Economics of food intake, nutrition and farm households' health in Southwest Nigeria

ABIODUN OLUSOLA OMOTAYO

(orcid.org/0000-0002-4423-9983)

25301284

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DECLARATION

I, the undersigned, declare that this thesis submitted to the North-West University for the degree of Doctor of Philosophy in Agricultural Economics in the Faculty of Agriculture, Science and Technology, School of Agricultural Sciences, and the work contained herein is my original work with exemption to the citations and that this work has not been submitted to any other University in partial or entirely for the award of any degree.

Name: **Abiodun Olusola Omotayo**

Signature: .....

Date: 26/04/2018

DEDICATION

I humbly dedicate this work to God Almighty, my dad (s) and a long list of friends:

- To God Almighty, the source of all wisdom, strength, and grace whose continual yet undeserved mercy has kept me through life journey. For the wisdom to conceptualize and complete this work. For providing strength to acclimatize throughout my period of sojourn in South Africa. For providing both human and material resources to accomplish this vision, of a truth "If God gives the vision, He will make Provision".

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2SPRM	Two Stages Probit Regression Model
ADP	Agricultural Development Programme
AIDS	Acquired Immune Deficiency Syndrome
BMI	Body Mass Index
CBN	Central Bank of Nigeria
CED	Chronic Energy Deficiencies
CFA	Comprehensive Framework for Action
CFS	Committee on World Food Security
CRTS	Constant Return to Scale
DDS	Dietary Diversity Scores
DHS	Demographic and Health Survey
DRTS	Decreasing Returns to Scale
ESPD	Economic and Social Policy Division
FAO	Food and Agricultural Organization
FNS	Food and Nutrition Security
GDP	Gross Domestic Product
GLM	Generalized Linear Model
GNP	Gross National Product
Ha	Hectare
HDI	Human Development Index
HHDDS	Households Dietary Diversity Scores
HHS	Households Size
HLTF	High Level Task Force on Global Food Security
IAASTD	International Assessment of Agricultural Science
ICN	International Conference on Nutrition
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILO	International Labour Organization

ILRI	International Livestock Research Institute
LDCs	Lesser Developed Countries
LGAs	Local Government Areas
LHS	Left Hand Side
MDG	Millennium Development Goals
MEI	Marginal Efficiency of Investment
MLE	Maximum Likelihood Estimate
NBRM	Negative Binomial Regression Model
NBS	National Bureau of statistics
NECA	Nigeria Employers Consultative Association
NGOS	Non-Governmental Organization
NPC	National Population Commission
PHC	Primary Health Care
PRM	Poisson Regression Model
RDP	Rural Development Policies
RHS	Right Hand Side
SCN	Standing Committee on Nutrition
SES	Socioeconomic Status
SHS	Self-rated Health Status
SNNP	Southern Nations, Nationalities and Peoples Region
SPSS	Statistical Package for the Social Science
TB	Tuberculosis
USAID	United States Agency for International Development
UNICEF	United Nations Children's Fund
UN	United Nations
UNDP	United Nations Development Programme
WFP	World Food Programme
WHO	World Health Organization

ABSTRACT

Persistent hunger, malnutrition, and poor health inextricably threaten the ability of several countries to develop. The burdens of this trio on economic development in the African continent cannot be overemphasized. This study investigated the economics of farming households' food intake, nutrition and health in the Southwestern part of Nigeria. Specifically, the study described farming households' food intake, nutritional and health status in relation to their socio-economic characteristics; determined the factors that influence farming household's nutrition (proxied by composite food index, food intake diversity, and hunger severity index) , analyzed the effect of food intake diversity on the health status of farmers (proxied by having a normal body mass index, self-rated health and day(s) of incapacitation to sickness or injury).

The data were collected with a structured questionnaire through a multistage sampling of 420 farming households from the southwest geopolitical zone of Nigeria. Indicators of food intake, nutrition and health were computed with dietary diversity scores (HDDS),coping options due to hunger, days of incapacitation to sickness and anthropometric measures such as household body mass index (BMI) and self-rated health. Data were analyzed using descriptive statistics (percentage, standard deviation, mean etc.), Principal Component Analysis (PCA), and inferential statistics such as Poisson regression, Ordinary Least Square regression, Logistic regression, Negative Binomial Regression and Two Stage Probit regression.

The descriptive results show that the farmers in Oyo state had highest average age (54.60 ±11.30 years), while years of farming were highest in Osun state (19.57± 13.04 years). Average years of schooling was highest in Ogun state (10.28 ± 5.18 years). Also, in Osun state, the average household size was 7 which was the highest of the three selected states. In addition, the majority (90.24%) of these farmers cultivated $\leq$ 4 hectares of land across all the selected states. In addition, 40.95% of all households' ate an average of two times in a day while 42.38% ate $\leq$ 3 types of food, 50.71% eat 4-6 food, 5.71% took 6-9 food types within 24 hours recall time. The mean scores of HDDS across the selected states were 5.20, 5.10 and 4.31 in Oyo, Ogun and Osun state respectively which was lower than the set cut-off point of 6 recommended by the Food and Agricultural Organization (FAO).

The most common illness across the selected states was malaria, with 40% in Oyo state. In addition, average annual sick time among farmers was 2 ill health episodes. The hospital was the most chosen source of health care with 62.80% in Osun state. Average days of incapacitation were 25.27days, 22.44 days and 21.60 days in Oyo, Ogun, and Osun states respectively, translating into an estimated average annual per capita income loss of ₦52,559.44 ($262.80), ₦46,942.67 ($234.71) and ₦48,912.92 ($244.56). Average body mass indices of 25.63 kg/m²±2.67 (overweight), 26.42 kg/m² ± 2.76 (overweight) and 26.22 kg/m² ± 3.2 (overweight) were recorded in Oyo, Ogun, and Osun states respectively. However, 1.67% was underweight, 32.14% normal, 60.24% overweight and 5.95% obese in the combined data.

The Poisson regression results showed that farming households' diversity in food intakes increased significantly ($p<0.10$) with total revenue, nutritional knowledge, households' possession of means of transportation and source(s) of finance. In the regression results of the composite food intake diversity indices (generated from PCA), type of agriculture practiced by the farmer(s) and households' other source(s) of income significantly reduced food diversity indices ($p<0.10$) while households number of working class, net returns, households' dependency ratio, possession of means of transportation, and farm yield were positively significant to the farming households nutrition status in the study area.

The factors that significantly increased ($p<0.10$) households' hunger severity were household heads' age, tribe of the head, alcoholism habit and households' water purity while the year (s) of education of the respondents reduced it. The Logistic regression model of the effect of farming households nutrition on health (captured with respondents self-rated health) showed that gender of the households' head, marital states of the head, household food security, respondents' use of insect net and the respondents knowledge of nutrition significantly reduced the probability of reporting good health while educational year(s) of the farmers, total cost of health, consumption of fruit and possession of means of transport increased it .

The Two-Stage Probit regression results of the linkage between the farming households' nutrition and health showed that respondents' nutrition status, choice of health care service, farm

distance significantly increased ($p<0.10$) the probability of having normal BMI, while farming as primary occupation, type of toilet and nutrition knowledge reduced it. In addition, using the Negative Binomial Regression model, assessment of the effect of farming households' nutrition on health (proxied by their day(s) of incapacitation to sickness) indicated that gender of the households' head, marital status of the head, 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 and being overweight was a major problem in the study area. In addition, environmental and health system of the rural farming households needs intervention. Ageing, large household size, lack of credit facilities, small land cultivation 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' nutrition and health status.

Keywords: Body mass index, Dietary Diversity Scores, Day(s) of incapacitation, Food intake, Health, Hunger severity index, Logistic Regression, Nutrition, Ordinary Least Square Regression, Poisson Regression, Principal Component Analysis, Self-rated Health, Two-Stage Probit Regression, 24 Hours Recall Period.

CHAPTER ONE. INTRODUCTION

1.1 The Background

Good nutrition is crucial to human health. Diverse, prime quality food is crucial to human nutrition. Agriculture plays a major role in producing and improving people's access to the nutritious food needed for healthy and productive lives (Akerele *et al.,* 2017; Maher *et al.*, 2015). Good nutrition remains the bedrock of healthy, effective and productive lives. Adequate maternal nutrition improves the probability of giving birth to healthy babies, with robust and reliable immune systems with a well-developed brain (Maher *et al.*, 2015). Nutrition helps to grow from childhood with the strength needed for daily activities and with resilience to diseases. It makes us apt to resist sickness (es), improve academic performance and have more opportunity to attain full potential in life and career (Von Grebmer *et al.*, 2014, p.6). Malnutrition and diet are by far the biggest risk factors for the global burden of disease: every country is facing a serious public health challenge from malnutrition (International Food Policy Research Institute (IFPRI), 2016).

Poor diets, illness and environmental factors mean that several people do not get the required and adequate nutrients for a healthy life as over 30% of the world's population, or about 2 billion people are anaemic, mainly due to iron deficiency or lack of food (United Nations Children's Fund (UNICEF), 2013; World Health Organization (WHO), 2010; Maher *et al.*, 2015). Food and Agriculture Organization (FAO/IFAD/WFP, 2015) opined that "approximately 795 million people in the world are malnourished and are therefore incapable of leaving a healthy and active life. Recent statistics have shown that one in four people still remain chronically hungry in sub-Saharan Africa (Food and Agriculture Organization (FAO, 2014). This accounts for the unsatisfactory progress towards international hunger targets especially in the sub-Saharan countries (Food and Agriculture Organization (FAO*/IFAD/WFP*, 2014, p. 18).

According to FAO (2015), "about one in every nine people in the world still lack adequate food for active and healthy life with the vast majority of these people living in developing countries, where 12.9% of the population is undernourished. The overwhelming majority of those undernourished people live in the rural parts of the countries where an estimated 791 million citizens were recorded to be chronically hungry within 2012–2014" (FAO/ IFAD/WFP, 2015;

Food and Agriculture Organization of the United Nations (FAO), 2015, p. 6). Hunger can lead to malnutrition, but the absence of hunger in any household, community, nation or region does not imply the absence of malnutrition.

James *et al.* (2013), estimated that "over 65% of the Nigerian population is food and nutrition insecure, hence malnourished". On the average, people suffering from malnutrition could lose about 10% of their possible lifetime earnings (Bain *et al.*, 2013). Malnutrition carries a huge economic and social costs. "It blights human flourishing and costs the global economy up to US$3.5 trillion per annum" (FAO, 2014). Malnutrition, as it were, has three primary key causes being inadequate access to safe, diverse, nutritious food; poor child feeding practices or adult dietary choices and poor health, which increases nutrient requirements and makes it difficult to utilize available food (von Grebmer *et al.*, 2014). The resultant effects the problems of malnutrition and restricted access to nutritious and sufficient food leading to poor food utilization among farming households in Nigeria.

On the other hand, poor health represents a great physical and economic burden on affected individuals and caregivers. While it is difficult to actually quantify, the welfare losses to the individual of being severely ill can be significant, particularly in developing countries which are characterized by restricted or no social security and health care (Cole and Neumayer, 2006 as cited by Osei-Akoto *et al.*, 2013). Individuals suffering from poor health may be weak and fragile, thereby unable to work and automatically unable to provide for their immediate household and other dependants.Ill health reduces farmer's tendency of exploring, experimenting, innovating and materializing substantial change (s) in agricultural systems and practices (Asenso-Okyere *et al.*, 2010).

In addition, serious health conditions resulting in catastrophic expenditures can also result in the depletion of productive assets such as the sale of draught animals and sale of cultivable land (Slater and Wiggins, 2005). The prime consequence(s) of these actions could be a reduction in farm sizes, cultivation of less-intensive crops, and reduction in livestock numbers which may end up or result in poverty and hunger. Directly, malnutrition and ill-health are farming households' problem which affects the physical strength of farmers and working days and hours available for farm work (Adhvaryu and Kathleen, 2012). Nigeria as a nation is no exception and her quest for food and nutrition security, good health and sustainable agricultural development

need to be addressed for achieving some Millennium Development Goals (MDG) (Poverty, 2015).

Food intake, nutrition and health status of agricultural households in Southwest Nigeria are positively and directly linked (Agulanna *et al.*, 2013). Undernutrition happens to be one of the major causes of immune deficiency. Ill-health on its part impairs nutritional status by reducing victims' appetite and the body's ability to absorb necessary nutrients, which in turn lowers the individual's resistance to further illness (Scrimshaw, 2003). Poor nutrition has serious and sometimes deadly consequences for farming households' health, especially children and women. Such effects include greater susceptibility to a range of infectious diseases, hence sickness.

Agriculture is generally known to be dominated by smallholder farmers, especially in sub-Saharan Africa. The majority of these farmers suffer from lack and poverty, malnutrition, as well as ill-health (World Health Organization (WHO), 2008;Omotayo *et al.*, 2016). According to Akinyele (2009), "food and nutrition security is achieved for farming household when secure access to food is coupled with a sanitary environment, adequate health services, and adequate care to ensure a healthy life for all household members".

Malnutrition and nutrition related diseases have been identified to continue to be problems of public health importance in Nigeria (UNICEF, 2014) .Underlying these problems of malnutrition and ill health are a number of issues such as poor maternal nutrition, poverty, inadequate health services and limited access to nutritious foods amongst others (Achinihu *et al.,*2016). The rural farming households are mostly affected. UNDP (2005), observed that 75% of Nigeria population live in the rural area, of percentage, 65% are poor and directly or indirectly linked with agricultural sector. Assessment of food intake, nutrition and health status of an individual is an important component of the nutritional-health and productive assessment of such individual.

With the estimated number of people worldwide suffering from food and nutrition insecurity, deficiency of food nutrients like minerals and vitamins hence ill health, the international development community began to ask how much more agriculture could do to improve human well-being if it's explicitly included nutrition and health goals must be achieved. What kind of change(s) could maximize food intake, nutrition–health sensitive agriculture and how can improved farming households' nutrition, food intake, and health contribute to a more effectively

productive and sustainable agricultural system which will be free from associated poor food, malnutrition and poor health stigma (Obayelu, 2012)?.

This study, therefore, seeks to analyze the economics of the magnitude of the effect of agricultural households' food intake, nutrition on health outcomes since food intake, nutrition, 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. 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 (the rural farmers).

1.2 Food Intake, Nutrition, and Health of Farming Households

Food is the major need of man and the main source of nutrients needed for human existence and well-being. Diversified staple foods are not very common in most Nigerian households, leading to monotonous meals which do not guarantee or provide a balanced diet required for vitality. Therefore, malnutrition is inevitably prevalent among some households due to inability to fully access food, utilize food properly, mostly due to insufficient income (Obayelu, 2012). According to WHO (2008), "Adequate food and nutrition are essential from conception to adulthood for proper growth and physical development, to ensure optimal work capacity and adequacy of the immune systems.

Nutrition is, therefore an essential input for healthy living and human development as improved nutrition means stronger immune systems, reduced illness, better health and development for people of all ages (Ruel *et al.*, 2013).Similarly, healthy people are known to be stronger, more productive and better able to break poverty cycles and hunger in a sustainable way through the realization of their full economic potentials. Poor nutrition is a major health problem, especially in African countries (Kadiyala *et al.*, 2014). Malnutrition implies access to poor food. It also indicates not enough as well as too much food such that the diet causes health problems. Not

enough nutrients is called under nutrition or undernourishment while too much is called over nutrition.

The wrong type of food makes the body's response to being weak to a wide range of infections that result in poor absorption of nutrients or the inability to utilize nutrients properly to maintain proper health (Agulanna *et al.*, 2013). Well over 50% of the global poorest populace live in farming rural communities where many of them suffer from undernutrition and malnutrition. Recent estimates suggest that globally, the combined effect of inadequate micro and macro-nutrient (including iron and iodine) intakes accounts for 35% of children mortality and are also responsible for about 11% of global disease and economic problems (Black *et al.*, 2008). Moreover, millions of people suffer from serious lack of mineral and vitamin in their diet as poor nutrition, disease, and other factors mean that many people do not get their much-needed nutrient for healthy life.

Over 30% of the world's people, indicating 2 billion people are anemic, many due to iron deficiency (WHO, 2010). Hunger and malnutrition have chains of effects that could last throughout one's life cycle, with poorly nourished children growing up to less healthy, weak and less productive than they should naturally be. Clifford *et al.*(2006); Donald (2006) and Bradley (2002), opined that health capital is affected by a number of preventable diseases such as malaria fever, Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS), farm injuries, cholera, fever, respiratory diseases and skin infections. Food insecurity could make citizens, especially the rural dwellers, have low immunity thereby either unable to prevent serious health risks and or have stunted growth (Covalan *et al.*, 2005).

Human health, on the other hand, raises physical capacities such as strength and endurance, mental capacities and reasoning abilities. These enhance peoples' efficiency (FAO/WHO, 1992) and have high impacts on the number of hours worked by people (Currie and Madrian, 1999). Developing countries need good healthy and productive agriculture to fight the poverty threat because, reduction in output by agricultural workers due to poor health, affects their incomes and increases incidence of poverty and ill health (International Food Policy Research Institute (IFPRI), 2007). For an instant, a study of farmers in mixed cropping systems found that the vast majority suffered from intense muscular fatigue, heat exhaustion, and skin disorders etc. which forced them to observe some days of incapacitation due to sickness (es), hence impede them from attending to their farming activities (Cole, 2006; Omotayo *et al.*,2016).

As pointed out by the World Bank (2007), illness and death from Human Immunodeficiency Virus infection and Acquired Immune Deficiency Syndrome (HIV/AIDS), malaria, typhoid, dysentery, tuberculosis and other diseases reduce agricultural output through loss of farm labour, productive adults' knowledge and assets to cope with illness. According to Lipton and De Kadt (1988), failure of Agriculture and Health Departments to coordinate their policymaking undermines efforts to overcome ill-health among rural poor and hampers agriculture's role in alleviating many of the world's most serious health problems. Poor health often results in loss of days worked or reduction in individual's capability to perform some tasks. When family and hired labour are not perfect substitutes or when there are liquidity constraints, this is likely going to reduce farm output (Antle and Pingali, 1994).

Timmer (2005), noted that "no country has been able to absolutely sustain a rapid transition out of hunger and poverty without improving its agricultural sector". Growth in agriculture is therefore not only associated with an increase in farm incomes, it also stimulates linkages with the non-farm economy, causing economic growth and rapid poverty reduction (Osei-Akoto *et al.*, 2013). Otherwise, in nations of the world where agriculture has failed or lagged far behind other sectors, hunger, malnutrition and ill health have obviously been inescapable. Incidentally, this has been the bane of most African countries economies as poor nutrition and health perpetually reduce(s) farmer's ability to experiment, innovate, operationalize, effect and materialize changes in their farming systems (Asenso-Okyere *et al.*, 2010).

1.3 Stylized Facts on Food Intake, Nutrition and Health in Nigeria

Nigeria's population is expected to rise tremendously in the next decade (i.e. 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 (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.

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). The World Health Organization recommends an intake of between 2500 – 3400Kcal of energy per person and 65-86g crude proteins per day out of which 35g (or 40%) must be animal protein (Babatunde and Qaim, 2010). However, "the calorie intake of an average Nigerian fell from 2256Kcal per day in 1985 to 2147 kcal per day in 1992 which is actually below the FAO recommendation of the minimum amount of 2260kcal per day" (Olayemi, 1996). 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. The FAO (2002), enlisted Nigeria as 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 (Von Grebmer *et al.*, 2012). 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.

Similarly, the state of the Nigerian human health system is dysfunctional and massively under-funded with a per capita expenditure of US$ 9.44 (World Bank, 2010). As a result, Nigeria remains one of the countries with worst health indices in the world and sadly accounts for 10% of the world's maternal death during childbirth. In the same vein, research has clearly indicated that there is a high rate of absenteeism (about 40%) among medical professionals, especially in the rural areas of Nigeria where health challenge is paramount (Hamid *et al.*, 2005).

More so, in some parts of Nigeria, especially in the rural areas where agricultural activities are mostly practiced, people still have to travel several miles to get drinking water which is usually unsafe for drinking (Abiodun, 2010). Without adequate supplies of safe, clean and hygienic water with proper sanitation, people would die or suffer from diseases that are spread under unsanitary conditions (Oluwatayo, 2015, p. 182). According to the Federal Ministry of Health (2008), the total share of public ownership in 2004 on health facilities were 14,607 while the private sector accounted for 9,029 in Nigeria.

Consequently, various Nigerian governments have made various concerted efforts toward the provision of healthcare facilities for its citizens. In fact, there is a continuous growing concern about the economic impact of health care expenditure on agricultural households who face illness, especially in the rural regions where pre-payment mechanisms do not really exist and households have to make out of pocket expenditures from their meagre income to use health services (Omonona *et al.*, 2015). In Nigeria, private expenditure accounts for almost 70% of total expenditure on health of which 90% is out-of-pocket (Onwujekwe *et al.*, 2010).

This high level of out-of-pocket expenditure implies that health care can place a significant financial burden on the agricultural households. Past research studies have set the threshold level for catastrophic expenditure ranging from 5% to 40% of total household expenditure that is spent on health (Onwujekwe *et al.*, 2010). Amidst the most recurring report of the effects of diseases and sicknesses on farmers, Nigerian small scale farmers spend as much as 13% of their total households' expenditure on treatment of malaria fever alone (Ajani and Ugwu, 2008). Also, recent studies gave the economic cost implication of a single farmer becoming sick once as ₦29, 225.53k ($146). In a like manner, it was recorded that farmers lose an average of 22 working days of crippling to only one infection scene or the other per time (Ashagidigbi, 2004; Ugwu, 2006).

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.

1.4 Problem Statement

In Africa, poor nutrition and health remain a persistent problem. The prevalence of malnutrition and ill health in the continent remains unacceptably high as recent global statistics revealed that more than one-third of stunted children under 5 years of age, and approximately 28% of wasted children under 5 years of age lived in Africa (UNICEF, 2015). In Nigeria, available statistic shows that the prevalence of stunting and wasting among under-5 children in the country are 32% and 9%, respectively (NPC/ICF, 2014), with the country's state of hunger and ill health still being classified as "serious" from an international perspective (Von Grebmer *et al.,* 2015). Also, the Global Food Index (2016), added that Nigeria's population is presently facing significant nutritional shortfalls with the country being ranked 23rd i.e second last out of 25 rated countries, below Ethiopia and Indonesia, for the nutrition and health of its population.

It is generally accepted that Nigerian agricultural households have suffered as a result of the resource curse effect of oil and inappropriate policies and institutions (Iwuchukwu and Igbokwe, 2012). This, coupled with heavy handed and unpredictable governments' food, nutrition and health intervention programmes which has led to short term investment decisions and rent seeking behaviour by programmers has created dysfunctional and disconnected benefit to the poor masses. In rural Nigeria, where majority of the small scale farmers reside, poor infrastructure and inadequate basic amenities such as water, knowledge of diversified food intake, health facilities and good roads are still lacking (NDHS, 2013). Malnutrition and ill health rates in these rural parts of the nation remain stubbornly high, as bulk of the population, and incidences of stunting, malnutrition, and wasting continue to disproportionately affect these rural poor.

While these rural Nigeria farming households are generally worse off in terms of poor food intake, malnutrition and ill health; addressing food and health problems in rural farming communities are of equal importance for fostering the economic growth and improving the nutritional status of the Nigerians. Given that the rural Southwestern part of the nation are key

small scale agricultural hub of the country, the food intake, nutrition and health situation of the farming households should be a subject matter to the policymakers. Actually, some empirical studies in Nigeria have documented prevalence of household food shortage (with their evaluation based on food calorie needs) between 49% and 78% (Omotesho *et al.,* 2007; Nnakwe and Onyemaobi, 2013; Obayelu, 2012).Also, in the time past and present, Nigeria governments have intervened through a number of failed programs and institutions.

Clearly, the persisted failures of agricultural programmes such as the National Accelerated Food Production Programme (NAFPP), Operation Feed the Nation (OFN), River Basin Development Authorities (RBDA), Green Revolution (GR) , Directorate for Food Roads and Rural Infrastructure (DFRRI), Agricultural Development Programme (ADP), Presidential Initiatives on Agriculture, National Special Program for Food Security (NSPFS) and Fadama Interventions (I-III) in collaboration with the World Bank, as well as the International Institute for Tropical Agriculture (IITA) and National Root Crops Research Institute (NRCRI) et.c in the nation have revealed the basic weakness of agricultural ,food, nutrition and health policies in Nigeria and the inability of the several administrations to solve the basic and fundamental problems of agricultural sustainability.

While these past efforts are laudable, they all largely focused on increasing the quantity and quality of food production with limited focus on the role food intake diversity could play in influencing nutritional/health well-being at the rural farming household level (Akerele *et al.,* 2017). Therefore, considering the evidence-based information on the food intake and health situation of Nigeria, urgent and detailed empirical investigation of the poor food intake, malnutrition and ill health among the rural farming households are salient policy issues of concern as these are capable of undermining the socio-economic condition of the respective rural farming households, communities, region and the country at large. Till date however, research with holistic approach on food intake, nutrition and health of small scale farming households in Southwest Nigeria are very few and at most very scanty.

Arimond and Ruel (2004); Chastre *et al.*, (2007), among others, noted that inadequate foods intake and diets of poor nutritional quality are major factors contributing to the rising rates of food shortage, malnutrition, and related health problems. This is because households that consume monotonous or less-diversified diets have a lower tendency of meeting their recommended requirements of essential micronutrients hence, such individuals or households

could have poor health (Sealey-Potts and Potts, 2014). This perhaps underscores why most of the food supply interventions have been unable to translate to substantial and sustained progress in food insecurity and ill health situation in Nigeria. A more holistic food policy strategy toward addressing the myriad of monotonous food intake, poor nutrition and their consequential health challenge (s) in the rural Nigeria should extend beyond merely promoting adequacy of calories to meeting diversified nutritional requirements of the rural farming households.

Although, previous studies have established a synergy between nutrition and health (Agulana *et al.,* 2013). However, in spite of the known links between food intake, nutrition, health, and agriculture; improving farming household's food intake and health is yet to be specifically included in the explicit goal of Nigeria agricultural policy especially at the grass root and household level (at national level, it aimed to attain food security , increase production and productivity as well as to generate employment and income).This situation seriously underscores the importance of understanding the confounding factors to inform potential policy interventions. Therefore, the potential policy interventions to promote integrated agricultural households' food intake, nutrition and health in Nigeria agricultural policies remain ambiguous.

Research evidence suggests that the strategies of rural farming households' food intake, nutrition and health policy have scored limited success in recent time. On the other hand, health status have been measured mostly with environmental indicators and nutrition, suggesting ways of solving health problems. Obviously, analysis of agricultural households' food intake, nutrition and health over the past decades shows that, although nutrition and health were common phenomenon, they operate in isolation as they are thought to be naturally taken care of by the poor farming households, since the national policies are specifically without focus on it. In addition, limited success of the majority of Nigerian Rural Development policy underscores the importance of understanding small-scale farmers' food intake, nutrition and health as well as other silent constraints they face.

The existing dimensions of farming household's food intake, nutrition and health makes it clear that the concept of food, nutrition and health problems are complex one with many dimensions. At one level the concern is with national food security and public health wellness, which is all about the ability of the country to produce sufficient food and health as the case may be, in all year to meet the requirement for both private and public distribution. At another level the concern is more with the problem of rural farming households' malnutrition and ill health. There

are limited empirical (econometrics) studies on the relationship between dietary diversity and nutrition in African settings, and Nigeria in particular. Paucity of such information can lead to faulty or misdirected policy actions on households' food intake, nutrition and health. This is important, especially from a sustainable development standpoint, so as to foreclose the rising population in the country from translating into future liabilities

Therefore, this study aims to empirically analyze the linkages between food intake, nutrition, and health of farming households' in the southwestern part of Nigeria. Haven identified the knowledge gap that in spite of the increasing evidence of the importance and significance of households' food intake, nutrition and health with respect to farming households' income in Nigeria. Empirical evidences at most have been largely limited to analysing the determinants of food security with solitary policies. Based on this views and with relatively few or no studies on the factors influencing food intake diversity, determinants of the household's hunger severity, as well as the linkage and the effect of some salient socio economic and environmental factors on nutrition and health (using different indicators of food intake, nutrition and health in the analysis) are necessary in the study area for timely policy intervention.

Considering the non-homogeneity of characteristics of rural areas in the Southwest Nigeria, examining these issues with locality specific is imperative. Therefore, some important insights indispensable for the integrated farming households' food intake diversity, nutrition and health conscious rural development policy which are obviously missing in this key small scale farmer's hub of Nigeria (i.e Southwest, Nigeria). The study is particularly important in regions where food intake, nutrition and ill health challenges are rampant, agricultural output is correspondingly low and farming households' income is as well low. Therefore, this research seeks to answers the following policy-relevant questions:

{1} What are the farming households' socio-economics, nutritional and health status?

{2} What are the cost of food intake, nutrition and health expenditures in relation to their income?

{3} What are the factors that influence farming households' nutrition status (proxied by food intake diversity, composite food index and hunger severity index)?

{4} What is the effect of farming households' nutrition on the health status of respondents (proxied by having normal BMI, self-rated health and day (s) of incapacitation to sickness or injury)?

1.5 Objective of the Study

The overall objective of the study is to analyze the linkages between food intake, nutrition, and health of farming households in Southwest Nigeria. Specific objectives are to:

(i) Describe farming households' nutritional and health status in relation to their socio-economic characteristics.

(ii) Analyze farming households' cost of nutrition and health expenditures in relation to their income.

(iii) Determine the factors that influence farming households' nutrition status (proxied by food intake diversity, composite food index and hunger severity index).

(iv) Analyze the effect of food intake on the health status (proxied by having normal BMI, self-rated health and day (s) of incapacitation to sickness or injury) of the farmers.

1.6 Research Hypotheses

The following hypotheses were set for the study, in their null forms:

(i) There is no significant relationship between farming households' socioeconomic characteristics and their nutritional status.

(ii) There is no significant relationship between the farming households' demographic characteristics and their food intake level.

(iii) There is no significant relationship between respondent's socioeconomic characteristics and their hunger severity level.

(iv) Farming households' food intake do not significantly affect their self-rated health status.

(v) Farming households' nutritional status and nutritional knowledge do not significantly influence their normal BMI health status.

(vi) Farming households' food intake components and knowledge of nutrition do not significantly affect their day(s) of incapacitation to sickness.

1.7 Justification and Policy Relevance of the Study

A holistic approach to farming households' problems of diversified food intake, malnutrition and ill-health in the Southwestern part of Nigeria is vital for an informed policy intervention. In the past decade, many empirical studies have examined food intake, nutrition, and health with respect to agriculture, although most parts of the emphasis have been on nutrition rather than health. There have been longstanding deliberations in development economics as regards the contributions of food intake, nutrition and health to the process of socio-economic development, especially in the developing nations of the world.

Developing nations need good food, proper food intake, good health and productive agriculture to achieve sustainable agricultural system in order to really alleviate poverty because lowered production by agricultural workers due to poor nutrition, food intake, and health which affects their income can further deepen the incidence, depth, and severity of poverty, hunger and ill health (Behrman, 1993). Attention to agricultural households' food intake-nutrition-health synergy can enhance the agricultural sector to better meet its own needs as it can enhance the antipoverty, food intake-nutrition-health impacts of agricultural principal operators and their households' hence, ensuring greater support for agriculture as an important public good. Improved nutrition and health, for instance, have been shown to have a direct effect on welfare, especially among poorer individuals (Adeyeye, 1989; Kennedy and Bouis, 1993; Hawkes and Ruel, 2006; Fahima, 1995).

Several studies have been carried out on the relationships between agriculture, nutrition, and health of farmers. Asenso-Okyere *et al.* (2009b),(2011a); Levitt *et al.* (2009), explained the bidirectional linkages between food intake diversity, nutrition and health of farming households but this can be further improved in other to contribute to knowledge. "In seeking to strengthen the links between agriculture, food intake, nutrition, and health outcomes, a key factor may be creating a shared understanding of what outcomes are intended to be improved, and how " (Croppenstedt and Muller, 2000). Historically, nutritionists have continually focused on food intake or indicators of nutritional status while agriculturalists frequently assume that increased food production and income automatically leads to improved nutrition (World Bank, 2014).

Furthermore, previous studies have failed to adopt a holistic approach to the problem of farmers' food intake, nutrition , and health status in rural communities. For instance, most of the available

empirical works in Nigeria have focused on the relationship between certain household socioeconomic characteristics (and spatial factors) and measures of nutritional, body mass index (Ajieroh, 2009) and nutrient intake/availability (Babatunde *et al.*, 2010; Ogundari , 2014) or adequacy (Babatunde *et al.,* 2007; Gegios *et al.*, 2010). The few available studies on the association between dietary diversity, nutrition and health of farmers are limited in terms of data and depth of analysis to establish the factors that influence food intake diversity, hunger severity and nutrition as well as the linkage between the farming households normal body mass index, days of incapacitation and self-rated heath indicator as proxy for health status.

In addition, despite the existing number of studies focusing on the links between nutrition, and health status, very few have focused on the contribution of improvements in farming households' food intake diversity, nutrition and health to rural agricultural efficiency. Clearly, what this study deemed essential is a common goal, right methodology or conceptual vision to guide nutrition and health in agricultural policymaking, strategy development, and institutional innovation so that those commonalities can be realized for the benefit of poor farmers. The knowledge and understanding of the linkages, interactions and their consequences will be useful in further planning development programme in agricultural households' food intake, nutrition, and health.

