ABSTRACT

Using the traditional income-expenditure approach, coastal households have been adjudged to be poorer than their non-coastal counterparts. Poverty encompasses deprivation in other welfare dimensions such as education, health, housing, household assets, potable water and social participation. However, only few studies have conceptualised poverty with these various dimensions in focus. Hence, the nature and determinants of multi-dimensional poverty among fishing households in southwestern Nigeria were investigated.

A multi-stage sampling procedure was adopted in collecting data from fishing households using structured questionnaire. Three coastal states (Ogun, Ondo and Lagos) were selected at the first stage. The three Local Government Areas (LGAs) with coastal characteristics were selected in Ogun and Ondo states while in Lagos state, three of such LGAs were randomly selected at the second stage. Subsequently, 100 coastal communities and 500 fishing households were selected based on probability proportionate to size. Data were obtained on socio-demographic characteristics and thirteen poverty dimensional variables including household expenditure, assets, housing quality, sources of drinking water and lighting, types of cooking fuel, waste disposal methods, and participation in grassroot politics and community development projects. Data were analysed using descriptive statistics, multiple correspondence analysis, Alkire-Foster counting and dimension-adjusted poverty measure and logit regression at $p = 0.05$.

Mean age and year of schooling of household heads were 46.0 ± 10.9 and 9.0 ± 4.0 years respectively. Household size and dependency ratio were 5.0 ± 3.0 persons and 0.4 ± 0.4, respectively. Majority (72.1%) of the households were male-headed with 33.7% of houses built onshore. Thirty seven percent (37%) of the houses were built with planks and bamboo with 47.5% of the households defecating directly into the river. Daily mean *per capita* household income was ₦1237.20 ± 776.60. Most households (97.5%) had no access to potable water and 60.0% lacked essential household assets. A multi-dimensional poverty cut-off value of 8 was obtained out of a possible 13 welfare indicators that had direct effect on the welfare status of the households. Poverty headcount ratio was 0.6 while the dimension-adjusted poverty incidence, depth and severity were 34.2%, 16.0% and 7.6% respectively. Large-sized households (> 12 members) had higher Poverty Incidence (PI) (0.5938) than small-sized households (< 6 members) with PI of 0.3326, while households with tertiary education had lower PI (0.3351) than those without formal education (0.3781). Households with higher

dependency ratio of 0.60 had higher PI of 0.4196 than those with lower dependency ratio of 0.10 having PI of 0.3326. Being fully engaged in onshore economic activities (0.13), using dugout canoes (0.11), and having house located onshores (3.13) increased the probability of households' multi-dimensional poverty while high educational attainment (- 0.005), income (- 0.14) and land size (- 0.11) reduced it.

Multi-dimensional poverty was high among the fishing households. Inadequate education, insufficient income, use of dugout canoes and living onshore increased multidimensional poverty incidence among the households. Reduction in the poverty incidence of households would be achieved through improved access to formal education and use of motorised canoes.

Keywords: Coastal Nigeria, Fishing households, Multi-dimensional poverty.
Word count: 490

DEDICATION

This research work is heartily dedicated to my lovely parents, Chief Samuel Kalejaiye and Chief (Mrs) Mary Arinola OLOGBON, both of whom spared much of their resources to ensure that I was formally trained, against all odds. Dad and Mum, you cooperated with the will of God to make me what I am today. You set the pace for my career upliftment. To you I am greatly indebted. I will forever be thankful to God and to you for this privilege given me. Thank you Dad and Mum.

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Ologbon, Olugbenga A. Christopher

July 2013

CERTIFICATION

I certify that this Ph.D work was carried out by Olugbenga Adesoji Christopher OLOGBON, Matriculation Number 108535 under my supervision in the Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background to the study

Poverty should be considered an essentially relative and multi-dimensional phenomenon, at least as far as the so-called developing countries are concerned. Any attempt at defining poverty meets with general agreement regarding its multi-dimensional nature, in that its causes and manifestations are manifold. The actual dimension of poverty, therefore, is much more multifaceted and complex, at least to the extent that it determines intermediate and/or alternative poverty definitions as those of absolute multi-dimensionality (Sen, 1985, 1992) and of relative uni-dimensionality. Poverty is multifaceted according to the types of deprivation. It consists in any form of inequity, which is a source of social exclusion in the distribution of the living conditions essential to human dignity. These living conditions correspond to the capabilities of individuals, households and communities to meet their basic needs in such areas as income, education, health, food/nutrition, safe water/sanitation, labour/employment, housing (living environment), access to productive assets, access to markets, and community participation/social peace (Maggio, 2004).

Poverty is a state of deprivation and is manifested in illiteracy, lack of access to water, poor housing and declining purchasing power (Adepoju, 2001). A poverty measure is an index that synthesizes all available information describing the poor people in a country. Given a distribution of one or several indicators of individuals' welfare and a poverty line, such a measure gives a single index that explains the extent of poverty generated by this distribution. A simple way of dealing with the multi-dimensional aspect of poverty lies in the assumption that the attributes of individuals can be aggregated into a single indicator of welfare. Poverty can then be defined with respect to this indicator. In other words, individuals will be considered poor if their global welfare index falls below a certain poverty line, the specification of which accounts for the multi-dimensional aspects of poverty.

Deprivation is a state of observable and demonstrable disadvantage relative to the local community or the wider society or nation to which the individual, family or group belongs (Townsend, 1987). This disadvantage may be with regard to food, clothing, housing condition, or lack of education, and exclusion from the decision-making class, among others. A person is, therefore, considered deprived to the extent that he falls short of the level attained by his contemporaries within the same society, or below generally acceptable social status. Townsend

(1987) identifies two forms of deprivation namely material and social deprivation. While the former involves lack of goods and modern life conveniences, the latter refers to exclusion from relationships among individuals within the family, workplace and the community. Townsend (1987) and Carstairs and Morris (1991) argue that material deprivation should be distinguished from "poverty", which is more related to lack of the resources required to acquire the necessary commodities. Social deprivation, on the other hand, is more closely related to the concept of "social capital", reflecting certain characteristics of social organization, such as isolation or cohesion, individualism or cohesion, and mutual assistance and trust.

Ringen (1998) has advocated the use of both income and deprivation criteria in identifying those excluded from society owing to lack of resources, a widely accepted definition of poverty. He further asserts that there is a fundamental problem in the manner in which the poverty line is used as a basis for identifying the poor, in that poverty is thus defined directly in terms of deprivation in consumption, but measured indirectly in terms of resources. Individuals, families and groups in the population can be said to be in poverty when they lack the resources to obtain the type of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged, or approved, in the societies to which they belong. Poverty is, thus, seen as exclusion arising from lack of resources. Where poverty is defined as exclusion due to lack of resources, as it commonly is, it would appear to necessarily entail deprivation in consumption. While that deprivation is produced by lack of resources, it is the fact that a minimum standard of living is not being attained that constitutes exclusion. Sardar *et al*. (2008) used data from a large sample of Irish households to show that employing both income and deprivation rather than income alone can make a substantial difference to both the extent and composition of measured poverty.

The difference between poverty and deprivation, according to Giannini and Mendelson (2009), lies essentially in the fact that the deprivation index captures dimensions of poverty that income does not address, thus reflecting the real life experiences of the poor people. Richard, Michael and Michael (2009) define a 'deprivation index' as a list of items (or activities) which have two characteristics, given the prevailing social and economic conditions in a time and place. First, the items on the list should be widely seen as necessary for a household to have a standard of living above the poverty level. In other words, these should be items which most households not in poverty are likely to have. Second, these items should be such that households in poverty are likely to find some of them unaffordable and so not have all those items. Therefore, the index, if it is well developed, should contain those items that distinguish

the poor from the non-poor in the prevailing social and economic conditions. The items in a deprivation index are not necessarily a comprehensive list of basic needs, since, in a wealthy society, most households, even the poor, are likely to have most of the basic necessities. A deprivation index brings important new insights to poverty measurement by measuring the actual standard of living of the poor people in the society.

The coastal areas in Nigeria predominantly comprise fishing communities/settlements of varying sizes, mostly located on the edge of freshwater forest and on the top of beach ridges. There are about 20 million of such people living along the coastline stretching some 800 km in length (Ibe and Awosika, 2004). Many of these fishing households are exposed to risky situations occasioned by devastating natural/environmental hazards, such as erosions and floods, which have perpetually subjected them to a situation of homelessness, hopelessness, reduced welfare status and abject poverty (Siyanbade, 2006). For instance, a study by Sardar *et al*. (2008) revealed that fishing households often do not find adequate and appropriate shelters; quality food and drinking water; adequate and hygienic sanitation; privacy for women, particularly for the lactating mothers and adolescent women. In addition, floods often force students out of academic activities since their learning centres are often used as makeshift flood shelters in affected coastal areas.

Flooding incidents in Nigeria date back to decades (for example, Ogunpa flood incident in Ibadan, Oyo State in 1983; in Cross River State in 1998; and in Victoria Island and Ikoyi areas of Lagos State in the early 2000s). They have rendered thousands of people homeless, with implications for the boundaries and landscape of the areas affected. The flooding situation in the southwestern zone of Nigeria is getting worse by the year. Recent occurrences in July-August 2011; February 2012 and during the late rainfalls (between August and October 2012) in some communities in Abeokuta (Ogun State); Lagos Island (Lagos State); Ibadan (Oyo State), Port-Harcourt (Rivers State) and several communities in Bayelsa State are practical evidence. Towns and villages along the coast were the worst hit by this disastrous incident. Many lives were lost and property worth billions of naira were reportedly destroyed by the floods. Hundreds of families were either displaced or rendered homeless, resulting into roaming, migration and the use of makeshift houses (VOA, 2012).

Nigerian Meteorological Agency (NIMET, 2012) forecast a cumulative 238 days of heavy rainfall in Lagos State in the rainy season of 2012, an incident that was feared to further worsen the disaster caused by the flooding event of 2011. At a stakeholders' summit in Ibadan, Nigeria in July 2013, the National Emergency Management Agency (NEMA) reported that

over three trillion naira worth of property were lost in 2012, over one million and two hundred thousand people lost their homes while more than four hundred people lost their lives to flooding incidents that occurred in seventeen states in Nigeria. Flood also provokes water level variability, rendering the use of fishing equipment less effective through the large volumes of debris it conveys, thereby causing more harms to the economic activities of the fisherfolks, with an attendant worsening condition of household poverty (Siyanbade, 2006).

Oil spillage is a common occurrence in major coastal areas in Nigeria. A recent disastrous instance was the Bonga Oil-spill on the shores of Niger Delta in December 2011 which environmental experts said had extended across over more than 900 square kilometres of the ocean, affecting aquatic lives, sources of drinking water as well as means of livelihood in many coastal communities of Delta, Bayelsa and Akwa-Ibom States (NODERA, 2011).

1.2 Statement of the problem

The economic crisis of the 1980's as a result of shocks in interest rate and term of trade, external debt crisis, instability and misallocation of scarce foreign exchange, fiscal indiscipline, corruption and weak external demand was so severe, thus causing an increase in poverty. The Structural Adjustment Programme (SAP) introduced in 1986 to correct these problems recorded little success, and in the long run, added to the problem. This, according to World Bank's (2001) assessment, was due to lack of complementary infrastructure, heavy dependence on export of primary products, lack of political will among the people and government, and weak entrepreneurial and managerial capacity. The scourge of poverty on the Nigerian population has been charted in the past by a series of Consumer Expenditure Surveys implemented by the then Federal Office of Statistics (now National Bureau of Statistics) in 1985, 1986, 1992, 1996 and 2004. Over the 20-year period, the report of the surveys indicated that poverty was most widespread in the rural areas and also among females.

World Bank's (2001) study revealed that the poor in Nigeria, the majority of whom are rural-based, are usually confronted with lack of assets, as well as receiving income from the natural (land) endowments. Disadvantaged households are typically land-poor and, for those that own land, it is often unproductive and largely uncultivated and (or) unexplored as a result of insufficient productive capacity. These situations not only affect the income and nutritional intake of the poor, but also affected their ability to acquire assets, most especially landed property and their quest for better social amenities, such as education, health care services, food and water, among others, which, in turn, have implications for child mortality, maternal

mortality and decreased life expectancy of the poor in the country. For instance, Sardar *et al*. (2008) reported that children enrolment in many rural and coastal communities suffer a lot of setback as a result of poverty and ignorance. Worst hit are girls whose parents never wanted to send to school because of their relatively disadvantaged social status in society compared to their male counterparts. Poor women, because of their lack of education, often have too many children and, more frequently, suffer from hunger and malnutrition and their attendant ailments, which often undermine their productivity. Thus, they continue to find themselves in poverty.

Vitamin A deficiency in the nutrition of the poor causes blindness in children, with its attendant effect of increased child mortality. About 90% of visually impaired children in developing countries are said to be deprived of schooling owing to socio-economic and physical barriers, such as discrimination and stigmatization in access to basic education and health care services, inability or assumed inability to cope, and physically inaccessible schools (ICEVI, 2004). A single case of blindness in the family is sufficient to result in reduced household school attendance and performances, as, for instance, blind adult members would have to depend on school-age children and other family members for guidance and assistance.

The health challenges posed by poverty and deprivation of welfare goods and services among fishing households are not only enormous, but are also peculiar and interwoven. For instance, river blindness (onhocerciasis) has been described in the VISION 2020 report as a major obstacle to the socio-economic development of fishing households, among whom it is predominant by nature, with women and girls bearing approximately two-thirds of the burden of this blindness across the world (WHO, 2002). This disease has contributed to decreased productivity in the coasts of many developing nations, as it causes farmers to abandon their land from fear of infection. Severe itching from onchocerciasis reduces school performance. The social, cultural and economic disadvantages that girls face because of their gender has been linked to the observed increase in their risk of being marginalized, neglected and abused as, for instance, girls with visual impairment are less likely to attend school than boys (Gilbert and Foster, 2001).

Aigbokhan (2000) observes that poverty incidence actually improved in the southern zone of Nigeria during the 1990s, but deteriorated in the North, particularly in rural areas. Oyekale (2010), in a poverty study across rural Nigeria, reported that, in the coastal south-southern area of the country, relative poverty was particularly high in Akwa Ibom (5.06%); Bayelsa (1.18%); Cross River (2.57%); Delta (3.32%); and Rivers (2.84%) - among other

southern states. This variation in the poverty level within a geographic zone underscores the need to pay particular attention to coastal communities when designing national policy intervention programmes to alleviate poverty. The poor attitude of artisanal fishermen towards adoption of appropriate fishing technology in Nigeria has been reported in the literature and this has considerable effects on their catch level and, hence, on their income and welfare status. For instance, Oladele and Adekoya (2006) reported the unwillingness of fisher folks to negotiate for optimum catch level that reduces wastage of fishing input resources and minimizes fishing cost, hence, they are constantly faced with low level of returns and poor welfare even in the face of abundant natural fish stock.

Wherever they exist, coastal regions are mostly affected by the scourge of poverty with lives and property at the risk of flooding and erosion. This situation can make even a coastal community within an urban metropolis far worse than rural areas (Sardar *et al.*, 2008). The situation in the Nigeria coastal region is not in any way different as the consequences of crude-oil exploration produced a shock in the local economy that results in decreasing economic activities (particularly agricultural) leading to decreasing crop outputs and fish catch, with an attendant increase in poverty level and welfare loss (Maduagwu, 2000). A World Bank (1995a) study reports that, though the incidence of poverty in Nigeria is much higher in the rural areas than in the urban centres, the urban slum-dwellers form one of the more deprived groups.

According to a 1995 poverty report, about 55% of the poverty incidences in Nigeria are found in the coastal areas, with Ondo State rated as having the highest number of the poor in the Niger-Delta area of Nigeria (Niger-Delta Development Commissions NDDC, 2002) rising from 25% in 1985 to 36% in 1997, and to 41% in 2002. Eighty-five percent of the households in this study were identified poor; about 45% in extreme poverty, out of which close to 55% were from the coastal areas. Extending the particular poverty situation in Ondo State to other coastal areas in the south-western zone, this study proffered relevant answers to the following policy-related questions:

(i) What is the incidence of welfare deprivation among the fishing households?

(ii) What attributes characterize poor fishing households in the coastal areas of south-western Nigeria?

(iii) What is the relative contribution of dimensional deprivations to the overall multi-dimensional poverty of the fishing households?

(iv) What factors determine multi-dimensional poverty among the deprived fishing households?

1.3 Objectives of the study

The general objective of this study was to generate multi-dimensional poverty estimates for fishing households in the south-western zone of Nigeria. The specific objectives were to:

i. Determine the incidence of welfare deprivation among the fishing households.

ii. Compute and profile dimension-adjusted poverty measures of the fishing households according to their socio-economic characteristics.

iii. Evaluate the relative contribution of dimensional deprivations to the overall poverty level of the fishing households.

iv. Estimate the determinants of multi-dimensional deprivation and poverty among the fishing households.

1.4 Justification of the study

Poverty is regarded as a complex manifestation of socio-economic deprivation of which income is only one aspect. Therefore, other non-monetary (or supplementary) variables need to be included into the analysis of poverty and social exclusion, determined by appropriately weighed indicators, to reflect the degree of deprivation as well as the various sources (dimensions) of poverty as experienced by the households (Maggio, 2004). In contemporary times, multi-dimensional approaches have been developed with the aim of achieving a more comprehensive analysis and measurement of poverty. The view of poverty as multiple deprivation enriched the explanatory power of this field of research. Moreover, by identifying the dominant dimensions of poverty, it provided the basic information for the design and implementation of structural socio-economic policies, purporting to generate socio-economic processes to reduce the relative proportion of poor as well as the intensity of poverty.

Many available analytical works on poverty in Nigeria are mostly descriptive (Oladunni, 1999; Okunmadewa, 1999 and Maduagwu, 2000). Adeyeye (2000) observes that several of the previous poverty studies in Nigeria focused mainly on the use of traditional approach to poverty measurement, with much emphasis on households' insufficient income to secure basic amenities. Such studies in Nigeria include Aluko (1975), Ogwumike (1987), World Bank (1995b), Olayemi (1995), Sancho (1996), Aigbokan (2000), Omonona (2001), Alayande and Alayande (2004), Osinubi (2003) and Oyekale *et al.* (2006). However, the global debate in recent times about the multifaceted and complex nature of poverty has made the

concept of univariate poverty measurement less appropriate thereby suggesting the application of a multi-dimensional approach to poverty analysis.

Only few of the regional studies recently conducted in Nigeria, have roots in the multi-dimensional approach to poverty measurement. Prominent among them are Oyekale and Okunmadewa (2008) and Oyekale *et al.* (2006). Several studies in the developed nations adopted the fuzzy set approach in addressing poverty globally (for example, Cerioli and Zani, 1990 and Dagum *et al.,* 1993). However, the lack of adequate local information (as is the case in Nigeria) still constrains the suitability and appropriateness of this global trend of a multi-dimensional approach to poverty analysis, thus creating a wide gap between the developing economies and several developed countries that have explored this concept of poverty, such as Brazil, Canada and Japan, among others (Qizilbash, 2004; Betti *et al.*, 2005; Bibi, 2005; and Ki *et al*., 2005).

This study distinguishes itself from those of previous authors in a number of ways. First, it was premised around five (5) welfare dimensions containing sixteen (16) welfare-enhancing variables for the analysis of households' multi-dimensional deprivation and poverty as against the traditional univariate approach to poverty measurement. Second, it brings the concept of welfare deprivation into the analysis of poverty, through the application of partial deprivation indices, to explore the true multi-dimensional nature of the fishing households. It follows similar approaches developed in Great Britain, Europe, the USA and Japan (for instance, Tello *et al.,* 2005; Benach *et al.,* 2003; Curtis *et al.,* 2006). This practice has conventionally been adopted by statistical agencies accounting for "material deprivation", defined as having or not having basic goods, or performing or not performing basic social activities. Third, the multi-dimensional poverty analysis is based on the counting method which, according to previous scholars (such as Qizilbash, 2004; Bossert *et al.,* 2006; Lasso de La Vega and Urrutia, 2010; Alkire and Santos, 2010), could alter the subset of the population adjudged by the traditional approach to be poor. Thus it provides a more appropriate results. One other strength of this methodological approach (even over the fussy set approach) lies in the adoption of a dual cutoff method, using the within dimension cutoff to determine household's deprivation status in each welfare dimension, and a cross-dimensional cutoff to determine which households are considered poor. The poverty counting approach does not make use of 'subjective' poverty line, thus avoiding the arbitrary nature of all dichotomies deriving from the division of a population into poor and non-poor. Fourth, this study is distinguished from other previous poverty studies in Nigeria with respect to the choice of a

coastal respondent group. Fishing households occupy a specially enclosed coastal areas going by their geographical location, occupational uniqueness, space limitation, and exposure to natural and ecological risks which predispose them to a state of deprivation and poverty.

Specific factors were expected to influence multi-dimensional deprivation and poverty among fishing households when compared to other population subgroups. Therefore, this study included variables that were adjudged to specifically address the likelihood of fishing households suffering deprivation in the thirteen final indicator variables generated to study the poverty situation in the study area, using a combination of maximum likelihood estimation procedures that have been found appropriate for such analyses. Re-scaling of multiple welfare dimensions for this study also followed recent approaches used for categorical ordinal variables (that is, multiple correspondence analysis) that have been adjudged to produce better results than other commonly adopted data reduction methods (Benach *et al.*, 2003; Tello *et al.*, 2005; and Curtis *et al.*, 2006). The policy relevance of this study borders on the fact that it leads to a set of information that enables the design and activation of socio-economic welfare programmes to deal with the main causes of poverty among the fishing households in the south-western zone of Nigeria.

1.5 Organisation of the study

This thesis is segmented into five chapters. Chapter one gives the general introduction of the work, containing the background, statement of the problem, objectives and justification of the study. Chapter two presents the theoretical, conceptual and methodological frameworks of the study and also reviews previous works on multi-dimensional poverty studies. Chapter three presents the research methodology, which consists of the study area, data source, sampling and estimation procedures as well as analytical techniques used in the study. Empirical results are presented in chapter four, comprising socio-economic and deprivation statistics, as well as the results of the analysis on multi-dimensional deprivation and poverty among the rural households. Chapter five concludes the study with summary of major findings, policy implications, recommendations and suggested areas of further research.

CHAPTER TWO

THEORETICAL FRAMEWORK AND REVIEW OF RELATED LITERATURE

This chapter discusses the basic theories and concepts of poverty measurement, starting with the theoretical framework of theory of consumption. It also reviews relevant methodologies and empirical framework as well as previous work on multi-dimensional poverty measurement. Under these frameworks, a general review is made, encompassing the traditional and the more recent welfare approaches to multi-dimensional poverty analysis.

2.1 Theoretical framework

2.1.1 Theory of welfare state redistribution

The ILC (1950) provides an early and famous definition of the welfare state, which is a state in which power is deliberately used in an effort to modify the play of market forces in at least three dimensions: guaranteeing a minimum income; narrowing the extent of insecurity; and offering all citizens a range of social services. The ILC (1950) points out that the first two conditions are concerned with minimum standards, and can be met by a 'social service state', but the third goes beyond this, being concerned with the optimum. Titmuss (1955), in his path-breaking work on the 'social division of welfare' (SDW), points out that to equate the 'welfare state' with visible state provision was very misleading, and he identifies three systems of welfare: social/public, fiscal and occupational. While many people content that public welfare should be progressive, Titmuss (1955) shows that fiscal and occupational welfare tend to be regressive, in that they broadly favour the middle class.

The 'mixed economy of welfare', 'welfare pluralism' or the 'welfare mix' are different terms for the variety of providers within welfare systems. Milanovic (2000) examines these and argues that 'total welfare' in society is the sum of the household (or family), market and the state (appearing to forget the voluntary or third sector). This is a useful reminder that welfare can be supplied from various sources, and that the welfare mix can change over time and between countries. However, the sectors are not simply additive or substitutable, in the sense that provision by different sectors has different distributional impacts.

Moene and Wallerstein (2001; 2003) point out the reasons for welfare provision, namely economic efficiency, social equality, social integration and stability, autonomy, and reduction of poverty. These tend to be associated with different values and ideologies and

different countries attach different weights or priorities to these. For example, Liberal welfare regimes (see extracts 38-42) tend to attach more weight to economic efficiency. Countries need to manage the tensions and trade-offs between the criteria. For example, many scholars argue that there is a tension between efficiency and equality.

Most empirical studies are guided by one of three theoretical perspectives. Economic theories see the welfare state as replacing insurance markets to compensate market and information failures (Barr, 1998; 2001), in which case government is seen as a more efficient insurer of risks, in particular under conditions of strong information asymmetries, credit constraints and adverse selection. A recent study adds the global-economy angle to this, arguing that heightened economic vulnerability in global markets intensifies social risks, explaining why welfare states are exceptionally large in very open economies (Iversen and Cusack, 2000). If the welfare state is primarily an insurer, its role in creating equality would appear irrelevant. But there are three kinds of social risks, each with its unique redistributive logic: life course risks, inter-generational risks, and class risks (Esping-Andersen, 2007).

Pooling life cycle risks, like old age infirmity, implies primarily horizontal redistribution across the life course. But horizontal redistribution is obviously inappropriate for risks, such as child poverty, that occurs early in the life course, which will obviously require vertical redistribution. Inter-generational risks are related to social inheritance in the sense that social origins influence life chances, whose policies are related to equal opportunity measures. In that case, the prevailing level of inequality in the parental generation helps dictate differences in parental investment in their children's life chances, strongly requiring vertical redistribution. Class risks refer to those that concentrate on distinct social or occupational groups: miners are more prone to work injury than college professors; the unskilled are more vulnerable to low earnings and unemployment; and lone mothers are over-represented among the poor. Class risks have given rise to a plethora of policy responses, including targeted support to the vulnerable, corporate risk pooling such as distinct insurance plans for high-risk clienteles (like miners' insurance), or universal pooling of the entire population regardless of its risk profile (like universal child benefits, or the tradition of a 'peoples' pension). Risk pooling can produce a complex combination of redistributive logics and cannot, as economic theory often assumes, be equated with horizontal redistribution.

The Robin Hood theory typically assumes that targeting benefits to the neediest will yield the strongest possible redistributive result, a postulation that has been challenged by the 'paradox of redistribution' thesis of Korpi and Palme (1998). The argument is that narrowly

targeted policies are typically ungenerous and potentially stigmatizing owing to lack of broad electoral support. In contrast, universal benefits canvasses strong citizen support and will, hence, offer more generous benefits that eventually reaches all the needy with greater certainty. In this perspective, pro-targeting welfare states (like the United States of America) are expected to produce less income equalizing opportunities than universalistic countries.

There is also the political perspective to the theories of welfare state redistribution which links redistribution to the legislative power of the non-ruling parties. The strength of this argument lies in the belief that non-ruling parties represent the less well off, and if they gain sufficient political power they will redistribute resources in favour of the poor and less-privileged. There are substantial, if not overwhelming reasons to support this position, according to Huber and Stephens (2001). Another tradition applies the median voter models of Milanovic (2000) and Moene and Wallerstein (2001; 2003). In this framework, high levels of earnings inequality fuels demand for welfare redistribution, particularly if median earnings fall far below the mean. Empirical analyses, however, fail to provide clear evidences to support this theory. Some theorists (such as Milanovic, 2000) conclude positively with respect to this postulation, while others (such as Moffitt *et al*., 1998), argue against it, holding a position that the more unequal the primary income distribution policy is, the less the hope and support for the poor will be.

Moene and Wallerstein (2003) offer an explanation for these ambiguous findings. They show that the theory appears irrelevant for large items such as pensions and health care, while some, like unemployment insurance, seem to respond to levels of pre-redistribution inequality – but not the way predicted by theory. They found that spending is more generous in nations with more egalitarian distributions. Most interestingly, they claim that rising inequality generates a double, counteracting effect: on the one hand, increasing demand for redistribution and, on the other hand, rising demand for (non-redistributive) insurance.

2.1.2 Welfare state design and welfare regimes - theory of production and consumption

According to Albertini *et al.* (2007), citizens obtain welfare from three basic sources: markets, family, and government. The market provides income and sells commercial welfare inputs such as child minding or medical insurance. For most people, during most of their lives, the market is undoubtedly the chief source of well-being. Families also play a pivotal role in welfare packaging, in part by providing services and care and, in part, via income transfers. Income pooling in families is the norm and income transfers between the generations is

substantial – particularly from the elderly to the young (Albertini *et al.* 2006). To fully understand welfare states, we need to situate them in the full context of welfare production and consumption, commonly termed welfare regime.

The theoretical framework for the non-monetary approach is premised around the choice of the disutility function φ, usually called the 'unmet basic needs' function. Suppose each household in a population set is endowed with K attributes, such as income expenditure, health, literacy rate, among others, where K > 1 is a positive integer. Let X be a K-dimensional random variable representing these attributes with a distribution function *F* defined on R_+^k. Given a poverty line $z = \{z_k\}_{k=1}^k$, the poor in terms of the *k-th* attribute is defined by $A(z_k) = \{x / x_k \leq z_k\}$ for k = 1,...,K. Denote $\underline{A}(z) = \cap_{k=1}^k A(z_k)$ and $\bar{A}(z) = \cup_{k=1}^k A(z_k)$. For an arbitrary A(z) such that $\underline{A}(z) \subseteq A(z) \subseteq \bar{A}(z)$, one can define a general poverty index for the multi-dimensional distribution:

$$p(A(z);\varphi) = \int_{a(z)} \varphi(x;z) dF(x) \qquad (1)$$

where φ is the *disutility function*. Following the welfare theoretical formulation of poverty index, we assume that $\varphi(x;z) \geq 0$ φ(x; z) is derived from individual utility function. In particular, we assume that for all x and z, and is a "proper" disutility function such that $p(A(z);\varphi)$ satisfies the usual properties of a poverty index, such as focus, symmetry, monotonicity, continuity, principle of population, scale invariance and subgroup decomposability. We also assume that φ(x;z) is properly normalized such that $0 \leq p(A(z);\varphi) \leq 1$. Given the poverty line z and disutility function φ, $p(A(z);\varphi)$ depends on the choice of A(z). Moreover, the construction is generally not invertible: $p(A_1(z);\varphi) = p(A_2(z);\varphi)$ does not imply $A_1(z) = A_2(z)$. Therefore, welfare comparison based on a single p(A(z); φ) can sometimes be arbitrary.

Most welfarist theories can also be usefully analysed in terms of the information used in two different – though interrelated -- parts of the exercise, namely: (i) the selection of relevant personal or individual member's features and (ii) the choice of combining characteristics. For the standard utilitarian theory, the only important "relevant personal features" are individual utilities, and the only useful "combining characteristic" is summation, yielding the total of those utilities. The set of welfarist theories, of which utilitarianism is a particular example, takes utilities as the only relevant features but can also use other combining characteristics, such as the utility-based maximin. By giving a larger opportunity to every member to maximize

his own utility, an aggregate household utility, resulting from a combination of all the individual utilities, could be increased. In this idea lies the double root of utility maximization, as a characteristic of welfarist theories, and of some form of well-being as a by-product of this maximization process, perceived as a social objective. Welfarist theories could then naturally be seen as a 'growth' (or endowment) and poverty reduction theories. To be more specific about the process by which reduced household poverty level emerges as a by-product of welfare (social utility) maximization, we have to consider how economic theory formalized progressively the welfarist approach.

A "welfare state" is a state in which organized power is deliberately used (through politics and administration) in an effort to modify the play of market forces in at least three directions. The first is by guaranteeing individuals and families a minimum income irrespective of the market value of their work or their property. The second is by narrowing the extent of insecurity through enabling individuals and families to meet certain "social contingencies" (for example, sickness, old age and unemployment) which lead to individual and family crises. The third is by ensuring that all citizens without distinction of status or class are offered the best standards available in relation to a certain agreed range of social services. The first and second of these objects may be accomplished, in part, at least, by what used to be called a "social service state", a state in which communal resources are employed to abate poverty and to assist those in distress. The third objective, however, goes beyond the aims of a "social service state". It brings in the idea of the "optimum" rather than the older idea of the "minimum". *Pareto optimality* in resource allocation occurs if there is no way to rearrange production or reallocate goods so that someone is made better-off without making someone else worse-off.

The difficulty in forging today's canonical model of consumption based on multi-period utility maximization is attested by the volume of the literature devoted to the problem from the 1950s to the 1970s, beginning with the seminal contribution of Modigliani and Brumberg (1954). The model that eventually emerged has several key characteristics. Utility is time separable; that is, the utility that consumption yields today does not depend on the levels of consumption in other periods, past or future. Future utility is discounted geometrically, so that utility one period away is worth β units of this period's utility, utility two periods away is worth β_2, and so on, for some β between 0 and 1. Furthermore, the utility function must satisfy various criteria of plausibility like decreasing marginal utility, decreasing absolute risk aversion, and so on. Finally, the model must incorporate a mathematically rigorous description of how non-capital income, capital income, and wealth evolve over time.

A version of the maximization problem inherited from this literature can be written as follows: A consumer in period *t* (who has already been paid for period *t*'s labour) has an amount of total resources *Xt* ('cash-on-hand' in Deaton's (1991) terminology), the sum of this period's wealth and this period's labour income. Given this starting position, the consumer's goal is to maximize expected discounted utility from consumption between the current period *t* and a final period of life *T*,

$$Max\ E_t\left[\sum_{S=T}^{T}\beta^{S=T}u(\tilde{C}_S)\right] \quad (2)$$

(where the ~ over C_s indicates that its value may be uncertain as of the date at which expectations are being taken) subject to a set of budget constraints and shocks,

$$W_{S+1} = R_{S+1}(X_s - C_S) \quad (3)$$

$$Y_{S+1} = P_{S+1}\xi_{S+1} \quad (4)$$

$$P_{S+1} = GP_S N_{S+1} \quad (5)$$

$$X_{S+1} = W_{S+1} + Y_{S+1} \quad (6)$$

where beginning-of-period wealth next period, W_{t+1}, is equal to unspent resources from period t accumulated at a (potentially uncertain) gross interest rate R_{t+1}; Y_{t+1} is labor (or more properly 'noncapital') income in period $t+1$, which is equal to 'permanent labour income P_{t+1} multiplied by a mean-one transitory shock ξ_{t+1}; $E_t\left[\tilde{\xi}_{t+1}\right]=1$ permanent labour income grows by a factor G between periods and is also potentially subject to shocks, N_{s+1}; and 'cash-on-hand' in period t + 1 is equal to beginning-of-period wealth W_{t+1} plus the period's labour income Y_{t+1}.

2.2 Conceptual framework on household multi-dimensional poverty

2.2.1 Households' welfare deprivation linkage to multi-dimensional poverty

The conceptual framework (Figure 1) establishes the basis for the empirical analysis carried out in this work. It links deprivation in selected welfare dimensions and variables to the resultant manifestation of multi-dimensional poverty among the fishing households. There has been strong acknowledgement, even among scholars, of the strong relationship between household welfare, deprivation as a result of neglect, and multi-dimensional poverty (such as Albertini *et al.*, 2006). Welfarism in general and utilitarianism, in particular, see value, ultimately, only in individual utility, which is defined in terms of some mental characteristic, such as pleasure, happiness, or desire. This characterization of welfarist theories seems largely shared in the economic community: The welfarist approach aims to base comparisons of well-

being and public policy decisions, solely on individual household "utilities". The essence of the approach is the concept of a *preference ordering* over goods, generally taken to be representable by a "utility function", the value of which is deemed to be sufficient statistics for assessing a person's well-being. Sen (1993) argued that in so far as utility is meant to stand for individual well-being, it provides a rather limited accounting of that concept. In his pioneering contribution to measuring deprivation in terms of social-welfare loss, Hugh Dalton (1920) used a simple utilitarian social-welfare function. Social welfare was taken to be the sum-total of individual households' utilities, and each household utility was taken to be a function of the total income (as a result of increased endowments and opportunities) of that household individual. The same utility function was taken to apply to all households.

Even without the restrictive condition of the same utility function for all, but with the basic utilitarian characteristic of a social welfare function additive with equal weights for all individual members, the welfarist maximization programme requires that all marginal utilities be equal. So, the space of individual marginal utilities is the first one where equality is required by this approach, bearing in mind that social optimality was explained by economic considerations developed through household resource allocation determining household endowment constraint. This resource space, household endowment, remains central to the issue of household multi-dimensional deprivation and poverty reduction.

The capability approach differs crucially from the more traditional approaches to individual and social evaluation, based on such variables as *primary goods*, *resources*, or *real income*. These variables are all concerned with the instruments of achieving well-being and other objectives, and can be seen also as the means to freedom. In contrast, functionings belong to the constitutive elements of well-being. Capability reflects freedom to pursue these important elements, playing a central role in well-being improvements, in so far as decision making and choices are also parts of living.

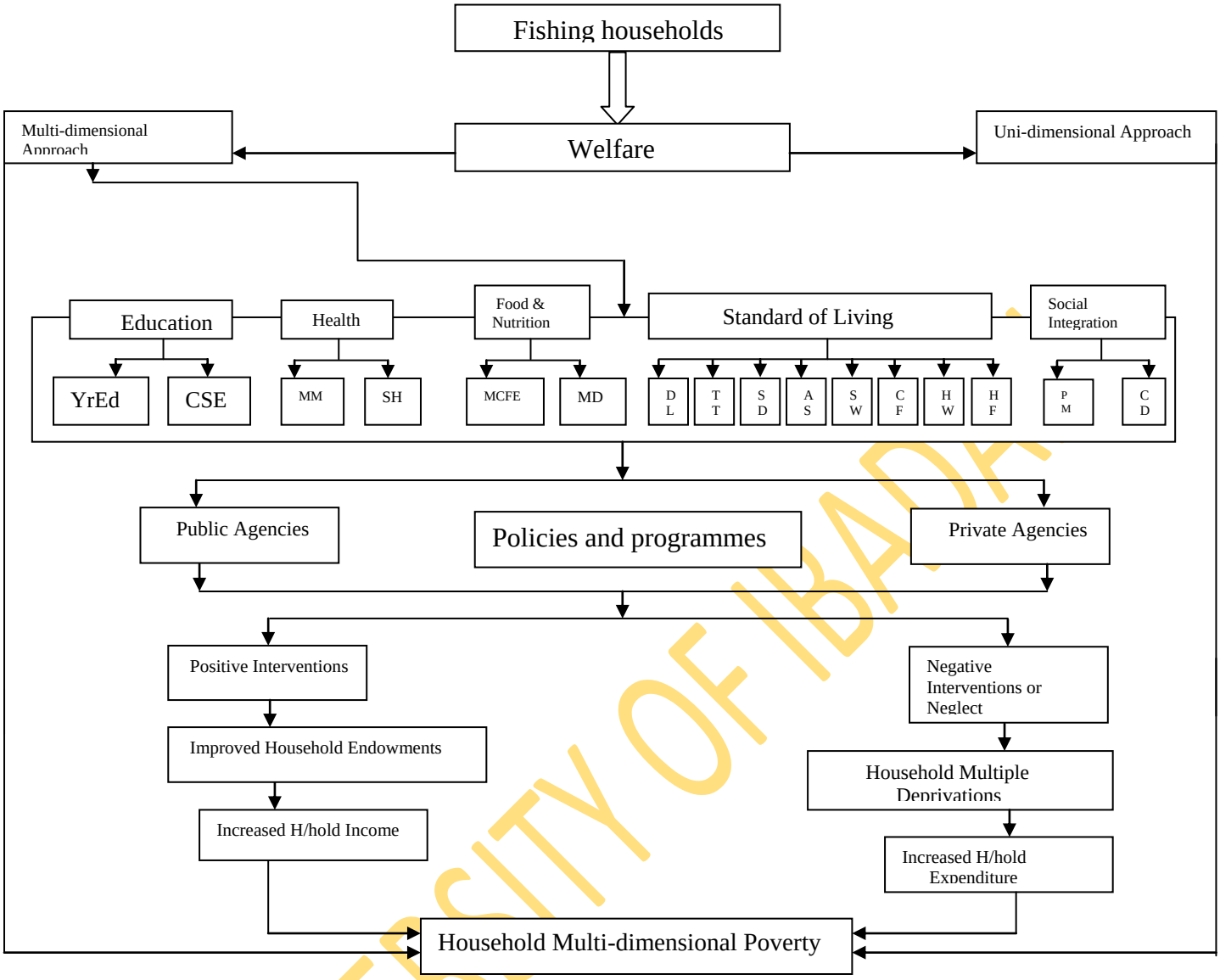

Figure 9: Conceptual Framework on Manifestation of Household Multi-dimensional Poverty through Welfare Deprivations and Negative Policy Interventions. (Adapted from Benach *et al.*, 2003; Tello *et al.*, 2005; Curtis *et al.*, 2006 and Alkire and Santos, 2010).

