UNIVERSITY OF CAPE COAST

MODELING POVERTY STATUS OF GHANAIANS: A LOGISTIC REGRESSION APPROACH

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature:…… Date:……...

Candidate's Name: Omar Seidu

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature:…….... Date:……

Supervisor's Name: Prof. Ben K. Gordor

ABSTRACT

The poor are not evenly distributed within the country and they do not share the same socio-economic and demographic characteristics. It is against this background that analysis of the characteristics that differentiate the poor from the non-poor in Ghana cannot be underestimated. Poverty indicators make it possible to analyze the likely determinants and are, therefore, essential for formulating policy interventions that may contribute directly or indirectly to its alleviation. This study therefore aims at determining the most important characteristics that differentiate poor households from non-poor households in Ghana.

To achieve this objective, data was obtained from the Ghana Statistical Service. It consists of 49,005 households surveyed in the country of which 17.2 percent were classified as being poor (extremely poor). The analysis of the data relied mainly on logistic regression. It was found that the region a household resides in, the number of persons in that household, access to improved sources of water and sanitation, are the most important characteristics. These and other interesting results are discussed.

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DEDICATION

This work is dedicated to my dear mother, Amina Agona, my sweetheart, Caroline Y. Wuni, and our son Rayyan Weppea Attega.

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CHAPTER ONE

INTRODUCTION

Background to the Study

The interrelationships between population variables and poverty and the linkages with socio-economic development have been the subject of concern and debate for a long time. Thomas Maltus, as contained in Birdsall et al (2001), was the first to assert that high fertility and rapid population growth were likely to worsen the means of subsistence. Although there have been counter arguments, empirical investigations since the 18th century by social scientists have improved knowledge of the processes and interactions involved. These have informed policy formulation and programme development across the world. The interactions between population and poverty have become even more critical today as the populations of developing countries continue to grow unevenly over space with varying socio-economic characteristics in the face of worsening poverty situations.

Every society has its own views on what constitutes a minimum standard of living. Such normative thresholds are commonly expressed by means of a poverty line, which specifies the minimum living standards to which everybody in a society should be entitled. A person is deemed poor if his or her income or consumption falls below that threshold. This means that poverty lines are very country-specific, insofar as views about what

individuals should be entitled to will differ from one society to another. In Ghana for instance, three dimensions of poverty are used to determine the poverty line. These are the consumption poverty, lack of access and limited human development (GSS, 2005). Strictly speaking, therefore, we should not be able to make cross-country comparisons of poverty rates, since it will be virtually impossible to agree on a common poverty basket that is uniformly acceptable in every country. In spite of this, global estimates based on a common international standard do play an important role in monitoring the level and change in poverty around the world. They can be used as a powerful tool to heighten public awareness about the need to fight poverty and achieve the Millennium Development Goals.

Assessing the extent of poverty involves two conceptually distinct tasks. The first task is to identify which individuals in a population are poor, and how poor they are. The second task is to aggregate this information so as to determine the extent of poverty experienced by the members of the population considered together.

Poverty indicators serve three distinct purposes. First, they depict the extent of poverty and the socioeconomic profile of the poor at one or more points in time in a given location. Such depictions provide yardsticks for monitoring the performance of national governments and international agencies in achieving their professed objective of reducing poverty.

Secondly, poverty indicators make it possible to analyze the likely determinants of poverty and are, therefore, essential for formulating policy

interventions that may contribute directly or indirectly to its alleviation. Finally, such indicators can help mobilize support for national and international policies for poverty reduction (Deaton, 2001).

The usefulness of poverty indicators for the first two purposes becomes compromised when data are aggregated over either time or space. This happens, for instance, when data are lumped together over long periods of time involving major systematic changes, or across regions of a country with widely distinct characteristics. Similar problems arise from poverty estimates that take the household as the relevant unit. By aggregating information across all members of a household, such estimates preclude a meaningful analysis of the welfare of some of its individual members, particularly women and children.

In fact, aggregate indicators tend to obscure the relationship between determinants of poverty and outcomes, which is likely to vary across the units being aggregated. By doing so, aggregation limits policy effectiveness insofar as policies are most effective in achieving their objectives when targets are clearly set (Pogge and Sanjay, 2003).

Poverty is a multidimensional phenomenon, encompassing inability to satisfy basic needs, lack of control over resources, lack of education and skills, poor health, malnutrition, lack of shelter, poor access to water and sanitation, vulnerability to shocks, violence and crime, lack of political freedom and voice (The World Bank Institute, 2005).

It is therefore no surprise that one of the four key pillars underpinning the Ghana Poverty Reduction Strategy II is the development of the human resource asset. The document asserts that, "an important aspect of this human resource development is the right to basic social services such as health care, safe drinking water and sanitation, and decent housing that improves the well being of all Ghanaians" (NDPC, 2005).

It is evident that in a nation's efforts to reduce poverty through various policies and programmes, analysis of the patterns and trends of poverty may not be enough to provide the necessary policy directions required to impact on the lives of those most affected. It is for this reason that this study seeks to identify the most important characteristics that differentiate the poor from the non-poor.

Objectives

Generally, this study seeks to evolve a model to determine the extremely poor households in Ghana. Specifically however, the study will:

1. Establish the most important variables that isolate the extremely poor from the others;
2. Establish those characteristics that will allow the classification of some households as extremely poor; and
3. Make recommendations for policy intervention or action.

Research Questions

In order to achieve the aim of the study, one needs to be guided by relevant questions. The main hypotheses that direct this study are that:

1. Do the demographic characteristics of the poor differ from those of the non-poor?
2. Do the poor and non-poor have different socio-economic profiles?
3. Do the poor and non-poor enjoy the same social support systems

Literature Review

According to the World Bank (2000), poverty is pronounced deprivation in well-being." This of course begs the question of what is meant by well-being. Perhaps the broadest approach to well-being (and poverty) is the one articulated by Amartya Sen (1987), who argues that well-being comes from a capability to function in society. Thus, poverty arises when people lack key capabilities, and so have inadequate incomes or education, or poor health, or insecurity, or low self confidence, or a sense of powerlessness, or the absence of rights such as freedom of speech. Viewed in this way, poverty is a multi-dimensional phenomenon, and less amenable to simple solutions. So, for instance, while higher average incomes will certainly help reduce poverty, these may need to be accompanied by measures to empower the poor, or insure them against risks, or to address specific weaknesses (such as inadequate availability of schools or a corrupt health service).

A low standard of living is often measured by using deprivation indicators (high deprivation equals a low standard of living) or by consumption expenditure (low consumption expenditure equals a low standard of living). Of these two methods, deprivation indices are more accurate since consumption expenditure is often only measured over a brief period and is obviously not independent of income currently available. Deprivation indices are broader measures because they reflect different aspects of living standards, including personal, physical and mental conditions, local and environmental facilities, social activities and customs (Gordon, 2003).

Social science research has shown that all cultures have a concept and definition of poverty although these definitions often vary (Gordon and Spicker, 1998). A major problem with many previous attempts to measure poverty on a global scale is that there was no agreed definition of poverty. This situation changed at the World Summit on Social Development in Copenhagen (United Nations, 1995). After the summit, the UN established four task forces to prepare coordinated action on the major commitments from all the global summits, including children, women, population, habitat and social development. The conclusion of this work was a statement of commitment to the action to eradicate poverty issued in June 1998 by the executive heads of all UN agencies (Langmore, 2000). Poverty was thus described as: "…not having enough to feed and cloth a family, not having a school or clinic to go to, not having the land on which to grow one's food or a job to earn one's living…." (UNFPA, 1999). Income is important but access

to public goods such as safe water supply, roads, healthcare, and education is of equal or greater importance, particularly in developing countries. These are the views of both the governments of the world and the institutions of the United Nations and poverty measurement clearly needs to respond to these views" (Gordon, 2003). In this direction the Ghana Poverty Reduction Strategy document defines poverty as "unacceptable physiological and social deprivation" (Government of Ghana, 2003).

Population Poverty Nexus

The complex relationships between population, poverty and development constitute practical challenges for policy makers working towards a comprehensive approach to socio-economic development. For this reason, the relationships and interactions between the characteristics of a given population, economic growth and poverty reduction have been studied in detail. Recent research has reviewed the long-standing skepticism by some economists of a linkage between population dynamics and microeconomic growth and, based on a more complete data record and improved techniques, concluded that population has a variety of effects on development at the household and national levels (Birdsall et al, 2001).

Income and assets are, of cause, two reasons why constraints differ between the poor and the non-poor. But there are others; the poor and non-poor households may incur different costs when trying to restore and maintain their health. Health facilities in developing countries vary hugely in their

quality of service and accessibility. What emerged from the World Bank's *Voice of the Poor* consultative exercise, as well as from other quantitative studies across the developing world is that it is precisely the people who are materially disadvantaged who have to struggle with poor quality and inaccessible health facilities, condemning them into further poverty due to ill-health (Wagstaff, 2001).

With regard to access to safe water, among those directly affected are the poor in both rural and urban areas. They also lack the financial and human resources to manage the impact of this deprivation. Research has it that, on the average, households in rural Africa spend 26 percent of their time fetching water, and it is generally women and girls who perform this duty (DFID, 2001). The water that is collected is often dirty, from unprotected sources, such as streams or dugouts. Simply by collecting water they may be exposed to water borne diseases and their health may also be affected by the heavy burden of carrying the water.

There is also a large body of research which supports the view that education can have significant benefits with respect to the wider goals of development. This is particularly the case when the education of women is improved. For example, Filmer (1999) found that the education of women has a significant impact on the enrolment of children into schools in all countries considered. Bicego and Boerma (1993) found that improving the mother's education is linked to reductions in child mortality and, whilst it is difficult to disentangle the effects of education on child mortality from other factors such

as income poverty, there is evidence that education is independently associated with improved health rates (Government of Pakistan, cited in Gwatkin, 2000).

Measuring Poverty

It takes time, energy and money to measure poverty, since it can only be done properly by gathering survey data directly from households. Why, then, do we need to go to the trouble of measuring poverty? At least four good reasons come to mind.

Perhaps the strongest justification is that provided by Ravallion (1998), who argues, "a credible measure of poverty can be a powerful instrument for focusing the attention of policy makers on the living conditions of the poor." Put another way, it is easy to ignore the poor if they are statistically invisible. The measurement of poverty is thus necessary if it is to appear on the political and economic agenda.

A second reason for measuring poverty is in order to target interventions. Clearly, one cannot help the poor without at least knowing who they are. This is the purpose of a poverty profile, which sets out the major facts on poverty and then examines the pattern of poverty, to see how it varies by geography (by region, urban/rural, etc.), by community characteristics (e.g. in communities with or without a school, etc.), and by household characteristics (e.g. by education level of household head, by size of household).

More generally, the third reason for measuring poverty is to be able to predict the effects of, and then evaluate, policies and programmes designed to help the poor. Policies that look good on paper – new opportunities for microcredit for the poor, for instance – may, in practice, not work as well as expected. To judge the effects, one would ideally like to monitor the effects of a policy on the poor, and evaluate the outcomes in comparison with a control group. Rigorous analysis of this kind is needed both to improve the design of projects and programs, and to weed out ones that are not working.

The fourth reason for measuring poverty is to help evaluate institutions. One cannot tell if a government is doing a good job of combating poverty unless there is good information on poverty. This does not only apply to governments. "Our dream is a world free of poverty," writes the World Bank, and its first mission statement is "to fight poverty with passion and professionalism for lasting results" (World Bank Institute, 2005). The institutions success in pursuing this goal can only be judged if there are adequate measures of poverty.

Conventionally, the money metric approach to measurement requires setting a poverty line of some type. Poverty lines are used to separate the 'poor' from the 'non poor'. They are based on some threshold expenditure deemed necessary to buy a minimum or socially acceptable standard of nutrition and other necessities (World Bank, 2000). This expenditure varies between countries and is affected by local tastes and cultural norms. For this reason, country-specific poverty lines are always used.