Therefore, this research will help to give timely information to decision makers in order to initiate proper assessment and influence the formulation of pertinent holistic food intake, nutrition-health-agriculture sensitive policies and strategies in order to protect the poor farming households from malnutrition-ill-health -knowledge menace. More so, this research is meant to serve a variety of audiences, from scholars, academics, students, and researchers, to practitioners working on the ground, to decision makers devising policies that successfully connect agriculture, nutrition, and health at the local, regional, and global levels. Finally, this study will provide basis for the need to passionately invest more on health capital especially health and nutrition of farming households in order to enhance the productive capacity of rural farmers, invariably establishing the fact that good nutrition, food intake, and health are key elements of development and drivers of growth in Nigeria, Africa the world at large.

1.7.1 Policy Relevance

Nigeria agricultural, nutrition and health policies have undergone changes especially after her independent. This is because these policies and programmes vary only in terms of name, time and organizational network. All the way, the past policies have emphasized almost the same objectives such as: to provide food for the inhabitants of the nation and export excess to other countries as well as to provide rural dwellers and farmers with extension services, agricultural support, rural development services, health and general sustainability. Despite all these past policies and their laudable programmes with impressive themes, Nigeria is yet to attain food sufficiency for intake, nutrition and good health status, most especially in the rural settings of the nation.

This continued absence of obvious progress in farmer's food intake, nutrition and health policies in Nigeria remains the consequence of non-interaction between the government and the various stakeholders within a particular programme as well as lack of opportunities for decision making and policy dialogue with other stakeholders among others (Iwuchukwu and Igbokwe, 2012). A good agricultural–nutrition and health policy should have strategy, targets, goals, specific objectives and most importantly programme or projects geared towards accomplishment of the goals. This is not the case in Nigeria as can be seen that from 1st October 1960 to 15th January 1966, there were several agricultural policies but no agricultural programme or project(s) to carry out the directives of the policies.

For example between 1960's -1990's, very few agricultural policies, decree and act existed with invention of numerous agricultural programmes like National Accelerated Food Production Programme (NAFPP in 1972), Operation Feed the Nation (OFN in 1976), Agricultural Development Projects (ADP), River Basin Development Authorities (RBDA in 1976), Green Revolution (GR in 1980) , Directorate for Food Roads and Rural Infrastructure (DFRRI in 1986) , Better Life Programme (BLP in 1987), Family Support Programme (FSP in 1994) , Family Economic Advancement Programme (FEAP in 1996) and National Agricultural Land Development Authority (NALDA) which was initiated in 1992 much more later than the decree (1978) and an act (1979) backing it.

However, these past policies and programmes as earlier listed have contributed little or nothing to the long run agricultural sustainability, food intake, nutritional and health of the populace in

Nigeria with this stake holders i.e the rural farmer's bearing majority of the brunt hence, the policies were said to be characterized as weak agricultural policy with non-interaction between and among stakeholders, short duration, conflicts each other, inconsistent and incompatibility et.c. There is urgent need to reverse this lingering situation so as to ameliorate the persistent failure of agricultural, food intake and nutrition-health policies and programmes in Nigeria.

At the moment, just like in the time past, the declared aims of Nigeria's national agricultural policy are to attain food security and, increase production and productivity as well as to generate employment and income. Eliminating hunger as articulated in the national policy on agriculture, the Vision 2020, and the Millennium Development Goals, especially MDG 1 on food security and poverty requires that there is need for stimulation by policymakers, who should create an environment in which agricultural households' food security and health can thrive Nwajiuba, (2012). This study contributes to the design of appropriate policy strategies the following ways;

Amongst the national agricultural strategic priorities, the agricultural policy recognizes the need for developing rural areas, training farmers and public awareness programmes to enhance agricultural outputs through agricultural extension, promote understanding and informed participation in the fight against food and nutrition insecurity. The evidence-based information on the understanding of the progress so far among small-scale farmers and the challenge they face in acquiring self-food security, proper diversified food intake and appropriate nutrition training are crucial for the timely design of appropriate farming households' integrated diversified food-nutrition knowledge policies.

In addition, the national agricultural policy in the quest for food security has been silent about the diversified food intakes linkage with health of the principal operators (the rural small scale farmers). Food intake, nutrition and health are meant to be considered so far, the evidence-based information on the nature and constraints to good health status by the farming households is indispensable for the design of all-encompassing, efficient strategies and policies in order to improve the overall health and efficiency of these vulnerable operators.

The national agricultural policy also aims at orienting the country's focus towards re-building agricultural by encouraging the youths back into agriculture, providing employment to these teaming youths as well as income . The policy have in its consideration that the poor youths, constitute the most affected stratum of Nigerian societies, and underscores the present approach

of winning the youths into this sectors. Even though youths are necessary in agriculture, the approach to win the youths is not explicit in the Nigerian national agricultural policy. The evidence-based information on the nature and constraints of winning youths into agriculture is indispensable for the design of appropriate strategies for restoration of the teaming unemployed youths to Agriculture roaming the streets of Nigerian cities.

The national policy on agriculture which is in line with the Vision 2020, and the Millennium Development Goals, especially MDG 1 on food security and poverty elevation have in its consideration that the rural poor, particularly small-scale farmers which constitute the most affected group of Nigerian working societies, and underscores the relevant guidelines of adaptation farming incentives, land and credit facilities. Even though how, and the means of credit facilities, land acquisition and incentive disbursement was not explicit in the current Nigeria agricultural policy. There should be appropriate tactic to achieving this.

Therefore, in line with the Vision 2020, and the Millennium Development Goals, especially MDG 1 policy guidelines, the agricultural policy of Nigeria aim to secure a conducive environment for these rural farmers. The evidence-based information on the nature and constraints to financing agricultural adventure by this farmers due to poverty as well as lack or partial provision of basic agricultural incentives cannot be under estimated for the design of appropriate strategies for reducing the vulnerability of these farming households' to poverty. As a developing nation, Nigeria advocates the integration of diversified food intake, nutrition and health into rural development programmes in order to leverage synergies between agricultural households and their income.

Moreover, the country's agricultural policy desires to promote sustainable use of agricultural resources and integrate environmental planning into land reform processes. However, the bidirectional relationship that exists between food intake diversity-nutrition and health of small-scale farmers remains at the intersection of policy debates. To inform the design for the holistic and bidirectional food intake-nutrition and health policy strategies, this study provides a key insights into national agricultural policy that are prioritized by these small scale farmers. This information is a strong basis for bridging the gap and aligning government's agricultural blue prints with the small scale farmers' as a center of consideration. Moreover, the evidence-based information on structural constraints to farming households' diversified food intake, nutrition and health in the Southwestern Nigeria forms an important basis for timely policy intervention.

1.8 Definitions of Technical Terms

Body mass index: it is derived by computing a person's weight in kilograms divided by the square of height in meters.

Dietary diversity score : can be 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 nutritional level.

Food Intake: is the sum of food consumed by a person.

Health: according to the World Health Organization, it is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Health Indicators: alcohol related indicators, injury rates, chronic pain hospital visit due to injury, days of incapacitation to sickness, alcohol consumption indicator, self-rated and BMI.

Nutrition: is defined by the World Health Organization as the intake of food, considered in relation to the body's dietary needs. Good nutrition an adequate, well-balanced diet combined with regular physical activity is a cornerstone of good health.

Nutritional Indicators: proportion of overweight individuals, food and nutritional intake assessments, coping mechanisms.

1.9 Chapter Summary

The chapter presented an introduction to the study of the economics of food intake, nutrition, and health, a detailed background of the study was also added. Problem statement with stylized facts on food intake, nutrition and health of the farming households in Nigeria. These have led to four major outlined research questions and objectives as well as six research hypothesis. Also, justification and policy relevance of the study with a plan of the study were addressed in this chapter. The outcome of the study will provide the basis for the Government of the day, non-Governmental Organizations and international community at large to invest more on rural farming households' food intake, nutrition and health in order to improve the productive

capacity of the rural farmers since food intake, nutrition and health are key elements of development and drivers of growth in any nation. The next chapter is the studies theoretical/conceptual framework and literature review.

1.10 Structure of the rest of the Thesis

The rest of the study is organized in the following order ; chapter two presents the conceptual framework and literature review based on the adopted indicators of nutrition and health of farmers; chapter three presents the description of methodology used in the study; chapter four presents the results of data analyses and discussions of the socioeconomic and demographic characteristics providing the main attributes of the respondents which were responsible for their food intake, nutrition and health status as well as the annual cost incurred on nutrition and health with respect to their income. Chapter five discusses factors influencing farming households' nutrition using three different approaches, while chapter six delve into the analyses the effect of agricultural households' nutrition on health status by employing three models .Lastly, chapter seven of the study presents the summary of major findings, conclusion and policy recommendations.

CHAPTER TWO

THEORETICAL/CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents the theoretical underpinning for the study and a review of the literature on farming households' food intake, nutrition, and health. The subsequent subsections described the theoretical framework for food nutrition security (FNS), health and income theory. A conceptual framework for the impact of food intake nutrition and ill health on agriculture and a review of empirical literature on the determinants of agricultural households' food intake, nutrition and health was also presented in this chapter.

2.2 Concept and Theoretical Framework for Food Intake and Nutrition Security (FNS)

The fact behind the terminology of food and nutrition security is the emphasis on the significance of the complementarities and persistent overlaps between households' food intake and nutrition. The linking of food intake and nutrition security suggests that nutrition can be at risk if absent from these interactions (Weingärtner, 2010). Pangaribowo *et al.* (2013) also submitted that food and nutrition security is a condition under which sufficient food (in terms of quantity, quality, safety, and socio-cultural acceptability) is available, accessible and always adequately utilized by all individuals to live a healthy and happy life. "Food and nutrition security as a term is more accepted and widely used as it combines both security concepts in a more integrated way as a single goal of policy making" (Pangaribowo *et al.*, 2013).

The economic models of food and nutrition security (FNS) offer a basis for the choice of appropriate, suitable and acceptable determinants of food and nutrition security (Pangaribowo *et al.*, 2013). As food and nutrition security develop across an individual's lifetime, static and dynamic models of food and nutrition status are hereby discussed. Unlike in the case of health capital, food nutrition security production models are still uncommon. The extensive and multidimensional concept of FNS might be one of the main reasons for the dearth of a suitable theoretical model framework of FNS. However, as the FNS concept is "closely related and

synergistically linked with health, FNS models are derived from the prevailing framework of health production functions" (Strauss and Thomas, 1998; Strauss and Thomas, 2007).

The variables involved in the FNS models are generally based on the UNICEF framework as illustrated in Figure 2.1. For simplicity purpose, Victoria *et al.* (2013) used a "static FNS production function" (Hoddinot *et al.*, 2012; Strauss and Thomas, 2007): This can be represented as :

$$G = F(N; A, B_H, D, \mu) \quad \ldots\ldots (2.1)$$

where G in the equation represents a variety of FNS outcomes. The FNS production function in equation (2.1) solely accounts for the demand aspect of the individuals' food nutrition security issue, thus assuming food supply as given in a partial equilibrium analysis. This corroborates with the conceptual framework that was developed by (Pangaribowo *et al.*, 2013), in which food nutrition security outcomes i.e. hunger and undernutrition were the result of individuals' deliberate action under their specific preferences and constraints. They were determined by a set of food and nutrition security inputs and behaviours, "N" which includes food intake, use of health care facilities "A" and also behaviours that influence FNS such as hygienic/healthful habit such as smoking and other physical activity (Pangaribowo *et al.*, 2013).

"Technology is a principal production function which is a fundamental structure of the FNS" (Evita *et al.*, 2013,p.10). The production function is different across various socio-economic characteristics, "A" which includes gender, marital status age, and households' size etc. The technology factor may depend on the genetic endowment "B_H" such as parental height, complexion, the colour of the eye, the shape of the nose and other physical attributes. Technology is also associated with environmental factors of the individual, "D" such as hygiene, healthy environment, access to sanitation, quality of public health infrastructure and environmental degradation level.

As in standard production functions, "μ" which represents the unobserved characteristics including measurement errors of the covariates and innate FNS . In addition, according to Pangaribowo *et al.* (2013), " the effect and influence of behavioural choices to food and nutrition security was recognized". Assuming that an individual's utility function depends on his/her consumption of purchased goods, "C" and on his/her labour supply "L". The utility also

depends on FNS and other covariates such as socioeconomic characteristics, "A" and non-FNS human capital such as education and households' characteristics,

$$B_U: U = U(C, L; F, A, B_U, \eth) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

In the equation above, "∂" represents unobserved characteristics including the heterogeneity of preferences which might relate to the unobserved characteristics of the FNS production function in equation "(2.1)". Following the standard microeconomic theory, the allocation of resources is subject to budget and time constraint. Let's assume that an individual holds total resources from labour income, "w" for each unit of labour supplied and non-labour income "V" this theory assumed that the consumption set consists of the consumption related to FNS inputs, " N_C ", with prices "P_n" and the consumption of non-FNS input, "C*" with prices "P_c". The budget constraint can be formed as follow:

$$P_c C^* + P_n N_c = WL + V \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.3)$$

Based on the equation (2.1),(2.2) and (2.3), it was established that individuals food and nutrition security depends on FNS inputs and its prices, observed and unobserved variables that influence FNS and the individual's utility, including their socio-economic characteristics, environmental safety, water sanitation, human capital and the public health infrastructure. Furthermore, "the connection between wage and FNS. Previous work on this labour output and efficiency-wage theory" (Dasgupta and Ray 1986;1986; Dasgupta, 1997) suppose that those elements go together. FNS enhances individuals labour output while the efficiency-wage theory highlights the wage effect of better food and nutrition status. The empirical literature has stated a positive relationship between FNS and labour output (Hoddinott *et al.*, 2008; Strauss and Thomas 2007; Thomas and Frankenberg, 2002).

Following Strauss and Thomas (2007); Lutter and Lutter (2011) and Victora *et al.* (2008), the assumption is that a person's real wage is equal to his/her marginal product. An individual's wage, "w" depends on the FNS level , "F" in this case is the individuals socio-demographic Characteristics, "A" households characteristics, "B_W", which includes human capital such as health and education and other informal training of households' head as well as other household members and community and regional characteristics. The labour demand and work characteristics might be affected by public infrastructure, "I" such as road density and electrification. Similar to equation (2.2), the wage function is also influenced by unobserved

Element $\alpha: w = w(F: A, B_w, I, \alpha)$ ..... (2.4)

From the aforementioned models, the reduced form of each demand function for FNS inputs, "N", and FNS output, F, is given thus:

$$\emptyset = \emptyset\ (P_n, P_c, A, B, V, D, I, \varepsilon\ ) \text{ ..... (2.5)}$$

Here, each demand function varies with FNS input prices, " Pn", consumption prices, "Pc", socio-economic characteristics, "A", refers to individual human capital as well as household characteristics, B (BH, Bu, and Bw), non-labour income ,"V" implies environment, "D" and non-FNS determinants of wage, "I". The dynamic nature of FNS as it evolves over the individuals' lifetime was considered. FNS at one point in time affects FNS in the later period. "The Barker's hypothesis even emphasized that the impact of the nutritional status on future life starts before birth" (Barker, 1997) and intrauterine growth is related to non-communicable diseases and human capital in adulthood (Strauss and Thomas, 2007).

Following Gross and Webb (2006); Strauss and Thomas (2007); and Pinstrup-Andersen and Watson II (2011), we assume that ""Ft" varies on all current and former FNS inputs, "Nσ", σ=0...t the health environment, "Dσ" (Sahn and Alderman, 1998), demographic characteristics that change over time, such as age, "Aσ," and other demographic characteristics, BH, which are time invariant.

$$Ft = F(Nt, Nt-1, .., N0, Dt, Dt-1, .., D0, At, At-1, ..., A0, BH, \mu, \mu t, \mu-1, .. \mu 0 \text{ ...(2.6)}$$

The FNS model over individuals' lifetime reflects that FNS progresses with several economic variables. This model also shows the basic mechanism of the nutrition-based poverty trap. For example, existing literature explained that undernutrition in the womb affects children's development and nutritional status. Perpetually poor nutrition and development prospects over time. Furthermore, undernourished children tend to grow up to become short adults on the long run, have poor and or lower educational achievement and possibly give birth to shorter infants thereby showing a vicious circle of FNS problems over the lifetime and into the posterity.

Finally, food intake and nutrition security analysis over time has been significant to understand showing the long term and short term nature of FNS problems. For instance, "long term FNS problems are partly a result of stationary and stagnant economic progress over time or lasting social, political and cultural factors such as governments' failure to provide public services" (health, education etc.) and gender discrimination. All these aspects are to be taken into

consideration to set the guidelines for choosing the appropriate indicators of FNS. In the dynamic model of FNS, a number of risk factors are at play, in this case with small-holder farmers representing the most vulnerable group. This group also represents a sizeable share of the total population under FNS risks and of the total domestic food supply in many developing countries such as Nigeria.

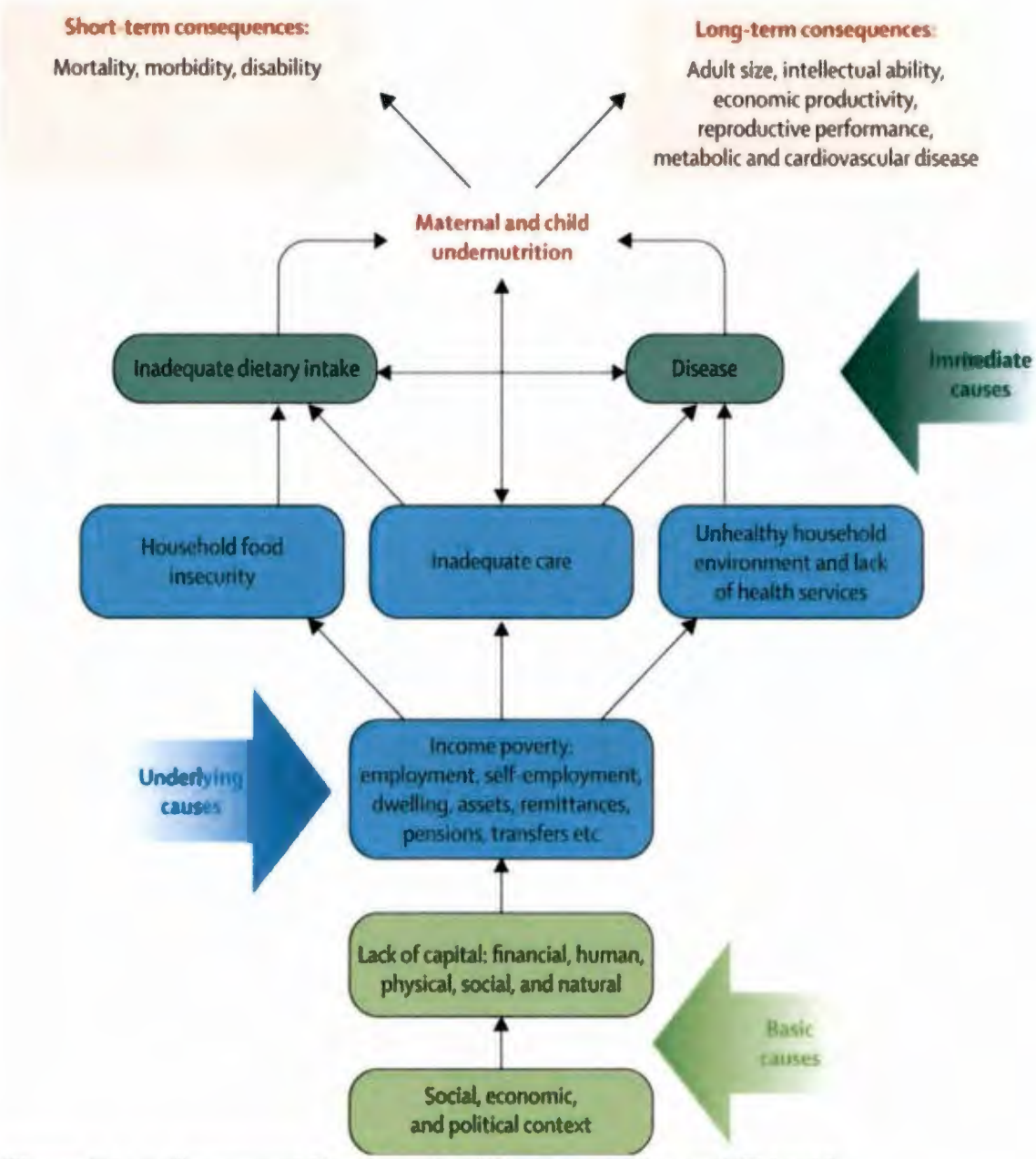

Figure 2.1: A Conceptual Framework of Under-nutrition and ill health
Source: Victora *et al.* (2008)

2.3 Health Capital Theory

The dynamic model of the demand for health and health investment like medical care arises from the work of (Cropper, 1977, Muurinen; Le Grand, 1985; Case and Deaton, 2005). In Grossman's human capital framework, individuals demand medical care for the consumption and production benefits. The model provides a conceptual framework for interpretation of the demand for health and medical care in relation to individual's resource constraints, preferences and consumption needs over their life cycle (Grossman, 2000).

Grossman's model has been one of the most important contributions of economics to the study of health behaviour. It has provided insights into various phenomenon related to health, inequality in health, medical care, relationship between health and socioeconomic status, occupational choice (Galama, 2011) and has become the standard framework for the economics of demand for medical care. A standard framework for health investment like medical care, demand health and has to meet the significant challenge of providing insight into a variety of complex phenomena. Ideally, it would explain the significant differences observed in the farmers' health and their socioeconomic status (Titus *et al.,* 2014.) which is often called the "SES-health gradient" (Grossman, 1972; Grossman, 2000).

2.3.1 The Demand for Health and Health Investment

Demand for health care is derived from demand for health. Also, demand for health is derived from the demand for a utility that is, healthy days in which to participate in leisure and their usual work. Individual farmers are not passive consumers of health but active producers who spend money and time on the production of their health asset which can be seen as lasting over the time period. Health also depreciates perhaps at a non-constant rate and can, therefore be analyzed as a capital good as in Grossman's basic formulation (Grossman, 1972; Grossman, 2000) of demand for health and health investment in discrete time.

The demand for medical care is a derived demand: individuals demand "*good health*", not the consumption of medical care. Using discrete time optimal control (Sydsæter *et al.*, 2005), the problem can be illustrated thus. Assuming individuals maximize their lifetime utility function

such that:

$$\frac{\sum_{t=0}^{T-1} U(Ct, Ht)}{\prod_{k=1} t(1-\beta k)} \quad \ldots\ldots 2.7$$

in which individual (farmer) live for T (endogenous) periods, βk is a subjective discount component and people derive utility $U(Ct, Ht)$ from intake Ct and from health Ht. Time t is measured from the time individuals starts employment. Utility increases with consumption $\partial Ut/\partial Ct > 0$ and with health capital $\partial Ut/\partial Ht > 0$. The objective function (2.7) is maximized subject situation to the dynamic constraints:

$$H_{t+1} = fI_t + (1 - d_t)H_t \quad \ldots\ldots 2.8$$

$$A_{t\,.\,1} = (1 + \delta_t)A_t + YH_t - pX_tX_t - pm_tm_t \quad \ldots\ldots 2.9$$

the overall time budget Ωt ; $$\Omega t = \tau wt + \tau It + \tau Ct + s(\mathrm{Ht}), \quad \ldots\ldots 2.10$$

With the preliminary and final situations: H_0, H_T , A_0 and A_T are given. Individuals live for T periods and die at the end of period $T-1$. The length of life T (Grossman, 1972) which is determined by a minimum health level Hmin. Furthermore, if health falls below this level $Ht \leq Hmin$ an individual (farmer) dies ($HT \equiv H$min). Individuals health can be improved via investment in health I_t and deteriorates on the normal biological rate of getting older dt. The relation between individuals input, health investment (I_t), and also the output, health improvement (f) , is directed by the health production function $f(\cdot)$.

The health production function $f(\cdot)$ is assumed to obey the law of diminishing marginal returns in health investment, following simple functional form will be important:

$$f(I_t) = I\alpha_t, \quad \ldots\ldots 2.11$$

wherein $0 < \alpha < 1$ (DRTS).Assets (A_t) (equation 2.9) offers the rate of return on capital δ_t , increase with income $Y(Ht)$ and reduces within purchases in the market of intake goods and services Xt and medical goods and services mt at prices pXt and pmt , respectively. Income $Y(Ht)$ is assumed to be increasing in health Ht as healthy individuals are more productive and earn a higher income (Currie and Madrian, 1999;Contoyannis *et al.*, 2004). Goods and services Xt bought in the market and personal inputs τCt are used in the production of consumption Ct.

Further, medical goods and services *mt* and personal time inputs τIt are used in the production of health investment *It*. "The efficiencies of production are assumed to be a feature of the consumer's stock of knowledge E (a persons' human capital unique of health capital as the greater educated may be extra efficient at investing in health" (Grossman, 2000):

$$It = I(mt, \tau It;\ E) \quad \ldots\ldots 2.12$$

$$Ct = C(Xt, \tau Ct;\ E) \quad \ldots\ldots 2.13$$

The total time available for any period Ωt (equation 2.10) is the sum of all possible uses farm work (τwt), (health investment)τIt, (consumption) τCt and (sick time; a lowering function of health) *s*.

In this component, one can interpret τCt, the personal time input into consumption *Ct* as representing leisure. Income earning *Y (Ht)* is taken to be a function of the wage rate *wt* times the time spent operating on the farm

$$\tau wt, Y(H_t) = Wt[\Omega t - \tau It - \tau Ct - sH_t] \quad \ldots\ldots (2.14)$$

As a result, we have the following optimal control problem: the objective function is maximized with respect to the control functions *Xt*, τCt, *mt* and τIt and subject to the constraints. The Hamiltonian of this problem is:

$$3t = \frac{U(C_t, H_t)}{\prod_{k=1} t(1-B_k)} + qt^H H_{t+1!} + q^A + 1,\ t = 0, \ldots T-1 \quad \ldots\ldots (2.15)$$

where q_t^H is the adjoint variable associated with the dynamic equation (2.8) for the key variable health H_t and *qAt* is the adjoint variable associated with the dynamic equation (2.9) for the key variable assets A_t. The optimal control problem presented so far was formulated for a fixed length of life *T* (Seierstad and Sydsaeter, 1977; Kirk, 1970). To permit differential mortality, we added an additional condition to the optimal control problem to optimize over all possible lengths of life *T* is essential (Ehrlich and Chuma, 1990).

Therefore, one way to achieve this is by first solving the most optimal control problem conditional on length of life *T* for a fixed exogenous *T*, by inserting the optimal solutions for consumption $C*t$ and health $H*_t$ (denoted by $*$) into the "indirect utility function" therefore,

$$V_T = \frac{\sum_{t=0}^{T-1} U(C*t, H*t)}{\prod_{k=1} t\,(1-B_K)} \quad \ldots\ldots (2.16)$$

and maximizing V_T with respect to *T*.

2.3.2 Health as a Merit Good

Individual and farm households have resources such as time and capital. Time refers to the availability of physical labour for agricultural activities while capital includes assets such as livestock, social capital, land, monetary resources and human capital in the form of knowledge and education. It additionally includes human capital in the form of food intakes and health. Resources such as health and education are often held by individuals, while others, such as land, may be individually or collectively owned.

These resources are allocated to different productive activities, including food production, livestock raising, cash crop production, and non-agricultural income generating activities, such a wage labour, handicrafts and services (Shenggen and RajulPandya-Lorch, 2012). Also, Agricultural production is affected by the settings within which the farming households reside, with the physical and economic setting being of tremendous importance. "Soil quality, temperature, elevation and so forth and the man-made physical setting, roads, bridges and other forms of infrastructure influence what livestock can be raised, what crops can be grown and when and the places where these products can be marketed" Agulanna *et al.* (2013).

The economic setting, notably the markets encountered by farmers provides signals on the type of activities, the type of inputs and profitability. Within these settings, the household allocates its resources, capital, knowledge, and time. In some cases, allocations of all resources may be a collective decision. In still other cases, some activities will be undertaken collectively or perhaps under the direction of one household member are also making choices about the technologies used in the generation of income. These technologies govern what crops will be produced, what livestock will be raised, how they will be produced, and when production will take place.

It is noteworthy therefore that the health and nutrition status of individual members will affect the choice of activities, the timing of these activities, and the intensity with which productive activities will be undertaken. For example, individuals who are suffering from iron deficiencies or have a physical disability will encounter greater difficulty in using their physical labour to produce agricultural output. In a population where there is severe dearth in energy intake, or where economic activities are physically demanding, increased nutrient intake can raise labour outcomes (Galama, 2011).

$$H\ Stock_t = H\ Stock_{t-1} - dep'n(d) + inv.in\ H\ (I) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.17)$$

A person is born with an initial endowment of H, which they add to by investment. The rate of H production will depend on the efficiency of investment in H. There will be a decrease in the value of the stock of H through age, accident, carelessness, sudden disease. As we are considering U over a lifetime we also need to be aware of the issue of time-preference.

2.4 Theoretical Concept of Demand for Health, Food Intake and Health Production

The economics approach emphasizes the role of economic factors in shaping health-related behavior. It is referred to as the "demand for health" approach since it views the individual as "demanding" a commodity "health". It is built up around three concepts/assumptions.

2.4.1 Demand for Health (The Indifference Map)

Health is assumed to be desirable; it is assumed not to be the only desirable thing in life; nor valued above all else. There are various reasons why good health might be thought to be desirable since it is in itself pleasant as ill-health may be viewed as being in itself unpleasant. Being in good health also permits one to engage in one's normal activities such as mental, social, economic, physical and agricultural activities. It is clear however, from our behaviour both as individuals and collectively that good health is not valued above all else. Every year patients in hospitals are denied life-saving treatments because the resources society has made available to the hospital sector are insufficient to "save" every life that could from a purely technological point of view be "saved". The resources are devoted instead to other things that society values, such as good roads, sports facilities, education, and defense (wagstaff, 1986).

At an individual and household level, if people valued their health above other things, they would not be nutritious illiterate, over-eat, smoke, drink alcohol or engage in any other health abuse attitudes. That people do engage in such activities, and that society does spend money on sports facilities and roads when people are left to die before they need to makes it clear that although people do value their health, they do not place an over-riding value on it. This idea can be stated more precisely. Suppose health can be measured in terms of "units of health". For brevity, the "other things in life" from which pleasure is derived can be labelled "food intake". Figure 2.2 shows units of health plotted along the horizontal axis and units of food intake plotted along the vertical axis.

Any point on the graph represents a combination of health and food intake. Thus, point "a" represents the combination 1 unit of health and 2 units of food intake. It was assumed that people derive pleasure from being in good health and from eating activities. Thus a person would experience a higher level of well-being at point "b", for example, than at "a", since at "b" he enjoys better health and consumes more than at point a. In general, the further the individual is away from the origin 0, the higher will be his well-being. The food intake above can be expressed in diagrammatic form using an "indifference curve".

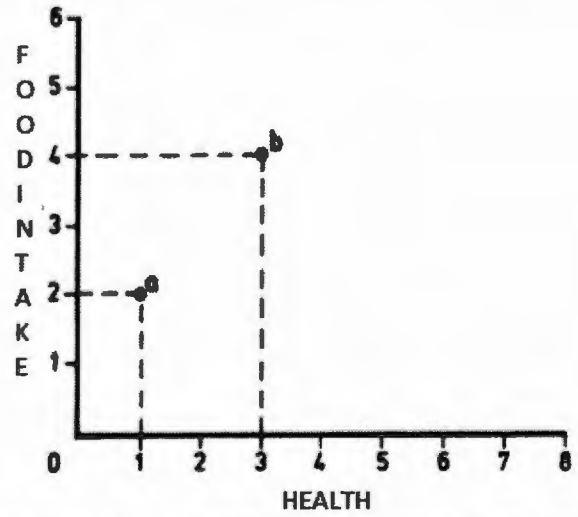

Figure 2.2: An Indifferent Graph of Food Intake and Health Relationship

Source: Adapted and Modified from Wagstaff (1986)

In the same way as a contour on a map links all places of the same height, the welfare contour in Figure 2.3 links all points giving rise to the same level of well-being. Because all the combinations of health and food intake along the contour yield the same level of welfare, the individual is "indifferent" between them all. Hence the term "indifference curve". The indifference curve slopes downwards because people value both health and food intake but do not view being in good health as so important that it takes priority over everything else. At point "a" in Figure 2.3 the individual has 4 units of health and 1-8 units of food intake. The indifference curve indicates that if he were to move to point "b"-2-6 units of food intake and 3 of health, he would be just as well off as he had been at a. His health would be worse, but the increase in consumption/food intake of 8 units would be sufficiently large to compensate for this deterioration in health.

The welfare contour slopes downwards, therefore, because to compensate for a reduction in health, food intake has to increase and vice versa. The indifference curve indicates that to compensate for a reduction in health from 3 to 2 units the individual would require 1-4 (4-0-1-6) units of food intake. Meanwhile, at point "c" the individual would be as well off as "b" and "a". However, as one moves down the indifference curve it becomes increasingly difficult to induce the individual to accept further deteriorations in his health. To part voluntarily with 1 unit of health starting at point "a", he has to be compensated with 0-8 units of food intake. Starting from point "b", however, he has to be compensated with 1-4 units of food intake. This reflects the assumption that as successively more units of health are taken away from the individual, he will require successively more units of food intake in compensation. (Or, equivalently, as the individual is given successively more units of health, he will require successively fewer units of consumption/food intake in compensation.) It is this (not unreasonable) assumption that gives the indifference curve its bowed shape.

The indifference curve in Figure 2.4 is just one possible indifference curve. Any number of these curves can be drawn, all with the same shape, some closer to the origin than that in Figure 2.3 and some further out. While the individual is indifferent between points along a given curve, he is not indifferent between the curves themselves. He will prefer IC_2 to IC_1 in Figure 2.4, for example, since IC_2 offers him more food consumption for a given level of health. The individual will therefore seek to attain the highest possible indifference curve. It cannot be said yet, however, on which indifference curve he will operate. In order to determine that, the other elements of the economics approach have to be introduced.

