectively. Also, the majority of these farming households fell into the category of 1–20 day(s) of incapacitation per annum with 53, 50% in Oyo state, 63.30% in Ogun state and 70.00% in Osun state. Therefore, considering the connection between health and welfare, farmer's incapacitation through sickness is likely to influence the capacity of households to absolutely escape poverty (Lawson, 2004).

3.4. Respondents income and cost categories on nutrition-health in the study area

Table 11 shows the mean cost expended by the selected farming households on nutrition and ill health per annum, total cost due to ill health which was computed as the sum of treatment cost, the cost of prevention and cost of days of incapacitation. These gives an average of ₦52,559.44 ($262.80), ₦46,942.67 ($234.71) and ₦48,912.92 ($244.56) for Oyo, Ogun, and Osun state respectively per annum while food expenditure was ₦351,045 ($1755.23), ₦417,382.50 ($2086.911) and ₦408,438.30 ($2042.19) across the selected states. This also implies that a household spends 48.80%, 53.51% and 57.52% of their gross income annually on food in Oyo, Ogun and Osun states respectively while 7.31%, 6.02% and 6.87% of the respondents' annual income were spent on health in Oyo, Ogun and Osun states of Nigeria.

In addition, this research ascertains the importance of the synergy between nutrition and health status of farmers holding to the fact that this twin takes almost 60% of the annual income of farming households in the study areas. Most factors that affect farming household income have serious economic implication on nutrition and health. Conversely, the majority of the factors affecting health and nutrition will have serious consequence on farming households' income. As a result, we could assert that productive farming practice with increased income is the real and sure way for farming households' to achieve the adequate nutrition and health they need.

3.5. Estimates of logistic regression with self-rated health as dependent variable

Logistic regression result of the effect of households' food intake on health status in South West Nigeria was explained here. The results show that the model fitted the data very well as shown by statistical significance of the chi^2 ($p < 0.01$). In addition, test for multicollinearity among the variables was carried out with variance inflation factor (VIF), the mean VIF of 1.25 (Table 12) was derived in the analysis. Also, the high levels of tolerance computed for the variables indicate that there was

Table 4. Socio-economic profile of respondents.

Variables	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
Age								
20 < 40	26	14.40	28	23.30	19	15.80	73	17.38
40 < 60	106	58.90	65	54.20	65	54.20	236	56.19
60 < 80	48	26.70	27	22.50	36	30.00	111	26.43
	$\overline{X} = 54.6$	SD = 11.30	$\overline{X} = 51$	SD = 11.8	$\overline{X} = 53.8$	SD = 11.18	$\overline{X} = 53$	SD = 11.44
Gender								
Male	148	82.20	97	80.80	96	80.00	341	81.19
Female	32	17.80	23	19.20	24	20.00	79	18.81
M. Status								
Singles	22	12.20	23	19.20	13	10.80	58	13.81
Married	139	77.20	82	68.30	92	76.70	313	74.52
Divorced	11	6.10	4	3.30	4	3.30	19	4.52
Widow (er)	7	3.90	9	7.50	10	8.30	26	6.19
Separated	1	0.60	2	1.70	1	0.80	4	0.95
House Size								
≤10	158	87.80	111	92.50	103	85.80	372	88.57
10 > 20	22	12.20	9	7.50	15	12.50	46	10.95
≥30	0	0.00	0	0.00	2	1.70	2	0.48
	$\overline{X} = 6.40$	SD = 0.52	$\overline{X} = 5.60$	SD = 3.47	$\overline{X} = 6.63$	SD = 3.83	$\overline{X} = 6.21$	SD = 2.61
Edu. Status								
Illiterate	17	9.40	5	4.16	7	5.80	29	6.90
Primary	57	31.70	46	38.33	40	33.30	143	34.05
Secondary	81	45.00	59	49.17	41	34.20	181	43.10
Tertiary	25	13.90	10	8.33	32	26.70	67	15.95
	$\overline{X} = 8.64$	SD = 4.60	$\overline{X} = 10.20$	SD = 5.18	$\overline{X} = 9.00$	SD = 4.72	$\overline{X} = 9.28$	4.83
Farm {Ha}								
≤4	174	96.67	116	96.67	110	91.67	400	95.24
5 > 8	4	2.20	2	1.67	9	7.50	15	3.57
8 > 12	2	1.11	1	0.80	1	0.80	4	0.95
≥12	0	0.00	1	0.80	0	0.00	1	0.24
	$\overline{X} = 3.18$	SD = 13.34	$\overline{X} = 3.48$	SD = 16.30	$\overline{X} = 2.32$	SD = 1.93	$\overline{X} = 2.99$	SD =10.5
Experience								
≤10	72	40.00	47	39.20	43	35.80	162	38.57
10 > 20	49	27.20	34	28.30	35	29.20	118	28.10
20 > 30	37	20.60	26	21.70	19	15.80	82	19.52
30 > 40	17	9.40	10	8.30	14	11.70	41	9.76
40 > 50	4	2.20	2	1.70	8	6.70	14	3.33
≥50	1	0.60	1	0.80	1	0.80	03	0.71
Total	**180**	**100.0**	**120**	**100.0**	**120**	**100.0**	**420**	**100**
	$\overline{X} = 17.80$	SD = 11.94	$\overline{X} = 17.40$	SD = 11.20	$\overline{X} = 19.57$	SD = 13.04	$\overline{X} = 18.20$	SD = 12.06

Table 5. Distribution of respondents according to daily food intake.