Critics of money metric measures argue that money provides only an indirect means for translating inputs into human development outcomes. Hence, measures that focused explicitly on outcomes should be used instead. While this is partly true, it is also the case that some of the direct means to wellbeing, such as, food, clothing and shelter, are purchased with money. Besides, money metric measures are often preferred because they are useful for poverty comparisons (Ravallion, 1994). By contrast, other methods and indicators, including the Human Development Index (HDI) developed by UNDP, are not as well suited to comparisons between individuals or households. Analysis that requires quantification thus typically relies on the money metric approach, which explains why the latter has remained a useful, albeit imperfect, tool for poverty analysis.

Poverty in Ghana as in other countries has many dimensions. Poor individuals and communities are characterized by low income, malnutrition, ill health, illiteracy, and insecurity. There is also a sense of powerlessness and isolation. These different aspects interact and combine to keep households, and at times communities, in persistent poverty. Three dimensions of poverty have usually been measured in Ghana: consumption poverty; lack of access to services and limited human development (GSS, 2000).

Rationale of the Study

The Consultative Group Meeting in November 1999 among the Ghana Statistical Service (GSS), its development partners and data users, after the

Ghana Living Standard Survey Round 4 (GLSS4), set two poverty lines - the lower poverty line of 288.47 Ghana Cedis per adult per year and the upper poverty line of 370.89 Ghana Cedis per adult per year. Individuals whose total expenditures fell below GH¢ 288.47 were considered extremely poor, implying that even if they allocated their entire budget to food, they would not be able to meet their minimum nutritional requirements (GSS, 2007).

Considering the upper poverty line, the proportion of the Ghanaian population defined as poor fell from 51.7 percent in 1992 to 39.5 percent in 1999 and further to 28.5 percent in 2006. The corresponding figures for those defined as extremely poor fell from a little over 36 percent in 1992 to 27 percent in 1999. This further declined in 2006 to a little above 18 percent (GSS, 2007).

A poverty profile describes the pattern of poverty, but is not principally concerned with explaining its causes. Yet a satisfactory explanation of why some people are poor is essential if we are to be able to tackle the roots of poverty. Poverty may be due to national, sector-specific, community, household or individual characteristics.

Two cautions are in order. First, it can be difficult to separate causation from correlation. For instance, it is known that poor people tend to have low levels of education; but are they poor because they have little education, or do they have little education because they are poor? A statistical association alone is not enough to establish causality, and additional information is likely to be required.

Second, most of the "causes" of poverty that we identified are immediate (or "proximate") causes, but not necessarily "deep" causes. For instance, suppose that it can be demonstrated that low levels of education do indeed increase the risk of poverty. This is interesting, but now begs the question of why some people have low levels of education in the first place: Were the school fees too high? Was there no school nearby? Was the quality of the education abysmal? Were their parents unsupportive, or even hostile to education? Was there a concern that an educated woman could not find a husband (Gibson, 1999)?

The weakest part of poverty analysis – what Howard White calls the "missing middle" – is developing a clear understanding of the fundamental causes of poverty. Such an understanding is needed if one is to develop an effective strategy to combat poverty. Since there is no reason to believe that the root causes of poverty are the same everywhere, country-specific analysis is essential (World Bank Institute, 2005).

As it is expected, the poor are not evenly distributed within the country and they do not share the same socio-economic and demographic characteristics. It is against this background that further analysis of the characteristics that differentiate the poor from the non poor in Ghana cannot be underestimated. This study is therefore meant to add to the world of knowledge in the quest to eradicate extreme poverty as outlined in national and international conventions.

Data Sources and Methodology

Data from the 2003 Core Welfare Indicators Questionnaire Survey (CWIQ II) is used. CWIQ is one of the key monitoring tools that the Government of Ghana has chosen to assess progress in tackling poverty and vulnerability. The main objective of the survey was to generate simple indicators for monitoring poverty and the effects of development policies and programmes on the welfare of the various population sub-groups in Ghana.

The survey collected data from a sample of 405 households in each of the 110 districts and 11 sub-metropolitan areas that existed in 2003 yielding a total sample of 49,005 households nationwide. Topics covered in the survey include education, health, employment, household assets, household amenities, poverty predictors, subjective well-being, violence, crime and safety, communication and child anthropometrics.

In order to obtain reliable household welfare indicators, a series of poverty correlates were identified that enabled the construction of welfare quintiles by imputation. A predictive model was estimated using the money metric welfare measures and a series of potentially correlated variables and every household and individual was thus classified into the various welfare quintiles; the first quintile being the extremely poor whiles the fifth quintile is the richest (GSS, 2005).

This study maintains the first quintile as the extremely poor while all the other categories are put together as the non poor. Though there are differences among the second, third, fourth and the fifth quintiles, the emphasis is on the extremely poor households, hence the decision to combine the other quintiles. Binary Logistic Regression Analysis methods are employed to determine the most important characteristics of the poor and a model evolved to predict the poverty status of Ghanaian households.

Outline of the Study

The report is structured in five chapters. Chapter One covers the background of the study, statement of objectives, research questions, literature review, rationale of the study, data source and methodology and the final aspect which is the outline of the study. Chapter Two reviews the basic methods used for analysis. Chapters Three and Four are made up of the preliminary and main data analysis where binary logistic regression is applied. Finally, Chapter Five deals with the summary, discusses the findings and concludes the study with some recommendation.

CHAPTER TWO

REVIEW OF BASIC METHODS

This chapter reviews the theory of the main techniques used in the main analysis of the data. Regression analysis methods are basically used with special attention on binary logistic regression.

Regression Analysis

When there is evidence that two variables are correlated, it may be of interest to describe the relationship between them using regression analysis. Regression analysis seeks to find regression models or mathematical equations that best describe the relationships that exist between two or more variables. Regression may be linear or non-linear, simple or multiple. In each case, the major purpose is to explore the dependence of one variable on the other(s).

Multiple linear regression generalizes the simple linear regression model by allowing for many terms in a mean function rather than just one intercept and one slope. We start with a response *Y* and the simple linear regression mean function

$$E(Y / X_1 = x_1) = \beta_0 + \beta_1 x_1 \qquad (1)$$

Now suppose we have a second variable X_2 with which to predict the response. By adding X_2 to the model, we will get a mean function that depends on both the value of X_1 and the value of X_2,

$$E(Y / X_1 = x_1, X_2 = x_2) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \qquad (2)$$

The main idea in adding X_2 is to explain the part of *Y* that has not already been explained by X_1 .

The Multiple Linear Regression Model

The general multiple linear regression model with response variable *Y* and predictor variables $X_1, \ldots, Xp$ is of the form

$$E(Y / X) = \beta_0 + \beta_1 X_1 + \ldots + \beta_p X_p \qquad (3)$$

The symbol *X* in *E(Y |X)* means that we are conditioning on all the terms on the right side of the equation. Similarly, when we are conditioning on specific values for the predictors $x_1, \ldots, x_p$ that we will collectively call *x,* we write

$$E(Y / X = x) = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p \qquad (4)$$

The βs are unknown parameters we need to estimate. Equation (3) is a linear function of the parameters, which is why this is called linear regression. When *p = 1, X* has only one element, and we get the simple regression problem. When *p = 2,* the mean function (3) corresponds to a plane in three dimensions. When *p > 2,* the fitted mean function is a hyperplane, the generalization of a *p*-dimensional plane in a *(p + 1)*-dimensional space.

Terms and Predictors

Regression problems start with a collection of potential predictors. Some of these may be continuous measurements, like the height or weight of an object. Some may be discrete but ordered, like a doctor's rating of overall health of a patient on a nine-point scale. Other potential predictors can be categorical, like eye colour or an indicator of whether a particular unit received a treatment. All these types of potential predictors can be useful in multiple linear regression. From the pool of potential predictors, we create a set of terms that are the *X*-variables that appear in model (3).

Transformation of Predictors

Sometimes the original predictors need to be transformed in some way to make model (3) hold to a reasonable approximation. The willingness to replace predictors by transformations greatly expands the range of problems that can be summarized with a linear regression model. Multiple linear regression however requires the outcome variable to be continuous, which is not the case in this instance. To overcome this drawback logistic regression is preferred.

Binary Logistic Regression

Logistic regression is a multivariate prediction method that is most likely to use all or some categorical and continuous predictors to explain a categorical, usually dichotomous, outcome. It bears similarities and differences to other prediction methods such as multiple regression and

discriminant function analysis. Logistic regression differs from the others in the nature of their assumptions. The traditional assumptions of linearity, homoscedasticity, and normality are not a requirement for logistic regression and the outcome variable must be exclusive and exhaustive so that each case must be classified into one, and only one, of the outcome categories. Logistic Regression is often used in one of the three ways suggested below:

First, logistic regression can be used as a prediction method whenever there are several independent or predictor variables (either categorical or continuous), and a single dichotomous outcome.

Secondly, logistic regression can also be used when there are multiple outcome categories and a set of predictor (either categorical or continuous). The goal, similar to the dichotomous linear regression, is to assess whether the set of predictors is significantly related to falling into one of the set of outcome categories.

Lastly, logistic regression can be used as an exploratory model-building method in which a number of nested models (models that are subsets of a larger model) are compared to determine the most parsimonious set of predictors needed to adequately predict the likelihood of falling into one of two or more outcome categories

When the response variable, denoted by $\boldsymbol{y}$, is continuous and believed to depend linearly on k variables x_1, x_2 ,..., x_k through unknown parameters β_0, β_1 ,..., β_k, then this linear (where "linear" is used to indicate linearity in the unknown parameters) relationship is given as

$$y_i = \sum_{j=0}^{k} \beta_j x_{ji} + \varepsilon_i \,, \qquad (5)$$

where x_{0i} = 1 for all i=1, 2 ,..., n.

The term ε_i is an unobservable random error representing the residual variation and is assumed to be independent of the systematic component

$$\sum_{j=0}^{k} \beta_j x_{ji} \,.$$

It is also assumed that $E(\varepsilon_i) = 0$ and $\text{Var}(\varepsilon_i) = \sigma^2$; hence

$$E(y_i) = \sum_{j=0}^{k} \beta_j x_{ji} \quad \text{and}$$

$$Var(y_i) = \sigma^2$$

To fit the model (5) to the data (y_i, x_i), one has to estimate the parameters $\beta_0, \beta_{1,\ldots,}\beta_k$. The most commonly used methods of estimation are;

i. the method of least squares and

ii. the method of maximum likelihood.

Applications of those methods of estimation to the linear regression model (5) are extensively discussed in Harlow (2005) and many other sources. It should be noted that no assumptions on the distribution of the response variable y are needed (except the independence of $y_1, y_2, \ldots, y_n$) to estimate the parameters by the method of least squares. However, the maximum likelihood method requires that the sample $y = (y_1, y_2,..,y_n)$ is randomly drawn from a distribution where the specified structure of that distribution in most applications is

$$N\left(\sum_{j=0}^{k}\beta_j x_{ji}, \sigma^2\right).$$

The least squares estimate of the regression parameters will then coincide with those obtained by the method of maximum likelihood. Another remark that should be made here is that there is nothing in the theory of least squares that restricts the distribution of the response variable to be continuous, discrete or of bounded range. For example suppose that we would like to model the proportion

$$\hat{P}_i = \frac{y_i}{n_i}, (i = 1, 2, \ldots, m)$$

of individuals classified as poor (extremely poor), observed over several geographical regions, as a function of *k* covariates, where

$$y_i = \sum_{j=1}^{n_i} y_{ij}$$

$$y_{ij} = \begin{cases} 1 & \text{if poor} \\ 0 & \text{elsewhere} \end{cases}$$

That is, we assume the relationship between p_i and the covariates to be

$$p_i = \sum_{j=0}^{k}\beta_j x_{ji} \qquad (6)$$

The least squares estimates are obtained by minimizing

$$s = \sum_{i=1}^{n}\left(\hat{p}_i - \sum_{j=0}^{k}\beta_j x_{ji}\right)^2$$

Several problems are encountered when the least squares method is used to fit model (6)

One of the assumptions of the method of least squares is variance homogeneity; that is, Var $(y_i) = \sigma^2$ does not vary from one observation to another. Since for binary data, the y_i follows a binomial distribution with mean $n_i p_i$ and variance $n_i p_i (1- p_i)$, then

$$Var(\hat{p}_i) = \frac{1 - p_i}{n_i}.$$

As was proposed by Cox and Snell, cited in Harlow (2005), one can deal with the variance heterogeneity by applying the method of weighted least squares using the reciprocal variance as a weight. The weighted least squares estimates are thus obtained by minimizing

$$S_w = \sum_{i=1}^{n} \left[Var(\hat{p}_i)\right]^{-1} \left(\hat{p}_i - \sum_{j=0}^{k} \beta_j x_{ji} \right)^2. \qquad (7)$$

Note that

$$W_i^{-1} = Var(\hat{p}_i)$$

depends on p_i which in turn depends on the unknown parameters β_0, β_1 ,..., β_k through the relationship (6).