Key:

YrEd:	Year of education	CSE:	Child school enrolment
MM:	Malaria treatment method	SH:	Self-reported health
MCFE:	Mean per capita food expenditure	MD:	No. of meal per day
DL:	Source of Domestic Light	TT:	Toilet type
SD:	Means of solid waste disposal	AS:	Ownership of basic assets
SW:	Source of drinking water	CF:	Type of cooking fuel
HW:	Material of the house wall	HF:	Material of the house floor
PM:	Political membership	CD:	Participation in comm. dev. projects

Two approaches to household poverty measurement have been identified in literature, namely: the uni-dimensional poverty (or traditional approach) and the multi-dimensional poverty. While the former has been variously adopted and extensively discussed (such as Adeyeye, 2000; Olayemi, 1995; Sancho, 1996; Aigbokan, 2000; Alayande and Alayande, 2004; Osinubi 2003 and Oyekale *et al.,* 2006), application of the latter is gradually gaining attention of policy makers especially in developing economies like Nigeria (for example Oyekale and Okunmadewa (2008) and Oyekale *et al.* (2006).

The uni-dimensional poverty measurement has extensively focused on a single indicator, such as income, consumption expenditure, food energy intake and cost of basic needs to analyse the poverty profile of the country, an approach which has been widely condemned (such as World Bank, 2001) as not being comprehensive enough and, as such, not suitable for drawing the poverty profile of a population. For instance, while such measures as the Foster-Greer-Thorbecke (1984) simply dichotomises the population into the poor and the non-poor, the Human Development Index (HDI) tends to summarise only a small aspect of the human well-being in its own application. By contrast, the strength of the multi-dimensionality approach developed for this study lies in the possibility of measuring household poverty level through a variety of welfare indicators, as itemized in Appendix II (which include household food consumption expenditure) to calculate indices accounting for different aspects of poverty as well as freedom to achieve certain social feats in society (Baliamounne-Luttz, 2004).

Poverty amid plenty is the world's greatest challenge. Poor people live without fundamental freedom of actions and choices that the better off take for granted (Sen, 2008). These include the lack of income and assets to attain basic necessities (food, shelter, clothing, and acceptable levels of health, education, and other welfare-enhancing goods and services). The poor experience a sense of voicelessness, powerlessness, exposure to ill treatment, gross inability to influence key decisions affecting their lives as well as inadequate social networking within the institutions of state and society. They face extreme vulnerability to ill health, economic dislocation, and natural disasters, and adverse shocks linked to inability to cope with such shocks. These deprivations keep them from leading the kind of life that every one values. These are all dimensions of poverty (World bank, 2001). Sickness due to malaria infection has profound human and socioeconomic consequences in all societies. The costs of lost productivity and man-labour as well as treatment of malaria-stricken individuals constitute a significant economic burden and welfare loss for the family and society.

Globally, access to adequate food and proper nutrition is one of human's basic needs. World Bank (2007) reported that many countries, especially the sub-Saharan Africa region, experience food insecurity, with food supplies being inadequate to maintain their citizens' per capita consumption. The average amount of food available per person per day in the region was 1,300 calories compared to the world wide average of 2,700 calories. Globally, nearly 1.2 billion people live on less than $1.25 USD a day (World Bank, 2007). More than 75% of these people dwell in rural areas, the situation being even worse in the Sub-Saharan Africa (SSA) containing nearly 97% of the poor on the continent. Nigeria was among the countries in Sub-Saharan Africa experiencing significant food shortages, as over 40% of the country's population is estimated to be critically food insecure. World Bank's (2007) report indicted most developing countries (Nigeria inclusive) of food insufficiency and inaccessibility to a very large segment of the population, the types and quality of food consumed being often nutritionally inadequate. WHO (2002) reported that Nigerian children below the age of 18 years (about 47% of the nation's population) are still victims of stunting, wasting and underweight, all of which are evidence of under-nutrition; This inadequate supply of calorie lowers productivity, hinders learning and increases the risk of diseases (Oladele and Adekoya, 2006). According to the World Bank (2007), 380 million people in SSA lived on just less than $1.25 USD/day in 2005 alone. In only two decades and a half, the number of people on the continent below the poverty line nearly doubled from 200 million in 1981 to 380 million in 2005 (World Bank, 2007).

Following Benach *et al.*, (2003), Tello *et al.*, (2005), Curtis *et al.*, (2006) and Alkire and Santos (2010), the conceptual framework for this study was developed around the resultant effect of negative policy intervention (or policy neglect) on the five basic welfare dimensions used in this study (comprising sixteen indicators) which increases households' multiple deprivations and eventually worsens the poverty situation of the fishing households. The expected interventions were conceptualized to either come from public (for example government and its parastatals) or private (for instance non-governmental organizations, incorporated organizations or self) agencies or both. Positive intervention of the agencies on the present state of households' welfare variables has the effect of improving the household endowments which will increase income and (or) reduce expenditure and, thus, reduce household multi-dimensional poverty level (Figure 9). Vision 2020 advocates for an increased recognition of the vital role of promoting and sustaining poverty intervention programmes

through accelerated efforts in three fundamental areas: advocacy and public relations; information, education and communication; and community participation.

2.2.2 Concept of poverty indicator, poverty measure, and poverty index

Let I_{ik} be the value of indicator I_k for the elementary population unit i (individuals, households, villages, regions or countries). I_{ik} is then a *poverty indicator* value. The value I_{ik} can be transformed as $g_k(I_{ik})$, with the function g_k, to better reflect a poverty concept relative to indicator I_k. This is frequently the case, especially with a quantitative indicator I_k to which is associated a poverty threshold (poverty line) z_k. A basic transformation is simply the censoring of I_k at z_k to get a value. In this case, well-known transformations are $g_k\left(I_{ki}^*\right)=\left(z_k-I_{ik}^*\right)^\alpha$ or $g_k\left(I_{ki}^*\right)=\left(1-I_{ik}^*/z_k\right)^\alpha$. Then, $g_k(I_{ik})$ is called a *poverty measure* value, again defined for individual i. In the particular case where the function g_k is the identity function, the poverty indicator and the poverty measure are the same. Finally, poverty measure values can be aggregated over the units for the whole population U, as $W_k\{g_k(I_{ik}), i = 1, N\}$. W_k is then called a *poverty index* relative to the indicator I_k for the population U. Obviously, this index W_k can be defined on any subpopulation of U consisting of n individuals, $n \geq 1$. For n =1, the poverty index is a poverty measure on each individual. Poverty indices are required for population comparisons, while poverty indicators and poverty measures are sufficient for comparisons between individuals.

2.2.3 Concept of the deprivation index

A 'deprivation index' is a list of items (or activities) which have two characteristics, given the prevailing social and economic conditions in a time and place. First, the items on the list should be widely seen as necessary for a household to have a standard of living above the poverty level. In other words, these should be items which most households not in poverty are likely to have. Second, these items should be such that households in poverty are likely to find some of them unaffordable and so not have all those items. A deprivation index, if it is well developed, should contain those items that distinguish the poor from the non-poor in the prevailing social and economic conditions. The items in a deprivation index are not necessarily a comprehensive list of basic needs, since in a wealthy society even the poor are likely to have most of the basic necessities. For instance, being able to afford fresh fruits and vegetables

everyday, as trivial as it may look, could distinguish the poor from the non-poor households even in a seemingly wealthy society.

The deprivation index advances the measure of poverty in a number of ways compared to existing measures: reflection of the real-life experiences of the poor; communicating a powerful and compelling picture of poverty to the public; measuring actual standard of living of the people; capturing dimensions of poverty that income does not, for example social isolation; reflecting public perception of poverty and not arbitrary decisions made by experts; reflecting government investment in services and in-kind benefits; as well as complementing (but not replacing) existing income measures. Building on Townsend's (1987) work, using the concept of deprivation to measure poverty, Mack and Lansley (1985) distinguish between lacking an item by choice rather than affordability and asking from the respondents whether an item was perceived as necessary by a respondent. By seeking the respondents about which items were necessary based on surveying rather than an expert's intuitive judgment, the resulting deprivation index would more likely reflect society's understanding of the concept of poverty at any given time. These refinements are highlighted in McKay and Collard's Developing Deprivation Questions for the Family Resources Survey (2003).

Following a similar procedure (such as Speder and Kapitany, 2005), the deprivation questionnaire used for this study addressed two areas: firstly, " identifying which of a given set of items, services and (or) living conditions was adjudged to be a necessity for an acceptable standard of living given the coastal community in focus; and secondly, "which of the given set of items, services and (or) living conditions did a coastal household lack as a result of unaffordability?'' A list of items was presented to the respondents randomly to respond to on the basis of the asked questions. The list contained items which could be acquired by the household disposable income. This study only regarded lack of an items, services and (or) living conditions as a well-being deficit when it was due to financial reasons (that is, as a result of unaffordability). The initial deprivation index was computed from a deprivation score generated by multiplying the likelihood of an item being perceived as a necessity by the likelihood of a respondent not having the item.

This approach reflects Mack and Lansely's (1985) concept of deprivation being about lack of socially perceived necessities. The results and feedback from the questionnaire led to the creation of a new list of items, services and (or) living conditions that were redefined from the previous list, using combined yardsticks to determine if an item would be kept, eliminated, altered or added in the final list. Items that were considered necessary and affordable within the

income of the household were dropped from the resultant deprivation list. The final deprivation score was calculated for an items, services and (or) living conditions, using the score to rank, by multiplying the likelihood of an item being perceived as a necessity by the likelihood of it being unaffordable for that population.

The methodological procedures adopted in this study to identify socially defined necessities for the fishing households involved the following:

- Choosing and categorizing a basic geographic unit (bgu). Since the index is required to substitute for individual measures, the political ward was chosen for this study, being the smallest possible geographical entity that could ensure a high degree of homogeneity in the socio-economic characteristics and conditions attributed to each household in the unit (following Pampalon *et al.*, 2009).
- Selecting the welfare indicators (Appendix II). Sixteen (16) indicators were originally included in this study, following scholars like Pampalon and Raymond, 2000; Oyekale and Okunmadewa, 2008).
- Combining the selected indicators using the preferred multiple correspondence analysis (MCA) approach (following Ki *et al.*, 2005) to reduce the indicators to fewer dimensions.
- Combining the wards into sufficiently large and homogenous groups in terms of the five dimensions of deprivation already identified.
- Grouping of wards in terms of their factorial scores reflecting the importance of each component in each ward. For each component, the factorial scores were ranked from least to most deprived ward, dividing the resulting distribution into 20% quintiles of approximately 90 wards each, according to the population size of each ward, a quintile representing each of the five deprivation dimensions.
- Cross-tabulation of the five sets of quintiles to determine which segments of the population were not deprived by any of the five dimensions, and which segments were deprived by each and a combination of dimensions.

2.2.4 Conceptual definitions of terms and variables

Multi-dimensional poverty refers to a measurement of poverty which relies on a vector *I* of *k* variables, here called primary poverty indicators, with $k > 1$. This study is in the domain of multi-dimensional poverty, as there are five poverty dimensions within the vector *I*.

"**Relative**" and "**absolute**" **poverty**: This is generally based on whether relative or absolute standards are adopted in the determination of the minimum income required to meet basic life's necessities. Absolute poverty has been described as "subsistence below minimum, socially acceptable living conditions, usually established based on nutritional requirements and other essential goods". The concept of relative poverty, on the other hand, is based on the argument that a person's welfare relative to that of the rest of society is what matters for determining whether he/she is poor. The relative conceptualization of poverty is largely income-based or ultimately so. Accordingly, poverty depicts a situation in which a given material means of sustenance within a given society is hardly enough for subsistence in that society. This view of poverty captures the idea that poverty is highly related to the time and social milieu in question. Whilst absolute poverty can be eradicated, relative poverty implicitly captures the notion that poverty can never be completely eradicated.

Poverty line: A poverty line is a welfare threshold that delineates the poor from the non-poor. To a large extent, the various measures of poverty are functions of the poverty line. A major drawback of the poverty line in the literature (for example, Justino and Litchfield, 2003; and Madden and Smith, 2000) is the arbitrariness inherent in its determination. Irrespective of the specific value of the line, it can be argued that, all things being equal, individuals whose estimated welfare levels are marginally higher than this threshold might be indistinguishable (from a well-being perspective) from those whose estimated welfare levels are marginally below the line. This tendency for poverty lines to retain some elements of arbitrariness has contributed to the increase in studies that employ poverty dominance analyses.

Counting approach to multi-dimensional deprivation has been defined as the analysis of the distribution of the "deprivation count" across the population of households (Atkinson, 2003a).

Primary poverty indicator(s): These are poverty variables, represented by k in this study. They are heterogeneous in nature, being a combination of quantitative/cardinal (for instance, year of formal education) and qualitative/categorical (such as type of toilet, nature of wall material, and so on). A minimal requirement for a variable to be admissible as a poverty indicator is to be ordinal. For categorical indicators, there is a ranking of the finite set of categories, from the worst one to the best one, in terms of some type of basic welfare.

Poverty dimension is defined a priori as being represented by a univariate or multivariate measurement, each variable of the subset being a poverty indicator. In this study, we have education dimension, health dimension, food and nutrition dimension, and so forth. A

poverty dimension is an *a priori* concept defined as a subset of indicators relative to the same domain of basic needs or basic welfare. However, the term 'dimension' and 'domain' are used interchangeably in some occasions.

Poverty type sets is a statistical concept defined from the multivariate distribution of the whole set of indicators in a given population. A poverty type can, and will usually be, poverty multi-dimensional. It is a concept that helps in exploring, reducing, and clarifying the meaning of multi-dimensional poverty in a given population, according to a behavioural specificity of that population and/or to specific poverty-reduction policies. Numerous poverty dimensions can thus shrink into just one poverty type, or some types, which obviously should simplify the analysis.

Poverty types algorithm: The poverty type sets from different axes are not necessarily disjoint: the same indicator can belong to more than one axis. The potential intersection between these sets can be eliminated by a sequential process, starting with the first axis and continuing with the others as ordered by MCA, since the discriminating power of each axis is decreasing. The way to eliminate these intersections, while trying to retain at each step the maximal inertia, is naturally coming out of the total inertia decomposition, at each step keeping a given indicator *k* into the poverty type set where its discrimination measure is larger. This is the whole idea about the *poverty types algorithm*.

Poverty by inclusion: *Exogenous* poverty is the association of (say income) poverty to each household member if the household is considered as poor, according to its per capita expenditure level. The statistical unit is poor because the demographic unit to which it belongs is poor in some dimensions. *Endogenous* transmission of poverty goes the other direction: a demographic unit (in this study, household) is poor/deprived if some of its members are poor/deprived at their own level.

Socially enforced lack and goods of necessity: Lacking an item by non-affordability rather than by choice is the basis for defining 'enforced lack'. Such goods or items must have been perceived as necessary by the respondent or household to reach an acceptable living condition. By seeking the respondent's or household's opinion about the status of the goods or items concerned with respect to its socially determined value rather than depending on expert's intuitive judgment is the basis for the social concept of owing or lacking a good or item.

Core-coastal fishing households are those with houses built directly onshore or around the river shores (that is, house is built within 100m away from the shores).

Non-core coastal fishing households, on the other hand, are those with houses located farther than 100m from the shores.

Household head: The household head is the person who is responsible not only to the family members, but also for the family's expenditure and all cases related to the economic and social aspects of the family. The head of household is expected to accept, provide and develop different capacities in the family besides being able to help other members, spend more time with them, do something that makes a difference in their lives. He/she should have a close association with the family.

2.3 Methodological framework

2.3.1 Measuring welfare state redistribution

The measurement of welfare state redistribution faces severe obstacles, both in terms of getting the right data and in terms of methodology (Atkinson *et al*., 1995a). Almost all previous research efforts made recourse to year-specific cross-national comparisons. It is not easy to compare income distributions before and after the advent of the welfare state. One can, however, examine how changes in policy (say, a pension reform) influenced the income distribution, but then, one is not measuring total welfare state effects.

The early attempts to compare across countries were severely hampered by the incomparability of national income data. This drawback changed by the efforts of the Luxembourg Income Study (LIS) and later by the Organisation for Economic Co-operation and Development (OECD), to harmonize national income surveys (Forster, 2000; Atkinson, 2003b). The LIS data allowed, from the 1980s onward, researchers to obtain truly comparable estimates of income distributions (Atkinson *et al*., 1995b). The majority of comparative research works over the past decades used the LIS data. But drawbacks remain. The data for any given country may represent an atypical year, owing to, for example, external economic shocks. It also means that we cannot determine whether a household's reported income reflects a transitory or stable situation. The mix of transient and persistent poverty may differ across countries. A second major drawback is that we have generally no information on the distribution of public service consumption which, we know, varies greatly across welfare states.

The methodological obstacles are no less severe. A first consideration has to do with how we measure distributions. Under the assumption that members of a household pool their income, the logical study unit is the household. In the literature, we find three prevailing

approaches: a *summary measure*, such as the Gini coefficient; a *decile approach*, where inequalities are captured via ratios (such as the top-to-bottom income decile); and a *poverty-rate approach*. It is broadly recognized that income alone may not give us an adequate picture of well-being. Many scholars, therefore, argue in favor of a more comprehensive, multi-dimensional measure of living conditions and household resources (Nolan and Whelan, 2007). This, however, creates greater obstacles for obtaining internationally comparable data.

Much research has focused on welfare states' effectiveness in reducing poverty with concern on the need to define a meaningful poverty line. One hotly debated issue is whether to adopt a relative or 'absolute' measure. Drawing the poverty line will, in all cases, provoke some artificiality of assessment. There may, for example, be a large population that falls just immediately below the line. They would be classified as poor whereas those with just a few additional income amount would not. The standard approach that has been adopted in most studies is the 50-percent of median line, although the European Union (EU) has officially chosen a 60-percent line. Studies that wish to capture the 'poverty gap', that is, how far below the line the poor find themselves, calculate either a gap measure or use several poverty lines (Kenworthy and Pontusson, 2005). The prevailing consensus is that the income data must be weighted by the number of members in the household. A single person and a family of four with identical incomes will obviously experience different welfare levels simply because of the number of household members that need to be fed and clothed. Following Atkinson *et al*. (1995b), most studies adopt the square-root scale according to which the adjustment equals the square root of a household's size.

A second methodological challenge lies in the difficulty of distinguishing between flux and stability. Cross sectional data confound the two and this means that short-lived, transitory low (or high) income is given the same importance as persistent levels. This problem is most acute in studies that focus on poverty. We know that poverty is short-lived among a significant share of poor households (Bradbury *et al*., 2001; Aaberge *et al*., 2002; Gangl, 2005). Studies that use permanent income, averaged over five or more years, found substantially less inequality than those that measure just one year. Those that are comparative found, additionally, that national differences are less accentuated than when we measure poverty rates in any given year (Bradbury *et al*., 2001).

Our ability to distinguish between transient as opposed to persistent or recurrent poverty is vital for understanding the effectiveness of welfare state guarantees. Although country differences are less marked, the evidence we have does suggest less persistency – especially

among families with children -- in strong welfare states. For instance, Whelan and Maitre (2007), using a more comprehensive measure of vulnerability, found that the share of the poor who were persistently vulnerable was substantially lower in Denmark than elsewhere. They attribute this mainly to the Danish active labour market policies, which are explicitly designed to minimize long-term joblessness.

Few comparative studies have attempted to tackle the role of services. Most research includes only a sampling of services (typically education and health) and assign a per capita value (based on the cost to government of the service) across households (for example Smeeding, 2005a; Garfinkel *et al.*, 2006). This approach may not be problematic in the case of universally consumed services, such as elementary schools, but is obviously inadequate for services that have different take-up profiles across society. We know from research on inequalities in health care that the greater the reliance on private financing, the more regressive is the effect. But even in countries with universal health care there exists strong social gradients in health care consumption (Wagstaff and van Doorslaer, 2000). There are very few comparative studies that estimate the global service effect. The recent effort of Organisation for Economic Cooperation and Development (OECD) is probably the only that exists (Matsaganis *et al.*, 2004). An additional advantage of the OECD study is that the distribution of services has been estimated via micro-data on reported use by household members.

The final and most intractable methodological problem has to do with the inherent endogeneity between primary incomes and the welfare state. Some studies (such as Carneiro and Heckman, 2003; Esping-Andersen, 2007) suggest that welfare state efforts to equalize opportunities, reconcile motherhood and careers, maximize employment or homogenize early childhood development have decisive effects on equalizing lifetime earnings and career prospects and on reducing poverty These may in fact overshadow the role of direct redistribution via taxes and income transfers. But in this regard, empirical research has made very little progress, basically because the counterfactual is virtually impossible to define.

Poverty reduction is arguably the single most relevant measure of welfare state redistribution; it has become the favoured approach in empirical research. Theoretically, it provides a good test of the Rawlsean maximin principle of justice, namely that any redistribution should be to the greatest benefit of the worst-off in society. It also speaks most directly to vertical, Robin Hood-redistribution. For two reasons, research has especially centred on child poverty. One is that poverty in childhood is known to have adverse consequences for later outcomes, such as schooling, health and social integration (Vleminckx and Smeeding,

2001). A welfare state's investment in children's well-being is a potentially very powerful tool for promoting greater equality of opportunities (Esping-Andersen, 2007).

Virtually all studies conclude that poverty reduction, in particular among families with children, is closely associated with levels of social expenditure. The Nordic countries are typically the most redistributive, while the Anglo Saxon (especially the US) are the least (Jantti and Danziger, 2000; Bradbury *et al.*, 2001; Smeeding 2005a and 2005b). Corak (2005) also shows a strong correlation between welfare state spending on families and poverty reduction among children.

2.3.2 The traditional univariate analysis and measurement of poverty

Dagum (1993) proposed a methodological research program (MRP) for univariate analysis (UA) and measurement of poverty and its implications for a socioeconomic policy purporting to reduce the extent, intensity and inequality of a poor population. He distinguishes between the structural and the business cycle causes of poverty. In general, the object of research in univariate analysis of poverty is a population of households. Thus, our economic units are households belonging to an economic space (nation or region), or subsets of this population, partitioned with respect to some socio-economic attributes such as gender, years of schooling, urban-rural location and age. It is our sample space. Symbolically,

$$A = \{a_1,\ldots,a_i,\ldots,a_n\}, \qquad (1)$$

where n is the cardinality of the set A, therefore, we are dealing with n observed households. In the case of a census, A contains all the households of a population, hence, each $a_i \in A$ has the constant weight of 1, i=1,...,n. If A is a representative sample of a population, being a stratified sample, which includes representative sub-samples of some socioeconomic attributes of the household head, to each a_i corresponds a weight n_i equal to the number of households the sample observation a_i represents, and $\sum_{i=1}^{n} n_i = N$, the size of the population. Its relative frequency is n_i / N.

To the i-th household is associated an income variable Y_i, such that,

$$Y_i = Y(a_i), \quad i = 1,\ldots,n. \qquad (2)$$

The power set P(A) = Γ is a sigma algebra. Assigning to each member $\gamma \in \Gamma$ a probability P_γ, it is obtained the probability space (PS)

$$(A, P(A), P_\gamma) = (A, \Gamma, P_\gamma). \qquad (3)$$

The income variable Y in (2) maps the PS in (3) into the induced PS

$$Y: (A, \Gamma, P_\gamma) \rightarrow (R^+, B^+, P_\beta), \qquad (4)$$

such that , R^+ is the non-negative order of real numbers (should we have negative income values, we should map **A** onto the set of real numbers R); B^+ is a set and $\beta \in B^+$, hence, $\beta \subset R^+$ and $P_\beta = P_\gamma$, since Y maps the event γ into the event β. The induced probability space generated by the income variable Y cogently introduces, as core methods of socioeconomic research on poverty, the content of probability theory, stochastic processes, statistical inference and methods of estimation. In UA, to the probability measure P_β , $\beta \in B$, corresponds the income distribution function

$$F(y) = P(Y \leq y) = \int_0^y dF(\xi) \qquad (5)$$

A mathematical specification of F(y) corresponds to a model of income distribution.

The economic interpretation of poverty as an insufficient command over resources implies the adoption of a univariate approach to the analysis and measurement of poverty. Hence, the choice of income, or expenditure, as an indicator of command over resources, implies a dichotomic partition of the households' population into *poor* and *non-poor*. The choice of income Y as an indicator of command over resources, the set of households A such that the income of the i-th household is $y_i = y(a_i)$, and the specification of non-overlapping income intervals in R^+ corresponding to each $a_i \in A$ allow us to obtain the induced probability space (4) and the income distribution function (5). This is a main step in the univariate approach, while it is a derived proposition in the multivariate approach.

Univariate analysis deals with a single variable, let us say income. Therefore, for a representative household, for example, a two-adult household, the UA has to determine the level of income Z = Z(2), that is, its poverty line. This poverty line will discriminate among poor and non-poor two-adult households. Very often, the literature erroneously calls them poor and rich households, respectively. To pass from the income (usually, disposable income) of a household of any size to its equivalent level of income corresponding to the assumption that all households are of size two, we need to build an equivalence scale. It will also allow us to determine the poverty line of the households. An approach to build an equivalence scale starts with the specification of an extended Engel microeconomic food consumption function, that is, food expenditures FE of a household as a function of its income *y* and size *N*. Hence,

$$FE = by^\alpha N^\beta, \quad b > 0, \quad 0 < (\alpha, \beta) < 1 \qquad (6)$$

The constraint $0 < \alpha < 1$ is supported by a well established behavioural regularity for cross sectional data, which states that, given N constant, food expenditure increases with income at a decreasing rate. On the other hand, the constraint $0 < \beta < 1$ implies that there is economy of scale, that is, given y constant, food expenditure increases with the size N of a household but at a decreasing rate. It follows from (6) that α and β are the partial elasticities of food expenditure with respect to income *y* and household size N, respectively. Dividing (6) by *y*, and postulating that all households with the same food expenditure-income ratio have the same level of welfare, we have

$$FE / y = by^{\alpha-1}N^{\beta}, \tag{7}$$

and for FE / y = constant, that is, an iso-welfare or iso-quant of (7), the elasticity of y with respect to N is

$$e_{yN} = \frac{d \log y}{d \log N} = \frac{\beta}{1-\alpha}. \tag{8}$$

The estimation of this elasticity plays an essential role in the construction of an equivalence scale. Since the welfare of a household is an increasing function of its income and a decreasing function of its size, we need to estimate Z for households of different sizes. Therefore, given S(N*), we need to obtain the equivalence scale S(N) for all $N \neq N^{*}$. It follows from the identity

$$\frac{S(N+\Delta N)-S(N)}{S(N)} = \frac{\Delta S(N)}{S(N)}, \tag{9}$$

and eq. (8), that

$$S(N+\Delta N) = S(N)\left[1+\frac{\Delta S(N)}{S(N)}\right] = S_N\left[1+\frac{N}{S(N)} * \frac{\Delta S(N)}{\Delta N} * \frac{\Delta N}{N}\right] = S(N)\left[1+e_{yN}\frac{\Delta N}{N}\right] \tag{10}$$

therefore,

$$S(N+\Delta N) = S(N)\left[1+\frac{\beta}{1-\alpha}\frac{\Delta N}{N}\right]. \tag{11}$$

where symbol *S* is a function notation.

It follows from (11), and given $N^{*} = 2$, hence S(2) = 100, that:

$$S(1) = S(2)\left[1 - \frac{\beta}{2(1-\alpha)}\right] = 100\left[1 - \frac{\beta}{2(1-\alpha)}\right];$$

$$S(3) = 100\left[1 + \frac{\beta}{2(1-\alpha)}\right];$$

$$S(4) = S(3)\left[1 + \frac{\beta}{3(1-\alpha)}\right];$$

and so on. Then, given $Z(N^*)$, the poverty line $Z(N)$ is

$$Z(N) = \frac{S(N)Z(N^*)}{S(N^*)} = \frac{S(N)Z(N^*)}{100}, N = 1,2,... \qquad (12)$$

The equivalence scale (11), besides being used to obtain from the poverty line $Z(N^*)$ the poverty line $Z(N)$ for any household of size $N \neq N^*$, allows us to transform the income $y(N)$ of an N-size household into its equivalent income $y^e = y^e(N^*)$, as it would be an N^*-size household. Hence, for the i-th household,

$$y_i^e = y_i^e(N^*) = \frac{100y_i(N)}{S(N)}, \qquad i = 1,2,...,n. \qquad (13)$$

Any N-size household with income $y(N) < Z(N)$, or equivalently, $y^e(N^*) < Z(N^*)$ is defined as poor, where $Z(N)$ is given by (7), and $y^e(N^*)$ is deduced from (13). The total number $q \leq n$ of households with income $y(N) < Z(N)$, for all N, is the number of poor households in a population of size n. The equations above afford us to measure some specific indicators of univariate poverty, which include:

(i) ***The head-count ratio H***, which is the proportion of poor households in the total population of households, *i.e.*,

$$H = \frac{q}{n} = F(Z(N^*)) = P(y^e(N^*) < Z(N^*)) = \\ = P(y(N) < Z(N); \qquad N = 1,2,...). \qquad (14)$$

(ii) ***The intensity of poverty or income gap ratio I,*** defined as the ratio between the average income gap of the poor and its poverty line, that is,

$$I = \frac{\sum_{i=1}^{q} g_i^e}{qZ(N^*)} = \frac{\sum_{i=1}^{q}\left[Z(N^*) - y_i^e(N^*)\right]}{qZ(N^*)} = \\ = 1 - \frac{\bar{y}_p^e}{Z(N^*)} = 1 - \frac{\bar{y}^e L(Z(N^*))}{Z(N^*)F(Z(N^*))}, \qquad (15)$$

where $\bar{y}_p^e$ stands for the average equivalent income of the poor, $\bar{y}^e$ for the average equivalent income of the households population, and L(Z(N*)) and F(Z(N*)) = H for the Lorenz curve and the cumulative distribution of equivalent income, respectively. For the household equivalent incomes, the income gap is defined as follows:

$$g_i^e = Z(N^*) - y_i^e(N^*), \quad \forall y_i^e(N^*) < Z(N^*), \quad i = 1,2,...,n; \qquad (16)$$

and 0 otherwise. For the household observed incomes, it follows from (12), (13) and (16), that

$$g_i(N) = Z(N) - y_i(N), \quad \forall y_i(N) < Z(N), \quad N = 1,2,...; \quad i = 1,2,...,n. \quad (17)$$

(iii) ***Income inequality of the poor G_p and the non-poor G_{np} households.***

The poverty line Z(N*) partitions the population into q poor and n – q non-poor households. For poverty analysis, and for the design of a socioeconomic policy, it is important to know the income inequalities of the poor and the non-poor subpopulations. Ordering the q poor and the n – q non-poor households by the increasing size of their corresponding equivalent incomes and using the well-known Gini ratio, we have, for each of these two sub-populations,

$$G_p = \frac{\Delta_p^e}{2\bar{y}_p^e} = -1 - \frac{1}{q} + \frac{2\sum_{i=1}^{q} i y_i^e}{q^2 \bar{y}_p^e}, \qquad (18)$$

and

$$G_{np} = \frac{\Delta_{np}^e}{2\bar{y}_{np}^e} = -1 - \frac{1}{n-q} + \frac{2\sum_{i=1}^{n-q} i y_{q+i}^e}{(n-q)^2 \bar{y}_{np}^e}, \qquad (19)$$

where Δ_p^e and Δ_{np}^e stand for the Gini mean differences of equivalent incomes of the poor and the non-poor households, respectively.

(iv) ***Directional income distance ratio D between the poor and the non-poor households.***

It purports to estimate the relative directional distance or relative deprivation of the poor with respect to the non-poor subpopulations of households. It is stated as a function of the poor and non-poor averages of equivalent incomes. Given that these two subpopulations do not overlap, Dagum (1993) proposes the following directional distance ratio D:

$$D = \frac{\left(\bar{y}_{np}^e - \bar{y}_p^e\right)}{\left(\bar{y}_{np}^e + \bar{y}_p^e\right)} \qquad (20)$$

It can be proved that:

$$D = \frac{[F(Z(N^*)) - L(Z(N^*))]}{[F(Z(N^*)) + L(Z(N^*)) - 2F(Z(N^*))L(Z(N^*))]}.$$

Dagum (1993) specifies the head-count ratio H as a poverty measure. It captures a very important aspect of poverty, that is, its diffusion. It says nothing about the intensity of the deprivation of being poor, the relative deprivation stemming from the income inequalities of the poor and non-poor, and on the disparity in the mean of the two subpopulations. Several authors, including Foster *et al.* (1984), have proposed weighted averages of the income gap of the poor. Sen (1985) was the first to advance a comprehensive measure of poverty. Starting from a set of axioms, he arrived at the poverty ratio

$$P_s = H\left[I + (1-I)G_p\right]. \qquad (21)$$

Sen combines in a single measure, (*i*) the head-count H, (*ii*) the income gap I, and (*iii*) the Gini income inequality G_p ratios of the poor, as defined in (19), (20) and (21), but ignores the directional distance between the income means of the poor and the non-poor and the income inequality of the non-poor, as if the poor and the non-poor were not members of the same society.

Combining the five ratios formalized in (17), (18), (19), (20) and (21), Dagum (1993) proposes the following comprehensible poverty measure:

$$P_{DGL} = P(H, I, D, G_p, G_{np}) = H\left(I + D + \alpha\left|G_p - \beta G_{np}\right|\right), \quad \alpha > 0, \quad 0.5 \le \beta \le 0.8. \qquad (22)$$

Besides P_{DGL} being a comprehensive measure of poverty, stated as a function of H, I and G_p, it provides important insights on the diffusion and the intensity of poverty and its disparity among the poor. Being also a function of *D* and G_{np}, it provides essential insights on the relative income deprivation and income disparity of the poor with respect to the non-poor.

2.3.3 Relative income and poverty measurement

While developing an index of child well-being in the United Kingdom, Bradbury *et al*., (2001) identified a host of problems with the relative income-based definition of poverty. These include the fact that:

• It is not easy to measure income correctly in surveys which tend to use proxy household informants.

• Income is not a good measure of command over resources – it excludes dissavings, borrowings, and the consumption of home production.

• Arbitrariness of the threshold poverty cutoff value.

• The relative threshold is very different in different countries. For instance, 60 per cent of the median is 2000 Euros in Latvia, Estonia and Lithuania and 14,000 Euros in Luxembourg (and over 9000 Euros in the UK).

• The modified equivalence scale of the Organisation for Economic Cooperation and Development (OECD) which is used to adjust income to household needs has no basis in science and also makes a difference to the composition of poor households.

• Poverty rates do not represent poverty gaps. Is it better to be a country with high rates but low gaps or low rates and high gaps?

• Poverty rates do not tell us anything about the persistence of poverty.

In order to overcome some of these problems, Jantti and Danziger (2000) have supplemented income poverty measures in the European Community Household Panel with additional measures of subjective poverty (the proportion of households with children saying that they have difficulty or great difficulty making ends meet) and measures of deprivation (proportion of households with children lacking 3 or more items from a list of nine deprivation indicators).

2.3.4 Multi-dimensional approaches to the analysis and measurement of poverty

In the multi-dimensional approach, a rigorous and comprehensive analysis and measurement of poverty can be achieved by applying the fuzzy set theory. Besides, it will be substantiated that the application of this theory provides basic information for the design of socioeconomic policies addressed to the gradual elimination in terms of the causes that produce and reproduce intergenerational states of poverty. A multi-dimensional concept of poverty demands a multidisciplinary analysis.

Three main socio-economic conceptual developments were introduced in the last three decades, although the first two were not made operational. The first one is the more embracing concept of social exclusion. It was introduced in 1974 by the French Government Minister of Social Welfare, René Lenoir. It has a strong mixture of individual and social dimensions, and it became a very fruitful and stimulating field of research in continental Europe and the third world. The second one was introduced by Sen (1985) and further developed in several other contributions of this author. In his analysis of poverty, Sen deals with the concepts of functioning, capabilities and entitlement.

Although the social exclusion approach is more socially oriented than Sen's, they are closely related and in need of a quantitative operationalization to be able to offer a meaningful and representative measurement of social exclusion and poverty. Jantti and Danziger (2000) portray social exclusion in relation to the social rights of citizens, to a certain basic standard of living and to the participation in the major social and occupational opportunities of the society. It purports to "study the evidence that, where citizens are unable to secure their social rights, they will tend to suffer processes of generalized and persisting disadvantage and their social and occupational participation will be undermined". Unlike income or expenditure as the only variable considered in the univariate analysis (UA), the social exclusion approach introduces and analyzes a vector of variables and attributes retained as indicators of some form of deprivation or poverty. In effect, labour market segmentation and informalization, the fiscal crises that government use as an excuse to restrict the universality of social coverage and the dominantly unidirectional international migration, as an aftermath of the reverse unidirectional imperialist occupation of the past, have brought to the fore issues such as race and ethnic relations, citizenship, nationality, and long-term unemployment and underemployment in multicultural and multiracial societies.

Research on social exclusion identifies a long list of economic and social phenomena. Among them, UNDP (1997) has proposed such welfare indicators as: the long-term and recurrently unemployed; the employed in precarious and unskilled jobs; the low-paid workers and the poor; the landless; the unskilled, illiterate, and school dropouts; the mentally and physically handicapped and disabled; substance abusers; child labourers and other forms of children abuse; racial, linguistic, ethnic and religious minorities; the political disenfranchised; recipients of social assistance; those needing, but ineligible for, social assistance. Sen's approach considers a person's endowment of commodities, including the characteristic vector of those commodities, and the norms and customs of the society to which that person (individual, family, household) belongs. He then presents the concepts of functioning as a person space of possible actions, and of capability as that person's ability to optimize the use or the consumption of the commodity endowment. Hence, capability is a person's ability to be or to do something.

The UNDP (1997, 1998) developed the third multi-dimensional approach to the analysis and measurement of poverty; its annual Human Development Report publishes two Human Poverty Indexes, one for developing countries (HPI-1) and another for industrialized countries (HPI-2). Unlike the social exclusion and Sen's approaches, the UNDP's approach was made

operational because it ends with a proposed measure of poverty. The HPI for developing countries is an average of percentages of deprivation in three essential dimensions of human life. Since 1991, these dimensions were already included in the UNDP Human Development Index (HDI). The component of the HPI-1 are deprivation in longevity estimated by the percentage of people not expected to survive up to age 40; deprivation in knowledge estimated by the percentage of adults who are illiterate; and deprivation in living standard estimated by an arithmetic mean of (a) the percentage of people without access to safe water, (b) the percentage of people without access to health services, and (c) the percentage of moderately and severely underweight children under five.

The HPI-1 for developing countries is the potential mean of order three of these three percentages. On the other hand, the HPI-2 for industrialized countries is the potential mean of order three of the percentages of deprivation in four essential dimensions of human life. These are deprivation in longevity, estimated by the percentage of people not expected to survive to age 60; deprivation in knowledge, estimated by the percentage of people who are functionally illiterate as defined by the OECD; deprivation in standard of living, estimated by the percentage of people living below the income poverty line, set at 50% of the median disposable household income; and deprivation due to social exclusion or non-participation, estimated by the rate of long term unemployment of the labor force, that is, unemployment lasting 12 or more months. Given a data set (sample survey or census), we select the socioeconomic attributes whose lack of, or partial (insufficient) possession of any of those attributes, contributes to the state of a household poverty. They are represented by the m-order vector of attributes:

$$X = (X_1,...,X_j,...,X_m) \qquad (23)$$

The m-order vector X maps the probability space (3) onto a new PS, *i.e.*

$$X : (A,\Gamma,P_\gamma) \to (R_m^+, B^+, P_\beta), \qquad (24)$$

where R_m^+ is the non-negative m-dimensional Euclidean space, B^+ is a Borel set generated by a base of R_m^+, and as in (9), $P_\beta = P_\gamma$.