Feeding Frequency	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
Once	43	23.89	21	17.50	23	19.17	87	20.71
Twice	73	40.56	45	37.50	54	45.00	172	40.95
Thrice	52	28.89	51	42.50	40	33.33	143	34.05
More	12	6.67	3	2.50	3	2.50	18	4.29
Total	180	100	120	100	120	100	420	100
	$\overline{X} = 2.09$	SD = 0.66	$\overline{X} = 2.06$	SD = 0.75	$\overline{X} = 2.20$	SD = 0.84	$\overline{X} = 2.12$	SD = 0.75

Table 6. Distribution of respondent's households' dietary diversity score.

Number of Food	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
≤3	64	35.56	59	49.17	55	45.83	178	42.38
4–6	107	59.44	55	45.83	51	42.50	213	50.71
6–9	6	3.33	6	5.00	12	10.00	24	5.71
9–12	3	1.67	0	0	2	1.67	05	1.19
Total	180	100	120	100	120	100	420	100
	$\overline{X} = 5.20$	SD = 0.73	$\overline{X} = 5.10$	SD = 0.31	$\overline{X} = 4.31$	SD = 0.70	$\overline{X} = 4.87$	SD = 0.58

Table 7. Distribution of respondent's households' dietary diversity score according to the 12 food groups eaten within the 24 h recall period.

Food Group	YES		NO		Mean	Standard Deviation
	Freq	%	Freq	%		
Cereal	331	78.81	89	21.19	0.7881	0.40915
Root and tubers	251	59.76	169	40.24	0.5976	0.49096
Vegetables	255	60.71	165	39.29	0.6071	0.48897
Fruits	178	42.38	242	57.62	0.4238	0.49475
Meat, poultry, offal	249	59.29	171	40.71	0.5929	0.49189
Eggs	59	14.05	361	85.95	0.1405	0.34789
Fish and seafood	168	40	252	60	0.4000	0.49048
Pulses/legumes/nuts	189	45	231	55	0.4500	0.49809
Milk and milk products	73	17.38	347	82.62	0.1738	0.37940
Oil/fats	394	93.81	26	6.19	0.9381	0.1262
Sugar/honey/sweet	53	12.62	367	87.38	0.1262	0.33246
Miscellaneous/Beverage	249	59.29	171	40.71	0.5929	0.49189

Table 8. Distribution according to their coping options during food shortage.

Coping Actions	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
Sales of Assets	2	1.10	12	10.00	49	40.80	63	15
Borrowing	61	33.90	31	25.83	54	45.00	146	34.76
Drawing Savings	3	1.70	10	8.30	2	1.70	15	3.57
Reduction of Prod.	19	10.60	6	5.00	12	10.00	37	8.81
Adjustment of food intake	70	38.89	41	34.17	2	1.70	113	26.90
Remittance	17	9.44	9	7.50	1	0.80	27	6.42
Scavenging	8	4.40	11	9.17	0	0.00	19	4.52
Total	**180**	**100**	**120**	**100**	**120**	**100**	**420**	**100**

Table 9. Respondents self–rated health status.

Self-Rated Approach	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
Very Good	42	23.30	45	37.50	25	20.80	112	26.67
Good	74	41.10	37	30.80	43	35.80	154	36.67
Moderate	49	27.20	33	27.50	43	35.80	125	29.76
Bad	11	6.10	2	1.70	6	5.00	19	4.52
Very Bad	4	2.20	3	2.50	3	2.50	10	2.38
Total	**180**	**100**	**120**	**100**	**120**	**100**	**420**	**100**

absence of serious multicollinearity and since some of the variables that were included to capture food intake status showed statistical significance, the null hypothesis is hereby rejected. The model used the households' socioeconomic characteristics and households' health status proxied by a binary variable with value 1 if respondents' re-categorized self-rated health status was good and 0, otherwise that serves as a proxy for health status.

Table 13 shows that the parameter of respondents gender was negative (-0.77538) and significant at ($p < 0.05$). This implies that a male headed household have a lower probability of having a good health

Table 10. Distribution of respondent's day(s) of incapacitation.

