FUZZY SET APPROACH TO MULTIDIMENSIONAL POVERTY DECOMPOSITION IN RURAL NIGERIA

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Abstract

Poverty is a serious problem in Nigeria and the rural areas are mostly affected. Recent literatures have emphasized the multidimensional nature of poverty. This study analyzed multidimensional poverty in Nigeria by using the 2006 Core Welfare Indicator Survey (CWIQ) data. Fuzzy set approach was used to assess the poverty profile of the rural households in Nigeria. The study decomposed multidimensional poverty across the zones, states, and the socio-economic groups of rural households. It further decomposed the absolute and relative contributions of welfare indicator to multidimensional deprivations. The result shows that the multidimensional poverty for the rural Nigeria is 0.3796. It is also reflected that some needs such as healthcare needs, public transportation, supply of drinking water, food needs, all seasons road, and primary school are important in solving multidimensional poverty in the rural area. Multidimensional approach (Fuzzy set) is very useful in order to implement socio-economic policies to reduced poverty diffusion. It is important that the government should look into the problems relating to housing and sanitation. Also, the rural infrastructure should be improved upon.

Keywords: Fuzzy set and Multidimensional poverty decomposition.

Introduction

Poverty is a critical problem in Nigeria, with the rural areas being worse affected. Occupational analysis of National Consumer Survey for 1985, 1992 and 1996 revealed that poor individuals were largely found among farming households, majority of who dwell in the rural areas (FOS, 1999). Higher incidence of poverty in Nigeria's rural areas have been traced to some environmental problems associated with agricultural

production, high vulnerability to health hazards (Alayande and Alayande, 2004), low level of education, high fertility rate, lack of access to improved seeds and inputs, and poorly developed social infrastructural facilities (Okunmadewa, 2002), among others. Similarly, due to lack of appropriate insurance against income shocks, rural poverty is often worsened because farmers dispose their productive assets to meet immediate consumption needs (Alayande and Alayande, 2004).

Governments at all levels have therefore embarked on several programs in order to alleviate its incidence and severity. Some of such programs include National Directorate of Employment (NDE), the Family Support Program (FSP), the National Agricultural Land Development Agency (NALDA), Directorate for Food, Roads, and Rural Infrastructure (DFRRI), Family Economic Advancement Program (FEAP) and National Poverty Eradication Program (NAPEP) (Osinubi, 2003). Minimum wage policy and Universal Basic Education (UBE) are also means of combating poverty. However, given the low response of households to escape from the scourge of poverty, it can be said that many of these programs have not made significant impacts.

Sen (1983) relates poverty to entitlements, which are taken to be the various bundles of goods and services over which one has command, taking into cognizance the means by which such goods are acquired. But poverty arises due to insufficiency of different attributes of well-being that are necessary to maintain a subsistence level of living. Examples of such attributes are health, income, literacy, housing and access to public services etc. Therefore, poverty is regarded as a multidimensional phenomenon of which income is only one aspect. Recent poverty analyses are flanked with the introduction of non-monetary (or supplementary) index, determined by appropriately weighed indicators of deprivation. This is to help our understanding of the different forms of deprivation that household faces (Maggio, 2004).

The issue of poverty in many developing countries is a very crucial one going by its intensity, incidence and severity. The situation in Nigeria presents a paradox, because despite the fact that the nation is rich in natural resources, the people are poor. World Bank (1996) referred to this situation as poverty in the midst of plenty. In 1992, for instance, 34.7 million Nigerians (one-third of the population) were reported to be poor, while 13.9 million people were extremely poor (World Bank, 1996). The incidence of

poverty increased from 28.1 percent in 1980 to 46.3 percent in 1985. The poverty problem grew so worse in the 1990s that in 1996, about 65.6 percent of the population was poor, while the rural areas account for 69.3 percent (FOS, 1999). Recent data showed that in 2004, 54.4 percent of Nigerians were poor (FRN, 2006). Also, more than 70 percent of the people are poor, living on less than $1 a day. Similarly, Nigeria's Human Development Index (HDI) of 0.448 ranks 159th among 177 nations in 2006, portraying the country as one of the poorest in the world (UNDP, 2006, IMF, 2005). The programs for poverty alleviation seem not to be making significant impacts.

Before poverty could be appropriately measured and tackled, it must have been properly defined. Aluko (1975) refers to poverty as a lack of command over basic consumption needs. World Bank (1990) defined poverty as inability to attain a minimum standard of living. Ajakaiye and Adeyeye (2001) noted that there is no concise and universally accepted definition of poverty because it affects many aspects of the human conditions, including physical, moral and psychological. Therefore, the idea of multidimensionality of poverty comes due to the fact that poverty seems to be elusive in definition.

There are various ways in which poverty has been measured. These include the use of monetary approach, Human Development Index (HDI), head count ratios, physical quality of life index (PQLI) etc. The convectional approach to poverty analysis has classified the population into two dichotomous group of poor and non-poor, defined in relation to some chosen poverty line based on household expenditure (Foster *et al*, 1984).

The publication of Sen (1976) was the pioneering paper on poverty measurement. In the last few years, poverty analyses made substantial improvements by gradually moving from the traditional unidimensional approach to multidimensional (Hagnenaars, 1986;Dagum, 1989; Sen, 1992). These efforts have assisted policy makers to address some issues related to poverty among the different sectors of the economy. Therefore, new concept of poverty greatly differs from traditional notion, because it includes many aspects other than income or wealth (Hagnenaars, 1986; Dagum, 1989; Sen, 1992; World Bank, 2001).

With multidimensional poverty analysis, it is possible to identify the main causes of poverty and adopt policies to reduce its intensity. Development economists have

further justified multidimensional analytical approach by viewing development as improvement in an array of human needs and not just growth of income (Streeten, 1981). Well-being is intrinsically multidimensional from the viewpoint of capacities and functionings since functionings deal with what a person enjoys (Sen, 1985,1992).

Arguments exist in literature in terms of the superiority of multidimensional measure of well-being over the unidimensional measure. Many studies in Nigeria followed the conventional view of poverty, with focus on insufficient income for securing basic goods and services (Adeyeye, 2000). However, poverty is multifaceted. It goes beyond economic deterioration and in addition to material dimension also includes social exclusion. Therefore, a more comprehensive measurement is required. The technical difficulties of income measurement, especially in developing countries, have been an important initiative for looking at other poverty measures (Asselin, 2002). One of the commonly recognized problems as identified by researcher and policy makers is a lack of effective poverty measurement (Shakarishvili, 2003). Since we do not seem to have a proper measure of poverty especially in term of multidimensionality and therefore limited knowledge of the problem, it is quite understandable why we have not been able to solve it.

This study intends to use the multidimensional measure of well-being to answer salient policy related questions with reference to Nigeria. How can a poverty profile be established for the households using the multidimensional approach? How can a set of indicators for multidimensional analysis of poverty be constructed for households or how can multidimensional poverty indicators be used to analyze household poverty? Given that government's expenditures on social programs are meant to affect the multifaceted dimensions of households' welfare, is there any linkage between retrospective households' perception of positive project impacts and multidimensional poverty? Provision of answers to these questions would add to the required information needed for analyzing poverty and proffer appropriate solution to addressing it.

Conceptual issues and application of multidimensional poverty analysis

The original meaning of poverty implies deprivation of something that is essential or desired. The concept of poverty varies depending on the recognized values. In one

extreme, it is found the most absolute forms of poverty, as starvation or death from lack of shelter. On the other side, poverty extends continuously towards a fuzzy limit. It also varies with the wealth of societies as well as with the pass of time (Baran *et al* 1999). Poverty appears as a multidimensional phenomenon, closely associated with the concept of exclusion. The poverty state is then, rather a continuum than a classical set or point on a scale of absolute values. It is defined with respect to a variety of quantitative and qualitative criteria that may change with societies and cultures. Poverty notion involves, above all, a comparative concept that refers to a relative quality. That is why there is no consensus on an absolute definition for poverty, even though attempts were made (Valentine, 1992).

When assessing well-being, there is need to gauge it either from capability or functioning point view. Although the two are inter related, never the less they have some distinct features. The capability approach view individual well-being in terms of what a person is actually able to do or to be. The functioning approach assesses individual well-being from the various things a person value doing and being (Sen, 1992). Capabilities are combinations of beings and doings that a person can achieve and reflect the real set of options that a person has to achieve what she or he values. While functionings constitute a person's achieved well-being, capabilities represent the real opportunities for a person to achieve well-being, and thus include the freedom of choice.

Functionings are the valuable achievements, actions, and activities that determine individual well-being. Chiappero Martinetti (2000) notes that "functionings achieved are strictly related to the intrinsic characteristics of the people (age, gender, health and disability conditions) as well as to environmental circumstances (at the social-economic and institutional level but also referred to the household environment); and the conversion process of the available resources into well-being is strictly related to and dependent on these individual and environmental features." A functioning therefore refers to the *use* a person makes of the commodities at his or her command.

Poverty analysis for Nigeria from the multidimensional point of view was conducted by Ayoola *et al* (2000) by using focused group discussions to determine households' perception of poverty and wealth in some Nigerian rural and urban areas. It was found that in urban areas, the rich were perceived to have money and live in

beautiful, cemented houses with boreholes or tap water. They eat good food, wear good clothes, have access to medical services and are healthy. Similar views were held for rural areas. Also, the rich were described as people with opportunities, both for themselves and their children. The urban rich achieve a good quality of life by having successful businesses and owning land and property. They are able to educate their children privately, who then in turn become successful. In rural areas being rich could be described in terms of ownership of land and productive capital inputs such as fertilizer, and access to markets.

Collicelli and Valerii (2000) used Principal Component Analysis (PCA) to compute multidimensional poverty indicators for some poor countries in the Middle East and North Africa. Some of the included indicators were life expectancy at birth, adult literacy, real per capita Gross Domestic Product, public expenditure on education, public expenditure on health and low infant birth weight. Three identified indicators of poverty were synthetic of basic social conditions and standard of living, social structure and policies for security and social promotion, and level of progress. These explained 71 percent of the variation in the level of multidimensional poverty indices. Also, Adams and Page (2001) analyzed data from the World Bank for some Middle East and North Africa countries using multidimensional approach. They observed that there is no clear relationship between a reduction in monetary poverty and an improvement in other welfare indicators. It was noted that to reach important conclusions, there is need to compute an over all index of multidimensional poverty from the identified composite indicators of welfare.

Bourguingnon (2002) proposed an econometric approach for multidimensional poverty ordering and asserted that there is need to consider poverty from the multidimensional point of view because in addition to insufficient income, other attributes like literacy and access to health care can determine the level of economic well being. It was stressed that a genuine measure of poverty should be based on monetary as well as non-monetary attributes.

