

Food Utilization, Nutrition, Health and Farming Households' Income: A Critical Review of Literature

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KEYWORDS Farming Households. Food Utilization. Health. Nutrition

ABSTRACT Farming households' nutrition, health and income are important for rural/agricultural development and poverty alleviation. This article addresses the basic research question, how does nutritional status influence the general physical health and income of agricultural households? Better still, what is the synergy between agricultural households' nutrition, health and income? It handled these issues by digging deep into the magnitude of the effects of the economic relationships between these terms from the perspective of the agreement between public health professionals and economists to explain the mechanism through which nutrition (an established dimension of health) and health as a form of human capital are related to households' income. This article discusses the definition and measurements of nutrition, health and income, theories that explain their linkage, followed by empirical studies' review that thoroughly addresses the issue, both at the micro and macro levels. These reviews as well identified and present some knowledge gaps important for further agricultural research.

INTRODUCTION

Nutrition, health, and agricultural income nexus came to prominence recently. With about one billion people worldwide suffering from food insecurity, and major food nutrients like vitamin, mineral deficiencies, thereby compromising the nutrition and health of billions of people, the international development community began to ask how much more could agricultural productivity do to improve human wellbeing if it explicitly included the MDGs nutrition and health goals? Also, what kind of change(s) could maximize agriculture's contribution to human nutrition, health and income? How could improvement in these contribute to a more productive and sustainable agricultural system, which will be free from the income poverty stigma associated with it, especially in the rural regions of the developing parts of the world?

The World Bank's 2013 report on "*End extreme poverty and promote shared prosperity*" stated that "more than 1 billion people worldwide still live in destitution, a state of affairs that is morally unacceptable given the resources and the technology available today while up to 2 billion people still lack food security intermittently due to varying degree of poverty". This

report is evidenced in the present inability to fully achieve the 1st and 6th millennium development goals (MDGs). Actually, recent literature reported that the progress towards accomplishing these goals was threatened by major impediments such as the effects of climate change and devastating impact of the recent global economic downturn, which was unprecedented in its severity and global dimensions leading to sluggish or even negative economic growth, diminished resources, increased food insecurity and health problems, fewer trade opportunities for the developing countries, and possible reductions in aid flows from donor nations. Agriculture is the primary source of calories and essential nutrients and is presently a major source of income for eighty percent of the world's poor (International Food Policy Research Institute (IFPRI) and International Livestock Research Institution (ILRI) 2010).

According to Gilbert et al. (2010), as cited in IFPRI and ILRI (2010), "*Agriculture-related health losses are huge, accounting for up to twenty-five percent of all disability-adjusted life years lost and ten percent of deaths in low-income countries*". For the purpose of this article, these four concepts, agricultural income (income poverty), health and nutrition need to be clarified. Agriculture is defined by Merriam-Webster (2010) as the science and practice of culti-

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vating the soil, producing crops, livestock rearing, preparation and marketing of the resulting products.

Agricultural income is, therefore, the return accrued from agricultural production during the year. It is also known as a gross agricultural product at factor cost less consumption. Income poverty describes a person or family who lives on or below the minimum acceptable way of life. It is common with rural households who are characterized by low income. Health according to WHO (1948) is defined as a state of complete physical, mental and social wellbeing and not a mere absence of disease or infirmity. Nutrition, however, is a dimension of health relating to the macro and micronutrient adequacy of an individual's diet.

Most factors that affect farming household income have implications on health and nutrition. Conversely, the majority of factors that affect health and nutrition will most likely have implications on farming households' income. As a result, one could assert that agriculture is the only realistic way for most people to get the nutrition they need. In many poor countries, agriculture is highly labor intensive and productive agriculture demands the unwavering labor of well-nourished and healthy people. However, more than fifty percent of the world's poorest people live in farming communities (rural settings), including many suffering from malnutrition. Black et al. (2008) gave a recent estimate that "*globally the combined effect of inadequate macro and micronutrient (including iron and iodine) intakes underpin thirty-five percent of all child deaths and are responsible for eleven percent of the global disease burden*".