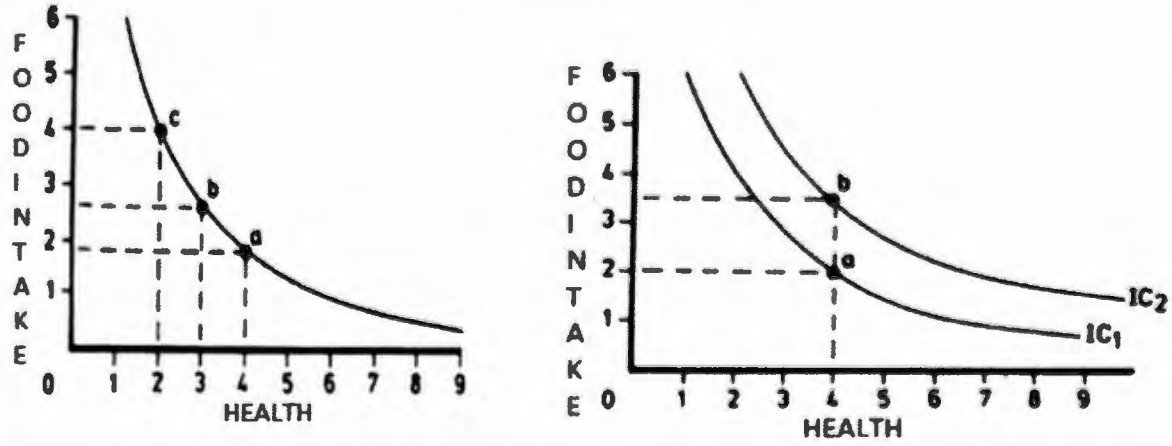

Figure 2.3 and 2.4 : The Indifferent Curve Individual Food intake and Health

Source: Adapted and Modified from Wagstaff (1986)

2.4.2 The Health Production Function

The second assumption on which the present approach is based may be stated as individuals exert a relatively high degree of control over their health by virtue of the fact that they can influence their health-affecting food intake patterns, health care utilization, and their environment. This assumption can be expressed rather more precisely using the concept of the "health production function". In economics one speaks of firms "producing" their outputs by combining "factor inputs", mainly labour as in the case of small scale farmers. The relationship linking these inputs to the final output is known as the "production function". The "demand for health" approach utilizes these ideas and conceives of the individual "producing" his health by combining "health inputs".

For instance, medical care is an example of a health input, and it is only one variable example of a determinant of health. As was the case with consumption /food intake, it is useful to talk in terms of a "bundle" of health inputs comprising food, health care, and other inputs. The "health production function" links these inputs to the output known as health. The health production function is illustrated in figure 4. The output-health-is measured along the vertical axis and the health inputs along the horizontal axis. Figure 2.5 indicates, for example, that 1 unit of health input produces 1.8 units of health. As more units of health input are used, more health is produced. Figure 2.5 also indicates that successive additions to the quantity of health inputs employed result in successively smaller increments in health.

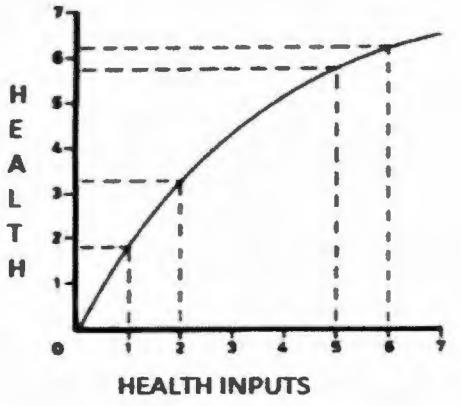

Figure 2.5 : Health Production Function Curve

Source: Adapted and Modified from Wagstaff (1986)

For example, increasing the amount of health input from 1 to 2 units results in an increase in health of 1.5 units. Increasing the amount of health input from 5 to 6 units, however, results in an increase in health of only 0-5 units. This phenomenon is termed the "law of diminishing marginal product", the term "marginal product" referring to the extra number of units of output resulting from the use of one extra unit of input. (The marginal product of health inputs in the range 1 to 2 along the horizontal axis, for example, is equal to 1-5.) That this principle applies in the' production of health is clear from, for example, the differing experiences of developing and developed countries.

At the low levels of health and health input currently prevailing in the rural communities of the developing nations even quite modest increases in the quantities of health input employed such as food, sanitation, environment et.c have relatively large impacts on life expectancy. At higher levels of health and health input, such as those enjoyed by citizens of the developed nations of the world, even quite large increases in the resources devoted to the promotion of health appear to have relatively small impacts on the quantity and quality of life. The health production function shows how much health can be obtained from a given quantity of health input for a given state of technical knowledge.

2.5 Conceptual Framework

2.5.1 The Conceptual Framework for Nutrition,Food intake and Health

Nutrition is directly related to food intake and health. Both food intake and infectious diseases reflect underlying social and economic conditions at the household, community, and national levels that are supported by economic, environmental and ideological structures within a country. The following diagram is a conceptual framework for nutrition adapted from UNICEF. It reflects relationships among factors and their influences on nutritional status. Although, socioeconomic, environmental, and cultural factors (at the household level) affect the nutritional and health status of the farming households.

The Food intake and nutrition framework developed by UNICEF recognizes three levels of determinants of undernutrition: the basic, underlying and immediate causes of undernutrition (See Figure 2.1). The immediate causes of the nutritional status at the level of the individual human being are dietary intake and health status. The two factors are interlinked: dietary intake

should meet a certain threshold in terms of quantity and quality, nutrient intake should be balanced in terms carbohydrates, protein and fat (macronutrients) and vitamins and minerals (micronutrients) and appropriately absorbed in the human body (IFPRI, 2012; Pangaribowo *et al.,* 2013). As an example of the interdependence, loss of appetite is a common consequence of infection and sickness which might further reduce dietary intake (International Food Policy Research Institute (IFPRI), 2012).

At the household level, the dietary intake of specific individuals involves two major issues: what food is being served on the table (household food demand) and who is to eat it (intra-household food distribution) (Weingärtner, 2010; Pangaribowo and Maximo, 2013). Other aspects such as habits and knowledge about food processing and feeding practices (all of which are shared at the household level) influence the diet composition of the individuals as well as their biological utilization of the food (Pangaribowo *et al.*, 2013). In addition to the immediate causes of the individual nutritional status, three other factors are at play. These are household food insecurity (in terms of availability and access), inadequate care, lack of (quality) health services, and an unhealthy environment.

These three factors result from the set of underlying causes of under-nutrition, broadly labeled as income poverty in Figure 2.1. Household food security is a direct prerequisite for adequate dietary intake at the individual's level (Quisumbing *et al.*, 1995; Smith and Haddad, 2000). The condition of sufficient intake which is adequate for physiological development supports the food utilization. These aforementioned factors emphasize the importance of caring practices such as child feeding and health seeking behaviors', support for mothers during pregnancy and lactation, and mothers' autonomy in household decision-making, particularly in health and nutrition related issues (Quisumbing *et al.,* 1995; Smith and Haddad, 2000).

Women's capacity and autonomy in the households are frequently hampered by cultural and institutional aspects. The impacts of unhealthy environments as underlying factors of the immediate causes of undernutrition are obvious. In developing countries, infectious diseases such as diarrheal diseases and respiratory infections are the major nutrition-related health problems due to unhealthy household environments. Similarly obvious is the impact of lacking health services on under-nutrition, morbidity, and mortality.Strauss (1990), pointed out that the quality of health might be more important in explaining nutritional status than the availability of

or distance to health care services. Diarrheal diseases are among the nutrition-health problems which are mostly associated with water and sanitation condition.

Water and sanitation improvements, in line with the changes in hygiene behavior and public health programs, have been shown to have significant effects on people and their health (Von Braun, 2008; Smith and Haddad, 2000; Ecker and Breisinger, 2012). In addition, the general socio-economic and political conditions affect under-nutrition (the basic causes in Figure 2.1). The complex interactions between economy, science and technology, policy, the natural resource base and its management all play a role in the macroeconomic performance of a country (or region) and in the quality of the environment individuals live in. The basic causes, as outlined in the social, economic, and political context, imply that macroeconomic stability, economic growth and its distribution, public expenditure, and governance, as well as the quality of institutions, are among the crucial factors Ecker and Breisinger (2012), affecting food utilization and nutrition.

Furthermore, Ecker and Breisinger (2012), argued that the macroeconomic stability in terms of external and internal balance are important factors to the aggregate food availability. Export of goods and services, remittances, foreign direct investment and aid are important components of the balance of payments which enhance the aggregate food provision. Financial resource injection through the international market or development agencies becomes an alternative buffer to social safety nets in the time of shock (Food and Agriculture Organization of the United Nations (FAO), 2015).

Public expenditure both through public investment in infrastructure (and in the services required to run this infrastructure) and expenditure on agricultural research are strong elements to enhance food, nutrition, and health (Pangaribowo *et al.,* 2013). The social and political contexts interact together with economic context to ensure that the public expenditures are spent and distributed in an effective and efficient manner (Black *et al.,* 2008; FAO *et al.*, 2014). All of these factors are considered as the basic drivers of under-nutrition. This indicates that there is a potential levy for government policies to mitigate under-nutrition problems by means of changing the social, economic and political context (Hawkes and Ruel, 2006; FAO/WFP, 2006, 2014).

An important set of factors that should be considered as potential causes of under-nutrition are those which might not be captured within a single layer of factors in Figure 2.1, but cut across causal layers or derive from the interactions between several causes: population growth control and natural resource management, poverty and social inequalities, and the effects of macroeconomic structural adjustment policies. Therefore, it is necessary to include agro-ecological indicators and macroeconomic indicators, such as international food prices, food price volatility, the degree of price transmission between international and national markets, as well as market and trade regulation, in a causal analysis of under or malnutrition.

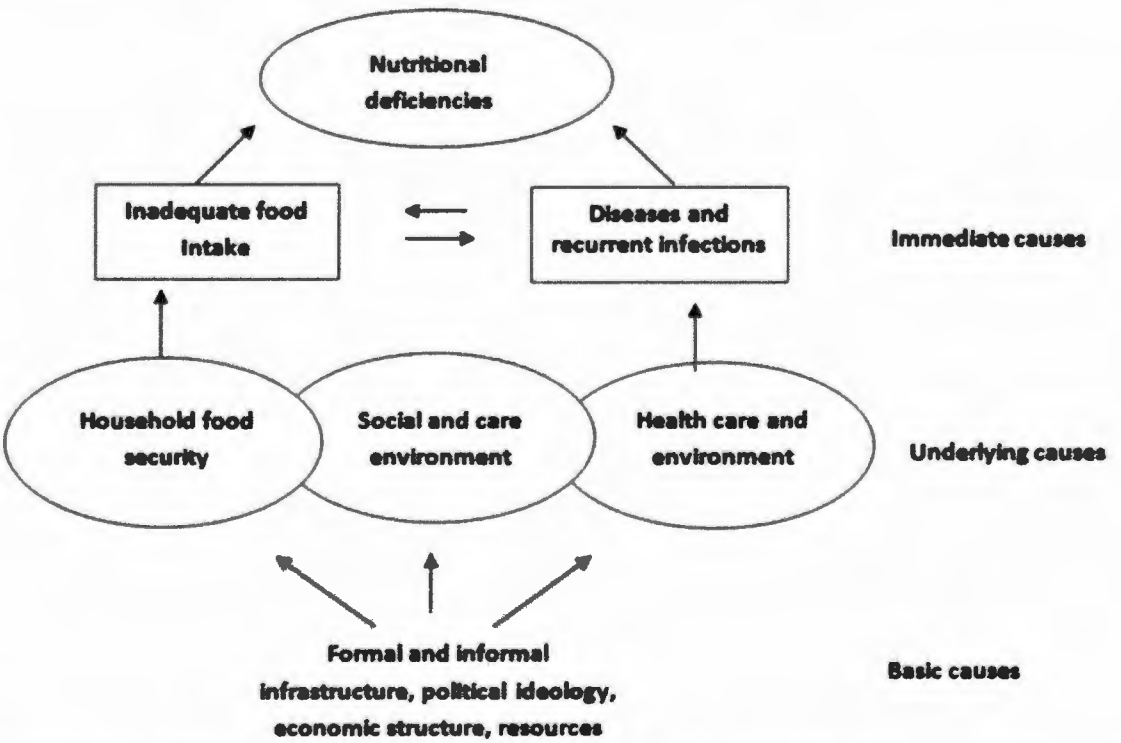

Figure 2.6: Conceptual framework of nutrition, food intake and health Linkage

Source:(https://www.bing.com/images/search?view=detailV2&ccid=IN2h%2bJhO&id=15DABAACAF81C258896F64671583088EF5355732&thid=OIP.IN2hJhOJDYDfe3sS3wdfgEsDF&q=food+intake+leads+to+health+conceptual+framework&simid=608048675214002365&selectedIndex=58).

2.5.2 Conceptual Framework for the Impact of Under Nutrition and Illness/Disease on Agricultural Households

Figure 2.2 was conceptualized on Negin (2005), where a rural farming households' health as the primary goal and quantifiable endpoint of food intake, nutrition and agricultural production as a

typical agricultural household in rural Nigeria's health status is important for their day to day farming activities. Agriculture, health, and nutrition have long operated in occupied separate realms. This separation is strange given that agricultural outcome, health, and nutrition are tightly wedded (International Food Policy Research Institute (IFPRI) and International Livestock Research Institute (ILRI), 2010; Hoddinott, 2011).Agriculture is widely known to be the primary source of calories and essential nutrients, it is also the major source of income for the world's poor (Gilbert, 2010, International Food Policy Research Institute (IFPRI) and International Livestock Research Institute (ILRI), 2010) whilst "agriculture related health losses are large– accounting for up to 25% of all disability adjusted life years lost 10% of deaths in low-income countries" (Asenso-Okyere *et al.*, 2011a).

Strengthening the relationship between food intakes, nutrition-health-agriculture requires a means of seeing how the links fit together. In bringing out the relationship that exists between these concepts, the study presents a framework that explains how food-nutrition affects agricultural households' health. As pointed out earlier, anything that affects nutrition and health is capable of affecting agricultural outcomes and income (Asenso-Okyere *et al.,* 2011a and IFPRI, 2012). Poor food intake and nutrition results in ill health (leading to morbidity or mortality), low labour and reduced income due to incapacitation of the economically active population also affects the quantity and quality of labour supply to the household because the sick abstain completely or partially from work during the period of illness (International Food Policy Research Institute (IFPRI), 2012).

The potential effect of malnutrition and ill health, therefore, lies in the productive time lost by the sick and the family members who divert productive time on the farm to care for the sick. In the event of malnutrition, it could lead to debilitation, the death of adults, the supply of farm labour is affected in addition to the loss of farming knowledge, which slows the acquisition and diffusion of agricultural innovations and inevitably reduced national income (Gilbert, 2010). Although new knowledge is needed for innovations in agriculture, knowledge that has been accumulated by farmers has been found to be useful in creating new technology and innovations. The knowledge that spills over from one farmer to another is an effective way of disseminating technology in rural areas. Such opportunities are lost when a farmer dies from malnutrition or illness.

Another important potential effect is the reduction in investments in agriculture due to high expenditures on treatment and prevention of sickness (Gilbert, 2010), cited in International Food Policy Research Institute (IFPRI) and International Livestock Research Institution (ILRI), 2010). Farm households may withdraw their savings, sell productive assets, or borrow money to pay for the cost of treating illness of household members. They may therefore not be able to make the necessary investments in their farms. The direct cost of treating and preventing ill health could make households adopt several measures, depending on the circumstance (Gilbert, 2010).

These could include a reduction in area under cultivation, planting of less labor-intensive crops, changes in cropping patterns, adoption of labour-scarce innovations that may be less productive farming techniques, and reduction in the use of farm inputs (Levitt *et al.*, 2009). Although the affected households could adopt coping mechanisms such as household labour reallocation and the hiring of labour, these strategies have cost implications. It is equally important to note that hired labour may not be a perfect substitute for family labour (Chima *et al.*, 2003; Larochelle and Dalton, 2006). It is anticipated that repeated expenditure on illness by agrarian households would cause a decline in farm output and farm income, and cause food insecurity and an increased poverty (ESPD, 2005).

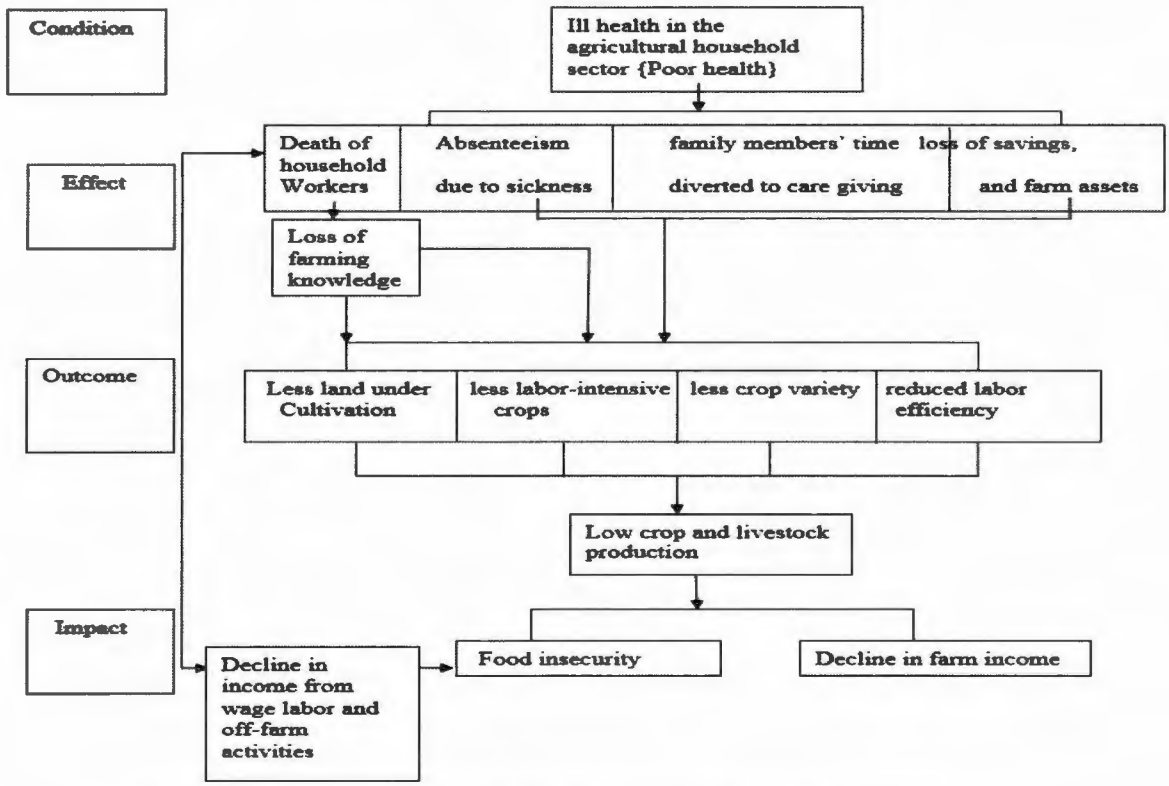

Figure 2.7: Conceptual Framework for the Impact of Ilness on Agriculture
Source: Adapted from Negin (2005)

2.5.3 Indicators of Households' 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 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 (Kennedy *et al.*, 2007; Ruel *et al.*, 2004; Savy *et al.*, 2005; Steyn *et al.*, 2006 and Arimond *et al.*, 2010). 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 hours 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 (Kennedy *et al.,* 2007; Ruel *et al.,* 2004; Steyn *et al.,* 2006; Savy *et al.,* 2005 and Arimond *et al.,* 2010).

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 *et al.* (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) Household's Hunger Scale

This is a dimention of food intake which is essentially a behavioural measure in qestion forms such as; was there ever no food to eat of any kind in your house because of lack of resources to

get food ? Did you or any household member go to sleep at night hungry because there was not enough food ? Did you or any household member go a whole day and night without eating anything because there was not enough food ? (Vhurumuku, 2014)

(iii) Coping/Fall Back Strategies or Mechanisms

These are remedial actions undertaken by people whose survival and livelihood are compromised or threatened WHO/EHA, (1999). Households with food shortage are almost by definition nutritionally unsustainable, and are likely to be economically and environmentally unsustainable as well. Coping Strategies Index (CSI) ,is a food intake behaviour 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.In studies of food intake in the US, approaches have included construction of a "hunger index" in the Community Childhood Hunger Identification Project (Wehler, 1994) .

2.5.4 Indicators of Households' Health Status

Anthropometric Measures

Body Mass Index (BMI Categories) and self-rated health approach were used to measure respondent's health status.

(i) Body Mass Index (BMI)

This measures the variation of nutrition and health status in the human life cycle. It is a very good indicator of health at individual and population level. It also serves as a proxy measure of adiposity, which is independent of gender, age and ethnicity. However, "it does not differentiate between muscularity and adiposity" (WHO, 2010). Body mass index (BMI) of the households' head was calculated as weight in kilograms (kg) divided by height in meters squared (m^2) and classified into the categories defined by the World Health Organization (WHO) as tabulated in Table 2.1.This study used respondents' BMI to categorize the farming households' heads into different categories across the selected states and also used it as an indicator for health. The cut-

off suggested by the International Dietary Energy Consultative Group and the World Health Organization was used to regroup respondents into healthy or otherwise categories.

Table 2.1: BMI Classifications are as Follows:

BMI FIGURE	CATEGORIES
< 18.50	Underweight
18.50-24.90	Normal/desirable weight or healthy
25.00-29.90	Overweight
30.00- 34.90	Obese I
35.00- 39.90	Obese II
>40.00	Severely Obese.

Source: (World Health Organisation (WHO), 2010)

(ii) Self-Rated/Self Assessed Health Status

This is another technique commonly used to assess the health status of adults. Self-Rated health approach enhances respondents to rate their 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).

(iii) Day of Incapacitation

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. It is a very good indicator of health at individual and population level.

2.6 Empirical Review

2.6.1 Food Intake , Nutrition, Health of Farming Households

Nutrition and health are affected by many variables. Human capital inputs have been called crucial elements in accomplishing sustained increase in agricultural output in African countries (Schultz, 2003). Some of the socioeconomic factors explaining farming households' food intake, nutrition status in relation to studies done in different places were thus reviewed as host of health, environmental, cultural and behavioural factors determine the nutritional benefits of foods consumed (International Fund for Agricultural Development (IFAD), 1983). The simultaneity between food intake, nutrition, health, and the agricultural outcome has led to a recent emphasis on the use of advanced statistics and econometric methods.

However, for several motives, estimation practices rarely employ all properties of the underlying model. For instance, estimation of the structural form of a simultaneous equation model requires detailed specification of all relations within the model and identification of all fitted parameters which may require unavailable information (Higgens and Alderman, 1993). Moreover, estimation of a system of the nonlinear equation requires advanced econometrics, which has not been available in the widely used econometric software programme packages until in recent times. Some empirical studies carried out by researchers on health capital using a few of the stated methodologies include that of Grossman (1972). He fitted an investment demand function and suggested the use of marginal efficiency of health capital, given by marginal value product of health divided by marginal cost of gross investment in health.

He argued that an individual's present value of expenditure on medical care, and production inputs are equal to the present value of the asset and all expected earnings over the life cycle. Grossman (1972), carried out some empirical studies on health capital using a few of the stated methodologies. He fitted an investment demand function and proposed the use of marginal efficiency of health capital, given by marginal value product of health divided by marginal cost of gross investment in health. He opined that an individual's present value of expenditure on medical care, and production inputs are equivalent to the present value of the asset and all anticipated earnings over the life cycle.

A study in Brazil simultaneously explored the effect of four separate dimensions of nutrition on urban wages (Thomas and Strauss, 1997). The relationship among wages, per capita calories, per capita protein, body mass index (BMI is measured as weight in kilogram divided by height in meters squared kgm^2), and height were examined. Research results revealed that height is associated with higher wages for both self-employed men and those who work in the market sector. Moreover, being taller and having a higher BMI is compensated most in self-employment. It was noted that many of the self-employed in urban Brazil work as manual labourers and returns to strength are large in such vocations in which a lot of energy is required.

A common mechanism households' adopt to cope with the burden of high medical costs is reducing consumption of basic needs, including food (Pitayanon *et al.,* 1997). If consumption reduction is substantial this can lead to malnutrition which increases susceptibility to opportunistic disease. In a Sri Lankan study that analyzed the effect of nutritional status on rural wages, it was found that per capita calorie intake had a positive significant effect on output for men but not for women (Sahn and Alderman, 1998). The different result may be due to the difference in the work done by men and women on farms. On re-examining the nutrition-health relationship taking seasonal variability into consideration using data from India, (Behrman and Deolalikar, 1988) found that, calorie intake is an important determinant during lean months. During peak seasons, energy is required to carry out strenuous and time-consuming tasks and so calorie intake becomes very extremely important.

Examining the link between food intake, nutrition and agricultural outcomes in the Philippines with height as the predictor of long-term nutritional status, Haddad and Bouis (1991), found that while height is a significant determinant of wages, energy intake as determined by a 24-hour food recall was not a significant predictor of wages. Research carried out in Ethiopia estimated the impact of health and nutritional status on the output of cereal growing farmers (Croppenstedt and Muller, 2000). Furthermore, a local study in Ethiopia showed that farming households in the youngest age group (15-19) and those in the oldest age group surveyed (45-49) were the most affected by undernutrition (Teller and Yimer, 2015).

Comparative studies on child nutrition for more than 15 countries Sommerfelt and Stewart (1994) and some local studies in Ethiopia Getaneh *et al.,* (1998); Genebo *et al.,* (1999) and Yimer (2000) all showed that the higher the level of economic status of the household, the lower the level of child stunting. Also, a study on the Southern Nations, Nationalities and Peoples

Region (SNNPR) the region of Ethiopia showed that women's malnutrition is significantly associated with marital status indicating that compared to married women malnutrition is higher among unmarried rural and divorced/separated urban women compared to married ones (Teller and Yimer, 2015). In addition, DHS surveys conducted in Burkina Faso, Ghana, Malawi, Namibia, Niger, Senegal, and Zambia shows a greater proportion of mothers age 15-19 and 40-49 that exhibit chronic energy deficiencies.

Also, a study by Sikwela (2008), in South Africa, using logistic regression model showed that fertilizer application, cattle ownership, access to irrigation and per aggregate production have a positive and significant effect on household food security whereas farm size and household size have a negative effect on household food security. Generally, comparative study in some in sub-Saharan Africa Sommerfelt and Stewart (1994), and in Jimma, Ethiopia Getaneh *et al.,* (1998), showed that unprotected water source and non-availability of latrine were associated with low child stature which is also a reflection of health status. Ismail *et al.,* (1999), associated poor functional ability with poor nutritional status in three developing countries in Africa (Malawi; India and Rwanda) stating that poor health may make older people more dependent with disabilities and hence reduced functional capacity.

Grossman used Beckers's (1965), equation of feasible time users, specifically: market work time, non-market production, consumption time and sick time with assumptions based on the following: that the amount of gross investment in health declines with an individual's age, that a worker's possible future time uses and his productivity levels can be predicted with certainty but factors like early retirement, change of job or outbreak of an epidemic cannot be easily forecasted; that the rate of interest on investment in health over a person's lifespan is known. Cyjetanovic (1974), conversely argues that the discount rate of investment in health or future projected earnings is highly arbitrary. He stated that the use of cost-benefit analysis in evaluating health programmes is merely applying the usual stereotype investment criteria, which may be misleading since investment in improved health programme save many indirect costs and benefits that are non-quantifiable.

2.7.0 Literature Review

2.7.1 Determinants of Household's Food Intake, Dietary Diversity Score,Hunger Severity and Nutrition Status

A number of works have examined the determinants of households' food intake, dietary diversity, hunger and nutrition in the developing countries (Clover 2003; Smith *et al.* 2007; Olofin and Babatunde, 2007; Rotimi and Ola, 2007; Swaminathan and Narendran 2008; Oriola 2009; Agulanna *et al.,* 2013; Otunaiya, 2014; Oluwatayo, 2015 et.c) . These respective authors argue that domestic policies in many developing nations have contributed marginally to households' nutrition in Africa and the world at large. In spite of the increasing global food production, hunger, malnutrition, and ill health are prevalent in many developing countries including Nigeria. Their findings reveal evidently that food intake and nutrition improvement in the Sub-Saharan Africa will enhance per capita Gross Domestic Products (GDP), increase purchasing power, food intake and health of the citizens.

Mbwana *et al.*(2016), for example identified in the determinants of households' dietary practices in rural Tanzania, using the Food and Agriculture Organization dietary diversity questionnaire with twelve food groups. In their study, two independent multinomial logistic regression models were used to establish the relationships between dietary diversity and categorical variables. The mean dietary diversity scores was found to be 4.7., while cereals were highly consumed by all households that participated in the study within the past 24 hours preceding the survey and the consumption of animal based protein foods was below 40%. They added that the major determinants of household dietary diversity included literacy status of the mother, nutrition training/knowledge, cultivated land size, literacy status of the mother and household's distance to a water source. The study recommended that food intake diversity, nutrition and food security interventions should not only empower rural women but also pay special attention to differences in agro-ecological environments for effective successful implementation and outcomes.

More so, Rasid *et al.* (2016), employed two indicators of dietary quality in a study conducted in Nigeria, using household's coping mechanism and household diet diversity. Two-stage least squares regression to was adopted to correct for the endogeneity of income, In the study, they find the significant roles of income, education, gender of household head, and prices of key

foods. Furthermore, the determination of dietary quality in the country has a strong gender dimension according to their finding. While male education plays a positive role, female education was found to have a substantially stronger influence. Finally, their study recommended that promoting female education and addressing the unique constraints faced by female headed households with respect to diet quality could be a significant policy instrument for government and non-government organizations in addressing food diversity quality in Nigeria.

Nyangweso *et al.,* (2007), in their research paper examined the determinants of dietary diversity among households where systematic random sampling of 300 households were employed. In the research, a dietary diversity index was constructed to capture the nutritional adequacy of households and the data was subjected to multiple regressions to determine the main determinants of dietary diversity. Result of their findings shows that household's income, ethnicity, number of adults, nutrition awareness, type of toilet, savings and educational attainment significantly influenced the households' dietary diversity. The study therefore recommends among others that malnutrition alleviation should be prioritized in the study area.

In addition, Pauzé *et al.* (2016), contributed in their research titled, "the *determinants of diet quality among rural households in Haiti*" where diet quality was assessed using the household dietary diversity score. In the study, the determinants were identified using multiple linear regression analyses. Results revealed that many households consumed cereal, oil/fats, condiments/ beverages, roots/tubers, whereas few households consumed animal-based foods such as meats/organs, dairy products and eggs. At households-level determinants, the number of adults per household, land ownership, practice of livestock rearing, number of meals consumed by children, use of latrines and accessibility of the dwelling location perceived as difficult were all associated with higher household dietary diversity. In summary, the determinants of diet quality were multidimensional and were associated with various factors including socio-economic status, household demographics, and physical environment according to them.

In South Africa, Labadarios (2011), adopted a cross-sectional representative of adults from all specified ages, provinces, geographic localities, and socio-economic strata. The study used dietary data collected by means of a face validated 24 hour recall. The author calculated dietary diversity score by counting each food groups. Dietary intake of lesser than four food was regarded as reflecting poor dietary diversity and poor food intake. The research findings

indicates that provinces with the highest prevalence of poor dietary diversity were Limpopo with 61.8% and the Eastern Cape with 59.6%.

By contrast, it was recorded in the study that only 15.7% of participants from Western Cape had a low score and there were significant differences in DDS by Living Standards Mean (LSM) analysis ($p < 0.05$) with the lowest LSM group having the lowest mean DDS (2.93).He added that the most commonly consumed food groups in the research were cereals/roots; meat/fish; dairy and vegetables other than vitamin A rich eggs, legumes, and vitamin A rich fruit and vegetables were the least consumed and concluded, that the study confirmed that the majority of South Africans consumed a diet low in dietary variety.

Furthermore, Parappurathu *et al.* (2016), in food consumption patterns and dietary diversity, modelled multiple regression analysis on the determinants of dietary diversity which showed that larger households with better educated male heads and higher purchasing power fared well on dietary diversity scores. Also, Public Distribution System (PDS) contributed to enhancement of dietary diversity through an indirect route, as PDS beneficiaries were better able to afford diverse food items. In contrast, low social status in the form of affiliation to scheduled castes/scheduled tribes diminished diversity scores while from policy perspective, they opined that it was important to focus interventions on improving dietary diversity and nutrition security with proper understanding of the socio-economic setting of the target area and its population.

In the same vein, Bhagowalia *et al.* (2012), in factors influencing dietary diversity, identified 3rd-5th quintile, irrigation for at least one crop, number of crops, farm equipment owned, poultry possession and milch buffalo as significant factors influencing the farming households dietary diversity. Also, Burchi (2010), identified possession of nutritional knowledge, health knowledge, age wealth index as the key variables that influenced agricultural household's dietary diversity. Also, Torheim (2004), observed that dietary diversity score had a positive correlation with mean adequacy ratio (MAR). Multivariate analysis approach to the study showed that the most important factors explaining mean adequacy ratio was the number of milk products, vegetables and green leaves consumed, as well as sex and the number of crops produced in the household.

Therefore, in this study, dietary diversity was associated with socioeconomic status, residence and age. In conclusion, he contributed that dietary diversity is useful as an indicator of nutrient adequacy and added that it is important to examine how various food groups contribute to the

nutrient adequacy of the diet in an area. Zakaria and Laribick (2014), in the socio-economic determinants of dietary diversity among women in northern Ghana modelled Probit Regression in analyzing the socioeconomic determinants of dietary diversity. They observed that more than half of the respondents had their dietary diversity score below 5.

