

Effect of off-farm income on multi-dimensional poverty among rural farm households in Nigeria

Off-farm
income

Ifeoluwa Damilola Adeoye, Wayo Seini, Daniel Sarpong and
Ditchfield Amegashie

*Department of Agricultural Economics and Agribusiness,
University of Ghana, Accra, Ghana*

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Abstract

Purpose – The purpose of this paper is to analyze the effect of the different components of off-farm income on multi-dimensional poverty. Furthermore, the study aims to measure multi-dimensional poverty and also identify the determinants of multi-dimensional poverty in Nigeria. The paper reveals the different contributions of the dimensions of education, health and living standard.

Design/methodology/approach – The study focuses on rural farm households in Nigeria. Data are obtained from the Nigeria General Household Survey, 2013. The survey covers both urban and rural areas of the 36 states of Nigeria. Owing to the interest of this study in the rural farm household's sub-sector, a nationally representative sample of 836 rural farm households are selected for the study after the data merging process. Rural farm households in this paper earn 50 percent of their total income from crop and livestock production. The paper employs the Multi-dimensional Poverty Index (MPI) to measure multi-dimensional poverty across the six different geographical zones of Nigeria. The probit regression model is used to estimate and analyze the effect of off-farm income components on multi-dimensional poverty and also to identify the determinants of multi-dimensional poverty.

Findings – The results of the study show that among the off-farm income components, the non-farm wage income and non-farm self-employment income have negative association with multi-dimensional poverty. Findings show that multi-dimensional poverty is high in Nigeria with deprivations in health contributing the most. Northern Regions have a higher estimate. Results reveal that sex, age, number of adults, formal credit access, access to extension services and location characteristics are key determinants of multi-dimensional poverty. The MPI for Nigeria averaged 47 percent. Across regions, deprivation in the health dimension contributes about 44 percent to multi-dimensional poverty. Deprivation in living standards contributes 40.5 percent, while deprivation in education contributes 15.5 percent to multi-dimensional poverty.

Research limitations/implications – Due to the nature of the data used, the health indicators (nutrition and child mortality) are absent but proxies are used instead. Future research could introduce gender dimensions.

Practical implications – Improving the involvement of rural farm households in non-farm self-employment sector could improve their livelihoods and prevent migration to urban centers, especially among the youths.

Social implications – Improving the quality of health, education and living standards will lead to lower poverty levels in Nigeria. Farmers can best reduce their multi-dimensional poverty by engaging in more off-farm jobs.

Originality/value – This paper provides information to policy makers on the effect of different components of income from the off-farm sector on multi-dimensional poverty alongside with the determinants of multi-dimensional poverty at a national level for the rural farm households. By using MPI, the contribution of the different dimensions used in computing the MPI across the six geographical regions within the country is revealed. This provides policy makers with more information for development purposes.

Keywords Nigeria, Multi-dimensional Poverty Index, Off-farm income, Rural farm households

Paper type Research paper

1. Introduction

Poverty in Sub-Saharan Africa has been an overarching challenge over the years. Nigeria, the largest country in Africa, is not left out as the level of poverty is still alarming. The poverty phenomenon has become more pertinent in Nigeria whose rural space is characterized by



high dependence on agriculture: a sector that has experienced inefficiency due to income constraints, unstable weather, climate change, fragmented landholdings, fire, pests and disease incidence and fluctuating food prices in international markets (Dimova and Sen, 2010). Higher poverty levels have been reported among farm households who depend solely on agriculture (Idowu *et al.*, 2011). The performance of the agricultural sector in Nigeria has not met up with expectation and the livelihood of farm households in the rural areas has been affected. In Nigeria, the contribution of agriculture to economic growth has improved, but has not met up with expectation (Oyakhilomen and Zibah, 2014) and the nation's agricultural productivity faces several constraints such as low credit access, poor agricultural extension services, poor market access (Phillip *et al.*, 2009).