The multi-dimensional distribution function of X is:

$$F(x_1,...,x_j,...,x_m) = P(X_1 \le x_1,...,X_j \le x_j,...,X_m \le x_m). \qquad (25)$$

The *m*-order vector of attributes considered in a multivariate approach to the analysis and measurement of poverty includes economic, social, cultural, family and political attributes represented by continuous and discrete quantitative, and dichotomic and politomic qualitative

variables. Among the m attributes considered in *X*, we could have household income; years of schooling of the household head (*H*) and the spouse (*S*), if present; age, job-status and gender of *H* and *S*; occupation of *H* and *S*; size, ownership and geographical location of household residence; availability of utility services within the home (for example drinkable water; sanitary -bathroom, shower, sewage); ownership of certain household assets, and number of dependants in the household. Once we estimate the multi-dimensional poverty index (MPI), we make

$$MPI = H = F(Z) \Rightarrow Z = F^{-1}(MPI) = F^{-1}(H), \qquad (26)$$

where Z is an imputed poverty line in multi-dimensional poverty analysis, *H* stands for the head-count ratio, (that is, the percentage of households that are poorer than the average MPI), and F(y) stands for the distribution of equivalent income.

2.3.5 Composite indicator of poverty (CIP)-based approaches to multi-dimensional poverty analysis.

2.3.5.1 CIP based on inequality indicies: entropy concepts and shorrocks index

(a) The Shannon's entropy $I_n(y)$ measure

Theil (1967) observes that Shannon's entropy $I_n(y)$ constitutes a natural measure of income equality, taking the maximal value $\log_2 n$ when every unit has the same income. Shannon's entropy is expressed thus:

$$I_n(y) = \sum_{i=1}^{n} y_i \log 2 \frac{1}{y_i} = -\sum_{i=1}^{n} y_i \log 2 y_i \qquad (27)$$

where y represents the *income shares* in a population of n units. When applied to a statistical distribution, the Shannon's entropy is a measure of the degree of uncertainty contained in the distribution, the maximal uncertainty corresponding to the uniform distribution.

The corresponding *inequality* measure is then taken as the difference between the maximal entropy (from a uniform distribution) and $I_n(y)$:

$$\log 2n - {}_n(y) \sum_{i=1}^{n} y_i \log 2 \left(\frac{y_i}{1/n} \right) \qquad (28)$$

Equation 28 is the Rényi information gain or divergence measure $I_1(q||p)$, where we take q = y and p = {1/n}, as the uniform distribution. This is the *Theil's first inequality index*. The pioneering work of Theil on entropy-based inequality indices has generated a search for larger

classes of inequality indices, on the basis of desirable properties defined with respect to redistributions of income in a given population.

(b). The Rényi β-information gain measure and the derived β-entropy.

Closely linked to this entropy measure, to its maximal property and to its concavity, Rényi (1966) derived the concept of divergence between two distributions p and q. The general expression of this Rényi divergence measure, called "information gain" between two distributions q and p, is given as:

$$I_1(q//p) = \sum_{k=1}^{n} q_k \log_2 \frac{q_k}{p_k} \tag{29}$$

Rényi (1966) notes that the concept of divergence between two distributions belongs to information theory rather than a metric as defined mathematically.

(c) The Shorrocks γ-entropy based inequality measure.

$$I_\gamma(y) = \frac{1}{n}\frac{1}{\gamma(\gamma-1)}\sum_{i=1}^{n}\left[\left(\frac{y_i}{1/n}\right)^{\gamma} - 1\right] \quad \text{for } \gamma \neq 0,1$$

$$I_\gamma^1(y) = \sum_{i=1}^{n} y_i \log\left(\frac{y_i}{1/n}\right)$$

$$I_\gamma^0(y) = \sum_{i=1}^{n} i/n \log\left(\frac{i/n}{y_i}\right) \tag{30}$$

Equation 3.2 can also be expressed as:

$$I_\gamma(y) = \frac{1}{\gamma(\gamma-1)}\sum_{i=1}^{n} y_i\left[\left(\frac{y_i}{1/n}\right)^{\gamma-1} - 1\right] \tag{31}$$

Obviously, $I_\gamma^1(y)$ is Theil's first inequality index, and $I_\gamma^0(y)$ is his second inequality index. This γ-class of entropy-based inequality indices is called the class of *Generalized Entropy* indices. This axiomatic development of inequality indices generates a class of divergence measures including, as a particular case, the Rényi's information gain measure I_1(q||p), where the case γ=1 corresponds to I_1(q||p) when p = {1/n}; and the case γ= 0 corresponds to I_1 (q||p)

when q = {1/n}. The γ-class of inequality indices is an *asymmetric* measure of divergence between a distribution y and the uniform distribution p = {1/n}.

The Generalized Entropy index above generates a divergence measure between *any* two distributions x and y if we substitute a distribution x to the uniform distribution {1/n} appearing as the denominator. This is precisely the divergence measure taken by Maasoumi as the distance between the composite indicator we are looking for, C, and any one of the primary indicators I_k, k = 1, K. We thus have

$$D_\gamma(C, I_k) = \frac{1}{\gamma(\gamma-1)} \sum_{i=1}^{n} C_i \left[\left(\frac{C_i}{I_{ik}} \right)^{\gamma-1} - 1 \right] \quad \text{for} \quad \gamma \neq 0,1 \qquad (32)$$

and obtain Theil's first and second measures for γ= 1 and 0, respectively. These indices were expressed directly in terms of income shares instead of using mean income μ, in order to keep more clearly the link with the theory of distributions. Maasoumi (1986) defines the optimal indicator as the C that minimizes a *weighted sum of the pairwise divergences*, that is, the C that minimizes

$$D_\gamma(C, I; \delta) = \sum_{k=1}^{K} \delta_k \left\{ \frac{\sum_{i=1}^{N} C_i \left[\left(\frac{C_i}{I_{ik}} \right)^{\gamma-1} - 1 \right]}{\gamma(\gamma-1)} \right\} \qquad (33)$$

where the δ_k are *arbitrary* weights on the divergence component relative to the indicator I_k, $\sum \delta_k = 1$.

By minimizing the divergence $D_\beta(C, I, \delta)$ for the function *C*, Maasoumi presents the following functional form for the composite indicator:

$$C_i = \left(\sum_{k=1}^{K} \delta_k I_{ik}^{-\gamma} \right)^{-i/\gamma} \qquad \gamma \neq 0, -1 \qquad (34)$$

We recognize here a CES function. For the two specific values γ= 0, −1, the functional forms are

$$C_i = \prod_{k=1}^{K} I_{ik}^{\delta_k}, \quad \text{for} \quad \gamma = 0, \qquad (35)$$

Facts about the entropy inequality indices approach

i). The whole context of entropy inequality indices, including the associated divergence concept, refers to probability distributions, that is, to numerical measures taking values in the interval (0-1). Thus, and as can be seen particularly from the divergence measure generated by the Generalized Entropy Index, the natural domain for real situation application is a set of numerical indicators, quantitative poverty indicators, expressed in terms of "shares," so that the individual value I_{ik} is in the interval (0-1). The money-metric type of poverty indicators, once transformed in individual shares, appears as the domain of validity of a functional form, like equation 35.

ii). There is a parametric problem with the choice of the γ-Generalized Entropy Indices in the Maasoumi composite indicator. A strong point can be made for the values $\gamma = 1$ and $\gamma = 0$ which provide a simple linear (log-linear) form (Asselin, 2002). The parametrization used by Maasoumi for the class is slightly different from Shorrocks's one. Maasoumi's parameter is Shorrocks's -1.

iii). If the weighting approach is maintained for the optimization criterion, obviously there remains the problem of determining the weights δ_k in a non-arbitrary way. There is, however, an optimal system of weights for the functional form β_i, as Maasoumi (1999) has himself observed: the basic factorial method of principal components.

2.3.5.2 CIP based on poverty structure analysis: inertia concepts, factorial approaches

The structural approach to multi-dimensional poverty analysis can be seen as an empirical step to implementing the analysis of interconnections between different freedoms that Sen calls for to assess the effectiveness of development. To a K-dimensional poverty vector is associated a K-dimensional distribution. In some sense, the entropy and Shorocks-based inequality indices approaches look at the marginal distributions of the primary indicators I_k, whereby a kind of distance between these marginal distributions, the divergence measure, serves as a basis for identifying a "mean" distribution which provides the CIP. These concepts represent looking at the multi-dimensional distribution from outside, from an external viewpoint. The poverty structure approach tries to look at the distribution from within, trying to identify the numerous associations between the poverty dimensions determining the global form of the poverty "mass" dispersion. It is a search for a poverty structure, an internal viewpoint. Intuitively, this is what any factorial technique tries to operationalize, relying on the

central concept of inertia, which is, in fact, a measure of the global dispersion of the distribution.

2.3.5.3.1 Principal component analysis (PCA)

Principal Component Analysis consists in building a sequence of uncorrelated (orthogonal) and normalized linear combinations of input variables (K primary indicators), exhausting the whole variability of the set of input variables, named "total variance" and defined as the trace of their covariance matrix, thus the sum of the K variances. These uncorrelated linear combinations, in fact the lines Δ above and their related unitary vectors β, are latent variables called "components." The optimality in the process comes from the fact that the first component looked for has a maximal variance λ_1, the basic idea being to visualize the whole set of data in reduced spaces capturing most of the relevant information. When all possible components have been extracted, the whole variance is explained.

Given that X(N, K) is the data matrix giving the distribution of the K numerical primary poverty indicators, K < N, and W represents the normalized (unitary) K-dimensional vector previously identified as β, and let Σ = X'X be the covariance matrix. The problem of estimating the first component consists in finding a linear combination XW such that W'ΣW is maximal under the constraint W'W = 1. With λ as the Lagrange multiplier, the problem consists in solving the equation:

$$\left(\sum - \lambda_1\right) W = 0 \qquad (36)$$

where *I* is the unit (K,K) matrix. There are different ways of solving equation (36), a frequent one being an iterative method. The vector *W* is called *an Eigen or characteristic vector*, and the value λ *an Eigen or characteristic value*. The line whose support is given by *W* is called a *factorial axis*, and the word "factor" is also taken to be the same as "component." The K elements of *W* are called *"factor-score coefficients."*

All subsequent components α have decreasing variances λ_α whose sum is the total variance of the K indicators, also named the *total inertia* of the distribution of the K indicators. The stepwise reduction process just described corresponds geometrically to a change in the Cartesian axis system (translation and rotation) of the K-dimension euclidean space R^K. It is neutral regarding the orientation of the factorial axis. The whole process relies on analyzing the structure of the covariance matrix of the K initial variables. The first component F_1 is an interesting candidate for the composite indicator of poverty C, but it must satisfy obvious

consistency conditions relative to the signs of the K elements of *W*. C has the following expression for the population unit *i*:

$$C_i = \sum_{k=i}^{k} W^{1,k} I_i^{*k} \qquad (37)$$

The I^{*k} are the standardized primary indicators, that is, the columns of the data matrix X after standardization. The factor score coefficients W^1,k must all be positive (negative) to interpret the first component as a decreasing (increasing) poverty indicator, depending on whether the primary indicators increase (decrease) when people become wealthier. At the end of the process, it comes out that the $W^{\alpha, k}$ are in fact the usual multiple regression coefficients between the component F_α and the standardized primary indicators. Built this way, the first component can be described *as the best regressed latent variable on the K primary poverty indicators* of which no other explained variable is more informative.

2.3.5.3.2 Factorial analysis (FA)

Factor analysis (FA) is the reverse way of exploring multi-dimensionality. It tries to identify *K linear combinations of m < K latent (non-observable) variables*, called *factors or communalities*, able to predict the K observed indicators with as small an error as possible. More precisely, the predictive model to be estimated is:

$$I = \Lambda f + U \qquad (38)$$

where *I* is the vector of the K primary indicators, Λ is a (K,m)-matrix of *factor loadings*, f is an m-component vector of non-observable factor scores and *U* is a K-vector of error. A difficult decision has to be made on the number m of factors to retain in the model. Different estimation techniques can be used, including a principal component approach. Clearly, this modelling factorial technique does not respond directly to our research objective to get a CIP. But the m latent factors can, in fact, be expressed as linear combinations of the K primary indicators (Sahn and Stifel, 2003) linking factor-score coefficients and factor loadings:

$$W = \sum^{-1} \Lambda \qquad (39)$$

where *W* is the (K,m) matrix of the *factor-score coefficients*, as defined above with PCA, and Σ^{-1} is the inverse covariance matrix of the K primary indicators. Once the matrix W is obtained through equation 3.15, as in PCA, the first factor is an interesting candidate for a CIP, again if consistency conditions hold with the first factor-score coefficients. This is actually the way

Sahn and Stifel (2003) proceeded to build a household asset index from data sets provided by the Demographic and Health Surveys (DHS), taking m = 1 in the model, that is, only one factor. In carrying out PCA, multi-collinearity is not a problem because there is no need to invert a matrix. For most forms of FA and for estimation of factor scores in any form of FA, singularity or extreme multi-collinearity has been identified as a major constraint (Sahn and Stifel, 2003)". However, apart from being theoretically developed for numerical variables for the objective of defining a CIP, both PCA and FA approaches appear to be full of unnecessary technical difficulties.

2.3.5.3.3 The fuzzy subset approach

A highly efficient and rigorous method to operationalize a multivariate analysis of poverty, including social exclusion and Sen's capability approaches, makes use of the fuzzy set theory. It claims to arrive at a poverty index as a function of the *m* attributes included in *X*. Cerioli and Zani (1990) applied fuzzy set theory to estimate the poverty in the Province of Parma (Italy). Dagum (1992), Martinetti (1994), Cheli and Lemmi (1995) among others, made further contributions and applications. The fuzzy set theory allows one to: (a) measure each household relative level of poverty or deprivation; (b) estimate the average poverty index of the population of households; and (c) measure the relative deprivation and poverty corresponding to each component or attribute included in *X*. The latter index is of a paramount importance for its policy implications. It identifies the most important variables or dimensions of poverty that need to be addressed to achieve a structural reduction of poverty, that is, to implement a structural socioeconomic policy purporting to target institutional, behavioural, technological and social structural changes with the scope of generating dynamic economic processes of growth and development with less social exclusion, decreasing absolute and relative levels of poverty, and more equity.

The classical application of the fuzzy set theory is based on the fact that we can observe characteristic dichotomization for the elements concerned, such that if an element possesses certain observed characteristics, it is assumed to be a member of the fuzzy set A, and to the compliment of A if otherwise. Given a certain set X, the fuzzy subset A can be represented by all the possible ordered pairs [x, f_A (x)], where x $\in$ X and f_A (x) is a function that assumes values in the interval [0,1], indicating the degree of membership of x to the fuzzy subset A precisely:

f_A (x) = 0 indicates that the element x does not belong to A;

$f_A(x) = 1$indicates that x belong completely to A;

$0 < f_A(x) > 1$ indicates that x belongs partially to A, the degree of membership increasing in relation to the proximity of $f_A(x)$ to 1.

Following Cheli and Lemmi (1995) and based on the approach proposed by Desai and Shah (1988), the Totally Fuzzy and Relative (TFR) method adopts the following specification of the deprivation measure according to a generic poverty indicator X:

$$g(x_i) = \{H(x_i)\} \quad \text{if the degree of poverty grows as X increases}$$

$$\text{and} \quad 1 - H(x_i) \quad \text{otherwise} \qquad (40)$$

where $H(\,)$ represents the observation distribution function of X and subscript I refers to the i-th household. According to the fuzzy sets theory $g(x_i)$ can be interpreted as membership function (m.f.) in the fuzzy subset of the poor calculated for the i-th household. However, when the X variable is ordinal and the frequency associated with one of the extreme categories is rather high, one should adopt a normalized version of the previous specification given by:

$$g(x_i) = 0 \qquad \text{if } x_i = x_{(1)}$$

$$\text{and} \quad g(x_{(k-1)}) + 1\frac{H(x_{(k)}) - H(x_{(k-1)})}{1 - H(x_{(1)})} \qquad \text{if } x_i = x \quad (k>1) \qquad (41)$$

where $x_{(1)}, \ldots\ldots, x_{(m)}$ represent the categories of X sorted in increasing order with respect to the risk of poverty. With some simple manipulations, however, the preceding formula is written as:

$$g(x_i) = \frac{H(x_k) - h(x_1)}{1 - h(x_1)}, \qquad \text{for } x_i = x_k, \quad k = 1,\ldots,m \qquad (42)$$

where functions $h(\,)$ associates any category of X to the corresponding relative frequency.

In this way, $g(\,)$ always takes value 0 in correspondence to the lowest category of X (lowest risk of poverty) and 1 in correspondence to the highest one. For intermediate categories g( ) takes values between 0 and 1 that are not influenced by the extreme categories and depends on the empirical distributions of X. For monetary variables, such as income or consumption that may be treated as continuous are concerned, later contributions (Cheli, 1995; Lemmi *et al*., 1997) make use of a modified version of the membership function specified as:

$$g(x) = [1 - H(x_i)]^{\alpha} \qquad (43)$$

where the exponent α determines the relative weight of the less poor with respect to the poor. The α values can be determined in order to make g(x) equal to the Head Count Ratio of the

poor according to a given poverty line. By this, it is possible to compare the results of the fuzzy analysis to those obtained using the traditional method of analysis. In practice, $g(x_i)$ represents an individual index of deprivation specific for items *X*.

Filippone *et al*. (2001) adopted an alternative specification of the fuzzy subset of the poor, which was reputed as possessing desirable features of overcoming the problem of interpretation posed by the original specification above. Denoting the sorted categories (or values) of variable X by $x_1,\ldots,x_m$, the sample distribution function can be defined as:

$$\tilde{H}(x_i) = 0.5h(x_1) \qquad \text{if } x_i = x_1$$

$$\text{and} \quad = H(x_{(k-1)}) + 0.5h(x_k) \qquad \text{if } x_i = x_k \ (k>1) \qquad (44)$$

Extending (v) to the case relating to the comparability of binary (or distinct) and non-binary (continuous) attributes, it becomes:

$$\tilde{H}(x_i) = H(x_{(k-1)}) + 0.5h(x_i) \quad \text{for } x_{(k-1)} < x_i \le x_k, i = 1,\ldots,n \qquad (45)$$

where, conventionally, $H(x_0) = 0$ and $h(x) = 0$ when $x \notin \{x_1,\ldots,x_m\}$ and where $m \le n$, being $m \equiv n$ only when all the values assumed by X in the sample differ from one another. $h(x_i)$ represents the relative frequency of x_i.

The membership function (m.f) in the fuzzy subset of the poor is stated as:

$$g(x_i) = \tilde{H}(x_i) \qquad \text{if deprivation grows as } x \text{ increases}$$

$$\text{and } 1 - \tilde{H}(x_i) \qquad \text{otherwise.} \qquad (46)$$

Filippone *et al*. (2001) observe that, with the alternative specification, half of the units (for which $X = x_i$) is considered less deprived and the remaining half is considered more deprived than the *i-th* one, whereas the original formulation considers everyone as being more deprived. The TFR index thus generated is relatively lower than what obtains in the case of the original specification, and is more suitable for aggregation when the global deprivation index is composed of binary and continuous variables. Such a difference is only profound in the case of binary or ordinal variable with a small number *m* of categories, but tends to disappear as m diverges. The two specifications however coincides when X is continuous.

For binary indicators (in the specific case where poverty symptom is just either present or absent, the membership function is given as:

$$g(x_{ij}) = \frac{1}{2}h(x_{j(1)}) = \frac{1-p_j}{2} \qquad \text{if } x_{ij} = x_{j(1)}$$

and $h(x_{j(1)}) + \frac{1}{2} h(x_{j(2)}) = 1 - \frac{1}{2} p_j$ if $x_{ij} = x_{j(2)}$ (47)

where $x_{j(1)}$ and $x_{j(2)}$ represent the categories of X_j that correspond respectively to absence and presence of the poverty symptom to which X_j refers; p_j stands for the (crisp, that is, non fuzzy) proportion of households that manifest the *j-th* poverty symptom (i.e. $X_j = x_{j(2)}$ in the referenced population. Binary indicators are generally grouped so as to give a joint representation of a certain aspect of living condition. The Total Fuzzy and Relative (TFR) index approach to multi-dimensional poverty analysis allows for the operationalization of the determination of individual household's measure of deprivation and collective effect of welfare indicators on the multi-dimensional poverty profile of a given population.

Practically, g(x_i) represents an individual index of deprivation specific for items *X*. A collective index *(P)* specific for *X* could be defined as the arithmetic mean of the $g(x_i)$ memberships in the population, as given by:

$$P = \frac{1}{n} \sum_{i=1}^{n} g(x_i) = \sum_{k=1}^{m} h(x_k).g(x) \quad (48)$$

However, when the membership function (m.f) is specified, the collective index (*P*) is given as:

$$P = \bar{g}(x) = \frac{1}{2} \quad (49)$$

(following Filippone *et al.*, 2001). In the case where X is a continuous variable (e.g income or consumption), a theoretical model is adopted in place of the sample distribution of X, and the TFR index is calculated as:

$$P = \bar{g}(x) = 1 - \frac{1}{n} \sum_{i=1}^{n} H(x_i; \hat{\theta}) \quad (50)$$

Since for any continuous variable x it holds that $H(x) \approx U[0,1]$, it follows that $P = E[H(x)] = 0.5$, which is only theoretical. In practice, P takes on a value close to 0.5 in the entire sample, which represents its expected value. P expresses the relative social position of the "average" household in the population analyzed, based on indicator X. For the purpose of determining the collective effect of identified welfare indicators on the multi-dimensional poverty profile of rural and urban households, there is the need for aggregating the different aspect of poverty. The TFR index derive from this multi-dimensional approach to poverty index where the different aspects of the overall poverty situation can be fussed together and

measured by a single index. To achieve this, we compute the *k* membership functions (m.fs) $g_1(x_{i1}),...,g_k(x_{ik})$ relative to the *k* corresponding poverty indicators for the *i-th* household. Then, we aggregate them to obtain an overall membership function which takes into account all the information jointly provided by the *k* items. Such a global m.f is weighted average of the specific membership functions, and is given as:

$$f(x_i) = f(x_{i1},..,x_{ik}) = \frac{\sum_{j=1}^{K} w_j . g_j(x_{ij})}{\sum_{j=1}^{K} w_j}, \text{ where } w_j = w(P_j) = w\left(\frac{1}{n}\sum_{i=1}^{n} g_j(x_{ij})\right) \quad (51)$$

This is a measure of the *individual household's measure of global deprivation.*

The *collective index of global deprivation* is the average of the individual measure over the entire population, given as:

$$P = \frac{1}{n}\sum_{i=1}^{n} f(x_i) = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{\sum_{j=1}^{K} w_j . g_j(x_{ij})}{\sum_{j=1}^{K} w_j}\right) = \frac{\sum_{j=1}^{K} w_j . \left(\frac{1}{n}\sum_{i=1}^{n} g_j(x_{ij})\right)}{\sum_{j=1}^{K} w_j} = \frac{\sum_{j-1}^{K} w_j P_j}{\sum_{j=1}^{K} w_j} \quad (52)$$

where each weight w_j is a decreasing function of P_j. n is the total number of households in the population sample.

Decomposition of multi-dimensional welfare deprivation indices among various demographic and socio-economic groups in a given population focuses on the measurement of multi-dimensional poverty index with reference to the entire population (totality of sampled households in Southwestern Nigeria as highlighted in section 3.3), as well as the various sub-groups (demographic and socio-economic). Chakravarty *et al.*, (1998) developed a desired property that enabled the determination of multi-dimensional poverty measures' sensitivity to the welfare levels of different segments (or sub-groups) of the population with homogenous characteristics, such as geo-political zones (demographic) as well as age, gender, sex, occupation, among other socio-economic attributes. The intensity of the *i-th* household poverty is:

$$g(x_i^k) = \frac{\sum_{j=1}^{m} w_j g(x_i^k)}{\sum_{j=1}^{m} w_j} \quad (53)$$

assuming that the entire population is divided into K groups of Q_k, each with size n_k (k ranging from 1 to K). The overall poverty index computed as a weighted average of the within-group poverty index, is given as:

$$g\left(x_i^{nk}\right)=\frac{\sum_{k=1}^{k}\sum_{j=1}^{nk}w_j g\left(x_i^k\right)}{\sum_{j=1}^{nk}w_j} \tag{54}$$

whereas, the multi-dimensional poverty index associated with the sub-group Q_k contribution to the global poverty index is given as:

$$g\left(x_i^{nk}\right)=\frac{\sum_{j=1}^{nk}w_j g\left(x_i^k\right)}{\sum_{j=1}^{nk}w_j} \tag{55}$$

Denoting by P_j^A the proportion of households that manifest the j-th poverty symptom in sub-group A and by P_j^B those in homogenous sub-group B, the TFR index for sub-group B with reference to A is given as:

$$P_j^{B/A}=\left(1-p_j^B\right)g\left(x_{j1}\right)+P_j^B.g\left(x_{j2}\right)=\frac{1}{2}\left(p_j^B-p_j^A+1\right) \tag{56}$$

which appears to be the function of the difference between the proportions of those who manifest the symptom of poverty in the two referenced demographic/socio-economic sub-groups, noting that $P_j^{A/A}=\frac{1}{2}$. Important implications from the basic fussy approach are that: (i) it is immediately applicable to categorical ordinal indicators; (ii) an important preliminary step before aggregation consists in a numerical rescaling of each primary indicator, based on marginal distributions; and (iii) indicator weights are defined *a priori* from the marginal distributions allowing for greater importance given to less frequent deprivations.

In the foregoing discussion, we have done an overview of methodological approaches for defining a composite indicator of poverty. The preferred methodological choice for the purpose of this research work is the factorial approach (essentially the multiple correspondence analysis, discussed under section 2.3.7), since it seems *a priori* more promising, with its internal viewpoint, to better articulate the understanding of multi-dimensionality, while offering, at first sight, an interesting proposal for a composite indicator.

2.3.6 Welfare approaches to poverty analysis

Generalization of the FGT monetary approach to the Alkire-Foster (AF) non-monetary multi-dimensional counting approach

The *utilitarian approach* places the conceptualization of welfare in the utility space whose satisfaction determines the level of welfare. However, since satisfaction is not directly observable, resources (that is, income or expenditure) has been used as a proxy for welfare. The utilitarian approach thus arises out of an essentially uni-dimensional welfare concept which has simply been reduced to lack of financial resources necessary for attaining a minimum standard of living. Applied to economic policy, poverty reduction is achieved by increasing labour productivity, through recommended arrays of economic interventions. This traditional approach to identifying the poor makes use of an income cutoff called poverty line, *Z*, and evaluates if the income of an individual or a household achieves this level.

Aggregation entails the choice of a poverty index, or measure, to determine the poverty status of the individual or household. The simplest and most widely used measure is the *headcount ratio*, $H = \frac{q}{n}$, where *q* is the number of poor persons (or households) and *n* is the population size. *H* = 1 for poor persons or households, and 0 otherwise. Invariably, *H* is the percentage of the population that is poor. The second measure, the (per capita) *poverty gap index* (PGI), identifies the aggregate by which the poor person falls below the poverty line, measured in poverty line units and averaged across the population. It measures the severity of poverty among the poor since it is sensitive to income decrement or transfer among the poor and registers an increase when the shortfall of a poor person rises.

The PGI assigns to the poor persons the *normalized shortfall* (the difference between their income, X_i, and the poverty line, *Z*, divided by the poverty line) before taking the population average. Thus, three poverty gap indices are identified, namely: the total poverty gap, $TPG = \sum_{i=1}^{H}(Z - X_i)$ (57); the average poverty gap, $APG = \frac{TPG}{H}$ (58); and the normalized poverty gap, $NPG = \frac{APG}{Z}$ (59). The third method of aggregation, suggested by Foster, Greer and Thorbecke (1984) transforms the normalized shortfall of the poor by raising them to a non-negative power α to obtain the associated P_α or FGT measure, denoted

by $P_\alpha = \frac{1}{n}\sum_{i=1}^{H}\left[\frac{Z - X_i}{Z}\right]^\alpha$ (60), where P_o , P_1, and P_2 represent the headcount ratio, the poverty gap measure and the FGT index, respectively. On the other hand, the *non-monetary approach* places welfare in the freedom and accomplishment framework, making a distinction between the capacities and basic needs approaches. While the capacities approach emphasizes the concept of 'functionings' with the argument that the individual or household must be adequately functioning – having enough food, health care, be free from fear of threats, be socially integrated – the basic need approach fundamentally adds to these variables other socially conceivable variables, such as access to basic social amenities/services including water, energy, housing, education, and infrastructures, among others. In terms of economic policy, the non-monetary approach usually recommends targeted interventions in favour of the poor within the society relative to the general forms of interventions.

It has often been recognized that poverty measurement based on a single attribute, such as income or wealth, is inadequate. An alternative basic needs approach contends that individual well-being and social welfare depend on the distribution of not only income or wealth, but also of other attributes, such as health, longevity and literacy. However, markets for all basic needs do not always exist. Hence an "equivalent income" does not necessarily reflect the true level of individual well-being. In contrast, multi-dimensional welfare analysis can often provide a more complete view on the overall social welfare. Since direct comparison of multivariate distributions is inherently difficult due to the course of dimensionality, poverty index of multi-dimensional distribution has often been used instead. The studies of Duclos and Gregoire (2003) and Bourguignon and Chakravarty (2003) are pointers to the various approaches for constructing multivariate poverty index.

A methodology, *M*, for analysing multi-dimensional household poverty and deprivation using the Alkire-Foster (A-F) *counting approach* comprises two basic issues: identification and aggregation. Regarding each welfare indicator, the former determines the specific cutoff or minimum basic requirements; the latter addresses the construction of poverty index given the overall multi-dimensional poverty cutoff. In identifying the poor households within a population, two criteria are used. The first is the *union* criterion, where a household is adjudged to be multi-dimensionally poor as long as there is at least one dimension in which it is deprived ($\rho(y_i; z)$ = 1 if and only if $c_i \geq 1$). The second is the *intersection* criterion, that adjudges a household to be poor only if the household is poor in all dimensions ($\rho(y_i; z)$ = 1 if and only if $c_i = d$). The alternative is the intermediate (dual) cutoff level, where c_i lies somewhere

between the two extremes of 1 and *d*. For $k = 1,...,d,$ take ρ_k as the identification method defined by $\rho_k(y_i;z) = 1$ whenever $c_i \geq k,$ and $\rho_k(y_i;z) = 0$ whenever $c_i < k$ (that is, ρ_k adjudges household *i* as being poor when the number of dimensions in which *i* is deprived is at least k; otherwise, if the number of deprived dimensions falls below the cutoff *k*, then household *i* is not poor according to ρ_k. ρ_k is dependent on both the within dimension cutoff z_j and the across dimension cutoff *k*, and it includes both the union and intersection criteria as special cases where *k* = 1 and k = d.

Considering the dimension-adjusted multi-dimensional poverty measure that uses the ρ_k identification method and its associated set $Z_k = \{1 : \rho_k(y_i;z) = 1\}$ of poor households, while including some notations that censor the data of non-poor households. Let $g^0(k)$ be the matrix obtained from g^0 by replacing the *i*th column with a vector of zeros whenever $\rho_k(y_i;z) = 0,$ and $g^\alpha(k)$ be defined as the analogy for $\alpha > 0$. The typical elements of $g^\alpha(k)$ is, thus, given by $g_{ij}^\alpha(k) = g_{ij}^\alpha$ for *i* satisfying $c_i \geq k$, while $g_{ij}^\alpha = 0$ for *i* with $c_i < k$. The number of non-zero entries in the matrix $g^\beta(k)$ falls as the cutoff *k* rises from 1 to *d*, reflecting the progressive censoring of data from persons or households who are not multi-dimensionally poor according to ρ_k. The union specification $k = 1$ does not alter the original matrix, thus $g^\alpha(1) = g^\alpha$, while the intersection specification $k = d$ removes the data of persons or households not deprived in all *d* dimensions. Thus, with $g^\alpha(d)$, a person or household deprived in a single dimension is not distinguished from that deprived in $d-1$ dimension. With $k = 2,...,d-1,$ the dual cutoff approach provides an intermediate option between the union and intersection methods, as shown in the matrix $g^\alpha(k)$.

Given an identification function $\rho(y_i;z)$ of the individual household's deprivation vector y_i and the cutoff vector z taking on two values: $\rho(y_i;z)$ = 1 if household *i* is poor, and $\rho(y_i;z)$ = 0 if otherwise. Applying ρ to individual household deprivation vector (of welfare indicators) expressed in *y* yields the set of $Z \subseteq \{1,...,n\}$ of households who are poor in *y* given *z*. For any given *y*, let $g^0 = \lfloor g_{ij}^0 \rfloor$ denote the 0-1 matrix of deprivations associated with *y*, whose typical element g_{ij}^0 is defined by g_{ij}^0 = 1 when $y_{ij} < z_j$, and g_{ij}^0 = 0 otherwise. The variable g^0 is an $n \times d$ matrix whose ij^{th} entry is 1 when household *i* is deprived in the j^{th} dimension, and 0

otherwise. The i^{th} row vector of g^0, denoted by g_i^0, is the household *i*'s *deprivation vector.* From the g^0 a column vector *c* of *deprivation counts* is then constructed whose i^{th} entry $c_i = \left| g_i^0 \right|$ is the *sum of weighted deprivations suffered by household i.* The vector *c* is instrumental to the identification of the welfare dimensions in which the poor households are deprived and the determination of the incidence of deprivation among the sampled households.

As a measure, the multi-dimensional poverty index (MPI) has the mathematical structure of one member of a family of multi-dimensional poverty measures proposed by Alkire and Foster (2007, 2009). This member of that family is called M_0 or Adjusted Headcount Ratio. M_0 is the appropriate measure to be used whenever one or more of the dimensions to be considered are of ordinal nature, meaning that their values have no cardinal meaning. For convenience, we refer to the measure in this study as M_0. The MPI is the M_0 measure with a particular collection of dimensions, indicators and weights, which are expressed in such a way that the true multi-dimensional poverty structure of a statistical unit (individuals, households, regions or countries) is easily analyzed. M_0 measures poverty in *d* dimensions across individuals or households within the population unit, *n*.

Let $y = \lfloor y_{ij} \rfloor$ denote the *n* x *d* matrix of achievements for *i* persons across *j* dimensions. The typical entry in the achievement $y_{ij} \geq 0$ represents individual *i*'s achievement in dimension *j*. Each row vector $y_i = (y_{i1}, y_{i2}, ..., y_{id})$ gives individual *i*'s achievements in the different dimensions, while each column vector $y_{.j} = (y_{1j}, y_{2j}, ..., y_{nj})$ gives the distribution of achievements in dimension *j* across individuals or households. M_0 allows weighting each dimension differently. This is the procedure followed by the MPI, which has 'nested weights'. For that purpose, we define a weighting vector *w*. The element w_j represents the weight that is applied to dimension *j*, while the condition must hold that $\sum_{j=1}^{d} w_j = d$, that is, the dimensional weights sum to the total number of dimensions.

To identify who is poor among the population, a two-step procedure is applied using two different kinds of cutoffs. First, we identify all individuals who are deprived in any dimension. Let $z_j > 0$ be the poverty line (or deprivation cutoff) in dimension *j*, and *z* be the vector of poverty lines for each of the dimensions of multi-dimensional poverty. Define a matrix of deprivations $g^0 = \lfloor g_{ij}^0 \rfloor$, whose typical element g_{ij}^0 is defined by $g_{ij}^0 = w_j$ when $y_{ij} < z_j$, and $g_{ij}^0 = 0$ when $y_{ij} \geq z_j$. That is, the ij^{th} entry of the matrix is equivalent to

the dimensional weight w_j when person *i* is deprived in dimension *j*, and is zero when the person is not deprived. From the matrix *g*0 we construct a column vector *c* of *deprivation counts*, whose i^{th} entry $c_i = \sum_{j=i}^{d} g_{ij}^{0}$ represents the sum of weighted deprivations suffered by person or household i. The counting approach renders the measure unable to discriminate between different sources of deprivation since it is only the number of deprivations and not the dimension from which deprivation comes from that count towards the score. Second, we need to identify who is to be considered multi-dimensionally poor. To do so, we select a second cutoff *k >0* and apply it across this column vector *c*. More formally, let $\rho : R_{\oplus}^{d} \times R_{\oplus\oplus}^{d} \rightarrow \{0,1\}$, ρ_k be the *identification function* that maps from person *i´*s achievement vector $y_i \in R_{\oplus}^{d}$ and cutoff vector *z* in $R_{\oplus\oplus}^{d}$ onto an indicator variable. ρ_k takes the value of 1 when $c_i \geq k$, and $\rho_k(y_i, z) = 0$ when $c_i < k$. That means that a person is identified as poor if his weighted deprivation count is greater than or equal to *k*. This is called a *dual cutoff* method, because it uses the *within dimension* cutoffs *j z* to determine whether a person is deprived or not in each dimension, and the *cross-dimensional* cutoff *k* to determine who is to be considered poor.

2.3.7 Procedures for rescaling (reducing) the indicators of multi-dimensional poverty

Rescaling the indicators of multi-dimensional poverty was based on the multivariate inertia statistical approach which aims at defining a composite indicator for each given population unit (that is, each coastal household), using the most adapted tools – the Multiple Correspondence Analysis (MCA) – which provides the descriptive tools for the hidden poverty structure in a set of categorical variables (Benach *et al.,* 2003) as against the Principal Component Analysis (PCA) adopted by Tello *et al.* (2005); and Curtis *et al.* (2006). Two major limitations of the PCA factorial technique were accommodated in the MCA. The first is the suitability of the former only for a set of quantitative variables measured in the same units, the optimal sampling properties for parameter estimation depending upon the multivariate normal distribution and not any more exist with categorical variables. The second is the operationalization of the composite indicator, for population units not involved in the sample used for estimation, which is not very appealing since weights are applicable to *standardized* primary indicators. The most important technical difference between PCA and MCA is the use of the χ^2 (chi-square) metric, instead of the usual Euclidean metric used in PCA to measure distances between two lines (households) or two columns (poverty indicators) of the data

matrix being analyzed. The χ^2 metric is directly linked to the statistics used in very old statistical tests like the Pearson χ^2-test of the theoretical distribution of a given empirical distribution and the Pearson χ^2-test of the independence of two categorical variables presented in a two-way frequency table.

The MCA procedures assume a system of *K* primary indicators which are categorical ordinals, the indicator *I*k having *Jk* categories. This general setting is applicable to any mix of quantitative and categorical poverty indicators, since a quantitative variable can always be expressed in terms of a finite number of categories. Associating with each primary indicator *I*k the set of *Jk* binary variable 0/1, each corresponding to a category of the indicator, the following notations are notable:

1. *X* (N,J): the matrix of N observations on the *K* indicators decomposed into *Jk* binary variables, where $J = \sum_{k=1}^{K} J_k$ is the total number of categories. *X* is named the *indicatrix matrix*.

2. *Nj*: the absolute frequency of category j, i.e., the sum of column *j* of *X*;

3. *N′*: the sum of the elements of matrix *X*, i.e., $N \times K$;

4. $f_j = \frac{N_j}{N'}$: the relative frequency of category $f_j^i = \frac{X(i,j)}{X(i)}$, where $X(i)$ is the sum of line i of the matrix *X*. The set $f_j^i \left\{ f_j^i, j = 1, J \right\}$ is named the profile of observation *i*.

The χ^2 metric is a special case of the Mahalanobi's metric developed in the 1930s and used in the Generalized Canonical analysis. It takes here the following form, for the distance between two observed profiles *i* and *i′* in the R^J space:

$$d^2\left(f_j^i\right) = \sum_{j=i}^{J} \frac{1}{f_j} \left(f_j^i - f_j^{i'}\right)^2 \qquad (61)$$

The only difference with the Euclidean metric lies in the term $\left(\frac{1}{f_j}\right)$, by which low-frequency categories receive a higher weight in the computation of distance.

Consequent upon the use of the χ2 metric, the difference between MCA and PCA shows up particularly in three relevant properties which seem highly relevant for the poverty meaning of

the numerical results: the distributional equivalence property; the marginalization preference property; and the duality property.

The distributional equivalence property means that the distance between two lines (individuals or households) of the profile matrix remains invariant if two identical columns (poverty variables) are merged, or if we add to the data matrix a column identical to another one. Concretely, it means that the factorial analysis run with the χ^2 metric, as obtained with the MCA, is quite robust (stable and invariant) to the way a set of categorical variables, such as poverty indicators, is built. Symmetrically, this property allows for easy extension of a set of indicators with closely correlated additional indicators and (or) adjusting categories within the same indicator while keeping invariant the distance between columns. PCA, with the Euclidean metric, is sensitive to such transformations.