Mehta *et al* (2002) applied the exploratory spatial approach to multidimensional poverty measurement in India. They found that spatial estimates at various disaggregating levels reflect convergence of deprivation in multiple or multidimensional poverty. Also,

those in poverty are unevenly distributed across India with concentration of poverty being largely found in some States. Poverty related estimates for 59 regions in 16 large states show that between 20 percent and 43 percent of the population living in rural areas of 12 regions and urban areas of 21 regions suffer from severe poverty. Indicators that contributed most to multidimensional poverty were incidence of child mortality, literacy, access to infrastructure such as electricity, toilet facilities, and postal and telegraphic communications.

Dagum (2002) compared unidimensional and fuzzy set estimated multidimensional poverty indicators using the Bank of Italy sample data for 1993, 1995, 1998 and 2000. The multidimensional analysis identified educational level of the house head and his/her father, housing condition, and educational level of the spouse as the most important cause of poverty. The superiority of the multidimensional approach over the unidimensional was judged by the low correlation coefficient, implying that those classified as poor by the two approaches differ. Costa (2003) also compared unidimensional and multidimensional poverty indices for 12 European countries. Using the Bravais-Person, Kendall's, Spearman, and Gini rank correlation indices, it was found that there was low correlation between the two. It was concluded that any socio-economic policy to reduce poverty that is developed based on the basis of income information is likely not to achieve the set goals without considering the multidimensional aspect of deprivation.

Bibi (2003) compared multidimensional poverty in Egypt and Tunisia and found that poverty in Egypt was more than that in Tunisia. It was concluded that there is need for descriptive and normative measures of multidimensional deprivation for policy formulation. Qizilbash (2004) identified a set of indicators of multidimensional poverty like employment, health, access to clean water, shelter, knowledge, energy use, and participation in the life of the community. The multidimensional poverty analysis integrates these composite indicators into simple indices for the understanding of poverty profile in the population.

Maggio (2004) provided new evidence on income poverty and lifestyle deprivation with cross sectional data collected in Great Britain between 1991 and 2000. It was concluded that income cannot be the only indicator for analyzing poverty, and that

the multivariate analysis seems to be the most proper choice if poverty and deprivation are to be investigated in a population. Duclos *et al* (2005) analyzed the multidimensional poverty of households in Ghana, Madagascar and Uganda, and found that it is difficult to conclude that poverty is lower in the urban areas than rural areas unlike what unidimensional approach gave.

Booysen *et al* (2005) used multiple correspondence analysis to study multidimensional poverty in selected African countries using asset index approach based on data collected between late 1980s and early 2000. Welfare indicator was computed from ownership of radio, television, refrigerators, bicycle, type of toilet and source of drinking water. It was found that improvements in asset index are largely driven by progress in the accumulation of private assets, while access to public services had deteriorated. Specifically, poverty declined in Ghana, Kenya, Mali, Senegal and Zimbabwe, while it increased in Zambia and Tanzania.

Deutsch and Silber (2005) compared empirical approaches for multidimensional poverty analysis using the fuzzy set, information theory, efficiency analysis and axiomatic derivation of poverty indices. Using the 1995 Israeli data, it was found that there was fair degree of agreement between the approaches on identification of the poor. The approaches showed that multidimensional poverty decreases with educational level of the house head, increases with age and household size, being a Muslim, migrated house heads, and single house heads.

Coromaldi and Zoli (2007) measure poverty in Italy by complementing income information with non-monetary indicators. A non linear principal component analysis was employed to select items in order to reveal underlying latent dimensions to be interpreted as deprivation indicators. They examined how such measures can be combined with income measures so as to obtain a better identification of the poor. They also, examine the overlapping between the income poor and the deprived and provide an analysis of deprivation profiles. The result revealed that a more comprehensive poverty measure, combining deprivation criteria and income poverty, leads to a different identification of poor people, compared to analyses based only on income measures.

Benhabib *et al*. (2007), employed logit- probit and fuzzy set approaches in analysing poverty dynamics in Algeria. The results revealed that the fuzzy set approach

is more pertinent than the others in capturing different graded attributes of poverty. The study also, revealed that income is not the sole indicator of well-being and should be supplemented with other attributes, mainly, housing, level of comfort and social capital. It was also, evident from the result that rural areas were the most hit by deprivation and poverty.

Silber and Sorin (2006) used data from the 1992-1993 Israeli Consumption Expenditures Survey and attempted to compare results based on a fuzzy approach with the more traditional approach using directly consumption or income data. For the fuzzy approach, the variables that were taken into account included non ownership of an oven or a microwave oven, non-ownership of a refrigerator, non-ownership of a TV set, non-ownership of at least two of the following durables: washing machine, vacuum cleaner, air conditioning, videotape, stereo and phone, non-ownership of a car, non-ownership of an apartment (house) and negative savings. Three different fuzzy approaches were used, that of Cerioli and Zani (1990), that of Cheli *et al*. (1994) and Cheli and Lemmi (1995) and that of Vero and Werquin (1997). They also compute the percentage of poor on the basis of a unidimensional approach using either income or expenditures as welfare indicator. They used five different approaches in computing the proportion of poor. It was observed that only 2% of the households were poor according to all the five approaches, more than 25% (in fact 28.9%) of the households were poor according to at least one of the five estimation methods.

Most of the works done on poverty in Nigeria have looked at the various welfare indicators such as access to water, healthcare facilities, housing etc (Ayoola *et al*, 2000; NPC and ORC Macro, 2004). However, not much has been done in computing multidimensional poverty index from these indicators. This study therefore seeks to decompose households' multidimensional poverty across some socio-economic characteristics.

Methodology

Scope of Study

Nigeria is one of the Sub-Sahara African (SSA) nations located in the western part of Africa. The country has 36 states plus the Federal Capital Territory (FCT) - Abuja. Nigeria shares its boundary with the Republic of Benin to the west, the Niger

republic to the north, the republic of Cameroon and the Chad Republic to the east, and the Atlantic Ocean forms a coastline of about 960 Km^2 to the south. The country is blessed with a total land area of about 92,377,000 hectares, out of which about 91,077,000 hectares are solid land area. The National Population Commission (NPC) putting the population at 88.5 million in 1991. About 140 million people live in Nigeria in 2006 with population growth declining to 3.2 per cent (FRN, 2007).

The data and Sampling procedures

The study will use data collected during the 2006 National Core Welfare Indicator Questionnaire (CWIQ) Survey. A two-stage cluster sample design was adopted in each LGA. The first stage involves the Enumeration Areas (EAs), while Housing Units (HUs) constitute the 2nd stage. The National Population Commission (NPopC) EAs as demarcated during the 1991 Population Census served as the sampling frame for the selection of 1st stage sample units. In each LGA, a systematic selection of 10 EAs was made. Prior to the second stage selection, complete listing of Housing Units (and of Households within Housing Units) was carried out in each of the selected 1st stage units. These lists provided the frames for the second stage selection. Ten (10) HUs were then systematically selected per EA and all households in the selected HUs were interviewed. The projected sample size was 100 HUs at the LGA level. The sample size using other defined reporting domains (FC, senatorial, state and geo-political zone) varied, depending on the number of the LGAs that made the reporting domain. Overall, 77,400 HUs were drawn at the national level out of which 59567 were from the rural areas. Also, sampling weights were constructed for each sample, thus making the data representative of the entire population in Nigeria. The detailed enumeration area and households sampled number are contained in table 1.

Welfare Attributes

Table 2 shows the attributes that were selected for multidimensional poverty measure. From the numerous attributes we selected a small set of material and non-material indicators whose changes are assumed to impact on poverty. These indicators are classified according to Ki *et al.* (2005), into categories of indicators comprising of

housing/sanitation, economic condition/security, goods of comfort, equipment and assets, means of transportation, education, energy, communication, community project involvement, health, ownership of land and livestock and access to basic infrastructure. The choice of indicators reiterated in table 2 was made by taking into account factors such as cultural dependence of indicators, temporal dependence, presence of objective elements and balance between qualitative and quantitative items.

The selected attributes are mixed dichotomous, categorical and discrete types. All of the variable under goods of comfort, equipment and assets are dichotomous variables, variables under ownership of land and livestock are discrete variables. The variables under the housing/sanitation are categorical except window/door net, maintain good drainage, and maintain good sanitation which are dichotomous variables. The health variables are dichotomous. The variables under community project involvement are dichotomous variables. The variables under economic condition/security are categorical and dichotomous. The variables under transportation are dichotomous variables. Educational variable is dichotomous. Energy variables are dichotomous and categorical. Access to basic infrastructure variables is categorical. Communication variables are dichotomous.

Analytical Approaches

Computation of Multidimensional Poverty Indices

Indices of multidimensional poverty are to be computed using the Fuzzy Set theory originally developed by Zadeh (1965). This approach had been widely applied to poverty analysis by authors like Cerioli and Zani (1990), Chiappero Martinetti (2000), Costa (2002), Dagum (2002), Costa (2003) and Deutsch and Silber (2005). Zadeh (1965) characterized a fuzzy set as a class with a continuum of grades of membership. Therefore, in a population A of n households [A = a_1, a_2, a_3, ……a_n], the subset of poor households B includes any household $a_i \in B$. These households present some degree of poverty in some of the m poverty attributes (X).

The welfare attributes to be considered in this study based on the CWIQ are presented in Appendix 3. The findings of Ayoola *et al* (2000) for some Nigerian rural and urban areas will assist in selecting relevant welfare attributes because their study was

based on focused group discussions and therefore considered to be the voice of the poor. Following Costa (2002), the degree of being poor by the i-th household (i=1,….,n) with respect to a particular attribute (j) given that (j = 1,……,m) is defined as: $\mu_B [X_j (a_i)] =$ x_{ij}, $0 \leq x_{ij} \leq 1$. Specifically, $x_{ij} = 1$ when the household does not possess welfare enhancing attribute and $x_{ij} = 0$ when the household possesses it. Betti *et al.* (2005) noted that putting together categorical indicators of deprivation for individual items to construct composite indices requires decisions about assigning numerical values to the ordered categories and the weighting and scaling of the measures. Individual items indicating non-monetary deprivation often take the form of simple 'yes/no' dichotomies. In this case x_{ij} is 0 or 1.

However, some items may involve more than two ordered categories, reflecting different degree of deprivation. Consider the general case of c = 1 to C ordered categories of some deprivation indicator, with c = 1 representing the most deprived and c = C the least deprived situation. Let c_i be the category to which individual *i* belongs. Cerioli and Zani (1990), assuming that the rank of the categories represents an equally-spaced metric variable, assigned to the individual a deprivation score as:

$$x_{ij} = (C-c_i)/(C-1) \qquad \qquad ….1$$

where $1 \leq c_i \leq C$. Therefore, x_{ij} needs not to be compulsorily 0 or 1, but $0 \leq x_{ij} \leq 1$ when there are many categories of the jth indicator and the household possesses the attribute with an intensity.