Poor diets, disease, and other factors mean that many people do not get the adequate and appropriate nutrients they need for a sound and healthy life. More than thirty percent of the world's population are anemic, many due to iron deficiency (WHO 2010). Moreover, hunger and malnutrition/starvation have effects that last throughout the life cycle, because poorly nourished children grow up to be less healthy and productive than they are actually supposed to be. WHO (2010) stated that being overweight affects more than one billion people worldwide, and obesity affects at least three hundred million globally. Malnutrition constrains an individual's long-term capability for taking advantage of economic opportunities. Many policy-

makers and donors believe that long-term sustained economic growth is the most effective way of dealing with the malnutrition problem. Since the economies of many developing countries are heavily based on agriculture, growth in the agricultural sector through technological change is viewed as a key means of generating this economic growth.

However, this long-term perspective does little to deal with the short-term acute malnutrition problem. Health as a capital good can either improve or reduce a household's productive ability. A study of farmers in mixed cropping systems found that the vast majority suffered from heat exhaustion, serious muscular fatigue, and skin disorders, which forced them to take days off from attending to crops and other farm activities (Cole 2006; Clifford et al. 2006; Donald 2006 and Bradley 2002) opined that health capital is affected by a number of preventable diseases such as HIV/AIDS, farm injuries, cholera fever, schistosomiasis, diarrhea, malaria, respiratory diseases and skin disorders.

Health raises physical capacities like strength and endurance, mental capacities and reasoning abilities. These enhance workers' efficiency and productivity (FAO/WHO 1992). In the same vein, Ugwu (2006), Clifford et al. (2006) and Bradley (2002) opined that health capital is affected by a preventable disease, malaria, musculoskeletal disorder, HIV/AIDS and yellow fever. These diseases according to Ngambeki and Ikpi (1982) make farmers not utilize fully all inputs at their disposal and debilitates farmer's physical performance and equally impacts negatively on the farm profit levels.

Poor health will result in a loss of days worked or reduced worker capacity, which when family and hired labor are not perfect substitutes or when there are liquidity constraints, is likely to reduce output (Antle and Pingali 1994). For example, prolonged exposure to pesticides could cause adverse dermal effects (skin diseases), cardiopulmonary problems, neurological and hematological symptoms, which could significantly hamper farmers' work capacity in the field and reduce their management and supervision abilities (Schultz 1999). As pointed by the World Bank (2007), illness and death from malaria, human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS), tuberculosis and other diseases reduce agricultural productivity through the loss

of farm labor, income to illness, productive adults' knowledge, and personal assets in order to cope with illness. For Lipton and De Kadt (1988), the failure of agriculture and health departments to coordinate their policymaking undermines efforts to overcome ill health among the rural poor and hampers agriculture's role in alleviating many of the world's most serious health problems.

Poor health results in loss of work days, decreases workers' capacity, causes absenteeism, decreased innovation ability and tendency to explore diverse farming operations and practices and by such makes farmers to capitalize on farm-specific knowledge hence, not exploring another method of agricultural practice, which could yield better output. According to Asenso-Okyere et al. (2010), poor health reduces a farmer's ability to innovate, experiment, operationalize and actualize changes in agricultural systems. Serious health conditions resulting in catastrophic expenditures may also result in depletion of productive assets such as the sale of draught animals and the sale of cultivable land (Slater and Wiggins 2005). The consequence of these actions includes reduction of readily small farm sizes, cultivation of less capita-intensive crops, and reduction in livestock reared resulting in poor livelihoods/welfare.

Furthermore, there is a reciprocal process in this relationship, whereby the health of individuals practicing farming may affect agriculture itself, and an unhealthy agricultural population may provide reduced labor and resources, which have negative consequences on productivity and implications for consumers. Health affects agricultural systems by affecting the health of the farm major operators, which are mostly household heads. Developing countries of the world need good nutrition, health and productive agricultural methods to alleviate poverty because lowered productivity by agricultural workers due to poor health, affects their income and further deepens the incidence, depth and severity of poverty and ill health (International Food Policy Research Institute (IFPRI) 2007).