Agricultural production in Nigeria is largely dependent on smallholder farmers producing about 80 percent of the total food requirement (Liverpool-Tasie *et al.*, 2011). Trade liberalization policies and the expansion of free market have contributed to making local farm products less competitive than foreign products, thereby rendering farming unattractive. Addressing the limitations of farmers is highly beneficial to farm households. Fostering an environment where these farm households are linked with other sectors within the rural space can be significant for improving rural incomes and livelihoods. Providing opportunities to generate income from off-farm activities could contribute to better the lives of farmers who are major food producers for the nation. The off-farm sector, through enhancement of income levels, augments farm production by the provision of productivity, enhancing input and implements in the face of credit and liquidity constraints. It also improves nutrition and food security, smoothens consumption, absorbs the growing rural labor force and reduces poverty (Aneani *et al.*, 2011; Bezu *et al.*, 2012; Holden *et al.*, 2004; Mishra and El-Osta, 2002). According to Stamoulis and Zezza (2003), off-farm enterprises offer a potential escape route from poverty as growth in agricultural sector can induce growth in the off-farm sector. The off-farm sector also promotes the farm sector, thereby creating a cycle where both farm and rural off-farm complement and sustain each other.

There is growing disagreement on the relevance of the off-farm sector *vis-à-vis* the farm sector. More recently, it has been increasingly opined that it would be costly to neglect the sector since the current state embraces the wide array of needs of all people living in rural areas (Davis and Bezemer, 2004) and their role in economic development has become of keen interest to policy makers. It is imperative to know how the various incomes from the activities in the off-farm sector could influence multi-dimensional poverty. Income other than that from the farm (crop and livestock) is considered as off-farm income (Babatunde and Qaim, 2009; Davis *et al.*, 2017; Senadza, 2012). It includes non-farm self-employment income; non-farm wage income: income earned from salaried jobs in the non-farm sector; agricultural wage income: salaried jobs earned by working on other people's farms; and others, which includes remittance income.

Most studies on poverty in Nigeria have measured poverty using either consumption expenditure or income. This paper contributes to literature by using a Multi-dimensional Poverty Index to measure poverty for rural farm households in the country. This permits identification of the level of contribution of different dimensions and indicators of multi-dimensional poverty across the six geographical regions within the country. The second contribution of this paper is the effect of different components of income from the off-farm sector on multi-dimensional poverty alongside with the determinants of multi-dimensional poverty with a view to improve living standards among rural farm households and also provide leverage points for policy interventions especially for rural farm households in Nigeria.

2. Literature review

2.1 Definitions and measurement of poverty

Different definitions of poverty have been submitted by authors and an overall definition is yet to exist. According to the World Bank (2000), "poverty is pronounced deprivation in

well-being where well-being is viewed as having control or command over commodities such as adequate income or consumption of basic amenities.” Suppa (2016) views poverty as insufficient income, consumption expenditure or lack of essential goods. Its occurrence is observed where necessities for well-being are in substandard measures to maintain a subsistence level of living.

Stamoulis and Zezza (2003) opine that poverty encompasses deprivations in different dimensions that relate to the capabilities of human beings. Bourguignon and Chakravarty (2003) define multi-dimensional poverty as the inability to meet a given threshold on dimensions of the well-being of an individual. Clark (2005) defines poverty from Sen’s capability approach as the deprivations of people in basic capabilities and opines that focus should not be on the means (income), but on the ends (people’s achievements from their resource endowment).

2.2 Monetary approach to measuring poverty

This often depends on the monetary (income and consumption expenditure) approaches. There have been misconceptions that monetary measures are good proxies for measuring poverty. Although commonly used by many researchers, they do not measure deprivations in different dimensions aside income, hence not providing sufficient policy guidance in these dimensions, since having income, being a means to an end, is not always synonymous to satisfaction of human deprivations. In developing countries, it seems challenging to elicit data on income or expenditure especially in the rural areas with high illiteracy levels. Such information is often unavailable and poor when available. Exclusively depending on income may not be appropriate while measuring human deprivation or well-being (Tsui, 2002; Deutsch and Silber, 2005).

Their reliability as measures of economic status is also questioned since it is difficult to assign monetary value to all things in a rural economy (Martin and Lorenzen, 2016). A market does not also exist for all goods such as public goods (Chakravarty and Silber, 2008).