Owing to the *marginalization preference property*, the factorial scores produced by the MCA attributes greater weight the smaller categories within each primary indicator. This is expressed as:

where: $W_{jk}^{\alpha,k} = \frac{N}{N_{jk}^{N}} Covariance\left(F_{\alpha}^{*}, I_{jk}^{k}\right)$ (62)

$W_{jk}^{\alpha,k}$ = the score of category jk on the factorial axis α (non-normalised)

I_{jk}^{k} = the binary variable 0/1 taking the value 1 when the population unit has the category jk.

F_{α}^{*} = the normalized score on the factorial axis α

I_{α}^{i} = the frequency of the category jk of indicator k

For binomial indicators, the marginal category will receive a higher weight, since the covariance is the same for both categories. Thus, in a socially marginalized society, where a minority group within the population is characterized by a poverty category *jk*, this category will receive more weight in the computation of a composite indicator of poverty (as the case is

with the fussy subset approach). If the factorial (regression) weights express a social order in poverty reduction, then these highly weighted poverty attributes reflect a priority rating in the sequence of poverty reduction.

The duality property provides the theoretical basis for allowing the simultaneous representation, in the same factorial plane, of the lines (individuals or households), often aggregated in socioeconomic groups, and of the columns (poverty attributes). This simultaneous representation of the MCA is a powerful tool for the identification of poverty determinants associated with poverty types. In fact, this property, much more than the distributional equivalence one, is the main advantage of MCA for applying factorial concepts and methods to multi-dimensional poverty analysis. The way it is defined, MCA can be applied on the indicatrix-matrix either to the row-profiles (observations) or to the column-profiles (categories), so that it has the following remarkable and unique duality property:

$$F_{\alpha}^{i} = \frac{\sum_{k=i}^{k}\sum_{jk=1}^{Jk}\frac{W_{jk}^{\alpha,k}}{\sqrt{\lambda_{\alpha}}}I_{i,jk}^{k}}{K} \qquad (63)$$

Where:

K = number of categorical indicators

Jk = number of categories for indicator k

$W_{jk}^{\alpha,k}$ = the score of category jk on the factorial axis α (non – normalised)

$I_{i,jk}^{k}$ = the binary variable 0/1 taking the value 1 when the unit i has the category jk.

F_{α}^{i} = the score (non-normalized) of observation i on the factorial axis α.

Equation 63 claims that the composite poverty score of a population unit is the simple average of the factorial weights (standardized) of the K poverty categories to which it belongs.

By the additive reciprocation,

$$W_{jk}^{\alpha,k} = \frac{\sum_{i=1}^{N_{jk}} \frac{F_\alpha^i}{\sqrt{\lambda_\alpha}}}{N_{jk}^k} \qquad (64)$$

if the composite indicator of poverty $C_i = F_1^i$. Then the duality relationships (64) stipulates that the weight of a given poverty category is the simple average of the composite poverty scores (standardized) of the population units belonging to the corresponding poverty group. With the simultaneous graphical representation of population units and poverty attributes, MCA appears as an analytic tool particularly efficient for the study of multi-dimensional poverty represented in a set of categorical ordinal indicators. It must also be observed that, by breaking down each indicator I_k in as many variables, J_k, as there are categories, MCA allows for *non-linearity* in the categorical weights, contrary to a PCA which would be run on a numerical coding 1 to *Jk* of the indicator *Ik*, as some researchers could be tempted to do.

The CIP functional form is defined as follows: Given *i* as the index of a given household, and C_i its CIP value of the functional form (following Benach *et al.*, 2003):

$$C_i = \frac{\sum_{k=1}^{K} \sum_{jk=1}^{J_k} W_{jk}^{Ik} I_{jk}^k}{K} \qquad (65)$$

where K = number of indicator categories; J_k = number of indicator k categories; W_{jk}^k = the category-weight (standardized score on the first axis, $\frac{score}{\sqrt{\lambda_1}}$) of category *jk*; λ_1 being the first eigenvalue; I_{jk}^k = the binary variable 0/1, which takes on the value of 1 when the unit has category j_k.

The weights given by MCA correspond to the standardized scores on the first factorial axis. The CIP value for any household *m* simply corresponds to the mean of standardized scores of categorical variables. The weight of a category is the mean of standardized scores of population units belonging to that category. With all the variable categories transformed into binary indicators coded as 0 or 1, giving a total of *P* binary indicators, the CIP for a given household *i*, was then expressed as:

$$ICP_i = \frac{1}{K}\left(W_1 I_{i1} + W_2 I_{i2} + \ldots + W_P I_{iP}\right) \qquad (66)$$

Wp = the weight (score of the first standardized axis, $\frac{score}{\sqrt{\lambda_1}}$) of category p; λ_1 being the first Eigen value; and *Ip, p =1 à p:* binary indicator 0/1, which takes on the value of 1 when the household possesses category *p*, and 0 otherwise.

MCA provides the basic elements for selecting the variables used in constructing the composite indicators of multi-dimensional poverty (CIP), the main criterion being the first axis ordinal consistency (FAOC) on the Factorial Axis which generally expresses a welfare state. This property is a necessary condition for the CIP to effect an ordering of households in the order of their level of welfare. For a given primary indicator, it ensures that the latter's ordinal welfare structure is respected by the ordinal structure of the coordinates (scores) of its modalities on the first axis. Other second order criteria deal with discrimination measures, the spreading over on the first axis, and the high frequency of non-responses or the very low frequencies of some of the modalities.

From equation (66) above, the axiomatic requirements for generating a relevant composite indicator of multi-dimensional poverty can be largely simplified with a two-step approach. The first step deals with provisions for computing the composite indicator of poverty, while the second step is concerned with the computation of aggregated poverty indices. The first step of constructing a composite indicator *C* from *K* ordinal categorical indicators I_k requires that the composite indicator of poverty must be monotonically increasing in each of the primary indicators I_k, meaning that if household i improves its situation for a given primary indicator I_k, then its composite poverty value C_i increases: that is, its poverty level would decrease. This monotonicity axiom translates into:

i) The *First Axis Ordering Consistency (FAOC-I)* requirement for an indicator I_k , with the provision that for an indicator I_k for which the ordering relation between categories is noted $<_k$, the ordering relation $<_w$ of the weights W_{jk}^k must be equivalent to either $<_k$ or to $>_k$.

ii) The *Global First Axis Ordering Consistency (FAOC-G)* with the provision that for all indicators I_k, the FAOC-I condition is fulfilled with

the same orientation: the ordering relation $<_w$ is equivalent to either $<_k$ for all indicators or to $>_k$ for all.

If and only if the monotonicity axiom is satisfied can $C = F_1$ be taken as a composite indicator of poverty, after eventually changing the sign of F_1 when $<_w$ is equivalent to $>_k$ for all indicators. But then the reciprocal bi-addivity property of MCA gives a very interesting consistency result for C_i. Due to equation 66, which implies that the weight of an indicator category, W_{jk}^{k} , is given by the average composite poverty score of the population group of size N_{jk} having the category (attribute) j_k, the following property of C therefore holds:

iii) The *Composite Poverty Ordering Consistency* (CPOC) with the provision that with $C = F_1$ satisfying the monotonicity axiom for a given indicator I_k, if a household P_{j1} has a category j_1 of I_k which is inferior to the category j_2 possessed by household P_{j2}, then household P_{j1} is also poorer than household P_{j2} relative to the composite poverty.

This simply indicates that the population ordering for a primary indicator I_k is preserved with the composite indicator, which is a remarkable consistency property specific to MCA, owing to the dual structure of its analysis. Because of the duality relationship emphasized in equation (65), the categorical weight $W_{jk}^{Ik} I_{jk}^{k}$ appearing in the CIP equation (63) is defined as the average multi-dimensional poverty level of the group of individuals or households having the category j_k of the primary indicator I_k. However, the numerical value of $W_{jk}^{*1,k}$, either negative or positive (the average is zero) is irrelevant inasmuch as the numerical scaling of I_k remains unchanged relative to the distances between categories. Developing this idea, it is possible to improve the meaning of the categorical weights by rescaling I_k with the gap between the worst-off individuals or household, $j_k = 1$, and any better-off group, $j_k = 1$. The indicator I_k is therefore rescaled on the factorial axis α, here supposed to satisfy the consistency requirements, with the following categorical weights:

$$W_{jk}^{+\alpha,k} = \frac{W_{jk}^{\alpha,k} - W_{1}^{\alpha,k}}{\sqrt{\lambda_\alpha}} \qquad (67)$$

Thus, the most deprived category for I_k always has a weight equal to zero, and the weight given to any superior category j_k, strictly positive, represents the *gain in* total *poverty*

reduction, as measured on axis α, when an individual can get out of the most deprived status in the primary indicator I_k by accessing the status j_k, $k > 1$. Under the hypothesis that the first factorial axis satisfies the FAOC condition, the definition of equation (67) of the CIP is now transformed as

$$C_i = \frac{\sum_{k=1}^{K}\sum_{jk=1}^{Jk} W_{jk}^{+1,k} I_{i,jk}^{k}}{K}; C_i \geq 0 \qquad (68)$$

With this approach, MCA is seen as a technique of rescaling numerically, in a meaningful way, a set of categorical ordinal indicators and of providing at the same time the rationale for a consistent aggregation of the rescaled indicators. The MCA run on the *K* primary indicators may not automatically satisfy the FAOC property; thus, using the first factorial component as the composite indicator of poverty would be inconsistent and incorrect. To overcome this shortcoming, part of the chosen *K* primary indicators will either be regrouped or eliminated, or more than one factorial axis will be exploited to obtain the required poverty type sets, especially with possible duplication of welfare dimensions made possible with a large number of indicators.

If all indicators satisfy FAOC-I but FAOC-G is not met, it means that, relative to the first factorial axis, there are two subsets of indicators with opposite ordering on this axis, thus negatively correlated. It means that the multivariate measurement of poverty cannot be limited to the first factorial axis only; it also reveals true multi-dimensionality of the households in the chosen K indicators. Sticking to the first factorial axis only would necessarily require the elimination of one of the two subsets of indicators to get out of this inconsistency, which does not seem a priori acceptable. Thus, a strategy that will enable going beyond the first factorial axis will be required to define the poverty characteristics of the households, considering the discrimination power of the indicators. Thus, given *L* as the factorial axes, determined by the rank of the matrix *X*, have $L \leq J - K$, where *J* is the total number of categories for the *K* indicators.

$$\text{Let} \qquad \Delta_l^k = \frac{\sum_{jk=1}^{Jk} N_{jk}^{k} W_{k,jk,l}^{2}}{N} \qquad (69)$$

be the *discrimination measure* of indicator I_k on the factorial axis *I*. It is the variance of the distribution of the categorical weights on axis *I*, since the average weight is always 0.

By the theory of MCA

$$\lambda_l = \frac{\sum_{k=1}^{K} \Delta_l^k}{K} \tag{70}$$

Thus, the Eigen value of axis *I*, is the average of the discrimination measures of the *K* indicators. From the basic factorial equation:

$$\text{Total Inertia} = I_{tot} = \sum_{l=1}^{L} \lambda_i \tag{71}$$

Total inertia decomposition across the K indicator variables is given as:

$$\text{Total inertia decomposition} = I_{tot} = \frac{\sum_{l=1}^{L}\sum_{k=1}^{K}\sum_{jk=1}^{Jk} N_{jk}^{k} W_{k,jk,l}^{2}}{K \times N} \tag{72}$$

In the case of MCA being considered, $I_{tot} = \frac{J}{K} - 1$, which is the average number of categories per indicator minus 1, and the contribution of indicator I_k to total inertia is $J_k - 1$. If all indicators are binomial, total inertia is precisely 1. The Poverty Type Set of the factorial axis *I*, $\{I_k\}_{k \varepsilon \kappa l}$, is the most discriminating subset of AOC indicators satisfying $2 \times \sum_{k \in kl} \Delta_l^k \rangle K\lambda_1$. This algorithmic approach to the CIP means that we move simultaneously in the whole matrices to identify any existing poverty ordering consistency, and to keep the most relevant ones according to the discrimination measure while avoiding any overlapping. This optimization process is translated into a CIP according to the duality framework defined by equation 3.18a. Once a complete or admissible sequence of complete poverty type sets is obtained, which is always possible with the poverty dimensions algorithm, the value C_i of the composite indicator of poverty for the population unit *i* is given by:

$$C_i = \frac{\sum_{l=1}^{L^*}\sum_{k \in k_l^*}\sum_{jk=1}^{Jk} W_{jk}^{+l,k} I_{i,jk}^{k}}{K} \tag{73}$$

A minimal sequence of poverty type sets is obtained when the poverty types algorithm is interrupted at the smallest value L* ≤ L for which either $\bigcup_{l=1}^{L^*} k_L^* = k$, all indicators are included in the sequence of disjoint poverty sets, or L* = L. Thus, the number *d* of non-empty subsets is the number of independent poverty types provided by the set of the *K* primary indicators. This definition allows for stopping the process to the first factorial axis once the FAOC condition has been met, which translates to information loss.

If a minimal sequence of poverty type sets is reached for a small $L^* < L$, say, for $L^* = 1$ (first axis), there can still be an important loss of information with some indicators having a very low discriminating power. In that case, important improvements can be obtained by considering additional axes beyond L^*, without necessarily exploring $L^* = L$. Beyond L^*, all K indicators remain in the disjoint sequence of poverty sets, but some indicators could be associated with a poverty set and axis I in which their discrimination measure is higher. It seems better to extend the algorithm until the sum of the L^* Eigen values represent at least 50% of the total inertia, I_{tot}, given by $I_{tot} = \frac{J}{K} - 1$. That type of minimal sequence can then be called an *admissible sequence of poverty type sets*. Each axis that appears in the sequence then has an inertia (Eigen value) larger than the average inertia per factorial axis, $1/K$. This application of the algorithm obviously requires analyzing less than half of the total number of factorial axes, possibly much less depending on the inertia captured by the first axes. When a minimal sequence exists, especially when it occurs immediately at $L^* = 1$, it will be appropriate to pursue the algorithm until an admissible sequence has been reached.

2.3.8 Multi-dimensional poverty index (MPI) and the Millennium Development Goals (MDGs)

The MPI is an index of multi-dimensional poverty, a product of two numbers: the Headcount *H* or percentage of people who are poor, and the Average Intensity of Deprivation *A* – which reflects the proportion of dimensions in which households are deprived. It reveals the combination of deprivations suffered by a household at the same time. This approach to the measurement of multi-dimensional poverty requiring additional quantitative targets are needed because income poverty measures, although it provides vital and important information about poverty, has been adjudged incomplete and inadequate to this subject.

On the global scene, the United Nations and the World Bank have compiled and reported data on the progress of nations and regions with respect to a uniform set of targets and indicators which were agreed upon within the MDG framework (Appendix III), and countries' progress towards them has been monitored since 2000. The MDG statistics is presented annually and has been tremendously useful in providing feedback regarding improved development outcomes and in creating incentives to address core deprivations among the nations of the world. While the international MDG framework reports progress on each indicator singly, the MPI presents a composite index which reflects the interconnections between indicators. The diversity of indicators, as well as the base population of MDG indicators, makes it difficult to construct an index that meaningfully brings all deprivations into the same frame.

The MPI developed in this study is related to the MDGs in a number of ways (UN, 2005 and 2008). Firstly, it employs indicators that relate to the MDGs: five of the indicators (categorized under similar dimensions) used in constructing the MPI are directly linked to MDGs, namely Education (year of schooling, child enrolment in schools) and Standard of Living (source of drinking water, cooking fuel, ownership of basic assets). The other ten indicators are related although they are categorized under different dimensions as follows: Health (method of malaria treatment, self-reported health); Food and Nutrition (food availability, food sufficiency); Social Affiliation (political participation, social participation) and other Standard of Living indicators (toilet type, means of solid waste disposal, material of the wall of the house, material of the floor of the house, source of domestic lighting). Secondly, the MPI establishes the 'base' population as being the household. People live in households where strengths and weaknesses are shared together as a result of the interaction among members. This is the basis for the concept of poverty by inclusion adopted in this study as defined under 2.2.4. Thirdly, the MPI reveals the simultaneous deprivations of households. This enables us to identify different 'types' of deprivations that occurs among the fishing households. The MPI analysis made in this study emphasizes the number of people whose lives are negatively affected by multiple deprivations but not the number of households so affected. Poor households were identified and an aggregate measure constructed using the methodology proposed by Alkire and Foster (2007, 2009).

2.3.9 Choice of dimensions, indicators, indicator weight and cutoffs

Sen (2008) has argued that the choice of relevant functioning and capabilities for any poverty measure is more of a value judgment rather than a technical exercise. In the context of choosing capabilities that have a moral weight related to human rights, Sen has suggested focusing on dimensions that are of special importance to the society or people in question, and are socially influenceable – which means that they are an appropriate focus for public policy, rather than a private good or a capability, like serenity, which cannot be influenced from outside.

Practically, the choice of poverty dimensions in the literature (such as the 2010 Human Development Report) has relied on certain mechanisms. The first is literature arising from participatory exercises, engaging representatives group from the society in making the value judgments to select focal capabilities. Following Alkire (2007), Alkire and Eli (2010), and Alkire and Santos (2010) among others, the dimensions and indicators used for the MPI construction in this study were those identified as important reflection of well-being and welfare deprivation by representative respondents during a pilot visit to the study area. The second is the use of some enduring consensus, particularly surrounding human rights and the Millennium Development Goals (MDGs). At least three of the dimensions (education, health and standard of living) used in constructing the MPI in this study are directly linked to MDG and MICS/UNICEF framework. The third is the philosophical and (or) psychological theory of basic needs, universal values, and human rights, among others. The fourth is the data handling and interpretability, which had posed a constraint to the number of dimension included in this study, even though an enlarged number of dimensions would have made a more encompassing human development-based multi-dimensional poverty measure. The MPI constructed in this study is based on five dimensions: education, health, food and nutrition, standard of living and social affiliation, all measured using sixteen indicators.

The standard-of-living indicators were considered and weighted individually rather than being combined into an asset index since ‘ownership of basic functioning assets’ itself is an indicator variable under the standard of living dimension. Each of the five dimensions was equally weighted (20% or 0.2); so also was each indicator within a dimension. If there is reason to believe that certain dimensions are more important than others, relative weights can be applied to them. Atkinson (2003a) notes that weights on dimensions should ideally be proportional; however, he also recognizes the fact that weights may be different if different variables are more relevant to different subsets of the population. An additional concern that

arises from the lack of identification of particular dimensions by the Alkire-Foter (AF) counting approach used in this study is the fact that, even when there is reason to believe that all dimensions carry equal weight, certain specific combinations of them may lead to more severe cases of deprivation. For example, one may easily consider being uneducated and being unhealthy a superior state to being unemployed and being poor. These specific interactions among dimensions, if known *a priori*, can be incorporated into the current measure by considering not just different combinations of the welfare variables but also different permutations. This is beyond the scope of the present study. However, an interesting avenue for future research would be the development of a framework for empirically identifying interactions among dimensions in terms of their contributions towards overall deprivation.

The Sixteen (16) initial indicators for which data were generated in this study were selected on the basis of their relation to a number of welfare issues and their association with the two dimensions of deprivation in the literature, namely material and social (Townsend, 1987; Pampalon and Raymond, 2000; Oyekale and Okunmadewa, 2008 and Rampalon *et al*., 2009). Three of them were as used in the UNDP Human Poverty Index; and they are generally within the Millennium Development Goals (MDG) framework (Appendix II). The Food and Nutrition dimension was added to this study for the wider coverage, as was done by the British Department of Communities and Local Government (BDCLG, 2007). Justification for the inclusion of the MDG-based indicators is adequately presented in the MDG literature (United Nations, 2003) while non-MDG indicators follow a combination of intuition and literature, since as the lack of many of them have been adjudged as representing acute poverty, especially as they affect women and children mainly. The dimensions, indicators, and deprivation criteria (that is, cutoffs for each indicator) and assigned weights are summarized in Appendix II. Since household is taken as the unit of analysis, the definition given to the indicator variables used in this study follow the concept of effective poverty inclusion, endogenous poverty and external capabilities (Basu and Foster, 1998; Foster and Handy, 2008).

The cutoff used for each of the sixteen welfare variables is more elaborately emphasized in Appendix IV. The cutoffs used for the indicators were based on MDG international standard and various studies. Households with no school-year children (6-15 years) under the 'child enrolment' and 'food adequacy' indicator variables were considered in each case as non-deprived. However, households with missing data or incorrect information on any of the indicator variables were excluded from the sample.

2.4 Review of related literature

2.4.1 Empirical evidences in poverty studies

2.4.1.1 Multi-dimensional poverty in Nigeria

Canagarajah *et al*. (1997) reported that between 1980 and 1990, poverty levels and inequality in Nigeria increased tremendously. However, in 2004, National Bureau of Statistics (2005) reported a decline in poverty incidence to 54.4 percent, although it later rose to 69 percent in 2010. This growth in poverty incidence raises a lot of questions in a country with large deposits of natural resources. Furthermore, the widening poverty gap in Nigeria confirms serious disparities in income and wealth distribution among the different socio-economic classes in Nigeria (Ali-Akpajiak and Pyke, 2003). These findings are in sharp contrast to the claims to progressive efforts made at ensuring poverty reduction in all its ramifications as a result of several economic reforms embarked upon by the Nigerian government since the country returned to democratic governance on 29th May 1999. Okonjo-Iweala and Osafo-Kwaako (2007) note that with macro-economic stability that resulted from the economic reforms, economic growth rates have averaged about 7.1 percent annually for the period between 2003 and 2006, giving notable attention to pro-poor expenditures within the national budgets in order to improve on the country's performance in some Millennium Development Goals indicators. Several authors (such as Iyoha and Oriakhi, 2007 and Dijkstra, 2011) have also argued that the 2005 debt relief that was granted Nigeria by the Paris Club had a modestly positive effect on economic growth and poverty reduction, especially through the stock and conditionality channels, noting that this will lead to a greater achievement of the MDGs in the future.

Until recently, though, most poverty studies in Nigeria have generally followed the conventional approach to poverty measurement and analysis, with focus on inadequate income for securing basic goods and services (Adeyeye, 2000). Following Ajakaiye and Adeyeye's (2001) observation that there is no concise and universally accepted definition of poverty as it affects many aspects of the human conditions, including physical, moral and psychological aspects, there has been a tremendous shift from the income-based approach of poverty analysis among Nigerian researchers to the more multi-faceted multi-dimensional approach which has gained researchers' attention in many developed economies of the world. As a result of the general defeat of the early conceptual formulations of poverty treating the poor as those that are lacking some basic incomes required to command enough expenditure for meeting their pressing needs (basically food, education, health and other social services) recent poverty

analyses have focused on the multi-dimensionality of poverty. As a result, emphasis has been placed on the fact that the poor not only lack income to command enough commodity items, but also asset deprivations, psychological disturbances, shame, lack of self-esteem and many other forms of moral deprivations are common manifestations of poverty (Ogwumike, 2002).

Ayoola *et al.* (2000) conducted a multi-dimensional poverty analysis in Nigeria using focused group discussions to determine households' perception of poverty and wealth in some Nigerian rural and urban areas. The outcomes of this study revealed that the urban rich were perceived to have money and live in more sophisticated, cemented houses, and sourced water from boreholes or tap. They also had access to good food, good clothes, and improved medical services. Ataguba *et al*. (2012), while examining the determinants of multidimensional poverty in Nsukka, Nigeria noted that the rate of poverty incidence jumped from 70% (based on monetary poverty) to 78% of Nsukka population when nonmonetary (multidimensional) indicators or factors were taken into consideration. Among the factors that determined incidence of multidimensional poverty among households in the study area were large family size, low level of education, poor employment and health conditions, as well as living in the rural area of Nsukka region. Oyekale and Oyekale (2013) analyzed the spatial distribution of multidimensional poverty in Nigeria using survey-based secondary data of the Demographic and Health Survey (DHS) for 1999, 2003 and 2008 to construct composite welfare indices (CWI) which were analysed using descriptive statistics. Among other findings, the study revealed that access to safe drinking water sources declined between 1999 and 2008 across the different wealth quartiles and poor households had suffered more severely while national access to electricity increased from 45.82 percent in 1999 to 51.41 percent in 2003, but declined to 45.58 percent in 2008.

A number of national studies were also conducted on child poverty and disparities. For instance, using the Demographic and Health Survey (DHS) data collected by Macro International in 2008, Adeoti and Popoola (2012) estimated the determinants of child poverty among rural households in Nigeria using the multidimensional approach. Their study revealed that the likelihood of a child being multi-dimensionally poor decreased with higher educational attainment of both parents. Multi-dimensional child poverty as well as income poverty were measured by the international poverty line, and the national poverty line. In analysing multidimensional child poverty using an approach developed by the University of Bristol and UNICEF (2005), a poverty headcount based on the number of children who have been exposed to two or more severe deprivations was estimated. As reported in the study, multidimensional

child poverty decreased from 53% in 1995 to 52% in 2006, while the income poverty headcount ratio at $1.25 a day decreased from 69% in 1995 to 64% in 2006. Furthermore, analysis by each dimension showed that while household deprivations accounted for a significant portion of overall deprivations, with 50% of children severely deprived of shelter, individual deprivations remained significant. A total of 79% of children from the north-east region were severely deprived in 2 or more deprivations. This was the worst in comparison to other regions in the country. Urban-rural disparities were significant across all of the dimensions. In addition, 92% of children in the poorest quintile, 77% of children in the second quintile and 49% in the middle quintile suffered from two or more deprivations.

In terms of child well-being, 37% of Nigerian children under-five were stunted, 27% were underweight and 12% were suffering from wasting, an indication of acute malnutrition. In 2005, 47% of Nigerian children experienced severe health deprivation, 28% of children were severely deprived of adequate sanitation and 37% of children experienced severe water deprivation. In 2006, however, 35% of the urban population, and 25% of the rural population used improved sanitation facilities. In 2008, the infant mortality rate in Nigeria was 96 deaths per 1,000 live births, and the under-five mortality rate was 186 deaths per 1,000 live births. A total of 25% of adolescents from the richest quintiles had comprehensive knowledge of HIV prevention as compared to 12% of those from the poorest quintile. In 2006, 30% and 18% of Nigerian children suffered from severe educational and information deprivations, respectively. The net enrolment ratio in primary school was 58% for females as compared to 68% for males. Also, 24% of girls and 22% of boys aged 12-14 were engaged in child labour, while 33% of girls in the north-western region were married before 15 years, as compared to 4% of girls in the south-western zone.

According to Olayemi (1995), the poor in Nigeria have no (or limited) access to basic necessities of life (such as food, clothing, and decent shelter), are unable to meet social and economic obligations, lack skills and gainful employment, have few, if any economic assets, and, sometimes, lack self-esteem. Okunmadewa (2002) also identifies low level of education, high fertility rate, and lack of access to improved seeds and inputs, and social amenities as being grossly responsible for the poverty status of many households in the Nigerian rural economy. Nubi (2008) submits that housing means more than shelter because it serves as one of the best indicators of a person's standard of living. However, in most Nigeria urban and rural areas, housing constitutes a major barrier to household welfare owing to progressively widening gaps between its supply and demand.

Poverty manifests itself not only in economic deprivation, but also in terms of individual's inability to access basic social amenities. Gass and Adetunmbi (2000) assert that poverty denies its victims the most basic needs for survival, such as food, water, clothing and shelter. Akerele and Adewuyi (2010), while examining the determinants of multidimensional poverty in Ekiti State, Nigeria, employed the multiple regression technique. They found that household head's educational attainment and household sizes were largely responsible for the high incidence of poverty among the households. Oyekale and Okunmadewa (2008) employed Tobit regression analysis to determine the influence of selected socioeconomic variables on households' multi-dimensional poverty in Abia State, Nigeria, and found among the significant factors male headship of the household, literacy level of household head as well as household location in a more urbanized area of the State.

A poverty-related study by Alayande and Alayande (2004) associated major environmental problems with low agricultural productivity, high vulnerability to health hazards as well as poor infrastructural developments (such as network of roads, markets, and means of communications, among others). These have been linked with the high incidence of poverty in the rural areas of Nigeria. In line with this submission, Medugu (2009) observes that Nigeria is one of the countries expected to be most affected by the impacts of climate change through sea-level rise along her coast line, intensified desertification, erosion and flooding disasters and general land degradation.

2.4.2 Empirical linkage of poverty to deprivation in household socio-economic correlates

The notion of social class (or socioeconomic status) is one important sociological variable that has been conceptualized in various terms, such as ownership and control of productive and other welfare assets, high occupational prestige, or possession of high social standing in the larger society (Marshall *et al*., 1997). Early researches have revealed substantial income differences between social classes, a term that was used to refer to a cluster of occupational groupings with members that are comparable in terms of their sources and levels of income, their degree of economic security as well as chances of economic advancement (for example Townsend 1987; Savage, 2000). By moving from static poverty to dynamic and lifestyle deprivation, the class pattern becomes more important in welfare outcomes (Vandecasteele, 2007).

According to Dao and Hoang (2006), households' could be categorized on the basis of their socio-economic condition as being poor, average or better off. Conventionally,

socioeconomic status is determined by financial measures, such as income or consumption expenditure, with the assumption that material living standards would lead to well-being (Falkingham and Namazie, 2002). However, monetary measures of socioeconomic status has not included all various features of well-being. This is due to the complexity in conceptualization, and, thus, measurement of socioeconomic status.

However, the links between social class and poverty are not without their own challenges. Towards the end of the 1980s, some scholars began to claim that traditional factors of social stratifications were losing their relevance. New perspectives on poverty determinants, like gender, education and social class, began to threaten the concept of traditional stratification of poverty. Life course perspectives, originally developed in response to criticisms of the traditional family-cycle approach (Dewilde, 2003), particularly emphasized the distinction between 'new' and 'old' social risks, where the former tends to involve mainly horizontal redistribution across life course from working-age groups to children and older people, while the latter tends to affect specific sub-groups at particular life stages (Taylor-Gooby, 2008). The new risks are associated with individuals who have a weak starting point in terms of age, experience, family relations and responsibilities, which also define their life course positioning.

Obviously, transition from one phase of life to another entails a substantial change in the level of social risk and might even require public intervention (Whelan and Maitre, 2008). Furthermore, social class analysis could be more relevant, taking into cognizance the fact that transition triggered substantial reshuffling by destroying large industrial sectors and creating new service spheres with the resultant intense mobility labour across sectors and occupations (Mickiewicz, 2005). The concepts of social class itself did not go unchallenged. For instance, arguments were put forward that, in line with economic and fiscal crises, the period since 1970s has been characterized by the increase rate of marriage divorce and single parenthood that undermine the role of the family as an agent of social integration and socialization, forcing individuals to create their own fortunes (Layte and Whelan, 2002).

In her study, Vandecasteele (2007) notes that the chances of transiting into poverty is related to both life course events, such as partnership dissolution and escape from the parental home, as well as to traditional social stratification determinants. Whelan and Maitre (2008) argue that life cycle effects are not simply a by-product of social class differences, although the possibilities of such events do not allow dismissing the impacts of social class in the course of life events. Consumption expenditure is a superior indicator of long term socioeconomic status rather than income. A household's capacity to pay is defined as the efficient income remaining

after basic survival needs have been met. Efficient income is the whole consumption expenditure of the household, which, in a lot of countries, is a more perfect reflection of purchasing power than the income reported in household survey (Xu and Klavus, 2003). To determine poverty and to measure household survival expenditure, Mehdi and Laily (2009) based the poverty line on the share of total expenditure spent on food. There is a defined subsistence expenditure and the poverty line for each country is independent of account for different consumption patterns, prices, and household sizes. The poorer the family, the higher the share of total income or consumption allocated to food.

Researchers have long well-known the poverty line as being the usual food expenditure of households whose food contribution was in the 45 to 55 the percentile range - used in preference to that for one household at the 50th percentile - (Ke *et al*., 2003). Most important items that contained structure of consumption around the world were food, clothing and footwear, rent, health care, education, transportation and communication. Expenditure is one of the dependent variables that have been given attention. This argument is mainly tenable in low-income countries, where income often comes from various sources and may differ significantly across seasons. Long-term aspects of socioeconomic status are more related to various health outcomes, adding to the reasons for choosing consumption expenditure over income. Within low-income countries, measure of consumption expenditure has its attendant problems associated with the inconveniences of data recall, unwillingness to divulge private information as well as the use of extended questionnaire that must be administered by skilful and well-trained interviewers (Deaton and Zaidi, 1999, Laura and James, 2008).

In recent poverty and social exclusion researches, along with the dynamic interpretation of income poverty, some other tendencies have been identified. In the first instance, a greater role has been attributed to material deprivation analysis in relation to household consumption, facilities and neighbourhood environment (Watson, *et al*., 2006 and Whelan and Maitre, 2008). Secondly, based on the 'individualisation hypothesis', which assumes that in the globalised world life-chances are increasingly shaped by personal achievements rather than social structures, examination of the determinants of poverty in its various dimensions surpasses the traditional stratification explanations, such as demography, human capital and social class (Layte and Whelan, 2002 and Vandecasteele, 2007). These findings emphasize that material deprivation can be a more acceptable indicator of the command of resources and the possibilities of exiting the poverty cycle (Whelan *et al*., 2004) while individual life experiences are important in determining individual well-being (Whelan and Maitre, 2008).

Besides income and consumption expenditure, asset ownership is a good reflection of household socioeconomic status. An asset-based approach to measuring household socioeconomic situation is one option to income and consumption expenditure. This approach has arisen from demographic studies, like the Demography and Health Survey (DHS), which suggest that, in the absence of income or consumption expenditure, data on possession of a range of durable property could be used (Falkingham and Namazie 2002; Rutstein and Johnson 2004). Data on asset have been claimed to be more consistent than income or consumption expenditure, because they use uncomplicated questions or straight surveillance by the interviewer, thus suffering less distortion occasioned by memory limitation or social desirability bias (Sahn and Stifel, 2003). As observed by Berkman and Macintyre (1997), variables other than family income, for instance property (hereditary wealth, savings, employment profit, or possession of homes or some vehicles such as car) to be used in measuring socioeconomic status of the household, may be valuable.

Although income represents a stream of resources for some period of time, wealth captures the accumulation of assets, that is economic reserves, at a given point in time. Wealth as a basis of economic protection provides an indicator of a household's capability to convene emergencies or act as a buffer to economic shocks, such as unemployment (John and MacArthur, 2002). However the significance of wealth as a foundation of economic security may vary from one society to another. For instance, a community may be vast in households with relatively little wealth, but have a social welfare system that enables the limited resources of those households to absorb huge economic shocks. Income and wealth are positively correlated, but they are not the same. For instance, an aged individual with moderate income may have accumulated considerable wealth (John and MacArthur, 2002). Bindon and Vitzhum (2002) reported some significant factors that measure household economic resources, such as education, occupation, and other traditional economic behavior, like using household labour in economic (especially agricultural) productions systems.

The problem of poverty in many developing countries is a very crucial one going by its intensity, incidence and severity. For the major part, the poverty phenomenon confronting most countries especially those in sub-Saharan Africa (SSA) have been described as more encompassing and surpassing the ordinary scope of income or nutrition insufficiency. This kind of poverty so described has been attributed to be the consequence of lacking various welfare attributes that are necessary to maintain a minimum level of living, such as health, income, human capital (literacy), housing condition, access to public services, employment

opportunities, and so on. The poor in most developing countries have been largely identified among four identifiable economic groups - the rural landless, the small farmers, the urban underemployed and the unemployed - who are disproportionately located in rural areas, slums and in coastal parts of major urban areas (World Bank, 2001). Thus, those most affected by extreme poverty are young children, pregnant mothers, the elders, the inhabitant of rural areas and marginal urban zones, and those groups of people who have not been integrated into the society, especially certain ethnic groups of people who find themselves segregated in their own societies.

The income dimension of poverty defines poverty as a situation of low income or low consumption. This has been used for constructing poverty lines. Accordingly people are counted poor when their measured standard of living in terms of income or consumption is below the poverty line. Thus, the poverty line is a measure that separates the poor from the non-poor. However, poverty has both income and non-income dimensions usually intertwined. The poor are those who are unable to obtain an adequate income, find a stable job, own property or maintain healthy conditions. They also lack an adequate level of education and cannot satisfy their basic health needs thus, the poor are often illiterate, in poor health, and have a short life span (World Bank, 1995). The poor often lack the capacity to escape from their situation by themselves. This characteristic is what causes extreme poverty to persist and to be transmitted from one generation to the next. Those most affected by extreme poverty are young children, pregnant mothers, the elders, the inhabitant of rural areas and marginal urban zones and those groups of people who have not been integrated into the society, especially, certain ethnic groups of people who find themselves segregated in their own societies. Among the groups most affected by extreme poverty throughout the world are those who are most vulnerable and lack resources, along with those who do not have capacity to organize themselves nor to exercise the right to protect their situation (Sancho, 1996).

In the past, successful periods of economic growth extended the promise that the poverty and deprivation would be eradicated in society, but these periods were followed by years in which it was obvious that, while it might be possible to mitigate the extent and(or) the level of poverty and deprivation, total eradication was not feasible. However, it is pertinent to emphasize that the mechanism responsible for creating disadvantaged situations undergo modifications along with changing social and economic structures, bringing alterations to the forms of disadvantages that evolve from time to time. The phenomena of poverty, deprivation, disadvantages and marginalization remain central issues of public discussions, since economic

growth could not substantially alleviate the inequalities (Toth, 2005) and, at first, its effects were beneficial to the affluent in society. This has led to the emergence of the mitigating agenda of these social malaise at major world organizations as well as the European Union, particularly regarding poverty and deprivation management as most pressing political issues of concern, as attested by such programmes as Joint Conclusion Memorandum or the Millennium Development Goals.

Among the factors responsible for the re-emergence of poverty, deprivation and marginalization, a number of traits which are characteristics of modern societies have been identified as contributors to the present alarming situation, among which are lack of education, exclusion from the labour market, unemployment status and single parenting. The most alarming case is the high level of impoverishment of women, children and families with children, which was an indication of weak family and occupation structures (Speder, 2002a, 2005). In addition to these, types of settlements and (or) regional status also exert a significant and growing influence on poverty and deprivation levels.

2.4.2.1 Household poverty and deprivation in family health status

The World Health Organisation (2003 and 2004) reported that, out of the 600 million people with disabilities worldwide, 82% live below the poverty line, 20% belong to the 'poorest of the poor', and only 3–4% benefit from development activities. Malnutrition affects 800 million people, causing blindness, illness and death. Over 161 million people in the world are visually impaired due to eye diseases, of whom 37 million are blind and 124 million have low vision. Additionally, an estimated 153 million people are visually impaired because of uncorrected refractive errors. At the launch of VISION 2020 in 1999, it was predicted that, without extra interventions, the numbers of people who would lose their sight due to eye diseases would rise to 75 million blind and 200 million visually impaired by the year 2020 (Resnikoff, 2004). The largest burden of visual impairment, more than 90%, is borne by the least developed regions. As much as 75% of blindness is preventable or curable. Many of the causes of avoidable blindness in low-income countries are directly related to poverty, including malnutrition and limited access to health, education, water and sanitation.

The VISION 2020 report recognizes the poverty trap of people living with visual impairment, the likelihood of their being excluded from basic health, education and social services and, thereby, their vulnerability to isolation, ill health and economic problems. The major thrust of the vision's initiative would result in a reduction in the projected increase in the

number of people who are blind, from 75 million to 24 million, in addition to ensuring the best possible vision for all people, thereby contributing directly to improving quality of life and creating favourable economic, social and health conditions for individuals and society.

2.4.2.2 Household poverty and deprivation in human capital development

There are two standard techniques of analysing welfare correlates with educational achievements using household data. One way is to estimate the probability of being poor using logit or probit techniques with household characteristics as the explanatory variables. The other method is to estimate household welfare functions with OLS methods. Both methods are helpful in understanding poverty as a major cause of low human capital development the world over. Applying the first technique, and using panel survey data from Côte d'Ivoire on both urban and rural households, Grootaert, *et al.* (1997) claim that, for urban households, human capital is the most important factor for determining welfare levels and welfare changes over time. Where an average households experienced welfare losses, more educationally endowed households achieved a higher level of welfare than those with lesser educational endowments. Well-educated households have greater chances of improving their welfare compared to others, and households with many dependants are in a worse welfare condition.