Days of Incapacitation	Oyo State		Ogun State		Osun State		Study Area	
	Freq	%	Freq	%	Freq	%	Freq	%
≤20	96	53.30	76	63.30	84	70.00	256	60.95
21–40	61	33.90	34	28.30	25	20.80	120	28.57
41–60	15	8.30	5	4.20	8	6.70	28	6.67
61–80	5	2.80	1	0.80	1	0.80	07	1.67
81–100	2	1.10	4	3.30	1	0.80	07	1.67
≥101	1	0.56	0	0.00	1	0.80	02	0.47
Total	180	100	120	100	120	100	420	100
	$\overline{X} = 25.27$	SD = 22.77	$\overline{X} = 22.4$	SD = 17.31	$\overline{X} = 21.6$	SD = 21.18	$\overline{X} = 23.1$	$SD = 20.42$

Table 11. Respondents cost categories across the selected states.

Total Cost Categories	Oyo State		Ogun State		Osun State	
	Average Cost (₦)	Dollar Equivalent @ $1 = ₦200	Average Cost (₦)	Dollar Equivalent @ $1 = ₦200	Average Cost (₦)	Dollar Equivalent @ $1 =₦200
Production Cost	251020.61	1255.10	268169.92	1340.85	232714.5	1163.57
Revenue	719383.33	3596.92	779992.50	3899.96	711325.0	3556.63
Feeding Cost	351045.00	1,755.23	417382.50	2086.911	408438.3	2042.19
Health Cost	52559.44	262.80	46941.67	234.71	48912.92	244.56
Other Expenses	57652.22	288.26	37755.92	188.78	14608.93	73.04
Net Return	7106.06	35.53	9742.49	48.71	6650.32	33.25

N.B: $1US was equivalent to ₦200.

Table 12. Multicollinearity test of variables applied in the model.

Variables	VIF	Tolerance	Eigenvalue
Households Heads Gender	1.15	0.8666	1.1112
Marital States of the Head	1.46	0.6831	0.8457
Households' Size	1.90	0.5256	0.7754
Age of the Households' Head	1.74	0.5737	0.7329
Educational Year of the Household	1.32	0.7597	0.6009
Dependency Ratio	1.11	0.9011	0.5917
Availability of Medications	1.07	0.9353	0.4752
Household Food Security	1.20	0.8318	0.4491
Total Cost in Health	1.27	0.7899	0.4250
Absence of ill Health	1.41	0.7111	0.3541
Respondent use of Insect net	1.15	0.8670	0.3182
Financial Source	1.10	0.9129	0.3058
Working Hour	1.11	0.9000	0.2637
Consumption of Fruit	1.08	0.9239	0.2370
Consumption of Cereal	1.14	0.8740	0.2190
Consumption of Vegetable	1.08	0.9241	0.1696
Root and Tuber Consumption	1.14	0.8749	0.1350
Consumption of Legumes	1.10	0.9074	0.1147
Possession of Means of Transport	1.18	0.8477	0.0986
Knowledge of Nutrition	1.18	0.8467	0.0396
Mean VIF	1.25		

status (proxied by self -rated health status) when compared with their female headed household counterparts in the study area. In addition, the coefficient of the farming households' marital status was negative (-0.61473) and significant at ($p < 0.10$). This indicates that married headed households' head status have lower likelihood of leading to good health status.

Also, the coefficient of respondents year(s) of education was found to be positive (0.14116) and significant ($p < 0.01$). This indicates that farming households' year(s) of education positively influence their probability of having good health status in the study area. It was marginally added that a unit increase in respondents' year of education will lead to 0.02167 increase in the probability of reporting good health. Education according to Higgins et al. (2008), is an important social determinant of health, for the population as a whole, greater levels of education help to create wealthier economies. Also, higher maternal education level was referred to as a marker of socioeconomic status associated with better diet (Inglis et al., 2005).

More so, the coefficient of respondents food security status captured in its dummy form 1 if yes and 0 otherwise was negative (-0.52679)

Table 13. Logistic Regression Result of the Effect of Households Food intake on Health.