Note that $0 \le \hat{p}_i \le 1$ and the estimates β_0, β_1,..., β_k of the regression parameters are not constrained. That is, they are permitted to attain any value in the interval $(-\infty, \infty)$. Since the fitted values are obtained by substituting β_0, β_1,..., β_k in (6), there is no guarantee that the fitted values should fall in the interval [0, 1].

To overcome the difficulties of using the method of least squares to fit a model where the response variable has a restricted range, it is suggested that

a suitable transformation be employed so that the fitted values of the transformed parameter vary over the a risk factor that has normal distribution with mean μ_1 and variance σ^2 in the population at risk of poverty, that is

$$X / B \sim N(\mu_1,\ \sigma^2),$$

which reads, given the information that the household is poor, the conditional distribution of X is $N(\mu_1, \sigma^2)$. Hence

$$f(X/B) = \frac{1}{\sigma\sqrt{2\pi}} \exp[-(x-\mu_1)^2 / 2\sigma^2] \qquad (8)$$

In a similar manner, we assume that the risk factor X, in the population of non-poor has a mean μ_2 and variance σ^2. That is

$$f(X/\bar{B}) = \frac{1}{\sigma\sqrt{2\pi}} \exp[-(x-\mu_2)^2 / 2\sigma^2]. \qquad (9)$$

Since

$$p = pr[y = 1/\ X = x] = \frac{p(y=1,\ X=x)}{f(x)}\ ,$$

then from Bayes' theorem,

$$P = \frac{f(X/B)P(B)}{f(X/B)P(B) + f(X/\bar{B})P(\bar{B})}$$

$$= \frac{\left(\frac{\pi}{\sigma\sqrt{2\pi}}\right)\exp\left[\frac{-(x-\mu_1)^2}{2\sigma^2}\right]}{\left(\frac{\pi}{\sigma\sqrt{2\pi}}\right)\exp\left[\frac{-(x-\mu_1)^2}{2\sigma^2}\right] + \left(\frac{1-\pi}{\sigma\sqrt{2\pi}}\right)\exp\left[\frac{-(x-\mu_2)^2}{2\sigma^2}\right]}$$

When this equation is manipulated, P is found to be

$$P = \Pr[y = 1/\ X = x] = \frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}} \qquad (10)$$

where

$$\beta_0 = -\ln\frac{1-\pi}{\pi} - \frac{1}{2\sigma^2}(\mu_1 - \mu_2)(\mu_1 + \mu_2) \quad \text{and}$$

$$\beta_1 = \frac{\mu_1 - \mu_2}{\sigma^2}$$

Note that

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x \qquad (11)$$

and it shows that, the log-odds is a linear function of the explanatory variable (in this case, the risk factor) *X*. The logarithmic transformation on the odds is called "logit".

The regression parameter β_1 has log-odds ratio interpretation in poverty analysis. To show this, suppose that the outcome variable has two levels (exposed, not exposed). Let us define a dummy variable *X* that takes the value 1 if the household is exposed to the risk factor, and 0 if not exposed. From Equation (10) we have

$$P_{11} = \Pr[y = 1 / X = 1] = \frac{e^{\beta_0+\beta_1}}{1+e^{\beta_0+\beta_1}}$$

$$P_{01} = \Pr[y = 0 / X = 1] = \frac{1}{1+e^{\beta_0+\beta_1}}$$

$$P_{10} = \Pr[y = 1 / X = 0] = \frac{e^{\beta_0}}{1+e^{\beta_0}}$$

$$P_{00} = \Pr[y = 0 / X = 0] = \frac{1}{1+e^{\beta_0}}$$

and that the odds ratio is

$$\psi = \frac{p_{11}\ p_{00}}{p_{10}\ p_{01}} = e^{\beta_1},$$

it follows that $ln\ \psi = \beta_1$.

The Equation (11) can be extended such that logit (p) is a function of more than just one explanatory variable. Let y_1, y_2,..., y_n be a random sample of n successes out of n_1, n_2 ,..., n_n trials, and let the corresponding probabilities of success be p_1, p_2 ,..., p_n. If we wish to express the probability p_i as a function of the explanatory variables x_{1i}, x_{2i} ,…, x_{ki}, then the generalization of (11) is

$$\text{logit}(p_i) = \log\left(\frac{p_i}{1-p_i}\right) = \sum_{j=0}^{k} \beta_j x_{ji} \qquad (12)$$

$x_{01} = 1$ for all $i = 1, 2,\ldots, n$.

We shall denote the linear function

$\sum_{j=0}^{k} \beta_j x_{ji}$ by η_i

which is usually known as the *link function*. Hence,

$$p_i = e^{\eta_i} / \left(1 + e^{\eta_i}\right) \qquad (13)$$

The binomially distributed random variables y_i $(i = 1,\ 2,\ldots, n)$ have mean

$\mu_i = n_i p_i$, and variance

$\sigma^2 = n_i p_i q_i$.

Since we can write

$y_i = \mu_i + \varepsilon_i$,

then the residuals

$\varepsilon_i = y_i - \mu_i$

have zero mean. Note that, in contrast to the normal linear regression theory, the residuals ε_i do not have a distribution of a recognized form.

Fitting the model to the data is achieved after the model parameters $\beta_0, \beta_1, \ldots, \beta_k$ have been estimated. The maximum likelihood method is used to estimate the parameters where the likelihood function is given by

$$L(\beta) = \prod_{i=1}^{n} \binom{n_i}{y_i} p_i^{y_i} q_i^{n_i - y_i}$$

$$= \prod_{i=1}^{n} \binom{n_i}{y_i} \left(e^{\eta_i}\right)^{y_i} \left(\frac{1}{1+e^{\eta_i}}\right)^{n_i} \qquad (14)$$

The log likelihood is then given by

$$\ell(\beta) = \sum_{i=1}^{n} \left\{ y_i \eta_i - n_i \ln\left(1 + e^{\eta_i}\right) \right\} \qquad (15)$$

Differentiating $\ell(\beta)$ with respect to β_r we have

$$\ell_r = \frac{\partial l(\beta)}{\partial(\beta_r)} = \sum_{i=1}^{n} \left\{ y_j x_{ri} - n_i x_{ri} e^{\eta_i} \left(1 - e^{\eta_i}\right)^{-1} \right\}$$

$$= \sum_{i=1}^{n} x_{ri} \left(y_i - n_i p_i\right) \qquad r=0, 1,..., k \qquad (16)$$

The $(k + 1)$ equations in (16) can be solved numerically. Given that

$$I = -E\left[\frac{\partial^2 \ell(\beta)}{\partial \beta_r \partial \beta_s}\right] = \sum_{i=1}^{n} n_i x_{ri} x_{si} p_i (1 - p_i) \qquad (17)$$

the large sample variance-covariance matrix is I^{-1}.

Once the parameters have been estimated, the predicted probability of success is given by

$\hat{p} = e^{\hat{\eta}_i} / 1 - e^{\hat{\eta}_i}$, where

$$\hat{\eta}_i = \sum_{j=1}^{k} \hat{\beta}_j x_{ji} \qquad (18)$$

Using statistical package like SAS, we obtain the maximum likelihood estimates, their standard errors

$$SE\left(\hat{\beta}_r^2\right) / v_{rr}^{\frac{1}{2}},$$

and the Wald chi-square values

$$\left(\hat{\beta}_r^2\right) / v_{rr} \quad , \qquad r = 0, 1,..., k$$

which can be used to test the hypothesis that the corresponding coefficient in η_i is zero.

Interpretation of Logistic Regression Results

Predictor variables can be evaluated in at least two ways with logistic regression:

Logistic Regression Weights and Significance Tests

The initial weights that come out of an LR analysis can be evaluated for significance much like what is done in multiple regression. The significance test for these weights is a Wald test that is interpreted as a *z*- or *F*-test and is simply the ratio of the LR coefficient divided by its standard error. Some computer programs use a χ^2 test to assess the significance of weights.

Odds Ratios

It is useful to examine the odds of falling into an outcome category given a one-unit change in a specific predictor. These odds ratios are calculated for each predictor and are helpful when interpreting which

explanatory variables provide relevant information in predicting membership in the outcome variable. Larger values for an odds ratio associated with an explanatory variable indicate that individuals/households with high scores on that explanatory variable have greater odds of falling into the baseline reference category. The reference category is usually the highest category (i.e., the one coded with a 1 versus a 0 in a dichotomous outcome). The odds ratio is the predicted change in odds for a unit increase in the corresponding independent variable. Odds ratios close to 1.0 indicate that unit changes in that predictor variable do not affect the dependent variable, in this case poverty status.

CHAPTER THREE

PRELIMINARY DATA ANALYSIS

As is the common practice in data analysis, the data is first explored in this chapter using basic exploratory techniques. The aim is to observe basic patterns exhibited by the various predictor variables in relation to the grouping variable.

Household Poverty

This section describes the household and individual characteristics of those who were captured in the 2003 Core Welfare Indicators Questionnaire Survey as living in extreme poverty in Ghana. Table 3.1 shows how poverty is distributed among surveyed households and individuals in the country. The first column presents the five groups in poverty categorization while the second and third look the number and percentage of the surveyed households who were classified into the various quintiles. The fourth and fifth columns give the number and proportion of the surveyed individuals who were classified into these quintiles.

Table 1: Household and Individual Level Poverty Status

	Household		Individual	
Quintiles	Number	Percent	Number	Percent
1st quintile	8420	17.2	56585	26.9
2nd quintile	8370	17.1	46006	21.8
3rd quintile	8331	17.0	38996	18.6
4th quintile	9487	19.4	35687	17.0
5th quintile	14395	29.3	32896	15.7
Total	49003	100.0	210170	100.0

From Table 1, about the same proportions of households fall in the first three poverty quintiles whiles three in every ten households were captured as non poor. Interestingly, the proportion of individuals who were captured as non poor (15.7%) is less than the number of households (29.3%) in the non poor quintile. This implies that there are fewer individuals in the non poor households. Similarly, though fewer households (17.2%) were recorded in the poorest quintile, the highest numbers of individuals (26.9%) who experience extreme poverty are in this quintile.

Figure 1 classifies each individual household into the two poverty groupings of poor (1st quintile) and the non poor (2nd to 5th quintiles).