Grootaert (1997) adopted the probabilistic approach using data from Côte d'Ivoire and argues that the way households manage to use their endowments is crucial in determining welfare outcomes. For urban households, the way out of poverty was to engage in paid employments and increase the wage share of their income. Coulombe and McKay (1996) examined the determinants of poverty in Mauritania. Their findings suggest that recent urban migrants are more likely to be found in the upper quintiles of the income distribution than in the lower ones, and that unemployment does not seem to correlate with standard of living. They concluded that, in urban areas, the lack of education and high dependency ratios in the household have negative effects on household welfare, while households in the main centres are better off.

Poverty significantly affect the resources available to students for a remarkable academic achievement. A study by Lacour and Tissington (2011) using both urban and rural data, found that mean household education and literacy strongly and positively correlated with consumption expenditure, while household size negatively correlated with per capita consumption expenditure. From these studies, it is evident that education is an important variable for improving the level of household welfare. In the United States of America (USA),

the gaps in achievement among poor and advantaged school children are found to be substantial (Rowan *et al.*, 2004). Building from the work of Sum and Fogg (1991) and measuring kindergarten students on the Early Childhood Longitudinal Study (ECLS) reading achievement assessment, Rowan *et al.* (2004) observed that low-income, middle-income and upper-income students cored at about the 30th percentile, 45th percentile and 70th percentiles, respectively. In a related study, Bergeson (2006) also discovered a similar trend in which 43.5% of low-income students did not successfully meet any of the required subject area assessment, while only 13.2% of them met all of the required subject area assessment. Through the reports of many studies, the US Department of Education (2001) has provided evidences that student and school poverty adversely affect students' achievement in school.

Poor households that depend on welfare aids are more likely to be educationally backward in society. Several researches have indicated that receiving 'welfare' or cash income through the Aid to Families with Dependent Children (AFCD) programme had a negative effect on academic achievement in the United States of America (Zill *et al.*, 1995; Peters and Mullis, 1997). Some of the results from these studies indicate that 'welfare children were twice as likely to fail and drop out from school as well as having discipline problems in school than their non-poor counterparts' (Zill *et al.*, 1995). Furthermore, the study of Zill *et al.* (1995) established the salient fact that children from families which are long-term recipients of AFCD showed significantly lower academic achievements than children from families which are short-term recipients of AFCD.

A probable reason for this negative effect of receiving welfare aids is that children from welfare families are often brought up in homes with limited intellectual stimulations, emotional supports, literate environments, and physically safe environment. Mayer (1997), however, avers that these possibilities are consistent with the fact that 'welfare receipt is a proxy for severe material deprivation'. He adds that such negative effects of welfare receipts on family educational endowments include reduction in the chances of students graduating from high schools; prolonged years in school before graduation; eventual negative effect on hours of work and earnings as well as poor performance of school-age children in test scores.

The evolution of farming systems based upon increasing climate change, specialization or integrated intensification has required extra knowledge on the part of farm operators. The need for better information and enhanced human capital has also increased, as production systems have become more integrated with regional, national and international market systems. Many farmers in developed countries now have a much better understanding of the nature of

the demand that they are responding to – in terms of its implications for varieties, timing, and packaging and permitted chemicals. As a result, they have progressively modified their production practices and their portfolio of products in response to changing patterns of demand. This knowledge-based approach has not yet been adopted in Nigeria.

Lack of education, information and training is a key limiting factor to smallholder development. The report of UNICEF (2005) notes that the poor state of the country's education has also had its toll on the poor people, the majority of whom are farmers in rural areas. In addition, they are faced with limited social services and infrastructure. FAO (2008) reported that about 90 per cent of Nigeria's food is produced by small-scale farmers who cultivate small plots of land and depend on rainfall rather than irrigation systems as a result of their low knowledge base, access to facilities and poor financing. Nwafor *et al*. (2007) note that low flexibility of Nigerian farmers to allow substitution in production practices, especially for export crops and cereals is a major limiting factor, which results from low human capital, technological capacities, credit market access and infrastructure. As reported by Narayan *et al*. (2000), the welfare context of rural households is not entirely dismal; with the appropriate intervention, some households are able to escape poverty. A key route to this escape is education. The education of a member to a reasonably high level can help enhance the household's welfare significantly.

2.4.2.3 Household poverty and deprivation in family living condition

In a multi-dimensional poverty study for developing economies by Alkire and Santos (2010), empirical findings revealed that Africa presents the highest MPI poverty rates, with considerable variation among the 38 countries. The percentage of multi-dimensionally poor ranges from 3 percent in South Africa to 93 percent in Niger, while the average percentage of deprivations ranges from 44 percent in Swaziland to 69 percent in Niger. In 33 of the estimated sub-Saharan African countries, the highest contributor to poverty is deprivation, measured by the living standard variables. In Nigeria, Madagascar, Mali, and Burkina Faso, 30 percent or more are poor and live in households where at least a woman or a child is undernourished. In Ghana and Mali, 30 and 87 percent people are MPI poor, respectively, with high level of deprivation in the basic living condition variables - cooking fuel, sanitation, and electricity - but a relatively low health deprivation level. In the case of The Gambia and Zambia with equal MPI values, there was a different configuration of deprivations, with deprivations in floor, water, and sanitation being much higher in Zambia, whereas schooling and education are more

problematic in The Gambia. Other striking poverty situations, according to Alkire and Santos (2010), include:

- In Guinea, Mali, and Niger, more than 50 percent are poor and live in a household where at least one child has died.
- In Liberia, the Central African Republic, Mali, Ethiopia, Burkina Faso, and Niger, more than 55 percent are poor and live in a household where there are children of school age not attending school.
- In Mozambique, Guinea, Burundi, Mali, Ethiopia, Burkina Faso, and Niger, more than 50 percent are poor and live in a household where no one has completed five years of education.

2.4.2.4 Household poverty and dwindling agricultural productivity

The report of World Economic Forum (2006) ranks Nigeria 88 out of 117 countries on its global competitiveness indicators (GCI). Despite the large domestic market, only a small proportion of producers have been able to develop into sizeable businesses that could compete internationally, as shown by the long-term decline in non-oil exports. Total factor productivity (TFP) growth has been low and appears to have fallen consistently between 1970 and 2000. Increases in productivity per capita have been negligible. In agriculture, yields have been falling and, in manufacturing, there is considerable unused capacity (World Bank, 2007). In other words, trade liberalization has had generally negative implications for the Nigerian farmers as their poverty increased (Nwafor *et al.*, 2007), essentially because of their unfavourable competitive position in comparison with their developed country counterparts, for reasons such as the ones mentioned above and the continued heavy agricultural subsidy in these countries. For instance, the World Bank (2007) asserts that farmers in developing countries cannot compete with highly subsidized farmers in industrialized countries who can afford to sell crops below production costs.

2.4.3 Implication of improved welfare attributes on socioeconomic well-being

The subjective and objective approaches differ in the area of measuring households' economic status. The objective approach is based on objective indicators provided by persons or household, such as asset, expenditure and income. The subjective approach is based on the perceptions of persons with respect to the needs of family or household or their degree of satisfaction as to economic or financial well-being. For instance, increased investment in

education will affect productivity and growth, and also promote entrepreneurship through several channels. A better educated person would be able to absorb new information faster, and apply unfamiliar inputs and new processes more effectively.

In a study by World Bank (2001), it was revealed that a one-year increase in educational attainments augmented non-farm wages by more than 10 percent and farm output by nearly 2 percent and 5 percent in Korea and Malaysia, respectively. In Peru, farmers with an additional year of schooling were able to adopt modern farm technology by 45 percent, while in Thailand, farmers with four years of schooling were three times more able to use new chemical inputs than farmers with one to three years of schooling (World Bank, 1991). In a study of entrepreneurs undertaken in northern Thailand, 40 percent of them had university degrees. In Malaysia, entrepreneurs in large enterprises were more educated than entrepreneurs in smaller firms (World Bank, 2001). In Peru, for instance, returns to an extra year of primary education were estimated to be as high as 33 percent for women self-employed in the retail textile sector. Post-primary education appears to have a relatively high payoff, 14 percent for men in the service sector (UNICEF, 2011).

Investing in education (most especially women education) will not only guarantee faster growth, but will also, enhance productive capacity, increase income levels and make the citizens better informed about the value of health care and personal hygiene. An educated woman will be able to improve the health and life expectancy of her children, and create incentives for reducing family size, which, in turn, will help reduce poverty. For instance, in Brazil, a woman who has completed primary education makes 91 percent of income more than her uneducated co-worker's income in the informal sector and 110 percent more than an uneducated woman in self-employment (Psachanopanlos and Winter, 1992).

An improvement in the quality of human factor, such as advance in knowledge and the diffusion of new ideas and objectives are necessary to reduce poverty, as well as instil the human abilities and motivations that are more favourable to economic achievement. Japan's rapid industrialization after the Maiji Restoration was fuelled by its aggressive accumulation of technical skills which, in turn, was based on its already high level of literacy and a strong commitment to education, especially in the training of engineers (World Bank, 2001). If there is under-investment in human capital, the rate at which additional physical capital can be productively utilized will be limited since technical, professional and administrative people are needed to make effective use of the material capital. Therefore, improvement in infrastructure,

health services, education, nutrition, food security, accountability and transparency on the part of government are equally necessary for alleviating poverty in Nigeria.

In assessing socioeconomic status, measuring variables other than household income may be useful, for instance assets such as inherited wealth, savings, employment benefits, or ownership of homes or means of mobility or transportation, like cars, motorcycles or canoes (Berkman and Macintyre, 1997). The goal of different approaches to measuring family economic status is to set a line below which individuals or families will be categorized under different economic status. Bindon and Vitzthum (2002) measured household economic status by using expenditure and asset and found that household economic status categorization is different in rural and urban asset indices, or a combined asset index.

CHAPTER THREE
METHODOLOGY AND ESTIMATION PROCEDURES

In this chapter, focus is on the methodology adopted in this study. The procedures taken in estimating the multi-dimensional poverty index are also clearly explained.

3.1 The study area

The empirical setting for this study is the coastal area of southwest geo-political zone of Nigeria characterized by the existence of the Lagoon, the Atlantic Ocean and brackish water. The Southwestern zone lies within latitude 5.45^0N and 8.15^0N and longitude 3^0E and 6^0E, with a temperature range of 27^0C and 32^0C. The coastal bed of the zone has artisanal and commercial capture fishing activities as the predominant occupation among the settlers, as well as homestead culture fishing that is undertaken by some households but to a smaller extent. Land-based farming activities, such as crop and livestock rearing, are also practised in some upland communities, either as primary occupation by permanent inhabitants of these communities or as secondary activity by displaced coastal settlers who occasionally migrate to the upland areas at the time of floods.

Households in the coast of southwestern Nigeria also engage in natural resource collection such as sharp sand from the lagoon bed and sea shores, as well as game, fuel wood and timber and non-timber products from the brackish water-dominated forest area. The climate in the study area also favours the growing of arable and tree crops, such as cassava, yam and grains, as well as tree crops like cocoa, rubber, and kolanut, among others, the production of which is predominantly characterized by small-holder, subsistence practices.

3.2 Source of data and methods of data collection

Primary data were used for this study. Primary data were obtained with the aid of a structured questionnaire. Copies of the questionnaire were administered to the household heads, following the assertion of Kathy (2007) that household heads are in the best position to give accounts of most activities bordering on the socioeconomic status of the household. Where the household head was not available, the spouse provided the required information. Information was collected on the socioeconomic, demographic, and community-specific variables that impinge on the welfare status of the fishing households.

3.3 Sampling procedure and sample size

Primary data were collected from households in the study area which were selected using the multi-stage sampling procedure. In the first stage, Ogun, Ondo and Lagos States were purposively selected, as they contain the coastal region of the southwest. Three (3) local government areas (LGAs) belonging in the coastal area of the three states were purposively selected at the second stage. They were Ogun Waterside, Ipokia and Ijebu-East LGAs in Ogun State; Ilaje, Ese-Odo and Irele LGAs in Ondo State; and Epe, Badagry and Ibeju/Lekki LGAs in Lagos State. A proportional selection of 20 political wards was done at the third stage and 100 coastal communities at the fourth stage. In the final stage, 5 households (HH) were proportionally selected per community, targeting a maximum of 500 households for the study (Appendix I). However, responses from only 448 copies of the questionnaire were used while others were discarded for incomplete information. The proportionality factor used in the third stage to select wards is given as: $P_i = \frac{n_i}{N_i} \times 20$ (74)

where P_i = number of sampled wards

n_i = number of wards in the particular LGA of interest

N_i = total number of wards in all the 9 LGAs (i.e, 114)

i represents the referenced State (Ogun, Ondo, Lagos).

This led to 20 wards being selected from the 9 LGAs.

Another proportionality factor was used in the fourth stage to select coastal communities, given as:

$$X_j = \frac{q_i}{Q_i} \times 100 \quad (75)$$

where Xi = number of sampled coastal communities

q_i = number of major communities in the particular ward of interest

Q_i = total sum of major communities in the 20 wards selected

i represents the referenced ward.

This led to 100 major coastal communities covered in the course of data collection.

A proportionality factor was eventually introduced in the final stage to select households as given below:

$$H_i = \frac{s_i}{S_i} \times 500 \quad (76)$$

where H_i = number of sampled households

s_i = number of households in the particular coastal community

S_i = total sum of households in the 100 coastal communities selected

i represents the referenced community.

This made it 500 households interviewed in this study.

3.4 Estimation procedures

3.4.1 Methodological steps to computing the multi-dimensional poverty index (MPI)

Step 1: Unit of analysis

The unit of analysis was chosen as the household. As such, the definition given to the indicator variables used in this study follows the concept of effective poverty inclusion, endogenous poverty and external capabilities as developed in literature (e.g, Basu and Foster, 1998).

Step 2: Choice of dimensions, indicators and weights

The dimensions and indicators used for the construction of multi-dimensional poverty index (MPI) were chosen on the basis of documented public consensus and their conformity to the framework of the Millennium Development Goals (MDGs) framework (United Nations, 2003; BDCLG, 2007) and on empirical evidence regarding people's values as well as the psychological theory of basic needs (Alkire, 2007; Alkire and Eli, 2010; and Alkire and Santos, 2010). The constructed MPI is based on five dimensions: education, health, food and nutrition, standard of living and social affiliation, from within which sixteen initial welfare indicators were carefully selected as guided by literatures (following Townsend; 1979; Pampalon and Raymond; 2000; Oyekale and Okunmadewa, 2008 and Alkire and Foster, 2010).

The chosen dimensions and indicators[1] are Education (*year of schooling*[2], *child enrolment in schools)* and Standard of Living *(source of drinking water, cooking fuel, ownership of basic assets, toilet type, means of solid waste disposal, material of the wall of the house, material of the floor of the house, source of domestic lighting)*; Health *(method of malaria treatment, self-reported health)*; Food and Nutrition *(food availability, food sufficiency)*; Social Affiliation *(political participation, social participation).*

[1] *Indicators chosen under each dimension are italicized and put in parentheses.*

[2] The Federal Government of Nigeria (FGN) has declared a minimum basic and compulsory 9 years of formal education for all children in Nigeria (especially female children)(NEEDS 2004, 2009).

Equal weights were assigned to each of the five dimensions and sixteen welfare indicators (following Atkinson, 2003; Decancq and Lugo, 2008 and Pampalon, *et al*., 2009). The dimensions, indicators, and deprivation criteria and assigned weights are summarized in Appendix II.

Step 3: Reducing the number of welfare dimension/indicator variables

The Multiple Correspondence Analysis (MCA) factor reduction technique was adopted in reducing the set of categorical ordinal indicators from sixteen to thirteen to capture the most relevant welfare indicators and to ensure ease of analysis for policy purposes and transparency (following the approach adopted by Delhey *et al*., 2001).

Step4: Setting the indicator-specific deprivation cut-off value/achievement (k)

The cut-off values or achievements used for each of the sixteen welfare variables were based on MDG international standard and relevant studies (as more elaborately emphasized in Appendix IV). Households with no school-year children (6-15 years) under the 'child enrolment' and 'food adequacy' indicator variables were considered in each case as non-deprived. The 9-year cut-off achievement for the *year of schooling* variable was based on the Education For All (EFA) policy of the Federal Government of Nigeria (FGN), whose aim is to make all children, particularly girls, have access to complete, free and compulsory universal basic education (up to Junior Secondary School) of good quality by the year 2015 (NEEDS, 2004). Households with missing data or incorrect information on any of the indicator variables were excluded from the sample.

Step 5: Applying the indicator-specific deprivation cutoff and counting the number of deprivation for each household

Following the deprivation counting approach of Alkire and Foster (2007), achievements of the fishing households in each dimensional indicator was measured against the cutoff value set for each of the thirteen (13) resultant variables on the basis of which households whose achievement levels were lower than the set cutoff values were counted as being deprived in the specific indicator. Those with achievements above the cutoff values were categorized as being non-deprived.

Step 6: Setting and applying the across-dimension identification cutoff (K) to obtain the set of poor households

Following the approach suggested by Alkire and Foster (2007, 2009) and Alkire and Seth (2008), the median value ($K = 8$) was chosen between the union ($K = 1$) and intersection ($K = 13$) values as a benchmark for the number of dimensions in which a household must be deprived in order to be considered multi-dimensionally poor. This cutoff was applied only to the deprived households after censoring away the set of non-deprived households. Households with an overall count of achievements below the cutoff value eight (8) were adjudged multi-dimensionally poor. This resulted into the profile of the poor and the dimensions in which they are deprived.

Step 7: Calculating the headcount ratio (H); average poverty gap (A) and multidimensional poverty index (M_0).

The headcount (H) is the proportion of the households that were poor, computed by dividing the number of poor households by the total number of households. The average poverty gap (A) is the number of deprivations suffered by a poor household, computed by adding the proportion of total deprivations each household suffers and dividing by the total number of poor households. The adjusted headcount ratio (M_0) is the product of H and A to reflect the breadth or extent of deprivation.

3.4.2 M_0 decomposition by dimension

The adjusted headcount ratio (M_0) was decomposed by the five dimensions to examine the relative contribution of each of the dimensions to the overall household multi-dimensional poverty level.

3.5 Methods of data analysis

3.5.1 Incidence of welfare deprivation among the fishing households

Achieving this objective involved identifying the number of welfare deprivations suffered by the fishing households, starting with an identification function $\rho(y;z)$ yielding the set $Z \subseteq \{1,\ldots,n\}$ of households who are poor in y given z, where:

y = household deprivation vector, and

z = vector of dimensional deprivation cutoff

$\rho(y_i;z)$ = 1 if household i is poor, and $\rho(y_i;z)$ = 0 if otherwise.

$g^0 = \left[g_{ij}^0\right]$ is an $n \times d$ matrix of deprivations associated with y, where $g_{ij}^0 = 1 \ (= w_j)$ when $y_{ij} < z_j$, and $g_{ij}^0 = 0$ when $y_{ij} \geq z_j$ (i and j represent individual household and dimension, respectively).

The i^{th} row vector of g^0, denoted by g_i^0, is the *deprivation vector* for the i^{th} household. From matrix g^0 a column vector c of *deprivation counts* was constructed whose i^{th} entry $c_i = \left|g_i^0\right| = \sum_{j=1}^{d} g_{ij}^0$ is the *sum of weighted deprivations suffered by household i.* The vector c identifies the number of welfare dimensions in which the poor households are deprived, which is the *incidence of deprivation*.

3.5.2 Welfare variables reduction using the Multiple Correspondence Analysis (MCA)

The Multiple Correspondence Analysis (MCA) factor reduction techniques was adopted in rescaling numerically the set of categorical ordinal indicators. The MCA is the most preferred multivariate statistical technique for constructing the weighting schemes required for the desired reduction process for the sixteen (16) initial welfare variables, as outlined in Appendix II (following the method adopted by Delhey *et al*., 2001).

The duality property of the MCA provides the analytical basis for allowing the simultaneous representation of the individual households in the same factorial plane, often aggregated in socio-economic groups, and of the columns poverty indicators, given as:

$$F_\alpha^i = \frac{\sum_{k=i}^{k} \sum_{jk=1}^{Jk} \frac{W_{jk}^{\alpha,k}}{\sqrt{\lambda_\alpha}} I_{i,jk}^k}{K} \qquad (77)$$

The composite poverty score of a population unit is the simple average of the standardized factorial weights of the K poverty categories to which it belongs. By the additive reciprocation, the weight of a given poverty category is the simple average of the standardized composite poverty scores of the population units belonging to the corresponding poverty group:

$$W_{jk}^{\alpha,k} = \frac{\sum_{i=1}^{N_{jk}} \frac{F_\alpha^i}{\sqrt{\lambda_\alpha}}}{N_{jk}^k} \qquad (78)$$

where:

K = number of categorical indicators

Jk = number of categories for indicator k

$W_{jk}^{\alpha,k}$ = the score of category jk on the factorial axis α (non-normalised)

$I_{i,jk}^{k}$ = the binary variable 0/1 taking the value 1 when the unit i has the category jk.

F_{α}^{i} = the score (non-normalized) of observation i on the factorial axis α.

Given i as the index of a given household, and C_i its CIP value of the functional form:

$$C_i = \frac{\sum_{k=1}^{K}\sum_{jk=1}^{J_k} W_{jk}^{Ik} I_{jk}^{k}}{K} \qquad (79)$$

The CIP value for any household m simply corresponds to the mean of standardized scores of categorical variables. The weight of a category is the mean of standardized scores of population units belonging to that category.

With all the variable categories transformed into binary indicators coded as 0 or 1, giving a total of P binary indicators, the CIP for a given household i, was then expressed as:

$$CIP_i = \frac{1}{K}\left(W_1 I_{i1} + W_2 I_{i2} + \ldots + W_P I_{iP}\right) \qquad (80)$$

Wp = the weight (score of the first standardized axis, $\frac{score}{\sqrt{\lambda_1}}$) of category p; λ1 being the first Eigen value; and Ip, $p = 1$ *à* p: binary indicator 0/1, which takes on the value of 1 when the household possesses category p, and 0 otherwise. The most deprived category for I_k always has a weight equal to zero, and the weight given to any superior category j_k, strictly positive, represents the *gain in* total *poverty reduction*, as measured on axis α, when an individual can get out of the most deprived status in the primary indicator I_k by accessing the status j_k, $k > 1$.

3.5.3 Multi-dimensional poverty measures

In order to profile poverty of the fishing households, multi-dimensional poverty measures were computed, following Bourguignon and Chakravarty (2003), as used by Alkire and Foster (2007) and Alkire and Santos (2010). The multi-dimensional poverty measures are defined as:

$$M_{\alpha} = \mu\left(g^{\alpha}(k)\right) \text{ for } \alpha \geq 0 \qquad (81)$$

where α is a poverty aversion parameter which takes on values 0, 1, or 2. The general form of the dimension-adjusted poverty index (MPI) is denoted by $M_\alpha(y;z)$, where *y* represents the household's level of achievement in any given indicator, and z represents the dimension-specific cut-off for the indicator.

In another expression, $$M_\alpha = \frac{|g^\alpha(k)|}{nd} \quad (82)$$

where d represents the number of dimensions and n is the total number of sampled households. The variable g^α is an $n \times d$ matrix whose ij^{th} entry is 1 when household *i* is deprived in the j^{th} dimension, and 0 otherwise, with i^{th} row vector g_i^α being the household *i*'s *deprivation vector*. In this case, M_α is defined as the quotient of the sum of the α powers of the normalized gaps of the poor and the highest possible value for this sum.

When $\alpha = 0$, $$M_0 = \mu\left(g^0(k)\right) \quad (83)$$

The notation μ portrays M_0 as the mean of the matrix $g^0(k)$,

that is, $$M_0 = \frac{|g^0(k)|}{nd} \quad (84)$$

where *n* and *d* are number of sampled observation and dimensions, respectively.

M_0 is a product of two quantities, the deprivation share *A* given as: $A = |c(k)|/(qd)$, and *H*, incidence of multi-dimensional poverty, $H = \frac{q}{n}$

Thus,

$$M_o = HA = \mu(g^0(k)) \quad (85)$$

where $q = q(y;z)$ is the number of poor households in the set Z_k, and hence the number of households identified to be multi-dimensionally deprived based on the dual cutoff criterion, ρ_k. The notation $c_i(k)/d$ represents the fraction of weighted indicators in which the poor household *i* is deprived given the cut-off *k*. M_0 is thus the dimension-adjusted Headcount Ratio. When $\alpha = 1$, the dimension-adjusted poverty gap, $M_1(y;z)$ results, defined as:

$$M_1 = HAG = \mu(g^1(k)) \quad (86)$$

G = *average poverty gap* across all dimensions in which the poor households are deprived, given as:

$$G = |g^1(k)| / |g^0(k)| \quad (87)$$

where $g^1(k)$ is a censored matrix defined by $g^1_{ij}(k) = 0$ if $c_i < k$ and $g^1_{ij}(k) = g^1_{ij}$ if $c_i \geq k$, so that $g^1(k)$ only includes the deprivations of the poor.

When $\alpha = 2$, the dimension-adjusted poverty severity $M_2(y;z)$ results, expressed as

$$M_2 = HAS = \mu(g^2(k)) \quad (88)$$

where S = average severity of deprivation across all dimensions in which the poor households are deprived,

$$S = |g^2(k)| / |g^0(k)| \quad (89)$$

For any defined increase in deprivation, the M_2 measure registers a greater impact the larger the initial level of deprivation. Indeed, $M_2 = (M_1)^2 + V$, where V is the variance among all normalized gaps given as:

$$V = \sum_i \sum_j \left((\mu(g^{'}) - g^{'}_{ij}\right)^2 / nd \quad (90)$$

In terms of the deprivation vector c, $M_2 = (M_1)^2 \lfloor 1 + C^2 \rfloor$, where $C^2 = V / (\mu(g^{'}))^2$ (91)

In order to compare the multi-dimensional poverty estimates with those generated using the uni-dimensional approach, the Foster, Greer and Thorbecke (FGT) (1984) weighted poverty measures were computed following the income-expenditure approaches of scholars like Gibson, 2001; Mukherjee and Benson, 2003; and Idowu, 2011). The FGT measure is specified as:

$$P_\alpha(y,z) = \frac{1}{n} \sum_{i=1}^{q} \left(\frac{Z - y_i}{Z} \right)^\alpha \quad (92)$$

where:

n = total number of households in the referenced population

q = the number of poor households in the population

Z = an absolute poverty line, determined by finding the two-third mean per capita household monthly expenditure.

y_i = household per capita expenditure

α = poverty aversion parameter, taking on value 0,1 or 2.

When α = 0,1 and 2, the FGT expression reduces to the headcount ratio (poverty incidence), poverty depth and poverty severity respectively. These FGT poverty estimates were compared to the multi-dimensional poverty estimates for the purpose of validating the true multi-dimensional poverty nature of the coastal households.

3.5.4 Contribution of dimensional deprivation to households' poverty level

Once identification process is achieved, M_0 can be broken down by dimensions. To decompose the multi-dimensional poverty index M_0 by population subgroups and welfare dimensions, the expression:

$$M_0(x,y;z) = \frac{n(x)}{n(x,y)} M_0(x,z) + \frac{n(y)}{n(x,y)} M_0(y,z) \quad (93)$$

was used, where *x* and *y* correspond to two population subgroups of size *n*(x) and *n*(y).
Since *M0* can also be expressed as:

$$M_0 = \sum_{j=1}^{d} \mu\left(g_{*j}^0(k)\right)/d \quad (94)$$

where $g_{*j}^0(k)$ is the j^{th} column of the censored matrix $g^0(k)$. The contribution of dimension *j* to multi-dimensional poverty is thus expressed as:

$$Contr_j = \left(\mu\left(g_{*j}^0(k)\right)/d\right)/M_0 \quad (95)$$

The relative contribution of each dimension to overall multi-dimensional poverty provides useful information on group or regional deprivation configuration which are instrumental for policy design targeted at the poor in society.

3.5.5 Determinants of households' multi-dimensional deprivation level

3.5.5.1 Determinants of households' multi-dimensional deprivation in specific welfare dimensions

The Tobit regression model was applied in estimating the determinants of multi-dimensional deprivation in each of the five (5) welfare dimensions stipulated in this study (Appendix II). The dependent variable used in the Tobit model for each of the five welfare dimensions was determined using the dimension-specific cutoff value (Z_i). Following the observation of Tobin (1958) and Blundell and Mhegur (2002), the Tobit estimation was suitable. The Tobit regression model (following Sardar, *et al.*, 2008; Oyekale and Okunmadewa, 2008) was specified as:

$$Y_{ij} = M_{ij} = w + \beta_i X_i + \ell_i \quad (96)$$

where

$$Y_{ij} = 0 \text{ for } M_{ij} < V_{k=8} \quad (97)$$

$$Y_{ij} > 0 \text{ for } M_{ij} \geq V_{k=8} \quad (98)$$

M_{ij} is the multi-dimensional deprivation value of *ith* household for each of the *jth* welfare dimensions (dependent variable); w is the intercept; β_i are the parameters to be estimated; $V_{k=8}$ is the deprivation value at the $k=8$ dual cutoff deprivation benchmark and ℓ_i the independently distributed error term. $X_i \ldots X_n$ represent vector of socioeconomic and demographic variables hypothesized to determine the level of household multi-dimensional deprivation, including:

AGE = Age of the household head (years)

AGESQ = Squared age of the household head (years)

GENDER = Gender of the household head where (female = 1; 0 otherwise).

HHSIZE = Household size (Number).

DEPRAT = Dependency ratio (ratio of non-working to all members of the household).

FAMTYP = Family type (polygamous = 1; 0 otherwise).

HHINC = Total monthly household income (₦).

EXTREM = Total monthly external remittances to the household (₦).

EMPFIS = Employment status of household head in fishing/on-shore natural resource collection (fulltime = 1; 0 otherwise).

SPCHWK = Spouse or at least a household child engaged in fishing and (or) natural resource collection activities (Yes =1; 0 otherwise).

CANOES = Type of canoe used by the household (dugout canoe = 1; 0 otherwise).

LANDSZ = Size of farmland cultivated by the household (Ha).

HOULOC = Location of house relative to water bodies (core coastal =1; 0 otherwise).

DSROAD = Trekking distance from house to the nearest main road (m).

DSFDMKT = Trekking distance from house to the nearest food market (m).

DSNFMKT = Trekking distance from house to the nearest non-food market (m).

Education variables (Reference category: no formal education)

PRYEDU = Highest educational status of the household (primary education = 1; 0 otherwise).

JSSEDU = Highest educational status of the household (junior secondary education = 1; 0 otherwise).

SSVEDU = Highest educational status of the household (secondary/vocational education = 1; 0 otherwise).

TRTEDU = Highest educational status of the household (tertiary education = 1; 0 otherwise).

Primary occupation variables (Reference category: formal sector employment).

FISNAT = Primary occupation of the household head (fishing/on-shore natural resource collection = 1; 0 0therwise).

OFSHFA = Engagement of household head in off-shore land-based farming (Engaged = 1; 0 otherwise).

State dummy variables ([3]Reference category: Lagos State)

OGUNST = Location of household within southwestern zone (Ogun State =1; 0 otherwise).

ONDOST = Location of household within southwestern zone (Ondo State =1; 0 otherwise).

The description, justification and expected signs of hypothesized explanatory variables are shown in Appendices VI, VII and VIII.

To generate a composite index to be used as dependent variable in dimensions where two or more welfare indicators were combined (specifically Household Health Condition Index; Food/Nutrition Index; Living Condition Indices - Sanitation Index and Basic Assets Index - and Social Integration Index, principal component analysis (PCA) was used (following Speder, 2002). Technically, a principal component is a linear combination of optimally-weighted observed variables. It is a multivariate statistical tool that allows a set of observed variables to be reduced into a smaller set of artificial variables called *principal components*, which may then be used in subsequent analyses. In performing the PCA, a score was calculated for each household on the given principal component to compute an aggregate index for the welfare attributes of the sampled households.

The actual scores on the welfare variables selected from each dimension were optimally weighted and then summed to compute their scores on a given component, by using a special

[3] Residency in Lagos State is taken as reference category as one having the highest poverty incidence among the three states under study (UNICEF, 2011) and also buttressed by Oyekale and Oyekale (2013).

type of equation called an Eigen equation. The resulting linear combination that explains the maximum amount of variation is the *first principal component*. The weights are created so as to satisfy a principle of least squares similar (but not identical) to the principle of least squares used in multiple regression. The PCA expression is as given below:

$$PC_1 = b_{11}X_1 + b_{12}X_2 + \ldots + b_{1p}X_p \qquad (99)$$

where:

PC_1 = the household's score on principal component 1 (the first component extracted)

b_{1p} = the regression coefficient (or weight) for observed variable p, as used in creating PC_1

X_p = the household's score on observed variable p.

The indicators and their attached weights are as presented under the indicator-specific cutoff criterion (Appendix IV).

3.5.5.2 Determinants of households' multi-dimensional poverty incidence

To estimate the probability of households being multi-dimensionally poor in the study area, the logit regression model was used, following the procedure proposed by Yun (2004). Generally, the logit model assumes the form:

$$g(P_i) = \frac{Log(P_i)}{1-P_i} = \sum_{l=1}^{L} X_l \delta_l + \sum_{m=1}^{M} \sum_{k_m=2}^{K_m} D_{mk_m} \beta_{mk_m} \qquad (100)$$

where:

$$P_i = P\left(Y_i = 1 \middle/ X_l = 1 \middle/ D_{mk_m}\right) = \frac{\exp\left(\sum_{l=1}^{L} X_l \delta_l + \sum_{m=1}^{M} \sum_{k_m=2}^{K_m} D_{mk_m} \beta_{mk_m}\right)}{1+\exp\left(\sum_{l=1}^{L} X_l \delta_l + \sum_{m=1}^{M} \sum_{k_m=2}^{K_m} D_{mk_m} \beta_{mk_m}\right)} \qquad (101)$$

which, following Yun (2005b) is transformed into a linearised form expressed in the form:

$$P = F\left\{\alpha + \sum_{l=1}^{L} X_l \hat{\delta}_l + \sum_{m=1}^{M} \sum_{k_m=2}^{K_m} D_{mk_m} \hat{\beta}_{mk_m}\right\} \qquad (102)$$

to overcome the path dependency problem arising with the use of dichotomous variables. P is an unobservable latent variable for a household being multi-dimensionally poor, taking on the observed binary value 1 if the household is poor; and 0 otherwise. The probability that P assumes value 1 is given as:

$$\text{Prob.}(P=1)=\frac{\varepsilon^{\sigma i}+\delta_l^{X_l}\beta_{mk_m}^{D_{mk_m}}}{1+\varepsilon^{\sigma_i+\delta_l X_l+\beta_{mk_m}D_{mk_m}}} \quad (103)$$

α represents the effect of unobserved factors in the model.

$\hat{\delta}_l$ and $\hat{\beta}_{mk_k}$ are parameters to be estimated.

With some adjustments, the likelihood function becomes

$$P^*=F\left\{\alpha^*+\sum_{l=1}^{L}X_l\hat{\delta}_l^*+\sum_{m=1}^{M}\sum_{k_m=2}^{K_m}D_{mk_m}\hat{\beta}_{mk_m}^*\right\} \quad (104)$$

With its parameters defined as:

$$\alpha^*=\alpha+\sum_{m=1}^{M}\overline{\hat{\beta}_m} \quad (105)$$

$$\hat{\delta}_l^*=\hat{\delta}_i, i=1,K,L \quad (116)$$

$$\hat{\beta}_{mk_m}^*=\hat{\beta}_{mk_m}-\overline{\hat{\beta}_m}, k_m=1,K,K_m, m=1,K,M \quad (107)$$

The same set of explanatory variables as specified for the Tobit model above was also used for the Logit model. D_{mk_m} is a vector of *M (=3)* sets of categorical (education, primary occupation and state of residence) variables in the model, the m^{th} set having K_m categories and K_m-1 variables.

CHAPTER FOUR

SOCIOECONOMIC CHARACTERISTICS OF THE COASTAL HOUSEHOLDS.

This chapter presents descriptive statistics for socioeconomic characteristics of the households, household heads and community variables using simple frequency tables. Percentage distribution of specific socioeconomic characteristics and the implications of the findings for analyzing the multi-dimensional poverty of the fishing households are also discussed.

4.1 Households' socio-economic and welfare characteristics.

This section presents the frequency distribution of selected socioeconomic characteristics of household heads, fishing households and the communities in which the households are based. Frequency distribution of the sixteen welfare indicators among the fishing households is also presented.

4.1.1 Socioeconomic characteristics of household heads

The socioeconomic characteristics of household heads are presented on Table 1, using simple descriptive frequency and percentage. The majority (about 72%) of the household heads were male, mostly polygamous (about 39%) with mean age of 46 ± 10.94 years. This finding implies that most heads of the fishing households were in their active years, with the tendency of having large households, a situation that may worsen the welfare status of their households. About 68% of the household heads were engaged in fishing and onshore natural resource collection activities, in which sub-sector up to 70% of the household heads had acquired practical experience for at least 10 years. Only 142 (about 32%) of the household heads engaged in off-shore agricultural activities, mainly crop farming, 81.92% of whom had cultivated less than 2 hectares of farm land in the 2009/2010 cropping season.

Table 1: Frequency distribution of household heads

Characteristic	Frequency	Percentage (%)
Age of Household Head (in Years)		
< 31	63	14.06
31 – 40	63	14.06
41 – 50	175	39.06
51 – 60	108	24.11
> 60	39	8.71
Total	*448*	*100.00*
Mean = 46	*S.D = 10.94*	
Gender of Household Head		
Male	323	72.10
Female	125	27.90
Total	*448*	*100.00*
Marital Status		
Single	65	14.51
Married (monogamous)	125	27.90
Married (polygamous)	174	38.84
Separated/Divorced	41	9.15
Widowed	43	9.60
Total	448	100.00
Primary Occupation of Household Head		
Fishing/Natural Resource Collection	306	68.30
Offshore Activities	142	31.70
Total	448	100.00
Years of Experience of Household Head in Fishing/Natural Resource Collection		
< 10	134	29.91
10 – 20	91	20.31
21 – 30	118	26.33
31 – 40	83	18.53
41 – 50	21	4.69
> 50	1	0.22
Total	*448*	*100.00*
Size of Farmland cultivated by Household Head in the 2009/2010 cropping season (Ha.)		
< 2.00	367	81.92
2.00 – 4.00	75	16.74
> 4.00	6	1.34
Total	*448*	*100.00*
Mean = 0.5	*S.D = 1.143*	

Source: Author's Computations from surveyed data, 2010

4.1.2 Socioeconomic characteristics of fishing households.

Table 2 presents the socioeconomic characteristics of sampled fishing households, using simple descriptive frequency and percentage tool. As indicated on Table 2, the mean household size was 5 with medium-sized households having between 7 and 12 members making the largest percentage of about 45%. About 84% of the households had members that were non-working as a result of under-age, over-age or other factors; while 77.46% and 94.42% had a maximum of ₦50,000 either as monthly income or external remittance.

The larger proportion (about 71%) of the households did not meet the policy of the Federal Government of Nigeria (FGN) on minimum educational attainment of Junior Secondary School (that is 9 years of formal education) (NEEDS, 2004) with only about 9% of them having members with tertiary education. This reflects a gross educational deprivation among the respondent households.

Table 2: Frequency distribution of households' socio-economic characteristics

Characteristic	Frequency	Percentage (%)
Household Size		
< 6	199	44.42
6 – 12	202	45.09
> 12	47	10.49
Total	*448*	*100.00*
Mean = 5	*S.D = 3.0168*	
Household Dependency Ratio		
0	71	15.85
0.1 - 0.50	303	67.63
0.6 - 1.0	74	16.52
Total	*448*	*100.00*
Mean = 0.41	*S.D = 0.4263*	
Highest Formal Education among Household members		
No Formal Education	80	17.86
Primary Education	169	37.72
Junior Secondary Education	68	15.18
Senior Secondary/Voc. Education	94	20.98
Tertiary Education	37	8.6
Total	*448*	*100.00*
Spouse/Child(ren) working (working members other than Household Head)		
Yes	377	84.15
No	71	15.85
Total	*448*	*100.00*
Monthly Household Income (₦)		
< 10,000	37	8.26
10,000 - 50,000	310	69.20
50,001 - 100,000	89	19.87
100,001 - 150,000	12	2.68
Total	*448*	*100.00*
Mean = ₦37,115.94.00	*S.D = ₦23,298.97*	
Monthly External Remittances (₦)		
< 10,000	349	77.90
10,000 - 50,000	74	16.52
> 50,000	25	5.58
Total	*448*	*100.00*
Mean = ₦13,909.00	*S.D = ₦9475.69*	

Source: Author's Computations from surveyed data, 2010

4.1.3 Socioeconomic characteristics of households by community variables

Table 3 presents the socioeconomic characteristics of sampled fishing households by selected variables in the communities of location, using simple descriptive frequency and percentage tool. Table 3 shows that 34% of the households were core-coastal (either having their houses built directly on the water bodies or built within 100 metres away from the shores), most (99%; 79% and 96%) of which were located within trekking distance of 5 kilometres away from the nearest food market, non-food market and major road, respectively.