Attempts to stimulate agricultural productivity have witnessed increased investment in human capital development, innovation, and training, increasing access to credit facilities, information, and improved technology. While these investments may yield positive returns, unanticipated health shocks have a tendency of dissipating anticipated benefits. Directly, ill

health affects physical strength and work days/hours available for farm work. Since agricultural productivity is dependent on physical strength and stamina, and therefore good health, it is more probable that health shocks directly affect worker productivity. Indirectly, ill-health involving high medical expenditures tends to deprive farming households of resources to invest in experimentations on improved practices and adoption of new technology.

Presently, there is a widespread recognition in the African continent, international organizations, and the donor communities that improving the productivity and income-generating capacity of agriculture is essential in poverty alleviation (as being desired by the Millennium development goal 1) and desired socioeconomic growth. The tendency for increased food production, adequate storage facilities, and development of vibrant agro-processing and agribusinesses necessary to kick-start the growth process is evident in all parts of Africa. The induced dynamics would indeed constitute a significant source of economic growth in Africa (Food and Agriculture Organization of the United Nations (FAO) 2002).

To foster progress toward agriculture-led food security and economic growth, developing countries need to pay closer attention to the development of human capital through investments in education and training, environmental health and sanitation, food and nutrition. Pursuing a vision that "promotes human development is key to sustaining social and economic progress in all countries" (World Bank 2007b). The Organization of African Unity said that in the year (2000), "*it has cost African economy USD 3.6 billion in a year as a result of working hours lost and the cost of treatments*". Rural households unlike the fixed wage earners not only lose valuable working hours in treating the sickness but also lose income that would have been generated at incapacitation period. Thus, poor nutrition and health status directly affects the productive capacity of the agricultural households. This, in turn, translates into income loss to sickness and consequently poverty through the sick and the caregivers to the farming households.

According to Fulginito and Perrin (1998), a developing country's agriculture is characterized by a widespread productivity decline. Despite concerted efforts by the different Nigerian

government in terms of human and material input into the agricultural system in order to attain self-sufficiency in food production, processing and storage, the rate of productivity decline has persisted (Falusi 1995; FAO 1987; NPC 2006. Agulana 2006; Schultz 1999). Strauss and Thomas (1998) opined that there is a correlation between health and welfare of farmers. Good nutrition and health enhance work effectiveness and productivity of an individual through increases in physical, social and mental capacities. There is, therefore, an established synergy between nutrition, health and income, as it is extremely difficult to separate nutrition and agriculture health stock from the agriculture labor supply and income.

This review article is divided into four sections. The next section comprises the further empirical literature on nature of nutrition-health-income linkage, theoretical proofs of the relationship between income and consumption and its implication on households' efficiency. The third section explains and clarifies issues related to the measures of nutrition, health and income while the final section highlights issues for further research in this area and a brief conclusion.

However, this review is not just a compilation of mere evidence agreeing or defying the nutrition-based efficiency wage hypothesis, rather, it describes how the wide issue of nutrition-health-productivity linkage has been worked on by both theoreticians and the empiricists, what is the foundation of this relationship, what are the different spans of nutrition and health status and how can they be beneficent or non-beneficent as far as workability of the research is concerned.

The review debates that putting into consideration, nutrition and health being the input of production and thus affecting the individual basic income and likewise the household income as well, it does not forget the relationship in the other way round in any way. It further mentions that the studies consider wage or income being a basic factor that impacts nutrition and health status of individual and households, and hence, the present review demonstrates the causality issue between nutrition, health and income. Furthermore, it also attempts to shed more light on the relationship between nutrition, health status and agricultural income. The very nature of the relationship between nutrition, health and income are causal, which stems from the idea of

nutrition-based efficiency wage hypothesis valid in most cases for a subsistence economy.