The multidimensional poverty ratio of an household, $\mu_B (a_i)$, which show the level of welfare deprivation and membership to set B is defined as the weighted average of x_{ij},

$$\mu_B (a_i) = \sum_{j=1}^{m} x_{ij} w_j / \sum_{j=1}^{m} w_j \qquad \qquad …………….2$$

w_i is the weight attached to the j-th attribute.

The intensity of deprivation with respect to X_j is measured by the weight w_j. It is an inverse function of the degree of deprivation and the smaller the number of households and the amount of their deprivation, the greater the weight. In practice, a weight that fulfils the above property had been proposed by Cerioli and Zani (1990). This can be expressed as:

$$w_j = \log[\sum_{i=1}^{n} g(a_i) / \sum_{i=1}^{n} x_{ij} g(a_i)] \geq 0 \qquad \text{...............3}$$

Ideally, $g(a_i)/\sum_{i=1}^{n} g(a_i) > 0$ and $g(a_i)/\sum_{i=1}^{n} g(a_i)$ is the relative frequency represented by the sample observation a_i in the total population. Therefore when $x_{ij}=0$, the welfare attribute should be removed.

Poverty Decomposition by Multidimensional Welfare Attributes

The poverty ratio of the multidimensional poverty indices will be decomposed based on the contributions of each welfare indicator or attribute. The poverty ratio of the population μ_B is simply obtained as a weighted average of the poverty ratio of the i-th household $\mu_B(a_i)$

$$\mu_B = \sum_{i=1}^{n} \mu_B(a_i) g(a_i) / \sum_{i=1}^{n} g(a_i). \qquad \text{...............4}$$

Similarly,

$$\mu_B(X_j) = \sum_{i=1}^{n} x_{ij} g(a) / \sum_{i=1}^{n} g(a_i) \qquad \text{...............5}$$

In this way it is possible to decompose the multidimensional poverty ratio of the population μ_B as the weighted average of $\mu_B(X_j)$, with weight w_j.

$$\mu_B = \sum_{i=1}^{n} \mu_B(a_i) g(a_i) / \sum_{i=1}^{n} g(a_i) = \sum_{j=i}^{m} \mu_B(X_j) w_j / \sum_{j=1}^{m} w_j \qquad \text{............... 6}$$

Sub-Group Multidimensional Poverty Decomposition

Sub-group decomposition is done with application to the Nigerian States, Geo-political zones, sector of the economy (rural-urban) and occupational groups. Using multidimensional poverty Gini index proposed by Mussard and Alperin (2006), there are several ways of dealing with inequality in multidimensional poverty indices. The most common approach is those of Sen (1976) with the Gini index of poverty gap ratio, that is a fundamental component of Sen's poverty index.. From (2), the dimension that tends to increase the level of poverty of each household can be determined by decomposing the household poverty index:

$$\mu_B(a_i) = \sum_{j=1}^{m} y_{ij} \qquad\qquad\qquad \ldots\ldots\ldots\ldots 7$$

where y_{ij} is the contribution of the j-th attribute to the overall amount of the household poverty index $\mu_B(a_i)$:

$$y_{ij} = x_{ij} w_j / \sum_{j=1}^{m} w_j \qquad\qquad\qquad \ldots\ldots\ldots\ldots 8$$

Following Mussard and Pi Alperin (2005) it is possible to decompose multidimensional poverty indices by sub-population. Suppose the total economic surface is divided into K groups, S_k, of size n_k (k=1,…,K). The intensity of poverty of the i-th household of S_k is given as:

$$\mu_B(a_i^k) = \frac{\sum_{j=1}^{m} x_{ij}^k w_j}{\sum_{j=1}^{m} w_j} \qquad\qquad\qquad \ldots\ldots\ldots 9$$

Where x_{ij}^k is the degree of membership related to the fuzzy sub-set B of the i-th household (i=1,…,n) of S_k with respect to the j-th attribute (j=1,…,m). Hence, the fuzzy poverty index associated with group S_k is:

$$\mu_B^k = \frac{\sum_{i=1}^{nk} \mu_B(a_i^k) g(a_i^k)}{\sum_{i=1}^{nk} g(a_i^k)} \qquad\qquad\qquad \ldots\ldots\ldots 10$$

Following equation (8), the overall poverty index can be computed as a weighted average of the poverty within each group:

$$\mu_B = \frac{\sum_{k=1}^{k} \sum_{i=1}^{nk} \mu_B(a_i^k) g(a_i^k)}{\sum_{i=1}^{n} g(a_i)} \qquad\qquad\qquad \ldots\ldots\ldots\ldots 11$$

Thus, the contribution of the k-th group to the global index of poverty is:

$$C_{\mu B}^k = \frac{\sum_{i=1}^{nk} \mu_B(a_i^k) g(a_i^k)}{\sum_{i=1}^{n} g(a_i)} \qquad\qquad\qquad \ldots\ldots\ldots 12$$

We tested the null hypothesis that there is no significant difference between average multidimensional poverty indices across the geo-political zones, state, age group, sex, marital status, household size and occupation.

Results and discussions

Descriptive statistics of households' socio-economic characteristics

Table 3 shows the percentage distribution of rural house heads sex and their marital status across the states and geo-political zones in Nigeria. The table shows that the percentage of male headed households is greater than that of the female headed households in all the zones and states. In all the zones, monogamy is practiced by the largest proportion of the population. It is highest in North West and lowest in the South West with 65.47 and 52.26 percent respectively. Polygamy is highest in the North East and lowest in the South South with 33.83 and 8.66 percent respectively.

Table 4 shows the percentage distribution of rural house heads educational status across the states and GPZs in Nigeria. The educational status have been divided into six groups –no education, some primary education completed primary, some secondary, completed secondary and post secondary. The largest proportion of the population in the States and GPZs did not have any education. North East has the highest percentage of no education, followed by North East and North Central with 78.89, 71.90 and 54.00 respectively.

Table 5 shows the average household sizes and house head ages across the States and GPZs in rural Nigeria. The overall mean age of rural house heads in Nigeria is 47 years and it has variability index of 32.97 percent. South East has the highest mean age of 55 year sand the lowest variability index of 26.86 percent while North West has the lowest mean age of 44 years and variability index of 33.46 percent. The table also shows that the mean age of the house heads across the states varies with majority in their early forties. Abia State has the highest mean age of 56 years with variability index of 27.94 percent. The least mean age is observed in the FCT which is 40 years and the variability index is 32.52 percent. The lowest variability index of 24.40 percent is recorded in Enugu and the mean age is 55 years.

Table 6 shows the percentage distribution of rural house heads employment group across the states and geo-political zones. It shows that 50.20 percent of the rural house heads in Nigeria are largely engaged in agriculture. Specifically, Benue state, Ebonyi state and Zamfara state have the high proportion of their rural house heads engaged in agriculture with 76.13, 72.59 and 96.32 percent respectively while Lagos recorded the lowest house heads that is engaged agriculture (13.37 percent).

Multidimensional Poverty Index

The average multidimensional poverty index for rural households in Nigeria is 0.3796. The multidimensional poverty index for rural households in Nigeria ranges from 0.0905 to 0.9968. The multidimensional poverty incidence of rural households in Nigeria is 53.38 percent (average multidimensional poverty index was used as the poverty line).

Decomposition by regional and States

Table 7 shows the multidimensional poverty decomposition by region and States. South East has the highest average multidimensional poverty index of 0.4049 with variability index of 26.82 percent. North East has the lowest average multidimensional poverty index of 0.3557 and variability index of 27.10 percent. The Levene's test shows that the variances of multidimensional poverty indices across the zones are significantly different ($P<0.01$). Using the Welch and Brown-Forsythe F statistics, it is concluded that multidimensional poverty indices are significantly different ($p< 0.01$) across the zones. Therefore null hypothesis for the GPZs is hereby rejected. Across the States, highest average multidimensional poverty index of 0.4443 is observed in Taraba, while the lowest average multidimensional poverty index of 0.3235 is observed in FCT. Kano has the highest absolute and relative contribution to multidimensional poverty of 0.0221 and 5.82 percent respectively. Lagos also has low absolute and relative contribution to multidimensional poverty of 0.002 and 0.53 percent respectively. The Levene's test shows that the variances of multidimensional poverty indices across the states are significantly different ($P<0.01$). Using the Welch and Brown-Forsythe F statistics, it is concluded that multidimensional poverty indices are significantly different ($p< 0.01$) across the states. Therefore null hypothesis for the states is hereby rejected.

Decomposition by socio-economic groups

Table 8 shows the multidimensional poverty decomposition by socio-economic groups. The multidimensional poverty index was decomposed across the sex, marital status, occupation and educational groups.

House head sex

The average multidimensional poverty indices for male and female house heads are 0.3747 and 0.4138, respectively. The absolute and relative contribution to multidimensional deprivation of male house head is 0.3288 and 86.61 percent respectively while that of the female is 0.0508 and 13.39 percent, respectively. The Levene's test shows that the variances of multidimensional poverty indices across the sex of house heads are significantly different ($P<0.01$). The Welch and Brown-Forsythe F statistics show that multidimensional poverty indices are significantly different ($p< 0.01$) across the sex of the house heads. Therefore null hypothesis for sex is hereby rejected.

Marital status

The average multidimensional deprivation index of the various marital status varies. The widowed, divorced or separated have the highest average multidimensional deprivation index of 0.4104. The polygamous has the lowest average multidimensional deprivation index of 0.3666. The average multidimensional deprivation index of the single, monogamous and informal or loose union is 0.3829, 0.3769 and 0.4091, respectively. The lowest absolute and relative contribution to multidimensional deprivation index is observed in the informal or loose union. Their corresponding values are 0.0025 and 0.66 percent. The Levene's test shows that the variances of multidimensional poverty indices across the house heads' marital status are significantly different ($P<0.01$). The Welch and Brown-Forsythe F statistics revealed that multidimensional poverty indices are significantly different ($p< 0.01$) across the marital status group. Therefore null hypothesis for marital status is hereby rejected.

Occupational groups

The unemployed has the highest average multidimensional deprivation index of 0.4152 with variability index of 28.75 percent. Those employed in the private formal sector have the lowest average multidimensional deprivation index of 0.3385 and highest variability index of 30.35 percent. Those who are self employed in agriculture have the highest absolute and relative contribution to multidimensional deprivation index with corresponding value of 0.1977 and 52.07 percent. The unemployed have the lowest absolute and relative contribution of 0.000 1.33 percent to multidimensional deprivation index. The Levene's test shows that the variances of multidimensional poverty indices across the occupational groups are significantly different (P<0.01). The Welch and Brown-Forsythe F statistics, showed that multidimensional poverty indices are significantly different (p< 0.01) across the occupational groups. Therefore null hypothesis for occupational group is hereby rejected.