Table 3: Socio-economic characteristics of households by community variables

Characteristic	Frequency	Percentage (%)
House Location (with respect to water bodies)		
Core Coastal	151	33.71
Non-core Coastal	297	66.29
Total	*448*	*100.00*
Trekking Distance to Nearest Food Market (Km)		
< 2.0	301	67.19
2.0 - 5.0	146	32.59
> 5.00	1	0.22
Total *Mean = 1.9 Km*	*448* *S.D = 0.766*	*100.00*
Trekking Distance to Nearest Non-Food Market (Km)		
< 2.0	120	26.79
2.0 - 5.0	234	52.23
> 5.00	94	20.98
Total *Mean = 1.9 Km*	*448* *S.D = 0.766*	*100.00*
Trekking Distance to the Nearest Major Road (Km)		
< 5.00	431	96.21
5.00 – 10.00	11	2.46
> 10.00	6	1.34
Total *Mean = 1.06*	*448* *S.D = 0.3456*	*100.00*
Location of H/Hold by State		
Ogun	136	30.36
Ondo	129	28.80
Lagos	183	40.85
Total	*448*	*100.00*

Source: Author's Computations from surveyed data, 2010

4.1.4 Distribution of welfare indicators among the fishing households.

The distribution of welfare indicator variables among the surveyed fishing households is presented in Tables 4 and 5. The tables show the percentage distribution of the sixteen (16) welfare indicators used in the study for determining household deprivation and multi-dimensional poverty, by categories. Twelve out of the sixteen welfare variables initially proposed for this study are presented in Table 4 with their indicator categories (excluding years of formal schooling which had been presented on Table 2). Table 4 shows that, at least some (or all) of the school-age children (6-15 years) in over 80% of the fishing households are currently out of school. The parents cited the need to introduce the children to fishing activities early enough as the major reason for not enrolling them in school (Table 2 has already shown that 84.15% of the households had either their spouses and/or at least one of their school-age children engaged in income-generating activities).

As for the health dimension, about 61% of the fishing households had poor or at best a fair health status with only 36% and 7% of the respondent households visiting a registered health care institution and (or) using bednets/insecticides to reduce incidence of malaria attack on their family members, respectively. About 67% of the households experienced problems of food insufficiency leaving as much as 73% of the households with less than three major meals per day. The degree of deprivation was highest among core-coastal households, as most of them defecate (48%) and dump refuse (55%) directly into the surrounding water, yards, or nearby bush. This is predominant among households in Lagos and Ondo States, where many of the sampled households owned houses built directly over water or along river banks.

Table 4: Percentage distribution of welfare indicators among surveyed households

Welfare Indicator	Frequency	Percentage (%)
All children of school age enrolled in school		
No	359	80.13
Yes	89	19.87
Total	*448*	*100*
Malaria treatment/control method		
Traditional/Religious	153	34.15
Self medication	101	22.54
Public and (or) private hospitals	161	35.98
Bed net/Insecticides	33	7.37
Total	*448*	*100*
Self-reported Health		
Poor	77	17.19
Fair	196	43.75
Good/sound	81	18.08
Excellent	94	20.98
Total	*448*	*100*
Food availability		
Severely insufficient (<1/3 MPCFE)	118	26.34
Moderately insufficient (<2/3 MPCFE)	182	40.63
Sufficient (>2/3 MPCFE)	148	33.04
Total	*448*	*100*
Food adequacy		
Max. of one major meals per day	120	26.79
Av. of two major meals per day	207	46.21
At least three major meals per day	121	27.01
Total	*448*	*100*
Source of domestic lighting		
Kerosine lamp (with/without shade)	307	68.53
Battery lamp	79	17.63
Electricity/Generator	62	13.84
Total	*448*	*100*
Toilet facility		
Into water/bush/yard	213	47.54
Pit/unprotected toilet	187	41.74
WC/protected toilet	48	10.71
Total	*448*	*100*
Solid waste disposal methods		
Into river/ditches/bushes	245	54.69
In pits (for burning/decomposition)	126	28.13
Collection bins	77	17.19
Total	*448*	*100*

Source: Author's Computations from surveyed data, 2010

As shown in Table 5, only a few of the households had the materials of their floor and wall concreted or made of cement (5.57%); most of them (72.77%) had houses with wall made from sacs, planks or iron sheets and about 45.76% of the houses built with wooden floor erected directly over the waters. With respect to the dimension of household living condition, the majority of the fishing households were non-deprived. Households that generated energy for domestic lighting and cooking from unhygienic sources (unshaded kerosene lamps and firewood/charcoal) were only about 12% and 32%, respectively. Only 14% of the households either had no access to electricity or were without generator for domestic lighting.

The majority (74.78%) of the households did not possess basic assets (radio, television sets, among others) as well as other means of transport (such as cars, motorcycles and bikes) apart from canoes which only a few (about 23%) households possessed. Perhaps due to their coastal location, 63% of the households obtained drinking water from nearby lakes, streams, lagoons, unprotected wells and rainfalls. Table 5 also portrays the fishing households as having strong socio-political affiliation as about 85% and 92% of them were actively involved in grass-roots politics and community development projects, respectively. Prominent among identified community development projects often embarked upon by members of the households was construction of wooden bridge networks across waters, which they engaged in periodically within their residential areas, especially during the rainy seasons.

Table 5: Percentage distribution of welfare indicators among surveyed households (cont'd)

Welfare Indicator	Frequency	Percentage (%)
Material of the wall		
Plant material/sack	49	10.94
Iron sheet	111	24.78
Planks/bamboo	166	37.05
Mud	97	21.65
Cement	25	5.58
Total	*448*	*100*
Material of the floor		
Covered by shrubs/straws/bare sand	134	29.91
Covered by mud/red earth	84	18.75
Covered by planks or bamboo over water	205	45.76
Total	*448*	*100*
Source of drinking water		
Lake/stream/lagoon	95	21.21
Rain water	92	20.54
Protected wells/boreholes	72	16.07
Pipe-borne	94	20.98
Total	*448*	*100*
Fuel for cooking		
Firewood/charcoal	145	32.37
Kerosene stove	64	36.61
Gas	16	3.57
Electricity	123	27.46
Total	*448*	*100*
Possession of basic and transport assets		
No	335	74.78
Yes	113	25.22
Total	*448*	*100*
Household member(s) actively involved in politics		
No	69	15.40
Yes	379	84.60
Total	*448*	*100*
Household member (s) involved in community development projects		
No	26	5.80
Yes	422	94.20
Total	*448*	*100*

Source: Author's computations from surveyed data, 2010

4.2 Household deprivation profile

In this section, descriptive statistics are used to present households' deprivation counts. In addition, descriptive tables are used to profile the fishing households according to selected socio-economic characteristics of the households and household heads. The Tobit model is used to estimate the determinants of deprivation in the five dimensions to which the thirteen welfare indicators belong.

4.2.1 Extent of households' welfare deprivation.

This section presents deprivation characteristics of the households with respect to the sixteen welfare indicators, including deprivation counts and incidence. Characteristics of deprived and non-deprived households are also compared using a simple t-test statistics. Lastly, households' deprivation profile is constructed by selected socio-economic characteristics

4.2.1.1 Household deprivation characteristics

Table 6 presents a profile of the sixteen (16) welfare indicators and the level of deprivation of households in each of the indicators. The procedures highlighted in section 2.2.3 were followed to identify households' enforced lack and socially defined necessities. The definition of deprivation as 'lack of basic necessities' is central to determining households' deprivation characteristics. The first step in examining the characteristics was to identify a set of items that was widely regarded as necessities but unaffordable to the households. The sample responses were collated and expressed in percentages.

Table 6: Profile of welfare indicators by extent of household deprivation (n = 448)

Welfare Indicators	% of h/holds lacking	% of h/holds experiencing enforced lack	% of h/holds stating necessity
H/hold member(s) with 9 years of education	56	36	52
Enrolled all children aged 6-15years in school	80	47	58
Uses hygienic mosquito prevention methods	77	12	54
Having 'good/sound' health condition	61	29	97
Food Availability (H/Hold spends at least two-third MPCFE[4])	67	55	82
Food Adequacy (H/Hold member aged 6-15 years eat average of two quality meals/day	27	41	91
House connected to modern power source	12	3	50
H/hold uses modern toilet	89	18	66
House floor made of concrete/tiles	94	46	49
H/hold uses hygienic water source	84	43	45
H/hold has basic assets[5]/means of transportation	75	31	81
H/hold has a political member	15	29	55
H/hold member(s) involved in community work	6	22	76

Source: Author's computations from surveyed data, 2010

[4] MPCFE is mean per capita food expenditure (see Appendix IV, Number 5)

[5] Assets considered are assumed to be the minimum basic that enables socially acceptable household functioning relating to information, communication, comfort, good public appearance and mobility.

The more widely lacked welfare-enhancing commodities tended to be more generally regarded as necessities by the respondent households, with the exemption of food adequacy (for household children) and access of households to acceptable source(s) of domestic lighting, which 91% and 50% of the households regarded as a necessity; those items were possessed by 73% and 88% of the households, respectively. For concrete/tiled floor as well as access to improved water source, only 49% and 45% of the households regarded them as a necessity but 94% and 84% respectively of them lacked those items.

Considering the observed characteristics of deprivation among the respondents, only 3% of the few households experiencing a lack in domestic lighting reported enforced lack (that is, they would like to enjoy power supply but could not afford the charges). This follows *a priori* expectation given the fact that many of the surveyed coastal communities have been connected to the power grid. Even where power supply was epileptic, access to domestic generator or, at the worst, a shade lamp for indoor lighting was not a major task for most households. A similar pattern was noticed for methods of malaria treatment and household-level participation in community-development activities, in which 12% and 22% respectively experienced enforced lack.

The most critical items among the categories of enforced lack are food availability (55%) and food adequacy for household children (41%), which as many as 82% and 91% of the households, respectively, regarded as a necessity. Also alarming is the case of education indicators (year of formal education and child enrolment in school) which 52% and 58% of the households identified as being socially necessary but in which 36% and 47%, respectively, were experiencing enforced lack.

4.2.1.2 Comparative statistics of deprived and non-deprived households by the distribution of welfare indicators

The descriptive statistics of deprived and non-deprived households were compared and test of differences in the mean values of welfare variables was carried out using the t-test statistics. Results are presented in Table 7.

Table 7: Comparative characteristics of deprived and non-deprived households

Welfare Variable	*Welfare Benchmark*	**Deprived Households**			**Non- Deprived Households**			**t-value**
		Freq.	***% of class in modality***	***% of class within modality***	***Freq.***	***% of class in modality***	***% of class within modality***	
Year of Schooling	< 9 years of education	249	55.58	58.36	199	44.42	42.74	-3.0390***
Child Enrolment	No school enrolment	359	80.13	53.20	89	19.87	56.18	-0.5032
Malaria treatment Method	Not using modern health facilities	153	34.15	56.86	295	65.85	52.20	-0.9369
Self-reported Health	Having poor health condition	273	60.94	56.41	175	39.06	49.71	-1.386
Food Expenditure	Below food poverty line	300	66.97	55.24	148	33.03	50.12	- 2.03**
No. of meals per day	Inadequate daily meals	120	26.79	47.69	328	73.21	54.83	1.0662
Domestic lighting	Primitive means of lighting	53	11.83	54.72	395	88.17	53.67	-0.1431
Toilet type	Unhygienic toilets	400	89.29	53.50	48	10.71	56.25	0.3603
Solid waste disposal	Not using hygienic means	304	67.86	54.99	144	32.14	48.05	-1.106
Wall material	Primitive wall materials	326	72.77	55.17	122	27.23	53.46	0.2865
Floor material	Primitive floor materials	423	94.42	54.46	25	5.58	40.91	-1.2425
Water source	Unhygienic	282	62.95	53.55	166	37.05	63.64	0.6617
Cooking fuel	Unhygienic	145	32.37	61.64	303	67.63	50.00	-1.326
Basic Assets	Have no basic h/hold assets	335	74.78	54.32	113	25.22	52.21	0.3893
Political Participation	No political influence	69	15.40	60.87	379	84.60	52.51	-1.2811
Participation in Comm. Dev. Projects	Not involved in community activities	26	5.80	50.00	422	94.20	54.03	0.3991

Source: Author's computations from surveyed data, 2010
**** and ** imply that variables are significant at 1% and 5% level, respectively.*

As shown in Table 7, fishing households were categorized as being deprived or otherwise on the basis of possession, accessibility or endowments. The deprived households are generally characterized by lack of welfare-enhancing goods and services. Proportions of fishing households that did not have access to the welfare endowments and (or) opportunities were relatively low. These welfare items are orthodox malaria treatment methods (34%); hygienic means of domestic lighting (12%) and cooking fuel (32%); adequate daily quality meals (27%); membership of political association (15%); and participation in community development projects (about 6%). On the contrary, the deprived households were generally lacking in hygienic means of sanitation (89%); sound health (61%); education (56%) and schooling (80%) opportunities; enriched feeding culture (67%); good housing condition; hygienic sources of drinking water (63%); basic household needs and a means of transportation other than dugout canoes (75%).

The non-deprived households had satisfactory access to the aforementioned welfare-enhancing endowments and opportunities, as equally shown in Table 7. Significant difference in the possession of welfare goods and services between deprived and non-deprived households exists in the year of formal education and the mean per capita food expenditure variables, at the 1% and 5% level, respectively. By implication, access to formal education (non-monetary factor) and amount of household monthly food expenditure (monetary factor) are a strong source of variation in the characteristics of deprived and non-deprived fishing households.

4.2.1.3 Households' deprivation counts

Table 8 presents the number and percentage of deprivations suffered by the fishing households, based on the *indicator-specific cutoff (z_j)* highlighted in Appendix IV. Following *a priori* expectation, none of the surveyed households suffered deprivation in exactly one or two welfare indicators, depicting the true multi-dimensional poverty status of the fishing households. Only three (1%); seven (2%) and twenty-one (5%) households suffered deprivation in exactly three, four and five dimensions, respectively. The percentage of the fishing households that experienced deprivation in exactly six (12%); seven (21%); eight (22%); nine (19%) and ten (14%) indicators was relatively larger than the other groups. Observably from Table 8, the greatest percentage (22%) of the households suffered deprivation in eight (62% of the total possible number of deprivation) indicators, beyond which the number of deprivations suffered diminished gradually. None of the households suffered multiple deprivation in as many as thirteen indicator variables.

Table 8: Distribution of households' deprivation counts

No. of deprivations suffered	% of total possible deprivation	Number of households	% of households
One	7.69	0	0
Two	15.38	0	0
Three	23.08	3	0.7
Four	30.77	7	1.6
Five	38.46	21	4.7
Six	46.15	52	11.6
Seven	53.85	95	21.2
Eight	61.54	100	22.3
Nine	69.23	85	19.0
Ten	76.93	61	13.6
Eleven	84.62	20	4.5
Twelve	92.31	4	0.9
Thirteen	100.00	0	0
Deprivation statistics: Mean = 8;		*Mode = 8;*	*Var. = 2.798*

Source: Author's computations from surveyed data, 2010

4.2.1.4 Incidence of multi-dimensional deprivation among fishing households

Incidence of multi-dimensional deprivation was a follow up on households' deprivations counts, based on the within-dimension *cutoff value, (k).* Summary statistics presented in Table 9 shows that the proportion of fishing households deprived in each dimension ranges from 6% for "participation in community development projects", to 98% for "source of drinking water". By implication, 94% of the fishing households participated in the various community development programmes as communal contributions to reduce suffering within the neighbourhood. Prominent among the projects reported were erection of passage planks on the flowing stream (common among core-coastal fishing households), onshore security surveillance against pilferages of fishing gadget and catches, and forming community self-help vigilant groups against criminal tendencies.

For the education, health and food/nutrition dimensions, households were more endowed in one (50%) of the two indicators making up each of those welfare dimensions. In about 71% of the surveyed households, none had a member with the minimum required universal basic education of nine years (Junior Secondary education) as set under the Nigerian education policy to achieve the second Millennium Development Goal (MDG2). However, only few (about 20%) of the households had their school-age children (6-15 years) not currently enrolled in school, implying that deprivation in the education dimension may only be temporary among the fishing households. Sixty-six (66%) of the households either visited registered hospitals, patronized drug sellers or used insecticide-treated bednets to treat/prevent malaria incidents, while about 61% of them had adult members with self-reported health status below average.

Table 9: Incidence of deprivation among fishing households *(k = 8)*

Welfare Dimension	*Welfare Indicator*	*Number of deprived households*	*Percentage of deprived households*	*% of dimension in which H/holds are non-deprived*
Education	Year of schooling	317	70.8 *(0.0215)*	50%
	Children school enrolment	89	*19.9 *(0.0189)*	
Health	Self-reported health	273	60.9 *(0.0230)*	50%
	Method of malaria treatment/control	153	*34.1 *(0.0224)*	
Food/Nutrition	No. of meals per day	65	*14.5 *(0.0167)*	50%
	Monthly food Expenditure	241	53.8 *(0.0236)*	
Household living condition	Material of the floor	443	94.4 *(0.0000)*	40%
	Domestic light	53	*11.8 *(0.0153)*	
	Toilet type	400	89.3 *(0.0146)*	
	Source of drinking water	437	97.5 *(0.0073)*	
	Household assets	113	*25.2 *(0.0205)*	
Social Integration	Political affiliation	69	*15.4 *(0.0171)*	100%
	Participation in community projects	26	*5.8 *(0.0111)*	

Figures in parentheses are the standard errors

* *Welfare indicators in which households were relatively more endowed compared to the 50 percentile*

Source: Author's computations from surveyed data, 2010

In terms of food adequacy, less than 15% of the households had children aged 6-15 years feeding on less than two major meals per day while food was available to close to 46% of the surveyed households. Obviously from Table 9, level of material deprivation was more prominent within the living condition dimension as only in two (basic assets and domestic lighting) of the five indicators were households not deprived, representing 40% of the indicators within this dimension. Only 3% of the households had access to drinking water from protected wells, boreholes or pipe-borne water. Most of the households (98%) obtained water from unprotected wells, springs, rivers, lagoons, rains, stagnant water and forest creeks that were common within their neighbourhood. All the households were, however, relatively endowed in the two indicators that make up the social integration dimension which is a reflection of high level of social capital among the fishing households in political and community development activities.

4.2.1.5 Households' deprivation profile by socio-economic characteristics

Table 10 shows the socioeconomic and demographic differences in the deprivation characteristics among the fishing households. The resulting five quintiles were labeled as Q_1 to Q_5, with Q_1 being the least deprived and Q_5 the most deprived segments of the sample of households, respectively. A cross-tabulation of the two welfare components with each other (each having 25 cells) produced households that were not deprived according to either of the two measures combined in a cross-table; which ones were deprived in one but not the other; and which ones were deprived according to both segments. For any two-component cross-table, cell Q_1Q_1 represents the most privileged, while cell Q_5Q_5 represents the most deprived households according to the combined welfare dimensions (Appendix V).

The pattern of material and social deprivation reflected in Table 10 shows both similarities and dissimilarities among the two deprivation components. Generally, the most deprived segments of the fishing households in terms of material component were more noticeable than the most privileged segments. Comparatively, there is not much difference in the proportion of most deprived households across the three states (Ogun, Ondo and Lagos States). For social network deprivation, a larger proportion of the households were more privileged across the three States with similar trend in their deprivation pattern.

Table 10 also shows the demographic pattern of the fishing households with respect to the two deprivation components. There was as twice as many materially deprived female-headed households as there were male-headed households. However, in terms of social

integration, more male-headed households were deprived. Polygamous households deprived in material variables were almost three times more than monogamous households that were so deprived, but in terms of social deprivation, a larger percentage (40%) of monogamous households were deprived. A decreasing percentage of the fishing households were associated with increasing educational achievement, but the reverse was almost the case with social deprivation. Households with increasing number of non-working members were more associated with material deprivations than other households, while it had no particular pattern of association with social deprivation.

The combined effect of the two dimensions of deprivation was shown in the pattern of their interactions with socioeconomic variables at the two extremes of the quintiles, Q_1Q_1 and Q_5Q_5. Pearson correlation coefficient (significant at 1% level) between the material and social deprivation components was (0.788). Interactions of the two components revealed an increasing deprivation proportion as household educational attainment decreased, with 7%, 5% and 5% of the most deprived households located in Lagos, Ondo and Ogun State, respectively. Similarly, female-headed households suffered more deprivation in the combined components.

Table 10: Characteristics of households by quintiles of material and social deprivation.

Characteristic → / ↓ Deprivation	Sex of H/hold Head		Household Dependency Ratio (DR)			Household Family type		Highest educational level within the household				State/Location of household		
	Male (%)	*Female* (%)	*0* (%)	*0<DR ≤0.5* (%)	*0.5<DR≤1* (%)	*Mono* (%)	*Polyg* (%)	*None* (%)	*1^0* (%)	*2^0* (%)	*3^0* (%)	*Og.* (%)	*Ond* (%)	*Lag.* (%)
Material														
QM1	10.94	4.02	5.13	1.12	8.75	11.38	3.57	3.79	7.14	3.79	0.22	2.46	5.13	7.37
QM2	13.62	5.36	3.57	2.01	13.39	13.39	5.58	0.67	6.70	9.15	2.46	5.36	5.13	8.48
QM3	10.27	3.56	2.90	2.90	7.81	10.71	2.90	1.12	2.23	7.59	2.68	2.90	2.90	7.81
QM4	3.79	0.67	2.01	0.89	1.56	3.13	1.34	0.25	0.22	2.68	1.56	1.56	0.89	2.01
QM5	18.08	44.20	9.82	12.05	40.40	14.51	47.77	28.57	16.7	16.0	0.89	20.50	19.8	21.88
Social														
QS1	36.61	16.07	8.04	10.27	34.38	39.96	12.72	14.29	26.3	11.6	0.45	17.19	18.3	17.19
QS2	13.62	4.24	4.24	2.01	11.83	13.62	4.24	1.79	5.13	9.15	1.79	4.91	4.24	8.71
QS3	9.38	3.13	1.56	2.23	1.56	9.15	3.35	0.68	3.80	5.80	2.23	3.34	3.13	6.03
QS4	4.24	2.01	2.01	3.13	3.13	5.13	1.12	0.45	0.67	3.79	134	1.33	1.34	3.57
QS5	1.12	0.67	0.89	0.22	0.67	1.35	0.45	0.67	0.22	0.67	0.89	0.67	0.22	0.89
Material & Social														
QM1QS1	3.57	4.24	0.67	0.22	7.37	15.85	12.95	26.12	1.34	5.13	4.46	8.04	1.56	4.24
QM5QS5	8.26	52.90	0.45	1.56	1.12	1.34	6.47	22.54	12.7	10.9	1.12	4.46	5.13	7.14

Source: Author's Computations from surveyed data, 2010.

Q_1: Least deprived population segment; Q_2: Less deprived population segment; Q_3:Deprived population segment; Q_4: More deprived population segment; and Q_5: Most deprived population segment.

Q_1Q_1 and Q_5Q_5 are most privileged and most deprived population segments, respectively, in the combined welfare components.

4.3 Determinants of households' multi-dimensional deprivation

This section explains factors that influenced the multi-dimensional deprivation status of the fishing households in the five welfare dimensions covered in this study, namely education; health; food and nutrition; standard of living and social affiliation. The standard of living dimension was divided into sub-dimensions – household sanitation and household living condition (basic assets) – for the purpose of simplicity. Maximum likelihood estimates (MLE) were generated to explain the influence of twenty-three included explanatory variables (Appendices VI-VIII) on dimension-specific deprivation status of the households. The dependent variable for each model was an aggregate index generated from the combined welfare indicators within each dimension, using the principal component analysis (PCA) as outlined in section 3.5.5.1.

4.3.1 Factors influencing households' deprivation in child school enrolment

Table 11 presents the determinants of households deprivation with regard to enrolment of children aged 6-15 years in school (related to MDGs 2 and 3; Targets 3 and 4), with Child School Enrolment Index as the dependent variable.

All the parameters of education variables were significant at the 1% level (although pre-secondary parameter had the unexpected sign) emphasizing the role of formal education in sustaining households' human capital development. Following *a priori* expectations, households with members having formal education appreciated the need for enrolling children in schools, as probability of deprivation in this welfare-enhancing dimension reduced by 0.022 and 0.027, with secondary and tertiary education attainment, respectively. The result underscores the fact that having household members with only Universal Basic Education (up to Junior Secondary School) was not enough assurance for giving necessary attention to human capital development needs of the households.

This finding is in consonance with previous studies which claim that parental educational level had a significant effect on the academic achievements of their children, particularly mother's educational level, which was reported to have 20% higher impact than the father's educational attainment on the academic outcomes of adolescents (Peters and Mullis, 1997). The reason adduced for this was the effect the mother's educational level has on the 'specific ways of talking, playing, interacting, and reading with young children at home (Smith *et al*., 1997).

Table 11: Maximum likelihood estimates of the Tobit regression for households deprivation in child school enrolment

Variable	Marginal Effect	Standard Deviation
HHSIZ	0.6203E-05	0.3072E-03
DEPRAT	- 0.5997E-05	0.1839E-04
FAMTYP	0.0055***	0.0021
AGE	- 0.0021***	0.0007
AGESQ	0.0028***	0.0007
GENDER	0.0124***	0.0021
PRYEDU	0.0154***	0.0023
JSSEDU	0.0262***	0.0033
SSVEDU	- 0.0223***	0.0025
TRTEDU	- 0.0265***	0.0029
FISNAT	0.0224***	0.0063
OFSHFA	0.0038	0.0028
EMPFIS	0.0025	0.0031
SPCHWK	0.0040	0.0026
HHINC	- 0.005**	0. 0023
EXTREM	- 0.1341E-06	0.9198E-07
CANOES	0.0018	0.0019
LANDSZ	-0.0047**	0.0021
HOULOC	0.0115***	0.0021
DSROAD	0.0002	0.0004
DSFDMKT	0.0022**	0.0011
DSNFMKT	-0.0007	0.0006
OGUNST	0.0123***	0.0046
ONDOST	0.0106***	0.0028
Constant	0.0829***	0.0183
Sigma (σ)	0.0179***	0.0006
	No. of obs. = 448	Log-lik. function = 1072.988
Dependent variable: Child School Enrolment Index.		

(*** p < .01; ** p < .05; and * p <0 .1)

Source: Author's computations from surveyed data, 2010

In line with the Millennium Development Goal 2, this results supports the Education For All (EFA) policy of the Federal Government of Nigeria (FGN); to have all children, particularly girls, to have access to complete, free and compulsory primary education of good quality by the year 2015 (NEEDS, 2004). This is also in consonance with the effect of the 'No Child Left Behind Law', a US educational policy that produced an overall positive impact on children educational development and closes the poverty achievement gaps among the citizens (Shields, 1991; Allington, 1991; and Phillips and Flashman, 2007).

In addition, engagement in onshore (fishing and natural resource collection) activities (FISNAT) ($p > 0.01$), having houses built on water or close to sea shores (HOULOC) ($p > 0.01$), belonging to a polygamous family (FAMTYP) ($p > 0.01$), as well as proximity of household to food market (DSFDMKT) ($p > 0.05$) weakly but significantly reduced likelihood of enrolling household school-age children in school by 0.022, 0.012, 0.006, and 0.002, respectively. This inverse relationship between engagement in onshore activities and child school enrolment confirms the findings of Morris *et al*. (2002) that only programmes which 'increase both parental employment and income have the tendency of improving the school achievements of their elementary school-age children'. Thus, children from fishing households may be consistently deprived in school enrolment and achievements unless they are introduced to other welfare-enhancing intervention programmes.

Older household heads had greater probability of enrolling their children in school by 0.002, although this tendency declined with additional increase in age as a result of the life cycle effects, as evident in the positive association of the age-square coefficient with the probability of deprivation in school enrolment for household children. Household wealth plays a significant role in ensuring possibility of reduction in school enrolment deprivation. A one naira increase in household income and an additional increase in the size of land owned by the fishing households had a significant (LANDSZ) ($p > 0.005$) reducing effect on school enrolment deprivation tendency by 0.005 and 0.005.

Fishing households in Ogun and Ondo States were less likely to enrol their children in school compared to those in Lagos State, both being significant at the 1% level. A study by Shields (1991) claims that students' achievements, particularly at-risk students, is affected by the norms, values and beliefs of the family and communities of their location, resulting in attitudes that reflect unpreparedness for the school environment. In this regards, previous studies (such as Redman, 2003; and Bergeson, 2006) have canvassed for the need to create stronger and better partnership between schools, families and communities while providing

better intervention programmes for students struggling with environmental barriers, especially in poverty-stricken areas.

4.3.2 Factors influencing households' deprivation in health condition.

Table 12 presents the determinants of deprivation in the health condition (related to MDG 6 Target 8) of fishing households, with Health Condition Index as the dependent variable. Having a member of the household with basic education up to primary and junior secondary school will reduce the likelihood of deprivation in health by 0.02 and 0.033, respectively at the 1% level, respectively. Engagement of household head in fishing/natural resource collection (FISNAT) ($p > 0.05$), offshore farming activities (OFSHFA) ($p > 0.01$), closeness of household to food market (DSFDMKT) ($p > 0.05$), as well as having houses built on water or close to sea shores (HOULOC) ($p > 0.01$) increased likelihood of household health deprivation by 0.0.008, 0.022, 0.003 and 0.014, in that order. In addition, households headed by female suffered the risk of health deprivation by 0.015 at the 1% level. As *a priori* expected, an additional increase in household wealth as proxied by size of land owned (LANDSZ) ($p > 0.1$) as well as a one naira increase in household income had the probability of reducing household health deprivation by 0.002, 0.004 and 0.119, respectively at 1%.

Table 12: Maximum likelihood estimates of the Tobit regression for households deprivation in health condition

Variable	Marginal Effect	Standard Deviation
HHSIZ	-0.3101E-05	0.0004
DEPRAT	-0.6047E-05	0.2331E-04
FAMTYP	0.0078***	0.0027
AGE	-0.0022**	0.0009
AGESQ	0.0030***	0.0009
GENDER	0.0154***	0.0026
PRYEDU	- 0.0200***	0.0029
JSSEDU	- 0.0334***	0.0042
SSVEDU	0.0105	0.0831
TRTEDU	0.0025	0.0537
FISNAT	0.0079**	0.0036
OFSHFA	0.0233**	0.0080
EMPFIS	0.0001	0.0040
SPCHWK	0.0045	0.0033
HHINC	- 0.119***	0.0103
EXTREM	-0.1092E-06	0.1166E-06
CANOES	0.0018	0.0024
LANDSZ	-0.0044*	0.0027
HOULOC	0.0140***	0.0026
DSROAD	0.0002	0.0005
DSFDMKT	0.0030**	0.0014
DSNFMKT	-0.0011	0.008
OGUNST	0.0161***	0.0059
ONDOST	0.0123***	0.0035
Constant	0.0491**	0.02313
Sigma (σ)	0.0227***	0.0008
	No. of obs. = 448	Log-lik. function = 959.7095
Dependent variable: H/hold Health Condition Index		

(*** p < .01; ** p < .05; and * p <0 .1)

Source: Author's computations from surveyed data, 2010

The negative relationship of age of household head ($p > 0.05$) with health deprivation tendency was not expected although the positive sign of the age-squared variable (0.003) suggested the likelihood of a worsening health condition as age of household head increased at the 1% level. Fishing households in Ogun and Ondo States were more likely to experience deprivation in health condition compared to those in Lagos State at the 1% level.

4.3.3 Factors influencing households' deprivation in food security

Factors influencing likelihood of deprivation in daily food intake (related to MDG 1) among fishing households is presented in Table 13. The model was estimated, with household Food/Nutrition Index as the dependent variable. Food availability (as proxied by the mean per capita household monthly food expenditure) and food adequacy (as proxied by the number of meals per day) were combined to generate the household Food/Nutrition index that served as regressand in the food security deprivation model. The sigma value (0.0246) showed a good fit of the data to the model specified to estimate determinants of food intake deprivation among the fishing households. Expectedly, a unit increase in household income, size of land owned and age of household head had the effect of reducing food intake deprivation by 0.0045, 0.0056 and 0.002, at the 1%, 5% and 10%, respectively.

The negative association between household wealth (income and land owned) and deprivation status is expected as wealthy households would be able to afford daily foods both in terms of adequacy and availability. The negative effect of age follows intuition as food consumption level of adult members of the household tend to fall with increase in age, in agreement with the life cycle hypothesis, freeing some foodstuffs for other members of the household. Households that have their houses located directly on water or close to the shore were significantly associated with increase in food intake deprivation at the 10% level. This may not be unconnected with the hardship that core-coastal fishing households experience in having frequent access to food markets, as they were more specifically constrained by means of transportation, which forced members, especially those in extreme and remote locations, to acquire foodstuffs only on scheduled market days.

Table 13: Maximum likelihood estimates of the Tobit regression for households deprivation in daily food intake

Variable	Marginal Effect	Standard Deviation
HHSIZ	0.0004	0.0004
DEPRAT	0.4993e^{-05}	0.2529e^{-04}
FAMTYP	0.0063**	0.0029
AGE	-0.0020**	0.0010
AGESQ	0.0029***	0.0010
GENDER	0.0162***	0.0028
PRYEDU	0.0195***	0.0032
JSSEDU	0.0351***	0.0046
SSVEDU	0.0298***	0.0034
TRTEDU	-0.0316***	0.0040
FISNAT	0.0037	0.0039
OFSHFA	0.0277***	0.0087
EMPFIS	0.0056	0.0043
SPCHWK	0.0040	0.0036
HHINC	- 0.0045***	0.0013
EXTREM	-0.1021e^{-06}	0.1266e^{-06}
CANOES	0.0022	0.0026
LANDSZ	-0.0056*	0.0029
HOULOC	0.0155***	0.0029
DSROAD	0.5533e^{-04}	0.0005
DSFDMKT	0.0021	0.0016
DSNFMKT	-0.0002	0.0009
OGUNST	0.0227***	0.0064
ONDOST	0.0189***	0.0038
Constant	0.0220	0.0251
Sigma (σ)	0.0246***	0.0008
	No. of obs. = 448	Log-likelihood function = 904.0635
Dependent variable: Household Food/Nutrition Index		

(***p < .01; ** p < .05; and *p <0 .1)

Source: Author's computations from surveyed data, 2010

Other significant factors that are likely to aggravate the food intake deprivation situation of the fishing households are polygamous family type (FAMTYP) ($p > 0.05$); household head being a female (GENDER) ($p > 0.01$); having limited educational status (basic and secondary education ($p > 0.01$); and residency of household in Ogun or Ondo State ($p > 0.01$) in reference to Lagos State. It was against *a priori* expectation that engagement of household in offshore farming activities did not significantly improve the food security status of the fishing households but this may not be unconnected with the fact that produce from these farming activities are usually meagre given the subsistent level of farming, guaranteeing minimal income and (or) foodstuff reserves. This, however, confirms the findings of Ribar and Hamrick (2003). As expected, however, household food security status both in terms of adequacy and availability significantly improved with the presence of at least a member with tertiary education in the household at the 1% level, in consonance with the findings of Gahia, *et al* (2007); Muyanga, *et al,* (2007) and Ayala, *et al* (2009).

4.3.4 Factors influencing households' deprivation in household sanitation condition

Table 14 presents the determinants of deprivation in the household living condition (related to MDG 7 Target 10). Following the Millennium Development Goal 7, basic sanitation indicators (use of hygienic toilet; means of solid waste disposal and access to hygienic source of drinking water) were combined to generate the Household Sanitation Index used as the dependent variable in the sanitation deprivation model. As captured in Table 14, household income (0.175), size of land owned (0.0053) and age of household head (0.0027) also significantly reduced the likelihood of fishing households suffering deprivation in sanitation facilities, at the 1%, 5% and 1% levels, respectively.

Expectedly, having basic education significantly reduced the risk of experiencing deprivation in the expected standard of sanitation, at the 10% level. However, houses that were built directly on the rivers or along the shores (0.0123); those located in Ogun (0.0218) and Ondo (0.0179) States; female-headed (0.0153) as well as polygamous (0.0065) households would significantly suffer the risk of experiencing deprivation in the expected standard of sanitation at probabilities ranging from 5% to 10% levels. By implication, a naira increase in the total monthly income of the household will significantly reduce the probability of suffering deprivation in sanitation by 0.175 at the 1%, a finding that is in agreement with achieving the Millennium Development Goal 7.

Table 14: Maximum likelihood estimates of the Tobit regression households deprivation in sanitation facilities

Variable	Marginal Effect	Standard Deviation
HHSIZ	0.0002	0.0004
DEPRAT	-0.8642e^{-05}	0.2215e^{-04}
FAMTYP	0.0065**	0.0026
AGE	-0.0027***	0.0009
AGESQ	0.0037***	0.0009
GENDER	0.0153***	0.0025
PRYEDU	- 0.0180***	0.0028
JSSEDU	- 0.0303***	0.0040
SSVEDU	0.0261	0.0330
TRTEDU	0.0300	0.0635
FISNAT	0.0051	0.0034
OFSHFA	0.0253***	0.0076
EMPFIS	0.0023	0.0038
SPCHWK	0.0034	0.0031
HHINC	- 0.175***	0.0638
EXTREM	-0.1145e^{-06}	0.1108e^{-06}
CANOES	0.0018	0.0023
LANDSZ	-0.0053**	0.0025
HOULOC	0.0123***	0.0025
DSROAD	0.6390e^{-04}	0.0004
DSFDMKT	0.0020	0.0014
DSNFMKT	-0.0007	0.0008
OGUNST	0.0218***	0.0056
ONDOST	0.0179***	0.0033
Constant	0.0631***	0.0220
Sigma (σ)	0.0216***	0.0007
	No. of obs. = 448	Log-likelihood function = 984.7083
Dependent variable: Household Sanitation Index		

(***p < .01; ** p < .05; and *p <0 .1)

Source: Author's computations from surveyed data, 2010

Similarly, the inverse effect of education on the likelihood of suffering deprivation in living household condition is expected as possession of basic education was sufficient to give proper orientation to the fishing households as regards minimum hygienic requirements sufficient to keep households away from diseased conditions. The findings, however, suggest that fishing households that have plots of land (in the upland parts of the study area) may not necessarily suffer poor sanitation condition even if they had their houses built directly on the rivers or along the shores. This is because of the availability of land space where they can dispose of refuse. The large household size and limited income that characterize female-headed and polygamous households, respectively justified their deprivation in standard living condition represented by availability of sanitation facilities.

4.3.5 Factors influencing households' deprivation in living condition (basic assets)

Table 15 presents the determinants of household deprivation in household living condition (basic assets), using Basic Asset Index as dependent variable. Household basic asset index was regressed against the set of given variables to determine the correlates of deprivation in the basic asset domain of household living condition. Items included in the household basic assets index were communication gadgets (radio, television and mobile phone) fan, mattress, iron, set of chairs and means of mobility (any one of bicycle, motorcycle, canoe or car). As captured in Table 15, gender, family type, educational factors, and location of household onshore as well as in Ogun and Ondo States would all significantly increase the likelihood of the fishing households experiencing deprivation in basic assets, at 1% level.

By implication, female-headed and polygamous households were more likely to be relatively deprived in basic household assets with a magnitude of 0.0128 and 0.0055, respectively. Having a member of the household with secondary school education will reduce household's deprivation level in basic asset by 0.0226. On the other hand, a unit increase in age of household head, household income, having the spouse and (or) a child working, and size of land owned would reduce household deprivation in basic assets by 0.21%, 6%, 2% and 0.48% at the 1%, 1%, 1% and, 5%, respectively. The influence of other household members working, apart from the head, on the likelihood of asset deprivation follows *a priori* expectation as it has the effect of increasing the income base of the household.