Theoretical Studies

The relationship between health, nutrition, income and economic wealth is well documented. The impact of nutrition and health can be manifested as increased income, wages, and productivity. It is likely that causality runs in both directions. However, nutrition, health, productivity and prosperity (increase in efficiency and/or productivity) are also affected by many other variables. That income, health, nutrition and productivity are interrelated is beyond question. Higher-income countries have better nutrition, health, and productivity, and so as incomes grow across populations, their overall health, nutrition and production improve. It is also widely known that agricultural productivity has historically played an essential role in economic development. Increases in productivity in the agriculture sector release resources for use in the nascent industrial sector.

Egbetokun et al. (2012) assessed the impact of health on agricultural technical efficiency in Nigeria, and they found that a one percent improvement in the health condition of the farmers would increase efficiency by twenty-one percent. Nonetheless, this process of economic development has always been accompanied by improved health. The health problem has direct and indirect costs on the productivity of the farmer. Adverse health and nutrition impact the outcomes by affecting the capacity of the labor. According to Hawks and Ruel (2006), in agricultural communities, poor nutrition and health reduce income, efficiency and productivity, further reducing people's ability to address health problems inhibit economic development. Nutritional, health status, and labor productivity are directly linked through an entwined relationship.

Undernutrition is one of the major causes of immune deficiency in man. Scrimshaw (2003) opined that "ill health on its part impairs nutritional status by reducing both appetite and the body's ability to properly absorb nutrients, which in turn lowers the individual and or households' resistance to further illness". Okoruwa and Agulana (2004) pointed out that "agriculture, health, and nutrition are already deeply related". There is, therefore, the need for multidisciplinary research studies that links households, welfare,

nutrition, health and labor productivity. The basic question in the theory of human capital is, what contribution of changes in the quality of the life of the people to economic development is attributable to health and nutrition? A person's physical productive ability does not only depend on upon his skills, but also upon his physical, and mental health as well as the level of his nutritional status from which he derives his immediate day-to-day energy requirements.

OBSERVATIONS AND DISCUSSION

The Shared Links Between Health and Agriculture

According to Hawkes and Ruel (2006), "the interactions between health and agriculture are two directional. Health affects agriculture and agriculture in turn affects health". They both continued by saying in both cases, there are negative or positive effects that contribute to good or bad outcomes. They concluded by saying that agriculture is essential for good health through the production of food and other raw materials for shelter and medicines. However, agriculture also contributes to major health problems such as occupational health hazards, malaria, food-borne diseases and diet-related chronic diseases. Health plays a major role in agricultural production in two main ways. Health shock reduces the capability of the labor force to work, leading to a decrease in farm productivity and its spillover effects are seen on agrarian economies as in the developing parts of the world. Asenso-Okyere et al. (2011) discussed that "illness and death from HIV/AIDS, malaria, and other life threatening diseases also reduce innovations in agriculture through loss of knowledge of productive adults working in the sector and at times loss of assets used to carry out innovations". Asenyo-Okyere et al. (2009) discussed that "Indeed, the two-way linkages between agriculture and health offer the chance for policymakers and practitioners to collaborate to ensure an increase in positive feedback between these two entities". Good health and productive agriculture work hand in hand in the fight against poverty. Since the majority of the world's poor work in agriculture and the poor suffer disproportionately from related ailment and disease, a conjoined view of agriculture and health is necessary to promote agricultural growth and de-

velopment and reduce pervasive rural poverty. Asenyo-Okyere et al. (2009) further stated, "Even though the linkage between agriculture and health was first recognized long ago, health considerations still play little part in the decisions of governments about agricultural policy". The health sector also has not reached out to agriculture as a key partner in addressing global ill health challenge. There have been reasons for this disjuncture; some borne out of unawareness while others are out of distinct policy conflicts.