In the probit regression analysis, they found variables such as age, marital status, and household membership structure, participation in household decision making, ethnicity and literacy as significant socioeconomic determinants of dietary diversity. The study concluded that, low dietary diversity among mothers, revealed a worrisome and great concerns requiring concerted policy intervention. They recommended as a matter of urgency that public health policy directions have to focus on helping improve dietary diversity among women through public education targeted at influencing eating habits and improving women's active participation in households' decision making processes.

On the other hand, Onianwa (2006), in the analysis of the determinants of food insecurity with severe hunger in selected southern states shows that, for both households with children and households without children, income was a significant predictor of food insecurity with severe hunger. However, the food stamp recipient variable was an equally important predictor of severe hunger and food insecurity among households with children. Also, Magaña-Lemus *et al.* (2016), in the determinants of households hunger said the major determinants include, less-educated household heads, household headed by single, widowed or divorced women, households with disabled household members, households with native language speakers, households with children, as well as rural and lower-income households. The finding suggested that low levels of education, native language speakers, and number of kids are factors associated with higher levels of food insecurity and hunger.

Masset (2011), in a review of hunger indices and methods to monitor country commitment to fighting hunger opined that existing hunger indices were found unsatisfactory in a number of ways: he said they ignored distributional issues, occurrence of food and health shocks and are sometimes based on unreliable data. Masset added that anthropometric measurements emerge as powerful indicators of hunger and are ideal for addressing a number of policy relevant issues. His finding also introduces a conceptual framework for an index measuring to fighting hunger. He therefore concluded that the elements of this hunger index includes political will, anti-hunger policies and programmes.

Akerele *et al.* (2012), suggested in the socioeconomic determinants of protein, calorie consumption and hunger in Nigeria that households' income, dependency ratio, education and gender of household head, among others, were factors that significantly influence per capita daily calorie intake and hunger of households. He added that malnutrition is more of inadequate calorie than protein intake. Muthayya *et al.* (2013), in the global hidden hunger indices and maps: an advocacy tool for action pointed out that a number of countries in sub-Saharan Africa, have alarmingly high level of hidden hunger, with stunting, iron deficiency anemia, and vitamin A deficiency all being highly prevalent.

The total daily adjusted life years rates per 100,000 population, attributed to micronutrient deficiencies, which were generally the highest in sub-Saharan African countries. According to them, the current indices and maps provide crucial data to optimize the prioritization of program assistance addressing global hunger and multiple micronutrient deficiencies. Moreover, the indices and maps serve as a useful advocacy tool in the call for increased commitments to scale up effective nutrition interventions.

Also, a research carried out in Ethiopia estimated the impact of health and nutritional status on the output of cereal growing farmers (Croppenstedt and Muller, 2000). Furthermore, a local study in Ethiopia confirmed that farming households in the youngest age group (15-19) and those in the oldest age group surveyed (45-49) were the most affected by undernutrition (Teller and Yimer, 2015). In Nigeria, Otunaiya and Ibidunni (2014), on the determinants of food intake among farming households observed that about 70% of the farming households were food secured and the probability of food insecurity conditions in households were found to be increased by the household size and dependency ratio while the educational status of household head, farm size, membership of the cooperative society, access to credit and access to food on credit enhance households nutrition.

Adepoju and Adejare (2013), in a study carried out in North-East, South-East and Southwest Geopolitical zones of Nigeria showed that almost half (49.4%) of rural households in the country were food insecure during the post-planting period. In a similar study conducted in Southwest Nigeria by Okunmadewa *et al.* (2005), the extent to which environmental qualities such as pollution (air, water, and soil), access to water supply, and socio-economic characteristics (sex, education, age, income etc.) as they affect cooking and nutrition of elderly farming household

heads was noteworthy to nutritional status. More so, in the analysis of food intake situation among urban households in Lagos state Nigeria, it was observed that there was a decline in food shortage incidence as income increases from 0.41 for the low-income group to 0.20 for the high-income group (Titus and Adetokunbo, 2007).

Arene and Anyaeji (2010), in determinants of food nutrition among households in Nsukka metropolis of Enugu State, Nigeria using expenditure method of estimating food security status found that majority (60%) of the households were malnourished. Similarly, Oluwatayo (2009), using Probit model found out that educational level, age, sex of household head, and income have a positive influence on food security whereas household size has a negative influence on household nutrition security. In Nigeria, the prevalence of malnutrition among rural preschool children and nursing mothers has also been widely reported (Okoruwa,1997).

According to Fakayode *et al.* (2009), in a study carried out in Ekiti State, a southwest state in Nigeria, they found that most of the farming households (87.8%) were food insecure at a different level of food-nutrition insecurity. They added that the belief that majority of households in Nigeria are not faced with serious food insecurity problem is an erroneous one. Also, Adepoju and Olawuyi (2012), in a study in Nigeria concluded that the majority of the households are farmers in the rural areas who are food insecure measuring high on the food insecurity scale. Fakayode *et al.* (2009), was another detailed work on nutrition- insecurity in Nigeria. The studies, using the recommended calorie required, revealed that 36% and 64% of the households were food secure and food insecure respectively. In the study, the Shortfall/Surplus index showed that the food secure households surpassed the recommended calorie intake by 42% while the food insecure households fell short of the recommended calorie intake by 38%.

Furthermore, the study conducted by Adio (2000), on nutrition security status of farming households in Oyo State revealed that food intake was about 97% carbohydrate and about 28% protein (from plant and animal products), which indicates a deficit of 18% and 11% of carbohydrate and protein intake respectively in three years. The situation was interpreted to depict food nutrition insecurity as the general livelihood pattern indicated that farmers have less money to cater for their households thus resulting in them having fewer resources, and health, consuming more of the unbalanced diets and generally remaining in the ultimate vicious cycle of poverty.

Abur (2014), in a study carried out in Benue state of Nigeria found "that households' whose heads had low level of education (30.8%), those having large number of persons per family (34.2%) and those whose heads had low level of income (31.7%) were worse affected by incidence, depth, and severity of nutrition insecurity". More so, Clement (2014) in his study, conducted in Nigeria opined that the trend of food insecurity and malnutrition was very high among the age 40-49 years (27.5%) while the depth and severity were higher (0.24 and 0.41 respectively) among people of age 50 and above. He concluded that households' with low-income, large household size, and poor education were mostly affected by food-nutrition insecurity condition.

In addition, Yusuf *et al.* (2015), observed that gender, years of schooling, respondents marital status, access to extension services, hired labour and type of farming adventure were the determinants of food security in Oyo state, Nigeria. Banwat *et al.* (2012), in his study showed that 66.2% of the North central Nigeria households cultivated most of the food they consumed, while about 43.8% spent between 25 to 50% of their income on nutrition on monthly basis. Ogundari (2013), combined two quantitative indicators of food insecurity defined as food expenditure and dietary diversity .In his study, the determinants of food-poverty reveal that odds of being food insecure relative to completely food secure households decreases with higher income among households' headed by male, and households in the rural areas but it increases with household size, among households headed by farmers and among household that only produce food consumed in the study.

More so, his results of determinants of household demand for dietary diversity shows that dietary diversity increased with increase in household income, assets, educational attainment and household size, among households headed by farmers. Finally, he found that the dietary diversity decreased significantly among educated household heads and households that only purchase food consume in the sample. He concluded that income drives down food insecurity and increases dietary diversity in the study suggests that policies tailor towards higher income is likely to promote nutritional/dietary quality security in the country.

Beyene and Muche (2010), in a study carried out in the rural household of central Ethopia reported that majority (64%) of the household were found to be malnourished. Using logistic regression model, they observed that variables such as age and educational level of household head, off-farm/non-farm income, use of fertilizer, asset possession, farm size cultivated and soil

conservation practices were influencers of households' nutrition. Also, Aidoo *et al.* (2013), found out that farm size, off-farm income, health care provider and credit access were found to have significant and positive effect on household food intake and nutrition in Ghana.

Similarly, Babatunde *et al.* (2007), utilizing recommended calorie approach stated that majority (64%) of the household in Nigeria were food and nutritious incapacitated .They added that household size, income, educational status of household head and amount of food obtained from own production influenced food and nutrition status of the households. Furthermore, Babatunde *et al.* (2011), in a research carried out in Kwara State, Nigeria revealed that 23.6%, 22.0% and 14.2% of children were stunted, underweight and wasted respectively. Significant determinants of child malnutrition were age, education, BMI of mother, calorie intake of the household, availability of clean water and toilet presence in the household.

In Tanzania, Mbwana *et al.* (2016), using multinomial logistic regression observed that determinants of households' dietary diversity were educational status of mother, knowledge/training on nutrition, farm size and distance to source of water. Revealing that rural women empowerment is key in nutrition and food security interventions. Also, Ndobo and Sekhampu (2013), in a study carried out in South Africa reported that food-nutrition insecurity was more prevalent in female-headed household and vulnerability to food insecurity increases with marital status, household size and age of household head whereas it decreases with household income. Finally, Swindale *et al.* (2006), enlisted the following set of 12 food groups to calculate the HDDS: cereals ,fish and seafood, root and tubers ,pulses/legumes/nuts, vegetables, milk and milk products, fruits ,oil/fats, meat, poultry, offal, sugar/honey ,eggs and miscellaneous. They suggested that this food components are good evaluators of nutrition and food security.

2.7.2 Determinants of Households' Obesity,Overweight,Day (s) of Incapacitation and Self-rated Health Status

Determinants of households' health in Africa have been well documented in some literature and these factors are most often than not, location specific (different study areas were found to have different factors as the determinants of overweight, obesity, self-rated and health status). Nwodo *et al.* (2014), in the determinants of underweight, overweight and obesity amongst young adults

in Ota, Nigeria employed anthropometric measurements and WHO cut-offs to categorize the respondents body weights into normal weight, underweight, overweight and obesity. They find out that males respondents were significantly ($p<0.05$) bigger in size (in terms of weight and height) than their females counterparts. According to them, body weight abnormality was higher in females (36.0%) than males (23.7%).

Furthermore, underweight was prevalent (12.9%) amongst females but low (2.6%) in males. The most prevalent abnormality was overweight (19.7% in females; 18.6% in males) whereas obesity was the least (3.4% in females; 2.6% in males). In the study, gender differences appear to influence the body weights of the young adults in Ota, Nigeria. Therefore the study suggests a dual challenge of malnutrition and over-nutrition amongst females. In addition, the prevalence of overweight, obesity and thinness among adolescents in rural and urban areas of Enugu State, Nigeria was studied by Ani *et al.* (2014), who employed anthropometric measurements by using the weight and height of the adolescents to calculate the Body Mass Index (BMI).

The BMI were categorized into obesity, overweight, normal and thinness using the International Obesity Task Force (IOTF) reference and the WHO adult BMI classification for adolescents up to 19 years. The results identified that the prevalence of overweight, obesity and thinness among adolescents were 7.5%. 2.1% and 13.9% respectively. They concluded that there was higher prevalence of obesity among males than females and therefore obesity was observed to be creeping into traditional societies as evident in their findings.

Abdalla *et al.* (2013), in the socio-demographic determinants of overweight and obesity among adults in Sudan, observed the prevalence of overweight and obesity which according to them were 33.7% and 25.6% respectively. Their inferential results showed that there was statistical association between overweight, obesity and sex, age group, marital status, monthly income, education level and family history of obesity were significantly associated with overweight and/or obesity. Furthermore, Bakari (2007), obesity, overweight and underweight in suburban northern Nigeria and concluded that both over-nutrition and under-nutrition are common in these communities with the former being more prevalent. He suggested that concerted efforts should be made to appropriately control the prevalence of overweight and obesity.

More so, Maruf and Udoji (2015), in their study "*the prevalence and socio-demographic determinants of overweight and obesity in a Nigeria*" .Their findings indicates the prevalence of

overweight was higher in males than in females, but the reverse was the case for prevalence of obesity. Also, older age and female sex were reported to be associated with increased risk of overweight and obesity, while working at a skilled occupation was associated with obesity, and tertiary educational attainment was associated with overweight.

In the same vein, Akter *et al.* (2014), in the determinants of overweight and obesity among Bangladeshi diabetic women of reproductive age suggested that BMI was significantly associated with age, income and management of diabetes ($p < 0.05$). Also waist circumference was significantly associated with age, income and management. They concluded by adding that high prevalence of both overweight and obesity exists in diabetic women of reproductive age in Bangladesh and it seems to be associated with increasing age, income, duration of diabetes, and use of oral hypoglycemic agents.

On the other hand, a study by Szwarcwald (2005), on the socio-demographic determinants of self-rated health in Brazil adopted Logistic regression model with age and sex as covariables, and educational level of the head, household assets index, and work-related indicators as measures of socioeconomic status. Besides, the effects of sex and age, with consistently worst health perception (self-rated health) among females and among the eldest, the results showed pronounced socioeconomic inequalities. In the study, factors that contributed most to deterioration of health perception were incomplete education and material hardship; among males, besides material hardship, work related indicators (manual work, unemployment, work retirement or incapable to work) were also important determining factors.

Ichoku *et al.* (2011), opined in the socioeconomic gradients in self-rated health: a developing country case study of Enugu State, Nigeria that self-rated health is a potentially useful indicator of health state for populations in developing countries and that specification of the concentration index detects larger levels of inequality than the standard specification, and thus raises questions for researchers who use results obtained from the instrument for policy advice.

In addition, Alawode and Lawal (2014), observed in income inequality and self-rated health in Nigeria by using self-rated health indicator and their dependent variable modelled Lorenz curve and multinomial logistic regression. The Lorenz curve showed that there is an unequal distribution in income with Gini coefficient of 0.2448 which was significant at 1%. Increase in income and higher level of education increases the likelihood of having good health status

(proxied by self-rated health), while increase in age increases the likelihood of having poor health status. Policy implication of the study was at improving the health status (self-rated health) of rural dwellers which will enable them to attain certain level of health care and education that will invariably allow the farmers to live a socially and economically productive life.

A cross-sectional survey of self-rated health and its determinants in patients with hypertension by Chunhua *et al.* (2015), added that 59.3% of the respondents rated their health status as good, and 41.7% perceived their health status as poor. In terms of levels of blood pressure control, nurse-measured blood pressure showed that 40.2% of the subjects had good control levels, 59.8% for poor control levels and added that there were positive relationships between good self-rated health and controlled blood pressure of hypertensive patients ($p<0.05$). The fitted logistic regression model showed that the determinants of subjects' self-rated health included income of the respondents, duration of hypertension diagnosis, treatment adherence, physical activity and social support.

Maziya-Dixon *et al.* (2004), posited that "the 2003 Nigeria DHS revealed that 38% (more than one-third) of below 5 years children in Nigeria are stunted, 29% of them were underweight while 9.2% wasted". Also, Ene-Obong *et al.* (2001), in the determinants of health and nutritional status of rural Nigerian women, used anthropometry, and observations of clinical signs of malnutrition. They pointed out that better-educated women had higher incomes than those with little or no education. Ajani and Ugwu (2008), opined that adverse health condition parameters in their inefficiency model have the largest positive coefficient which was statistically significant. This suggests that health plays a major role in determining the inefficiency of the farmers.

In addition, Titus *et al.* (2015), on health care access and utilization among rural households in Nigeria opined that 58% of the respondents have access to health care services while about 42.50% properly utilize these services. Adding that 40.5% of them even travel a distance of 5-9 km before accessing medical facilities .They however added that accessibility indicators show unequal access to modern health facilities among the farmers. On the other hand, Omotara *et al.* (2015), opined that the alarming rate of the older populations increase will aggravate the burden on the health resources adding that food intake, no smoking habit, and adequate sleep were positively correlated with healthy aging. They recommended that good health practices and family support should be maintained.

Furthermore, Oluwatayo (2015), revealed that the mean technical efficiency of rural farmers in Southwest Nigeria was 75%, indicating that about 25% of the farmers have the potential to improve their outputs further if there is an upgrade in the health status and production level of the farmers. Also, Riman and Akpan (2012), observed an uneven disparity in the spatial distribution of health facilities of considered respondents with a concentration of health facilities in the urban areas rather than the rural, which eventually contribute to the poor service demand. The studies therefore, recommended among others, a prompt review of the current national revenue distribution formula, with priority given to the Local Government Areas (who are the principal institution responsible for primary health care in Nigeria).

Egbetokun *et al.* (2012), gave the mean technical efficiency of a farmer as 0.56,indicating that, the farmers still have 44% potential to be on the frontier. They added that adverse health, age, household size, educational attainment and year(s) farming have positive effects on the inefficiency of the farmers. Likewise, Ibitoye *et al.* (2015), opined that an increase in socioeconomic status amplified the odds of seeking biomedical treatment, and those in the polygamous family were more likely to seek biomedical health treatment. Those living with chronic conditions had higher odds of seeking biomedical treatment compared to those with no chronic illness. They concluded that since the elderly seem to use biomedical health care, there is a need for the government to ensure that health care services are accessible and affordable for them, most especially for those living with chronic conditions.

Also, Achinihu *et al.* (2016), observed in their study on nutritional assessment of rural farmers; an implication for health and well-being in Imo state, Nigeria. The nutritional status result (BMI) of the farmers' overall index showed that most of the farmers were underweight and pre-obese. They added that the nutritional status of the farmers could pre-dispose them to non-communicable diseases as rural farmers suffering from NCDs have intensive and often health care needs. They recommended that eating of healthy and adequate diet could improve the health and well-being of rural farmers and this must be encouraged by the government of the day. They concluded by saying, nutritional status assessment of rural farmers is important requirement which enables them to perform physically, maintain wellness and fight diseases.

Sekyi and Domanban (2012), in the effects of health care on outpatient utilization and healthcare expenditure in Ghana reported that sex, employment status, age, education, household size, type

of Illness, severity of illness, self-assessed health status, employment and income were significant to health. He concluded that there should be improved healthcare services which will thereby improve health. Etowa *et al.* (2015), used multiple regression model to investigate the health-related determinants of agricultural outcomes among the households observed that age of household head, number of years of farming experience, participated in government agricultural programme (s) in last two years?, amount of loans obtained for farm business in last 2 years , participated in government. Health insurance programme in last 2 years, days of incapacitation, procession of assets and funeral cost incurred on the sick that died were the determinants of health. They recommended among others that, farmers themselves have to take the bull by the horn by giving priority to their health and those of their households.

In the same vein, Ginnis and Foege 1993; Lantz *et al.* 2001; Mokdad *et al.* (1998); Danaei *et.al.* (2009) and Stringhini *et al.* (2010), observed that activity patterns, alcohol, cigarette smoking, alcohol drinking sedentary lifestyle relative body weight, poor diet/physical inactivity, alcohol, overweight/obesity, physical inactivity, health behaviors smoking, diet, alcohol consumption, and physical activities affect household's health. Abdulraheem (2007), on the determinants of health-seeking behaviour among elderly Nigerians contributed that socio-economic indicators and nature of illness were the most pervasive determinants of health care seeking behaviour among the senior citizens while variables such as respondents overriding age and sex, in terms of health-care expenditure, nature of illness and quality of service provided ranked the major determinants of the elders health.

Furthermore, a study conducted in the Southwest Nigeria, selecting two states in Southwest zone by Agulanna *et al,* (2013), on effect of the nutritional status of farmers on their health using Tobit regression model reported that age, distance to the source of refuse disposal, body mass index, years of education and self-medication were factors that significantly influenced frequency of illness in the study area. They also opined that there was a significant relationship between farming households' nutrition and health in the study. All these studies have shown that food intake is a very important dimension of food intake, nutrition and health of farming households. In general, it was observed that farming households' food intake, nutrition and health were mainly determined by various socio-economic, environmental, natural and political factors based on the specific locations and other contributing factors.

Conclusively, in spite of the increasing evidence of the importance and significance of households' food intake, nutrition and health with respect to farming households' income in Nigeria, It could be summarized that empirical evidences from existing literature at most have been largely limited to analysing the nature and determinants of farming household's food intake, nutrition and health and this was with solitary based policies on their respective views and with relatively few or no studies on the factors influencing food intake, nutrition and health in relation to income of the small scale farmers, determinants of the household's food intake as well as linkage between farming households nutrition and health with respect to the effect of some salient socio economic, environmental factors on this key factor variables in the Southwestern Nigeria, this study therefore seeks to fill these identified research gap in the study area for timely policy intervention .

2.8 Chapter Summary

This chapter reviewed the concepts of food and nutrition security (FNS), the theoretical framework for food intake and nutrition security (FNS), health capital theory, demand for health and health investment were the theoretical underpinning base for this study. The study further explored the UNICEF's conceptual framework of under-nutrition and ill health. Furthermore, the chapter explored empirical/ literature review on food intake, nutrition and health in Nigeria and other nations of the world. Determinants of nutrition and health were also discussed in this chapter. The chapter builds upon important work that has been carried out in the preparation of sustainable development on food intake, nutrition, and health by assessing the linkages that exist between food intake, nutrition and health incorporated to positively contribute to the ongoing international debate on sustainable development.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methods that were used for data collection and analyses. The subsequent subsections describe the methods of data collection, validity and reliability test, research instrument, sampling procedure and sample size as well as methods of data analysis.

3.2 Study Area

This research was carried out in the Southwest Nigeria which 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 is bounded on the North by Kwara and Kogi States, in the East by Edo and Delta States, by Republic of Benin in the East and the Atlantic Ocean in the South. It lies between Latitude 4^0 to the South and Latitude 6^0 to the North. It is marked by longitude 6^0 to the East and 4^0 to the West. The geographical location of Southwest Nigeria covers 1014, 271 kilometers square, which is almost 12% of Nigeria's total land area and it is typically made up of rainforest vegetation. The total South West population was 27,581,992 in 2006, out of which above 96% was of the Yoruba tribe (National Population Commission (NPC), 2006). The major occupations of the people include farming, trading, artisans and agricultural products' processors and marketers. Agriculture provides employment for the majority of the people who are engaged in subsistence or commercial livestock and crop production.

Figure 3.1: Map of Nigeria and the Southwest States

Source: Adapted and modified from Faleyimu and Agbeja (2012)

3.3 Method of Data Collection

Primary data were used in this study. These data were collected by administering a structured questionnaire to respondents in the study areas. The data collected include demographics characteristics, housing conditions, environment-related issues, consumption expenditures pattern, cost and food compositions, cost and returns of enterprises, nutrition, and health status. The questions were translated into the local language of the respondents during administration and their response was recorded in English language.

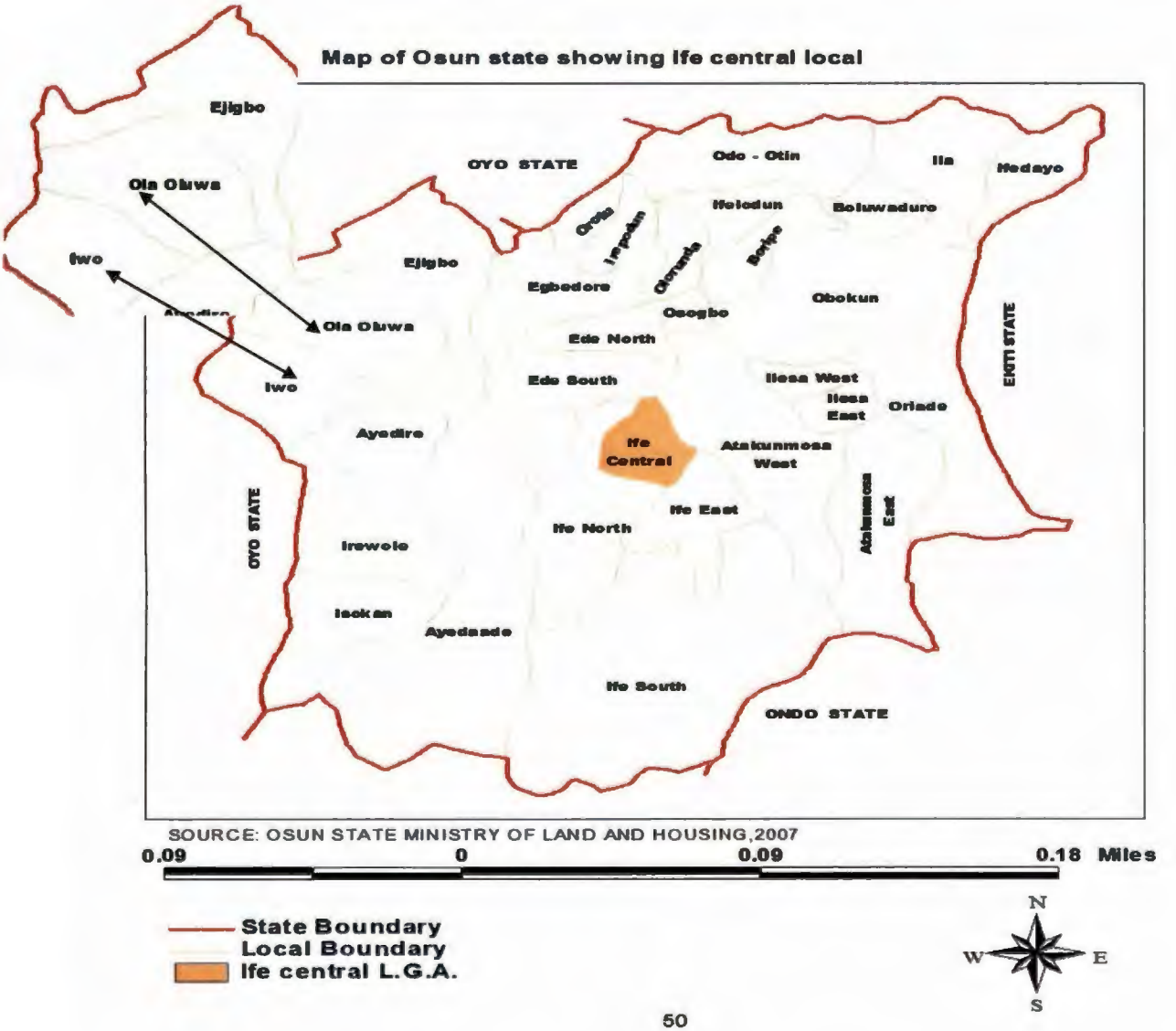

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Figure 3.2: The Map of Osun state Showing the Iwo and Ejigbo Local Government Areas

Source: Adapted and Modified from Fadamiro and Adedeji (2014)

Figure 3.3: Map of Ogun state Showing the Odogbolu and Ijebu Ode Local Government

Source: Adapted and Modified from Google map; www.nigerianmuse.com

Figure 3.4: Oyo state Map Showing Ogo-Oluwa and Iseyin local Government Areas

Source: Adapted and Modified from www. kingstartechsupports.com/idolg

3.4 Research Instrument

The research instrument for this study i.e. the questionnaire was divided into seven sections. Section elicited information on the respondent's socio-economic characteristics. Section (B) elicited information about respondent's health and environmental profile. Section (C) elicited information on food utilization and nutrition while Section (D) requested information about respondent's labour productivity. Section (E) elicited information about respondent's production cost and return, section (F) elicited information on cost implication of health and nutrition and section (G) was on respondent's general view on health, nutrition and production problems.

3.5 Validity and Reliability

To ensure the reliability of the questionnaire, a split half technique was used to determine the reliability of the instrument. A high-reliability coefficient of r=0.81was derived which showed the instrument was consistent and highly reliable.

3.6 Population, Sampling Procedure, and Sample Size

A multi-stage sampling procedure was adopted in the selection of respondents in the study (Table 3.1). 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 last and final stage of sampling was the selection of farming household heads. The samples were representatives, sufficiently robust and satisfactory to give estimates at local government, state and at the regional level. 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). The sample size n and margin of error E are given by :

$$x = Z(^{c}/_{100})^{2}r(100-r) \quad \text{..... (3.1)}$$

$$n = {}^{Nx}/_{((N-1)E^{2}+x)} \quad \text{..... (3.2)}$$

$$E = \text{Sqrt}[{}^{(N-n)x}/_{n(N-1)}] \quad \text{..... (3.3)}$$

where N is the population size, r is the fraction of responses that you are interested in, and $Z(c/100)$ is the critical value for the confidence level c.

Table 3.1: 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**

Source: Authors Computation, 2015

3.7 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.

3.7.1 Descriptive Statistics

Percentages, frequency distributions, mean and graphs (graphical illustrations were used to describe respondents socio-economic characteristics , environmental, health , food and nutrition profile and their households' food problem coping methods. SPSS version 22 software was used for descriptive analyses.

3.7.2 Poisson Regression Model (PRM) of Correlates of Dietary Diversity

Poisson regression model was used to analyze the factors influencing farming household's nutrition status. This is due to fact that the dependent variable in this case is a count variable which was the dietary diversity score of the rural farming households (the qualitative one day recall of all the actual number of foods items consumed out of the 12 food group by each respondent). Areal *et al.* (2008) opined that for most count data analyses, Poisson regression model is normally the first step in this case. Poisson Regression model rests on the assumption that the dependent variable y given a vector of predictor variables x has a Poisson distribution.

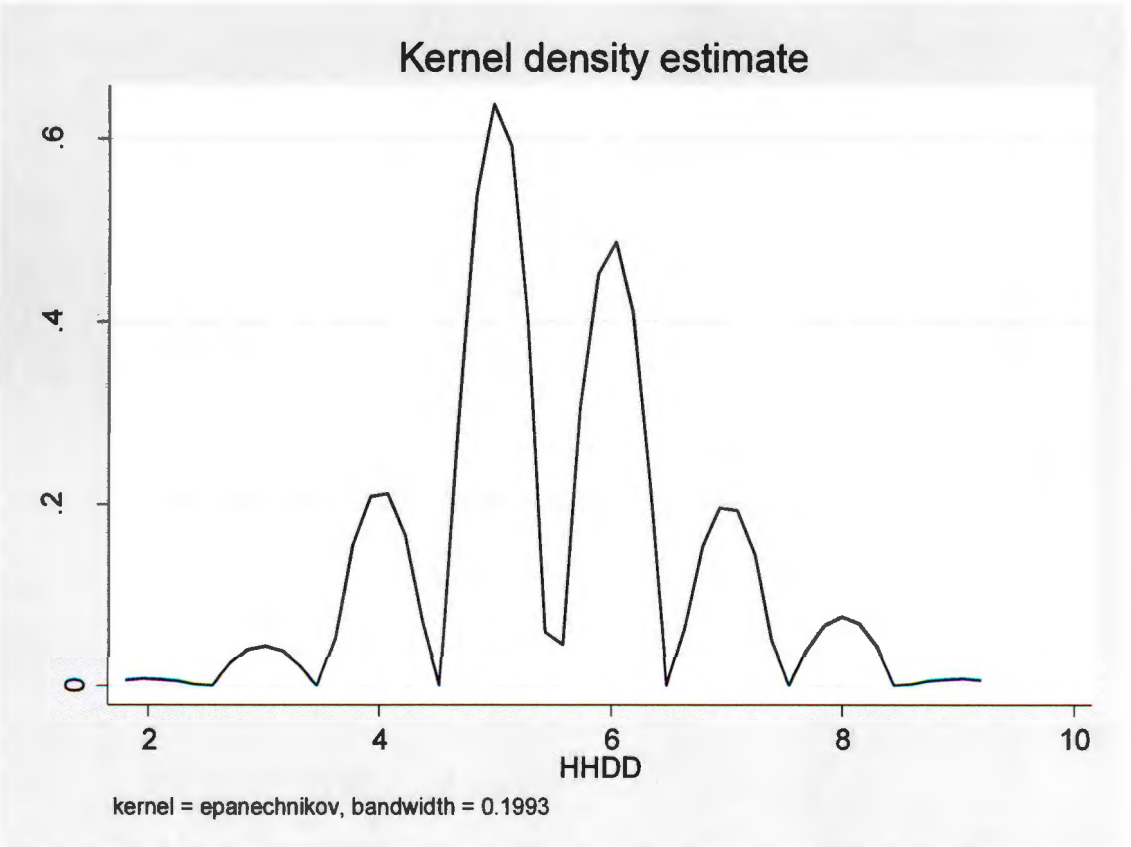

Figure 3.5: Kernel Density Graph of Respondents' Household Dietary Diversity Score

Furthermore, Winkelmann and Zimmermann (1995), pointed out that "the log-linear regression model is responsible for the non-negative constraint imposed on the exogenous variable by Poisson". Poisson distribution is frequently used to model data on counts of various kinds, especially in situations where there is no natural "denominator", and thus no upper bound or limit on how large an observed count can be. This is opposed to the Binomial distribution which focuses on observed proportions (Wawire, 2013). Firstly, the model has a minimum value of zero, it will not predict negative values. This makes it ideal for a distribution where the mean or the most typical value is close to zero. Secondly, it is a primarily skewed model; meaning, that it is data characterized with a long 'right tail'.

Therefore, in the specification of the Poisson model, it should be noted that a random variable Y is said to have a Poisson distribution with parameter μ if it has integer values y = 0, 1, 2, 3, 4 … with probability

$$\Pr\{Y = y\} = \frac{e^{-\mu}\mu^{y}}{y!} \text{ for} \mu > 0 \quad \text{.....(3.4)}$$

The model takes the form of

$$lnY_i = \alpha + \beta_j \sum_{j=1}^{k} X_k \quad \text{.....(3.5)}$$

Due to the assumption that the mean and variance of a Poisson distribution are meant to be the same, the conventional assumption of homoscedasticity can no longer hold. The analysis was therefore done with the Maximum Likelihood Estimation (MLE). The likelihood function for *n* independent Poisson observations can be stated thus:

$$Log\ L(\beta) = \sum_{i=1}^{k} y_i ln(\mu_i) - \mu_i - \log(y_i!) \quad \text{.....(3.6)}$$

The goodness of fit for the model should, therefore, be judged by the deviance goodness of fit which can be computed as:

$$Deviance = 2\sum_{i=1}^{n} y_i ln\left[\frac{y_i}{\mu_i}\right] - (y_i - \mu_i) \quad \text{.....(3.7)}$$

Where n is defined as the number of observations recorded in the study. If the value is statistically significant ($p<0.05$), other covariates should be added in order to get a Poisson distribution since the null hypothesis indicating that the distribution is Poisson had been rejected.