Contributions of welfare indicators to Multidimensional Poverty

Table 9 shows the absolute and relative contributions of each of the attributes to multidimensional poverty. The result shows that having problem satisfying healthcare needs (0.0097 and 2.55 percent), time to the nearest public transportation (0.0097 and 2.55 percent), problems with supply of drinking water (0.0097 and 2.55 percent), problems satisfying food needs (0.0096 and 2.54 percent), time to all seasons road (0.0095 and 2.51 percent), time to nearest primary school (0.0095 and 2.50 percent), are the main attributes influencing the overall multidimensional poverty index in rural Nigeria.

Table 10 shows the multidimensional poverty decomposition across grouped attributes. The attributes/indicators were classified in line with Ki *et al* (2005), into categories of indicators comprising of housing/sanitation, economic condition/security, goods of comfort, equipment and assets, means of transportation, education, energy, communication, community project involvement, health, ownership of land and livestock and access to basic infrastructure. Housing/Sanitation has the highest absolute and relative contribution of to multidimensional poverty.

Table 11 shows the absolute contribution of multidimensional welfare attributes to deprivation across the GPZs in Nigeria. Across the zones, own a personal computer,

own a gas cooker, own a camel, own a fixed line telephone and use insecticide treated net have absolute and relative contribution to multidimensional poverty that is approximately equal to zero except North East where the attributes own a gas cooker, own a camel, have the same absolute and relative contribution to multidimensional poverty of 0.0001 and 0.03 percent. In the North West, the material of the walls of the house has the highest absolute and relative contribution to multidimensional poverty. In the North East, the material of the walls of the house has the highest absolute and relative contribution to multidimensional poverty. In the North Central, problems with supply of drinking water and type of toilet facility has the highest absolute and relative contribution to multidimensional poverty.

Table 12 shows the absolute contributions of multidimensional poverty decomposition of the grouped attributes across the GPZs, in rural Nigeria. Housing/sanitation has the highest absolute and relative contribution to multidimensional poverty in the Northern zones and South West. There absolute and relative contribution is as follows 0.0132 and 3.48 percent; 0.0228 and 6.01 percent; 0.0132 and 0.3.48 percent; and 0.0116 and 3.06 percent respectively. The second attribute in North West is access to basic infrastructure is with absolute and relative contribution. The second attribute in North East is economic condition/security with absolute and relative contribution. In the South East the first attribute is economic condition/security while access to basic infrastructure is second attribute.

Conclusion

This study examines the multidimensional aspects of the phenomenon of poverty, living conditions and poverty response in rural Nigeria. It further looked at a synthetic analysis of decomposition that point out the dominant attributes/dimensions (housing/sanitation, economic condition/security, education, energy, etc.) and the most urgent sub-groups (gender, zone, occupation, etc.) of policy interventions. The result shows that the multidimensional poverty for the rural Nigeria is 0.3796. It had been shown that housing/sanitation and economic condition/security are the main factor of poverty. It is also reflected that some needs such as healthcare needs, public

transportation, supply of drinking water, food needs, all seasons road, and primary school are important in solving multidimensional poverty in the rural area.

Multidimensional approach (fuzzy set) is very useful in order to implement socio-economic policies to reduced poverty diffusion. Based on the findings, reform actions should be directed towards education, women, improving the status of those employed in agriculture, improving housing/sanitation conditions. The policies should be concentrated in the Northern zones and South West of rural Nigeria. These directions will allow the state of poverty in rural Nigeria to be alleviated.

Policy Recommendations

The following poverty reduction policies are recommended based on the findings.

(i)   The government should embark on programmes that would encourage people to take up agriculture as the main occupation has their multidimensional poverty is higher than those in other sector in the rural area.

(ii)   The government should ensure that healthcare facility in the rural area is within the reach of the rural people. Also, ensure that the dilapidated health facility is rehabilitated.

(iii)   Housing/sanitation poverty should be tackled in the Northern zones and South West, to be specific it should be tackled in the following states Adamawa, Bauchi, Bayelsa, Benue, Borno, Cross River, Ekiti, Gombe, Jigawa, Kaduna, Kano, Kastina, Kebbi, Kogi, Kwara, Niger, Ogun, Ondo, Osun, Oyo, Plateau, River, Sokoto, Yobe and Zamfara.

References

Adams, R.H. (Jr.) and J. Page (2003): International Migration, Remittances and Poverty in Developing Countries. World Bank Policy Research Working Paper 3179, December, Washington, D.C.: World Bank.

Adeyeye V.A (2000) "Designing and Managing Poverty Alleviation Programme in Nigeria: The Micro-Project Option" Paper Presented at the Workshop on Poverty Alleviation Policies and Strategies, organized by National Center for Economic Management and Administration (NCEMA), Ibadan.

Ajakaiye, D.O. and V.A. Adeyeye (2001). Concept, Measurement and Causes of Poverty Central Bank of Nigeria Economic and Financial Review Vol. 39, No 4.

Alayande, B. and O. Alayande (2004). A Quantitative and Qualitative Assessment of Vulnerability to Poverty in Nigeria. Being a Paper submitted for presentation of CSAE Conference on Poverty reduction, Growth and Human Development in Africa, March, 2004.

Aluko, S. (1975), "Poverty: Its remedies" in Poverty in Nigeria. The Nigerian Economic Society, Ibadan.

Asselin L M (2002), Multidimensional Poverty.Intitut de Mathematique Gauss Levis, Quebec, Canada G6W 1H2.

Ayoola G.B., Aina, B Mamman, N. Nweze, T. Odebiyi, F. Okunmadewa, D. Shehu, O. Williams, J. Zasha (2000). NIGERIA: Voice of the Poor Country Synthesis Report World Bank.

Baran B., Rojas A., Brietz D., and Baran L.,(1999), Measurement and Analysis of Poverty and Welfare using Fuzzy set. (*http://www.cnc.una.py/cms/invest/download.php?id=115572,95,1*)

Benhabib A., Ziani T., Bettahar S., and Maliki S. (2007). The Analysis of poverty Dynamics in Algeria: A Multidimensional Approach. Laboratory MECAS. University of Tlemcen B. P. 226, Tlemcen, 13000, Algeria.

Betti, G.,Cheli, B., Lemmi,A., and Verma V., (2005). The Fuzzy approach to multidimensional poverty: the case of Italy in the 90's. Paper presented at 'The measurement of multidimensional poverty, theory and evidence. Brasilia, august 29-31 2005.

Bibi, S. (2003) . Comparing Multidimensional Poverty Between Egypt and Tunisia. JEL classification D31. D63; 132.

Booysen, F., S. van der Berg, R. Berger, M. von Maltitz, and G. du Rand (2005). Using Asset Index to Assess Trends in Poverty in Seven Sub-Saharan African Countries. Conference paper at the International Conference on the Many Dimensions of Poverty, Brasilia, Brazil 29-31 August 2005.

Bourguignon, F. (2002) Multi-dimensional Poverty Orderings. Working Paper 2002/22 of DELTA and the World Bank JEL classification D3, 132.

Cerioli A., Zani S. (1990), "A Fuzzy Approach to the Measurement of Poverty", in Dagum C. andZenga M. (eds.), *Income and Wealth Distribution, Inequality and Poverty,* Springer Verlag, Berlin, 272-284.

Cheli, B., Ghellini A., Lemmi A., and Pannuzi N., (1994), "Measuring Poverty in the Countries in Transition via TFR method: The Case of Poland In 1990-1991", *Statistics in Transition*, Vol.1, No.5, pp. 585-636.

Cheli, B. and Lemmi A., (1995), "Totally Fuzzy and Relative Approach to the Multidimensional Analysis of Poverty", *Economics Notes by Monte dei Paschi di Siena*, Vol. 24 No 1, pp. 115-134

Chiappero Martinetti, E. (2000). A Multidimensional Assessment of Well-Being Based on Sen's Functioning Approach. Societa Italiana Di Economia Pubblica Working Paper.

Collicelli, C and M. Valerii (2000). A New Methodology for Comparative Analysis of Poverty in the Mediterranean: A Model for Differential Analysis of Poverty At A Regional Level Via the Principal Component Analysis. Unpublished Paper.

Coromaldi, M. and Zoli, M. (2007). A Multidimensional Poverty Analysis. Evidence from Italian Data, University of Rome 'Tor Vergata' and University of Cassino.

Costa, M. (2002): *A Multidimensional Approach to the Measurement of Poverty: An Integrated Research Infrastructure in the Socio-Economic Sciences* IRISS Working Paper Series No. 2002-05.

Costa, M. (2003): *A Comparison Between Unidimensional and Multidimensional Approaches to the Measurement of Poverty An Integrated Research Infrastructure in the Socio-Economic Sciences* IRISS Working Paper Series No. 2003-02.

Dagum C. (1989), "Poverty as Perceived by the Leyden Evaluation Project. A Survey of Hagenaars' Contribution on the Perception of Poverty", *Economic Notes*, 1, 99-110.

Dagum, C. (2002). Analysis and measurement of Poverty and Social Exclusion Using Fuzzy Set Theory. Application and Policy Implication. Unpublished paper.

Duclos, J-Y., D. Sahn and S.D. Younger (2005) Robust Multidimensional Spatial Poverty Comparisons in Ghana, Madagascar, and Uganda. SAGA Research Paper.

Duetsch, J. and Silber (2005). Measuring Multidimensional Poverty: An Empirical Comparison of Various Approaches. Review of Income and Wealth 51 (1): 145-174.

Federal Office of Statistic (FOS) (1999), Poverty and Agricultural sector in Nigeria FOS, Abuja, Nigeria.

Federal Republic of Nigeria (FRN) (2006). Poverty Profile for Nigeria. National Bureau of Statistics (NBS) FRN.

Federal Republic of Nigeria (FRN) (2007), Legal notice on publication of 2006 census results. Federal Republic of Nigeria Official Gazette. No 4, Vol. 94.

Foster, J. Greer, J and Thorbecke, E. (1984) 'A class of Decomposable Poverty Measures', *Econometrica*, 52(3): 761-776.

Hagenaars A.J.M. (1986), *The Perception of Poverty,* North Holland, Amsterdam.

IMF (2005). Nigeria: Poverty Reduction Strategy Paper— National Economic Empowerment and Development Strategy. IMF Country Report No. 05/433.

Ki, J.B, S. Faye and B. Faye (2005). Multidimensional Poverty in Senegal: A Non-monetary Basic Needs Approach. PMMA Working Paper 2005-05. Poverty and Economic Policy (PEP) Network, Canada.

Maggio, G. (2004). Multidimensional Analysis of Poverty Dynamics in Great Britain Institute for Social and Economic Research (ISER) Working Paper.

Mehta, A.K.. R. Panigrahi, and S. Sivramkrishna (2002). Operationalizing Multidimensional Concept of Chronic Poverty: An Exploratory Spatial Analysis. Paper presented at the Research Design Workshop for Exploring Appropriate Solutions to Chronic Poverty Held At IIPA on 15th and 16th May, 2002.