This approach measures the incidence of poverty (H), poverty depth and poverty gap. The income and consumption expenditure approach allows for measurement of the Foster–Greer–Thorbecke class of indices: the poverty incidence (headcount ratio), poverty severity and poverty gap:

$$P_{\infty} = \frac{1}{N} \sum_{i=1}^q \left[\frac{Z_i - Y_i^{\infty}}{Z_i} \right], \quad (1)$$

where P_{∞} is the weighted poverty index, N is the number of people in the population, Z_i is the poverty line, q is the number of people who do not meet the poverty threshold and Y_i is the income or expenditure on consumption of the i th household within the population. When the parameter equals 0, the index measures the incidence; when the parameter equals 1, the index measures depth; and when the parameter equals 2, the index measures severity.

The headcount, for instance, measures the proportion of people below the poverty line, and the gap measures the distance from the poverty line to the average income of the poor. According to Bourguignon and Chakravarty (2003), both measures have been identified as not being sensitive to the income distribution among the poor and the headcount ratio does not change as the number of deprivations of the poor increases. He further stressed that despite the fact that higher income could be considered important as a measure of welfare, supplementing with other non-monetary attributes will be a better approach since it is inappropriate considering income as a sole indicator of well-being. This implies that information on other forms of deprivation should complement those on poverty measures based on a lack of economic resources. The poverty incidence remains unchanged as the

number of deprivations in dimensions by a household increases. It violates the monotonicity property, which states that overall poverty increases as an individual becomes deprived in an extra dimension. It cannot be decomposed to reveal the contribution of each dimension's deprivation to poverty (Sen, 1976).

The limitation of monetary measures of poverty in accounting adequately for poverty provides a recommendation for the non-income measures. Income is quite important. Although it is a means to an end, the latter is important for policy since there is the possibility of having incomes and not being able to have the necessary ends. The Multi-dimensional Poverty Index (MPI) also called the adjusted headcount ratio measures the total deprivations households experience at the same time.

2.3 Multi-dimensional approach to measuring poverty (Alkire and Foster's method)

Poverty is considered a multi-dimensional phenomenon (Ravallion, 2011). The multi-dimensional poverty approach has been of top priority for development practitioners. The MPI, also referred to as the adjusted headcount ratio (M_0), is a measure of deprivations that a household could experience when households' deprivations are equally shared across the population. It reflects both the multi-dimensional deprivation incidence, and its intensity. Two conditions have been clearly stated as key requirements for any good poverty measure, namely, identification and decomposability, which makes this approach appropriate (Batana, 2008).

The MPI is fast gaining international acceptance and it is composed of three dimensions (education, health and standard of living) and ten indicators: (Alkire and Santos, 2010). The education dimension consists of years of schooling and school attendance of a school-aged child; the health dimension consists of child mortality and nutrition; and the living standards dimension comprises of electricity, sanitation, water, flooring material, cooking fuel and asset ownership (Alkire and Seth, 2015).

This approach overcomes the problems encountered via the use of the union and intersection approaches in that to be multi-dimensionally poor, a household's dimension deprivation must exceed a given threshold level; the union approach identifies the poor by counting deprivation in any dimension leading to identifying large numbers as poor, and the intersection approach identifies poor households by the count of people deprived in all dimensions, thereby a small proportion of the population are represented (Whelan *et al.*, 2014). The properties of this method include: it satisfies the dimensional monotonicity property, which implies an increase in poverty level as a household experience deprivation in an extra dimension; it exhibits decomposability property; estimates could be obtained for various population groups; and it reveals the deprivations in each indicator in which households are most deprived (Alkire and Santos, 2014). This helps to inform policy and enables the assessment of the effect of economic developments on the poor with an overall objective of improving the economy.

2.3.1 Selection of dimensions and indicators. The dimensions and indicators have been selected as being related to the target of international MDGs and compiled by the World Bank and the United Nations. Despite the fact that there are several indicators of poverty and the fact that human beings are deprived differently in these indicators, the selection of the dimensions is through a participatory process which centers on value judgment, focusing on capabilities, use of human right- based consensus, theory and data availability.