Alternatively, other models such as Negative Binomial should be used.

Table 3.2: Variable used as Correlates of Dietary Diversity in the Poisson Regression

Independent Variable	Description	Expected Sign
Age of the households' head	Number of Years (Continuous)	+
Households Size	Number of Members of the Household (Continuous)	+/-
Household Heads' Marital status	Dummy;1 if Married,0 otherwise	+/-
Total Revenue	Total value in Naira (Continuous)	+
Households' Head Education	Number of Educational Years (Continuous)	+
Nutritional knowledge (self-rated)	Dummy, 1 if yes, 0 if otherwise	+
Households Dependency Ratio	The ratio of the dependent population to the total productive population within the households (Continuous)	-
Households Food Security Level	Dummy, 1 if secured, 0 otherwise	+
Possession of Means of Transport	Dummy, 1 if yes, 0 if otherwise	+
Ownership of Agricultural Land	1=Leased,0=Otherwise	+/-
Total Cost of Feeding	Total value in Naira (Continuous)	-
Eating Outside Family Food	Dummy, 1 if yes, 0 if otherwise	-
Financial Source	1 = personal saving ,0= Otherwise	+

Source: Authors Computation

3.7.3 Composite Indices of Food Intakes and Its Correlates

Principal Components Analysis (PCA) was used to compute composite indices of food intakes from the different food classes that the questionnaire probed into. This approach helps capture the different dimensions of food that were consumed by households in a composite manner bearing in mind the likely correlation that could exist among some food classes . The selection of the indicator was guided by insights drawn from the nutrition literature as well as availability of data. All the major dimensions of nutrition (body's dietary needs) have been represented by at least one indicator. Following the identification of the indicators as explained above, the PCA was employed. The PCA is a data reduction method used to re-express multivariate data in fewer dimensions. The procedure transforms the selected indicators into smaller components that capture most of the information (variation) in the original indicators. A detailed account of the use of PCA for constructing socio-economic status indices has been outlined in Vyas and Kumaranayake (2006).

While this technique has been widely applied by the World Food Program for generating national food index, it has also been used by Qureshi (2007), and Demeke *et al.* (2011), for constructing households' food intake index. Application of PCA on the selected indicators would yield a series of components with the first component explaining the largest variance in the data and subsequent components explaining additional but smaller proportion of the variance in the original variables. Using the factor scores from the first principal components as weights, a dependent variable can then be constructed for each household, which has a zero-mean and variance equal to one. It is this dependent variable that can be regarded as households' food nutrition index (Vyas and Kumaranayake, 2006). Accordingly, our dependent variable (PCA-based household food nutrition index) was generated.

The variables selected for constructing the food index were the 12 food categories stated in the questionnaire which were coded as 1 if yes and 0 otherwise, these major food groups according to the FAO cereals, fish and sea food, root and tubers, pulses/legumes/nuts, vegetables, milk and milk products, fruits, oil/fats, meat, poultry and offal, sugar/honey eggs, miscellaneous. In order to provide a simple measure of the aggregation of the food component into food index (which on STATA was done with the command, pca , cereals, fish and sea food, root and tubers et.c after which the command Predict food index was used. this study followed the lead of Rahman (2009), and the index was computed as follows:

$$\textit{FOOD index} = \emptyset_i + \beta_i \sum_{n=1}^{c} N_{ir} + z_v \quad \ldots\ldots 3.8$$

Where food index is the Composite food Index, $\emptyset_i$, β_i represents that parameters to be estimated. However, N_{ir} represents the vector of independent variables coded as cereals (yes=1,0 otherwise), fish and sea food (yes=1,0 otherwise) , root and tubers (yes=1,0 otherwise), pulses/legumes/nuts (yes=1,0 otherwise) , vegetables (yes=1,0 otherwise) , milk and milk products (yes=1,0 otherwise), fruits (yes=1,0 otherwise), oil/fats (yes=1,0 otherwise), meat (yes=1,0 otherwise), poultry and offal (yes=1,0 otherwise) , sugar/honey eggs (yes=1,0 otherwise) , miscellaneous (yes=1, 0 otherwise) and z_v represents the error term. Using the index generated by PCA as the dependent variable, the Ordinary Least Square regression model which was estimated as follows: Ordinary Least Square regression model was employed for the composite indices of food intakes and its Correlates i.e proxy for food intake. The Ordinary

Least Square regression model is stated as:

$$Y = f(X1, X2, X3, X4, X5, X6 \ldots \ldots X10, ei) \ldots \ldots (3.9)$$

Y is the generated food index of respondents while the independent variables that were included are presented in table 3.3 while ei represents the error term.

Table 3.3: Variable used to analyze the Determinants of Composite Nutrition Indices

Independent Variable	Description	Expected Sign
Educational Status of the Head	Number of educational years (Continuous)	+
Type of Agriculture Practiced	1= crop planting/forestry,0=Otherwise	+/-
Household Heads' Age	Number of years (Continuous)	+/-
Tribe of the Head	1=Yoruba,0=Otherwise	+/-
Working Class Number	The total number productive population within the households (Continuous)	+/-
Total Cost of Feeding	Total value in Naira (Continuous)	+/-
Total Revenue	Total value in Naira (Continuous)	+/-
Net Returns	Total value in Naira (Continuous)	+/-
Households' Dependency Ratio	The ratio of the dependent population to the total productive population within the households (Continuous)	+/-
Possession of Means of Transport	Dummy, 1 if Yes , 0 if otherwise	-
Financial Source	Dummy,1 personal savings, 0 otherwise	+/-
Households' Water Purity (self-rated)	1 =Yes, 0= otherwise	+/-
Households Other Source of Income	Dummy, 1 if Yes , 0 if otherwise	+/-
Total Cost on Health	Total value in Naira (Continuous)	+/-
Yield	In kilogram per hectares (Continuous)	+

Source: Authors Computation

3.7.4 Correlates of Hunger Severity Indices

The variables selected for constructing the hunger severity index were the 7 coping options categories (sales of assets, borrowing, drawing savings, reduction of production, adjustment of food intake, remittance and scavenging) highlighted in the questionnaire and described in Table 4.15. The variables selected for constructing the food index were coded as 1 if yes and 0 otherwise, In order to provide a simple measure of the aggregation of these coping mechanism into Hunger severity index (which on STATA was done with the command, pca sales of assets, borrowing, drawing savings, reduction of production, adjustment of food intake, remittance and scavenging , after which the command Predict food index was used. this study followed the lead of Rahman (2009), and the index was computed as follows:

The index was computed as follows:

$$HUNGER\ index = D_i + \beta_i \sum_{n=1}^{c} X_{ir} + z_0 \ldots\ldots 3.10$$

Where hunger index is the Composite food Index, D_i and β_i represents the parameters to be estimated. However, X_{ir} represents the vector of independent variables coded as sales of assets (yes=1,0 otherwise), borrowing (yes=1,0 otherwise) , drawing savings (yes=1,0 otherwise), reduction of production (yes=1,0 otherwise) , adjustment of food intake (yes=1,0 otherwise), remittance(yes=1,0 otherwise) and scavenging (yes=1,0 otherwise) and z_0 represents the error term. Using the index generated by PCA as the dependent variable, the Ordinary Least Square regression model which was estimated as follows:

$$Z = f(X1, X2, X3, X4, X5, X6 \ldots\ldots X12, qi) \ldots\ldots (3.11)$$

Z is the generated food index of respondents while the independent variables that were included are presented in table 3.4 while qi represents the error term.

Table 3.4: Determinants of Hunger Severity Indices

Independent Variable	Description	Expected Sign
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	+/-
Number of Households Working class	Number of Members (Continuous)	+
Household Heads' Age	Number of Years (Continuous)	+/-
Tribe of the Head	1= Yoruba ,0 = others	+/-
Year of Education of the head	Number of Educational Years (Continuous)	-
Alcoholism Habit	Dummy, 1 if yes, 0 if otherwise	-
Existence of Environmental Problem	Dummy, 1 if yes, 0 if otherwise	-
Total Cost of Health	Total value in Naira (Continuous)	-
Total Farm Revenue	Total value in Naira (Continuous)	+
Households Water Purity (Self-rated)	Dummy, 1 if yes, 0 if otherwise	+
Farming Experience	Years of farming	+
Eating Outside Family Food plan	Dummy, 1 if yes, 0 if otherwise	-
Knowledge of Nutrition	Dummy, 1 if yes, 0 if otherwise	+

Source: Authors Computation

3.7.5 Logistic Regression Model (LRM) of the Effect of Farming Households' Nutrition on Self-Rated Health

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

$$Yi = \beta 0 + \beta 1X1 + \beta 2X2 \ldots. + \beta nXn \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.12)$$

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. This method allows for maximum likelihood even when there is a single response to the category, it reduces the amount of computation required and directly estimates the probability of an event occurring, hence considered commendable for this study. In addition, it was necessary to create dummy variables to use the selected socio-economic, nutritional, and environmental and health and enabling variables of this study in the logistic regression model.

Table 3.5: Variables Used to Analyze Effect of Farming Households Nutrition on Self-Rated Health

Independent Variable	Description	Expected Sign
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	

Source: Authors Computation

3.7.6. Two-Stage Probit Regression Model (2SPRM) of the Linkage between Farming Households Nutrition and Health

Analyzing the effect of farming households' nutrition on health in the study area requires serious econometric decisions and choices are to be made based on some conventional expectations. Probit regression and or Logit regression are ideal for such modeling. However, Two Stage Probit Regression gave the best fit for this objective. The correct method is to adopt simultaneous equation related model and estimate it by a two stage due to the number of endogenous variables, for this research work, Two Stage Probit Regression was employed to achieve objective four.

Two-stage Probit (2SPR) regression was used due to the dichotomous nature of the dependent variable (Health status) (Gujarati, 2004). A supposed variable that can influence uptake of health status (Gujarati, 1995) Probit model generally specifies the probability of observing a value of equation 3.13 (Gujarati, 2004) below:

$$\Pr(U_i = 0)/Z_I, \propto) = 1 - f(-Z_i' \propto) \ldots \quad (3.13)$$

where f is defined as a continuous and consistently increasing function that takes a real value and returns a value which ranges from zero to one. However, the choice of the function f determines the type of binary model which follows thus:

$$\Pr(U_i = 0/Z_I, \propto) = f(-Z_i' \propto) \ldots \quad (3.14)$$

Given such a model specification, the parameters of this model can be estimated using the method of Maximum Likelihood Estimate (MLE) which is stated below, therefore, specifying the dependent variable (Ui) as 1 or 0 otherwise implies that the expected value of Ui is simply the probability that Ui =1

$$\frac{E(U_i)}{Z_i} \propto = 1.\Pr\left(U_i = \frac{1}{Z_{i,\propto}}\right) + 0.5\Pr\left(U_i = \frac{0}{Z_i}, \propto\right) = \Pr\left(U_i = \frac{1}{Z_i}, \propto\right) \ldots \quad (3.15)$$

Estimated Probit model applied is of the form:

$$\Pr\left(U_i = \frac{1}{Z_i}, \propto\right) = 1 - \emptyset(-Z_i' \propto) = \emptyset(-Z_i' \propto) \ldots \quad (3.16)$$

where is $\emptyset$ the cumulative density function of the standard normal distribution

$$U_i = \acute{\eta} + \alpha_{im} \sum_{m-1}^{24} Z_{im} + \rho N_i + e_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.17)$$

Ui is the health status variable with value 1 if respondents BMI falls within the Normal /healthy category (BMI 18.5 – 24.9 kg/m²) and 0 otherwise. Zi represents the independent variables which were stated in Table 3.8 and ei is the error term. and ρ are the parameters to be estimated in this analysis. Finally, the nutrition status in dummy form (where the re-categorized form of dietary diversity scores was with value 1 if respondents nutrition status is nourished (≥ 6 food intake) and 0 otherwise. The model is specified as:

$$N_i = \sigma + X_j \sum_{j=1}^{3} Iy + v_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.18)$$

Table 3.6: Independent Variables, their Description and *priori* Expectation Signs of 2 Stage Probit Model Analysis of the Effect of Farming Households Nutrition on Health

Independent Variable	Description	Expected Sign
Nutrition Status	Dummy; 1 if nourished,0 if otherwise	+
Households' Head Gender	Dummy;1 if head is male and 0 if otherwise	+/-
Age of Households' Head	Number of years (Continuous)	+
Education Status	Number of years of education (Continuous)	+/-
Primary Occupation	1=Crop planting/forestry,0 otherwise	-
Health Care Service	Dummy; 1 Private hospital, 0 if otherwise	+
Type of Toilet	Dummy; 1 Water closet, 0 if otherwise	-
Nutritional Knowledge	Dummy, 1 if yes, 0 if otherwise	+
Farm Distance	Kilometers (Continuous)	-
Possession of Electricity	Dummy, 1 if yes, 0 if otherwise	+/-
Alcoholic Habit	Dummy, 1 if yes, 0 if otherwise	-
Food Security Status	Dummy, 1 if yes, 0 if otherwise	+
Type of Labour Used	1=Self, 0= Otherwise	+
Wealth Index Variables		
Total Cost	Total value in Naira (Continuous)	
Possession of Transportation means	Dummy, 1 if yes, 0 if otherwise	
Farm Gross Total Revenue	Total Value in Naira (Continuous)	

Source: Authors Computation

3.7.7 Poisson Regression Model (PRM) of the effect of Nutrition on Number of 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).

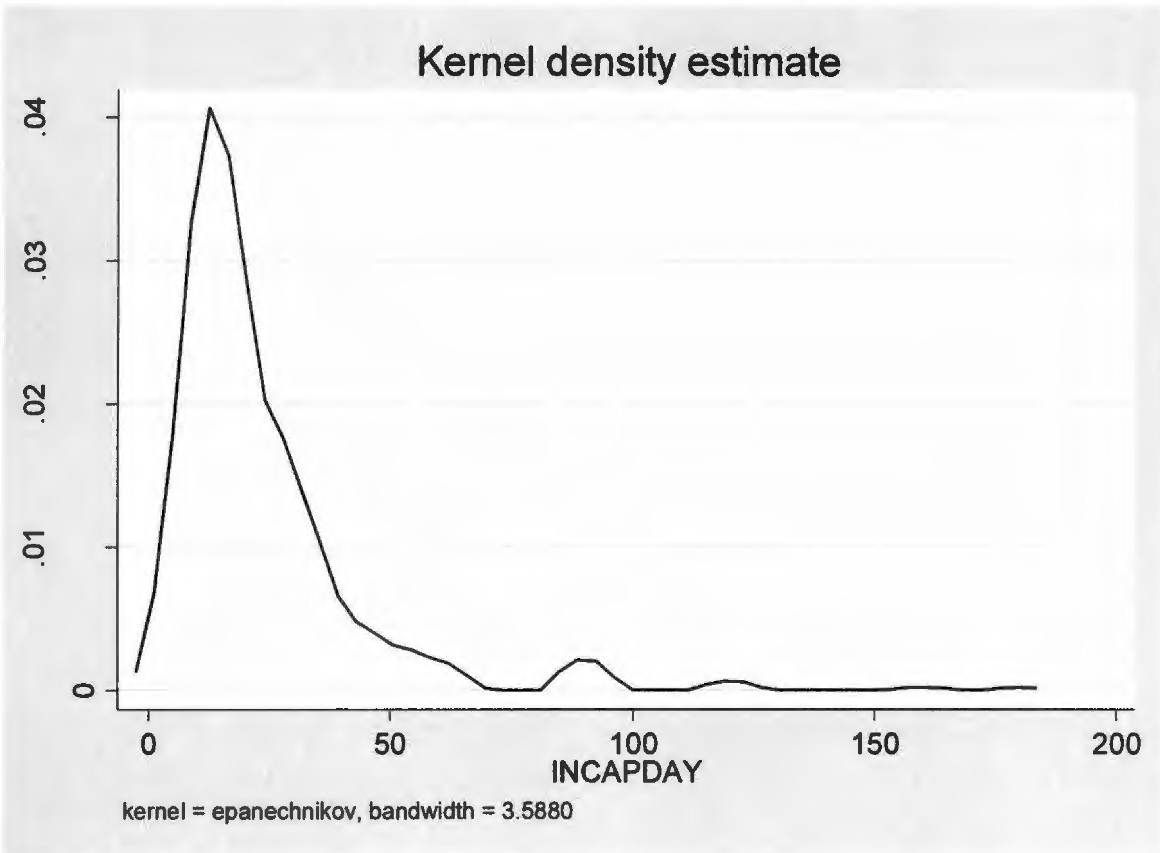

Figure 3.6: Kernel Density Graph of Respondents Households' Day(s) of Incapacitation

The count index (days of incapacitation) is discrete and small and hence the appropriateness of the Poisson maximum likelihood regression (Equation 3.19).The model takes the form of

$$Dk = \beta 0 + \beta 1Ak + \beta 2Ck + vk \text{ .... } (3.19)$$

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

Ak =Socioeconomic characteristics of the respondents e.g gender, marital status, household size

Ck =Nutritional components such as vegetable, cereal, legume, fruits etc (see Table 3.7)

Vk = Error Term.

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 (Lord *et al.*, 2005; Cameron and Trivedi, 1998).Poisson regression uses Maximum Likelihood Estimation (MLE) due to violation of homoscedasticity assumption.Also,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 3.7: Variable Used for Poisson Regression of Effect of Farming Households' Nutrition Days Incapacitated

Independent Variable	Description	Expected Sign
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)	

Source: Authors Computation

3.8 Ethical Considerations

Ethical considerations were diligently applied to all respondents irrespective of gender, sex, religion or age. The privacy and confidentiality of information of respondents were highly respected and participants were guided during the survey. Equal respect and standard

measurement and treatment to every respondent were adhered to. Permission and consent were obtained at every level and stage of the survey process from respondents before the start of the interviews. Questions and interactions focused largely on the objectives of the study.

3.9 Limitation of the Study

- Lack of proper record keeping by the respondents was a great challenge in the course of this research as majority wholly rely on memory recall so, in order to minimize error, information on relevant variables were strictly used in this study.

- The problem of generalizability of this work; large randomly sampled size was used, therefore making the data representatives and sufficiently robust to give estimates at local government, state, regional, and national level. Therefore drawn sample were sufficient to reach a general conclusion about the entire population of the study.

- Ebola fear and stigma was a real threat during the data capturing period as the majority of this farmers were a bit restrained to come close to us for information especially on their weight and height (for BMI).The problem was overcome by persuading them and also using hand gloves in case of touch during measurement.

- The problem of finance, ethic and time were also major constraints to this research. However, a financial assistant from NWU, people who believed in my dream, Gods wisdom and more time was devoted to data collection than budgeted period in the research time frame.

- Finally, in spite of these aforementioned limitations, the research outcome is worthwhile and reliable.

3.10 Chapter Summary

The chapter explained the quantitative nature of the study, the methodology adopted in the study, study location and category of respondents (farming households') involved. It explained the sample size, the data collection instruments, validity and reliability and how data was collected.

As a quantitative method of research, use of statistical measuring tool (descriptive statistics; anthropometric measures of food intake, nutrition and health namely; households' dietary diversity scores, farming households coping mechanism ,body mass index ,self-rated health and day(s) of incapacitation were applied. Also, the fitted models for the inferential statistics; Principal Component Analysis, Poisson regression, Logistic regression, Negative Binomial Regression and Two-Stage Probit regression models were explained in this chapter. The next chapter covers all the descriptive findings of this research and their respective discussion.

CHAPTER FOUR

SOCIO-ECONOMIC CHARACTERISTICS OF FARMING HOUSEHOLDS', FOOD INTAKE, NUTRITION, AND HEALTH STATUS

4.1 Empirical Results and Discussion

This chapter presents the results of the descriptive analysis results across the selected states. The chapter also presents the results of the assessment of food intake, nutrition and health status of farmers in the research using anthropometric measure i.e body mass index (BMI) as well as self-rated health and day (s) of incapacitation to sickness approach for measuring the respondents' health. Also, households' dietary diversity score (HDDS) and coping option strategy were employed for nutritional measurement in this chapter. Finally, this chapter elucidates the various annual income, nutrition (food intake) and health cost categories of respondents by presenting a cost arithmetic table.

4.2 Socio-Economic Characteristics of Respondents across the Selected States

4.2.1 Age of Respondents

The distribution of respondent according to age groups in the selected states is presented in table 4.1. The results reveal that majority of the respondent fall into the age intervals of 40-60 years with 58.90%, 54.20% and 54.20% in Oyo, Ogun and Osun states, respectively. Also, the average age of households' head across the selected states and their standard deviation (in parenthesis) were 54.6 years (11.30), 51.0 years (11.840) and 53.8 years (11.18) in Oyo, Ogun and Osun states, respectively. According to Muchara (2010), the age of the household's head is highly important because it reveals whether the households benefit from the experience or has to base its decisions on the risk of taking advice from other farmers.

The study indicates that farming households in Southwest Nigeria were ageing as evidenced through the highest mean age of 54.6 years in Oyo state, which confirms previous findings (Olofin and Bababatunde, 2007; Oriola, 2009; Agulanna *et al.*, 2013; Otunaiya, 2014 and Oluwatayo , 2015). Also, Olatunji *et al.* (2012), which opined that well able-bodied people tend

to migrate to urban areas in order to seek white collar jobs or pursue some form of higher education which invariably pose a great danger on farm labour productivity among the older aged farming categories. This could be the reason why hired labour was not the major source of labour used as indicated in Table 4.7. The consequences of lack of young people in farming can be detrimental for agricultural sustainability in Nigeria where the majority of the current small-scale farmers are ageing already (Oyekale and Otuwehinmi, 2012).

Table 4.1: Respondents Distribution According to Age across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Age	Freq	%	Freq	%	Freq	%	Freq	%
21-40	26	14.40	28	23.30	19	15.80	73	17.38
41-60	106	58.90	65	54.20	65	54.20	236	56.19
61-80	48	26.70	27	22.50	36	30.00	111	26.43
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=54.6	SD=11.30	$\bar{X}$ = 51.0	SD=11.84	$\bar{X}$=53.8	SD=11.18	$\bar{X}$=53	SD=11.44

Source: Field Survey 2015

4.2.2 Distribution of Respondents According to Gender

Table 4.2 shows that 82.20%, 80.80% and 80.00% of the respondents were male in Oyo, Ogun, and Osun respectively. This finding is in line with the traditional belief that farming is predominantly a male oriented and dominated enterprise in Southwest Nigeria while women are mostly known to be involved in processing and marketing of farm produce. This is supported by the report of Ajani and Ashagidigbi (2008), in Ondo state, which showed that majority of the farmers were male.

Table 4.2: Sex Distribution of Respondents across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Gender	Freq	%	Freq	%	Freq	%	Freq	%
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
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.2.3 Distribution of Respondents According to Marital Status

The result shows that majority of the respondents representing 77.20%, 68.30%, and 76.70% are married in Oyo ,Ogun and Osun states respectively while 12.20%, 19.20% and 10.80% of the respondents are single. This can positively influence farming households' nutrition, health and

hence agricultural outcomes as the wife(s) and children will help in cooking activities thereby enhancing the farmer's devotion to his farming activities. The family member the wife and the children can also join and assist on farm, thereby serving as a good source of labour. This confirms earlier findings by various researchers such as Otunaiya and Ibidunni (2014); Oyekale (2014) and Titus *et al.* (2015), that agriculture is primarily practiced by married and old farmers in the Southwest Nigeria due to the rural-urban migration of the youths.

Table 4.3: Distribution of Respondents by their Marital Status in the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Marital Status	Freq	%	Freq	%	Freq	%	Freq	%
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
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.2.4 Respondents Household Size

Table 4.4 shows the distribution of household size across the selected states. The result indicates that a larger percentage of the respondents that is 48.30%, 40.80%, and 43.30% in Oyo, Ogun and Osun respectively have less than 10 household members. The mean household size of 6.21 (which could be interpreted as 7 since we are dealing with human being) across the three states appears large considering the farming system and income of these rural farmers. Although, large household size could be said to be based on a personal view of interest as an increase in households size increases expenditure and this, in turn, decreases farmers' income (Ali and Ahmad, 2013). Large household size could lead to correspondingly poor food intake and health in the study area. Also, FAO (2014), opined that larger household size exacerbates poverty levels.

Table 4.4: Distribution of Respondents by Household Size across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
House Size	Freq	%	Freq	%	Freq	%	Freq	%
1-5	71.00	39.40	62.00	51.70	51.00	42.50	184	43.81
6-10	87.00	48.30	49.00	40.80	52.00	43.30	188	44.76
11-15	19.00	10.60	7.00	5.80	12.00	10.00	38	9.05
16-20	3.00	1.70	2.00	1.70	2.00	1.70	7.00	1.67
21-25	0.00	0.00	0.00	0.00	3.00	2.50	3.00	0.71
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=6.40	SD=0.71	$\bar{X}$=5.64	SD=0.68	$\bar{X}$=6.63	SD=0.83	$\bar{X}$=6.21	SD=0.74

Source: Field Survey 2015

4.2.5 Educational Attainments of the Respondents

Table 4.5 presents the educational status of the farming households heads across the selected states. It shows that 45.00%, 49.17% and 34.20% from Oyo state, Ogun state, and Osun states respectively have secondary education. Mean years of education are 8.64 years in Oyo state,10.28 years in Ogun state and 9.09 years of education in Osun state. The implication of these results is that higher number of educational years could have a positive influence on the ability of the farmers to know their nutrition composition of food and the need for diversity. It can also enhance their knowledge of the association between nutrition and health (Acker and Gasperini, 2009; Zuckerman, 2002).

Table 4.5:Distribution of Respondents' Educational Attainments across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Educational Status	Freq	%	Freq	%	Freq	%	Freq	%
No Education	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
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=8.64	SD = 4.6	$\bar{X}$=10.2	SD =5.1	$\bar{X}$=9.0	SD=4.7	$\bar{X}$=9.2	4.83

Source: Field Survey 2015

4.2.6 Respondents' Distribution According to Land Ownership Pattern

Land ownership pattern as shown in table 4.6 shows that majority of the farmers across the selected states own land through inheritance with 70% in Oyo state, 65% in Ogun state and 74.20% in Osun state, while other identified land tenure systems in the study areas were lease

and purchase. Land tenure by inheritance is often characterized by land fragmentation; this will, in turn, lead to low output due to diseconomies of scale. This might in the long-run affect farmers' nutrition and health.

Table 4.6: Distribution of Respondents According to Means of Land Ownership in the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Land Ownership	Freq	%	Freq	%	Freq	%	Freq	%
Leased	18	10.00	23.00	19.20	18	15.00	59	13.33
Purchased	36	20.00	19.00	15.80	13	10.80	68	16.19
Inherited	126	70.00	78.00	65.00	89	74.20	293	69.76
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.2.7 Respondents' Source of Labour across the Selected States

Table 4.7 presents respondents sources of labour across the selected states. The most used source of labour in the states was a combination of self, family and hired labour with 32.80%, 35.00% and 42.50% in Oyo state, Ogun state, and Osun state respectively. It is imperative to say the combination of hired, self and family labour can enhance food production which may, in turn, enable farming households to have better nutrition for better health. This is in consonance with Omonona (2009), who opined that in the absence of perfect labour market, households' composition is an important determinant of farm labour use.

Table 4.7: Distribution of Respondents According to Major Source(s) of Labour

	Oyo State		Ogun State		Osun State		Study Area	
Labour Type	Freq	%	Freq	%	Freq	%	Freq	%
Self	24	13.30	21	17.50	14	11.70	59	14.05
Family	6	3.30	6	5.00	3	2.50	15	3.57
Hired	45	25.00	28	23.30	26	21.70	99	23.57
Self &Family	46	25.60	23	19.20	26	21.70	95	22.62
Combination the of all Labour type	59	32.80	42	35.00	51	42.50	152	36.19
Total	180	100.0	120	100.0	120	100.0	420	100

Source: Field Survey 2015

4.2.8 Respondents' Farm Size

Distribution of respondents by the size of their farms is presented in Table 4.8. The result reveals that majority of these respondents {96.67%} cultivate less than 4ha in Oyo state and Ogun state with a mean of 3.18 and 3.48 farm size respectively. Also, 91.67% of the respondents in Osun state cultivates less than 4ha with an average farm size of 2.32ha.This indicates that most of the respondents in the study areas are small scale farmers. This is actually in line with the finding of Hoddinott and Yohannes (2002);Hatloy *et al.* (2000), who opined that Nigeria's food security depends mainly on food production by small-scale farmers.

Table 4.8: Distribution of Respondents by Farm size across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Farm{Ha}	Freq	%	Freq	%	Freq	%	Freq	%
≤ 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
9- 12	2	1.11	1	0.80	1	0.80	4	0.95
≥ 13	0	0.00	1	0.80	0	0.00	1	0.24
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=3.18	SD=13.34	$\bar{X}$=3.48	SD=16.30	$\bar{X}$=2.32	SD=1.93	$\bar{X}$ =2.99	S.D =10.52

Source: Field Survey 2015

4.2.9 Years of Farming Experience of Respondents across the Selected States

The distribution of respondents according to year of farming experience is presented in Table 4.9 The results reveal that 40.00%, 39.20 and 35.80% of the respondents in Oyo, Ogun, and Osun states respectively have less than 10 years of experience in farming with a mean of 17.80 years, 17.40 years and 19.57 years in Oyo state, Ogun state, and Osun states respectively. This shows that farming households' has been into the farming enterprise for quite a number of years which would have helped them acquire a better idea of the season, crops, and mastery of efficient farming practices and income generation which might lead to better nutrition and health.

Table 4.9: Distribution of Respondents According to Years of Farming Experience

	Oyo State		Ogun State		Osun State		Study Area	
Farming Experience	Freq	%	Freq	%	Freq	%	Freq	%
≤ 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
≥ 51	1	0.60	1	0.80	1	0.80	03	0.71
Total	180	100.0	120	100.0	120	100.0	420	100
	$\bar{X}$=17.80	SD=11.94	$\bar{X}$=17.40	SD=11.2	$\bar{X}$=19.57	SD=13.04	$\bar{X}$=18.26	SD =12.06

Source: Field Survey 2015

4.2.10 Distribution of Respondents According to Tribes

Table 4.10 shows the distribution of the farmers according to tribes. Yoruba tribe dominates the three states with 84.88%, 81.67% and 85.83% in Oyo, Ogun and Osun states respectively. Other tribes that are present in the study area are Igbo and Hausa. Tribal differences can have some effects on nutrition and health as various ethnic groups in Nigeria have their favourite food and cultural beliefs about food and nutrition, which could also reflect on their health status.

Table 4.10: Distribution of Respondents According to their Tribe

	Oyo State		Ogun State		Osun State		Study Area	
Tribe	Freq	%	Freq	%	Freq	%	Freq	%
Yoruba	152	84.44	98	81.67	103	85.83	353	84.05
Igbo	16	8.89	9	7.50	7	5.83	32	7.62
Hausa	12	6.67	13	10.83	10	8.33	35	8.33
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.2.11 Respondents Access to Credit across the selected States

Distribution of respondents according to credit accessibility is shown in Table 4.11.The result shows that most of the respondents across the selected states Oyo state (56.11%), Ogun State (50.84%) and Osun state (54.17%) were without access to credit. This shows that larger percentages of the respondents are still credit constrained and they might have to continue to plough their limited capital year after year hence, a low output which will invariably affect their farming returns, nutrition and health status.

Table 4.11: Distribution of Respondents by access to Credit Facilities

	Oyo State		Ogun State		Osun State		Study Area	
Credit Account	Freq	%	Freq	%	Freq	%	Freq	%
Access	79	43.89	59	49.16	55	45.83	193	45.95
No Access	101	56.11	61	50.84	65	54.17	227	54.05
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.3. Respondents Food Intake and Nutrition Profile Across the Selected States

4.3.1 Food Source of Respondents across the Selected States

The distribution of respondents by the source of food across selected states is represented in Table 4.12. The result shows that most of the farming households' 36.11% in Oyo state, 37.50% in Ogun State and 40.83% in Osun State usually obtain food from their self-farm. Other food sources identified in the study were the purchase of food, borrowing, food aid and other sources. Considering the fact that majority of the respondents eats from their self-farm across the selected states suggests that the South-west farmers are majorly small scale farmer with low agricultural output and returns.

Table 4.12: Distribution of Respondents by Food Source across the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Food Source	Freq	%	Freq	%	Freq	%	Freq	%
Self-Farm	65	36.11	45	37.50	49	40.83	159	37.86
Purchased	54	30.00	38	31.67	41	34.17	133	31.67
Borrowed	22	12.22	18	15.00	15	12.50	55	13.09
Food Aid	10	5.55	7	5.83	12	10.00	29	6.90
Other	29	16.11	12	10.00	03	2.50	44	10.48
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.3.2 Respondents Daily Frequency of Food intake across the Selected States

Table 4.13 shows the respondents' 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. This could be because of these respondents, being rural farmers who lack adequate nutritional knowledge

and or as result of their poor status decides to eat twice as a coping strategy, even the 2 meals eaten per day most likely lacks the appropriate nutritional contents. Poor food intake with is a key factor leading to malnourished status (Matthew, 2017).