According to Lipton and De Kadt (1988), "whatever the reasons, the divisions are slowing down efforts to overcome ill health among poor rural communities". Asenyo-Okyere et al. (2009) stated, "Taking advantage of the positive policy synergies between agriculture and health sectors has the possibility to yield great welfare benefits for the poor in developing countries". In the first instance, Goodman (2000) opined, "The energy and time devoted by farmers to their work conflicts with their time allotted to food preparation, child care and nutritional activities". On the other hand, the labor processes also expose producers to occupational hazards such as accidents and waterborne vector diseases such as malaria. Agricultural systems affect health in several ways, also in the interaction between agricultural producers and their respectful outputs. Asenyo-Okyere et al. (2009) stated, "A notable intermediary process in this regard is environmental changes in air, soil and water. A good example is a relationship between irrigated agricultural systems and malaria. Irrigation creates a suitable environment for parasitic vectors (mosquito) that spread the diseases to producers and its subsequent negative effects on productivity".

Conversely, income of producers can be increased through agricultural irrigation, enhancing and improving access to both curative health-related and preventive services. Agricultural outputs affect health mainly through the quantity and quality of food produced through the level of variety, and price. All these affect nutrition and food-borne diseases that mainly arise in the microbiological and chemical hazards introduced in agricultural systems. However, there is also the potential to employ agricultural methods that can be adapted to prevent these food-borne diseases.

Beckers (1965) developed a framework that links health, labor productivity and income. It was a household production theory, and in it household was considered as producers rather than a consumer of goods and services. Grossman (1972, 1999) also built on this model and viewed health as a durable capital stock that yields an output of healthy time when invested in brings an increase in the household income. Pitt and Rosenzweig (1986) developed a framework that makes it possible to evaluate the impact of a change in health on productivity, labor supply, and overall farmers' income. There is a causality effect which runs in both directions between household and health and income because higher income households invest more in their human capital as their income increase, they even invest on improved diet, sanitation, and better healthcare knowing fully well that if a household is healthier and energetic then they will be more productive and efficient hence, receive a worthwhile return from his agricultural activities. According to the study done by Schultz (2003), he stated that "human capital inputs have been recognized as critical factors in achieving recent sustained growth in productivity in some African countries". According to Antle and Pingali (1994), farmers affected by malnutrition and ill health could experience lower productivity and income due to impaired work capacity in the field and reduced management and supervision abilities. Strauss (1986) further stated that "farm work, particularly traditional agriculture, is physically demanding, and it is thus likely that nutrition affects labor productivity through its effect on the person's energy expenditure level".

Weight and height are a human capital attribute of farm household members associated with their current productivity. This form of heterogeneity is to some degree reproducible. Schultz (2003) stated that "weight and height are formed as a result of the biological process of growth, in which the inputs of nutritional intakes, healthcare protection from exposure to disease and activity levels conjoin to yield a net cumulative effect on the individual's realization of his or her genetic potential". According to Schultz (2003), this "characteristic of farm household members can be viewed as an indicator of human capital because it can be augmented by private or social investments, but also varies across individuals because of genetic and en-

vironmental factors that are not controlled by the individual, family, or community".

Rampant poor health among the adult population in developing nations contributes to low productivity. For instance, Asenso-Okyere et al. (2011) highlighted that in Oyo State, one of the southwestern states of Nigeria, the estimated average number of workdays lost per year due to malaria alone was 64 days in agrarian households. Asenso-Okyere et al. (2011) further stated that "caregiving responsibilities also take time away from productive work. Lost labor may be replaced by bringing in extended family members, who may be unemployed or underemployed, by withdrawing children from school to assist on the farm, or by hiring labor if the household can afford to do so". They continued saying "beyond the direct impacts due to loss of labor, ill-health undermines long-term agricultural productivity in several ways. When illness leads to long-term incapacitation, households may resort to withdrawing from savings, withdrawing children from school, selling important assets or reducing the nutritional standard of their food consumption". All of these emergency responses can have adverse effects on the long-term labor productivity of household members (Asenso-Okyere et al. 2011). Agulanna et al. (2013) stated that "agriculture has made remarkable progress in the past decades but progress in improving the nutrition and health of poor farmers in developing countries is lagging behind". They further stated that agriculture has the potential to greatly reduce poverty, a key contributor to poor health and undernutrition. Some seventy-five percent of the world's poor people live in rural areas. World Bank (2007a) discussed in a survey that in sub-Saharan Africa, for example, agriculture employs sixty-five percent of the labor force and generates thirty-two percent of the growth in gross domestic product.