Mussard, S. and Pi Alperin , M. N.(2005),'Multidimensional Decomposition of Poverty: A Fuzzy Set Approach' . Accepted paper to be presented in the International Conference in Memory of Two Eminent Social Scientists: C. Gini and M. O. Lorenz. Their impact in the XX-th century development of probability,statistics and economics. Università Degli Studi di Siena, 23-26 may, 2005.

Mussard, S and Pi Alperin, M.N. (2006); Inequalities in Poverty: Evidence from Argentina. Working Paper 06-03 Universite de Sherbrroke, January 2006.

National Population Commission (NPC) [Nigeria] and ORC Macro. 2004. *Nigeria Demographic and Health Survey2003.* Calverton, Maryland: National Population Commission and ORC Macro.

Okunmadewa, F. (2002), Poverty and Agricultural Sector in Nigeria: Okunmadewa F. Poverty Reduction and the Nigeria Agricultural Sector. Elshaddai Global Ventures Ltd.

Osinubi, T.S. (2003). Urban poverty in Nigeria: A case study of Agege area of Lagos State, Nigeria. Unpublished paper.

Qizilbash, Mozaffar (2004). On the Arbitrariness and Robustness of Multi-Dimensional Poverty Rankings Research Paper No. 2004/37 World Institute for Development Economics Research (WIDER).

Sen A.K. (1992), *Inequality Reexamined,* Harvard University Press, Cambridge (MA).

Sen, A. (1976) "An Ordinal Approach to Measurement", Econometrica, 44, 219-232.

Sen, A. (1983). Poor Relatively Speaking. Oxford Economic Paper 35.

Sen, A.K. , (1985), *Commodities and Capabilities*, North-Holland, Amsterdam

Sen, A. K., (1992), Inequality reexamined. Clarendon Press, Oxford.

Shakarishvil G.(2003), Challenges in Measuring Poverty: Case Study of the Cis- Region (Draft Research Paper for International Policy Fellowship Program, January, 2003).

Silber, J. and M. Sorin, (2006), "Poverty in Israel: Taking a Multidimensional Approach," Chapter 9 in Petmesidou M. &   Papatheodorou C, eds: *Poverty and Social Deprivation in the Mediterranean Area: Trends, Policies and Welfare Prospects   in the New Millennium.* London: Zed Books / CROP Series.

 Steeten, P. (1981) First Things First: Meeting Basic Human Needs in Developing Countries. New York: Oxford University Press.

United Nations Development Program (UNDP) (2006). Beyond scarcity: Power, poverty and the global water crisis. Human Development Report 2006. UNDP.

Valentine C. (1992) Cultura de la. Pobreza y Seguridad. Pp. 22-40. Amorrotiu Editores. Argentina.

Vero, J. and Werquin P., (1997), "Reexamining the Measurement of Poverty: How Do Young People in the Stage of Being Integrated in the Labor Force Manage", *Economie et Statistique*, No. 8-10, pp. 143-156 (in French).

World Bank (1990). Poverty World Development Report. Oxford University Press.

World Bank (1996) "Poverty in the Midst of Plenty: The challenge of growth with inclusion in Nigeria" A World Bank Poverty Assessment, May 31, World Bank, Washington, D.C..

World Bank (2001), *World Development Report 2000/2001*, Oxford University Press, New York.

Zadeh, L.A. (1965). Fuzzy Set. *Information and Control,* 8:338-53.

Table 1: Frequency distributions of enumeration areas and sample sizes of the 2006 Core Welfare Indicator Questionnaire (CWIQ) across the States in Nigeria

State	LGA	EA	HU	Total sample	Rural sample	Total samples used
Abia	17	170	1700	1697	1367	1353
Adamawa	21	210	2100	2100	1630	1610
Akwa Ibom	31	310	3100	3090	2830	2781
Anambra	21	210	2100	2100	1280	1255
Bayelsa	20	200	2000	2000	1840	1832
Bauchi	8	80	800	792	682	656
Benue	23	230	2300	2300	2080	2078
Borno	27	270	2700	2683	2173	2163
Cross river	18	180	1800	1799	1359	1357
Delta	28	280	2800	2468	1878	1870
Ebonyi	13	130	1300	1300	1030	1025
Edo	18	180	1800	1800	1360	1325
Ekiti	16	160	1600	1599	839	831
Enugu	17	170	1700	1694	1136	1125
Gombe	11	110	1100	1089	899	883
Imo	27	270	2700	2690	2370	2240
Jigawa	27	270	2700	2700	2570	2526
Kaduna	23	230	2300	2300	1920	1896
Kano	44	440	4400	4399	3840	3828
Katsina	34	340	3400	3400	2960	2957
Kebbi	21	210	2100	2099	1749	1738
Kogi	21	210	2100	2097	1467	1467
Kwara	16	160	1600	1597	1147	1094
Lagos	20	200	2000	1975	330	329
Nasarawa	13	130	1300	1291	1291	1281
Niger	25	250	2500	2470	1930	1903
Ogun	20	200	2000	1989	1210	1199
Ondo	18	180	1800	1765	1225	1212
Osun	30	300	3000	2972	2221	2203
Oyo	33	330	3300	3260	1847	1828
Plateau	17	170	1700	1672	1302	1271
Rivers	23	230	2300	2300	1720	1669
Sokoto	23	230	2300	2290	1940	1907
Taraba	16	160	1600	1597	1337	1325
Yobe	17	170	1700	1698	1198	1190
Zamfara	14	140	1400	1390	1240	1232
FCT	6	60	600	600	370	350
Total	774	7740	77400	77062	59567	58789

Source: National Bureau of Statistics (NBS), 2007. www.nigerianstat.gov.ng

Table 2: Welfare attributes that were considered for multidimensional poverty in rural Nigeria

Housing/sanitation	Goods of comfort, equipment and assets	Communication
Material of the roof of the house	Own an electric iron	Own a television
Material of the walls of the house	Own a charcoal iron	Own a fixed line telephone
Material of the floor of the house	Own a refrigerator	Own a mobile phone
Housing unit type	Own a personal computer	Own a radio
Number of rooms per person	Own a mattress or bed	**Community project involvement**
Main source of drinking water	Own a watch or clock	Member provide materials
Problems with supply of drinking water	Own a modern stove	Member provide labour
Water treated before drinking	Own a gas cooker	Member provide management
Type of toilet facility	Own a fan	Member provide funds
Type of refuse collection	Own a mat	**Health and access**
Maintain good drainage	Own a VCR	Use bed net to prevent malaria
Maintain good sanitation	Own furniture	Use insecticide against malaria
Dwelling has window/door net	**Means of transportation/access**	Use anti-malaria drug
Owns the dwelling	Own a bicycle?	Use fumigation against malaria
	Own a motorcycle	Use insecticide treated net
Economic condition/security	Own a vehicle	**Ownership of land and livestock assets**
Problem satisfying food needs	Own a canoe	Area of land owned (hectares)
Problems paying school fees	Own a donkey	Number of cattle and other large animals
Problems paying house rent	Own a camel	Number of sheep, goats, etc. owned
Problems paying utility bills	**Education/access**	**Access to basic infrastructure**
Problems paying for health care	Education level of head of household	Time to supply of drinking water
Improved household economic state	**Energy**	Time to food market
Improved community economic state	Own a generator	Time to nearest public transportation
Members perceived household to be poor	Source of electricity	Time to nearest primary school
Security situation of the community	Main fuel used for lighting	Time to nearest secondary school
	Main fuel used for cooking	Time to nearest health clinic or hospital
		Time to nearest all seasons road

Source: Extracted by the Author from the 2006 CWIQ data

Table 3: Percentage distributions of rural house heads' sex and marital status across the States and Geo-Political Zones in Nigeria

	Sex		Marital status				
	Male	Female	Single	Mono-gamous	Poly-gamous	Informal or loose union	Widowed, divorce, separated
Abia	71.3969	28.6031	5.6911	59.4974	5.2476	0.2217	29.3422
Adamawa	93.6025	6.3975	6.1491	64.4099	20.8696	0.0000	8.5714
Akwa Ibom	77.3822	22.6178	9.4930	61.3089	5.0701	0.7911	23.3369
Anambra	74.1036	25.8964	4.9402	65.4980	4.8606	0.0000	24.7012
Bauchi	98.9083	1.0917	1.5830	67.1397	28.5480	0.0000	2.7293
Bayelsa	77.1341	22.8659	9.6037	48.0183	22.4085	5.0305	14.9390
Benue	91.2897	8.7103	10.6352	61.5977	16.0731	0.1444	11.5496
Borno	95.4693	4.5307	3.2362	67.1290	21.5442	0.0000	8.0906
Cross River	76.7133	23.2867	13.0435	56.8902	7.0744	3.3898	19.6021
Delta	70.5882	29.4118	9.4652	52.0856	9.7861	4.5455	24.1176
Ebonyi	76.3902	23.6098	5.7561	55.6098	13.1707	0.3902	25.0732
Edo	76.6038	23.3962	9.6604	53.2830	12.9057	1.7358	22.4151
Ekiti	75.8123	24.1877	5.8965	55.9567	12.8761	1.2034	24.0674
Enugu	71.1111	28.8889	3.9111	58.8444	6.4889	0.2667	30.4889
Gombe	98.5277	1.4723	5.6625	61.2684	29.7848	0.0000	3.2843
Imo	76.2946	23.7054	6.8750	64.0179	3.4821	0.0893	25.5357
Jigawa	97.5455	2.4545	1.4648	60.6888	34.2043	0.0000	3.6421
Kaduna	97.4156	2.5844	4.2194	64.5042	28.1646	0.0000	3.1118
Kano	98.6938	1.3062	1.9331	60.1881	35.3187	0.0000	2.5601
Katsina	98.1062	1.8938	1.4204	57.5922	38.6202	0.0000	2.3673
Kebbi	99.5397	0.4603	0.4028	62.1404	36.4212	0.0000	1.0357
Kogi	77.6414	22.3586	11.1111	55.7601	12.8834	0.6817	19.5637
Kwara	80.2559	19.7441	6.6728	53.4735	22.3035	0.0000	17.5503
Lagos	87.2340	12.7660	6.3830	62.3100	16.4134	0.0000	14.8936
Nasarawa	97.3458	2.6542	9.7580	60.4996	25.5269	0.0781	4.1374
Niger	98.7388	1.2612	3.2055	66.8944	26.4845	0.0000	3.4157
Ogun	75.3962	24.6038	7.3394	48.4570	15.5963	0.4170	28.1902
Ondo	78.3828	21.6172	8.6634	49.1749	14.6865	2.1452	25.3300
Osun	73.4453	26.5547	6.1280	46.8906	24.3305	0.1816	22.4694
Oyo	85.7221	14.2779	9.3545	59.7921	14.5514	0.2188	16.0832
Plateau	95.0433	4.9567	6.6876	73.8788	12.7459	0.0000	6.6876
River	77.4116	22.5884	12.9419	57.9389	5.8718	4.1342	19.1132
Sokoto	98.5842	1.4158	1.5207	73.4662	23.2826	0.0000	1.7305
Taraba	96.7547	3.2453	11.0943	65.7358	17.3585	0.3019	5.5094
Yobe	97.8992	2.1008	2.7731	64.1176	29.2437	0.0000	3.8655
Zamfara	98.5390	1.4610	1.2987	58.5227	38.2305	0.0812	1.8669
FCT	96.0000	4.0000	14.5714	62.8571	18.5714	0.0000	4.0000
North West	96.6456	3.3544	4.7540	65.4671	24.0586	0.0444	5.6759
North East	98.3213	1.6787	1.7719	61.9560	33.8224	0.0062	2.4434
North Central	90.8937	9.1063	8.2486	62.3676	19.3244	0.1482	9.9111
South East	74.1355	25.8645	5.6588	61.3461	5.9731	0.1715	26.8505
South West	78.3478	21.6522	7.4849	52.2626	17.4691	0.6446	22.1389
South South	75.8542	24.1458	10.6130	56.3160	8.6560	2.8784	21.5366
Total	87.7188	12.2812	5.9229	60.3072	20.4341	0.6090	12.7269

Source: Author's computation from the 2006 CWIQ data.