The education indicators are a good proxy for the level of knowledge and functioning (literacy, ability to read and write, understand relevant information). Drawing from the notion of "proximate literacy" developed by Basu and Foster (1998), which states that there is a "positive intra household externality" to illiterate family members when at least a

member can read and write. This implies that an individual who cannot read may have proximate literacy through one or more relationships. The external capability approach confirms that individuals have access to a broad array of capabilities through their relationships such as family or friends (Foster and Handy, 2008). The years of schooling especially at the basic level could reflect the level of information the household head could process.

The absence of child from school reflects the current exposure to knowledge a household possesses and future knowledge, abilities and opportunities that household can access. It also shows whether a child of school age is given exposure to an environment of learning. Health indicators (nutrition and child mortality) based on this methodology are not available from the data and the MPI does not permit the use of variables from different data sources; hence, the health dimension is represented by access to health care services and household head suffering from illness as indicators of health (Adeoti, 2014; World Health Organization, 2012). Living standards is represented by access to portable drinking water, good sanitation (toilet facility), electricity, flooring material, cooking fuel and possession of radio, television, phone or bicycle.

2.3.2 Assigning weights. There are different weights that could be applied in poverty analysis. They include equal weights, specific weights, proportional weights, normative weights, statistical weights (Belhadj, 2012). With equal weights, the same level of importance is given to all dimensions and its application in multi-dimensional indices is quite common and simple to apply. In proportional weights, the weights are set in terms of the proportion of the population suffering deprivation in that dimension. Specific weights are assigned by the researcher. This is done arbitrarily and an indicator can be weighted higher than others based on perception of their importance. The challenge lies on the means of identifying the relative importance of different dimensions.

Although ethical preferences could be solicited sometimes, no economic theory supports how to form such preferences. Statistical weights involve the use of statistical methods to assign weights. Normative weights are based on the preferences of decision or policy makers. An individual's value judgments about the trade-offs and each indicator are being relied upon. As recommended, weights of dimensions and indicators chosen should be in a manner that reflects equality (Atkinson *et al.*, 2002). The equal weighting approach was adopted for the study (see Battiston *et al.*, 2013; Wagle, 2005).

The MPI, also referred to as the adjusted headcount ratio (M_0), is a measure of deprivations that a household could experience when households' deprivations are equally shared across the population. It reflects both the multi-dimensional deprivation incidence, and its intensity. There have been many approaches to measuring multi-dimensional poverty, but there is yet to be a superior approach in targeting the poor. Two conditions have been clearly stated as key requirements for any good poverty measure. They are identification and decomposability, which makes this approach appropriate (Batana, 2008). The global MPI is fast gaining international acceptance and is composed of three dimensions, namely, education, health and standard of living, with ten indicators: (Alkire and Santos, 2010). The education dimension consists of years of schooling and school attendance of a school-aged child, the health dimension consists of child mortality and nutrition, while the living standards dimension comprises of electricity, sanitation, water, flooring material, cooking fuel and asset ownership (Alkire and Seth, 2015).

The household is the base population upon which the types of deprivation that exist within each household are identified. It is represented mathematically as M_0 , with a given choice of dimensions, indicators and weights. The M_0 measures poverty in d dimensions across a population of n households. Assume $y = [y_{ij}]$ denotes the $n \times d$ matrix of i number of

the household's achievements in j dimensions. Each row vector $y = (y_{i1}, y_{i2}, \dots, y_{id})$ provides the distribution of the household's achievement in the various dimensions. Each column vector $y = (y_{1j}, y_{2j}, \dots, y_{nj})$ reveals the distribution of achievements in j -dimension across households. A weight w_j is assigned to each dimension and the sum total of the weights can be expressed as $\sum_{j=1}^d w_j = d$ (the dimensional weight).