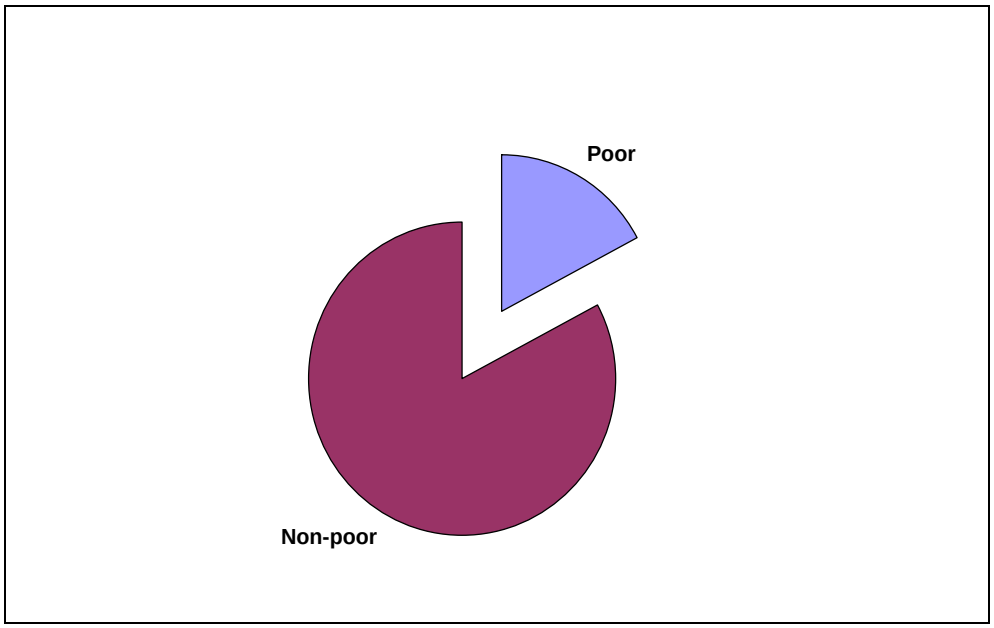

Figure 1: Poverty Dichotomy

From Figure 1, about one in five households (17.2%) are extremely poor and it is the characteristics that differentiate these groups that this study seeks to establish. To better understand the situation of the poor, their characteristics are considered at the regional, community and household levels.

Regional Level Characteristics

At the regional level, there are numerous characteristics that might be associated with poverty. Several studies have indicated that households in the three Northern regions of Ghana have a higher risk of poverty than the other regions. Figure 2 presents the poverty status of Ghanaian households by region of residence as captured by this survey.

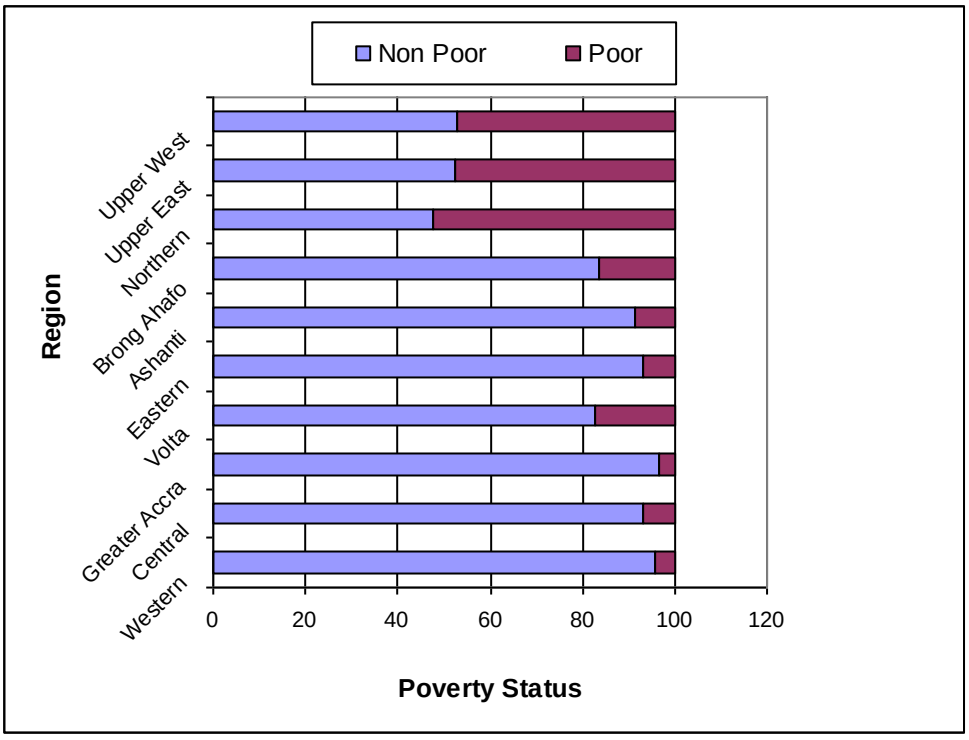

Figure 2: Household Poverty by Region

As evidenced by Figure 2, households in the three northern regions were found to have higher risk of poverty than those in other regions. Other regions that had relatively higher number of households classified as poor are Volta (17.2%) and Brong Ahafo (16.2%) regions. This may be due to the fact that these regions share boundary with the Northern Region therefore households across these regions may be sharing similar characteristics.

Community Level Characteristics

As with regional characteristics, there are a variety of community-level characteristics that may be associated with poverty for households in that community. At this level, access to social infrastructure and services are very vital. Many indicators are often used in econometric exercises; this section however reflects a few.

Place of Residence

Figure 3, presents the poverty status of households by whether it resides in a rural or urban community.

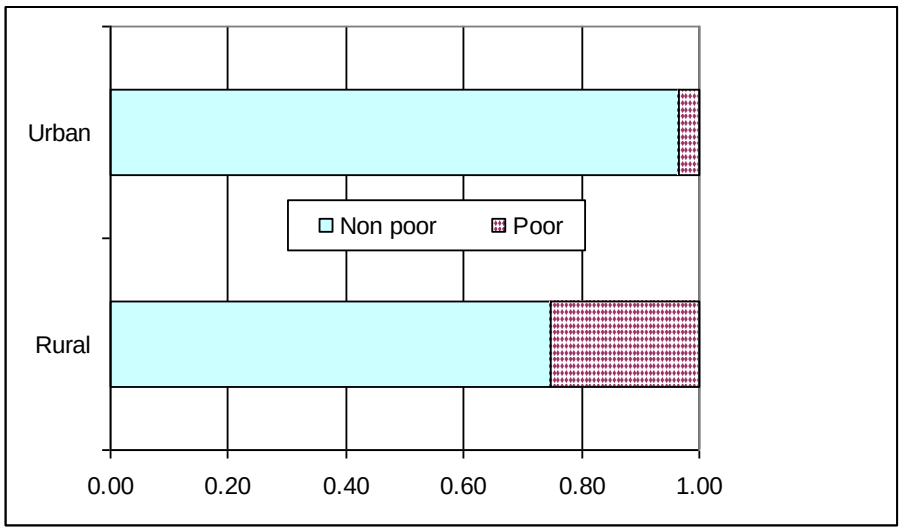

Figure 3: Poverty Status by Place of Residence

Households living in rural communities are at higher risk of being extremely poor. Their risk level stands at 25 percent of all rural households compared with a risk level of less than four percent for households in urban communities.

Source of Drinking Water

Sources of drinking water are of great concern to every nation, not only because water is a necessity, but also because it is a source of many diseases. The problem is therefore not just access to water, but access to safe water (piped water, borehole, protected well). Lack of water and sanitation leads to unhealthy living conditions; the rural poor have to collect their water

from unprotected sources while the urban poor have to buy it from vendors at a cost far higher than would be paid if their houses were connected to the main supply. Figure 4 takes a look at the various sources of drinking water for households in relation to their poverty status.

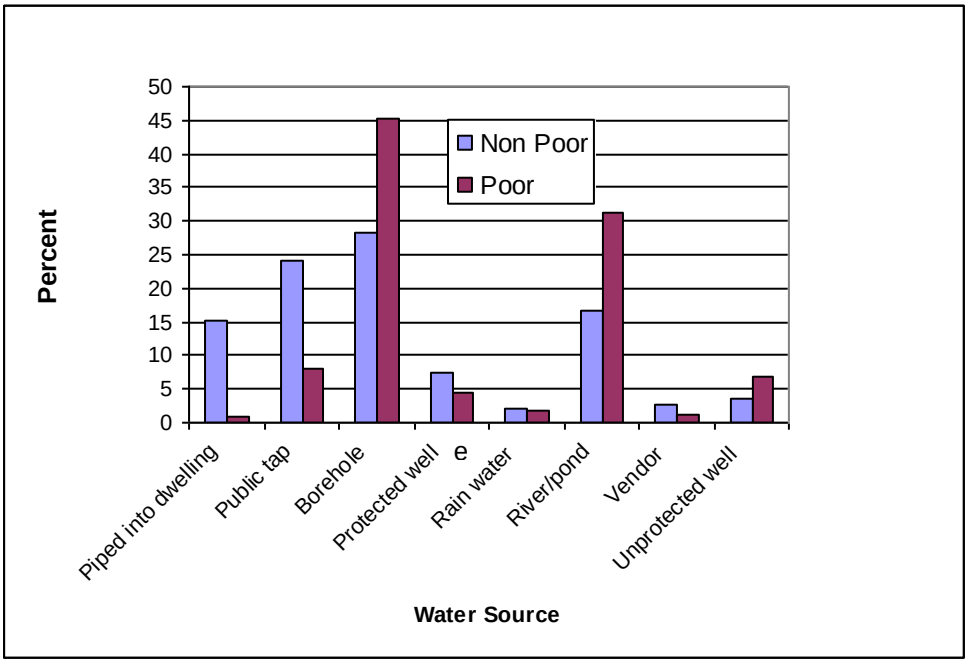

Figure 4: Source of Drinking Water by Poverty Status

Whiles three-quarters of non poor households have access to safe water; fewer than 60 percent of poor households have access to that facility. The risk of poverty is highest among households that draw their drinking water from either a borehole (45.3%) or those that fetch from a river or a lake or a pond (31.3%). About one in four households among the non poor category also rely on the borehole for water. This indicates how important that source is in providing water for many households in the country.

Solid Waste Disposal

Waste disposal is a source of worry to many nations due to its health implications. Improper waste disposal in a community can lead to disastrous health consequences for the population. Figure 5 displays the culture of solid waste disposal by households that participated in the survey.

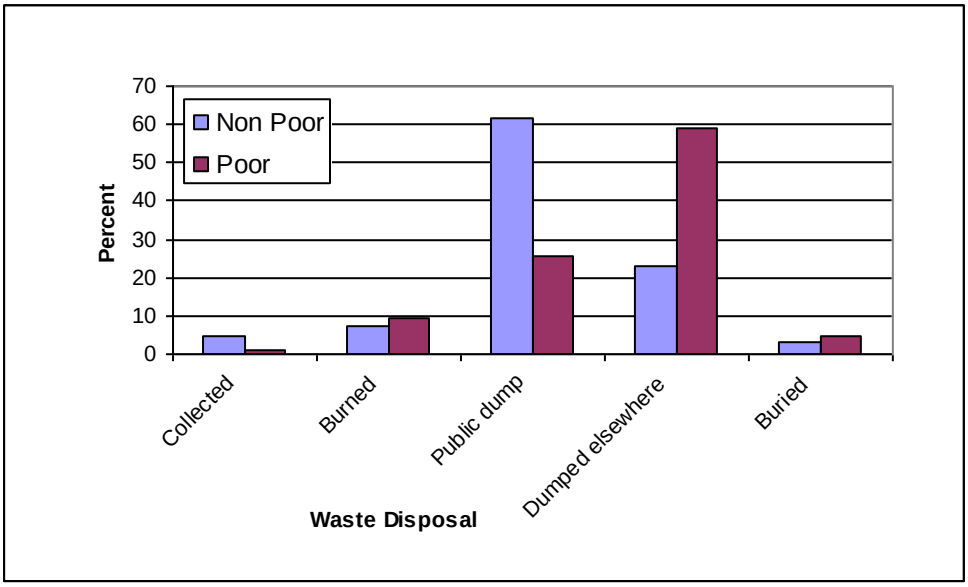

Figure 5: Solid Waste Disposal by Poverty Status

The risk of poverty was highest among households that dispose of their solid waste indiscriminately (59.2%) compared to a less than ten percent risk for households who either burned (9.2%) or buried (4.7%) their refuse. Door to door refuse collection is not a culture that is well known in the Ghanaian society.

Time Spent in Accessing Social Services

Access to social services is often either measured by the distance or time taken to access the facility or service. In Ghana access to health,

education, water and a food market is defined for a walking distance of less than 30 minutes (GSS, 1998). The time households spend in accessing social services/facilities have health, social and economic ramifications to the individual and the household at large. Table 2 depicts how much time households in the two poverty groupings spend in accessing some essential social services.