Table 4: Percentage distribution of rural house heads' educational levels across the States and GPZs in Nigeria

States/GPZs	None	Some primary	Completed primary	Some secondary	Completed secondary	Post secondary
Abia	30.5248	9.6083	31.8551	5.2476	14.6341	8.1301
Adamawa	56.7081	2.5466	10.4348	6.5217	14.9068	8.8820
Akwa Ibom	24.0201	13.3046	31.6433	7.0838	13.5563	10.3919
Anambra	31.1554	11.8725	37.9283	4.6215	8.6056	5.8167
Bauchi	72.9258	1.5284	10.7533	2.7838	7.2052	4.8035
Bayelsa	30.6402	4.1159	16.3110	7.9268	27.2866	13.7195
Benue	37.5361	4.2830	19.3455	7.8441	21.0298	9.9615
Borno	83.5876	0.7397	4.9468	0.8784	5.1780	4.6694
Cross River	29.8452	8.9904	25.9396	8.2535	14.6647	12.3066
Delta	33.3690	4.7594	20.8021	9.4652	19.8396	11.7647
Ebonyi	55.5122	7.9024	20.2927	2.5366	7.1220	6.6341
Edo	36.1509	3.0189	22.0377	5.8868	24.0755	8.8302
Ekiti	44.7653	3.3694	17.2082	4.3321	13.8387	16.4862
Enugu	49.6000	7.7333	28.4444	2.2222	5.5111	6.4889
Gombe	76.1042	1.8120	10.0793	2.4915	4.5300	4.9830
Imo	28.6161	12.3214	32.7232	3.6607	13.4375	9.2411
Jigawa	82.1457	1.2272	9.1053	0.7918	2.8899	3.8401
Kaduna	56.0654	3.2173	9.9684	4.1667	15.0844	11.4979
Kano	73.8767	1.0188	14.0543	1.4107	4.8328	4.8067
Katsina	80.7237	1.5218	10.0778	1.3527	3.4156	2.9084
Kebbi	90.1611	0.5754	4.9482	0.4603	1.7261	2.1289
Kogi	50.3067	3.3401	15.6101	2.7267	16.1554	11.8609
Kwara	62.7057	1.7367	10.5119	2.0110	10.9689	12.0658
Lagos	28.5714	1.8237	24.3161	4.2553	27.0517	13.9818
Nasarawa	42.0765	3.8251	16.3154	8.3528	15.2225	14.2077
Niger	78.8229	0.2102	4.5192	0.6831	7.9874	7.7772
Ogun	55.2127	3.7531	18.8490	4.5038	9.8415	7.8399
Ondo	36.9637	3.2178	23.0198	6.1881	16.8317	13.7789
Osun	43.8947	3.4044	18.1117	4.6300	17.5216	12.4376
Oyo	55.9081	2.5164	18.2166	3.7199	12.0350	7.6039
Plateau	54.2093	3.9339	15.0275	6.5303	12.9819	7.3171
River	28.8796	3.1756	19.5327	4.0743	30.7370	13.6010
Sokoto	89.0928	0.8390	4.6146	0.7341	1.9927	2.7268
Taraba	50.5660	3.6981	8.3019	7.0189	17.6604	12.7547
Yobe	90.2521	1.0084	4.2017	1.0924	1.2605	2.1849
Zamfara	86.7695	1.2175	4.5455	1.6234	3.1656	2.6786
FCT	48.0000	0.8571	11.7143	5.1429	18.8571	15.4286
North West	71.8983	1.7994	8.0084	3.3655	8.5860	6.3423
North East	78.8858	1.3492	9.2328	1.4611	4.6755	4.3957
North Central	54.0025	2.7848	13.4795	4.7226	14.5277	10.4828
South East	36.7534	10.3315	30.9803	3.7439	10.6030	7.5879
South West	46.8956	3.1439	19.2055	4.5909	14.8908	11.2733
South South	29.6024	7.2582	24.2907	7.0822	20.2733	11.4931
Total	56.5701	3.9208	16.0795	3.8766	11.4460	8.1070

Source: Authors' computations from the 2006 CWIQ data.

Table 5: Descriptive statistics of households' size and house head ages in rural Nigeria across the states and GPZs

| States/GPZs | Age | | | House size | | |
	Mean	Std. Deviation	Coefficient of variation	Mean	Std. Deviation	Coefficient of variation
Abia	55.9815	15.6434	27.9439	4.4353	2.4583	55.4258
Adamawa	44.1814	14.5845	33.0105	5.5155	3.0782	55.8100
Akwa Ibom	46.9615	14.0591	29.9375	5.0029	2.5862	51.6940
Anambra	55.3060	15.3414	27.7391	4.2606	2.5330	59.4517
Bauchi	43.0764	14.5488	33.7744	5.7129	2.7688	48.4658
Bayelsa	44.8796	15.3003	34.0919	4.4375	2.9776	67.1008
Benue	43.7060	15.1923	34.7602	5.0448	2.8385	56.2659
Borno	44.9903	14.6589	32.5824	4.7379	2.5607	54.0472
Cross River	44.2697	13.7370	31.0303	4.6964	2.8736	61.1873
Delta	49.2807	17.3166	35.1387	4.1011	2.5137	61.2933
Ebonyi	51.3659	13.3203	25.9322	5.4400	3.2144	59.0882
Edo	51.4302	17.1171	33.2822	3.7849	2.2722	60.0333
Ekiti	54.2671	17.0893	31.4911	3.6919	2.2828	61.8327
Enugu	55.2969	13.4931	24.4012	4.5067	2.5308	56.1564
Gombe	41.8732	15.2498	36.4190	6.1857	3.4348	55.5281
Imo	55.9580	14.9706	26.7533	4.4268	2.4482	55.3041
Jigawa	47.6991	14.6201	30.6507	6.2668	3.1760	50.6798
Kaduna	42.9367	13.7574	32.0411	6.0116	3.2621	54.2634
Kano	44.9467	14.1242	31.4243	6.0144	3.1332	52.0950
Katsina	44.4498	14.3828	32.3574	5.4833	2.5558	46.6106
Kebbi	45.6743	13.3038	29.1275	5.8130	2.5589	44.0203
Kogi	51.2379	17.3058	33.7754	4.3504	2.6144	60.0956
Kwara	51.3711	16.7930	32.6896	4.8126	3.1371	65.1851
Lagos	46.6930	15.3607	32.8972	4.4802	2.2740	50.7567
Nasarawa	42.7330	15.4178	36.0794	5.6838	3.1131	54.7715
Niger	42.1876	13.7334	32.5532	5.7299	3.7072	64.6992
Ogun	52.8315	17.2609	32.6716	3.7048	2.5734	69.4612
Ondo	50.2104	16.6173	33.0953	4.1741	2.6525	63.5466
Osun	52.9605	17.3974	32.8498	4.0563	2.5787	63.5727
Oyo	49.9672	16.8975	33.8172	3.9923	2.4216	60.6568
Plateau	43.6042	13.7755	31.5921	5.1684	2.5067	48.5005
River	46.8580	15.0178	32.0496	4.7118	2.6648	56.5559
Sokoto	46.1872	13.9494	30.2019	4.9827	2.4002	48.1707
Taraba	42.1442	14.6176	34.6847	5.3358	2.9201	54.7266
Yobe	45.0521	13.9742	31.0179	5.6555	2.9915	52.8954
Zamfara	45.4115	13.8939	30.5956	5.5154	2.5981	47.1063
FCT	39.7457	12.9259	32.5215	5.0371	3.1132	61.8054
North West	43.7398	14.6332	33.4551	5.4266	2.9354	54.0928
North East	45.3120	14.1469	31.2211	5.7738	2.9042	50.2996
North Central	45.1655	15.6995	34.7599	5.1511	3.0789	59.7717
South East	55.0667	14.7932	26.8641	4.5599	2.6297	57.6701
South West	51.6535	17.1137	33.1317	3.9828	2.5164	63.1817
South South	47.4861	15.5325	32.7096	4.5294	2.6514	58.5376
All	47.3860	15.6225	32.9686	5.0401	2.8867	57.2747

Source: Authors' computations from the 2006 CWIQ data.