Table 4.13: Distribution of Respondents According To Daily Food Intake

	Oyo State		Ogun State		Osun State		Study Area	
Feeding Frequency	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
	$\bar{X}$=2.09	SD=0.66	$\bar{X}$=2.06	SD =0.75	$\bar{X}$=2.20	SD=0.84	*$\bar{X}$=2.12*	*SD=0.75*

Source: Field Survey 2015

4.3.3 Households' Dietary Diversity Score across the Selected States

Table 4.14 shows the dietary diversity scores of respondents. Households' Dietary diversity score (HDDS) as earlier mentioned, was based on 12 food groups earlier mentioned in chapter three. 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 6 which was set according to (FAO, 2011, p. 26) recommendation. Therefore, this indicates an inadequate household dietary diversity score (HDDS) in Oyo, Ogun, and Osun state respectively. 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 Organization (WHO, 2000).

From apriori expectation, a household with a lower HDDS is meant to equally record a low BMI. Contrariwise, this supposition was not supported by the finding of this research (i.e. juxtaposing this HDDS with the respondents BMI result in Table 4.31) probably because the farming households, being rural farmers with small scale farming do not really eat enough as earlier recorded (twice daily). Also, the food eaten by this farming households might lack the appropriate nutritional value or contents. More so, poor food intake may be as a result of their lack of nutritional knowledge, cultural background and belief as most farmers in this part of Nigeria eat more of monotonous meals principally carbohydrate class than diversified diets

needed for proper body nourishment. Finally, poor dietary intake may be a contributing factor to malnutrition (Govender, 2016).

Table 4.14: Distribution of Respondents Households' Dietary Diversity Score

	Oyo State		Ogun State		Osun State		Study Area	
Number of Food	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
	$\bar{X}$=5.20	SD =0.73	$\bar{X}$= 5.10	SD=0.31	$\bar{X}$=4.31	SD = 0.70	$\bar{X}$= 4.87	SD =0.58

Source: Field Survey 2015

4.3.4 Respondents Coping Mechanism for Food Shortage across the Selected States

Table 4.15 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. This signifies the presence of poverty in the study area as these respondents do not have enough to save during on-season while others resolve to coping actions such as sales of asset, reduction of production inputs, remittances, scavenging. Therefore, to wrestle poverty, developing countries need good/sound health and sustainable agriculture since scanty output by farming households due to illness affects their return and further deepens their poverty level in all its dimensions i.e. poverty incidence, depth and severity (Ajani and Ashagidigbi, 2008; White, 2012).

Table 4.15: Distribution According to Their Coping Options during Food Shortage

	Oyo State		Ogun State		Osun State		Study Area	
Coping Actions	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

Source: Field Survey 2015

4.4 Environmental and Health Profiles of Farmers Across the Selected States

4.4.1 Presence of Stagnant Water

The majority of the respondents across the selected states (see Table 4.16) do not have stagnant water all around their environment. In Oyo state (76.10%), Ogun state (73.30%) and Osun state (75.80%) claimed not to have stagnant water in their vicinity. The absence of stagnant water. reduces breeding of mosquitoes that are vectors for malaria infection. The literature on previous findings is full of reports of human diseases, illnesses related to the environmental condition of farmers in developing nations of the world (WHO, 2010, Akerele *et al.,* 2017).

Table 4.16: Respondents Distribution according to Presence of Stagnant Water

	Oyo State		Ogun State		Osun State		Study Area	
Stagnant Water	Freq	%	Freq	%	Freq	%	Freq	%
Yes	43	23.90	32	26.70	29	24.20	104	24.76
No	137	76.10	88	73.30	91	75.80	316	75.24
Total	180	100.0	120	100.0	120	100.0	420	100

Source: Field Survey 2015

4.4.2 Respondents' Refuse Disposal Method and Distance across the Selected States

The results show that most of the respondents across the selected states burn their refuse. In Oyo state, 52.2% of the farming households' burn their household refuse. Likewise, 46.7% in Ogun state, 49.2% in Osun state burn their household wastes. Other sources of refuse disposal identified by the respondents were the use of the plastic drum, organized private companies and disposal inside the bush. In addition, the result shows that after burning of refuse nearby was widely used across all the selected states. This report generally implies that respondents do not have a good refuse management system which is dangerous for their health. According to (Mafimisebi and Oguntade, 2010), the major factor that influences health includes the physical, social, economic environment and the individuals' characteristics and habits.

In addition, Table 4.17 shows how far the means of refuse disposal of respondents across the selected states. The majority of the farming households (72.8%, 80.00% and 67.50% of respondents from Oyo state, Ogun state, and Osun state respectively) throw wastes 10-20 meters away from their residence. However, in Oyo state, 1.70% claimed that they throw their waste away at ≥30 meters while 0.80% of the farmers in Osun state throw theirs at ≥30 meters. The

proportion of respondents that throw their refuse waste far from their residence is extremely low compared to those that dispose their refuse close to their resident across the selected states. This can lead to various forms of the disease(s) outbreak which could lead to high morbidity and or mortality among the farming households in the study areas.

Table 4.17: Respondents' Refuse Disposal Method and Distance to place of Refuse Disposal

	Oyo State		Ogun State		Osun State		Study Area	
Refuse Disposal	Freq	%	Freq	%	Freq	%	Freq	%
Plastic Drum	41	22.78	22	18.33	15	12.50	78	18.57
Burning of Refuse	94	52.20	56	46.70	59	49.20	209	49.76
Private Company	10	5.60	3	2.50	10	8.30	23	5.49
Disposal In Bush	35	19.40	39	32.50	36	30.00	110	26.19
	180	100	120	100	120	100.0	420	100
	Oyo State		**Ogun State**		**Osun State**		**Study Area**	
Distance (m)	Freq	%	Freq	%	Freq	%	Freq	%
≤ 10	46	25.60	24	20.00	38	31.70	108	25.71
11-20	131	72.80	96	80.00	81	67.50	308	73.33
11-30	3	1.70	0	0.00	1	0.80	04	0.95
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.4.3 Respondents Means of Excreta across the Selected States

The study (in Table 4.18), shows that pit latrine is the most accepted means of excreta by majority of the respondents across the selected states (Oyo state 48.9% , Ogun state 34.17% and Osun state 45.80%) while low percentage of the farming households across the states use water closet, bush, bucket etc. This shows that larger proportion of these respondents are prone to health related problem like toilet diseases as their most used means of excreta is naturally not hygienic.

Table 4.18: Respondents Distribution According To Means of Excreta

	Oyo State		Ogun State		Osun State		Study Area	
Means of Excreta	Freq	%	Freq	%	Freq	%	Freq	%
Pit Latrine	88	48.90	41	34.17	55	45.80	184	43.81
Water Closet	36	20.00	38	31.67	31	25.80	105	25.00
Bush	53	29.40	29	24.17	33	27.50	115	27.38
Bucket	2	1.10	1	0.80	1	0.80	04	0.95
Others	1	0.60	11	9.17	0	0.00	12	2.86
Total	180	100.0	120	100.0	120	100	420	100

Source: Field Survey 2015

4.4.4 Use of Joint Toilet by Respondents across the Selected States

Sharing of toilets (as shown in Table 4.19), was common across the selected study areas as 68.89%, 73.30% and 71.67% of the respondents from Oyo state, Ogun state and Osun state respectively claimed they were sharing a toilet with their neighbours . It could be very dangerous to their health because they will be prone to several toilet and infectious diseases. Also, sharing of toilets implies that these households jointly use toilets which could lead to disease transmission from one person to the other within the family. This is not ideal because it could lead to poor health status.

Table 4.19 : Use of Toilet by Respondents

	Oyo State		Ogun State		Osun State		Study Area	
Sharing Toilet	Freq	%	Freq	%	Freq	%	Freq	%
Yes	124	68.89	88	73.30	86	71.67	298	70.95
No	56	31.11	32	26.67	34	28.33	122	29.05
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.4.5 Environmental Problems Experienced by the Respondents

The respondents indicated that they were experiencing some environmental problems ranging from irregular or no waste removal to excessive noise (pollution). According to these respondents, the most common problem being faced across the selected states was irregular or no waste removal and littering as shown in Table 4.20. Lack of proper or regular means of waste disposal will lead to littering and dirtiness of the environment which can lead to disease outbreak in the study areas. Disease outbreak will deteriorate farming households' health and farming activities will be reduced thereby increase the incidence of poverty amidst the rural farming households in the study area. Croppenstedt and Muller (2000), opined that sound health is only realistic when there is absolute unity between human being and their very environment.

Table 4.20: Environmental Problems Facing Respondents in the Selected States

	Oyo State		Ogun State		Osun State		Study Area	
Problem Faced	Freq	%	Freq	%	Freq	%	Freq	%
No waste Removal	50	27.80	40	33.30	27	22.50	117	27.86
Littering	42	23.30	29	24.20	21	17.50	92	21.90
Water Pollution	25	13.90	16	13.30	16	13.30	57	13.57
Air Pollution	11	6.10	10	8.30	8	6.70	29	6.90
Land Degradation	44	24.40	15	12.50	32	26.70	91	21.67
Excessive	8	4.40	10	8.30	16	13.30	34	8.10
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.4.6 Use of Window/Door Screening Net across the Selected States

The majority of the farming households were using screening net in their house as presented in Table 4.21.This shows that a good number of them are preventing free entrance of mosquitoes through their door and windows. Awareness of the danger of mosquito bites and infection will largely help to curtail the incidence of malaria in the study areas since malaria episodes gulp lots of money from farmers, affect their health and farming operational activities.

Table 4.21: Respondents Use of Screening Net on Window/Door

	Oyo State		Ogun State		Osun State		Study Area	
Use of Net	Freq	%	Freq	%	Freq	%	Freq	%
Yes	102	56.70	72	60.00	65	54.20	239	56.90
No	59	32.80	40	33.30	42	35.00	141	33.57
Spoilt	19	10.56	8	5.80	13	10.80	40	9.52
Total	180	100	120	100	120	100.0	420	100

Source: Field Survey 2015

4.4.7 Respondents Sources of Water across the Selected States

The respondents' source(s) of water is represented in Table 4.22, it shows that well water is the most used source of water in the selected states with percentage respondent of 44.40% for Oyo state, 49.20% of Ogun state respondents and 44.20% of Osun state respondents. These show a poor level of nutrition as water is an important component of food consumed by farmers, well water is mostly known to be unsafe for household consumption considering hygienic level. This could also complement the poor health status recorded in the study area as reported by the average BMI result across the selected states. This basically conforms to previous studies which submitted that water used in domestic washing and intake is indeed highly regarded as a key

element of an individual's general health process (von Braun, 2008; Smith and Haddad, 2000). In addition, Oyekale and Otuwehinmi (2012), explained that water and sanitation improvements have significantly had effects on the population and its health.

Table 4.22: Distribution of Respondents According to Source of Water, for Drinking

	Oyo State		Ogun State		Osun State		Study Area	
Source of Water	Freq	%	Freq	%	Freq	%	Freq	%
Borehole	72	40.00	47	39.20	55	45.80	174	41.43
Well	80	44.40	59	49.20	53	44.20	192	45.71
River	14	7.80	9	7.50	8	6.70	31	7.38
Tap	13	7.20	3	2.50	2	1.70	18	4.29
Rain	1	0.60	2	1.70	2	1.70	05	1.19
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.4.8 Respondents Most Common Sicknesses across the Selected States

Table 4.23 shows the type of illness those farmers across the selected states considered being most common in their households. It indicated that majority of the farming households have malaria more than any other sickness(s) across the three states with 40% in Oyo state, 32.50% in Ogun state and 37.50% in Osun state. This could be due to the agricultural vegetation and dirty environments earlier reported (i.e. the presence of stagnant water, bush and refuse around residence) which serves as breeding space for mosquitoes. This is in line with the report of Rwaheru (2011); Agulanna (2013); Oluwatayo (2015) and Omonona (2015). Other major identified sicknesses in the study areas were injury/severe body ache, whitlow which occurs from infected hand injuries. Also, some of the respondents identified tuberculosis, cough/catarrh, cholera and typhoid which were conventionally known to be caused by drinking infected water or food.

Table 4.23: Distribution Respondents According to Most Common Sicknesses

	Oyo State		Ogun State		Osun State		Study Area	
Ill Health	Freq	%	Freq	%	Freq	%	Freq	%
Malaria	72	40.00	39	32.50	45	37.50	156	37.14
Tuberculosis	2	1.11	1	0.83	5	4.17	8	1.90
Guinea worm	5	2.78	4	3.33	1	0.83	10	2.38
Pneumonia	16	8.89	16	13.33	3	2.50	35	8.33
Cholera	0	0.00	2	1.67	2	1.67	4	0.95
Cough/Catarrh	18	10.00	12	10.00	16	13.33	46	10.95
Diabetes	2	1.11	4	3.33	3	2.50	9	2.14
Whitlow/Blister	16	8.89	17	14.17	4	3.33	37	8.81
Typhoid Fever	18	10.00	12	10.00	12	10.00	42	10
Injury/ Ache	31	17.22	13	10.83	29	24.17	73	17.38
Total	180	100	120	100	120	100	420	100

Source: Field Survey 2015

4.4.9 Respondents Frequency of Illness across the Selected States

Table 4.24 shows the frequency of sickness episode by farmers in the study area was 2.60 with highest of 37.20% from Oyo state and 32.50% from Ogun state falling sick twice per annum. Furthermore, respondents from Osun state also had 30% of them signifying that they were sick two times with an average of 2.72 times per annum and standard deviations of 1.66. According to Ulimwengu (2009), ill health results in lost days or in decrease the working capacity, which is likely to reduce individuals farm output.

Table 4.24: Distribution of Respondents' Frequency of illness

	Oyo State		Ogun State		Osun State		Study Area	
Illness Frequency	Freq	%	Freq	%	Freq	%	Freq	%
0	0	0.00	0	0	1	0.80	1	0.24
1	38	21.10	34	28.30	25	20.80	97	23.10
2	67	37.20	39	32.50	36	30.00	142	33.81
3	35	19.40	26	21.70	32	26.70	93	22.14
4	20	11.10	13	10.80	14	11.70	47	11.19
5	8	4.40	2	1.70	4	3.30	14	3.33
6	6	3.30	3	2.50	4	3.30	13	3.10
7	1	0.60	3	2.50	1	0.80	5	1.19
8	5	2.80	0	0.00	1	0.80	6	1.43
9	0	0.00	0	0.00	1	0.80	1	0.24
10	0	0.00	0	0.00	1	0.80	1	0.24
Total	180	100	120	100	120	100.0	420	100
	$\bar{X}$=2.67	SD =1.5	$\bar{X}$=2.42	SD=1.39	$\bar{X}$=2.72	SD=1.66	$\bar{X}$ =2.60	SD=4.55

Source: Field Survey 2015.

4.4.10 Respondents Days of Incapacitation Due to Ill Health across the Selected States

Table 4.25 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).

Table 4.25: Distribution of Respondents Day(s) of Incapacitation

	Oyo State		Ogun State		Osun State		Study Area	
Days of Incapacitation	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
	$\bar{X}$=25.27	SD=22.77	$\bar{X}$=22.4	SD=17.31	$\bar{X}$=21.6	SD=21.18	$\bar{X}$=23.1	SD=20.42

Source: Field Survey 2015

4.4.11 Respondents Source of Health Care across the Selected States

Table 4.26 reveals the sources of respondents health care services in Oyo state, Ogun state and Osun state with 62.80%, 56.70% and 60.80% respectively using hospitals. This is the most chosen source of treatment by respondents. Similarly, they use the traditional herbs, self-medication, a combination of hospital and traditional herbs, a combination of traditional herbs and self-medication and the combination of hospital and self-medication were used by some other respondents. Farming households' choice of good, reliable and efficient health care provider when sick is an important factor in the determination of their health status as this can determine how quick they will recover from their sicknesses and return to their farming enterprise, produce better and generate more income than their colleagues who choose poor health provider, recover slowly or die.

Table 4.26: Respondents Distribution According to Source of Health Care

	Oyo State		Ogun State		Osun State		Study Area	
Health Care	Freq	%	Freq	%	Freq	%	Freq	%
Hospital	113	62.80	68	56.70	73	60.80	254	60.48
Traditional	28	15.60	22	18.30	23	19.20	73	17.38
Self-medication	13	7.20	10	8.30	6	5.00	29	6.90
Hospital & traditional	16	8.90	8	6.70	5	4.20	29	6.90
Traditional & Self	6	3.30	7	5.80	9	7.50	22	5.24
Hospital & medication	4	2.20	5	4.20	4	3.30	13	3.10
Total	180	100	120	100.0	120	100.0	420	100

Source: Field Survey 2015

4.4.12 Health Care Provider's Drug Availability across the Selected States

Availability of drug in the study areas' health centers was probed in the study (Table 4.27). The results show that 39.44% in Oyo state, 35.80% in Ogun state and 39.20% in Osun states claimed that the treatments they received from their chosen health care provider were fair. This could be one of the reasons for a high number of days of incapacitation due to ill health by the respondents. Opara and Ellah (2008), opined that rural households in Nigeria were seriously underserved because health care services only reach less than 20% of potential users. Some of the primary health care facilities in rural areas have been abandoned without adequate repair and provision of required equipment and drugs.

Table 4.27: Health Care Provider's Degree of Drug Availability

	Oyo State		Ogun State		Osun State		Study Area	
Degree of Drug Availability	Freq	%	Freq	%	Freq	%	Freq	%
Good	56	31.10	36	30.00	37	30.83	129	30.71
Fair	71	39.44	43	35.80	47	39.20	161	38.33
Poor	30	16.70	18	15.00	21	17.50	69	16.43
Excellent	23	12.80	23	19.20	15	12.50	61	14.52
Total	180	100	120	100.0	120	100	420	100

Source: Field Survey 2015

4.4.13 Respondents Waiting Time for Treatment across the Selected States

Table 4.28 indicates the average waiting time for treatment. This comprises of waiting time for treatment and traveling time to the place of receiving treatment per annum in each of the selected states. The results show that an average of 42 hours 13 minutes was used by respondents from Oyo state, 46 hours, 13 minutes by those from Ogun state and 43 hours and 4 seconds by those

from Osun state. These high number of hours derived in the study imply that an average farming household in Southwest Nigeria chooses travels to their chosen public hospitals which are characterized by long queues thereby wasting lots of respondents' time that ought to be ploughed into the productive agricultural venture in the course of sickness episode(s).

Table 4.28: Distribution of Respondents Waiting Time

	Oyo State		Ogun State		Osun State		Study Area	
Waiting Time{Hr}	Freq	%	Freq	%	Freq	%	Freq	%
≤30	74	41.10	43	35.80	59	49.20	176	41.90
31-60	82	45.60	63	52.50	48	40.00	193	45.95
61-90	13	7.20	6	5.00	1	0.80	20	4.76
91-120	8	4.40	7	5.80	12	10.00	27	6.43
121-150	1	0.60	0	0.00	0	0.00	1	0.24
≥151	2	1.11	1	0.80	0	0.00	3	3
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=42.13	SD=26.64	$\bar{X}$=46.33	SD=30.15	$\bar{X}$=43.04	SD=31.39	*$\bar{X}$=43.83*	*SD=29.39*

Source: Field Survey 2015

4.4.14 Self- Rated Health Status of Respondents across the Selected States

Table 4.29 presents the result of farmers' self–rated health status. Alawode and Lawal (2014), opined that at the individual level, it has been established that richer people have better health because they can afford better goods and services, better 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, this finding does not corroborate with their assertion in the sense that it reveals that the poor revenue farming households (shown in Table 4.31) mostly have very good, good and moderate health status across the three states. 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.

Table 4.29: Respondents Self–Rated Health Status

	Oyo State		Ogun State		Osun State		Study Area	
Self-Rated Approach	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

Source: Field Survey 2015

4.4.15 Respondents' Body Mass Index (BMI)

Table 4.30 reveals the body mass index of the farmers with a minimum value of 15 kg/m², maximum BMI of 39 kg/m² and average BMI of 26.08 kg/m² ± 2.88 in the study area. When the respondent's body mass index was classified into categories following the specification of (WHO, 2010). The finding was that majority of the respondents (60.24%) were overweight as compared with the other groups of 1.17%, 32.14%,5.24 and 0.71 being underweight, healthy, obese 1 and obese 2 respectively in the study area. However, respondents' body mass index (BMI) was further analyzed across the selected states of the study area. The result indicates an average BMI of 25.63, 26.42 and 26.22 kg/m² for Oyo, Ogun and Osun states respectively.

This is similar to the BMI report of Asenso-Okyere *et al.* (2011a) in Ogun and Osun states of Nigeria who discovered in their study that majority of the farmers (35.5%) were overweight when compared with the other groups of 17.00%, 29.10%, 15.00%, and 3.20% belonging to underweight, normal weight, obese 1 and obese 2 categories respectively. Furthermore, the finding reveals that most of the rural agricultural households were overweighed, this will in one way or the other affect their efficiency level. The success of farming livelihoods relies on the health of its workforce. This is also in line with Ajani and Ashagidigbi (2008), who opined that rampant ill-health among the adult population in developing nations contributes to low agricultural outputs.

Table 4.30 : Body Mass Index (BMI)

	Oyo State		Ogun State		Osun State		Study Area	
BMI (kg/m²)	Freq	%	Freq	%	Freq	%	Freq	%
Underweight	5	2.78	1	0.83	1	0.83	7	1.67
Normal Health	63	35.00	33	27.50	39	32.50	135	32.14
Overweight	109	60.56	75	62.50	69	57.50	253	60.24
Obese 1	3	2.80	10	8.33	9	7.50	22	5.24
Obese 11	0	0.00	1	0.83	2	1.70	3	0.71
Severely Obese	0	0.00	0	0.00	0	0.00	0	0
Total	180	100	120	100	120	100	420	100
	$\bar{X}$=25.63	SD=2.67	$\bar{X}$=26.42	SD=2.76	$\bar{X}$=26.2	SD=3.2	$\bar{X}$=26.08	SD=2.88

Source: Field Survey 2015

4.5.0 ECONOMICS OF FARMING HOUSEHOLDS' NUTRITION AND HEALTH IN RELATION TO THEIR INCOME ACROSS THE STATES

4.5.1 Respondents Income and Cost Categories on Nutrition-Health in the study Area

Table 4.31 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 Kadiyala *et al.* (2014).

Table 4.31: Respondents Cost Categories across the Selected States

	Oyo State		Ogun State		Osun State	
Total Cost Categories	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

Source: Field Survey 2015

N.B: As at 2014/2015 (Period of Data Collection), $1US was equivalent to ₦200

4.6 Chapter Summary

This section provided an elaborate overview of the descriptive data analysis by describing the farming households' food intake, nutrition, and health status in relation to their socio-economic characteristics as well as analyzing the farming households' cost of nutrition and health expenditures in relation to their income. It used the descriptive statistics to explain the respondents' socioeconomic characteristics, environmental, food intake, nutrition and health profiles; providing the main characteristics of the farming households which were expected to reveal what is actually responsible for farmers' under-nutrition (inadequate household dietary diversity score i.e. HHDDS ≤ 5) and ill health status (average body mass index of 26.08 kg/m² ± 2.88 i.e. overweight category) in the study area. Respondents' food intake and nutrition status were measured with Households Dietary Diversity Scores while their health status was measured with Body Mass Index and Self-rated health. The next two empirical chapters expatiate on about 6 different inferential statistic approaches' results and discussion.

CHAPTER FIVE

FACTORS INFLUENCING FARMING HOUSEHOLDS' FOOD INTAKE AND NUTRITION IN SOUTHWEST NIGERIA

5.1 Introduction

This chapter presents the results of the factors influencing farming households' nutrition in Southwest Nigeria using different approaches.The first section presents Poisson regression correlates of dietary diversity where count outcomes of the actual dietary diversity score (a proxy for nutritional status) were used as the dependent variable which was regressed against the explanatory variables. The second section presents the composite indices of food intake and its correlates. Principal Component Analysis was adopted in which a composite food index from the 12 FAO's recommended food categories was used as the dependent variable and was regressed against the independent variables. Thirdly, the farming household's hunger severity indices was generated from their coping option during the household's food shortage to generate a dependent variable which was regressed against the socio-economic, environmental and health independent variables in the study area.

5.2 Factors Influencing Farming Households' Nutrition in Southwest Nigeria

This section presents the factors influencing farming households' nutrition status in the study area. To achieve this, Poisson regression model was employed as presented in equation 3.4-3.7. The actual dietary diversity score (a proxy for nutritional status) was used as dependent variable which was regressed against the explanatory variables.

5.2.1 Estimates of Poisson Regression Models of Correlates of Dietary Diversity Scores

Poisson regression estimated parameters for the contributing factors to farming households' nutrition in Southwest Nigeria (Omotayo, 2016) was explored here. In this section, respondents' count outcomes of the actual dietary diversity score (a proxy for nutritional status) was used as the dependent variable which was regressed against the explanatory variables. In order to avoid inconsistency and biasness from the estimated parameters, the study subjected the variables to multicollinearity test using Collin command in STATA 13. Test for multicollinearity among the

variables was carried out with variance inflation factor (VIF), the mean VIF was 1.27 (See Table 5.1).

Also, high level of tolerance computed for the variables indicates that there was the absence of serious multicollinearity in the analysis. The conclusion that the model fits reasonably well was because the goodness-of-fit chi-square test was not statistically significant. If the test had been statistically significant, it would have implied that the data do not fit the model well. In that situation, the need to determine if there were omitted predictor variables, if the linearity assumption holds and/or if there is an issue of over-dispersion so remedial measure(s) such as the use of an empirical scale parameter or the specification of negative binomial errors could have been needed. Also, since some of the variables that were included to capture the respondents' socioeconomic profile showed statistical significance, the first null hypothesis of this study, that there is no significant relationship between farming households' socioeconomic characteristics and their nutritional status is hereby rejected.

Out of the independent variables considered in the model (See Table 5.2), four were statistically significant. These are total revenue, nutritional knowledge, households' possession of means of transportation and source(s) of finance of the farming households'. The total revenue of the households' head was statistically significant ($p<0.05$) with a positive coefficient (0.1961). This implies that respondents' total revenue has a strong positive relationship with their nutrition status. In addition, the Poisson regression model marginally indicates that if the respondents' total revenue increases by a naira, households' dietary diversity scores will increase by 0.98, other factors being held constant. This is expected as households' have the propensity to spend more money on food when revenue rises while rising food prices and falling revenue on the other hand put pressure on their food budgets.

According to Kant and Graubard (2013), both households' income and education contribute to differences in nutrient intake patterns of low and high socio–economic status households. In the same vein, the coefficient of respondents' nutritional knowledge (0.119) which was based on their perception about nutrition) was found to be positive and significant ($p<0.05$) .This implies that households' that answered yes to the question of whether they had knowledge about nutrition had significantly higher ($p<0.05$) dietary diversity scores when compared with those that answered no. This also indicates that households' with adequate knowledge of nutrition had higher food diversity. This is in line with the a *priori* expectation that better knowledge of

nutrition enhances good nutrition. This also corroborates with some findings (Aidoo *et al.* (2013); Ruel *et al.,* 1998; Oniang'o and Mukudi, 2002; Victora *et al.*, 2008; Abur, 2014; Yusuf *et al.,* 2015 and Akerele *et al.,* 2017), that education provides with necessary information for innovations that are important for building their human capital and enhance activities.

Furthermore, Smith and Haddad (2000), indicated a strong relationship between nutritional status and possession of assets. Expectedly, the farming households' parameter of assets possession captured with a possession of means of transportation was positive (0.1600) and significant ($p<0.05$). This indicates that farming households that possessed asset(s) like a bicycle or vehicle consumed higher number of food. This is expected as possession of means of transportation (asset) indicates a better economic status of the farming households which might invariably reflect in better nutritional status as against their counterparts without assets. Also, Akinyele (2009), added that the degree of resources such as land, capital, and labour at the disposal of farming individuals to a large extent their economic access to required foods.

Finally, the parameter of households' source(s) of finance (captured as 1 if personal savings and 0, otherwise) was positive (0.1062) and significant ($p<0.10$). This stands to indicate that households' that used their personal savings had significantly higher ($p<0.10$) number of food intake when compared with those that did not. This by implication indicates that respondents' who finance their farming enterprise through personal savings had a higher food diversity index. This might be because the farming households were well experienced (as indicated in Table 4.9) and are adapted to persistent lack of credit facilities (Table 4.11) hence, leverage their meagre revenue by saving some money for the subsequent farming season, thereby preventing them from undue interest rate which could have possibly emanate from other source(s) of finance therefore, private savings leads to better and improved livelihood as well as nutritional status in the study area.

Table 5.1: Multicollinearity Test of Variables

Variables	VIF	Tolerance	Eigenvalue
Age of the Households' Head	1.69	0.5931	1.1817
Households' Size	1.90	0.6775	0.7918
Marital Status	1.46	0.6871	0.7375
Total Revenue	1.11	0.9008	0.6424
Educational Status of the Households Head	1.09	0.9201	0.5281
Nutritional Knowledge	1.18	0.8497	0.3483
Households Dependency Ratio	1.15	0.8720	0.3272
Households Food Security Level	1.05	0.9498	0.1923
Means of Transportation	1.28	0.7782	0.1239
Ownership of Agricultural Land	1.06	0.9413	0.1015
Total Cost of Feeding	1.12	0.8951	0.0692
Eating Outside Family Food	1.06	0.9462	0.0326
Financial Source	1.19	0.8381	0.0251
Mean VIF	1.27		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

Table 5.2: Poisson Regression Results of the Correlates of Dietary Diversity

Variables	Coefficient	Std. Error	Z	P>|z	Margina Effects	Tolerance
Household Head's Age	0.00058	0.0023531	0.25	0.805	0.00316	0.5931
Household's Size	-0.00229	0.0080492	-0.29	0.775	-0.01253	0.6775
Marital Status	0.00448	0.0578815	0.08	0.938	0.02441	0.6871
Total Revenue	0.19616	0.0948485	2.07	0.039**	0.982949	0.9008
Educational Status of the Head	-0.00027	0.0044616	-0.06	0.951	-0.00149	0.9201
Nutritional Knowledge	0.11197	0.0448358	2.50	0.013**	0.60349	0.8497
Households Dependency Ratio	0.08932	0.0605289	1.48	0.140	0.50306	0.8720
Households Food Security	0.03949	0.042663	0.93	0.355	0.21586	0.9498
Possession of Means Transportation	0.16000	0.0643124	2.49	0.013**	0.92705	0.7782
Ownership of Farming Land	0.05805	0.0621019	0.93	0.350	0.31002	0.9413
Total Cost of Feeding	9.92e-08	1.71e-07	0.58	0.561	5.41e-07	0.8951
Eating Outside Family Food	0.02624	0.0534872	0.49	0.624	0.14424	0.9462
Financial Source	0.10625	0.0562559	1.89	0.059*	0.59998	0.8381
Constant	1.26141	0.169747	7.43	0.000		
Observation Number	420					
LR chi^2 (13)	31.18					
Prob> chi^2	0.0032					
Pseudo R^2	0.0196					
Log likelihood	-779.688					
Deviance goodness of fit = 68.4798						
Prob > chi^2(420) = 1.0000						
Pearson goodness of fit = 67.95932						
Prob > chi^2 (420) = 1.0000						

Source: Authors Compilation from Computer Printout of Poisson Regression Analysis
Note: **and * Means 5% and 10% Levels of Significant Respectively.

5.3 Determinants of Farming Households' Food Intake in Southwest Nigeria

This section presents the determinants of farming households' food intake in the study area. To achieve this, ordinary least squared regression was employed on composite indices of food intakes as presented in equation 3.8-3.9.The dependent variable here was generated with Principal Component Analysis as households' food intake index (from the 12 food categories) which was eventually regressed against some selected explanatory variables.

5.3.1 Estimates of the Composite Diversity Indices of Food Intake and its Correlates

Following the procedure described in chapter 3, Principal Component Analysis was employed to construct food intake index at the farming household level. Previous study by Demeke *et al.* (2011), used fives variables as indicators. Accordingly, as described in section 3.7, this approach is justified because cereals, fish and sea food, root and tubers, pulses/legumes/nuts, vegetables, milk and milk products, fruits, oil/fats, meat, poultry and offal, sugar/honey eggs, miscellaneous food consumed are all the food groups belonging to the key classes of food needed for proper nutrition (FAO *et al.* 2011; ACF International (2010). The 12 food groups were used to compute the food diversity index variable which was the dependent variable in the Ordinary Least Square regression.

Breusch-Pagan/Cook-Weisberg test for heteroscedasticity was carried out after regression and none of the degree of freedom for chi-squared test was significant. The null hypothesis of homoscedasticity was accepted .If it had been found heteroscedastic, there could have been need to estimate the robustness of the standard error. In addition.in order to avoid inconsistency and biasness from the estimated parameters, the study subjected the variables to multicollinearity test using Collin command in STATA 13. Table 5.3 shows the test for multicollinearity among the variables, this was carried out with variance inflation factor (VIF), and the mean VIF was 1.10. Also, high level of tolerance computed for the variables indicates that there was the absence of serious multicollinearity in the analysis. Obviously, since some of the variables that captured the socioeconomic characteristics of the respondents showed statistical significance. This implies that the second null hypothesis should be rejected.

Table 5.4 shows the estimated parameters for the determinants of farming households' food intake in Southwest Nigeria using ordinary least square regression. Among the variables that

were included in the analysis, type of agriculture practiced, working class number, net returns, households dependency ratio, possession of means of transportation, households' other source(s) of income, farm yield have significant positive or negative influence on households' food intake captured as their food index. Type of agricultural practice being engaged by the farming households was statistically significant ($p<0.10$) with a negative coefficient (-0.23721).This implies that there is indirect relationship between the crop farming households and their composite food diversity level in the study area. It means that those farmers that were growing crops had their composite food diversity indices being reduced by 0.23731, when compared with other farmers. This might be due to the small scale nature of cropping activities in the study area which leads to little returns to the crop planting households.