Productive land is being abandoned severally all over because of labor shortage while illness and death among the farming community are leading to loss of skills and knowledge, hence agricultural labor is in short supply. Labor also tends to be of poor quality. There has been a shift toward less labor intensive crops. The risks for the rural population are increasingly magnified by human diseases. WHO (2010) conducted a survey where they discovered that "ill-health lowers both labor and human capital accumula-

tion, and malnutrition is responsible for three percent of the disease burden in low-income countries, enhances vulnerability to disease leading to declining in productivity.”

Nutrition and Agricultural Productivity

According to Kennedy and Howarth (1992), agricultural research is assumed to have its most direct impact on nutritional status through the effect on food prices and wages. However by influencing the choice of technology that is adopted, agricultural research may also have an effect on the community health and sanitation environment. Khalid (2016) stated that the three main pathways through which agricultural policies and programs influence the nutritional status of individuals and these include, increased incomes and lower food prices, which permit increased food consumption, effects on the health and sanitation environment at the household and community level, and effect on time allocation patterns, particularly of mothers, which may increase or reduce time spent on nurturing activities time that is often related to women's control over household income and is an important determinant of women's nutritional status.

Contrary to the general belief, Bouis et al. (2011) highlighted in their paper that “nutrient intakes are not the only link through which household allocation decisions affect nutrition status. Morbidity is an important determinant of appetite and of how well nutrients are absorbed by the body”. Bouis et al. (2011) continued to show that the “household that earns less income because it allocates more time to food preparation and childcare could enjoy better nutrition because of reduced morbidity, than if it had earned extra income and spent more for food”. Von Braun et al. (1992) discussed that “achieving a sufficient food supply is indeed one part of a strategy to ensure household food security, but while food availability at the national, or local village level is one factor that can influence household-level food availability, it is not necessarily the most important”. For example, the World Bank (1986) in its report stated that “it is common to have twenty-thirty percent of a country's population consuming less than eighty percent of caloric requirements even though national-level food availability is at or greater than one hundred percent.”

Kirimi et al. (2013) discussed some insight that “it is the household's ability to obtain food when it needs it that is critical in ensuring household food security, and to the extent that technological change in agriculture increases access to food (through higher incomes or lower food prices or both), household food security will improve”. An increase in household food intake often is assumed to improve the food intake of each of the household members. But Garcia and Pinstup-Andersen (1987) show that results from a number of studies now indicate household consumption is often a poor proxy for an individual's caloric intake. They explained further that this is because “the effect of increase in household food consumption can be modified by variety of factors including intra-household income-earning patterns, the education of household members and characteristics of the individual such as gender, age, birth order and genetic endowment, the strength and direction of each of these factors vary by sociocultural movement”.

In some cultures, mainly in South Asia, boys get preferential treatment in the allocation of food and other resources. But there is little evidence of this gender bias in the allocation of food in Africa (Svedberg 1990). Outside of Africa however, a number of studies have shown that children and women tend to consume a lower proportion of their caloric requirements relative to other household members (Haaga and Mason 1987; McGuire and Popkin 1989; Piwoz and Viteri 1985). There are also differences in the allocation of healthcare among various types of household members. Again, most empirical evidence on intra-household gender bias comes from south Asia. A study in Punjab found that in the first two years of life (years of peak mortality), expenditures for medical care for sons were 2.34 times higher than for daughters (Das Gupta 1977).

Das Gupta concludes that gender bias in the Punjab is culturally determined and related to the structure of the rights of asset ownership and decision-making, which severely restrict women's authority. Similarly, findings on mis-distribution of medical expenditures were reported for Bangladesh, where boys were favored over girls in the allocation of healthcare (Chen et al. 1981). The education of a child's mother can play an important role in the effect of increase household resources including food on the child's consumption and nutritional status.