Table 6: Percentage distributions of rural employment groups across the States and GPZs in Nigeria

State/GPZs	None	Public	Private formal	Private informal	Self agriculture	Self others	Unemployed	Others
Abia	2.0695	7.4649	3.1042	2.0695	49.4457	23.5772	0.5174	11.7517
Adamawa	6.7702	9.3168	0.9317	1.6770	45.7143	10.0621	2.2981	23.2298
Akwa Ibom	3.5958	10.8234	3.1643	4.3150	32.1108	38.4754	1.5822	5.9331
Anambra	3.5060	4.6215	3.1076	3.4263	43.5857	28.5259	1.2749	11.9522
Bauchi	3.0022	6.6048	0.7096	3.6572	36.2445	30.2948	3.3297	16.1572
Bayelsa	4.5732	19.0549	2.2866	1.9817	24.6951	36.7378	3.3537	7.3171
Benue	3.1280	7.7478	0.8181	0.6256	76.1309	5.1011	0.8181	5.6304
Borno	4.6694	5.8252	0.8322	3.4674	57.6976	13.4073	0.1849	13.9159
Cross River	2.3581	14.5173	2.5792	1.4738	59.9116	14.1489	0.4422	4.5689
Delta	3.7433	9.0374	3.7433	5.7219	36.3102	29.6257	2.5134	9.3048
Ebonyi	3.4146	6.4390	0.6829	0.9756	72.5854	11.7073	0.0976	4.0976
Edo	4.9057	5.7358	1.5094	0.8302	60.3019	17.3585	1.1321	8.2264
Ekiti	3.0084	11.4320	1.8051	1.5644	51.9856	21.5403	0.3610	8.3032
Enugu	1.8667	9.5111	0.8889	3.2000	56.0889	18.3111	0.1778	9.9556
Gombe	2.8313	4.6433	0.2265	4.0770	52.0951	17.6670	3.0578	15.4020
Imo	4.8661	6.0268	3.0804	2.1429	38.3929	31.2946	0.8482	13.3482
Jigawa	2.8108	7.4426	0.2375	2.7316	50.8709	17.8147	0.4355	17.6564
Kaduna	5.9072	12.9747	1.2131	1.5823	48.5232	21.3608	0.2637	8.1751
Kano	2.7952	7.5496	1.1494	1.9854	49.6343	30.3292	1.2017	5.3553
Katsina	3.3480	4.5654	0.2367	4.8698	62.4958	15.4210	2.0291	7.0342
Kebbi	3.0495	6.9620	0.2301	7.7675	61.6226	15.6502	1.3809	3.3372
Kogi	2.3858	12.0654	2.5222	1.0225	48.3299	21.7451	0.6817	11.2474
Kwara	4.2048	11.4260	1.8282	1.1883	44.3327	27.5137	1.0969	8.4095
Lagos	2.1277	17.6292	6.3830	1.2158	13.3739	46.8085	1.2158	11.2462
Nasarawa	2.4980	16.8618	1.0929	7.3380	45.0429	14.1296	3.0445	9.9922
Niger	3.1529	10.6674	0.9459	4.7819	64.0568	11.2454	0.2627	4.8870
Ogun	3.7531	5.0876	1.1676	1.0008	56.5471	25.0209	0.3336	7.0892
Ondo	2.4752	8.0858	1.9802	2.3927	51.8977	25.8251	0.7426	6.6007
Osun	2.9051	7.2628	2.4058	1.9973	37.5851	36.3595	0.4993	10.9850
Oyo	3.0088	5.1422	1.7505	2.6805	51.7505	28.6652	0.7112	6.2910
Plateau	2.0456	9.2054	1.6522	1.5736	60.1101	8.1825	1.2589	15.9717
River	5.1528	14.7993	6.4709	8.7478	28.2804	27.8011	2.1570	6.5908
Sokoto	3.3561	6.3450	0.3146	6.2402	58.5737	15.1547	1.5207	8.4950
Taraba	6.1132	13.8113	0.7547	5.8113	53.3585	13.4340	0.9057	5.8113
Yobe	11.0924	5.8824	0.0840	8.2353	32.2689	17.6471	3.1092	21.6807
Zamfara	4.4643	4.3831	0.2435	2.8409	69.3182	9.1721	0.1623	9.4156
FCT	2.5714	18.0000	6.8571	0.2857	51.4286	13.4286	0.0000	7.4286
North West	5.5870	7.6752	0.6553	4.2208	46.6400	17.2276	1.9771	16.0169
North East	3.4879	7.1748	0.5782	3.7802	55.9251	19.5598	1.1005	8.3934
North Central	2.8907	11.2452	1.5989	2.6154	58.4075	13.4689	1.0483	8.7251
South East	3.3867	6.6733	2.3864	2.3578	49.3141	24.3498	0.6430	10.8888
South West	2.9729	7.4454	2.0916	1.9863	46.7903	29.8737	0.5788	8.2610
South South	3.9656	11.5448	3.4790	4.3177	39.5320	28.4842	1.7602	6.9165
Total	2183	5055	965	1968	29536	12695	713	5674

Source: Authors' computations from the 2006 CWIQ data.

Table 7: Multidimensional poverty decomposition across GPZ and States

Group	Freq	Mean	Std. Deviation	CV	Absolute	Relative
North West	9003	0.4003	0.1059	26.4539	0.0613	16.1481
North East	16084	0.3557	0.0964	27.1027	0.0973	25.6405
North Central	9444	0.3686	0.1049	28.4731	0.0592	15.5978
South East	6998	0.4049	0.1086	26.8166	0.0482	12.6987
South West	7602	0.3708	0.1105	29.7928	0.0480	12.6329
South South	9658	0.3993	0.1086	27.2049	0.0656	17.2820
Abia	1353	0.3645	0.1007	27.6334	0.0084	2.2100
Adamawa	1610	0.3940	0.0969	24.5943	0.0108	2.8426
Akwa Ibom	2781	0.4060	0.1027	25.2908	0.0192	5.0594
Anambra	1255	0.4092	0.1154	28.2019	0.0087	2.3012
Bauchi	1832	0.3775	0.1041	27.5755	0.0118	3.0990
Bayelsa	656	0.4010	0.1021	25.4716	0.0045	1.1788
Benue	2078	0.3868	0.1071	27.6841	0.0137	3.6015
Borno	2163	0.3795	0.1019	26.8502	0.0140	3.6785
Cross River	1357	0.4225	0.1086	25.6973	0.0098	2.5689
Delta	1870	0.3957	0.1109	28.0182	0.0126	3.3157
Ebonyi	1025	0.4251	0.1123	26.4125	0.0074	1.9525
Edo	1325	0.3900	0.1095	28.0809	0.0088	2.3157
Ekiti	831	0.3614	0.1008	27.9057	0.0051	1.3457
Enugu	1125	0.4109	0.0972	23.6414	0.0079	2.0717
Gombe	883	0.3755	0.0999	26.6101	0.0056	1.4859
Imo	2240	0.4148	0.1071	25.8156	0.0158	4.1633
Jigawa	2526	0.3523	0.0999	28.3571	0.0151	3.9882
Kaduna	1896	0.3413	0.1041	30.5049	0.0110	2.8996
Kano	3828	0.3392	0.0873	25.7354	0.0221	5.8193
Katsina	2957	0.3680	0.0953	25.8857	0.0185	4.8764
Kebbi	1738	0.3801	0.0967	25.4398	0.0112	2.9601
Kogi	1467	0.3572	0.0953	26.6869	0.0089	2.3485
Kwara	1094	0.3610	0.1030	28.5265	0.0067	1.7699
Lagos	329	0.3577	0.1041	29.1136	0.0020	0.5274
Nasarawa	1281	0.3733	0.0995	26.6666	0.0081	2.1428
Niger	1903	0.3305	0.0978	29.5833	0.0107	2.8185
Ogun	1199	0.3931	0.1041	26.4821	0.0080	2.1123
Ondo	1212	0.3607	0.1014	28.1268	0.0074	1.9589
Osun	2203	0.3517	0.1111	31.5915	0.0132	3.4723
Oyo	1828	0.3926	0.1184	30.1615	0.0122	3.2162
Plateau	1271	0.4230	0.1024	24.1993	0.0091	2.4092
River	1669	0.3802	0.1132	29.7842	0.0108	2.8434
Sokoto	1907	0.3502	0.0887	25.3363	0.0114	2.9930
Taraba	1325	0.4443	0.1068	24.0344	0.0100	2.6383
Yobe	1190	0.4508	0.0985	21.8423	0.0091	2.4038
Zamfara	1232	0.3811	0.1017	26.6901	0.0080	2.1038
FCT	350	0.3235	0.0910	28.1426	0.0019	0.5074
Total	58789	0.3796	0.1065	28.0541	0.3796	100.0000

Source: Authors' computations from the 2006 CWIQ data.

Table 8: Multidimensional poverty decomposition across sex, marital status, employment and educational groups

Group	Freq	Mean	Std. Deviation	CV	Absolute Contribution	Relative Contribution
Male	51569	0.3748	0.1047	27.9483	0.3288	86.6118
Female	7220	0.4138	0.1124	27.1623	0.0508	13.3882
Single	3482	0.3829	0.1119	29.2167	0.0227	5.9741
Mono-gamous	35454	0.3769	0.1049	27.8297	0.2273	59.8749
Poly-gamous	12013	0.3666	0.1035	28.2415	0.0749	19.7343
Informal or loose union	358	0.4091	0.1031	25.2086	0.0025	0.6563
Widowed, divorce, separated	7482	0.4104	0.1102	26.8469	0.0522	13.7604
Private formal	965	0.3385	0.1027	30.3537	0.0056	1.4637
Private informal	1968	0.3935	0.1116	28.3614	0.0132	3.4704
Self agriculture	29536	0.3934	0.1012	25.7232	0.1977	52.0722
Self others	12695	0.3609	0.1006	27.8912	0.0779	20.5289
Unemployed	713	0.4152	0.1194	28.7489	0.0050	1.3268
Others	5674	0.3967	0.1144	28.8401	0.0383	10.0859
None	33257	0.3931	0.1043	26.5362	0.2224	58.5781
Some primary	2305	0.4070	0.1099	26.9972	0.0160	4.2035
Completed primary	9453	0.3759	0.1024	27.2453	0.0604	15.9245
Some secondary	2279	0.3791	0.1034	27.2645	0.0147	3.8715
Completed secondary	6729	0.3560	0.1032	28.9918	0.0407	10.7341
Post secondary	4766	0.3132	0.1016	32.4564	0.0254	6.6882
Total	58789	0.3796	0.1065	28.0541	0.3796	100.0000

Source: Author's computations from the 2006 CWIQ data.

Table 9: Multidimensional poverty decomposition across the attributes

Attributes	Absolute contribution	Relative contribution
Material of the roof of the house	0.007356	1.937929
Material of the walls of the house	0.009317	2.454445
Material of the floor of the house	0.008987	2.367656
Housing unit type	0.002903	0.764666
Number of rooms per person	0.008078	2.128075
Main source of drinking water	0.008342	2.197689
Problems with supply of drinking water	0.009674	2.548624
Water treated before drinking	0.002836	0.747263
Type of toilet facility	0.008334	2.19545
Type of refuse collection	0.006016	1.584861
Maintain good drainage	0.000596	0.15696
Maintain good sanitation	0.002031	0.535192
Dwelling has window/door net	0.001146	0.301988
Owns the dwelling	0.006544	1.724076
Problem satisfying food needs	0.009636	2.53854
Problems paying school fees	0.009425	2.483015
Problems paying house rent	0.007026	1.850959
Problems paying utility bills	0.008557	2.254271
Problems paying for health care	0.009678	2.549543
Improved household economic state	0.009216	2.427843
Improved community economic state	0.009117	2.401809
Members perceived household to be poor	0.007107	1.872287
Security situation of the community	0.008917	2.349279
Own an electric iron	0.003666	0.965921
Own a charcoal iron	0.006304	1.660873
Own a refrigerator	0.00183	0.482018
Own a personal computer	0.000121	0.031756
Own a mattress or bed	0.007189	1.89393
Own a watch or clock	0.009132	2.40591
Own a modern stove	0.00573	1.50945
Own a gas cooker	0.000272	0.071653
Own a fan	0.004885	1.286828
Own a mat	0.00661	1.741341
Own a VCR	0.001967	0.518103
Own furniture	0.007798	2.05431
Own a bicycle?	0.007468	1.967426
Own a motorcycle	0.004305	1.134109
Own a vehicle	0.001041	0.274134
Own a canoe	0.000862	0.227048
Own a donkey	0.001595	0.420282
Own a camel	0.000252	0.066285
Education level of head of household	0.006009	1.58294
Own a generator	0.001336	0.351846
Source of electricity	0.00705	1.857199
Main fuel used for lighting	0.006257	1.648326
Main fuel used for cooking	0.008405	2.214232
Own a television	0.00416	1.095896
Own a fixed line telephone	0.000112	0.029526
Own a mobile phone	0.002963	0.780481
Own a radio	0.008943	2.356044
Member provide materials	0.001106	0.29129
Member provide labour	0.003768	0.99273
Member provide management	0.001059	0.278992

Member provide funds	0.00249	0.655918
Use bed net to prevent malaria	0.003494	0.920551
Use insecticide against malaria	0.007286	1.919551
Use anti-malaria drug	0.00394	1.037888
Use fumigation against malaria	0.000629	0.16559
Use insecticide treated net	0.000181	0.047813
Area of land owned (hectares)	0.007802	2.055428
Number of cattle and other large animals	0.002251	0.59311
Number of sheep, goats, etc. owned	0.004484	1.181386
Time to supply of drinking water	0.008395	2.211605
Time to food market	0.009387	2.473091
Time to nearest public transportation	0.009675	2.548883
Time to nearest primary school	0.009474	2.495826
Time to nearest secondary school	0.008384	2.208646
Time to nearest health clinic or hospital	0.009138	2.407281
Time to nearest all seasons road	0.009543	2.514131

Source: Author's computation from the 2006 CWIQ data.