Variables	Coefficient	Std. Error	Z	P>|z	Marginal Effects	Tolerance
Gender of the Households' Head	-0.77538	0.32768	-2.37	0.018**	-0.13681	0.8666
Marital States of the Head	-0.61473	0.36634	-1.68	0.093*	-0.08586	0.6831
Households Size	0.03268	0.05064	0.65	0.519	0.00501	0.5256
Age of the Households' Head	0.01224	0.01445	0.85	0.397	0.00187	0.5737
Educational Year	0.14116	0.03164	4.46	0.000***	0.02167	0.7597
Dependency Ratio	-0.56763	0.38273	-1.48	0.138	-0.09821	0.9011
Availability Medications	-0.44796	0.28240	-1.59	0.113	-0.06562	0.9353
Household Food Security	-0.52679	0.30102	-1.75	0.080*	-0.07740	0.8318
Total Cost of Health	0.00001	0.00000	3.37	0.001***	0.00000	0.7899
Absence of ill Health	0.18061	0.11081	1.63	0.103	0.02772	0.7111
Respondents' use of Insect Net	-0.49689	0.26694	-1.86	0.063*	-0.07801	0.8670
Financial Source	-0.43641	0.26898	-1.62	0.105	-0.06833	0.9129
Working Hour	0.08528	0.06862	1.24	0.214	0.01309	0.9000
Consumption of Fruit	0.66801	0.25934	2.58	0.010**	0.10559	0.9239
Consumption of Cereal	-0.44758	0.29958	-1.49	0.135	-0.06489	0.8740
Consumption of Vegetables	0.03578	0.26220	0.14	0.891	0.00549	0.9241
Root and tuber Consumption	0.09417	0.27845	0.34	0.735	0.01457	0.8749
Consumption of Legume	0.25994	0.28040	0.93	0.354	0.03900	0.9074
Possession of Means of Transport	1.74243	0.59993	2.90	0.004***	0.17696	0.8477
Knowledge of Nutrition	-0.63774	0.29119	-2.19	0.029**	-0.09395	0.8467
Constant	-0.96240	0.96220	-1.00	0.317		
Observation Number	420					
LR chi^2 (20)	103.30					
Prob > chi^2	0.0000					
Pseudo R^2	0.2121					
Log likelihood	-191.915					

Note: ***, ** and * Means 1%, 5% and 10% levels of significant respectively.

and significant at ($p < 0.10$) level of significance. This indicates that households' that answered yes to the question of whether they were food secured had a significantly lower probability of having good health when compared with their counterparts who answered no. This could be because the farming the households lack adequate knowledge about food intake and nutrition security. In addition, this may be due to the low level of education of the respondent as earlier shown in Table 4.

On the other hand, the parameter of the farming households' total cost on health, captured in naira was positive (0.00001) and significant ($p < 0.01$). This implies that there is a direct and positive relationship between farming households' cost expended on health and their probability of having good health status by 0.0000 unit. Also, holding other factors constant, a unit increase in farming households' cost of health will increase the probability of having good health status by 0.0000. One of the most significant financial benefits of working (besides income) is the enablement to afford health care bills (State Health Access Data Assistance Center, 2013).

Furthermore, respondents use of insect treated net in their household's parameter was negative (-0.49689) statistically significant ($p < 0.10$). This indicates a negative relationship between the households' use of the net (captured in its dummy form; 1 if yes, 0 if otherwise) and their health status. In other words, households who identified that they use insect treated net in their households have a lower probability of having a good self-reported health report when compared with their counterparts that answered no in the study area.

On the other hand, the coefficient of the fruits consumption as enlisted by the FAO (2011) was positive (0.66801) and statistically significant at ($p > 0.05$) to the farming households health. This indicates a positive relationship between respondents' fruit consumption as an essential nutritional component and their health status. Specifically, this means that there is direct and positive relationship between the respondents' consumption of fruit and their health capital in the study area. It further implies that farming households that includes fruits intake in their meal in the study area have a higher likelihood of having good health than their counterparts who do not add this food components. This is in line with the apriori expectation as these food components has been recommended by health experts as a booster of health (Danaei et al., 2009; FAO, 2011; Stringhini et al., 2010).

In the study, the parameter of households' possession of means of transportation which is also recognized as asset have a positive (1.74243) effect on their health status, this significance was at ($p < 0.01$) level as expected apriori, meaning that respondents who possesses a means of transportation (asset) higher likelihood of having good health status. In addition, households that answered yes to weather they have means of transportation have higher likelihood of having good health status (proxied by their self-assessed health status). This is probably because farming households' possession of means of transportation, such as bicycle or car could help these farmers to preserve their strength and avoid undue fatigue of going about on their feet or boarding public transport in order to solve domestic, career and another kind of problems.

Finally the coefficient of nutrition knowledge was also found to be negative (-0.63774) and significant ($p < 0.05$). This shows that nutritional knowledge of the farming households' negatively influenced their likelihood of having good health in the study area. This implies that households' that answered yes to the question of whether they have knowledge about nutrition and food intake had a significantly lower probability of having good health when juxtaposed with those that answered no. Farming households' knowledge about food intake and nutrition is expected to positively influence their likelihood of belonging to normal BMI category. However, this corroborates with the finding of Agulanna et al. (2013), in a similar study, this situation may be homogeneous to the Southwest Nigeria.

Table 14. Multicollinearity test of variables fitted in the model.