More educated women often exhibit behavior that is more child-centered, which leads to better feeding practices and ultimately to healthier and better nourished children (Tucker and Sanjur 1988).

This maternal education effect on child nutrition has been documented for both formal and informal education of mothers. More subtle factors, such as the decision-making power of the child's caretaker influence intra-household allocation of resources and may determine nutritional outcomes to a significant extent. There has been a strong belief that the greater the maternal control over how household income is spent, the more resources will be given to children in the form of better dietary intake and more healthcare and consumption goods. Until recently, there was little empirical information to support or refute this position.

New evidence suggests that in certain types of female-headed households where women have more decision-making power, mothers allocate a larger share of household food supplies to preschool-aged children (Kennedy and Peter 1992). Other data from Malawi indicate that at a low level of income, children from some types of female-headed households are healthier than children from higher-income male-headed households. Similarly, recent evidence from Brazil indicates that female-headed households were able to use scarce resources (such as land, labor, capital and credit) to improve short-term nutritional status for their children (Vosti and Witcover 1990). In view of the demographic shifts that are occurring in developing countries, in particular the growing number of female-headed households, it is very important to understand how different household structures influence the success or failure of particular agricultural policies and programs.

In examining the links between household consumption and an individual's food intake, prior research has concentrated on dietary energy as a proxy for the overall nutrient quality of the diet. Some recent studies suggest that energy may not be a sensitive measure of overall nutrient consumption. Evidence from Indonesia shows that vitamin A consumption was low in communities with low prevalence rates of protein-energy malnutrition, and conversely, communities with a high prevalence of protein-energy deficiency, in general, had adequate vitamin A consumption.

Similarly, a multicounty analysis showed that high caloric intake of preschool-aged children was not accompanied by high levels of consumption of all nutrients (Kennedy and Payongayong 1992). Again, vitamin A was one of the nutrients that did not increase concurrently with a rise in caloric intake. Vitamin A is particularly important because it is a nutrient known to be lacking in large segments of the child population in developing countries. In a number of large field trials, vitamin A supplementation has been shown to be associated with decreased mortality and decrease in morbidity in some cases. The health and sanitation environment and the nurturing behavior of caretakers may be as important as food intake or in some cases more important, in influencing an individual's nutritional status. It may not be readily apparent how agricultural policies and programs influence the health and sanitation environment and nurturing behaviors.

However, these linkages are more important than once thought. For example, the unrestrained use of certain types of pesticides use or introduction of irrigation may have negative health effects (Vosti and Witcover 1990). Similarly, if agricultural policies and programs change the allocation of time within the household, because of increased or altered labor requirements, the time devoted to nurturing behavior may also change. For these reasons, there needs to be a clear understanding of the range of linkage between household income generation and an individual's nutritional status. Therefore, the issue is beyond food-linked malnutrition.

Caring activities are critically important in influencing child health. This encompasses activities such as breastfeeding and weaning practices, childcare, and other nurturing activities, all of which may be reduced if new agricultural technologies put added demand on women's time. Juster and Stafford (1991) discussed that "time-allocation studies indicate that, on average, women in developing countries put in more hours per day in non-leisure activities than do men". According to Kennedy and Howarth (1993), "not only are women actively engaged in the own-farm production and wage earning activities, but a substantial amount of a woman's day is devoted to home production such as child care, food preparation, cleaning and collecting water and fuel". Lesile (1989) said, "Many of the health-promoting strategies such as growth

monitoring and oral rehydration, which have been advocated as part of the child survival revolution, add to the demand on women time, hence the low level of utilization of some of these health strategies may be related to the lack of time of the mother”.

Concept of Nutrition and Health Measurements

Measurement of Nutrition

The Dietary Diversity Score (DDS) is a common indicator used both at household and individual level. “This describes the number of food groups consumed, with the number and type of food groups providing a broad indication of household access to foods or individual consumption of foods. Indexes of dietary quality are increasingly used as a tool in monitoring population’s adherence to dietary advice” (Kennedy and Payongayong 1992; Stookey et al. 2000). Ruel (2002) highlighted that “dietary diversity can simply be defined as the number of different foods or food groups consumed over a given reference period, it is usually measured using a simple count of foods or food groups over a given reference period. The higher the DDS the better their nutritional status vis a vis”.