Table 2: Time to Nearest Public Service Outlet by Poverty Status of Household

Time (minutes)	Time to nearest clinic/hospital		Time to nearest primary school		Time to nearest secondary sch		Time to nearest water supply	
	Non Poor	Poor	Non Poor	Poor	Non Poor	Poor	Non Poor	Poor
0-14	91.4	8.6	85.8	14.2	94.5	5.5	85.8	14.2
15-29	89.4	10.6	82.9	17.1	92.4	7.6	73.6	26.4
30-44	80.9	19.1	71.9	28.1	85.2	14.8	66.8	33.2
45-59	75.0	25.0	67.3	32.7	79.7	20.3	62.4	37.6
60+	65.6	34.4	61.8	38.2	67.0	33.0	52.7	47.3

As expected, the proportions of poor households increased with increased time spent accessing the selected social facilities. Whereas nine in ten non-poor households have access to a clinic or hospital in less than 15 minutes just about one in ten poor households have access to that facility within the same time frame. In all cases households that spend over 30 minutes to access the nearest clinic or school or water supply have an increased risk of being poor. For instance, as only 14 percent of households with access to the nearest water supply in less than 15 minutes are classified as poor, this appreciates to 26 percent of households in less than 30 minutes walk, to 33 percent households in less than 45 minutes, and then to 47 percent

households in over 60 minutes. This trend is observed for all the other services that are so essential to all households.

Social Networks

Recent research has also stressed the importance of social networks and institutions in efforts at reducing poverty. The central importance of social isolation as contributing to poverty is stressed in the *Urban Poverty Assessment* conducted in Lesotho (Lesotho 1997). Many communities, in conceptualizing poverty, stress the importance of social network as a safety net in times of difficulty. Figures 6 & 7 and Table 3 depict how social network impacts on the poverty status of Ghanaian households.

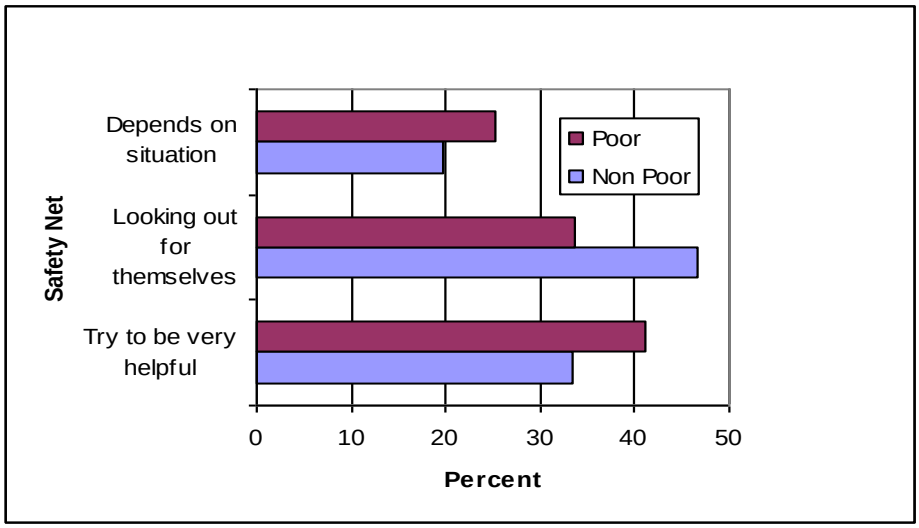

Figure 6: Safety Net by Poverty Status

As to whether other people are helpful to one's household in times of need, it was found that both poor and non poor households enjoy about the same level of support. This assertion is further confirmed by Figure 7, which

shows how often both poor and non poor households receive transfers in kind or cash from other households or individuals.

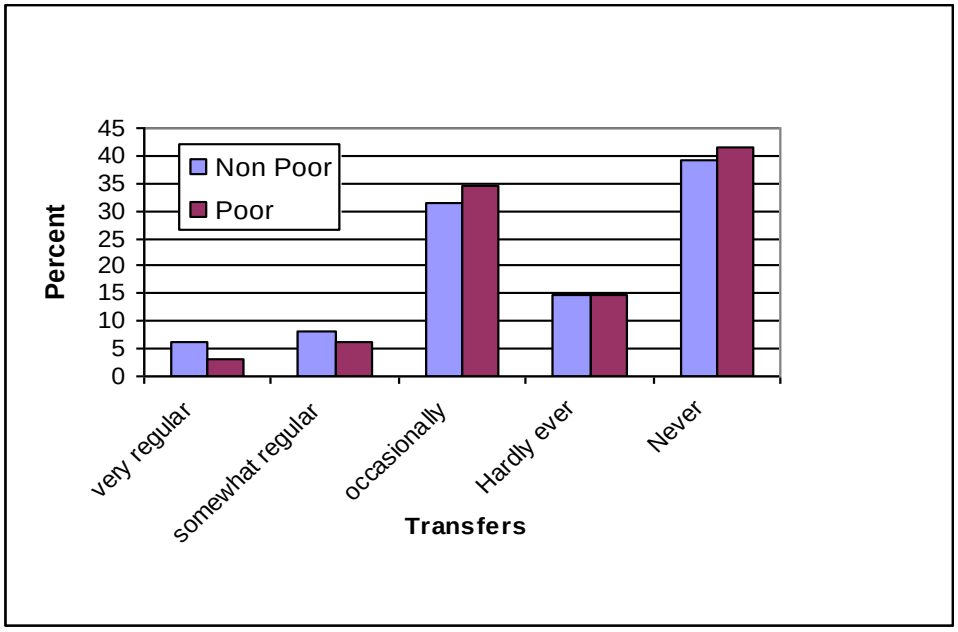

Figure 7: Transfers to Household by Poverty status

Though transfers to households are not a regular phenomenon, the poverty status of a household does not necessarily act to its disadvantage. Between 31 and 34 percent of all households reported some occasional transfers, whiles about 40 percent of them never received any.

Table 3 shows the social network institutions available to all households and individuals in Ghana and which ones are highly patronized and by which category of households.

Table 3: Main Source of Support by Poverty Status of Household

Poverty Status	Family/ relatives	Friends/ neighbours	Groups/ Associations	Government	Bank/ credit societies	Money lenders	No one	Total
Non Poor	55.0	7.4	2.5	1.6	5.2	3.5	24.2	100.0
Poor	59.6	8.6	1.4	1.7	1.8	2.8	23.8	100.0
Total	55.8	7.6	2.3	1.6	4.6	3.4	24.1	100.0

About three quarters of all households had at least one social network institution to turn to in times of need. Since the poverty status of a household does not play to its disadvantage as indicated above, all households can be thought of as having some safety net. As carried in Table 3, family members or relatives are the most important source of support for all households in times of need.

On account of the foregoing therefore, social network may not be considered as a determinant or characteristic of the poverty status of Ghanaian households.

Household Level Characteristics

Examination of the characteristics of individuals and households living in poverty is of paramount importance if policies are to make any meaningful impact in the fight against poverty. Who are the poor? Where do they live? What is available to them? Are some of the many questions that need answers to give meaning to poverty reduction programmes. This section examines some demographic, social, economic and housing characteristics of households living in poverty in relation to other households.

Gender and Literacy of Household Head

Table 4 presents information on the gender and literacy status of the household head in relation to the household's poverty status.

Table 4: Gender and Literacy of Household Head by Poverty Status

	Gender		Literacy	
Poverty Status	Male	Female	Yes	No
Non Poor	79.25	91.43	92.30	74.51
Poor	20.75	8.57	7.70	25.49
Total	100.00	100.00	100.00	100.00

Evidence from Table 4 has it that female headed households (8.57%) are less likely to be poor compared with male headed households (20.75%). This confirms other studies in Ghana on the same subject, where more males than females are among the poorest.

As expected, more households headed by illiterate were found to be poor compared with those who are literate. One in four households headed by an illiterate adult were likely to be poor compared with less than one in 10 for households whose heads are not illiterate.

Poverty Status and Education Level of Household Head

Literacy and schooling are important indicators of the quality of life in their own right, as well as being key determinants of the poor people's ability to take advantage of income-earning opportunities. The level of schooling attained or completed by an individual is therefore important in this regard. Figure 8 examines the level of education attained by the head of household in relation to the household's poverty status.

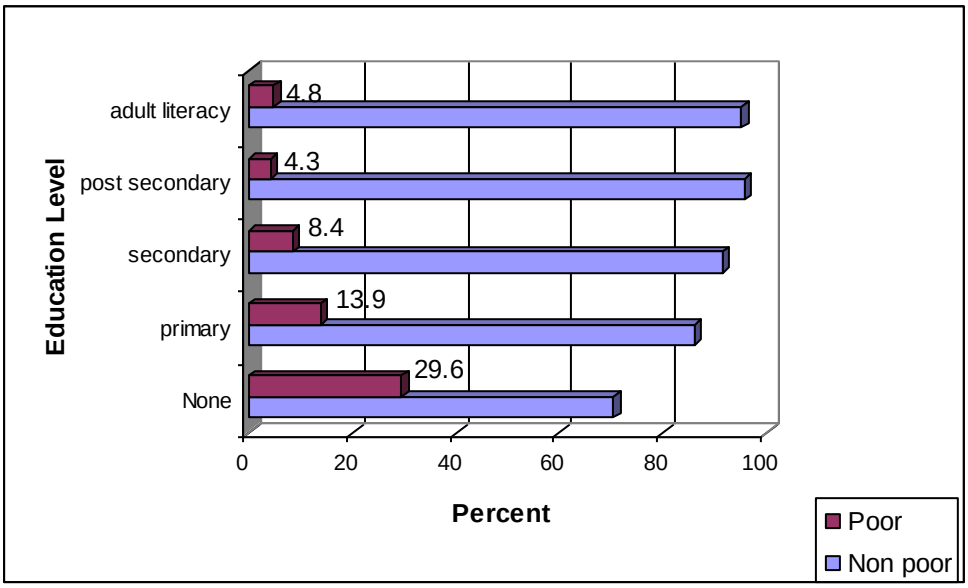

Figure 8: Poverty Status by Educational Level of Head

As expected, household heads with no schooling at all are more likely (29.6%) to be poor compared to those with a post secondary schooling (4.8%). Even household heads who have completed a course in adult literacy are less likely to be poor (4.3%). This may be case for encouraging the adult literacy programme among the elderly in Ghana.

Poverty Status and Age of the Household Head

Age is perhaps the most important demographic characteristic that determines an individual's role in society. In view of its centrality in understanding the socio-economic, cultural and political make up of households, it is important to reflect on the age of the household head in relation to the poverty status of the entire household. Figure 9 classifies all surveyed household heads into four age categories and examines the household's poverty status.

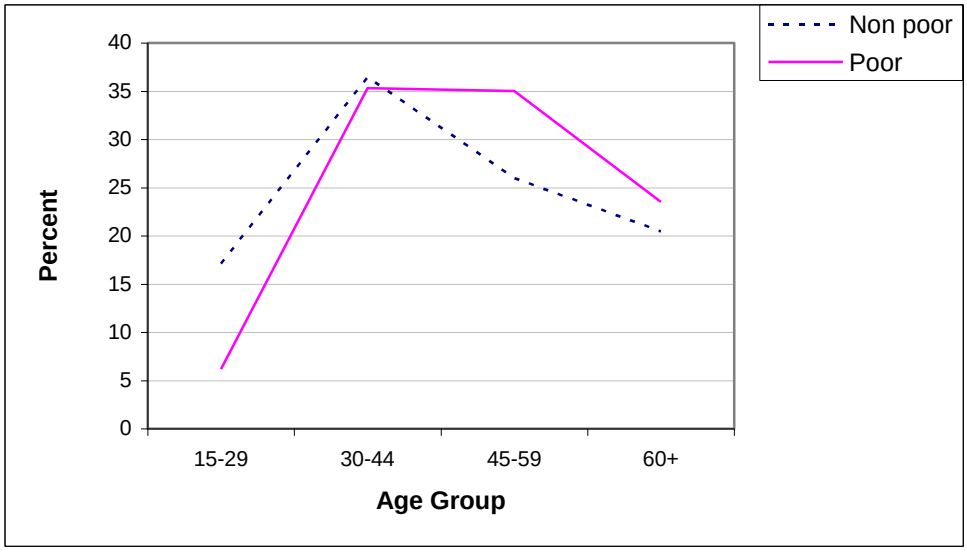

Figure 9: Poverty Status and Age of Head

The proportion of households in either poverty status is lowest in the younger age category and peaks in the 30 to 44 age group. Whiles the proportion of households in the non poor category declines sharply, that of those in the poor category remains stationery till age 60 years. This means that the risk of poverty remains highest for households whose head is aged between 30 and 60 years. The risk of poverty, therefore, is lowest when the household head is aged below 30years or above 60 years.