Table 10: Multidimensional poverty decomposition across grouped attributes

Attributes/indicators	Absolute contribution	Relative contribution
Housing/sanitation	0.08216	21.64487
Economic condition/security	0.078679	20.72755
Goods of comfort, equipment and assets	0.055504	14.62209
Means of transportation	0.015523	4.089284
Education	0.006009	1.58294
Energy	0.023048	6.071603
Communication	0.016178	4.261947
Community project involvement	0.008423	2.21893
Health	0.01553	4.091393
Ownership of land and livestock	0.014537	3.829924
Access to basic infrastructure	0.063996	16.85946
Total	0.379587	100

Source: Author's computation from the 2006 CWIQ data.

Table 11: Absolute contributions of multidimensional welfare attributes to deprivation across the GPZs in Nigeria

Attributes	North West	North East	North Central	South East	South West	South South	All Zones
Material of the roof of the house	0.0013	0.0025	0.0011	0.0007	0.0008	0.0010	0.0074
Material of the walls of the house	0.0020	0.0034	0.0015	0.0004	0.0009	0.0011	0.0093
Material of the floor of the house	0.0018	0.0028	0.0014	0.0007	0.0010	0.0013	0.0090
Housing unit type	0.0005	0.0008	0.0005	0.0003	0.0004	0.0005	0.0029
Number of rooms per person	0.0011	0.0027	0.0010	0.0007	0.0012	0.0014	0.0081
Main source of drinking water	0.0013	0.0020	0.0014	0.0011	0.0010	0.0015	0.0083
Problems with supply of drinking water	0.0016	0.0028	0.0017	0.0010	0.0013	0.0013	0.0097
Water treated before drinking	0.0005	0.0008	0.0004	0.0003	0.0003	0.0005	0.0028
Type of toilet facility	0.0012	0.0017	0.0017	0.0009	0.0015	0.0014	0.0083
Type of refuse collection	0.0010	0.0015	0.0010	0.0006	0.0009	0.0009	0.0060
Maintain good drainage	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0006
Maintain good sanitation	0.0003	0.0006	0.0003	0.0002	0.0003	0.0003	0.0020
Dwelling has window/door net	0.0002	0.0003	0.0002	0.0001	0.0001	0.0002	0.0011
Owns the dwelling	0.0004	0.0009	0.0010	0.0005	0.0019	0.0018	0.0065
Problem satisfying food needs	0.0016	0.0021	0.0012	0.0017	0.0010	0.0021	0.0096
Problems paying school fees	0.0012	0.0016	0.0014	0.0017	0.0011	0.0023	0.0094
Problems paying house rent	0.0010	0.0015	0.0010	0.0011	0.0012	0.0013	0.0070
Problems paying utility bills	0.0012	0.0019	0.0011	0.0016	0.0012	0.0016	0.0086
Problems paying for health care	0.0017	0.0022	0.0013	0.0016	0.0008	0.0021	0.0097
Improved household economic state	0.0011	0.0020	0.0016	0.0015	0.0013	0.0018	0.0092
Improved community economic state	0.0011	0.0020	0.0015	0.0014	0.0013	0.0017	0.0091
Members perceived household to be poor	0.0013	0.0015	0.0011	0.0010	0.0009	0.0013	0.0071
Security situation of the community	0.0013	0.0024	0.0015	0.0011	0.0012	0.0015	0.0089
Own an electric iron	0.0006	0.0011	0.0006	0.0004	0.0004	0.0005	0.0037
Own a charcoal iron	0.0010	0.0017	0.0010	0.0007	0.0009	0.0010	0.0063
Own a refrigerator	0.0003	0.0005	0.0003	0.0002	0.0002	0.0003	0.0018
Own a personal computer	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Own a mattress or bed	0.0012	0.0019	0.0011	0.0008	0.0015	0.0008	0.0072
Own a watch or clock	0.0018	0.0023	0.0015	0.0011	0.0011	0.0013	0.0091
Own a modern stove	0.0011	0.0018	0.0009	0.0005	0.0006	0.0007	0.0057
Own a gas cooker	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0003
Own a fan	0.0009	0.0015	0.0008	0.0005	0.0005	0.0007	0.0049
Own a mat	0.0005	0.0010	0.0013	0.0009	0.0011	0.0017	0.0066
Own a VCR	0.0003	0.0006	0.0003	0.0002	0.0002	0.0003	0.0020
Own furniture	0.0014	0.0026	0.0012	0.0007	0.0009	0.0010	0.0078
Own a bicycle?	0.0011	0.0018	0.0011	0.0008	0.0014	0.0013	0.0075
Own a motorcycle	0.0007	0.0012	0.0006	0.0005	0.0006	0.0007	0.0043
Own a vehicle	0.0002	0.0003	0.0002	0.0001	0.0001	0.0002	0.0010
Own a canoe	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0009
Own a donkey	0.0002	0.0004	0.0003	0.0002	0.0002	0.0003	0.0016
Own a camel	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0003
Education level of head of household	0.0010	0.0020	0.0009	0.0007	0.0007	0.0008	0.0060
Own a generator	0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.0013
Source of electricity	0.0014	0.0022	0.0012	0.0006	0.0007	0.0010	0.0071
Main fuel used for lighting	0.0011	0.0018	0.0010	0.0007	0.0007	0.0010	0.0063
Main fuel used for cooking	0.0014	0.0024	0.0014	0.0010	0.0010	0.0013	0.0084
Own a television	0.0007	0.0013	0.0007	0.0004	0.0005	0.0006	0.0042
Own a fixed line telephone	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Own a mobile phone	0.0005	0.0009	0.0005	0.0003	0.0003	0.0004	0.0030
Own a radio	0.0018	0.0019	0.0013	0.0009	0.0012	0.0019	0.0089
Member provide materials	0.0002	0.0003	0.0002	0.0001	0.0001	0.0002	0.0011
Member provide labour	0.0006	0.0010	0.0006	0.0005	0.0005	0.0006	0.0038
Member provide management	0.0002	0.0003	0.0002	0.0001	0.0001	0.0002	0.0011
Member provide funds	0.0004	0.0007	0.0004	0.0003	0.0003	0.0004	0.0025
Use bed net to prevent malaria	0.0005	0.0009	0.0006	0.0005	0.0005	0.0006	0.0035
Use insecticide against malaria	0.0010	0.0015	0.0011	0.0011	0.0010	0.0015	0.0073
Use anti-malaria drug	0.0007	0.0012	0.0007	0.0004	0.0004	0.0006	0.0039
Use fumigation against malaria	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0006
Use insecticide treated net	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
Area of land owned (hectares)	0.0009	0.0017	0.0011	0.0012	0.0011	0.0017	0.0078
Number of cattle and other large animals	0.0003	0.0006	0.0004	0.0003	0.0003	0.0004	0.0023
Number of sheep, goats, etc. owned	0.0006	0.0011	0.0007	0.0006	0.0006	0.0008	0.0045
Time to supply of drinking water	0.0011	0.0010	0.0015	0.0020	0.0007	0.0019	0.0084
Time to food market	0.0017	0.0025	0.0015	0.0012	0.0009	0.0015	0.0094
Time to nearest public transportation	0.0018	0.0026	0.0016	0.0014	0.0007	0.0016	0.0097
Time to nearest primary school	0.0018	0.0024	0.0012	0.0014	0.0010	0.0017	0.0095
Time to nearest secondary school	0.0016	0.0024	0.0012	0.0010	0.0009	0.0013	0.0084

	North West	North East	North central	South East	South West	South South	All Zones
Time to nearest health clinic or hospital	0.0016	0.0023	0.0013	0.0013	0.0009	0.0017	0.0091
Time to nearest all seasons road	0.0019	0.0027	0.0013	0.0013	0.0008	0.0015	0.0095

Source: Author's computations from the 2006 CWIQ data

Table 12: Absolute contributions of multidimensional poverty decomposition of the grouped attributes across the GPZs, in rural Nigeria

Group of attributes	North West	North East	North central	South East	South West	South South	All Zones
Housing/sanitation	0.0132	0.0228	0.0132	0.0079	0.0116	0.0134	0.0822
Economic condition/security	0.0114	0.0172	0.0117	0.0128	0.0099	0.0157	0.0787
Goods of comfort, equipment and assets	0.0093	0.0151	0.0091	0.0061	0.0075	0.0084	0.0555
Means of transportation	0.0024	0.0039	0.0024	0.0018	0.0025	0.0026	0.0155
Education	0.0010	0.0020	0.0009	0.0007	0.0007	0.0008	0.0060
Energy	0.0040	0.0068	0.0038	0.0025	0.0025	0.0034	0.0230
Communication	0.0030	0.0040	0.0025	0.0017	0.0020	0.0029	0.0162
Community project involvement	0.0013	0.0023	0.0013	0.0010	0.0011	0.0014	0.0084
Health	0.0023	0.0039	0.0025	0.0020	0.0021	0.0028	0.0155
Ownership of land and livestock	0.0019	0.0033	0.0022	0.0021	0.0021	0.0030	0.0145
Access to basic infrastructure	0.0115	0.0160	0.0096	0.0097	0.0060	0.0112	0.0640
Total	0.0613	0.0973	0.0592	0.0482	0.0480	0.0656	0.3796

Source: Author's computation from the 2006 CWIQ data.