Similarly, the parameter of the number of the working class among the household members is statistically a significant ($p<0.05$) with positive sign (0.12848). This implies that as the number of working class members in a household increases, the composite diversity indices of food intake increased. This is expected because increase in the number of working members in a household would lead to increase in family income which would as well possibly influence food intake and its diversity. Similarly, the coefficient of household heads' net return/profit was statistically significant ($p<0.10$) with a positive coefficient (0.23528). This indicates that respondents' net return have a strong positive relationship with their food diversity index. This is expected as households' are more likely to spend more money on food when they have better profit from their farming business. Kant and Graubard (2013), observed that both households' income and education contribute to differences in food intake patterns of low and high socio–economic status households.

In the same vein, the dependency ratio parameter (captured as the ratio of the dependent population to the total productive population within the households) of the farming households have a significant ($p<0.05$) and positive (0.36500) effect on their composite food diversity. This indicates that if the farming households' dependency ratio increases by one individual, composite food diversity would increase by 0.36500 unit. This is in line with the a priori knowledge as households' dependency ratio is supposed to affect their food intake level. A farming household with lower number of dependants will possibly have more access to more diversified food for consumption when compared with their counterparts in this same small scale farming adventure and with a larger dependants in the study area (Ndobo and Sekhampu, (2013); Aidoo *et al.* (2013) .

As expected, the parameter of assets possession captured with a possession of means of transportation (captured as 1 if yes and 0 otherwise) was positive (0.45974) and significant ($p<0.05$). This implies that farming households that possesses asset(s) like bicycle or vehicle have better possibility of increasing their composite food diversity index. This is expected as possession of vehicle or bicycle (asset) indicates a better welfare of the farming households which might invariably reflect in improved food intake as against their counterparts without such assets. Moreover, assets possession is one of the major means of wealth accumulation in rural areas (Babatunde *et al.* (2011); Beyene and Muche, 2010).

Contrary to expectation, the parameter household head's possession of other source (s) of income had a negative (-0.25169) and significant coefficient ($p<0.10$). This indicates that access to other source(s) of income aside their farming enterprise's revenue reduced households' composite food diversity index. This is not expected as non-farm enterprise has been confirmed in literature as good support for farming enterprise (Omotayo, 2016). In addition, the parameter of the farming households yield (Captured as in Kilograms per hectares) was positive (0.0000) and significant ($p<0.10$) as expected. This means that farming households' food intake is a function of their farm yield. This by implications indicates that the higher the households farm yield, the better their food intake level. This could be due to the fact that increase in farm yield leads to increase in the farming households' access to food and revenue which could invariably enhance the farming households' propensity to consume.

Table 5.3: Test of Multicollinearity among Variables

Variables	VIF	Tolerance	Eigenvalue
Educational Status of the Head	1.21	0.8223	1.1796
Type of Agriculture Practiced	1.13	0.8738	0.9847
Household Heads' Age	1.13	0.8826	0.8744
Tribe of the Head	1.06	0.9337	0.8029
Working Class Number	1.08	0.9268	0.6557
Total Cost of Feeding	1.12	0.8916	0.5404
Total Revenue	1.04	0.9598	0.4981
Net Returns	1.08	0.9211	0.4669
Households Dependency Ratio	1.09	0.9163	0.3682
Possession of Vehicle	1.13	0.8869	0.3307
Financial Source	1.06	0.9253	0.2716
Households Water Purity (Self-rated)	1.11	0.8975	0.2178
Households Other Source of Income	1.02	0.9744	0.1399
Total Cost on Health	1.06	0.9450	0.0678
Yield	1.03	0.9667	0.0445
Mean VIF	1.10		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

Table 5.4: Composite Indices of Food Intake of the Farming Households and its Correlates in Southwest Nigeria

Variables	Coefficient	Std. Error	T	P>|t	Tolerance
Educational Status of the Head	-0.01992	0.01385	-1.44	0.151	0.8223
Type of Agriculture Practiced	-0.23721	0.13353	-1.78	0.076*	0.8738
Household Heads' Age	0.00812	0.00564	1.44	0.151	0.8826
Tribe of the Head	0.19457	0.28349	0.69	0.493	0.9337
Working Class Number	0.12848	0.06393	2.01	0.045**	0.9268
Total Cost of Feeding	0.00000	0.0000	1.23	0.219	0.8916
Total Revenue	0.27854	0.25828	1.08	0.281	0.9598
Net Returns	0.23528	0.12935	1.82	0.070*	0.9211
Households Dependency Ratio	0.36500	0.18269	2.00	0.046**	0.9163
Possession of Means of Transportation	0.45974	0.19393	2.37	0.018**	0.8869
Financial Source	-0.18526	0.12795	-1.45	0.148	0.9253
Households Water Purity (Self-rated)	0.12717	0.13174	0.97	0.335	0.8975
Households' Other Source of Income	-0.25169	0.13504	-1.86	0.063*	0.9744
Total Cost on Health	0.00000	0.00000	-0.04	0.970	0.9450
Yield	0.0000	0.00000	1.77	0.077*	0.9667
Constant	-0.89348	0.51020	-1.75	0.081	
Observation Number	420				
Prob> F	0.0011				
R-Squared	0.0869				
Adj R-Squared	0.0530				
Root MSE	1.2515				
Cook-Weisberg test for Heteroskedasticity Ho: Constant variance fitted values of food index: chi^2 (1) = 2.14: Prob > chi^2 = 0.1437					

Source: Authors Compilation from Computer Printout of PCA Regression Analysis
Note: ** and * Means 5% and 10% Levels of Significant Respectively

5.4 Factors that Contribute to the Severity of Hunger among the Farming Households in Southwest Nigeria

This section presents the contributing factors to severity of hunger in the study area. To achieve this, Principal Component Analysis Regression was employed as presented in equation 3.10-3.11.The dependent variable which was the generated households' coping option index (from the

7 coping action categories presented in Table 4.15) which was eventually regressed against the explanatory variables.

5.4.1 Estimates of the Correlates of the Farming Household's Hunger Severity Index

This section estimated the determinants of the farming households' severity of hunger in Southwest Nigeria using ordinary least square regression. High level of tolerance computed for the variables indicates that there was absence of serious multicollinearity in the analysis. In order to avoid inconsistency and biasness from the estimated parameters, the study subjected the variables to multicollinearity test using Collin command in STATA 13. Test for multicollinearity among the variables was carried out with variance inflation factor (VIF), the mean VIF of 1.15 was derived as indicated in Table 5.5. Since some of the variables that were included to capture the respondent demographic characteristics showed statistical significance, the third null hypothesis is therefore rejected.

Following the procedure described in chapter 3, Principal Component Analysis was employed to construct the severity of hunger index at the farming households' level. Also, the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity was carried out after the regression and none of the degree of freedom for chi-squared test was significant so, the null hypothesis of heteroscedasticity is accepted. If it had been found heteroscedastic, there could have been need to estimate the robustness of the standard error.

Table 5.6 shows that five out of the fourteen variables in the analysis were significant. The variables that significantly affect the households' nutrition were household heads' age ($p<0.10$), tribe of the head ($p<0.10$), year of education of the head ($p<0.01$), alcoholism habit ($p<0.10$), households water purity ($p<0.01$).While other variables such as gender of the households head, marital status of the head, ratio of the households working class, existence of environmental problem, total cost of health, total farm revenue, farming experience, eating outside family food plan, knowledge of nutrition were statistically insignificant ($p>0.10$).

Table 5.5 shows that the parameter of the farming household heads' age was positive (0.0113) and significant ($p<0.10$) .This implies that if the household heads' age increases by one year, hunger severity index would increase by 0.0113 unit. This could imply that older age of the farming households head translate into reduced productive capacity hence, reduced income and

increased severity of hunger. Good nutrition and avoidance of hunger contributes significantly to the health and wellbeing of older individuals, and to their ability to recover from illness (Forster and Gariballa, 2005).

In addition, the parameter of the farming households' tribe was positive (0.4723) and significant ($p<0.10$). This indicates that there is positive and direct relationship between being from Yoruba tribe of the Southwest Nigeria and having good nutrition status (hunger severity index) This could be due to the fact that the region of the nation still remains a considerably educated region where an average household have basic knowledge of food and nutrition .On the other hand, the coefficient of respondents year(s) of education was negative (-0.0414) and significant ($p<0.01$) in the model. It implies that if the households' heads educational level increases by one year, hunger severity index would decrease by -0.0414. However, this study does not posit in any way to downplay the importance of education in nutrition and health for evidence abound in the literature on the positive role education play in nutrition and health status and ability to attract higher income all over the world (Acker and Gasperini, 2009).

Furthermore, the dummy parameter of respondents, alcoholic habit was positive (0.8009) and significant ($p<0.10$) with their hunger severity level. This by implication implies that a unit increase in alcoholic consumption by the farming households would lead to 0.8009 unit increase in their hunger severity level. This is expected, as literature affirms that alcoholics often eat poorly, limiting their supply of essential nutrients and affecting both energy supply and structure maintenance thereby being unfit for economic activities that could bring in income hence hunger consequence. Furthermore, alcohol interferes with the nutritional process by affecting digestion, storage, utilization, and excretion of nutrients of the farming households (Leiber, 1988). Expectedly, the farming households' parameter of self-rated water purity level captured in its dummy form was positive (0.3406) and significant ($p<0.01$).This indicates that the farming households who drink/use pure water for consumption and other activities have higher likelihood of having good nutritional status and less hunger severity in the study area.

Table 5.5: Multicollinearity Test among the fitted Variables

Variables	VIF	Tolerance	Eigenvalue
Gender of the Households' Head	1.14	0.8851	1.1935
Marital Status of the Head	1.25	0.8750	1.0521
Number of the Households Working class	1.07	0.7990	0.8896
Household Heads' Age	1.46	0.9315	0.8434
Tribe of the Head	1.07	0.6839	0.7729
Year of Education of the Head	1.23	0.9363	0.5612
Alcoholism Habit	1.09	0.8138	0.4093
Existence of Environmental Problem	1.09	0.9176	0.3730
Total Cost of Health	1.07	0.9150	0.2964
Total Farm Revenue	1.08	0.9388	0.2748
Households Water Purity (Self-rated)	1.14	0.9225	0.2391
Farming Experience	1.34	0.8778	0.1830
Eating Outside Family Food plan	1.03	0.7455	0.1271
Knowledge of Nutrition	1.05	0.9681	0.0132
Mean VIF	1.15		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

Table 5.6: Principal Component Regression Results of the Correlates of the Farming Household's Hunger Severity Index in Southwest Nigeria

Variables	Coefficient	Robust Std. Error	T	P>|t	Tolerance
Gender of the Households' Head	0.1269	0.1584	0.80	0.424	0.8851
Marital Status of the Head	0.0306	0.1669	0.18	0.855	0.8750
Number of the Households Working Class	0.0513	0.0745	0.69	0.491	0.7990
Household Heads' Age	0.0113	0.0060	1.87	0.062*	0.9315
Tribe of the Head	0.4723	0.2697	1.75	0.081*	0.6839
Year of Education of the Head	-0.0414	0.0136	-3.04	0.003***	0.9363
Alcoholism Habit	0.8009	0.4111	1.95	0.052*	0.8138
Existence of Environmental Problem	-0.0289	0.1279	-0.23	0.821	0.9176
Total Cost of Health	2.37e-06	2.49e-06	0.95	0.341	0.9150
Total Farm Revenue	4.45e-07	2.81e-07	1.58	0.114	0.9388
Households Water Purity (self-rated)	0.3406	0.1261	2.70	0.007***	0.9225
Farming Experience	-0.0062	0.0056	-0.11	0.912	0.8778
Eating Outside Family Food Plan	0.2211	0.1591	1.39	0.165	0.7455
Knowledge of Nutrition	0.0702	0.1235	0.57	0.570	0.9681
Constant	-0.9006	0.4137	-2.18	0.030	0.9568
Observation Number	420				
Prob> F	0.0001				
R-squared	0.1149				
Root MSE	1.1391				

Source: Authors Compilation from Computer Printout of Principal Component Analysis
Note: ***and * means 1% and 10% levels of significant respectively.

5.5.0 Chapter Summary

This chapter presented the results of different inferential statistical approaches (Principal Component Regression and Poisson regression) on factors influencing farming households' nutrition and hunger severity along with their discussions. The Significant explanatory variables in the chapter were type of agriculture practiced ,working class number, possession of means of transportation ,households dependency ration, households' other source(s) of income, farm yield ,total revenue, nutritional knowledge, source(s) of finance of the farming households' ,year(s) of education of the head, farming households net return, household heads' age , tribe of the head , alcoholism habit and households water purity were statistically significant to the nutrition status and hunger severity in the study area .Year(s) of education, asset procession, income and nutritional knowledge were the key determinants of farming households' nutritional status and hunger prevalence in the study, this shows that respondents' human capital and asset portfolio among others are major determinant of the farming households nutrition and hunger severity status in the study area.

CHAPTER SIX

EFFECT OF FARMING HOUSEHOLDS' NUTRITION ON HEALTH STATUS IN SOUTHWEST NIGERIA

6.1 Empirical Results and Discussion

This chapter presents the results on the effect of farming households' nutrition on health status in Southwest Nigeria. The first section presents the results of the Logistic regression with self-rated health approach.The second section, presents Two Stage Probit Regression of the linkage between farming households' nutrition and health status. Finally, the Negative Binomial Regression with respondents day(s) of incapacitation as the dependent variable was adopted to assess the effect of farming households nutrition on their health.

6.2 : Estimates of Logistic Regression with Self-Rated Health indicator as Dependent Variable

Logistic regression result of the effect of households' nutrition on health status in Southwest 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 6.1) was derived in the analysis. Also, the high levels of tolerance computed for the variables indicate that there was absence of serious multicollinearity and since some of the variables that were included to capture nutrition status (i.e households' food security level, fruit consumption and nutritional knowledge parameters) showed statistical significance, the fourth null hypothesis of this study is hereby rejected.

The model used the households' socioeconomic characteristics, environmental 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 6.2 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 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 in the study area.

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. However, the benefits of education go far beyond economic ones. Education can impact positively on levels of social engagement, an important factor in generating more cohesive, safer and healthier societies. Also, higher maternal education level was referred to as a marker of socioeconomic status associated with better diet in Dutch preschoolers in a study by Wijtzes *et al.* (2013).

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

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 (Mokdad *et al.* (1998); Danaei *et.al.* (2009) ; Stringhini *et al.* (2010) and FAO *et al.* (2011).

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 coefficient of nutrition knowledge of respondents 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 had a significantly lower probability of having good health when juxtaposed with those that answered no. This is not in line with the apriori expectation, as farming households' knowledge about nutrition is expected to positively influence their likelihood of belonging to normal BMI category. However, this corroborates with the finding of Agulanna (2013), in a similar study, this situation may be homogeneous to the Southwest Nigeria.

Table 6.1: Multicollinearity Test of Variables Applied in the Model

Variables	VIF	Tolerance	Eigenvalue
Households Sex	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		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

6.2 : Logistic Regression Analysis Result of the Effect of Farming Households Nutrition on Health Status in Southwest Nigeria

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					
Pse udo R^2	0.2121					
Log likelihood	-191.915					

Source: Authors Compilation from Computer Printout of Logistic Regression Analysis
Note: *, ** and * Means 1%, 5% and 10% Levels of Significant Respectively**

6.3 Linkage between Farming Households' Nutrition and Normal BMI

This section presents the effect of farming households' nutrition on health status in the study area (Omotayo, 2016). To achieve this, Two Stage Probit Regression was used as indicated in equation 3.13- 3.18. The selected instruments have positive and significant effect at ($p<0.10$) level on the instrumented variable nutrition status which was the re-categorized dummy form of the actual dietary diversity score as shown in the regression form (where dietary diversity scores was with value 1 if respondents nutrition status is nourished ($\geq$ 6 food intake) and 0 otherwise). The selected instrumental variables (total cost, households' procession of transportation and

farm gross total revenue) were meant to cater for the potential problem of endogeneity in the analysis.

The choice of instrument, in addition, was to allow consistent estimation as required when the explanatory variables (covariates) are correlated with the error terms in a 2SLSP regression relationship. The instrumented results were meant to correct the potential problem of endogeneity. Also, Wald test of exogeneity was statistically significant ($p<0.01$) in the fitted model. The result implies that the inclusion of nutrition status as an endogenous variable was justified and the selected instruments satisfied the necessary conditions (Gujarati, 2004). The Wald Chi-Square statistics was also statistically significant ($p<0.01$), showing that the models produced a good fit and estimated parameters were jointly unequal to zero.

In addition, test for multicollinearity among the variables was carried out with variance inflation factor (VIF), the mean VIF was found to be 1.08 (see Table 6.3) in the analysis. Also, the high levels of tolerance computed for the variables indicate that there was the absence of serious multicollinearity in the analysis. The statistical significance of some of the variables fitted to capture the farmer's nutrition status i.e nutritional status and nutritional knowledge therefore leads to the rejection of our fifth null hypothesis of this study.

The choice of Two-stage Probit regression (2SPR) in the analysis of the effect of farming households nutrition on health was because the dependent variable was dichotomous in nature and the nutrition status (Ni) variable being endogenous (Angba, 2000 and Gujarati, 2004). The selected instrumental variables for nutrition status were the total cost, households procession of transportation and farm gross total revenue, with correlation coefficients of 0.0312 , 0.1156 and 0.0120 respectively , as against their correlation of -0.0336, 0.1120 and -0.0464 with health status variable. In the study, a check was firstly performed on the instrumental variables so as to avoid the introduction of another form of specification bias.

Moreover, because the selected instrumental variables were more than one, the models to be estimated in equations will be over-identified. Over-identification is an issue which should be corrected. However, because the estimated procedure is the two-stage least square (2SLS) method, this would have been automatically addressed (Gujarati, 2004; Keshk, 2003).The last issue of concern is to test for exogeneity of the endogenous variable. There are different econometric tests proposed in the literature. However, because data analysis was done with the

ivprobit command of STATA 11.0 software, the results provide Wald test of exogeneity statistics. If the test shows statistical significance ($p<0.05$), selected instruments had properly addressed the problem of endogeneity.

Table 6.4 presents the results of analyses for the effect of farming households' nutrition on health using Two-stage Probit model. The model used the households' socioeconomic characteristics, nutrition, and household health status proxied by the body mass index and includes the potential endogenous variable of nutritional status which was instrumented (total cost, possession of transport and farm gross total revenue). The instrumental variables chosen for the study is similar to chosen instruments on previous studies on farming households' food intake, nutrition and health (Adeyeye, 1989; Kennedy and Bouis, 1993; Hawkes and Ruel, 2006; Asenso-Okyere *et al.,* 2009; Oyekale and Otuwehinmi, 2012).

Nutritional status, primary occupation, respondents' choice of health care service, type of toilet, nutrition knowledge, and farm distance were the explanatory variables that made a significant contribution to having BMI in the normal range ($p<0.01$). However, the other exogenous variables such as gender of households' head and marital status and household's heads educational status were not statistically significant. In the study, farming households' nutritional status was found to have a positive and significant contribution to having BMI in the normal range.

The parameter of farming households' nutrition status, which was the re-categorized dummy form of the actual dietary diversity score was positive (1.8092) and statistically significant ($p<0.01$) to having normal BMI category in this model. This indicates that farming households' probability of belonging of having normal BMI improves with high diversity of food intakes. In other words, the farming households with dietary diversity scores above average set cut off point have a significantly higher probability of belonging to normal BMI category. This is consistent with similar studies on farming households' food intake, nutrition and health (UNSCN, 2010; Agulanna *et al.,* 2013). The research hypothesis which stated that there is no significant relationship between farming households' food intake diversity and the probability of having normal BMI, therefore, has to be rejected.

The coefficient of respondents primary occupation was negative (-0.3994) and significant ($p<0.10$). It further suggests that the households' that answered yes to the question of whether

they practice crop farming as their main job had a significantly lower probability of being in the normal BMI category when compared with their contemporary who answered no. This may be due to the laborious nature of the agricultural practices of the small scale farmer. In like manner, the parameter of health care service (captured as 1 if private hospital and 0 otherwise) was with a positive sign (0.3024) and statistically significant ($p<0.05$). This indicates that households' that choose private hospital when sick had a significantly higher probability of belonging to the normal BMI category when compared with their contemporary who answered no. This is expected as the choice of the private hospital which is known for better health care provision could increase farmers' chances of belonging to normal BMI category after being sick. This also corroborates with previous studies (Oluwatayo, 2015 and Omonona, 2015).

Furthermore, the parameter of respondents' type of toilet (captured as 1 if water closet and 0 if otherwise) was positive (0.20356) and significant ($p<0.10$) statistically. This suggests that respondents that choose water closet as their toilet type had a significantly higher probability of belonging to normal BMI category when compared with their colleagues who choose another type of toilets. This is in conflict with the apriori knowledge as water closet is expected to be a better means of excreta than other means of excreta in the study area. Also,the coefficient of nutrition knowledge of respondents was also found to be negative (-0.2112) and significant ($p<0.10$).This indicates that farming households' nutritional knowledge negatively influence their probability of belonging to normal BMI category in the study area. This implies that households' that answered yes to the question of whether they have knowledge about nutrition had a significantly lower probability of being in the normal BMI classification when juxtaposed with those that answered no.

This is not in line with the apriori expectation, as farming households' knowledge about nutrition is expected to positively influence their likelihood of belonging to normal BMI category. However, this corroborates with the finding of Agulanna (2013), in a similar study, this situation may be homogeneous to the Southwest Nigeria due to farming households' lack of adequate knowledge of food that can improve their health status, probably due to cultural trend of monotonous starchy meals as against diversified nutritious food among the rural dwellers.

Lastly, the parameter of the farming households' farm distance captured in kilometers was positive (0.0039) and significant ($p<0.05$).Implying that a direct relationship exists between farming households' farm distance and their probability of belonging to normal BMI category.

Holding other factors constant, a unit increase in farming households' farm distance will increase the probability of belonging to a normal health status category. This could be as a result of the fact that regular walk is a good means of exercise to the body since the majority of this households does not possess means of transportation being a poor rural farmer as indicated in their farm size and annual income.

Table 6.3: Multicollinearity Test of Variables

Variables	VIF	Tolerance	Eigenvalue
Nutrition Status	1.03	0.9686	7.8829
Gender of the Households' Head	1.12	0.8954	1.0267
Age of Household Head	1.18	0.8444	0.9519
Education Status	1.11	0.9043	0.8393
Primary Occupation	1.04	0.9636	0.6922
Health Care Service	1.05	0.9481	0.5949
Type of Toilet	1.05	0.9511	0.4758
Nutritional Knowledge	1.03	0.9664	0.4188
Farm Distance	1.05	0.9505	0.3874
Possession of Electricity	1.03	0.9711	0.3441
Alcoholic Habit	1.09	0.9202	0.2060
Food Security Status	1.04	0.9627	0.1196
Type of Labour Used	1.18	0.8452	0.0476
Mean VIF	1.08		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

Table 6.4: 2SP Regression Analysis of the Linkage between Farming Households' Nutrition on Health

Variables	Coefficient	Std. Error	Z	P>|z	Marginal E.	Tolerance
Nutrition Status	1.80920	0.3895974	4.64	0.000*	1.80920	0.9686
Household Head's Gender	-0.17745	0.1548894	-1.15	0.252	-0.17745	0.8954
Household Head's Age	-0.00254	0.0053998	-0.47	0.638	-0.00254	0.8444
Education Status	-0.01037	0.0128441	-0.81	0.419	-0.01037	0.9043
Primary Occupation	-0.39943	0.2333994	-1.71	0.087*	-0.39943	0.9636
Health Care Service	0.30249	0.1320735	2.29	0.022**	0.30249	0.9481
Type of Toilet	-0.20617	0.1182563	-1.74	0.081*	-0.20617	0.9511
Nutritional Knowledge	-0.21123	0.1188857	-1.78	0.076*	-0.21123	0.9664
Farm Distance	0.00397	0.001872	2.12	0.034**	0.00397	0.9505
Possession of Electricity	-0.21465	0.2509836	-0.86	0.392	-0.21465	0.9711
Alcoholic Habit	-0.51283	0.4142788	-1.24	0.216	-0.51283	0.9202
Food Security Status	0.18937	0.1267841	1.49	0.135	0.18937	0.9627
Type of Labour Used	-0.01932	0.0458273	-0.42	0.673	-0.01932	0.8452
Constant	-0.37502	0.4439501	-0.84	0.398		
Observation Number	420					
Wald chi^2 (13)	81.65					
Prob>chi^2	0.0000					
Log Likelihood	-511.4313					

Source: Compilation from Computer Printout of 2SPR Analysis.
Note: ** and * Means 5% and 10% Levels of Significant Respectively.

Table 6.5: Correlation Coefficients of the Selected Instrumental Variables on Nutrition and Health Status of Respondents

	Nutrition Status	Total Cost	Possession of Transport	Farm Gross Total Revenue
Nutrition status	1.0000			
Total Cost	0.0312	1.0000		
Possession of Transport	0.1156	0.1518	1.0000	
Farm Gross Total Revenue	0.0120	0.8154	0.1418	1.0000
Observation = 420				
	Health Status	**Total Cost**	**Possession of Transport**	**Farm Gross Total Revenue**
Health Status	1.0000			
Total Cost	-0.0336	1.0000		
Possession of Transport	0.1120	0.1518	1.0000	
Farm Gross Total Revenue	-0.0464	0.8154	0.1418	1.0000
Observation = 420				

Source: Authors Compilation from Computer Printout of Correlation Coefficients.

6.4 Estimates of Negative Binomial Regression with Respondent Days of Incapacitation as the Dependent Variable

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. Also, the study subjected the fitted variables to multicollinearity test using Collin command in STATA 13 in order to avoid inconsistency and biasness from the estimated parameters. Test for multicollinearity among the variables was carried out with variance inflation factor (VIF), the mean VIF was 1.22 (See Table 6.6). 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 6.7 shows the results of Negative Binomial regression model. The model produced a better result than Poisson regression 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. 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 is expected to positivelyaffect 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 cosume 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.

Table 6.6: 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		

Source: Authors Compilation from the Computer Printout of Multicollinearity Test

Table 6.7: Negative Binomial Regression Results of the Assessment of the Effect of Farming Households' Nutrition on Health in Southwest Nigeria

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					

Source: Authors Compilation from Computer Printout of Negative Binomial Regression
Note: *, ** and * means 1% and 5% and 10% levels of significant respectively**

6.5.0 Chapter Summary

The chapter presented the results of three different inferential statistics and their discussions appropriately fitted to determine the effect of farming households' nutrition on health in the study area. In general, gender of the households head, year(s) of education, respondents use of insect net ,consumption of fruit, possession of transportation means, households food security status, total cost of health, nutrition status, primary occupation, respondents' choice of health care service, type of toilet, nutrition knowledge, farm distance, marital status of the head , consumption of milk and total cost of health were the socioeconomic, environmental, food components and health dependent variables that was statistically significant in the study. The study established a link between farming households' nutrition and health amongst the farming households. Finally, it was observed that among others, respondents' choice of health care provider, educational attainment and nutritional knowledge, possession of assets and the diverse food components such as egg, cereal, fruits, milk consumption were important nutritional component for good health of these farming households.

CHAPTER SEVEN

SUMMARY OF MAJOR FINDINGS, CONCLUSION AND POLICY RECOMMENDATIONS

7.1 Summary of Major Findings

Farming households' Food intake diversity and Nutrition remains inextricably linked with farmers' Health. Only a few empirical works exist in the literature which investigates the effect of farming households' food intake, nutrition on health in Southwest Nigeria in recent times, these existing literature were at most with partial treatment of these concepts. A holistic approach is therefore needed to establish the bi-directional linkage between these concepts as well as their effects on the farming households and agriculture. Thus, this study specifically determined the farming households' nutritional status, identified factors that influence farming households' nutrition, evaluated the health status of the farming households, examined the respondents' cost of nutrition and health with respect to their income, estimated the determinants of farming households' food intake and hunger severity and finally, analyzed the effect of farming households' nutrition on health in Southwest, Nigeria.

Descriptive analysis of the respondent's socioeconomic characteristics reveals that majority of the respondents across the selected states had a basic primary education with 70% (Oyo state), 65% (Ogun state) and 74.20% (Osun state). In addition, the majority of these respondents (96.70%) cultivated less than 4 ha land area. The farmers' nutritional profile indicates that the majority (37.86%) ate from their own production. The mean score of the study's household dietary diversity score across the selected states were 5.20, 5.10 and 4.31 for Oyo, Ogun and Osun states respectively. The study also found that majority (34.76%) of the farmers across the selected states borrowed in order to cope with food insecurity. An average food expenditure of ₦351,045($1755.23), ₦417,382.50 ($2086.911) and ₦408,438.30 ($2042.19) per annum were computed for Oyo, Ogun and Osun state respectively.

The respondents' environmental and health profile indicated that average days incapacitation across Oyo state, Ogun, and Osun state were 25.27days, 22.44 days and 21.60 days respectively per annum with average total cost on the ill health of ₦52,559.44 ($262.80), ₦46,942.67

($234.71) and ₦48,912.92 (₦48,912. 92) .The majority of the farmers disposed their refuse at 10-20 meters away from their residential houses and (49.76%) burnt them. Pit latrine was mostly used (43.81%) and 70.95% shared a toilet with other households. Furthermore, the study recorded average body mass index (BMI) of 25.63, 26.42 and 26.22 kg/m² for Oyo, Ogun and Osun state. Also, in the combined data set, 1.67% of the respondents were underweight, 32.14% normal, and 60.24% overweight while 5.95% were obese.

The study further applied several models in two empirical chapters (i.e chapter 5 and 6), these models were Poisson regression, Principal Component regression, Logistic regression, Two-stage Probit regression model and Negative Binomial Regression. In the Principal Component Regression of factors influencing the farming household's nutrition, seven out of the variable analyzed were either positively or negatively significant. Variables such as type of agriculture practiced ($p<0.10$), working class number ($p<0.05$), net returns ($p<0.10$), households dependency ratio ($p<0.05$), possession of means of transportation ($p<0.05$), households' other source(s) of income ($p<0.10$) and farm yield ($p<0.10$) were statistically significant to the respondents' nutrition status (captured as food composite index).

On the other hand, Poisson regression model of factors that contribute to farming households nutrition shows that four factors (i.e. total revenue ($p<0.05$), nutritional knowledge ($p<0.05$), households' possession of means of transportation ($p<0.05$) and source(s) of finance of the farming households' ($p<0.05$) was statistically significant to the nutrition status (captured as dietary diversity score) in the study area. Also, the Principal Component Analysis with respondents' coping mechanisms' i.e the composite index for hunger severity as their dependent variable in the interplay between the farmers socioeconomics, environmental and health status shows that variables such as household heads' age ($p<0.10$), tribe of the head ($p<0.10$), year of education of the head ($p<0.01$), alcoholism habit ($p<0.10$) and households water purity ($p<0.01$) were significant to their nutrition.

Furthermore,in order to analyze the effect of farming households' nutrition on health , Logistic regression approach to achieving this aforementioned objective indicated that variables such as gender of the households' head ($p<0.05$), marital states of the head ($p<0.10$), educational year(s) ($p<0.01$), household food security ($p<0.10$), total cost of health ($p<0.01$), respondents' use of insect net ($p<0.10$), consumption of fruit ($p<0.05$), possession of means of transport($p<0.01$),

knowledge of nutrition ($p<0.05$) were the significant variables that affect health (captured as self-assessed health status).

In addition, the study further fitted Two-stage Probit model to analyze the effect of farming households' nutrition on health. Nutrition status ($p<0.01$), primary occupation ($p<0.10$), respondents' choice of health care service ($p<0.05$), type of toilet ($p<0.10$), nutrition knowledge ($p<0.10$) and farm distance were the explanatory variables which were statistically significant to the farming households' health status (captured as 0, normal BMI category and 1 otherwise). Finally, to assess the effect of the farming households nutrition on their health (proxied by the respondents day(s) of incapacitation composite index) The significant variables in the model 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 ($p<0.01$).

7.2 Conclusion

Poor food intake, malnutrition, and ill-health are major problems of many farming households of developing nations. In Nigeria, these trio-threats constitute physical and economic problem by eating deeply into the financial base of the victims and or their caregivers. This study, therefore, evaluated the economics farming households' nutrition and health in the Southwestern part of Nigeria. Among others, this study adopts UNICEFs' conceptual framework to recognize the knowledge gaps, encourage/foster new thinking and also stimulate concrete actions on leveraging agriculture for improving farming households' food intake, nutrition, and health.

The finding of the study concludes that farmers in the study were ageing, this is evidenced in the highest mean age of 54.6 years in Oyo state. Also, a large households' size was recorded in the research as the study recorded average of 7 in the study area, large household size could lead to correspondingly poor food intake, nutrition and health in the study area. Furthermore, the mean years of education was 8.64 years in Oyo state,10.28 years in Ogun state and 9.09 years of education in Osun state. A higher number of years of education could have a positive influence on the ability of the farmers to know their nutrition composition of food and the need for food intake diversity. It can also enhance their knowledge of the association between food intake, nutrition, and health.

The study also identified that majority of the respondents {96.70%} cultivate less than 4 ha in Oyo state and Ogun state with a mean of 3.18 and 3.48 farm size respectively. This indicates that the respondents are mostly small-scale farmers. 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 and environmental variables persistently constitute to the full achievement of the sustainable agricultural system.

The findings of this research emphasized the significance of 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. Family planning technique in relation to achieving a sustainable agricultural system through extension officers was identified due to the recorded family size in the study area. In addition, farmland cultivated by the farmers and farm revenue was small when compared to their average family size. More agricultural settlement should be created by the government of the day with subsidized farm incentives.