Variables	VIF	Tolerance	Eigenvalue
Gender of the Households Head	1.10	0.9132	0.9981
Marital Status of the Head	1.39	0.7176	0.8765
Households Size	1.48	0.6766	0.8325
Year of Education of the Head	1.12	0.8964	0.7307
Possession of other Occupation	1.04	0.9600	0.5991
Knowledge about Food	1.08	0.9269	0.5756
Eating Outside Family Food plan	1.07	0.9385	0.4792
Cereal Consumption	1.14	0.8766	0.4109
Root and Tuber Consumption	1.14	0.8780	0.3742
Fruits Consumption	1.08	0.9248	0.3329
Consumption of Egg	1.12	0.8962	0.2952
Vegetable Consumption	1.12	0.8958	0.2350
Consumption of Milk	1.08	0.9243	0.1897
Legume Consumption	1.10	0.9092	0.1392
Total Cost of Health	1.12	0.8957	0.1113
Total Cost of Feeding	1.76	0.5694	0.0266
Total Revenue	1.79	0.5588	0.0185
Mean VIF	1.22		

Table 15. Negative binomial regression results of the effect of nutrition on health.

Variables	Coefficient	Std. Error	Z	P>|Z	Marginal Effect	Tolerance
Gender of the Households Head	0.21075	0.07762	2.72	0.007***	4.9329	0.9132
Marital Status of the Head	0.14440	0.08272	1.75	0.081*	3.0517	0.7176
Households Size	0.01123	0.01067	1.05	0.292	0.2458	0.6766
Year of Education of the Head	-0.01558	0.00644	-2.42	0.016**	-0.3410	0.8964
Possession of other Occupation	-0.10272	0.11982	-0.86	0.391	-2.1514	0.9600
Knowledge about Food	-0.02425	0.06315	-0.38	0.701	-0.53205	0.9269
Eating Outside Family Food plan	-0.00168	0.07787	-0.02	0.983	-0.03694	0.9385
Cereal Consumption	0.05724	0.07107	0.81	0.421	1.2377	0.8766
Root and Tuber Consumption	0.00853	0.06700	0.13	0.899	0.18645	0.8780
Fruits Consumption	0.09137	0.06335	1.44	0.149	1.9869	0.9248
Consumption of Egg	0.02582	0.06418	0.40	0.687	0.56626	0.8962
Vegetable Consumption	-0.01056	0.06305	-0.17	0.867	-0.23113	0.8958
Consumption of Milk	0.13960	0.06746	2.07	0.039**	3.1377	0.9243
Legume Consumption	-0.00450	0.06520	-0.07	0.945	-0.09855	0.9092
Total Cost of Health	1.00e-05	9.84e-07	10.16	0.000***	0.00021	0.8957
Total Cost of Feeding	3.02e-07	2.96e-07	1.02	0.307	6.61e-06	0.5694
Total Revenue	-4.32e-07	2.05e-07	-2.11	0.035	-9.45e-06	0.5588
Constant	2.59373	.188523	13.76	0.000		
Lnalpha	-1.127072					
Alpha	0.3239803					
Observation Number	420					
LR chi^2 (17)	134.13					
Prob > chi^2	0.0000	0.07572				
Pseudo R^2	0.0395	0.02453				
Log likelihood	-1631.083					
Likelihood-ratio test of alpha	0					
chibar2 (01)	2703.06					
Prob>=chibar2	0.000					

Note: ***, ** and * means 1% and 5% and 10% levels of significant respectively.

3.6. Estimates of Negative Binomial Regression with respondent days of incapacitation

Negative binomial regression estimated parameters for the assessment of the effect of farming households' nutrition on their health in Southwest Nigeria. The respondents' day(s) of incapacitation to sicknesses (an indicator of health status) was used as the dependent variable which was regressed against the explanatory variables. Multicollinearity test among the variables was carried out with variance inflation factor (VIF), the mean VIF of 1.22 (Table 14) was derived in the analysis. Since some of the variables that were included to capture nutrition showed statistical significance, the first null hypothesis that

farming households' food intake components and knowledge of nutrition does not significantly affect their day(s) of incapacitation to sickness is therefore rejected. In addition, Table 15 shows the results of Negative Binomial regression model. The model produced a better result than the Poisson regression which failed the condition for its satisfactory use since the likelihood ratio test of alpha equal to zero and was statistically significant ($p < 0.01$). Also, the likelihood ratio chi square value was statistically significant ($p < 0.01$) showing that the estimated parameters were not jointly equal to zero. I therefore proceed to Negative Binomial regression as the condition dictates.

In the model, five out of the fitted variables were statistically significant. These were gender of the households head ($p < 0.01$), marital status of the head ($p < 0.10$), year(s) of education of the head ($p < 0.05$), consumption of milk ($p < 0.01$) and total cost of health ($p < 0.01$). Other dependent variables were not statistically significant ($p > 0.10$). The results showed that gender of the household heads had a log of day(s) of incapacitation to sickness significantly higher by 0.21075 ($p < 0.01$). This translates into a direct relationship between the respondents gender and their health status proxied as day(s) of incapacitation. Also, the respondents coefficient of marital status had a log of day(s) of incapacitation to sickness significantly higher by 0.14440 ($p < 0.10$). This indicates a direct and positive relationship between the marital status and the health state of the farming households in the study area.