A dual cut-off approach is applied using two types of cut-offs in identifying the poor (Alkire and Foster, 2007). The first step involves identifying those who are deprived in each dimension using certain thresholds or poverty line, $z > 0$ in each dimension j . This threshold can also be referred to as the deprivation threshold or cut-off, below which a household is considered to be deprived. The second cut-off point or poverty threshold, k , describes the minimum weighted deprivation count across dimensions. This poverty threshold reveals the minimum number of the household's deprivations in a given number of dimensions. The deprivation of each household is weighted across the different indicators. A household is regarded as being multi-dimensionally poor when the number of deprivations $c_i \geq k$, otherwise that household is multi-dimensionally non-poor. A household having a weighted deprivation score below this threshold is considered multi-dimensionally non-poor.

This approach overcomes the problems encountered via the use of the union and intersection approaches in that to be multi-dimensionally poor, a household's dimension deprivation must exceed a given threshold level. The union approach identifies the poor by counting deprivation in any dimension leading to identifying large numbers as poor, and the intersection approach identifies poor households by the count of people deprived in all dimensions, thereby a small proportion of the population is represented (Whelan *et al.*, 2014; Jayaraj and Subramanian, 2010). In this approach, poverty is dimension-specific and the deprivation in each dimension is identified separately and aggregated into a composite index (Deutsch and Silber, 2005).

The MPI can capture the joint distribution of the different poverty dimensions (Deutsch and Silber, 2005) and is obtained by multiplying the multi-dimensional headcount ratio (H) which represents the proportion of poor people, and the intensity of multi-dimensional poverty (A).

The mathematical expression is:

$$H = \frac{q}{n}, \quad (2)$$

$$A = \frac{\sum_{i=1}^n C_i(K)}{q}, \quad (3)$$

$$MPI = H \times A, \quad (4)$$

where q is the number of people who are multi-dimensional poor, n is the entire population, $C_i(K)$ is the censored deprivation scores of household i . We assign equal weights to each of the three dimensions (education, health and living standards) which sums up to 1, implying one-third (0.33) for each and also equal weighting across indicators (Table I). The weighted value of each dimension is divided by the number of indicators in each dimension to obtain the indicator weights.

3. Data

This study uses data from the General Household Survey 2013. The survey data consist of information of households, farm and location characteristics. A nationally representative

Dimensions	Indicators	Deprivation cut-off	Weights
<i>Education</i>	Years of schooling	Household head does not have at least 5 years of education	0.33
	School attendance	No school-aged child is attending school	0.165
<i>Health</i>	Health care services	No access to health care services	0.33
	Illness	Suffers illness	0.165
			0.165
<i>Living standards</i>	Electricity	No access to electricity	0.33
	Drinking water	No access to clean drinking water	0.055
	Sanitation	No access to good toilet	0.055
	Flooring	Floor made with sand, dirt, mud, clay	0.055
	Cooking fuel	Use of firewood and coal as fuel	0.055
	Assets	Does not have more than one radio/television, phone, bicycle, refrigerator	0.055
			0.055

Table I.
Dimensions,
indicators, deprivation
cut-off and weights

Note: Indicators are coded as dummy

sample of 836 rural farm households are selected based on the interest of this study on rural farm households. Farm households in this paper are those who earn 50 percent of their income from crop and livestock production. We compute off-farm income as the sum of income from the non-farm sector which includes income from non-farm self-employment, non-farm wage, agricultural wage, transfers and other incomes in line with Senadza (2012), Babatunde and Qaim (2009) and Davis *et al.* (2017).

3.1 Measuring multi-dimensional poverty using Alkire and Foster's framework

Following Alkire and Santos (2010, 2014), the dimensions considered are education, health and living standards. Table I shows the dimensions and indicators considered. Due to data constraint for this study, the indicators: nutrition and child mortality in the health dimension are not included but are replaced with indicators: access to health care services and illness which are also recognized indicators of health (World Health Organization, 2012; Adeoti, 2014).

A household is considered deprived in years of schooling if the household head does not have at least five years of education and if no primary school-aged child is currently attending school. Households are considered as deprived in health dimension if they lack access to health care services and also suffer from illness. The household is deprived in indicators like clean drinking water (if the household lacks access to borehole and pipe-borne water), sanitation (if the household lacks access to good toilet), electricity, floor quality (if flooring is made of sand, dirt, mud, clay), cooking fuel (if cooking fuel is made of firewood and coal), assets (if the household does not own more than one phone, radio, bicycle, television, refrigerator or motorbike). This is the indicator cut-off (the first cut-off) for identifying deprivations in each indicator (Alkire and Seth, 2015).