Table 15: Maximum likelihood estimates of the Tobit regression for households deprivation in basic assets

Variable	Marginal Effect	Standard Deviation
HHSIZ	$0.6498e^{-04}$	0.0003
DEPRAT	$-0.5143e^{-05}$	$0.1847e^{-04}$
FAMTYP	0.0055^{***}	0.0021
AGE	-0.0021^{***}	0.0007
AGESQ	0.0029^{***}	0.0007
GENDER	0.0128^{***}	0.0021
PRYEDU	0.0155	0.0023
JSSEDU	0.0269	0.0033
SSVEDU	$- 0.0226^{***}$	0.0025
TRTEDU	- 0.0251	0.0029
FISNAT	0.0033	0.0028
OFSHFA	0.0035	0.0026
EMPFIS	0.0028	0.0032
SPCHWK	$- 0.0230^{***}$	0.0064
HHINC	$- 0.053^{*}$	0.0301
EXTREM	$-0.7207e^{-07}$	$0.9239e^{-07}$
CANOES	0.0017	0.0018
LANDSZ	-0.0048^{**}	0.0021
HOULOC	0.0107^{***}	0.0021
DSROAD	$0.3680e^{-04}$	0.0004
DSFDMKT	0.0017	0.0011
DSNFMKT	-0.0009	0.0007
OGUNST	0.0150^{**}	0.0047
ONDOST	0.0111^{***}	0.0028
Constant	0.0818^{***}	0.0183
Sigma (σ)	0.0180^{***}	0.0006
	No. of obs. = 448	Log-likelihood function = 1071.030
Dependent variable: H/hold Basic Asset Index		

($^{***}p < .01$; $^{**}p < .05$; and $^{*}p < 0 .1$)

Source: Author's computations from surveyed data, 2010

4.3.6 Factors influencing households' deprivation in social integration

The correlates of household deprivation in social integration are presented in Table 16. Two social indicators – membership of grass-roots political association and participation in community development projects – were combined to generate the household Social Integration Index that served as the dependent variable in the social deprivation model. Social integration among households, although not among the eight Millennium Development Goals, has been identified as a precursor of social peace by the United Nations Children Emergency Funds (UNICEF, 2009). The results in Table 15 also show that female-headed and polygamous households were less likely to participate in political and community development activities at 1% level. Core-coastal fishing households were also less likely to participate in socio-political activities than those that were located far away from the shores. Households in Ogun and Ondo states also had greater tendency to get involved in social activities than households located in Lagos.

Table 16: Maximum likelihood estimates of the Tobit regression for households deprivation in social integration

Variable	Marginal Effect	Standard Deviation
HHSIZ	$0.3875e^{-04}$	0.0003
DEPRAT	$-0.4284e^{-06}$	$0.2083e^{-04}$
FAMTYP	0.0064^{***}	0.0024
AGE	-0.0024^{***}	0.0008
AGESQ	0.0032^{***}	0.0008
GENDER	0.0145^{***}	0.0023
PRYEDU	0.0164^{***}	0.0026
JSSEDU	0.0288^{***}	0.0038
SSVEDU	0.0247^{***}	0.0028
TRTEDU	0.0269^{***}	0.0033
FISNAT	0.0045	0.0032
OFSHFA	0.0239^{***}	0.0072
EMPFIS	0.0021	0.0036
SPCHWK	0.0039	0.0029
HHINC	-0.006^{**}	0.0025
EXTREM	$-0.1280e^{-06}$	$0.1042e^{-06}$
CANOES	0.0020	0.0021
LANDSZ	-0.0048^{**}	0.0024
HOULOC	0.0117^{***}	0.0024
DSROAD	0.0002	0.0004
DSFDMKT	0.0024	0.0013
DSNFMKT	-0.0008	0.0007
OGUNST	0.0189^{***}	0.0053
ONDOST	0.0143^{***}	0.0031
Constant	0.0700^{***}	0.0207
Sigma (σ)	0.0203^{***}	0.0007
	No. of obs. = 448	Log-likelihood function = 1019.487
Dependent variable: H/hold Social Integration Index		

($^{***}p < .01$; $^{**}p < .05$; and $^{*}p < 0.1$)

Source: Author's computations from surveyed data, 2010

4.4 Household poverty profile

Multiple Correspondence Analysis (MCA) was carried out to reduce the sixteen hypothesized poverty indicators to thirteen that were finally used to compute multi-dimensional poverty measures and construct a poverty profile for the fishing households. Descriptive statistics were presented for poverty counts. The Alkire and Foster (AF) methodology was adopted in computing incidence of multi-dimensional deprivation and poverty as well as other dimension-adjusted poverty measures. Lastly, the logit regression model was used to estimate the determinants of multi-dimensional poverty incidence among the fishing households.

4.4.1 Household poverty

Sixteen poverty indicators were preliminarily proposed to be aggregated into a composite indicator of multi-dimensional poverty for the fishing households (Appendix II). These indicators belong to five dimensions, namely education (years of formal schooling and child enrolment); food and nutrition (food availability and food sufficiency); health (methods of malaria treatment and self-reported health); household living conditions (materials of the wall, materials of the floor, toilet types, sources of domestic lighting, means of solid waste disposal, sources of water, cooking fuel, and ownership of household assets); and social integration (political involvement and participation in community development projects). Child enrolment and food adequacy were reported for household members of the age range 6-15 years, while self-reported health was considered for adult household members aged between 18-59 years. Results of the MCA computations are presented in Tables 17 and 18.

4.4.1.1. Components of multi-dimensional poverty

The factorial weight of the fifty-eight categories of the sixteen welfare variables are presented in Tables 17 (a and b). The true multi-dimensionality in the poverty condition of fishing households manifested in the retention of two components by the Multiple Correspondence Analysis (MCA).

Table 17a): Categorical scores and discrimination measures of the first two factorial axes (components) in the multiple correspondence analyses (MCA)

Indicator	Category	H/Hold Distribution (%)	Factorial score		Discrimination measures	
			Axis I	Axis II	Axis I	Axis II
Wall material	Cement	5.58	1.716	-1.557	0.07	0.01
	Mud	21.65	0.193	-0.841		
	Planks	37.05	0.425	-1.009		
	Iron sheets	24.78	-1.906	0.683		
	Plant part /sac	10.94	-1.923	0.060		
Floor material	Concrete	5.57	1.966	-1.705	0.40	0.02
	Mud	18.75	1.446	1.557		
	Planks	45.76	-2.746	0.511		
	Shrubs or Bare sand	29.91	-1.299	-0.812		
Cooking fuel	Electricity	27.46	1.643	-5.023	0.51	0.01
	Gas	3.57	2.050	0.140		
	Kerosine	36.61	-0.532	0.067		
	Charcoal/ Wood	32.37	-0.895	0.174		
Source of light	Electricity/ Generator	13.84	0.790	0.402	0.29	0.02
	BatteryLamp	17.63	0.320	-0.210		
	Shaded Kero Lamp	56.70	-0.299	0.541		
	Unshaded Kero Lamp	11.83	-0.021	-2.750		
Toilet type	Septic Tank	10.71	1.175	-1.875	0.07	0.01
	Pit Latrine	41.74	-1.670	0.395		
	River/Bush	47.54	-1.731	0.075		
Method of solid waste disposal	Trash can/ Refuse bin	17.19	1.974	-2.386	0.06	0.03
	Burning	14.96	1.851	1.703		
	Decomposed	13.17	-1.322	0.631		
	Ditch filling	54.69	-1.445	0.132		
Water source	Pipe-borne	20.98	1.389	0.099	0.53	0.05
	Borehole	16.07	1.169	1.468		
	Open wells	21.21	-0.570	1.841		
	Rain water	20.54	-0.266	-1.824		
	Stream/lake/lagoon	21.21	-2.036	1.122		
Self-reported health status	Excellent	12.05	-0.821	-0.751	0.01	0.54
	Good and sound	27.01	1.594	4.530		
	Fair	43.75	-0.347	-1.064		
	Poor	17.19	0.052	-0.480		

Source: Author's computations from surveyed data, 2010

Two components (or axes), 1 and 2 were retained as the most relevant representative variables emanating from the MCA for the fishing households. On component 1, monthly food expenditure (proxy for food availability) was the most discriminating indicator (0.60), followed closely by ownership of basic assets (0.59). On the second component, however, the most discriminating indicators belong to the health dimension: malaria treatment and control methods (0.65) and self-reported health condition (0.54) for adult members of the households. As shown in Table 17a, there are fifty-eight (58) categories corresponding to the sixteen (16) indicator variables, thus producing a total explained inertia of 2.625. The inertia for the first component was 0.30625 and 0.10125 for the second component. Seven (7) of the welfare indicators were loaded on the first component, while thirteen (13) indicators formed the second poverty component. The discriminating power decreased from component 1 to component 2, as required in the theory of MCA.

Table 17(b): Categorical scores and discrimination measures of the first two factorial axes (components) in the multiple correspondence analyses (MCA)

Indicator	Category	H/Hold Distribution (%)	Factorial score		Discrimination measures	
			Axis I	Axis II	Axis I	Axis II
Malaria control & treatment method	Uses bednet & Insecticide	7.37	-0.954	-2.897	0.00	0.65
	Private hospitals	9.15	-0.182	-1.965		
	Public hospitals	26.7	0.22	-0.66		
	Unprescribed medication	22.54	0.260	-0.468		
	Trado-religious	34.15	-0.094	1.980		
Monthly food expenditure	Above 2/3 MPCFE[6]	33.04	0.449	-0.204	0.60	0.00
	1/3<MPCFE>2/3	40.63	-0.360	-0.004		
	< 1/3 MPCFE	26.34	-0.525	1.164		
No. of major meals per/day	At least three	27.01	0.049	-0.670	0.44	0.02
	Av. of two	46.21	0.577	1.600		
	Av. of one	18.53	-0.497	1.390		
	No major meal	8.26	-1.203	0.220		
Highest education	Tertiary	8.26	0.028	-1.389	0.42	0.01
	Senior Secondary	20.98	-0.131	0.138		
	Junior Secondary	15.18	-0.216	-0.741		
	Primary	37.72	0.899	0.400		
	No formal education	17.86	-1.573	0.246		
Child school enrolment	No child enrolled	80.13	-0.219	2.453	0.00	0.23
	At least one child enrolled	19.87	0.054	-0.608		
Basic & transport asset	Have	25.22	0.300	0.890	0.59	0.01
	Not have	74.78	- 0.101	-0.300		
H/Hold involved in politics	Yes	84.60	0.270	0.325	0.41	0.01
	No	15.40	-1.485	-1.785		
H/Hold involved in comm. dev. projects	Yes	94.20	0.063	-0.037	0.50	0.00
	No	5.80	-1.023	0.594		
Average eigenvalue:					*0.78*	*0.10*
Number of obs. = 448;		Total inertia = 2.6875;		No. of axes retained = 2		

Source: Author's Computations from surveyed data, 2010

[6] Mean per capita household food expenditure

4.4.1.2 Multi-dimensional poverty type sets

According to the total inertia decomposition, the inertia relative to the ten (10) consistent indicators on factorial axis 1 is 0.2931, which is 11% of the total inertia. For factorial axis 2, the inertia relative to the three (3) consistent indicators is 0.088, which is only 3.38% of the total inertia. Therefore, the inertia explained by the first two axes is (4.69 + 1.42)/16 = 0.3819, that is, 15% which is 30% more than with only the first axis. The two retained poverty components are shown in Table 18.

The loading on the first and second retained components took preeminence in understanding the poverty structure of the surveyed households. In Table 18, the two food and nutrition indicator variables loaded highly on the first axis, while the two health indicator variables aligned with the second axis. The two education variables belonged to different components: years of formal schooling on axis 1 and child enrolment on axis 2. Only five of the eight variables in the standard of living dimension discriminated satisfactorily on the axis 1, the remaining three indicators (material of the wall, cooking fuel, and means of solid waste disposal) showing poor loading on both axes. The two social integration variables also loaded on the first factorial axis bringing the total number of welfare variables on the first component to eleven (11). Only two (2) indicator variables were consistent on the axis 2, thereby forming a complimentary second poverty component. Thus, these first two axes were retained to explain the poverty structure of the fishing households. With respect to the ordinal structure of the poverty indicators, axes 1 and 2 were found to be consistent with the welfare status of the fishing households, but with decreasing values of their explained inertia. This implies that, from left to right, the welfare condition expressed by these thirteen (13) retained indicators was deteriorating.

Table 18: Retained poverty components

Welfare Indicator	**Discrimination measures of the Factorial Axes**	
	Axis 1	***Axis 2***
Wall material	***0.07***	***0.01***
Floor material	0.40	0.02
Toilet type	0.51	0.01
Domestic light	0.29	0.02
Cooking fuel	***0.07***	***0.01***
Solid waste disposal method	***0.06***	***0.03***
Water source	0.53	0.05
Self-reported health condition	0.01	0.54
Malaria treatment & control method	0.00	0.65
Monthly food Expenditure	0.60	0.00
No. of meals per day	0.44	0.02
Years of education	0.42	0.01
H/Hold with children not enrolled in school	0.23	0.00
H/Hold has basic assets & a means of transport	0.59	0.01
H/Hold member(s) involved in politics	0.41	0.01
H/Hold member(s) involved in comm. development projects	0.50	0.00
Total discrimination measure	*4.90*	*1.62*
Eigen value (λ_i)(=Average of all discrimination measures = 4.90/16).	*0.30625*	*0.10125 (=1.62/16)*
*Total inertia explained[7] (50% of K * λ_i) (K=16)*	*2.45*	*0.81*
Poverty relevant inertia	*4.69*	*1.42*

Source: Author's computations from surveyed data, 2010

[7] Total inertia explained = $\frac{J}{K} - 1 = \frac{58}{16} - 1 = 2.625$

4.4.2 Household multi-dimensional poverty measures

4.4.2.1 Identification of multi-dimensionally poor households

Table 19 shows the number and percentage of fishing households identified as being poor with deprivation in varying number of poverty indicators. With across-dimensions benchmark (cutoff *k)* set at 1, 2 and 3, indicating deprivation in at least one, two or three welfare dimensions respectively, all (100%) the sampled households were identified as poor. This presents a situation where all the fishing households were adjudged poor in about 6%, 12% and 19% respectively' of the thirteen dimensions of deprivation considered. Increasing the cutoff to six ($k = 6$) shows a slight change in the poverty condition of the households, as over 93% of the households were still adjudged poor. Generally, for any seven of the thirteen indicators considered, over 81% of the total households were identified as poor, reflecting a high level of multi-dimensional poverty among the fishing households.

At the other extreme when deprivation in 13 indicators was required as a condition for being poor, none of the fishing households was adjudged to be poor. Intervening values of cutoff (k between 4 and 12) reveal households who are poor in a specified number but not in all thirteen indicators. The number of households identified as poor declines at an increasing rate, as the number of deprivation increases up till the ninth indicators. At welfare dimension ten through twelve, the number of poor households declines at a decreasing rate until it fades out to zero.

Table 19: Descriptive statistics of multi-dimensionally poor households (varying values of cutoff *k*)

Value of cutoff (*k*)	Number of MPI poor households	Percentage of MPI poor households
1*, 2, 3	448	100
4	445	99.3
5	438	97.8
6	417	93.1
7	365	81.5
8	270	60.3
9	170	38.0
10	85	19.0
11	24	5.4
12	4	0.89
13**	None	None

(* and ** value of cutoff (*k*) = 1 and 13 is the union and intersection approach, respectively)

Source: Author's computations from surveyed data, 2010

4.4.2.2 *Multi-dimensional poverty headcount ratio (H)*

In Table 20, the censored headcount is presented for the union (k =1), intersection (k =13) and intermediate (k = 8) cutoff values. Two adjoining cases to the intermediate cutoff position (k = 6 and k = 10) are also presented for comparison. At the median *(k = 8)* position (following the approach suggested by Alkire and Foster (2007, 2009), Alkire and Seth (2008), 270 (60.3%) of the households were multi-dimensionally poor, with deprivation in 8 (about 62%) of the weighted indicators.

This censored headcount value is different from the traditional headcount in three ways. Firstly, it is the proportion of households that are deprived in some combination of one to three indicators (50% of the weighted indicators within a dimension) and deprived in each dimension. For instance, core-fishing households with house floor made of planks directly on the river, but with at least a canoe, or which uses a bed net, may not be adjudged poor. Secondly, the headcount refers to the percentage of households with individual members deprived that are affected by some levels of deprivation, bearing in mind the concept of poverty by inclusion. Therefore, households that were deprived in a particular indicator but still not considered as being multi-dimensionally poor were not included in this headcount. For example, if a household has a child of school age not registered in school, such a household is considered deprived in education but may not necessarily be poor within the multi-dimensional context of poverty analysis. This makes the headcount in the multi-dimensional sense to be different from the traditional definition of literacy headcount – the percentage of people who are themselves educationally deprived. Thirdly, contrary to the usual trend in uni-dimensional poverty identification, the number of households adjudged to be multi-dimensionally poor decreased as the dual cutoff value increased. Therefore, moving the cutoff value from 6 to10 showed a remarkable decline in the proportion (and percentage) of the fishing households that were identified as being multi-dimensionally poor, from 417 (93%) to 85 (19%), respectively.

Table 20: Incidence of multi-dimensional poverty (at k = 8≡ 62% of 13 indicators)

Cutoff value	*Deprived households (MPI poor)*		*Non-deprived households (MPI non-poor)*	
	Frequency	Percentage (%)	Frequency	Percentage (%)
k = 1	448	100	0	0
k = 6	417	93.1	31	6.9
k = 8	***270***	***60.3***	***178***	***39.7***
k = 10	85	19.0	363	81.0
k = 13	0	0	448	100

Source: Author's computations from surveyed data, 2010

At the one extreme, all the surveyed households (100%) were identified as being multi-dimensionally poor in the case of union criterion (k =1) where deprivation in any one dimension/indicator was enough to identify a household as poor. This satisfies the axiomatic condition that the union identification approach often predicts high numbers, identifying a large percentage of the population as being multi-dimensionally poor (in consonance with the findings of Charavarty *et al.*, 1998; Tsui, 2002; Bourguignon and Charavarty, 2003). In the case of intersection criterion (k =13) where deprivation in all 13 indicators is required as poverty identification criterion, no household was particularly poor (confirming the findings of Alkire and Seth, 2008). There is a clear indication that the households were mostly deprived in 7 to 10 weighted indicators, as already indicated in Table 8.

4.4.2.3 Household poverty measures: Uni-dimensional versus multi-dimensional estimates

Table 21 presents a comparison of households' poverty estimates using both uni-dimensional and multi-dimensional approaches. As see in the table, the value of the multi-dimensional headcount ratio is 0.603 at k = 8 (representing about 62% of the 13 final poverty indicators considered) compared to the uni-dimensional estimate of 0.6090. The implication of the multi-dimensional poverty headcount ratio is that 60.3% or 270 of the fishing households are poor when deprivation in exactly eight indicators is required to adjudge a household multi-dimensionally poor. Using the uni-dimensional approach, the poverty headcount ratio is 60.9% or 273 fishing households. The adjusted multi-dimensional poverty rate of the households (M_0) at k = 8 is 0.3422, while the value is 0.6094 for the uni-dimensional approach. The value of the adjusted poverty gap (M_1 = 0.1608) shows a deepening of the deprivation of households in the identified dimensions, implying that the poor coastal households require about 16% of the overall achievements of the non-poor to come out of poverty. Poverty severity (M_2 = 0.0761) shows a further decrease in value, reflecting that 7.61% of the coastal households suffer severe multi-dimensional poverty. This also indicates a 21.90% level of inequality among deprived states of the poor households.

Comparatively, the uni-dimensional poverty estimates are higher than their multi-dimensional equivalents. This buttresses the findings of Alkire and Foster (2007, 2009) that the uni-dimensional poverty measurement approach tends to over-estimate the poverty measures of a given population. This presents an unnecessarily overblown poverty situation for such a population compared to the multi-dimensional approach. Thus, the application of the multi-dimensional approach for the coastal households, as carried out in this study, is empirically justified.

Table 21: Poverty incidence, poverty depth and poverty severity (*at k = 8*)

Poverty Measures	*Multi-dimensional (at k = 8)*	*Uni-dimensional (at 2/3 [8]MPCE =₦6,937.67)*
H	0.6030	0.6090
M_0	0.3422	0.6094
M_1	0.1608	0.2698
M_2	0.0761	0.1564

Source: Author's computations from surveyed data, 2010

[8] MPCE is mean per capita household expenditure.

4.4.3 Multi-dimensional poverty profile by selected socio-economic characteristics of households

This section addresses the decomposition of multi-dimensional poverty among the fishing households according to socioeconomic and demographic characteristics in order to observe the trend of multi-dimensional poverty across various sub-groups. The results are presented in Tables 22 and 23.

4.4.3.1 Poverty profile by household socio-economic characteristics

The size of fishing households strongly affects the pattern of multi-dimensional poverty indices, as depicted in Table 22. The result shows an increase in multi-dimensional poverty incidence, intensity and severity as household size increases. There was a slight increase in the proportion of poor households from 33.26% to 35.69% for small-sized and medium-sized households, respectively. Similar trend was noticed for poverty depth, as 15.55%, 17.18% and 43.75% of small-sized, medium-sized and large-sized households were trapped below the multi-dimensional poverty cutoff. Similarly, 7.22%, 8.48% and 20.78% of small-sized, medium-sized and large-sized households were severely poor in the five welfare dimensions considered. In all cases, the percentage increase in poverty index was more prominent as household size increased beyond 12 members. This trend is in line with the findings of Agboola *et al.* (2004) .

Table 22: Multi-dimensional poverty profile by households' socio-economic characteristics

Household Characteristics	*Multi-dimensional Poverty Incidence* (M_0)	*Multi-dimensional Poverty Depth* (M_1)	*Multi-dimensional Poverty Severity* (M_2)
Household Size			
1- 6 (small-sized households)	0.3326 (0.0203)	0.1555 (0.0155)	0.0722 (0.0084)
7-12(medium-sized households)	0.3569 (0.0405)	0.1718 (0.0354)	0.0848 (0.0194)
> 12 (large-sized households)	0.5938 (0.0313)	0.4375 (0.1250)	0.2078 (0.1101)
Total	*0.3393 (0.0133)*	*0.1607 (0.0106)*	*0.0762 (0.0058)*
F_{value}	0.640^{NS}	1.092^{NS}	0.927^{NS}
Dependency Ratio			
0	0.3768 (0.0328)	0.1725 (0.0264)	0.0788 (0.0142)
0.1 – 0.5	0.3326 (0.0170)	0.1592 (0.0135)	0.0759 (0.0074)
0.6 – 1.0	0.4196 (0.0751)	0.2381 (0.0651)	0.1123 (0.0372)
Total	*0.3396 (0.0134)*	*0.1610 (0.0106)*	*0.0761 (0.0058)*
F_{value}	0.850^{NS}	0.622^{NS}	0.551^{NS}
Year of Formal Education			
No Formal Education	0.3781 (0.0291)	0.2065 (0.0291)	0.1100 (0.0164)
Primary Education	0.3173 (0.0217)	0.1298 (0.0160)	0.0599 (0.0085)
Junior Secondary Education	0.3472 (0.0338)	0.1945 (0.0294)	0.0961 (0.0162)
Senior Secondary/Vocational Education	0.3414 (0.0306)	0.1386 (0.0193)	0.0545 (0.0096)
Tertiary Education	0.3351 (0.0485)	0.1979 (0.0404)	0.0967 (0.0224)
Total	*0.3393 (0.0133)*	*0.1607 (0.0106)*	*0.0762 (0.0058)*
F_{value}	0.655^{NS}	2.543^{**}	3.844^{***}
Household Income			
< 1000	0.1971 (0.0295)	0.0510 (0.0251)	0.3137 (0.0851)
10,000 – 50,000	0.1568 (0.0184)	0.0709 (0.0098)	0.3328 (0.0326)
50,001 – 100,000	0.1516 (0.0156)	0.0707 (0.0084)	0.3341 (0.0203)
100,001 – 150,000	0.1330 (0.0526)	0.1030 (0.0166)	0.3590 (0.0237)
Total	*0.1607 (0.0109)*	*0.0758 (0.0059)*	*0.3414 (0.0137)*
External Remittances			
< 10,000	0.3385 (0.1375)	0.0621 (0.0133)	0.3390 (0.0145)
10,000 – 50,000	0.1628 (0.0116)	0.0777 (0.0063)	0.3447 (0.0351)
> 50,000	0.1414 (0.0254)	0.1721 (0.0849)	0.4531 (0.1539)
Total	*0.1621 (0.0106)*	*0.0763 (0.0058)*	*0.3408 (0.0133)*

Source: Author's Computations from data, 2010

(Figures in the parentheses are standard variations)

Contrary to expectation, Table 22 also shows that multi-dimensional poverty incidence, intensity and severity decreased slightly by 4.42%, 1.33% and 0.29% as dependency ratio increased from zero to 0.5, but later increased to 41.96%, 23.81% and 11.23%, respectively with an increase in the number of non-working household members. This confirms the findings of Riber and Hamrick (2003) and London and Scott (2005). Households' educational status significantly influenced the level of multi-dimensional poverty depth and severity at the 5% and 1% confidence level, respectively. As expected, poverty indices were highest among households with no formal education (incidence, 37.81%; intensity, 20.65%; and severity, 11.00%). There is no particularly clear trend for the poverty indices with respect to the educational attainment of the fishing households. However, the proportion of fishing households that experienced multi-dimensional poverty decreased with increase in household income and remittances, while intensity and severity of multi-dimensional poverty increased gradually as household income and remittances increased.

4.4.3.2 Poverty profile by household heads' socio-economic characteristics

The relationships between multi-dimensional poverty indices and household heads' socio-economic characteristics are depicted in Table 23. The reduction in poverty depth (from18.68% to 13.04%) and severity (from 9.58% to 5.49%) as age of household head increases from 31 to 60 years followed *a priori* expectations as this is the age bracket when household heads are more occupationally active and productive. However, the lack of clear relational trend between multi-dimensional poverty incidence and age of household head may be the effect of unobservable factors as captured in the life cycle hypothesis. Generally, poverty indices increased with age of household head beyond 60 years. This validates the findings of Agboola *et al*. (2004).

A higher proportion (35%) of female-headed households experienced multi-dimensional poverty than their male counterparts, while this observed gender difference was not particularly prominent in the case of poverty depth and severity. This result is in agreement with Bouis (2003), who found female-headed households more food insecured than male-headed households. Poverty incidence (43.55%), intensity (18.95%) and severity (8.95%) were higher among polygamous (married) households than for households whose heads were unmarried or monogamous (married) for which poverty incidence, depth and severity were 42.05%, 18.56%, 8.48% and 32.01%, 16.23%, 7.80%, respectively, in accordance with the findings of Jimoh

(2004). This finding may be due to the larger household size and number of dependants that characterize large and polygamous families.

The higher values of poverty indices for unmarried households than those of monogamous, separated and widowed households could be as a result of unemployment or lesser assets, which tend to increase vulnerability to poverty. The result in Table 23 also shows a 5%-level of significance in poverty incidence across the various sub-groups of marital status. Household heads with over 50 years experience in fishing/onshore natural resource had higher values for their poverty incidence (63%), depth (31%) and severity (10%) than other sub-groups. This could be for the fact that this category of fishers were in the inactive age period of 60 years or above, adding to the dependency burden of the households, as also evident in Table 23.

Table 23: Multi-dimensional poverty profile by household heads' socio-economic characteristics

Household Characteristics	*Multi-dimensional Poverty Incidence* (M_0)	*Multi-dimensional Poverty Depth* (M_1)	*Multi-dimensional Poverty Severity* (M_2)
Age of Household Head			
< 31	0.3254 (0.0339)	0.1558 (0.0311)	0.0844 (0.0174)
30-60	0.3542 (0.0342)	0.1868 (0.0312)	0.0958 (0.0175)
> 60	0.3173 (0.0483)	0.1800 (0.0367)	0.0838 (0.0201)
Total	*0.3401 (0.0133)*	*0.1608 (0.0106)*	*0.0761 (0.0057)*
F_{value}	0.564^{NS}	0.833^{NS}	1.351^{NS}
Gender of H/hold Head			
Male	0.3362 (0.0156)	0.1619 (0.0125)	0.0773 (0.0068)
Female	0.3500 (0.0253)	0.1580 (0.0197)	0.0731 (0.0106)
Total	*0.3401 (0.0133)*	*0.1608 (0.0106)*	*0.0761 (0.0057)*
λ^2_{value}	1.431^{NS}	1.279^{NS}	1.279^{NS}
Marital Status			
Single	0.4205 (0.0315)	0.1856 (0.0278)	0.0848 (0.0151)
Married (polygamous)	0.4355 (0.0442)	0.1895 (0.0421)	0.0895 (0.0233)
Married (monogamous)	0.3201 (0.0170)	0.1623 (0.0136)	0.0780 (0.0074)
Separated/Divorced	0.3042 (0.0538)	0.1118 (0.0348)	0.0477 (0.0178)
Widowed	0.3023 (0.0443)	0.1265 (0.0326)	0.0608 (0.0179)
Total	*0.3401 (0.0133)*	*0.1608 (0.0106)*	*0.0761 (0.0057)*
F_{value}	2.952^{**}	0.946^{NS}	0.771^{NS}
Years of Experience in Fishing/NRC			
< 10	0.3694 (0.0240)	0.1732 (0.0104)	0.0804 (0.0106)
10-20	0.3146 (0.0304)	0.1664 (0.0241)	0.0804 (0.0133)
21-30	0.3061 (0.0259)	0.1255 (0.0192)	0.0590 (0.0103)
31-40	0.3645 (0.0307)	0.2018 (0.0264)	0.0981 (0.0146)
41-50	0.3274 (0.0580)	0.0833 (0.0403)	0.0396 (0.0212)
> 50	0.6250 (0.0514)	0.3125 (0.0226)	0.0977 (0.0173)
Total	*0.3393 (0.0133)*	*0.1607 (0.0106)*	*0.0762 (0.0058)*
F_{value}	1.123^{NS}	1.847^{NS}	1.450^{NS}

Source: Author's computations from surveyed data, 2010

(Figures in the parentheses are standard variations)

4.5 Contribution of households' specific deprivation to multi-dimensional poverty

Table 24 presents the absolute contribution of each indicator variable (and, by extension, each welfare dimension) to the overall multi-dimensional poverty of the fishing households, made possible by the fact that M_0 is group-decomposable. This characteristic property of M_0 enables the design of policy to address the poverty condition of the coastal people by eliminating deprivation in each of the specified dimensions. Education dimension contributes 15% to overall multi-dimensional poverty of the fishing households, inability to enrol a school-age child 6-15 years in school having a slightly weightier effect (8%) than having no member of the household that has completed 9 years of schooling (7%).

For absolute contribution of health dimension (12%), the two variable indicators (household members not using drugs, bednets/insecticides nor visiting registered hospitals; and health of any adult member aged 18-59 years being generally described as poor or fair) are almost of equal influence on the overall multi-dimensional poverty of the fishing households. This is also the case for the Social Integration dimension, the relative effect of household members not participating in politics (7%) and their non-involvement in community development projects (7%) on overall multi-dimensional poverty having no significant difference.

Table 24: Contribution of welfare dimension to overall multi-dimensional poverty (at *k = 8*)

Deprivation dimension	*Indicator variable*	*Household is deprived if…*	*Contribution of individual indicator to overall MPI*	*Contribution of individual dimension to overall MPI (%)*
Education	Year of formal educ.	No member has completed 9 years of schooling	0.0649 *(2.3989)*	14.60
	Child enrolment in school	No school-age child 6-15 years is enroled in school.	0.0811 *(1.5924)*	
Health	Method of malaria prevention	Members do not use drugs, hospitals or bed nets/insecticides.	0.0569 *(2.3380)*	11.51
	Self-reported health	Health of any adult member aged 18-59 years is generally poor or fair.	0.0582 *(1.9974)*	
Food/ nutrition	Food availability	Per capita monthly food expenditure is below 2/3 mean value.	0.0564 *(2.0054)*	10.11
	Food adequacy	Any child age 6-15years takes < 2 major meals per day.	0.0447 *(2.1439)*	
Standard of Living	Source of domestic lighting	It uses kerosene lamp w/out shade, and not connected to power grid.	0.0913 *(1.9604)*	49.16
	Toilet type	It does not have a toilet; it uses a pit toilet, or if it does not use a septic tank, or it shares one with other households.	0.0992 *(1.9209)*	
	Material of house floor	House floor is made of planks/bamboo/mud/covered by shrubs/sand.	0.0948 *(1.9140)*	
	Source of drinking water	It drinks water from wells/springs/rivers/streams/lagoon/rain/ ponds/forest creeks.	0.0912 *(1.9587)*	
	Ownership of assets	It lacks any one of : radio/TV, phone, fan, mattress, pressing iron, etc, bicycle, motorcycle, canoe or car.	0.1151 *(1.5986)*	
Social Integration	Political affiliation	No member is a registered member of a political party.	0.0739 *(1.8011)*	14.67
	Participation in community dev. projects	No member participates in community dev. project.	0.0728 *(1.7430)*	
Total			1.00	100.00

(Figures in the parentheses are standard variations)

Source: Author's computations from surveyed data, 2010

For the Food and Nutrition dimension, there is also a mere marginal difference in the effect of ‘‘having household per capita monthly food expenditure below the food poverty line’’ (2/3 mean value) and ‘‘under-nourishing children of age 6-15 years takes with less than two major meals per day’’ (4.47%). Among the indicators making up the living condition dimension only lack of basic functioning facilities (radio/TV, phone, fan, mattress, pressing iron, bicycle, motorcycle, canoe or car) has slightly higher effect (11.51%) on the overall multi-dimensional poverty among the other four variables of almost equal effect (about 9%).

4.6 Determinants of households' multi-dimensional poverty incidence

The factors determining the probability of fishing households being multi-dimensionally poor are presented in Table 25. The χ^2 values being significant at 1% level for the model shows a good fit to the data. The Pseudo-R^2 value of 0.3054 implies that the regressors explained 31% of the total variation in the determinants of poverty rates among the households. The educational variables exhibited the expected influence on the risk of multi-dimensional poverty. Higher educational attainment of the households constituted a significant negative factor for the likelihood of becoming poor compared with the non-literate category at 1% level of significance for the fishing households. However, having a member of the household with just primary school education increases the probability of households becoming multi-dimensionally poor at 10% level of significant.

The implication of this is that having a minimum basic education (from primary to junior secondary school) as stipulated under the mandatory Universal Basic Education (UBE) policy of the Federal Government of Nigeria (FGN) is not a sure guarantee against fishing households in the southwestern zone becoming multi-dimensionally poor. These findings may not be unconnected with the relative difficulty with which households with larger numbers of formally non-literate members may have access to formal-sector job opportunities. Non-literate households may also have limited access to school enrolment opportunities, information about improved health care services, political affiliation and other welfare-enhancing opportunities than households that are more educationally endowed, as previously reported by Omonona (2001) and Ribar and Hamrick (2003). This result also strongly agrees with the *a priori* expectation that investments in human capital is likely to reduce the risk of households falling into poverty, as already established by Muyanga, *et al*. (2007), Gahia *et al*. (2007) and Ayala *et al.* (2009).

Building house(s) directly on the river or within 100 metres away from the shores, engaging in fishing and natural resource collection activities as full-time employment, as well as using dugout canoes as means of transportation and livelihood activities, increased likelihood of multi-dimensional poverty at 1% level of significance. However, engaging in offshore farming activities as a complimentary income source would, against *a priori* expectation, also significantly increase household poverty rate at 1% level. This confirms the positive relationship of farming activities with the tendency of households becoming poor, as observed by Mahbud (2004) and others. Unexpectedly, involvement of spouse or at least a household child in fishing and (or) natural resource collection activities significantly increased the likelihood of multi-dimensional poverty among the households by 0.0681 at 1% level of significance.

Table 25: Maximum likelihood estimates of the logit regression for multi-dimensional poverty incidence among fishing households

Explanatory variable	Marginal effect	Standard deviation	t-value
Constant	0.1260	0.1469	0.858
Household Head Characteristics			
AGE	0.0025	0.0059	0.423
AGESQ	0.0048		0.791
GENDER	0.1323***	0.0172	7.709
Household Characteristics			
HHSIZE	-0.9821E-03	0.0033	-0.296
DEPRAT	-0.0646***	0.0060	-10.711
FAMTYP	0.0704***	0.0177	3.971
HHINC	- 0.1356**	0.0537	2.525
EXTREM	-0.5404E-06	0.7737E-06	-0.698
H/hold Educational Attainment: (Ref. category: No formal Education)			
PRYEDU	0.0414*	0.0222	1.858
JSSEDU	0.0038	0.0314	0.120
SSVEDU	0.0079	0.0245	0.323
TRTEDU	-0.0052***	0.0028	-1.857
Pry. occupation of H/hold head (Ref. category: Formal sector job)			
FISNAT	0.0122	0.0239	0.511
OFSHFA	0.3725***	0.0493	7.558
Other occupational factors			
EMPFIS	0.1275***	0.0265	4.820
SPCHWK	0.0681***	0.0218	3.118
H/Hold Wealth Variables:			
CANOES	0.1097***	0.0155	7.093
LANDSIZ	-0.1101***	0.0166	-6.634
Community variables			
HOULOC	3.1118**	1.4346	2.169
DSROAD	0.0095*	0.00505	1.889
DSFDMK	-0.0099***	0.0036	-2.737
DSNFMK	-0.0032	0.0061-02	-0.513
State dummy (Ref. Cat: Lagos State)			
OGUNST	0.1218***	0.0332	3.674
ONDOST	0.1667***	0.0212	7.879

No. of observation = 448; χ^2 = 125.8415; Prob. > λ^2 = 0.0001; Pseudo-R^2 value = 0.3054

***; ** and * denote variable is significant at the 1%; 5% and 10% level, respectively.

Source: Author's computations from surveyed data, 2010

Even though this involvement may temporarily increase the income base of the household, the implication of this inverse relationship may be connected with the attendant negative effect of non-enrolment of the concerned child(ren) in school, as well as the risk of non-diversified sources of household income on the part of the active adult female spouse, both of which have the tendency of worsening the poverty condition of the household in the long-run (as previously confirmed by Rupasingha and Goetz, 2007). Locating major paved roads closer to the households reduces the risk of falling into poverty at 10% level of significance. This is expected as feeder roads form a link between remote communities and major towns, increasing their accessibility of basic utility services and welfare enhancing opportunities (Dasgupta *et al.*, 2003). A coastal household that is female-headed was more prone to poverty at 1% level of significance than their male-headed counterparts (in consonance with the report of Levernier *et al.*, 2000). In addition, polygamous households suffered more risk of being multi-dimensionally poor than single or monogamous households as also evident in the socio-demographic poverty profile of the households that linked as much as 43.55% of married polygamous households with multi-dimensional poverty incidence.

Among household and community characteristics that reduced the likelihood of fishing households falling into poverty were a unit increase in household income at 5% (confirming the findings of Grundig (2007); a unit increase in the size of land owned by household (at 1%); and having household members with tertiary education (at 1%). The relationship of dependency ratio (0.0646) and distance from house to the nearest food market (0.0099) with the likelihood of household becoming poor was against *a priori* expectation, as a unit increase in the variables was found to reduce household poverty rate at 1% level of significance. The unexpected result for distance to the nearest food market may not be unconnected with the resentment that fishing households have for food locally sourced from within the coastal areas, such as fresh fish, games, periwinkles and water snails.

Other consumables in this category include packaged water, home processed foodstuff and food, and meat from domesticated livestock (such as pig and poultry), among others. The dislike for these set of riverside consumables might have resulted from social belief, diminished utility, or for hygienic reasons, thus, fishing households would prefer to patronize food markets outside their immediate community. With respect to the location within the southwestern zone, fishing households in Ogun and Ondo States had the likelihood of experiencing higher multi-dimensional poverty incidence at 1% level of significance compared to households in Lagos State, holding other factors constant.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter summarises the major findings of the study. It also concludes the work and gives necessary recommendations.