In addition, the model further reveals that if the farming households year(s) of education increased by one year, the log of the day(s) of incapacitation significantly decreased by -0.01558 ($p < 0.05$). This shows an indirect relationship between the respondents year(s) of education and their health status. This is contrary to the aprior expectation because years of education is expected to positively affect the health of the farmers. Furthermore, farming households who consume milk in this study had their log of sick time significantly higher by 0.13960 ($p < 0.05$) compared with those who did not consume milk as a componet of their nutrition. This is not in line with the apriori knowledge (Akerele et al., 2017), as milk consumption is supposed to result into good health.

However, this could be peculiar to the study area, it might be that the milk mostly consumed by the farming households are not well prepared and so not ideal for their health. Finally, the model indicates that if the farming households cost of health increased by one naira, the log of days of incapacitation to sickness significantly increased by 1.00e-05 ($p < 0.01$). Households cost of health can trigger health status in different forms. For instance, large cost on health may imply further reduction in respondents frequency of sickness, prevention od spread of disease and good health status in the study area.

4. Conclusion

Of a truth, the government of Nigeria in the time past and at present had taken several steps to address malnutrition and poor health challenge as a limiting factor for sustainable agriculture since several socio-economic variables persistently constitute to the full achievement of the sustainable agricultural system. The findings of this research emphasized the significance of age, household size, educational attainment and large households' size as a contributor to farming households, nutrition, and health in the study area. There is a serious need to enhance the knowledge/education of these farmers on food intake diversity, nutrition, and health issues. Food components such as fruit and milk were found in the study to be important to the farming household's health. Also, nutritional knowledge was repeatedly emphasized in the models to be significant to nutrition and health of the farmers. It was concluded that diversity of food intakes among the farmers was low in the study. Farming household's capability to endure shocks like food insecurity and ill health was greatly determined by their respective asset portfolio such as financial, physical and human assets which are intangible. Food intake, nutrition and health of farming households, therefore, must be seen as both consumption and investments assets. Based on the findings of this study, the general conclusion is that food intake has a tangible effect on the health of farming households. There is need for the government of the day to enhance the wellbeing of South Western farming households through capacity development and skill building programs.

5. Policy recommendation

Based on the outcomes of this study, the following policy implication, and recommendations are made:

(1) Education attainment is a key significant variable as it was emphasized in this study. It contributes to farming households' food intake, nutrition and health status. It is therefore suggested that school enrolment should be encouraged and standard of education should be enhanced by the government of the day through extension agencies so that the farmers will be knowledgeable about the importance of various food components, nutrition and health and their implication on the sustainable agricultural system.

(2) Elimination of extreme hunger and poverty through enhancing agricultural productivity, credit and capital investment are identified to enhance farming activities in the rural Southwest, Nigeria. The government should, therefore, provide standard loan acquisition systems, to facilitate access to credit. Also, access to farming farm inputs like fertilizers, chemicals, insecticides, treated seeds etc. should be enhanced and channeled through farmers' co-operative societies in order to increase farmers output and income in the study.

(3) Food intake is an important pillar of food security. The rural households' should be enlightened on the various food classes and the need for a balanced diet. The various government administrators should mobilize nutritionists and trained agricultural extension officers to educate the farmers on the need to eat adequate meals. Also, needed assistance and encouragement should be given to farmers to plant different type food crops as this will help meet their nutritional requirement since they signified that they eat from their own produce.

(4) There should be enlightenment programmes to South West Nigeria farmers on how to improve environmental and health condition since improving individuals wellness remain an ultimate vision of public policy makers, refuse dumps should not be close to farmers' residence to reduce the incidence of diseases. Rural development policies (RDP) should be supported by health policies that will place better emphasizes on the vulnerable residents' health care services. Also health care and infrastructural facilities should be made available to the rural farmers to improve their standard of living.

(5) The study reveals that there is an important linkage between farming households' food intake, nutrition and health of farming households' in South West Nigeria. This relationship was further identified to constitute a huge economic burden on the financial base of the rural farming households. There should be a proper orientation of farmers by extension workers through informal education, information dissemination and more effective communication on the effect of nutrition on health status as well as its economic implication on their wellbeing just like that of HIV crusade.