Marital Status and Poverty

The marital status of the head is an important feature of household composition in Ghana and the developing world in general. The marital status of the head influences many demographic variables of the household and often determines the economic status of the household. Table 5 presents information on the poverty status of the household in relation to the marital status of the head.

Table 5: Poverty and Marital Status

Poverty Status	Never Married	Informal Union	Married (Monogamy)	Married (Polygamy)	Divorced	Separated	Widowed
Non Poor	96.56	91.40	80.75	57.36	93.13	93.22	88.38
Poor	3.44	8.60	19.25	42.64	6.87	6.78	11.62
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Evidence from Table 5 has it that, living in a household where the head is married and polygamous, presents the biggest risk of the household being poor. Four in ten polygamous households were found to be poor compared with one in five monogamous households. Also one in ten households with a divorced household head was found to be poor.

Number of Household Members and Poverty

The number of persons in the household presents a challenge in determining the poverty status of the household. The number of persons who contribute to or use up the household's income to a greater extend will determine the poverty status of the household. Figure 10 presents how the poverty status of the household relates to the total number of persons in the household.

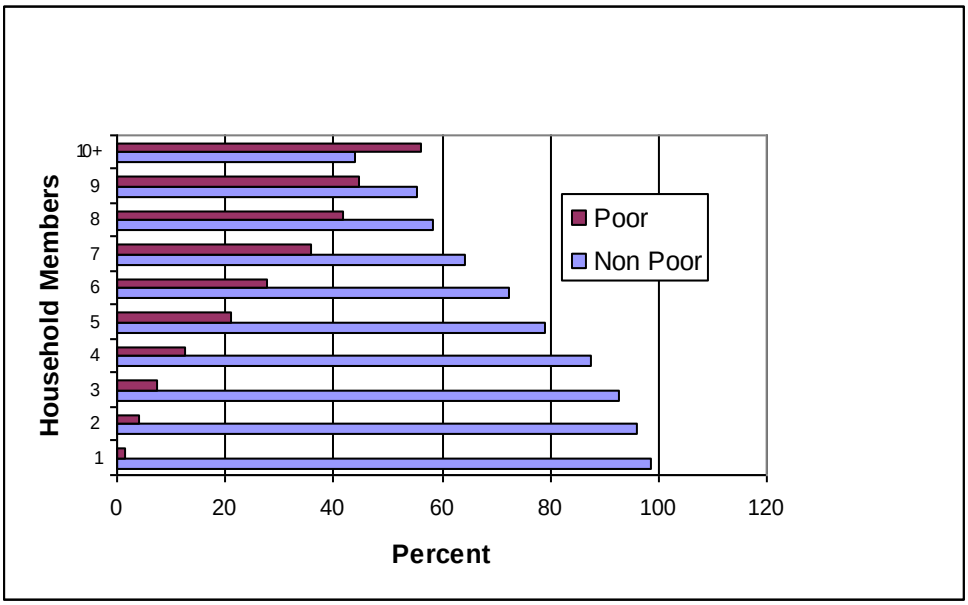

Figure 10: Number of Household Members by Poverty Status

From Figure 10 the risk of poverty rises as the number of household members increases. The risk of poverty for households with 10 or more members is almost 60 percent in contrast to less than eight percent for households with up to three members. Just about one in 10 households with a membership of four were found to be poor compared with about one in three for seven-membership households. It is therefore apparent that a household risk falling into extreme poverty when it membership increases.

Housing Characteristics

According to the World Bank Institute (2005), shelter refers to the overall framework of personal life of the household. It is evaluated by three components: housing, service, and the environment. The housing indicators include the type of building (size and type of material), the means through which one has access to housing (renting or ownership), and household equipment. The service indicators focus on the availability and the use of

drinking water, communications services, electricity, and other energy sources. Finally, the environmental indicators concern the level of sanitation, the degree of isolation and the degree of personal safety. To this end, the section looks at some of these indicators under the topic housing characteristics.

Dwelling Tenure and Household Poverty

Whether a household owns, rents or uses their dwelling without paying rent contribute significantly to the well being of the household members. Figure 11 presents results on the tenure and that reflects on the poverty status of the household.

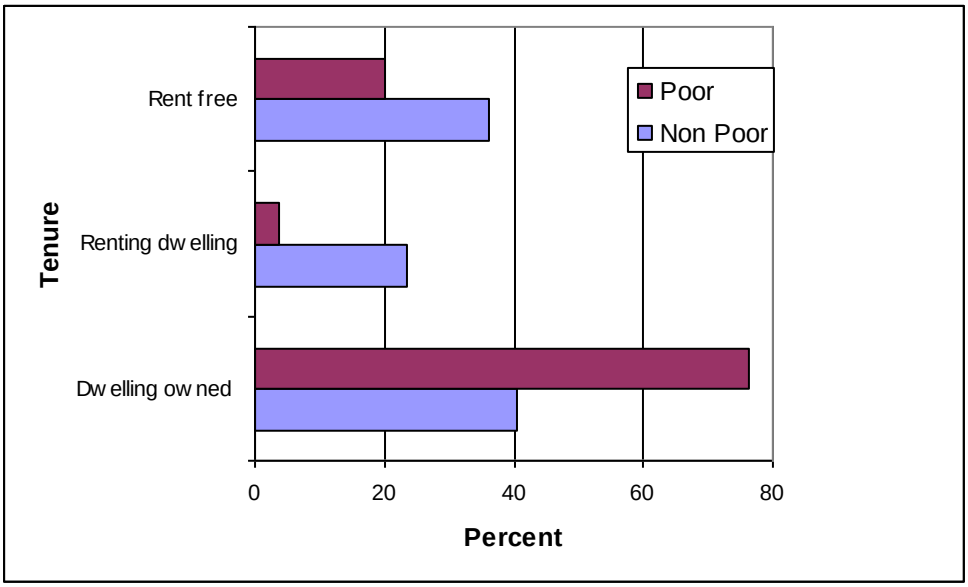

Figure 11: Housing Ownership by Poverty Status

As observed from Figure 11, the proportion of poor households that own their dwelling is twice that of non poor households. However, there were

more non poor households (23.6%) that rent their dwelling compared to the poor households (3.7%) that rent their housing unit.

Construction Material of Dwelling by Poverty Status of Household

The material used in constructing the dwelling unit of a household is a direct correlate of the standard of living of that household. It is therefore imperative that this indicator is critically examined in assessing household poverty. Table 6 reviews the construction materials used for the flour, walls and roof of the housing unit occupied by the households in the survey. In each case the materials that constitute more than 95 percent of all construction materials are considered.

Table 6: Construction Materials of Building and Poverty Status

	Material of the Floor		Material of the Wall		Roofing Material of Dwelling		
Poverty Status	Mud	Cement	Mud	Cement	Thatch	Asbestos	Mud
Non Poor	13.6	85.1	54.9	41.1	14.0	10.9	1.4
Poor	33.3	66.4	91.4	7.0	44.5	2.1	11.3
Total	17.0	81.9	61.2	35.2	19.2	9.3	3.1

Of all the households interviewed, over 95 percent of them used cement or mud for either the walls or the floor of their housing unit. Whiles a good proportion of both poor and non poor households have cement as a flooring material, just seven percent of the poor have that material for the outer walls of their dwelling as against 41 percent of the non poor. Therefore the risk of poverty is highest among households that reside in dwellings with

mud/earth as the main construction material of the floor (33 %) and the outer walls (91%).

Regarding the material used for the roof of their dwelling, the risk of poverty is highest among households that lived in housing units with thatch as the main construction material. The use of mud (11%) as a roofing material is also an important indication of poverty among the Ghanaian households.

Toilet Facility and Household Poverty Status

Households' access to sanitation facilities is as important as their need for other social facilities. Lack of this facility leads to unhealthy living conditions and may result in poverty due to poor health. In view of this, the standard of living of a household is also often measured by the kind of toilet facility available to its members. Figure 12 examines the toilet facilities available to the surveyed households in relation to their poverty status.

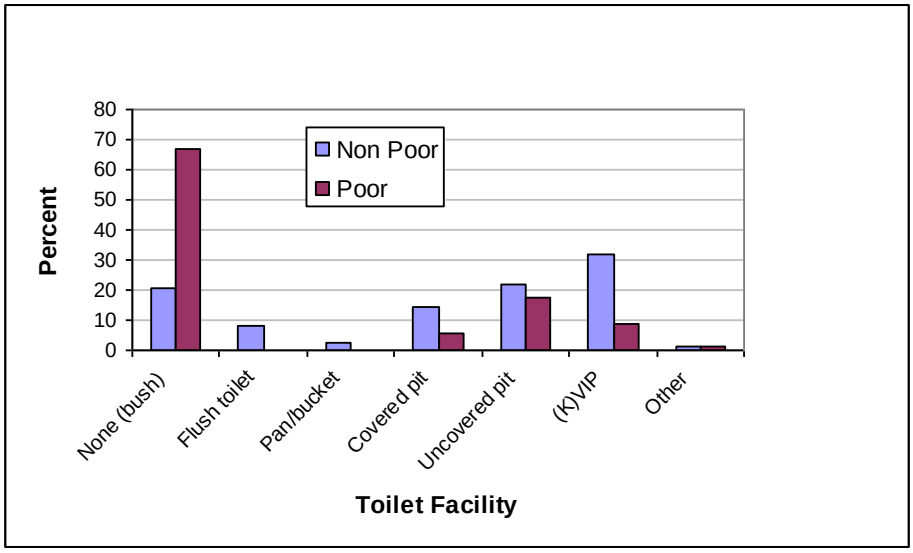

Figure 12: Toilet Facility by Poverty Status

Though not many households in Ghana reported using improved toilet facilities (flash toilet, ventilated pit and covered pit latrine), there exist a huge differential in its use by poor (10%) and non poor (40%) households. The risk of poverty was found to be highest among households that have no toilet facility and thereby use the bush or beaches; 67 percent of poor households in contrast with 20 percent of non poor households.

Source of Lighting and Household Poverty

The source of lighting has been identified as one of the indicators of poverty for households in developing countries. Figure 13 presents the results of the main source of lighting for households that participated in the survey in relation to their poverty status.

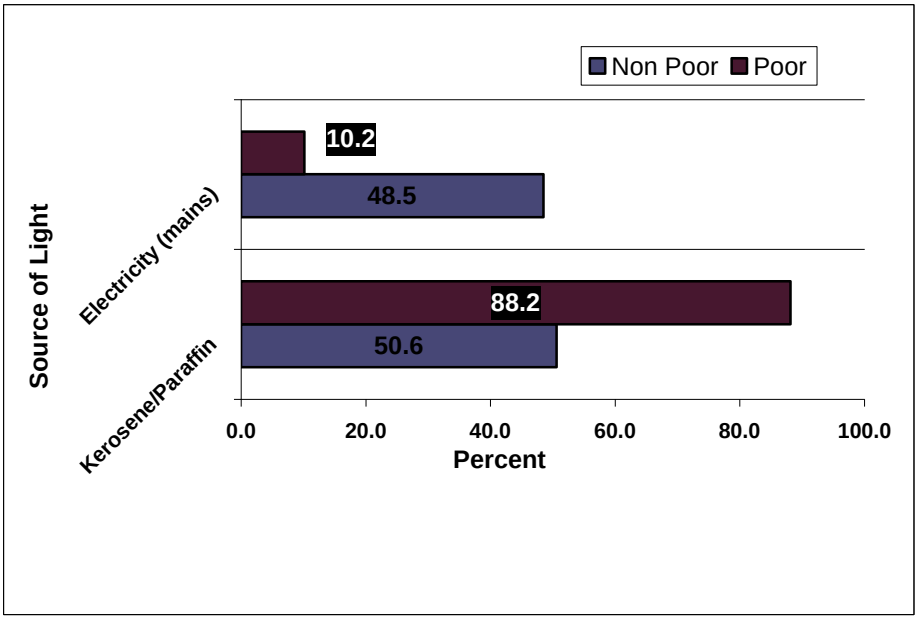

Figure 13: Main Source of Lighting by Poverty Status

About 98 percent of all the surveyed households reported using either kerosene or electricity. Even for non poor households, about half (48.5%) of them reported using kerosene as their main source of lighting. This compares with 88 percent of poor households. Poor households were however found to be less likely to use electricity (10%), though the use of electricity is not widespread in the country.