Farming households' possession of asset such as bicycle, vehicle and livestock were repeatedly significant to food intake, nutrition and health status in the models. This indicates that rural farming households in the southwest Nigeria need financial support, in form of loan for their farming enterprise so that they can make better revenue and profit in order to possess assets since assets possession is an indicator of good welfare. Also, respondents' total revenue and sources of finance were emphasized in the empirical findings to be significant to nutrition and health, this buttress the need for financial support by the government of the day in order to enhance farming households' income.

Furthermore, the study identified respondent refuse disposal management and toilet type as an important factor which contributes to the respondent wellness and health status. There is a need for modern refuse disposal method and modern toilets in respective households of southwest Nigeria in order to encourage good health practice and prevent ill health situation. In addition, respondent water source was identified to be relevant to their health, this calls for the need for

the households' to be careful of the water they take while there is also need for good water sources in the study area.

This study also validates self-rated health approach of measuring the health status of individuals as this was significant to the health status of the farming households. This is a contribution to the international debate on the goodness of self-rated health approach of health measurement. Also, there is an indication that food security status of the farming households in the study area was significant to their health status. Food security is important as a goal that must be achieved by the international communities especially in the developing nations such as Nigeria in order to prevent the ill health consequence of the farming households'.

The total cost of feeding and total cost of health were significant to nutrition and health status of the respondents. This was also added by the cost implication of this duo, this implies food intake, and nutrition and health are important areas that must be given attention in the study area. Also, waiting for time for treatment when sick was very high and households' that choose private hospital when sick had a significantly higher probability of being in the normal BMI classification when compared with their contemporary who answered no. In addition, drug availability and respondents choice of health care service provider were found significant to their health status in the study. This obviously calls for overhauling of public hospitals in rural southwest Nigeria in order to ensure quality and efficient treatment and reduction in waiting time by these poor farmers since the income of the households are expected to determine their choice of treatment and health care provider when sick.

Finally, it was concluded that diversity of food intakes among the farmers was low and overweight was a major problem 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 nutrition has a tangible effect on the health of farming households. The findings further stressed the need for the government of the day to enhance the wellbeing of Southwestern farming households through capacity development and skill building programs.

7.3 Policy Recommendation

These results can serve as inputs for the development of evidence-based policy interventions to promote farming households food-nutrition and health, particularly in the rural areas of Southwest Nigeria, putting the farmers "the principal operators" perceptions and needs into account. The evidence of agricultural households' vulnerability to poor food intake, nutrition and health was articulated previously in spite of the existing Nigerian national agricultural policies, signifies the importance of formulating at least workable region-specific policy strategies in order to achieve this national aim. This endeavor could invariably guarantee the appropriateness and more effectiveness of interventions which will steer up the support and uptake by the local stakeholders (such as the farming communities, farming households, agricultural extension expert, and Non-Governmental Organization et.c). Based on the outcomes of this study, the following policy implication, and recommendations are made:

(1) Farming households' across the selected states were found to be ageing. The government of the day should encourage the young stars by implementing policies that will make agriculture more lucrative so that the ageing farmers can be replaced by the youths who are presently migrating to urban areas as identified in the labour type used by farmers in this study.

(2) The study shows that farmers occupy small land hectares for their farming enterprise. There is room for improvement in this regard for agricultural sustainability, this could be achieved by ensuring that land ownership for smallholders is respected and enforced, which would incentivize farmers to invest in more sustainable farming practices in the study area.

(3) 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.

(4) 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.

(5) The Large household size was also identified among the farming households in the study. There should be a proper orientation of farming households on family planning methods.

(6) 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.

(7) There should be enlightenment programmes to southwest 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.

(8) Extreme hunger, malaria, farm work hazards and other diseases were prevalent among the rural farming households in this study. There should also be more serious interventions by the government of consistent mobilization of resources, formulation, and implementation of holistic policies and programmes that will promote awareness of the entwined-bidirectional nature of nutrition-health agriculture.

(9) The study reveals that there is an important linkage between farming households' food intake, nutrition and health of farming households' in Southwest 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.

7.4 Future Research Directions

This study investigated the economics of food intake, nutrition and farm households' health in the Southwest, Nigeria. Further studies are expected to be undertaken on health and nutrition outcomes which often are analyzed in terms of labour productivity or labour supply decision at the household-level. But the manifestation of undernutrition and health hazards in terms of creating a heavy burden of diseases on labour household is not well captured in the literature. It will relate the whole health-labour productivity issue into the broad quest of wellbeing. It will further be interesting to examine how nutrition and health affect the labour market outcomes and the welfare considering neighborhood effects.

Health entitlement is found to be effective not only through public initiatives but also through channels of individual characteristics like age, sex, social group, the level of education, etc. Though the channels of individual characteristics through which health influences the individual's productivity are addressed in the literature, the question of ethnicity is not well explored. Besides, the functioning of political economy in explaining the health inequality and its impact on labour market outcomes also remains an uncharted land. Entitlement to health status largely depends on the structure of the political ideology and political economy.

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APPENDIX A

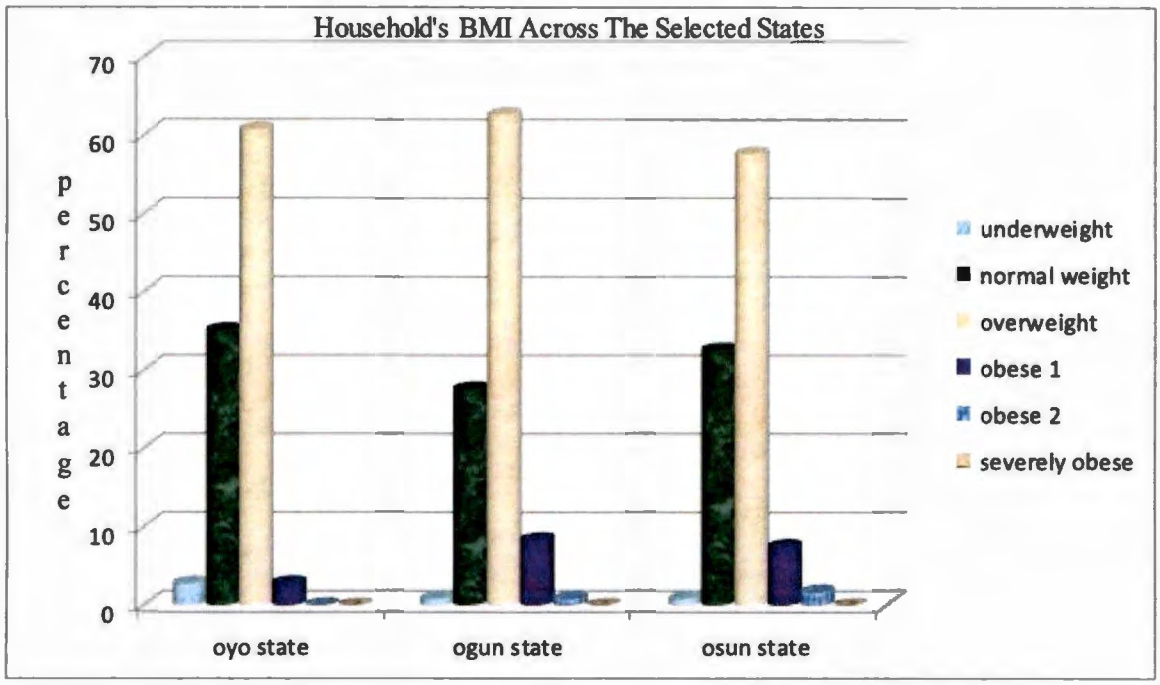
Table of Study Objectives

S/N	OBJECTIVES	DATA USED	ANALYTICALTOOL
1	To describe farming households' nutritional and health status in relation to their socio-economic characteristics.	24 hours Data of farming households' nutrition, health and environmental profile and socio-economic profile.	Household Dietary Diversity score (HDDS) and BMI, and cost of nutrition and Health. Descriptive statistics {On SPSS version 22}.
2	To analyze farming households' cost of nutrition and health expenditures in relation to their income.	Respondents cost on health, nutrition, income and expenditure.	Descriptive statistics {On SPSS version 22}.
3	To determine the factors that influence farming households' nutrition status (proxy as food intake) in the study area.	Households' demographic characteristics and HDDS.	Poisson regression, Principal Component Analysis, {On STATA version 11 Software}.
4	Analyze the effect of food intake on the health status (proxy as having normal BMI) of the farmers.	Farming households' socio-economic characteristics, data on Nutrition, and Health.	Logistic regression, Ordered Probit regression ,Probit regression, Principal Component Analysis and Two-stage Ordinary least square method. {On STATA version 11 and 12 Software}.

Source: Authors Computation, 2015

APPENDIX B

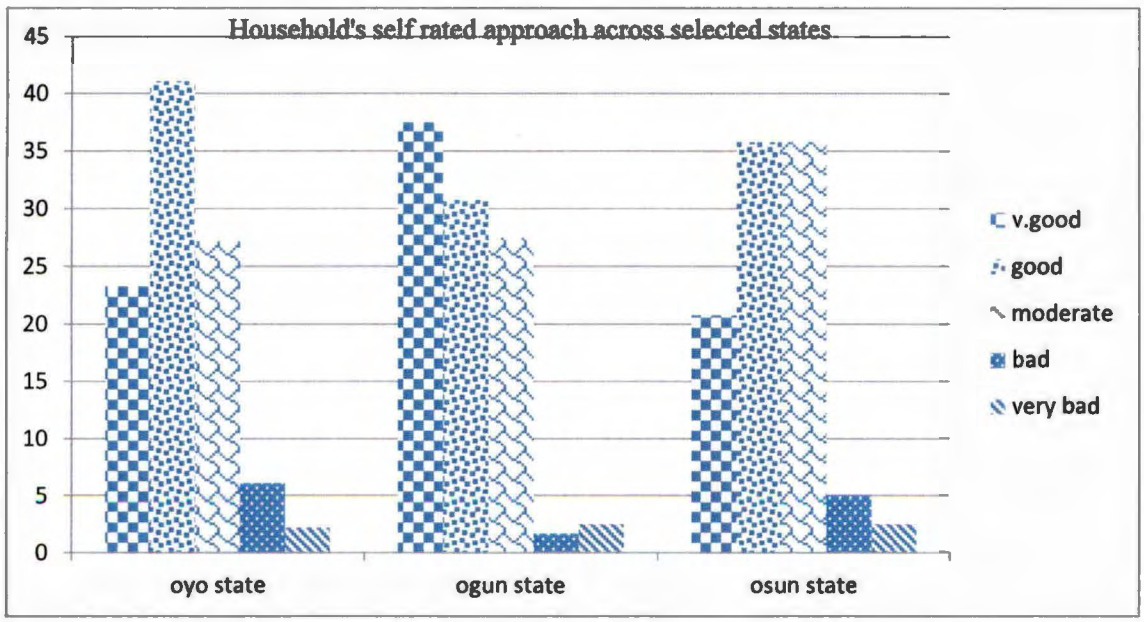
Body Mass Index (BMI)



Distribution of Respondents Households BMI across the Selected States

Source: Field Survey 2015.

Respondents Self–Rated Health Status



Distribution of Respondents Self-rated Health Status across the selected states

Source: Field Survey 2015.

Health Profile of Result of Respondents as Being Asked In the Study Area

Ill-heath/Hazard	Frequency		Percentage		Mean	Standard deviation
	No	Yes	No	Yes		
Malaria Fever	55	365	13.1	86.9	0.8690	0.33775
Typhoid	316	104	75.2	24.8	0.2476	0.43214
Dysentery	396	24	94.3	5.7	0.0571	0.23239
Diarhoea	372	48	88.6	11.4	0.1143	0.31854
Cholera	395	25	94.0	6.0	0.0595	0.23688
TB/Severe Cough	405	15	96.4	3.6	0.0357	0.18580
Guinea worm	396	24	94.3	5.7	0.0571	0.23239
HIV	420		100		0.0000	0.00000
Flu/Acute Resp.	393	27	93.6	6.4	0.0643	0.24555
Hookworm	393	27	93.6	6.4	0.0643	0.24555
Depression	390	30	92.9	7.1	0.0714	0.25785
Diabetes	411	9	97.9	2.1	0.0214	0.14498
Cough/Catarrh	418	2	99.5	.5	0.0048	0.06892
Gunshot wond	414	6	98.6	1.4	0.0143	0.11881
Witow/blister	316	104	75.1	24.7	0.2476	0.43214
Hypertension	397	23	94.5	5.5	0.0548	0.22779
Road accident	387	33	92.1	7.9	0.0786	0.26939
Alcoholism	411	9	97.9	2.1	0.0214	0.14498
Pneumonia	385	35	91.7	8.3	0.0833	0.27672
Other illness/injury	378	42	90.0	10.0	0.1000	0.30036
Total	420		100			

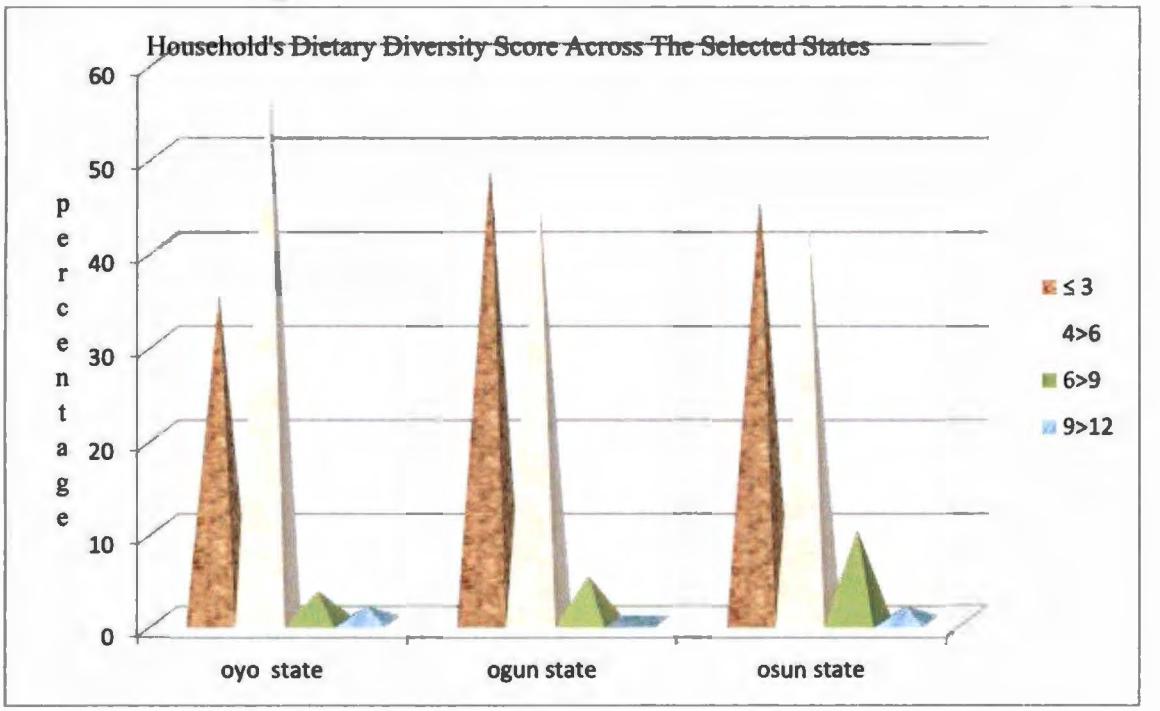
Source: Author, 2015

Distribution of Respondents Households' Dietary Diversity Score According to the 12 Food Groups Eaten within the 24 Hours Recall Period

	YES		NO			
Food Group	**Freq**	**%**	**Freq**	**%**	**Mean**	**Standard Deviation**
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

Source: Author 2015

Households' Dietary Diversity Scores



Respondents Households HDDS across the Selected States

Source: Field Survey 2015.

APPENDIX C

{1} Analysis of Variance of the Major Indicators of Food Intake and Nutrition

Summary Interpretation

There was a statistically significant difference between indicators of food utilization and nutrition groups as determined by one-way ANOVA with Households Dietary Diversity Score having ($F(2,417) = 13.252$, $p = 0.000$),Sanitation ($F(2,417) = 6.029$, $p = 0.003$) and Households food security status ($F(2,417) = 3.672$, $p = 0.026$). In addition, a Tukey post hoc test which shows how groups differed from each other gave an additional insight. The Tukey post hoc test is generally the preferred test for conducting post hoc tests on a one-way ANOVA and in this study, it revealed that the Household Dietary Diversity Scores between Ogun and Osun states was statistically significant ($p = 0.001$) while Osun and Oyo state gave ($p = 0.000$) .However, there were no differences between the Households Dietary Diversity Scores between Ogun and Oyo state groups ($p = 0.470$) in this study. This shows some level of consistency in the reports of this study as this is in line with the reports in descriptive table 4.14 of chapter four.

Also, the parameter of sanitation level of the respondents across the states revealed that sanitation level between Ogun states and Osun state was ($p = 0.003$) while Osun and Oyo state gave ($p = 0.018$).However, there were no differences between the sanitation level of Oyo and Ogun state groups ($p = 0.773$).Finally, the parameter of households food security level of the respondents across the states revealed that food security level between Ogun states and Osun state was ($p = 0.046$) while between Ogun and Oyo state was ($p = 0.051$) .However, there were no differences between the food security status of Oyo and Osun state groups ($p = 0.985$) in the study area.

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
HHDDS	Between Groups	32.327	2	16.164	13.252	.000
	Within Groups	508.613	417	1.220		
	Total	540.940	419			
SANITATION	Between Groups	2.734	2	1.367	6.029	.003
	Within Groups	94.531	417	.227		
	Total	97.264	419			
HHFSEC	Between Groups	1.787	2	.894	3.672	.026
	Within Groups	101.477	417	.243		
	Total	103.264	419			

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) STATE	(J) STATE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
HHDD	Ogun	Osun	.50000*	.13698	.001	.1778	.8222
		Oyo	-.15288	.13040	.470	-.4596	.1538
	Osun	Ogun	-.50000*	.13698	.001	-.8222	-.1778
		Oyo	-.65288*	.13040	.000	-.9596	-.3462
	Oyo	Ogun	.15288	.13040	.470	-.1538	.4596
		Osun	.65288*	.13040	.000	.3462	.9596
ENVHYG	Ogun	Osun	-.19231*	.05906	.003	-.3312	-.0534
		Oyo	-.03846	.05622	.773	-.1707	.0938
	Osun	Ogun	.19231*	.05906	.003	.0534	.3312
		Oyo	.15385*	.05622	.018	.0216	.2861
	Oyo	Ogun	.03846	.05622	.773	-.0938	.1707
		Osun	-.15385*	.05622	.018	-.2861	-.0216
HHFSEC	Ogun	Osun	-.14615*	.06119	.046	-.2901	-.0022
		Oyo	-.13654	.05825	.051	-.2735	.0005
	Osun	Ogun	.14615*	.06119	.046	.0022	.2901
		Oyo	.00962	.05825	.985	-.1274	.1466
	Oyo	Ogun	.13654	.05825	.051	-.0005	.2735
		Osun	-.00962	.05825	.985	-.1466	.1274

***. The mean difference is significant at the 0.05 level.**

{2} Analysis of Variance of the Major Indicators of Farming Households Health

Summary Interpretation

There was a statistically significant difference between indicators of health as determined by the one-way ANOVA with respondent Body mass Index ($F(2,417) = 0.917$, $p = 0.401$), and Self rated health approach status ($F(2,417) = 12,267$, $p = 0.000$).The Tukey post hoc test revealed that there were no differences between the Households Dietary Diversity Scores between, Ogun and Osun ($p = 0.771$),Osun and Oyo ($p = 0.803$) and Ogun and Oyo state groups ($p = 0.366$) in this study. This shows some level of consistency in the reports of this study as this is in line with the reports in descriptive table 4.30 of chapter four.

Also, the parameter respondents self-rated health approach status revealed that self-rated health between Ogun states and Osun state was ($p = 0.000$) while Oyo and Osun state gave ($p = 0.000$).However, there were no differences between self-rated health status of Oyo and Osun state groups ($p = 0.983$).These is also in consonance with the descriptive illustration earlier discussed in table 4.29 of this thesis.

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
BMI	Between Groups	15.492	2	7.746	.917	.401
	Within Groups	3523.565	417	8.450		
	Total	3539.057	419			
SEFRATHAPR	Between Groups	21.525	2	10.762	12.267	.000
	Within Groups	365.854	417	.877		
	Total	387.379	419			

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) STATE	(J) STATE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
BMI	Ogun	Osun	.24769	.36055	.771	-.6004	1.0957
		Oyo	.46465	.34323	.366	-.3427	1.2720
	Osun	Ogun	-.24769	.36055	.771	-1.0957	.6004
		Oyo	.21696	.34323	.803	-.5904	1.0243
	Oyo	Ogun	-.46465	.34323	.366	-1.2720	.3427
		Osun	-.21696	.34323	.803	-1.0243	.5904
SEFRATHAPR	Ogun	Osun	.50000*	.11618	.000	.2267	.7733
		Oyo	.48077*	.11060	.000	.2206	.7409
	Osun	Ogun	-.50000*	.11618	.000	-.7733	-.2267
		Oyo	-.01923	.11060	.983	-.2794	.2409
	Oyo	Ogun	-.48077*	.11060	.000	-.7409	-.2206
		Osun	.01923	.11060	.983	-.2409	.2794

*. The mean difference is significant at the 0.05 level.

APPENDIX D

DEPARTMENT OF AGRICULTURAL ECONOMICS
HOUSEHOLD SURVEY QUESTIONNAIRE ON STUDY TITLED:
ECONOMICS OF FOOD UTILIZATION, NUTRITION AND FARM HOUSEHOLDS' HEALTH IN SOUTHWEST NIGERIA

Questionnaire number:…….. Village :……

State and L.G.A:…….. Date of interview ……

Dear sir/ma,

Your assistance is required in providing correct answers to the following questions. The researcher is a student of the above-mentioned department and school. Your answers will be confidentially treated and used for academic purpose only.

Thanks and Regards!

RESPONDENTS SOCIO- ECONOMIC CHARACTERISTICS

(1) Sex: Male ( ) Female ( )

(2) Marital status: single ( ) Married ( ) Divorced ( ) Widow(er) ( ) separated ( )

(3) If married how many wives: ……..

(4) Number of children: ……

(5a) Household size: ……

(b) Number of nonworking member(s) ……

(c) Number of working member(s) ……..

(6) Age;……

(7) What tribe are you…….

(8) Year(s) of Education ……..

(9) What is your primary occupation? Farming ( ), others…….....

(10) What another source of income do you have apart from farming (specify)……

HEALTH AND ENVIRONMENTAL PROFILE

(1) How many times did you fall sick last year .....

(2) What's your believe about the sickness..... (a) Spiritual ailment (b) medical ailment (c) physical problem. (d) Others.

(3) What type of sickness or illness did you suffer from Last year from the list below?

S/N	SICKNESS	Yes=1 /No=0	SS/N	SICKNESS	Yes=1/ No=0
1	Malaria/ Fever (Ako Iba)		11	Depression or mental illness(Arun Opolo)	
2	Typhoid (Iba Jedojedo)		12	Diabetes (Ito sugar)	
3	Dysentery (Igbe gbuuru)		13	Cough/catarrh (Iko ati ofinkin)	
4	Diarhoea (Igbe eleje)		14	Gunshot wounds (Asita ibon)	
5	Cholera (Arun Onigbameji)		15	Whitlow/blister (Akandun)	
6	TB/severe cough& blood (Iko'fe/awugbe)		16	High blood pressure/hypertension (Eje riru)	
7	Guinea worm (Sobia)		17	Road/domestic accident (Ijamba ojuona tabi tile)	
8	HIV/AID (Arunkogboogun)		18	Abuse of alcohol or drugs (Ewu Otimimu tabi Oogun)	
9	Flu or acute respiratory tract infection		19	Pneumonia (Otutu aya)	
10	Hookworm (Arun mujemuje)		20	Other illness / farm injury/body ache (Arariro)	

Source: Authors computation, 2015

(4) what did you think is the cause of the sickness (a) sunshine (b)stress (c) mosquitoes bite (d) cold weather (e) flies (f) change in season (g) no idea (h) dirty water (i) food (j) more than one of these (k) others (spiritual/contagious).

(5) How knowledgeable are you about your health: Good ( ), Very good ( ), Moderate ( ), Bad ( ), Very bad ( ).

(7) In the past one year, have you or any member of your household used.....(a) pesticides ?

(8) How long does it take you to recover (days of incapacitation) from the sickness?: .....

(9) What source of health care do you use when you are sick (a) hospital (b) traditional (herb) (c) self-medication (d) combination of any

(9b) What is the degree of drug availability (quality care) in your choice source (a) very good ( ) (b) good ( ) (c) fair ( ) (d) excellent ( )

(10) What was the waiting time for treatment? .....

(11) Did you have screening net on your window & or door? (a) yes (b) no (c) yes but spoilt.

(12) House structure (a) a flat (b) bungalow (c) mud (d) a room (e) a hurt (f) others

(13) How is your sleeping condition?: (a) bad (b) normal (c) good (e) very good.

(14) Environmental hygiene? : (a) present of growing bush yes/no (b) Stagnant water yes/no (c) Refuse dump site yes/no (d) Uncovered water storage method yes (e) Others .....

(15) What is your means of refuse disposal? (a)Plastic disposal (b) burning (c) bush (d) private organized packing (d) others

(16)What is your means of excreta (i) Pit latrine toilet (ii) Water Closet (iii) Bush (iv)bucket (v) others

(17) Is your family toilet facility shared with other neighbours? (a) Yes (b) No

(18) Environmental problems experienced in your community/on your and neighboring farms? (a) Land degradation/land over-utilisation (b) vicinity littering (c) Water pollution (d) Air pollution (e) Irregular or no waste removal in the environment (f) Excessive noise/noise pollution.

(19) How close is your refuse disposal means..... metre

(20) Do you personally have transportation means (a) Yes (b) No

FOOD UTILIZATION AND NUTRITION

(1a) What is your height (M)..... (b) Body mass.....Kg

(2a) What is your primary source of obtaining food (a) Own production (b) Purchased (c) Borrowed, exchanged for labour, gift from friends or relatives (d) Food aid (f) Other.....

(2b) How many time do you eat in a day? Once ( ), Twice ( ), Thrice ( ), More ( )

(3)Which of this classes of food do you eat in the last 24 hours in your house?

QUESTION NUMBER	FOOD GROUP	YES=1,NO=0
1	CEREAL	
2	TUBERS AND WHITE ROOTS	
3	VITAMIN A RICH VEGETABLES AND TUBER	
4	DARK GREEN LEAFY VEGETABLES	
5	OTHER VEGETABLES	
6	VITAMIN A RICH FRUITS	
7	OTHER FRUITS	
8	ORGAN MEAT	
9	FLESH MEATS	
10	EGG	
11	FISH AND SEAFOOD	
12	LEGUMES, NUTS, AND SEEDS	
13	MILK AND MILK PRODUCTS	
14	FAT AND OIL	
15	SWEETS	
16	BEVERAGES ,SPICES AND CONDIMENTS,	
17	HH QUESTION	

Source: (FAO/WHO ,2011).

(4) Did you and or your household run out of money to buy food during the past one year (a) yes (b) No

(5) What is your source of drinking water (i) well (ii) borehole (iii) river (iv) tap (v) rain (vi) others

(5b) Do yo know about nutrition: (i) yes (ii) No

(6) Do your household members treat water before drinking (i) Yes, always (ii) Yes, sometimes (iii) No, never.

LABOUR PRODUCTIVITY

(1) What type of labour do you use on your farm? (a) Self (b) family (c) hired (d) A and B (e) All

(2) How long is it to your farm from house..... (Hours/minute)

(3a) What is the size of your farm? ..... .(Ha) (3b) Is this farmland yours (a) Yes (b) No

(4) Year of experience in farming? .....

(5) How do you acquire your farmland? (a) Leased ( ) (b) purchased ( ) (c) inherited ( )

(6) Source of financing your "farming" enterprise (a) personal saving (b) friends & relation

(c) Cooperative loan (d) bank loan (e) others .....

(7)How many hours do you use on farm daily (working hour).....

(8)Type agric. practiced? (a) Fish farming (b) crop planting/forestry (c) Livestock (d) A & B

(e) B & C (f) A & C

(9a) Did you have livestock's Yes ( ) No ( )

(9b) Do you own the land you are presently using for agriculture? Yes ( ) No ( )

(10) Are you a member of any cooperative or professional association Yes ( ) No ( )

PRODUCTION COST AND RETURN

How much do you pay on your farming land .....₦

How much is a daily pay of a labourer.....₦

How much is your cost /annum on the following:

Land clearing.....₦

Stumping and other preparatory activities.....₦

Estimate on ridges.....₦

Weeding .....₦

Application of chemicals (herbicide).....₦

Application of chemicals (insecticides).....₦

Fertilizers .....₦

Seed/seedlings .....₦

Your transportation cost to farm per anum.....₦

Transportation to point of sale (if applicable) .....₦

Labour including family self & labour.....₦

Tax.....₦

Electricity .....₦

Miscellaneous.....₦

Clothing and wears .....₦

Cell phone and maintenance .....₦

Fuel and Power .....₦

Remittance and others .....₦

Income from non-farm activity per month.....₦

What was your Total cost (TC)..... ₦

(5) What was your total farm revenue (TFR) from last year harvest of your farm.....₦

(6) How much do you make from non-farming activities last year (if applicable).....₦

(7) Total income i.e. sum of income from farming and non-farming activities.....₦

(8) Did you have access to any credit facility for your farming activities? (A) Yes (B) No

(9) Do you belong to any farming professional society (A) Yes (B) No

COST IMPLICATION OF HEALTH AND NUTRITION

What is the Total cost implication of your days of incapacitation last year? ....₦

What is the Total Amount spent on ill health preventive measures ..... ₦

What was your treatment and transport cost for your illness/injury last year.....₦

What's Total money lost due to health (treatment cost + preventive measure incapacitation period)? .....₦

How much do you spend on feeding (your family) per week .....₦

What is your total food expenses per annum .....₦

GENERAL VIEW

What coping strategy do you adopt when you have health, nutrition and production problem (a) Remittances (b) Borrowing (c) Sales of assets (d) Drawing on savings (e) Migration (f) Income from off/non-farm jobs (g) Adjustment in food intake (h)Interruption of education (i) Mention others.....

General comment/suggestion about your health, nutrition, production and effects on your household income.....

Remark .....

THANKS FOR YOUR TIME AND COOPERATION

APPENDIX E

LIST OF PUBLICATIONS

The following articles, were published, accepted or under review and form part of the research presented in this thesis.

- ✓ **Article Publication 1 – Chapter 4 and 6 of the Thesis:**

Economics of Food Intake and Farming Households Health Synergy in Southwest, Nigeria: A Two-Stage Probit Regression Approach. Journal of Developing Areas Volume 51, Number 4 pp.109-125. https://muse.jhu.edu/article/662832

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches, wrote the manuscript and effect the reviewer's corrections.

- ✓ **Article Publication 2 – Chapter 1 and 2 of the Thesis:**

Food Utilization, Nutrition, Health and Farming Households' Income: A Critical Review of Literature .Journal of Human Ecology, India 56(1,2): 171-182 (2016). http://krepublishers.com/02-Journals/JHE/JHE-56-0-000-16-Web/JHE-56-1,2-000-16-Abst PDF/JHE-SV-56-1,2-171-16-2923-Omotayo-A-O/JHE-SV-56-1,2-171-16-2923-Omotayo-A-O-Ab[22].pmd.pdf

Authors: Abiodun Olusola Omotayo , Rhoda Bukola Aremu, and Oluwadara Pelumi Alamu

Candidate's Contribution: Designed the study, managed the literature searches, and wrote the first draft of the manuscript.

- ✓ **Conference Presentation at the International Conference on Sustainable Development 2017 Ottawa, Canada**

Food security-Poverty in Some Selected States of Nigeria : A Linear Regression with Endogenous Treatment effects' Approach; Presented at the International Conference on Sustainable Development 2017 Ottawa, Canada, (Ref no. 040) http://www.ontariointernational.org/index_htm_files/Program.pdf

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches and wrote the manuscript

✓ Publication 4 – Extracted from the Dataset

Understanding the Link between Households' Poverty and Food Security in South West Nigeria. Accepted and paid for publication in the Journal of Developing Areas. Ref. Number JDA 17002

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches, wrote the manuscript and effect the reviewer's corrections.

✓ Publication 5 – Chapter 4 and 5 of the Thesis:

Farming Households Environment, Nutrition and Health Interplay in Southwest, Nigeria Accepted for publication in International Journal of Scientific Research in Agricultural Sciences, Cannada 3(3), pp.084-098,(2016).

https://www.researchgate.net/publication/312179705_Farming_Households'_Environment_Nutrition_and_Health_Interplay_in_Southwest_Nigeria

Author: Abiodun Olusola Omotayo

Candidate's Contribution: designed the study, managed the literature searches, wrote the first draft of the manuscript from this research and effect the Journal reviewers corrections.

✓ Publication 6 – Chapter 4 and 5 of the Thesis

Disentangling Driver of Monotonous Dietary Intakes among the Rural Farming Households in Southwest, Nigeria. *Agroecology and Sustainable Food Systems* ***(Undergoing review)***

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches and wrote the manuscript

✓ Work in Progress on Publication 7 – Chapter 5 of the Thesis

Correlates of Hunger Severity and Food Intake among Rural Households in Nigeria: Facing the Key Challenges of the 21st Century. Agrekon *(Tentative Publisher)*

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches and wrote the manuscript

✓ Work in Progress on Publication 8 – Chapter 6 of the Thesis

Nutritional and Health Assessment of Some Farmers in Rural Areas of Nigeria. Journal of Renewable Agriculture and Food Systems (Tentative publisher).

Authors: Abiodun Olusola Omotayo

Candidate's Contribution: Designed the study, managed the literature searches and wrote the manuscript