Declarations

Author contribution statement

A. Omotayo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2020.e05433.

References

Abdullahi, Y.Z., Abdullahi, H., Mohammed, Y., 2010. Food security first: the role of women through empowerment for sustainable food, general security and economic development in Nigeria. Eur. Sci. J. 8, 42–66.
Adebayo, I., 2011. "Nigeria Is 14th Most Failed State in the World", 7th Annual Failed States Index Report. Fund for Peace, an American Independent Non-Profit Research and Educational Organization, Georgia, USA.
Agulanna, F.T., Ikpi, A.E., Okoruwa, V.O., Akinyosoye, V.O., 2013. A synergetic linkage between agricultural productivity, nutrition and health. Afr. J. Biomed. Res. 16, 1–9.
Ahmed, S.M., Adams, A.M., Chowdhury, M., Bhuiya, A., 2000. Gender, socioeconomic development and health-seeking behaviour in Bangladesh. Soc. Sci. Med. 51 (3), 361–371.
Ajith, M.M., Ghosh, A.K., 2019. Economic and social challenges faced by injured artisanal and small-scale gold miners in Kenya. Saf. Sci. 118, 841–852.
Akerele, D., Sanusi, R.A., Fadare, O.A., Ashaolu, O.F., 2017. Factors influencing nutritional adequacy among rural households in Nigeria: how does dietary diversity stand among influencers? Ecol. Food Nutr. 56, 187–203.
Akinyele, I.O., 2009. Ensuring Food and Nutrition Security in Rural Nigeria: an Assessment of the Challenges, Information Needs, and Analytical Capacity. International Food Policy Research Institute (IFPRI).
Alawode, O., Lawal, A., 2014. Income inequality and self-rated health in rural Nigeria. Peak J. Agricul. Sci. 3, 36–50.
Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M., Deitchler, M., Fanou-fogny, N., Joseph, M., Kennedy, G., Martin-Prevel, Y., Torheim, L.E., 2010. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. J. Nutr. 140, 2059–2069.
Babatunde, R.O., Omotesho, O.A., Sholotan, O.S., 2007. Socio-economic characteristics and food security status of farming households in Kwara State, North-Central Nigeria. Pakistan J. Nutr. 6 (1), 49–58.
Danaei, G., Ding, E.L., Mozaffarian, D., Taylor, B., Rehm, J., Murray, C.J., Ezzati, M., 2009. The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. PLoS Med. 6, 1000058.
Daud, A.S., Awotide, B.A., Omotayo, A.O., Omotoso, A.T., Adeniyi, A.B., 2017. Effect of income diversification on household's income in rural Oyo State, Nigeria. Œconomica. Acta Univ. Danub.
Dryland, R., Carroll, J.A., Gallegos, D., 2020. Moving beyond coping to resilient pragmatism in food insecure households. J. Poverty 1–18.
FAO, IMF, UNCTAD, 2011. The World Bank, the WTO, IFPRI and the UN HLTF Price Volatility in Food and Agricultural Markets: Policy Responses. FAO, Rome.
FAO, 2013. Guidelines for Measuring Household and Individual Dietary Diversity, pp. 2–12.
FAO/WFP, 2014. The State of Food Insecurity in the World 2014, Strengthening the Enabling Environment for Food Security and Nutrition. Food and Agriculture Organization of the United Nations, Rome.
Gebrehiwot, T., van der Veen, A., 2014. Coping with food insecurity on a micro-scale: evidence from Ethiopian rural households. Ecol. Food Nutr. 53 (2), 214–240.
Ghatak, A., 2010. Health, Labour Supply and Wages: A Critical Review of Literature. Institute for Social and Economic Change, Bangalore.
Hamenoo, S.V.Q., Adjei, P.O.W., Obodai, J., 2018. Households' coping dynamics in response to large-scale land acquisition for jatropha plantations: evidence from Asante Akim North district of Ghana. Global Soc. Welfare 5 (4), 225–241.
Higgins, C., Lavin, T., Metcalfe, O., 2008. Health Impacts of Education a Review. Institute of Public Health in Ireland (IPH).
Ijatuyi, E.J., Omotayo, A.O., Nkonki-Mandleni, B., 2018. Empirical analysis of food security status of agricultural households in the platinum province of South Africa. J. Agribus. Rural Develop. 47, 29–38.
Ikelegbe, O.O., Edokpa, D., 2014. Agricultural production, food and nutrition security in rural Benin, Nigeria. Afr. J. Food Nutr. Sci. 13, 8388–8400.
Inglis, V., Ball, K., Crawford, D., 2005. Why do women of low socioeconomic status have poorer dietary behaviours than women of higher socioeconomic status? A qualitative exploration. Appetite 45 (3), 334–343.
Kennedy, G., Pedro, M.R., Seghieri, C., Nantel, G., Brouwer, I., 2007. Dietary diversity score is a useful indicator of micronutrient intake in non breast-feeding Filipino children. J. Nutr. 137, 1–6.