In line with Alkire and Santos (2010, 2014), Alkire and Seth (2015), Batana (2008), Wambugu (2010), Wang and Wang (2016) and Adeoti (2014), equal weights are used as value judgment in this study. The MPI assigns equal weight to each of the three dimensions (education, health and living standards) which sums up to 1, implying one-third (0.33) for each dimension. The weighted value of each dimension is divided by the number of indicators in each dimension to obtain the indicator weights. For example,

education and health are assigned weights of 0.33 each. This is divided by 2 (the number of indicators in each dimension), giving each indicator a weight of 0.165. Each of the six indicators in the living standard dimension is assigned a weight of $(0.33/6 = 0.055)$, as shown in Table I.

The deprivation score, which reveals the household's deprivations across dimensions, is obtained by summing up the weighted deprivations for the dimensions. The second cut-off of 0.33 is the minimum deprivation score a household must have to be identified as multi-dimensionally poor. Hence, households with a deprivation score less than 33 percent are considered as multi-dimensionally non-poor, implying that they are deprived in less than 33 percent of the weighted indicators, while households with a deprivation score greater than 33 percent are regarded as multi-dimensionally poor, implying that they are deprived in more than 33 percent of the weighted indicators.

3.2 The probit regression model

The probit model is used to estimate and analyze the effect of off-farm income (non-farm self-employment income, non-farm wage income, agricultural wage income) on multi-dimensional poverty. Under situations of binary dependent variables, the probit and logit regression models are commonly used and they often provide similar marginal effects. However, the choice of probit regression model in this study stems from the distribution of the error term which lies on the assumption of a standard normal distribution and its ability to report the predicted probabilities, which is of interest in this study. The logit regression model is based on the logistic distribution. The determinants of being multi-dimensional poor are also analyzed as well. The probit model is expressed as:

$$\Pr(Y = 1|X) = \Phi(X\beta + \varepsilon). \quad (5)$$

Variables for the probit regression are included in Table II.

Definition of independent variables	Description	A priori signs
Sex	Male = 1; female = 0	-
Age	Number of years	+
Adult workers	Number of persons between 16 and 64 years	-
Access to formal credit	Dummy (yes = 1; otherwise = 0)	-
Extension service	Dummy (yes = 1; otherwise = 0)	-
Farm size	Hectares	-
Membership in organization	Dummy (yes = 1; otherwise = 0)	-
Off-farm income		
Non-farm self-employment income	Naira	-
Non-farm wage income	Naira	-
Agricultural wage income	Naira	-
Region	Dummy (1 if resident in region; 0 if otherwise)	+/-

Table II. Variables described in the probit model and *a priori* expectations dependent variable: poverty status (poor = 1; non-poor = 0)

Notes: The units of measurement have been highlighted in the description column. Off-farm income includes all income from non-farm wage employment, non-farm self-employment, agricultural wage, transfers and other income (Davis *et al.*, 2017; Senadza, 2012). Non-farm self-employment income refers to income from self-employment activities/enterprises in the non-farm sector; non-farm wage income refers to wage income or salaries received from working in the non-farm wage sector; agricultural wage income refers to wage income or salaries received from working on other people's farm

4. Results and discussions

4.1 Multi-dimensional poverty estimate in Nigeria

Table III shows that the average estimate of multi-dimensional poverty for the rural farm households in Nigeria is 0.47. This indicates that the deprivations of farm households across indicators averaged 47 percent. The multi-dimensional deprivation headcount (*H*) is 86.6 percent and the average multi-dimensional poverty intensity which measures the average percentage of simultaneous deprivations suffered by the poor individuals (*A*) is 54.3 percent.