5.1 Summary of major findings

The mean household size in the coastal area of southwestern Nigeria was 5. Most of the households (72%) were male-headed; 39% were married and polygamous; 39% of the household heads were in the active age range of 41-50 years; 68% of whom were primarily engaged in fishing and onshore natural resource collection. Members of the households heads had strong socio-political affiliation, as over 84% and 92% were actively involved in politics and community development projects. Members of the fishing households had low educational attainment, a larger percentage (71%) of them were either non-literate or had a minimum basic education up to the junior secondary school, with a mean monthly income of ₦37, 115.94K.

Significant difference in the possession of welfare goods and services between poor and non-poor households in the coastal communities existed only in the human capital variable (that is, year of formal education variable) at 1% level. This implies that access to formal education is a strong source of variation in the characteristics of the poor and non-poor among fishing households. The proportion of deprived fishing households was relatively low for use of orthodox malaria treatment methods (34%); use of hygienic means of domestic lighting (about 12%) and cooking fuel (32%) and access to less than two quality meals per day (about 27%). Most fishing households had strong socio-political affiliation, as about 85% and 92% of them were actively involved in grass-roots politics and community development projects, respectively.

The majority of the coastal houses (73%) were built with wall made from sacs, planks or iron sheets. About 46% of the houses had floor constructed with planks built directly over the waters. The degree of deprivation in sanitation facilities was highest among households, which defecated (48%) and dumped refuse (55%) directly into the surrounding water, yards, or nearby bush, predominantly among households in Lagos and Ondo states. Most households (75%) did not possess basic assets (radio, television sets, among others) and other means of

transport (such as cars, motorcycles and bikes) apart from canoes, which only a few households (about 23%) possessed.

The findings showed an increasing multi-dimensional deprivation status among fishing households with the number of households suffering deprivation increasing gradually with a rise in the number of dimensions: three (1%); seven (2%) and twenty-one (5%) households suffered deprivation in exactly three, four and five dimensions, respectively. The more widely lacked welfare-enhancing goods and services tended to be more generally regarded as necessities by the households, with the exemption of food adequacy (for household children) and use of improved source(s) of domestic lighting, which 91% and 50% of the households regarded as necessities but were actually possessed by 73% and 88% of the households, respectively. About 52% and 58% of the households identified the two education variables (year of formal education and child enrolment in school) as being socially necessary but 36% and 47%, respectively, were experiencing enforced lack.

Incidence of deprivation in specific welfare-enhancing assets was experienced among fishing households. In about 71% of the surveyed households, no household had a member with Junior Secondary education (the minimum required universal basic education under the Nigeria Policies on Education). However, only 20% of the households had their school-age children (6-15 years) not currently enrolled in school, indicating a gradual fading away of deprivation in the education dimension among the fishing households. Sixty-six (66%) of the households either visited registered hospitals, patronized drug sellers or used insecticide-treated bednets to treat/prevent malaria incidence, while over 60% of them still had adult members with self-reported health status below average. In terms of food adequacy, less than 15% of the households had children aged 6-15 years feeding on less than 2 major meals per day, while food was available to close to 46% of the surveyed households.

Only 2.5% of the households had access to drinking water from protected wells, boreholes or pipe-borne water. The majority of the households (98%) obtained water from unprotected wells, springs, rivers, lagoons, rains, stagnant water and forest creeks that were common within their neighbourhood. All households were 100% endowed in the social integration variables, a reflection of high level of social capital among the fishing households, with the implication that such social capital asset could help alleviate part of their sufferings through community efforts. Censored headcount ratio was 0.603, representing 270 multi-dimensionally poor households with deprivation in 8 (over 60%) of the weighted poverty indicators.

Average deprivation share across all poor households (*A*) was 0.5652, meaning that at k = 8, the average poor household endured deprivation in about 57% of the 13 dimensions of poverty considered. The adjusted poverty gap (M_1 = 0.1110) shows a deepening of the deprivation of households in the identified dimensions by *G* = 0.3257, being the average poverty gap across all dimensions in which poor households are deprived. Thus, the average achievement of a poor household in a deprived state will not exceed 67% of 8 indicators. Poverty severity M_2 (= 0.0746) was 22%, a reflection of the level of inequality among deprived states of the poor households. At k = 6, average poverty gap across all deprived dimensions was 38%, reflecting the amount of achievements that was required to move the deprived households out of the state of deprivation at that level. Likewise, the level of inequality among deprived states of the poor households was 19%. The Standard of Living dimension contributed most (50%) to overall multi-dimensional poverty level of the fishing households. The Food and Nutrition dimension contributed the least.

Among the factors that significantly reduced the probability of being deprived in specific welfare variables were age of household head; educational endowments; increased household income; and household wealth. On the other hand, the household factors that significantly aggravated likelihood of households falling into a deprived status were being female-headed and polygamous, involvement in offshore farming, short distance to food market (against *a priori* expectation); building house directly onshore and (or) along river banks, and being resident in Ogun or Ondo State. Factors that increased poverty incidence (from the estimated logit model) among fishing households were being female-headed and polygamous, involvement in offshore farming, full-time employment in fishing and natural resource collection activities, spouse or children getting involved in fishing activities, low educational attainment, shortening the distance to the nearest major roads, use of dugout canoes, building house directly onshore and (or) along river banks, and being resident in Ogun or Ondo state. On the contrary, among the factors that significantly reduced the probability of household been poor were increased dependency ratio (against *a priori* expectation), increased household assets, high educational attainment, and increased distance to food market (against *a priori* expectation).

5.2 Conclusion

This study examined the multi-dimensional poverty level among fishing households in southwestern Nigeria using five welfare dimensions consisting initially of sixteen poverty

indicators, namely Education (year of schooling, child enrolment in schools); Standard of Living (source of drinking water, cooking fuel, ownership of basic assets; toilet type, means of solid waste disposal, material of the wall of the house, material of the floor of the house, source of domestic lighting; Health (method of malaria treatment, self-reported health); Food and Nutrition (food availability, food sufficiency); Social Affiliation (political participation, social participation). This study used household as the unit of poverty measurement. The Alkire-Foster MPI methodology (counting approach) was used to identify the multi-dimensionally poor and to aggregate data of the poor into a single index. In addition, the deprivation indices of the households were aggregated into a two-component deprivation structure using the principal component analysis, namely: material deprivation and social deprivation.

The fishing households consisted of between 5 and 14 members with a mean household size of 5, with quite a good proportion of them (56%) not meeting the Policy of the Federal Government of Nigeria (FGN) on minimum educational attainment of at least 9 years of formal education. Poverty, as manifested in deprivation in a number of the welfare indicators, was predominant among the surveyed fishing households. For instance, the findings revealed that over 89% and 68% of the households defecated and dumped refuse directly into the surrounding water and (or) bush, a practice that was predominant among households in Lagos and Ogun states whose houses were built directly over water, on river brinks or bushes around the river side. Expectedly, 46% of the households constructed their houses on the river with plank walls and floor; the surrounding water bodies also served as a source of drinking water to about 63% of them. The households also lacked basic household assets (such as radio, TV sets, set of chairs, mattress, bednet, and so on) and other means of transport (such as cars, motorcycles and bikes) apart from one or two canoes which only a few (about 23%) of the households possessed. As a form of community self-help strategy, the surveyed fishing households possessed strong socio-political affiliation, as over 84% and 92% were actively involved in grass-roots politics and community development projects.

The results of the analysis revealed the need to put a lot of intervention programmes in place in order to address the deprivation and poverty levels of the surveyed fishing households. For instance, access to basic educational facilities as well as formal means of economic livelihood other than offshore farming, onshore fishing and natural resource collection activities will reduce households' deprivation and, by extension, poverty rates in many of the indicated dimensions. In addition, non-food markets should be located close to the fishing households, as this could reduce their susceptibility to deprivation and, eventually, poverty.

5.3 Policy implications and recommendations

Poverty as a manifestation of deprivation in basic standard of living commodities and services is very predominant among fishing households, as indicated by their low level of education, limited access to hygienic source of drinking water, food, energy, health care, toilet facilities as well as improved means of livelihood to better the lots of the household members. With the incidence of multi-dimensional poverty as high as 0.603, average deprivation share of 0.5652, and 21.90% level of inequality among deprived states of the poor households, the coastal communities suffer a notable level of poverty. This has a lot of policy implications. These include (i) Poor households in the coastal communities experience deprivation in a number of welfare commodities, services and activities that requires a mix of poverty reduction interventions to abate. (ii) As there also exists some level of inequality among the deprived households, poverty-reduction intervention programmes should be targeted at different socio-economic groups among the poor.

The following policy recommendations are made from the study:

(i). Since involvement of fishing households in offshore economic activities has the tendencies of increasing poverty rate, a policy to improve the means of income generation and livelihood among the fishing households should be put in place by way of raising productivity of fishing activities, promoting of non-farm cottage enterprises and enhancing households' human capital development.

(ii). Policies that will increase access of fishing households to improved basic educational services should be a priority to enhance their human capital development. Such policies as building of more schools, distribution of educational materials as well as deployment and sustenance of trained teachers in the coastal areas will further promote the education policy of government at the different levels.

(iii). In addition, proximity of the fishing households to feeder roads will increase their access to many of the welfare-enhancing goods, facilities, services and opportunities examined in this study. This also should form part of policy intervention to the fishing households.

(iv). The increased multi-dimensional poverty incidence associated with a reduction in distance to food market is a matter for public policy formulation. The resentment of fishing households for locally sourced consumables from within the coastal environment (especially foodstuffs and drinking water) should inform a policy to bring hygienic source of drinking water (for instance, pipe-borne water) and food commodity markets to the coastal areas.

(v). Specific policies and aids schemes should be put in place to discourage the building or locating houses directly on the river or too close to river banks, as this has been found to increase the likelihood of the fishing households falling into poverty. The natural and ecological risks as well as geographical limitations such households are exposed to may aggravate their level of deprivation, as they are either constrained in terms of acquisition or suffer loss of assets in times of disasters.

5.4 Major contributions of the study to knowledge

The following are the major contributions of this study to knowledge:

- Measuring poverty through the concept of household deprivation in welfare commodities, services and social opportunities as used in this study was a major shift from the common uni-dimensional approach, thereby showing poverty as a true manifestation of deprivation in some welfare-enhancing endowments.
- The study established a link between building houses directly onshore or close to river banks and the likelihood of such households being multi-dimensionally poor.
- The study revealed, against *a priori* expectation, that involvement of spouse or household children in fishing and (or) natural resource collection activities would significantly increase the likelihood of multi-dimensional poverty among the fishing households.
- The study further established greater contributory effect of deprivation in standard of living endowments than the effect of food and nutrition deprivation on overall multi-dimensional poverty of fishing households.
- Lastly, the study revealed that fishing households showed resentment to locally sourced or produced consumables (foods and drinks) as a result of social belief, diminished utility, or for hygienic reasons and fear of disease contamination and thus, they preferred to patronise distant markets for consumable items.

5.5 Suggestions for further studies

The following suggestions are made for future studies:

- This study could only cover fishing households in southwestern Nigeria. Further attempts could be made to undertake similar or related studies that will have wider geographical spread covering the entire coastal regions of Nigeria. Also, attempts should be made to use national data for these studies.

- Efforts should be made to fully exhaust the ordinal nature of such multi-dimensional scaling tools as multiple correspondence analysis beyond the scope employed in this study on locally generated data so as to further understand the nature of multi-dimensional deprivation and poverty among fishing households in Nigeria.
- Future research efforts should develop a framework for empirically identifying specific interactions among welfare dimensions to consider the different combinations of variables leading to household deprivations and their combined contribution to overall household poverty rates. In addition, multi-dimensional deprivation of households within the context of persistence and duration should be conceptualized to introduce the dynamic context of time into understanding the deprivation of fishing households.

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APPENDICES

Appendix 1: Sampling procedures for the study.

1st Stage: Selection of states	2nd Stage: Selection of LGAs	3rd Stage: Selection of fishing communities	4th Stage: Selection of households	No of Valid responses
Ogun state	- Ogun Waterside	10	50	48
	- IjebuEast	10	50	45
	- Ipokia	10	50	43
Ondo state	- Ilaje	10	50	46
	- Ese Odo	10	50	44
	- Irele	10	50	39
Lagos state	- Epe	15	75	67
	- Badagry	10	50	47
	-Ibeju/Lekki	15	75	69
Total		100	500	448

Source: Author's Design of Sampling Procedure for Field Survey, 2010.

Appendix II: Dimensions, indicators, cutoffs and assigned weights as used in the study.

Dimension	Indicator	Household deprived if …	Related to:	Relative Weight
(1) Education	(1) Year of schooling	No h/hold member has completed *9 years of schooling	MDG 2	10%
	(2) Child enrolment	Any school-age child 6-15 years not enrolled in school	MDG 2	10%
(2) Health	(3) Method of malaria prevention/treatment	Members do not use drugs, hospitals or bed nets/insecticides	MDG 6/UNICEF	10%
	(4) Self-reported health	An adult h/hold member aged 18-59 years describes his general health condition as poor or fair		10%
(3) **Food/Nutrition	(5) Food availability	H/hold's per capita monthly food expenditure is below the food poverty line (=2/3 mean value)	(MDG 1-Target 1)	10%
	(6) Food adequacy	Any child age 6-15years takes < 2 major meals of ***average quality per day	(MDG 1-Target 2)	10%
(4) Household living condition	(7) Source of domestic lighting	H/hold uses kerosene lamp w/out shade, and/or h/hold is not connected to electric power supply		2.5%
	(8) Toilet type	H/hold does not use a septic tank, or shares it with others h/holds		2.5%
	(9) Means of solid waste Disposal[1]	H/hold does not use refuse bins, or refuse is not regularly burned or collected by sanitation agent	MDG7	2.5%
	(10) Wall of the house[2]	House wall made of planks/bamboo/iron sheets/sac/shrubs/straw/other plant material		2.5%
	(11) Floor of the House	Floor made of planks/bamboo/mud/or covered with shrubs/straw/ bare sand	MDG7	
	(12 Source of drinking water	H/hold drinks water from unprotected wells/springs/rivers/streams/lagoon/rain/stagnant ponds/forest creeks	MDG7	2.5%
	(13)Cooking fuel[3]	H/hold uses charcoal/firewood/sawdust/wood shavings/plant material	MDG7	2.5%
	(14) Ownership of Basic assets	H/hold lacks any one of these basic assets: radio/TV, mobile phone, fan, mattress, pressing iron, set of chairs and does not have any one of a bicycle, motorcycle, canoe or car.	MDG7	2.5%
(5) Social affiliation	(15) Membership of a political party	No h/hold member is a member of a political party at the ward/LG/state/national level		10%
	(16) Involvement in comm. dev. projects.	No h/hold member participates in comm. devt. projects		10%

Source: Author's choice of Dimensions, Indicators, Cutoffs and Weights as used in the study.

MDG1 is Eradicate Extreme Poverty and Hunger * In addition to the MDG2 (Achieve Universal Basic Education), the Nigerian education policy enjoins a citizen to have at least 9 years (Junior Secondary Education) of formal schooling. MDG7 is Ensure Environmental Suitability.

**Food/Nutrition: while mean per capita food expenditure was used as a proxy for food availability in the h/hold in terms of the quantity purchased of the various classes of food, number of meals per day measures food adequacy among aged 6-15 h/hold members.

*** A meal is adjudged to be of average quality if it is taken with any one of half-whole egg, a piece of fish or meat, milk or fruits.

Indicators denoted [1],[2],[3] are those that were excluded from the list in the final analysis using the MCA technique

Appendix III: The Millennium Development Goals (MDGs)

Goal 1: *Eradicate extreme poverty and hunger*

Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than US$ 1 a day.

Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger

Goals 2 and 3: *Achieve universal primary education and promote gender equality and empower women.*

Target 3: Ensure that children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.

Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015.

Goal 4: *Reduce child mortality*

Target 5: Reduce, by two-thirds, between 1990 and 2015, the under-five mortality rate.

Goal 5:

Target 6:

Goal 6: *Combat HIV/AIDS, malaria and other diseases*

Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS.

Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.

Goal 7: *Ensure environmental sustainability*

Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking-water and basic sanitation.

Goal 8: *Develop a global partnership for development.*

This goal addresses aid, trade, finance and debt and actions that donor countries should take in support of Millennium Development Goals 1–7.

Appendix IV: Indicator-specific cutoff criterion

The following stated questions, deprivation criteria and cut-off (z_i) were set for each of the sixteen indicators used in the analysis:

1. **Year of schooling:** What is the maximum year of formal education attained by any member of the household?
   (0 = No formal Education; 1 = Primary school; *2 = Junior Secondary school; 3 = Senior Secondary school; 4 = Tertiary Education*) z_1 = 3: Household is deprived if it falls within a category below 2.

2. **Child Enrolment:** Is there any household school-age child (age 6-15 years) not presently enrolled in school for whatever reason?
   (*No = 0;* Yes = 1). z_2 = Household is deprived if any of its school-age children is not presently enrolled in school for whatever reason.

3. **Method of malaria treatment:** What method of malaria prevention/treatment do the household adopt?
   (0 = None; 1 = Visits traditional/religious healing centre; *2 = Buys drugs for self medication; 3 = Visits public hospitals; 4 = Visits private hospitals; 5 = Uses bednets/insecticides to prevent attacks)*
   z_3 = 2: Household is deprived if members do not use drugs or bednets/insecticides or visit hospitals.

4. **Self-reported Health:** How can you generally describe your health status in the last 12-18 months?
   (0 = poor; 1 = Just fair; 2 = Good/sound) z_4 = 2: Households with member(s) describing health status in the last 12-18 months as poor or just fair are deprived.

5. **Food Availability:** What is the monthly food expenditure of the household?
   (0 = Below one-third mean per capita household food expenditure (MPCFE); 1 = Below two-third mean per capita household food expenditure; 2 = Above two-third mean per

capita household food expenditure). z_5 = 2: Households below two-third mean per capita household food expenditure the (food poverty line) are deprived.

MPCFE is computed as $\frac{\sum M_{ni}}{N}$; $M_{ni} = \frac{\sum HHFE_{ith}}{HH_{ith}}$

where *HHFE* is monthly food expenditure for the *ith* household *(HH)*; M_{ni} is monthly per capita household food expenditure; *N* is total number of surveyed households.

6. **Food Adequacy** (among aged 6-15years household members): How many times per day do your children aged 6-15years eat major * quality meals?
(0 = No particular major meal any day; 1 = Average of one major quality meal per day; *2 = Average of two major quality meals per day; 3 = At least three major quality meals per day).* z_6 = 2: Household is deprived if any household member aged 6-15years eats less than two major quality meals per day on the average. (* A meal is adjudged to be of average quality if it is taken with any one of half-whole egg, a piece of fish or meat, milk or fruits).

7. **Source of Domestic Light:** What is the main source of domestic light for the household?
(0 = Kerosine lamp without shade/household never connected to power grid/household has been permanently disconnected from power grid; *1 = Kerosine lamp with shade; 2 = Battery-powered lamps; 3 = Electricity/Generator/Rechargeable lamps.)* z7 = 1: Household is deprived if it falls below category 1.

8. **Toilet Type:** Where (or by what means) do majority of the household members defeacate? (0 = into the surrounding rivers/bush (without a toilet); 1 = uses pit/uncovered/unprotected toilet; *2 = uses toilet with septic tank*). z_8 = 2: Household is deprived if it falls within categories below 2.

9. **Means of Solid Waste Disposal:** Where (or by what means) does the household dispose of its garbage/solid wastes? (0 = disposes into the surrounding rivers or bush; 1 = for filling pathways, potholes or ditches; *2 = disposes into pits or heaped up for burning; 4 = disposes in trash cans and collected by sanitation agents).* Z9 = 2: Household is deprived if it falls below category 2.

10. **Wall of the House:** What material is your house wall made of?
(0 = straw/plant materials/sac; 1 = iron sheets; 2 = planks/bamboo; *3 = mud; 4 = concreted*). z_{10} = Household is deprived if it falls below category 3.

11. **Floor of the House:** What material is your house floor made of?
(0 = covered by bare sand/straw/plant materials; 1 = filled with mud; 2 = planks/bamboo over the river; *3 = concrete; 4 = tiles*). z_{10} = Household is deprived if it falls below category 3.

12. **Source of Drinking Water:** What is the main source of drinking water for the household?
(0 = from stagnant pond/forest creeks/rivers/streams/lagoon; 1 = rainfalls; 2 = unprotected wells; *3 = bore holes; 4 = pipe*). z_{12} = 3: Household is deprived if it falls below category 3.

13. **Source/Type of Cooking Fuel:** What is the main source or kind of fuel the household uses for cooking?
0 = firewood/charcoal; *1 = kerosene stove; 2 = gas; 3 = electricity*). z_{13} = 1: Household is deprived if it falls below category 1.

14. **Ownership of Basic Assets:** Does the household own any one of the listed basic assets (radio/TV, mobile phone, fan, mattress, pressing iron, set of chairs), and at least one of the listed means of transportation (bicycle, motorcycle, canoe or car)?
(No = 0; *Yes = 1*). z_{14} = Household is deprived if its response is No.

15. **Membership of Political Party:** Is any household member a registered member of a political party at the ward/local government/state/national level?
(No = 0; *Yes = 1*). z_{15} = Household is deprived if its response is No.

16. **Involvement in Community Development Projects:** Does any household member participate in community development projects at the local level?
(No = 0; *Yes = 1*). z_{16} = Household is deprived if its response is No.

Appendix V: Cross-tabulation of quintiles of the 2-component welfare deprivations profile.

		Material Deprivation				
		Q_1	Q_2	Q_3	Q_4	Q_5
Social Deprivation	Q_1	Q1Q1	Q1Q2	Q1Q3	Q1Q4	Q1Q5
	Q_2	Q2Q1	Q2Q2	Q2Q3	Q2Q4	Q2Q5
	Q_3	Q3Q1	Q3Q2	Q3Q3	Q3Q4	Q3Q5
	Q_4	Q4Q1	Q4Q2	Q4Q3	Q4Q4	Q4Q5
	Q_5	Q5Q1	Q5Q2	Q5Q2	Q5Q4	Q5Q5

Source: Author's Cross-tabulation of the 2-component quintiles for welfare deprivations, 2010.

Q1: Least deprived segment of the households according to a particular welfare component.

Q2: Less deprived segment of the households according to a particular welfare component.

Q3: Deprived segment of the households according to a particular welfare component.

Q4: More deprived segment of the households according to a particular welfare component.

Q5: Most deprived segment of the households according to a particular welfare component.

Appendix VI: Description, justification and expected sign of explanatory variables used in the Tobit and Logit Models.

S/No.	Explanatory Variable	Variable Code	Variable Type & Measurement	*a priori* expectation	Variable Description / Justification for Inclusion
	Characteristics of HH Head				
1.	Age	AGE	*Continuous* (Years)	+ (Agboola, 2004; London and Scott, 2005).	
2.	Age Square	AGESQ	*Continuous* (Years)	+ / -	$(Age^2/100)$ Captures the life-cycle or non-linear effect of age on poverty)
3.	Gender	GENDER	*Dummy* Female =1	+ (Bouis, 2003)	
	Household Characteristics				
4.	Household size	HHSIZE	*Continuous* (Number)	+ (Anton J. and Carrera M, 2007)	(All people living under the same roof with h/hold head)
5.	Dependency raatio	DEPRAT	*Continuous* (Number)	+ (Grundig, 2007)	(Ratio of non-working to total H/hold size)
6.	Type of family	FAMTYP	*Dummy* Polygamy =1	+ (Jimoh, 2004)	Housewives and their children living under the same roof with the male spouse.
7.	Monthly household income	HHINC	Naira	- (Grundig, 2007)	Variable includes income of other h/hold members apart from that of h/hold head.
8.	External Remittances	EXTREM	*Continuous* Naira/month	- (Grundig, 2007)	Reflects effect of external transfer on h/hold income

Source: Author's Description and expected sign of explanatory variables in the Tobit and Logit Models

Appendix VII: Description, justification and expected sign of explanatory variables used in the Tobit and Logit Models (cont'd).

S/No.	Explanatory Variable	Variable Code	Variable Type & Measurement	*a priori* expectation	Variable Description / Justification for Inclusion
	Household Educational Attainment				
9. 10. 11. 12.	- Primary Education - Junior Sec. Education - Senior Sec. & Vocational Education - Tertiary Education	PRYEDU JSSEDU SSVEDU TRTEDU	*Dummy* Pry. Educ = 1 JSS Educ = 1 SS/Voc. Educ = 1 Tert. Educ = 1 (No formal education is Ref. Category)	- - - - (Omonona, 2001; Muyanga, *et al*, 2007; Ayala, *et al*, 2009).	Educational attainment is a reflection of the level of human capital development of the household. (Variable is implied if at least one h/hold member falls in the category of specified educational attainment).
	Primary occup. of H/hold head				
13. 14.	-On-shore exploitation - Off-shore farming activities	FISNAT OFSHFA	*Dummy* Fishing/NRC = 1 Off-shore farming activities = 1 (Formal sector occupation is Ref. Category)	+ / - (Ribar and Hamrick, 2003) + / - (Ribar and Hamrick, 2003)	Capture fishing and other on-shore natural resource collection (NRC) Crop, livestock, produce processing
15.	Employment status in fishing/NRC	EMPFIS	*Dummy* Full-time = 1	+ / -	Time commitment of ≥8 hours/day is full-time
16.	Spouse/Child working	SPCHWK	*Dummy* Spouse/Any H/hold child working = 1	+ / -	Reflects effect of other members' efforts on h/hold income

Source: Author's Description and expected sign of explanatory variables in the Tobit and Logit Models

Appendix VIII: Description, justification and expected sign of explanatory variables used in the Tobit and Logit Models (cont'd).

S/No.	Explanatory Variable	Variable Code	Variable Type & Measurement	*a priori* expectation	Variable Description / Justification for Inclusion
	H/hold Wealth Variables				
17.	Type of canoes owed	CANOES	*Dummy* Dugout canoe = 1	-	Proxy for wealth and a means of livelihood and transport activities among coastal h/holds
18.	Size of farmland	LANDSZ	*Continuous* (Hectares)	- (Grundig, 2007)	Proxy for wealth among non-core coastal h/holds
	Community characteristics				
19.	House location relative to major water bodies	HOULOC	*Dummy* Located on river or along shore ($\leq$100m away from shores) = 1	+	Variable delineates between core and non-core coastal h/holds.
20.	Distance of house relative to major feeder or paved road(s)	DSROAD	*Continuous* (m)	-	Variable captures access to welfare enhancing opportunities/infrastructures not available within the core coastal area
21.	Distance of house relative to major food market(s)	DSFDMKT	*Continuous* (m)	-	Variable captures access to food market.
22.	Distance of house relative to major non-food market(s)	DSNFMKT	*Continuous* (m)	-	Variable captures access to non-food market.
23.	State	STATE	*Dummy* Ogun = 1 Ondo = 2 Lagos = 3 (Lagos State is Ref. Category)	+ / - (Van de Walle and Gunewardena, 2001; Palmer-Jones and Sen, 2003)	Captures geographical fixed effect variations associated with differences in ecological conditions which may differ within the study area.

Source: Author's Description and expected sign of explanatory variables in the Tobit and Logit Models

Appendix IX: Descriptive statistics of variables used in the Tobit and Logit models.

Variable	Mean	Standard Error
Dependent variables		
Poverty incidence (M_0)	0.3422	0.0133
Child Enrolment	0.0889	0.0009
H/Hold Sanitation Index	0.0724	0.0010
H/Hold Health Condition Index	0.0657	0.0019
H/Hold Food/Nutrition Index	0.0522	0.0012
H/Hold Basic Asset Index	0.0882	0.0009
H/Hold Social Integration Index	0.0814	0.0010
Explanatory variables		
HHSIZE	5.8527	0.1425
DEPRAT	0.4082	0.0212
FAMTYP (polygamous = 1)	24.33%	0.0203%
AGE	46	0.5169
GENDER (female = 1)	28%	0.0210%
YREDUC	8	0.2173
OCCUP (fishing/NRC = 1)	31.70%	0.0220%
EMPFIS (full-time)	18.97%	0.0186%
SPCHWK (spouse/children working =1)	84.15%	0.0173%
EXTREM	₦3909.60	₦447.68
CANOES (using dugout canoe = 1)	100%	0.1201
LANDSZ	0.5103 Ha.	0.0540 Ha.
HOULOC (core-coastal = 1)	33.71%	0.0224%
DSROAD	2.68 Km	0.1138 Km
DSFDMKT	1.95 Km	0.0362 Km
DSNFMKT	3.22 Km	0.0620 Km
OGUNST	30.36%	0.0218
ONDOST	28.79	0.0214

Source: Author's Computation of the descriptive statistics of explanatory variables in the Tobit and Logit Models

Appendix X:

RESEARCH QUESTIONNAIRE

UNIVERSITY OF IBADAN
DEPARTMENT OF AGRICULTURAL ECONOMICS

TOPIC: Welfare deprivation and the measurement of multidimensional poverty among riverine households in Southwestern Nigeria

NOTE: All information would be made confidential. Questionnaire number: ----------

State: ---------- LGA: ---------- Town/Village: ----------

SECTION A: HOUSEHOLD INFORMATION

1. Personal data of household head

(a) Age:_____

(b): Sex: Male_____; Female_____

(c) Marital status: Single (never married before)_____; Single (Separated)_____;
Married (monogamy)_____ Married (polygamy)_____
Fully divorced _____; Widowed (Spouse late) _____.

(d) Religion/Belief system: Christianity_____; Islam_____; Traditional_____

(e) Native of incumbent Community: Yes _____; No _____

(f) Main Occupation: _____

Other Occupation(s): (i) _____(ii)_____ (iii)_____

(g) Educational background of household head

	Never went to School	Attempted Pry School	Finished Pry School	Attempted Sec. School	Finished Sec. School	Attempted Tertiary Institution	Finished Tertiary Institution
Highest level of Education							

Please tick the appropriate box for the reason(s) for not having formal education:

	School not within community vicinity	High tuition	Nobody to sponsor	Ill-health	Engaged in domestic work	Engaged in farm work	Engaged in petty trading/other Income employment	Early marriage
Reason(s)								

Employment data

Please provide the following information about your employment status (household head only)

Employment status: / Employment sector	In public sector	In private formal sector	In private Agric. sector	In private Non-agric. sector
Fully employed by another				
Employed on part-time basis				
Employed on casual basis				
Fully Self-employed				
Not employed at all				

Please tick the appropriate box for the reason(s) for not having being gainfully employed:

	Under-age	Over-age	Lack of formal Education	Ill-health	Seasonality of work	Domestic duties	Schooling	No work available
Reason(s)								

(h) Years of experience of household head in his primary occupation: _____

(i) Number of other household adult members working: _____

Average Net income/month: (₦) / Employment sector	From public sector (₦)	From private formal sector (₦)	From private Agric. Sector (₦)	From private Non-agric. Sector (₦)
Household head:				
Other household members:				
1. Spouse(s)				
2. Child(ren)				
3. Remittances (write in any Of the column)				

Household data

(j) Household size and composition

	<18 years		Between 18 and 65 years		Between 18 and 65 years		Above 65 years	
	Male	Female	Male	Female	Male	Female	Male	Female
No. of household member								

Please provide the following information on household children

	Going to school and not working	Not going to school but working	Going to school and working	Neither going to school nor working	Engaged in domestic work	Engaged in farm work
No. of children below 18 years						

Please provide the following information on children' closeness to parents.

Description	**Number**	**Reason(s), if any.**
Children staying presently under the same roof with parents.		
Children staying permanently away from parents		
Children coming home occasionally to parents		
Children staying presently with parents but have their own family(s).		

Health needs of household head

Did you have any need for visiting a health worker in the last 4 weeks? Yes_____ No_____

Did you actually visit a health worker in the last 4 weeks? Yes_____ No_____

Please tick the appropriate box for the type of healthcare service received in the last 4 weeks

Public hospital	Private registered hospital	Private unregistered hospital	Religious hospital	Traditional herbalist (Alagbo)	Consulted a pharmacist	Bought drugs for self treatment

Tick the appropriate box for reason(s) for not visiting a public/registered healthcare centre.

	Could not afford hospital bills	Hospital not within community vicinity	Does not believe in modern medicines	Believes more in the efficacy of Traditional herbs (Alagbo)	Other reason(s)
Reason(s)					

Please specify by ticking the appropriate column(s) 1-5 for each of the items listed

Having problems satisfying:	**Always (1)**	**Occasionally (2)**	**Often (3)**	**Rarely (4)**	**Never (5)**
- Food needs of the household					
- Non-Food needs of the household (clothing footwears, cosmetics,etc)					
- Health needs of the household					
- Payment of House rent					
- Payment of utility bills (PHCN, Water, etc)					
- Payment of children school fees					

Monthly Household food and non-food expenditure

Food item	***Expenditure/Month (₦)***	**Non-Food item**	***Expenditure/Month (₦)***
Starch		Transport	
Protein		Telecomms (Recharge cards & calls)	
Fats / Oil		Health Care	
Water		Domestic Services	
Vitamins & Others		Utility Bills (rent, PHCN, water rates, etc.)	

Household possession/ownership of tangible assets

Please mark (Y) if household possesses at least 1unit of the listed items, and (N) if not.

Item	***Yes***	***No***	***Necce-sary but can't afford***	***Can afford but unneccesary***	**Item**	***Yes***	***No***	***Neccesary but can't Can afford but not Neccesary afford***		
Household Equipment					**Malaria control device**					
Charcoal iron					Use bed nets					
Electric iron					Uses insecticides					
Refrigerator					Uses Insecticide treated nets					
Personal computer					Uses Anti-malaria drugs					
Fan					**Toilet types**					
Mat/Matress					Pit latrine					
Transportation means					WC system					
Bicycle					Bush					
Motorcycle					**Refuse collection**					
Car					Uses dust-bin					
Canoe					Pit throws					
Horse/Donkey/Camel					Burning					
Source/meansof Information & communication					**Use of Agric. Inputs**					
Item (Cont'd)	***Yes***	***No***	***Necce-sary but can't afford***	***Can afford but unneccesary***	Improved seedlings					
Television					Fertilizer					

Radio										
Mobile phone					Treatment chemicals					
Fixed Analogue telephone					Improved livestock species					
Domestic Energy Source					Vaccines/drugs					
Charcoal pot					Hook & Net					
Kerosene stove					**Ownership of apartment**					
Electric stove					Owes the building					
Gas cooker					Rented some rooms					
Generator					Owned by relative					

Source of drinking water				**Wall of the house:**		
Well				Made of mud		
Bore-hole				Made of planks		
Lakes & ponds				Made of sacks		
Rain water				Made of roofing sheets		
Water vendor				**Roof of the house**		
Floor of the house				Made of bamboo		
Cemented				Made of iron sheets		
Covered by mud/earth				Made of sacks		
Made of planks over water				Thatched roof		
Becomes better				Bank loan		
Becomes worse				Micro-credit loan		
Perception on community's security status (last 6 months)				Cooperative loans		
Remain the same				Grant		
Becomes better				**Access to basic infrastructures**		
Becomes worse				Water source within treckable distance & affordable		
Type of housing unit occupied by household				Food market within treckable distance &		

				affordable		
Single room				Healthcare source within treckable distance & affordable		
Flat				Pry. & Sec. Schools within treckable distance & affordable		
Thatched house built on top of water				Public transport within treckable distance & affordable		
others (please specify)						
Household's poverty coping strategy Farm work Casual work				**Integration into Society** Participation in community decision-making		
Children hawking				Membership of a political party		
Eating wild fruits/food				Membership of an NGO		
Reducing No. of meals				Membership of a Coop. society		
Reducing non-food				Household head involves in community development projects		
Reducing non-food consumption						
Formal borrowing				**Major reason for deprivation of access to welfare enhancing goods/facilities/services**		
Informal borrowing				High cost of services		
Withdrawing children from school				Ignorance of its existence		
Buying on credit				Not available within vicinity		
Sales of household property				Under-age		
Work-for-food on daily basis				Over-age		
Work-for-loan repayment				Inadequate education		

Possession/Ownership of land, labour and livestock assets by household head

S/No	Item	Quantity owned	Financial worth (₦)
1.	Arable land (uncultivated)	(Ha)	
2.	Cultivated land (arable crops)	(Ha)	
3.	Cultivated land (tree crops)	(Ha)	
4.	Cattle	(No.)	
5.	Goat & Sheep	(No.)	
6.	Poultry	(No.)	
7.	Paid labour force	(No.)	
8.	Unpaid labour force	(No.)	

Approximate distance, travel time and travel cost from community to the following:

Town / City	*Distance (km)*	*Travel/Trecking time (Hr)*	*Travel cost (₦)*
(a) The nearest paved road (b) The nearest town (c) Local government headquarter (d) Nearest water source (e) Nearest food market (f) Nearest healthcare centre (g) Nearest call booth (h) Nearest public car/bus park (i) Nearest primary school (j) Nearest secondary school (k) Nearest post- secondary School			

Reason for staying in present house accommodation/building/location

Reason	Please Tick
Low cost of house rent	
Nearness to the place of daily occupation/primary assignment	
Security of life and property is more guaranteed	
Closeness to relatives/other extended family members	
Other reasons (please state)	

MCA graph showing the distribution of welfare variables on the first and second factorial axes

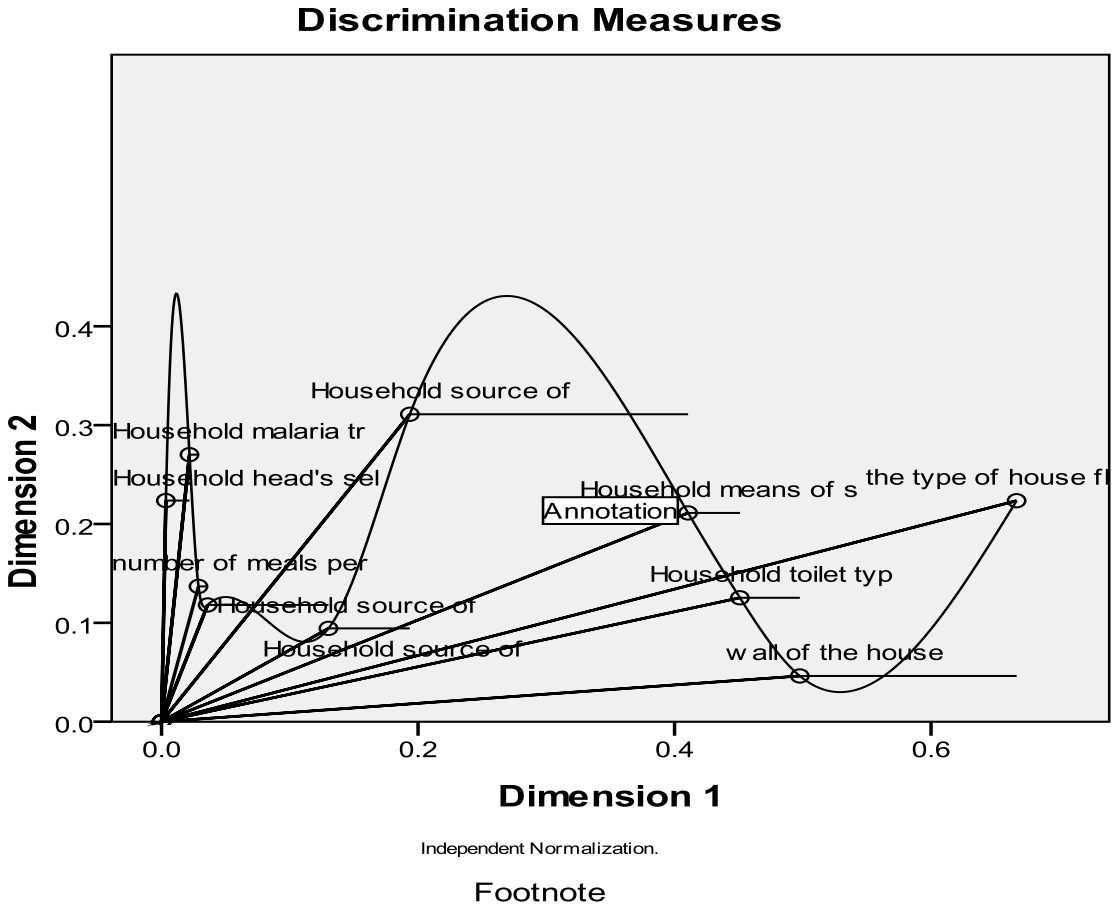

Figure 9: Distribution of welfare variables on the first and second factorial axes.