Main Source of Cooking Fuel and Household Poverty

Some sources of fuel for cooking have been identified as increasing individuals risk of ill health as their combustion emanates harmful gases. Aside from that, their use has a telling effect on the environment. Studies in the developing world have indicated that the poor are less likely to have access to environmentally friendly and cheaper cooking fuel. Figure 14 presents findings on the main sources of cooking fuel with respect to the poverty status of the households.

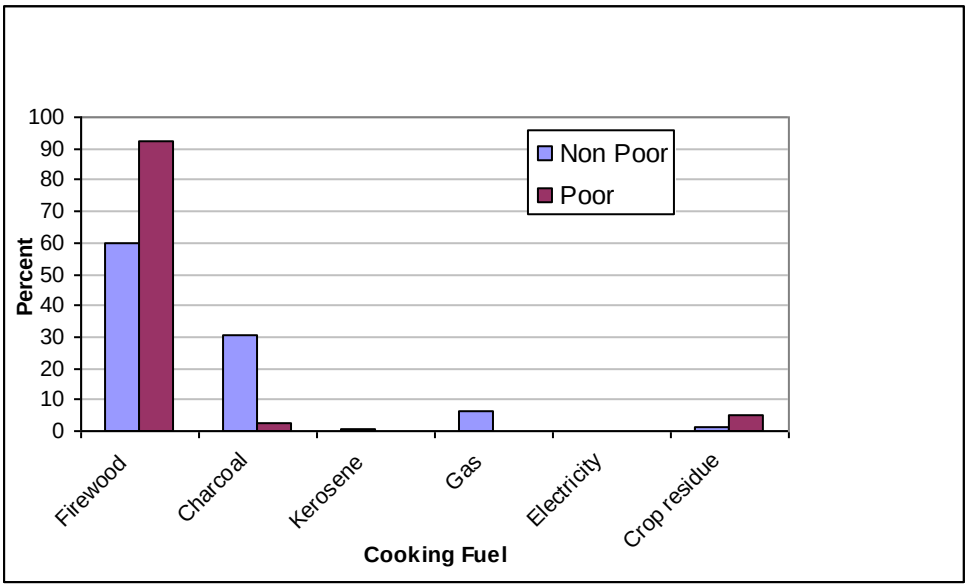

Figure 14: Main Source of Cooking Fuel by Poverty Status

Over 90 percent of all the surveyed households reported using either charcoal or firewood as their main source of cooking fuel. About five percent of poor households also reported using crop residue whiles the use of liquefied petroleum gas is non existent among the poor. Whereas six out of every 10 non poor households use firewood, nine in every 10 poor households use that fuel for cooking. Interestingly, charcoal that is mostly produced in the rural areas is seldom used by the poor households.

It is observed from this preliminary analysis that certain distinguishable characteristics are peculiar to poor households and the need to determine the most important of such characteristics cannot be overemphasized. It is also important to establish whether or not the characteristics exhibited by the poor are not by chance. In the next chapter, these characteristics are further studied by means of logistic regression.

CHAPTER FOUR

FURTHER ANALYSIS

This chapter is concerned with statistical inferential analysis of the most important variables that differentiate the poor from the non poor. The technique that will be employed is binary logistic regression analysis. All analyses assume the risk value (α) = 0.05 level of significance. Detailed computer outputs can be found in the Appendix.

Binary Logistic Regression Analysis of the Data

The preliminary model is constructed by an iterative maximum likelihood procedure using the backward binary logistics. The analysis uses poverty status as the dichotomous dependent (criterion) variable coded with the reference category 1='poor' and the non poor category is coded 0. Twenty-six predictor (independent) variables are used with a set of dummies representing the categorical variables. The first iteration for the model consists of a rather large number of variables. It is therefore presented in Appendix II for convenience.

The rows in Table 7 indicate the number of iterations performed to arrive at the final model, whiles the columns present the chi-square, its associated degrees of freedom and level of significance.

Table 7: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11029.345	67	0.000
	Block	11029.345	67	0.000
	Model	11029.345	67	0.000
Step 2	Step	-2.181	4	0.703
	Block	11027.165	63	0.000
	Model	11027.165	66	0.000
Step 3	Step	-5.195	3	0.158
	Block	11021.970	60	0.000
	Model	11021.970	62	0.000

Omnibus Tests of Model Coefficients gives the overall indication of how well the initial model (with the set of variables used as predictors) performs over and above the predictive ability of the model with the constant only. This is referred to as goodness of fit test and it tests the null hypothesis that the step is justified. Here, the step is from the constant-only model to the all-predictors model. For this set of results, a highly significant or probability value (the significant value should be less than 0.05) is expected. In this case, the value is 0.000 (which really means $p < 0.05$) which shows that the initial model is good.

Table 8 presents results of the last iteration of the initial model indicating the level of importance for each of the predictor variables that

remained in the last step. The B column provides the values for the logistic equation for predicting the poverty status of the households from the predictors. The Wald column provides the Wald chi-square value and 2-tailed p-values used in testing the null hypothesis that the coefficient is zero. The Exp(B) are the odds ratios for the predictors. It is the predicted change in odds for a unit increase in the corresponding independent variable. Odds ratios close to 1.0 indicate that unit changes in that predictor variable do not affect the poverty status of a household. A 95% confidence interval is provided for each predictor in the last column.

Table 8: Variables In the Equation

	Predictors	B	Wald	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 3[a]	Region		663.448	0.000			
	Region(1)	0.568	30.668	0.000	1.765	1.443	2.158
	Region(2)	1.185	72.893	0.000	3.271	2.492	4.294
	Region(3)	1.105	134.365	0.000	3.019	2.505	3.64
	Region(4)	0.375	14.406	0.000	1.454	1.199	1.765
	Region(5)	0.675	53.863	0.000	1.964	1.64	2.352
	Region(6)	1.241	177.294	0.000	3.459	2.881	4.152
	Region(7)	2.007	380.642	0.000	7.439	6.081	9.1
	Region(8)	1.995	221.239	0.000	7.355	5.655	9.567
	Region(9)	2.307	353.407	0.000	10.047	7.899	12.779
	Dwelown		6.412	0.041			
	Dwelown(1)	-0.2	6.152	0.013	0.819	0.699	0.959
	Dwelown(2)	-0.01	0.04	0.841	0.991	0.902	1.087
	Dwelown(3)	-0.193	174.681	0.000	0.824	0.801	0.848
	Hhsize	0.379	961.674	0.000	1.461	1.427	1.497
	Hage	0.007	19.174	0.000	1.007	1.004	1.01
	Nschool	-0.067	15.632	0.000	0.936	0.905	0.967
	Wallmat1		58.815	0.000			
	Wallmat1(1)	-0.447	49.903	0.000	0.639	0.565	0.724
	Wallmat1(2)	-0.446	13.17	0.000	0.64	0.503	0.814
	Roofmat1		85.459	0.000			
	Roofmat1(1)	-0.408	14.71	0.000	0.665	0.54	0.819
	Roofmat1(2)	-0.769	52.057	0.000	0.464	0.376	0.571
	Floormat1		5.474	0.065			
	Floormat1(1)	0.016	0.097	0.755	1.016	0.921	1.121
	Floormat1(2)	-0.809	5.189	0.023	0.445	0.222	0.893

Table 8 (CONTINUED)

Predictors	B	Wald	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Water1		17.293	0.002			
Water1(1)	0.499	11.097	0.001	1.646	1.228	2.208
Water1(2)	0.577	14.922	0.000	1.78	1.328	2.385
Water1(3)	0.482	10.101	0.001	1.62	1.203	2.18
Water1(4)	0.551	13.152	0.000	1.735	1.288	2.337
Toilet1		88.536	0.000			
Toilet1(1)	-0.42	32.277	0.000	0.657	0.568	0.759
Roilet1(2)	-0.46	62.618	0.000	0.631	0.564	0.708
Toilet!(3)	-0.513	62.002	0.000	0.599	0.527	0.68
Toilet1(4)	-0.325	5.975	0.015	0.723	0.557	0.938
Cookfuel1		129.144	0.000			
Cookfuel1(1)	-0.929	99.762	0.000	0.395	0.329	0.474
Cookfuel1(2)	-2.304	20.003	0.000	0.1	0.036	0.274
Cookfuel1 (3)	-0.564	20.322	0.000	0.569	0.446	0.727
Litefuel 1		84.266	0.000			
Litefuel 1 (1)	-0.501	83.07	0.000	0.606	0.544	0.675
Litefuel 1 (2)	0.156	0.579	0.447	1.169	0.782	1.749
Refuse 1		7.028	0.071			
Refuse 1 (1)	0.119	5.292	0.021	1.127	1.018	1.247
Refuse 1 (2)	-0.006	0.006	0.937	0.994	0.856	1.154
Refuse 1 (3)	0.006	0.005	0.943	1.006	0.843	1.201
Timarket 1		5.263	0.072			
Timarket 1 (1)	0.01	0.028	0.868	1.01	0.897	1.137
Timarket1 (2)	0.116	4.664	0.031	1.123	1.011	1.248
Timeprim1		9.124	0.010			
Timeprim1(1)	-0.075	1.964	0.161	0.928	0.835	1.03
Timeprim1(2)	-0.17	8.797	0.003	0.844	0.754	0.944

Table 8 (CONTINUED)

Predictors	B	Wald	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Supotneed1		7.547	0.056			
Supotneed1(1)	-0.091	0.918	0.338	0.913	0.757	1.1
Supotneed1(2)	-0.197	6.958	0.008	0.821	0.71	0.951
Supotneed1(3)	-0.014	0.092	0.762	0.986	0.9	1.08
Hmstat1		14.909	0.002			
Hmstat1 (1)	-0.097	1.857	0.173	0.908	0.789	1.043
Hmstat1 (2)	-0.289	11.125	0.001	0.749	0.632	0.888
Hmstat1 (3)	-0.081	0.778	0.378	0.923	0.771	1.104
Hseg1		27.103	0.000			
Hseg1 (1)	0.07	0.216	0.642	1.073	0.798	1.442
Hseg1 (2)	0.237	6.025	0.014	1.268	1.049	1.532
Hseg1 (3)	0.459	18.827	0.000	1.582	1.286	1.946
Transfout1		39.356	0.000			
Transfout1 (1)	0.178	10.127	0.001	1.195	1.071	1.333
Transfout1 (2)	0.349	37.082	0.000	1.418	1.267	1.587
Transfin1		4.693	0.096			
Transfin1 (1)	0.065	0.857	0.355	1.067	0.93	1.223
Transfin1 (2)	-0.031	0.205	0.650	0.969	0.848	1.109
Timehosp		8.533	0.074			
Timehosp(1)	-0.129	4.604	0.032	0.879	0.781	0.989
Tmehosp(2)	-0.009	0.019	0.891	0.991	0.877	1.121
Timehosp(3)	0.057	0.592	0.442	1.058	0.916	1.223
Timehosp(4)	0.026	0.149	0.699	1.026	0.901	1.168
Urbrur(1)	-1.211	313.919	0.000	0.298	0.261	0.341
Hgender(1)	-0.159	6.827	0.009	0.853	0.757	0.961
Constant	-3.542	192.487	0.000	0.029		

Out of the 24 explanatory variables that remained in the final step, only six of them had *p*-values greater than 0.05, indicating that they were not significant in predicting the poverty status of a household. For instance, timehosp has a significance value of 0.74 > 0.05 which indicates that the time a household spends in accessing a health facility does not really determine its poverty status. Likewise, whether or not a household receive transfers (transfin1, sig value = 0.96) from others, the main source of support (supotneed1, sig value = 0.56) to the household in times of need, the time spent in accessing a food market (timarket1, sig value = 0.72), how the household dispose of their refuse (refuse1, sig value = 0.71), and the construction material used in the flooring of the household's dwelling (floormat1, sig value = 0.65) are all not statistically significant in determining the poverty status of a household.