Table IV shows the estimates across the regions in the country. The incidence of poverty and the multi-dimensional index reveals that poverty is highest in the northern areas. This could be due to unfavorable weather conditions and inadequate infrastructure in Northern Nigeria. This shows the need to invest in providing facilities to improve education, health care services and proper sanitation in rural areas of Nigeria. Across regions, deprivation in the health dimension contributes about 44 percent to multi-dimensional poverty (Table V). The contribution of living standards to poverty is also high, indicating deprivation in standards of living. Most rural areas of African countries have lower standard of living compared to urban areas (Sahn and Stifel, 2003). Our findings show that deprivations in education contribute 15.5 percent to multi-dimensional poverty. Deprivations in living standards contribute 40.5 percent to multi-dimensional poverty.

Estimates

MPI	0.470
<i>H</i>	0.866
<i>A</i>	0.543

Table III.
Multi-dimensional
poverty estimates

Notes: *H* is the multi-dimensional deprivation headcount (*H*); *A* is the average multi-dimensional poverty intensity; *MPI* is the product of *H* and *A*

	NC	NE	NW	SE	SS	SW	<i>F</i>
MPI	0.506	0.533	0.468	0.363	0.320	0.471	6.15***
<i>H</i>	0.940	0.919	0.878	0.686	0.646	0.931	

Table IV.
MPI estimates
by region (%)

Note: ***Significant at 1 percent
Source: Author's computation

Indicators	NC	NE	NW	SE	SS	SW	Overall MPI
Years of schooling	0.135	0.132	0.152	0.164	0.112	0.122	0.141
Child schooling	0.002	0.027	0.014	0.007	0.000	0.000	0.014
Illness	0.229	0.228	0.239	0.269	0.257	0.244	0.237
Health care service	0.229	0.205	0.174	0.243	0.265	0.207	0.203
Electricity	0.081	0.083	0.074	0.057	0.043	0.085	0.075
Access to portable water	0.080	0.075	0.064	0.028	0.061	0.093	0.069
Access to good toilet	0.100	0.095	0.103	0.101	0.107	0.106	0.101
Floor quality	0.029	0.052	0.063	0.018	0.032	0.041	0.048
Cooking fuel	0.100	0.094	0.104	0.101	0.104	0.102	0.100
Asset	0.015	0.009	0.013	0.013	0.019	0.000	0.012

Table V.
Deprivations and
contribution of each
indicator and
dimension to poverty
by region

4.2 Effect of off-farm income on multi-dimensional poverty

Our findings (Table VI) show that among the off-farm income components, non-farm self-employment income and non-farm wage income are most important. The log of non-farm wage income and log non-farm self-employment income are significant at ($p < 0.01$) and ($p < 0.05$), respectively, with both being negatively related to the average MPI. This implies that the probability of a farm household being multi-dimensionally poor decreases by about 0.9 and 3.9 percent, respectively, with a percentage increase in non-farm self-employment income and non-farm wage income.

The determinants of multi-dimensional poverty are also highlighted and the marginal effects are reported. Holding all other factors constant, we find that being a male-headed household reduces the probability of being multi-dimensionally poor by 18 percent. This suggests that female headed households could be at a disadvantage perhaps due to involvement in caregiving at home and limited access to productive resources and opportunities such as credit. Our findings also reveal that age is significant at 1 percent, indicating that as farmers get older, the likelihood to be multi-dimensionally poor increases by 0.8 percent. This agrees with Adeoti (2014), who finds that having older ones (above 60 years) increases the probability of being multi-dimensionally poor in Nigeria and is confirmed by El-osta and Morehart (2008) in the USA. Garza-rodriguez (2002), however, observes that an increase in age reduces the likelihood to be poor in Mexico.

The number of adult workers is significant ($p < 0.1$) with an expected negative sign. The marginal effect indicates that having more adults in a household reduces the likelihood of being multi-dimensionally poor by about 1.56 percent. Adults are expected to engage their labor in productive activities, thereby earning some income to meet the felt needs of household members.

Access to formal credit is significant at 1 percent and negatively correlated to the probability of being multi-dimensionally poor. This indicates that having access to formal credit by rural farm households reduces the likelihood to be multi-dimensionally poor by 14.2 percent, thereby revealing the role of credit in promoting rural livelihoods and poverty alleviation.