Kirkland, T.M., Kemp, R.J., Hunter, L.M., Twine, W.M., 2013. Toward improved understanding of food security: a methodological examination based in rural South Africa. Food Cult. Soc. 16 (1), 65–84.
Kolawole, B.O., Omobitan, O.A., 2014. Raging poverty and agricultural output in Nigeria: an empirical investigation. J. Econ. Sustain. Dev. 5, 63–72.
Lawson, D., 2004. The Influence of Ill Health on Chronic and Transient Poverty.
Matemilola, S., 2017. The challenges of food security in Nigeria. Open Access Lib. J. 4, 1.
Maxwell, D.G., 1996. Measuring food insecurity: the frequency and severity of "coping strategies". Food Pol. 21 (3), 291–303.
Maxwell, D., Caldwell, R., 2008. The Coping Strategies Index: a tool for rapid measurement of household food security and the impact of food aid programs in humanitarian emergencies. Field Method. Manual 2.
Nkonki-Mandleni, B., Ogunkoya, F.T., Omotayo, A.O., 2019. Socioeconomic factors influencing livestock production among smallholder farmers in the free state province of South Africa. Int. J. Entrepreneur. 23, 1–17.
NPC, 2006. Population Facts. http://www.population.gov.ng/.
Obadan, M.I., Ighodaro, C.A.U., 2012. Poverty Alleviation Programs and Employment Generation in Nigeria. In: A Paper Presented at the International Colloquium. Benin city.
Okojie, C., Ogwumike, F.O., Anyawu, J.C., Alayande, B.A., 2001. Poverty in Nigeria – an Analysis of Gender Issues, Access to Social Services and the Labour Market, Collabourative Research Report Submitted to the African Economic Research Consortium (AERC). Nairobi, Kenya.
Omotayo, A.O., 2016. Malaria treatment and farming households' income poverty in Lagos state, Nigeria. J. Hum. Ecol. 56 (1-2), 126–134.
Omotayo, A.O., 2016. Farming households' environment, nutrition and health interplay in Southwest, Nigeria. Int. J. Scient. Res. Agricul. Sci. 3, 84–98.
Omotayo, A.O., 2017. Economics of farming household's food intake and health-capital in Nigeria: a two-stage probit regression approach. J. Develop. Area. 51 (4), 109–125.
Omotayo, A.O., 2020. Data on the Agricultural Household's Dietary Diversity and Health in the South West Geopolitical Zone of Nigeria Data in Brief, p. 105413.
Omotayo, A.O., Oladejo, A.J., 2016. Profitability of cassava-based production systems. J. Hum. Ecol. 56, 196–203.
Omotayo, A.O., Oyekale, A.S., 2013. Effect of malaria on farming households' welfare in Ido local government area of Oyo state, Nigeria. J. Hum. Ecol. 44 (2), 189–194.
Omotola, J.S., 2008. Combating poverty for sustainable human development in Nigeria: the continuing struggle. J. Poverty 12, 496–517.
Ruel, M., Graham, J., Murphy, S., Allen, L., 2004. Validating simple indicators of dietary diversity and animal source food intake that accurately reflect nutrient adequacy in developing countries. GL-CRSP.
Savy, M., Martin-Prevel, Y., Sawadogo, P., Kameli, Y., Delpeuch, F., 2005. Use variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. Eur. J. Clin. Nutr. 59, 703–716.
State Health Access Data Assistance Center, 2013. State-Level Trends in Employer-Sponsored Health Insurance. University of Minnesota, Calverton.
Steyn, N.P., Nel, J.H., Nantel, G., Kennedy, G., Labadarios, D., 2006. Food variety and diet diversity scores in children: are they good indicators of dietary adequacy? Publ. Health Nutr. 9, 644–650.
Stringhini, S., S, S., Martin, S.E.B., Hermann, N., K, M., S-M, A., 2010. Association of socioeconomic position with health behaviors and mortality. J. Am. Med. Assoc. 303, 159–166.
Szasz, T., 2009. Coercion as Cure: A Critical History of Psychiatry. Transaction Publishers.
Tefera, T., 2012. Post-harvest losses in African maize in the face of increasing food shortage. Food Secur. 4 (2), 267–277.
Von Grebmer, K., Ringler, C., Rosegrant, M.W., Olofinbiyi, T., Wiesmann, D., Fritschel, H., Badiane, O., Torero, M., Yohannes, Y., 2012. Global hunger index: the challenge of hunger: ensuring sustainable food security under land, water, and energy stresses. International Food Policy Research Institute (IFPRI), Washington DC, USA.
Von Grebmer, K., Bernstein, J., De Waal, A., Prasai, N., Yin, S., Yohannes, Y., 2015. Global hunger index: armed conflict and the challenge of hunger. International Food Policy Research Institute (IFPRI).
Werhane, P.H., Newton, L.H., Wolfe, R., 2020. Alleviating Poverty Through Profitable Partnerships 2e: Globalization, Markets, and Economic Well-Being. Routledge.
World health Organisation (WHO), 2000. A Global Agenda for Combating Malnutrition: Progress Report. Geneva.