Arimond et al. (2010), Kennedy et al. (2007), Ruel et al. (2004) and Steyn et al. (2006) highlighted and discussed that the recall period of 24 hours was chosen by FAO, as it is less subject to recall error, less cumbersome for the respondent and also conforms to the recall time period used in many dietary diversity studies. In addition, household dietary diversity score (HDDS) is actually meant to reflect, in a snapshot form, the economic ability of a household or individuals to access a variety of foods. Studies have shown using Hoddinott (2011) as a case study that “an increase in dietary diversity is associated with socioeconomic status and individual/household food security (household energy availability)”.

Measurement of Health Status

“Being a dimension of human capital, health is nothing but the ‘unobservable general ability of the people’” (Lucas 1988), and because of its unobservable nature, measurement of health is much complicated. According to Munongo (2013), practically, there is no direct way of as-

sessing magnitude of health. He further stated that there are two components of the health status, and these include mortality and morbidity. Additionally he defined Mortality as the quantitative component while Morbidity shows the quality of health. Hassan (2015) in a presentation he made indicated some examples such as “Crude Death Rate, Life Expectancy at Birth, Infant Mortality Rate, Child Mortality Rate, Maternal (puerperal) Mortality Rate, Under-5 Proportionate Mortality Rate, Disease-Specific Mortality and Proportional Mortality Rate, all indicate the quantitative component of health status, whereas, Disability Rates, Sullivan’s Index, Health-Adjusted Life Expectancy (HALE), Disability-Adjusted Life Years (DALY), Nutritional Status Indicators and Health Care Delivery Indicators, Mid Arm Circumference, self-rated health status, activities of daily living (ADL) stunting and body mass index (BMI) show the quality of health status”.

Knowledge Gaps for Further Research

The few existing empirical studies on the relationship between nutrition, health and wages did not cater/provide for the effect of other important economic variables and other unobserved human-specific effects. More so, the possible existence of endogeneity problem in nutrition-health-income linkages necessitates the selection of proper analytical instruments to determine the direction of the relationship. Nutrition as a dimension of health has their outcomes often analyzed in terms of labor productivity at household-level. But the issue of health shocks in terms of creating a heavy burden of diseases on the income of the household is not well captured in literature. Relating the whole nutrition health-income poverty issue into the broad quest of individual, household and national wellbeing will further be interesting to examine with respect to how health affects the household and national income and also the welfare considering health at the macro level. Furthermore, nutrition, health and income need to be explored from the angle of race, ethnic affiliation and other demographic angles and also, potential effects of governments’ political ideologies on the relation between inequality in health status and growth have not been well explored in recent time.

CONCLUSION

Studies on nutrition, health and income poverty are necessary for agricultural sustainability, food security, poverty alleviation, and development especially in the developing part of the world. Although, literature have not been silent about the linkage between this concept but further studies are necessary at micro and macro level amidst the unprecedented multidimensional challenges faced by the world today. Finally, the separation in the treatment of nutrition, health and agricultural income by various literatures have been long overdue as this terms are synergistically entwined. Moreover, a very good field research will, in this case render an outstanding contribution to the world of knowledge with respect to agricultural income and its linkage with the nutrition and health status and by also providing a genuine output from the experience of the rural farming households.

ACKNOWLEDGEMENTS

The researcher is grateful to Professor Eno Ebenso for his useful assistance, support and mentorship. Thanks to the unknown referees of this paper. Also, the financial support given by the North-West University in publishing this paper is deeply appreciated.

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APPENDIX 1**Table 1: WHO BMI classifications**

<i>BMI figure</i>	<i>Classification</i>
< 18.5	Underweight
18.5-24.9	Normal or desirable weight
25.0-29.9	Overweight
30.0- 34.9	Obese I
35.0- 39.9	Obese II
>40	Severely Obese