Independent variables	Coefficient	Marginal effect
Sex	-0.5097* (0.265)	-0.1802* (0.093)
Age	0.0235*** (0.004)	0.0083*** (0.001)
Adult worker	-0.0443* (0.026)	-0.01567* (0.009)
Formal credit	-0.4017* (0.238)	-0.14207* (0.083)
Access to extension service	0.1973*** (0.058)	0.06978*** (0.020)
Farm size	-0.00557 (0.032)	-0.0019 (0.011)
Membership in organization	-0.1116 (0.173)	-0.0394 (0.061)
North-Central	0.6463*** (0.219)	0.2285*** (0.075)
North-East	1.0162*** (0.216)	0.3593*** (0.072)
North-West	0.6546*** (0.206)	0.2314*** (0.071)
South-East	0.0809 (0.242)	0.0286 (0.085)
South-West	0.4001 (0.321)	0.1414* (0.113)
Log NF self-employment income	-0.0243** (0.011)	-0.0086** (0.004)
Log non-farm wage income	-0.1106*** (0.022)	-0.03911*** (0.007)
Log agricultural wage income	0.0104 (0.010)	0.00368 (0.0036)
Constant	-0.825** (0.369)	
χ^2	95.88***	
Pseudo R^2	0.107	
Observations	836	
Log likelihood	-517.15	

Notes: Robust standard errors in parentheses; figures in brackets are standard errors. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Author's computation

Table VI.
Probit estimates of the relationship between off-farm income and multi-dimensional poverty, dependent variable: poverty status: multi-dimensionally poor = 1, otherwise = 0

We find that access to extension services is significant ($p < 0.01$) with a positive sign. This implies that an increase by rural farm households to services provided by extension agents increases the likelihood of being multi-dimensionally poor by about 6.9 percent. This was not anticipated, however, it could be explained by the poor quality of service provided by extension agents, which invariably determines the level of productivity. Dispersion of farm households in rural areas in Nigeria is wide. The access to extension services and the quality of service is poor as extension agents are poorly remunerated and lack sufficient technology to extend to farmers (Phillip *et al.*, 2009). Low quality of the extension service, regardless of the number of visits, could make understanding of the innovations disseminated difficult and inhibit adoption of practice which negatively affects productivity. Most rural farmers are uneducated and this could be a limiting factor to understanding the modern techniques taught by extension agents, especially where the majority are laggards, invariably, deterring higher outputs and increasing poverty levels.

Farm households residing in the Northern Regions (North-Central, North-East and North-West) have a higher likelihood of being multi-dimensionally poor compared to farm households in the South-South Region. This shows the high poverty levels in the northern regions. Being located in the North-Central Region, North-East Region and North-West Region increases the likelihood to be multi-dimensionally poor by about 22.9, 35.9 and 23.1 percent, respectively. Being located in the South-East and South-West Regions does not have significant influence on the likelihood of being multi-dimensionally poor.

4.2.1 Concluding remarks. This paper shows the estimates of multi-dimensional poverty in Nigeria. We provide the estimates across the six regions of Nigeria. The role of off-farm income on multi-dimensional poverty and other determinants of multi-dimensional poverty among rural farm households are also highlighted through the use of a probit regression model. The variables include individual, institutional and location characteristics. Sex and age are the individual characteristics which influences multi-dimensional poverty. Institutional characteristics include access to formal credit and access to extension services. We discover that location plays an important role as well.

Among the dimensions, health has the highest contribution to multi-dimensional poverty, while education has the least contribution to multi-dimensional poverty.

5. Recommendation

In a multi-faceted environment where farmers engage their productive assets into different activities, it is important to identify where to explore resources for maximizing income levels and minimizing poverty multi-dimensionally. Most of the focus of the poverty has been on income dimension which limits the scope of horizon in understanding and conceptualizing poverty experienced by rural farm households. It is with this focus that this study examines how income from the off-farm sector could reduce multi-dimensional poverty.

From the findings, having more off-farm jobs with emphasis on the non-farm self-employment and non-farm wage sectors could be beneficial to better rural farm households' livelihoods.

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Corresponding author

Ifeoluwa Damilola Adeoye can be contacted at: ifeayanfe7@yahoo.ca