Final Logistic Model

In formulating the final model the six variables that were not statistically significant are excluded leaving 18 variables. It should be noted however that some of these variables are dummies. As a result, the effective number of predictors is 40. The final model is of the form shown in Equation 19. The values of the parameter in the equation are shown in Table 9.

$$P(Y=1) = P = \frac{Exp\left(\sum_{i=1}^{n} B_i X_i\right)}{1 + Exp\left(\sum_{i=1}^{n} B_i X_i\right)} \qquad (19)$$

Table 9 presents the most important predictors in determining the poverty status of Ghanaian households. The B_i column is vector of coefficients and the corresponding is X_i is the vector of predictor variables.

Table 9: Poverty Status Predictors

i	X_i	B_i	i	X_i	B_i
1	Region(1)	1.765	21	Water1(1)	1.646
2	Region(2)	3.271	22	Water1(2)	1.780
3	Region(3)	3.019	23	Water1(3)	1.620
4	Region(4)	1.454	24	Water1(4)	1.735
5	Region(5)	1.964	25	Toilet1(1)	0.657
6	Region(6)	3.459	26	Toilet1(2)	0.631
7	Region(7)	7.439	27	Toilet1(3)	0.599
8	Region(8)	7.355	28	Toilet1(4)	0.723
9	Region(9)	10.047	29	Cookfuel1(1)	0.395
10	Dwelown(1)	0.819	30	Cookfuel1(2)	0.100
11	Dwelown(2)	0.991	31	Cookfuel1(3)	0.569
12	Numroom	0.824	32	Litefuel1(1)	0.606
13	Hhsize	1.461	33	Hmstat1(1)	0.908
14	Hage	1.007	34	Hmstat1(2)	0.749
15	Nschool	0.936	35	Hseg1(2)	1.268
16	Wallmat1(1)	0.639	36	Hseg1(3)	1.582
17	Wallmat1(2)	0.640	37	Transfout1(1)	1.195
18	Roofmat1(1)	0.665	38	Transfout1(2)	1.418
19	Roofmat1(2)	0.464	39	Urbrur(1)	0.298
20	Timeprim1(2)	0.844	40	Hgender(1)	0.853

Equation 19 shows that to be able to predict the poverty status of a Ghanaian household, the listed predictors (Table 9) could be very important determinants.

Assessing the Model

The results of Table 10 also support the model as being worthwhile. This test, which SPSS states as the most reliable test of model fit available in SPSS is interpreted very differently from the Omnibus Test presented earlier.

Table 10: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	13.923	8	0.084
2	13.368	8	0.100
3	13.015	8	0.111

The Hosmer-Lemeshow Goodness-of-fit tests the null hypothesis that there is a linear relationship between the predictors and the log odds of the criterion variable. Cases are arranged in order by their predicted probability on the dependent variable. These ordered cases are then divided into deciles based on the predicted probabilities, and computes a chi-square from observed and expected frequencies. If the Hosmer-Lemeshow Goodness-of-fit test statistics is 0.05 or less, we reject the null hypothesis that there is no difference between the observed and predicted values of the dependent. If it is greater, we fail to reject the null hypothesis that there is no difference, implying that the model's estimates fit the data at an acceptable level. Therefore to support the model we actually expect a value greater than 0.05. In this case, the chi-square value for the Hosmer-Lemeshow Test is 13.015 with 8 degrees of freedom and a significance of 0.111. This significance value

is greater than 0.05, indicating support for the existence of the model and conclude that the data fits the model well.

Cox and Snell R Square and Nagelkerke R Square values (see Appendix II) provide an indication of the amount of variation in the dependent variable explained by the initial model. In this case, the two values are 0.323 and 0.500 respectively; suggesting that between 32.3 percent and 50.0 percent of the variability in the dependent variable is explained by the set of predictor variables. When the stepwise method was employed to come out with the final model, only six variables were dropped, with the final model still accounting for between 32.3 percent and 50.0 percent of the variability in the response variable. This suggests a non reduction in the power to explain the variability in the response variable in spite of the drop of some predictor variables.

Table 11 tallies correct and incorrect estimates for the model with all the predictor variables. The columns are the two predicted values of the dependent variable, while the rows are the two observed (actual) values.

Table 11: Classification Table

		Predicted		
		Non-poor	Poor	Percentage Correct
Observed	Non-poor	20977	1271	94.3
	Poor	2746	3301	54.6
	Overall Percentage Correct			85.8

The classification table provides us with an indication of how well the model is able to classify households by their poverty status. Before then, we need to have a decision rule for the classification. If the probability of the event is greater than or equals to 0.5, the model predicts that the event will take place. By this rule the model was able to correctly classified 94.3 percent of the non-poor households and 54.6 percent of the poor households. The latter is known as the sensitivity of prediction (that is the percentage of occurrences correctly classified), whiles the former is the specificity of prediction (the percentage of non occurrences correctly classified).

The overall final model's predictions were correct 24278 out of 28295, for an overall success rate of 85.8 percent. This signifies an improvement over the 78.6 percent obtained in the initial model. A false positive would be predicting that the event would occur when, in fact, it did not. The positive predictive rate is 27.8 percent, indicating that our decision rule predicted a poverty status 4572 times and the prediction was wrong only 1271 times (27.8% of the time). On the other hand, the false negative (predicting that the event would not occur when, in fact, it did occur) predictive rate is 88.4 percent indicating that of the people predicted to be non poor, our model accurately missed 11.6 percent of the time.

CHAPTER FIVE

SUMMARY, DISCUSSION AND CONCLUSIONS

This chapter presents the summary, general discussion on the results of the last two chapters, and concludes with some recommendations. The chapter also assesses how far the objectives of the study have been achieved.

Summary

To determine the most important characteristics that differentiate poor households from non poor households in Ghana, both bivariate and multivariate analyses are employed. Of the 49,005 households surveyed in the country, 17.2 percent of them were classified as being extremely poor (i.e. they fall in the first poverty quintile). This indicates that if such households devoted their entire annual income on food, it will still not meet their nutritional requirements. This study therefore sought to establish the most important factors that differentiate the poor (extremely poor) households from the others.

The analysis focused on the first poor quintile, so the need to collapse the other four quintiles into one group called the non poor. Some demographic, socio-economic and housing characteristics of the two groups were studied so as to determine what discriminate one group from the other.

In the bivariate analysis whiles some variables demonstrated high differentials between the poor and the non poor, others did not show much difference. For instance, the risk of extreme poverty was found to be between 40 and 60 percent in the three Northern regions, whiles less than five percent of households in the Western and Greater Accra regions fell within that category. Also one in every four households living in rural areas was found to be extremely poor compared with only about three percent of urban households. Another variable that exhibited great difference between the poor and the noon poor is the size of the household. More than half of households that had 10 or more members were found to be extremely poor. Access to some household amenities and housing facilities and to certain social services were found to constitute risks for some households being poor. However, the kind of social networking that exists in communities did not significantly determine the poverty status of the households.

At this stage, the net effect of each predictor had to be estimated whiles controlling the effect of others by employing binary logistic regression. An examination of the correlation matrix indicates that no marked correlations were found among the predictors. The most correlated variables were found to be those in Table 12. This shows that multicollinearity was not a matter of concern. This situation accounts for the many predictors that remained in the final model.

The analysis used poverty status as the dichotomous dependent (criterion) variable coded with the reference category 1='poor' and the non

poor category is coded 0. Twenty-six predictor (independent) variables are used with a set of dummies representing the categorical variables as per Appendix II. The amount of variability in the dependent variable that is explained by the set of predictors used ranges from 32 percent to 50 percent, with an overall correct classification of households of 85.8 percent. Only six of the explanatory variables had p-values greater than 0.05 indicating that they were not statistically significant in predicting the poverty status of Ghanaian households.

As established in the preliminary analysis, the region a household resides in, whether the household lives in a rural or urban community, the main source of water available to the household among others are very important in determining the poverty status of that household. These results confirm the earlier observations in the preliminary analysis. All together, 18 predictors remained in the model to determine the poverty status of Ghanaian households.

Discussion

A poverty profile describes the pattern of poverty, but is not principally concerned with explaining its causes. Yet a satisfactory explanation of why some people are poor is essential if we are to be able to tackle the roots of poverty. As argued by Ravallion (1998), "a credible measure of poverty can be a powerful instrument for focusing the attention of policy makers on the living conditions of the poor." Clearly, the poor cannot

remain on the political and economic agenda without at least knowing who they are. This is the purpose of a poverty profile, which sets out the major facts on poverty and then examines the pattern of poverty, to see how it varies by geography (by region, urban/rural, etc.), by community characteristics and by household characteristics.

The geographical location of households in Ghana is very important in determining their poverty status. With a Wald chi-square value of 663.448, region has a significant value = 0.000 and a degree of freedom of 9. Households residing in the Upper West Region are 10.047 times more likely to be poor compare with those in the Western Region. The odds of being extremely poor are seven (7) times higher for households living in the Northern and Upper East regions. At the community level, households in urban areas are 70.2 percent [0.261, 0.341] less likely to be poor compared with those in rural communities, which is consistent with previous studies on the subject. Though statistically significant, the time poor and non poor households spend in accessing primary and secondary education and a health facility were not too different. In each case the odds ratio was near 1.0.

In assessing the social support systems available to all households, the model indicates that in times of need, whether or not a household receive some kind of support from relatives, friends or some other source does not really determine their poverty status. On the other hand, with a Wald chi-square of 39.356 (p=0.000), households that hardly ever transfer resources to other households were 1.418 [1.267, 1.587] times more likely to be poor

compared with those who regularly did. This is to be expected, since by definition, spending their entire budget on food will not even meet their minimum nutritional requirements.

With regards to characteristics associated with the household head, it was found that the age of the household head in either case did not significantly affect their poverty classification. Also regarding the employment status of the household head, there was no significant difference between those working in the public sector and those in the private formal sector. However households whose heads are in the agriculture and other sectors were 1.582 times more likely to be poor than those in the public sector. Households headed by females were also 14.7 percent less likely to be poor than male headed households, which is consistent with other studies. Examining the marital status of the household head revealed that those in monogamous marriages or those who were either widowed or divorced were just about 10 percent less likely to be poor compared with households whose had never been married. Interestingly however, those in polygamous households were 25 percent less likely to be poor.

At the household level, the number of persons in the household was found to be highly significant in classifying households as either poor or non poor with a Wald chi-square value of 961.674 ($p=0.000$) and odds ratio of 1.461 [1.427, 1.497]. Also significant but with no marked difference among the two groups are the number of rooms available to the household and the number of household members currently schooling.

Sources of drinking water are of great concern to every nation, not only because water is a necessity, but also because it is a source of many diseases. The problem is therefore not just access to water, but access to safe water (DFID, 2001). The main source of drinking water was therefore found to be an important determinant of the poverty status of the household. The odds for using public outdoor taps was found to be 1.646, implying that households who use this source are 1.646 times more likely to be poor as against those who have their water source within their premises. Also households that relied on boreholes, rivers or ponds, rain water or other sources were, respectively, 1.780, 1.620 and 1.735 times more likely to be poor compared with those who have their water source within their premises.

Related to water in terms of ill health is sanitation, and there is a large body of research that shows the nexus of these and poverty. This study found that households that had access to flush toilets, or (K)VIP, or pit latrines, or other sources were between 28 and 40 percent less likely to be poor compared to those who have no facility and are therefore using the bush or the beach. As remarked by Adam Wagstaff, that 'households with no sanitation facility may experience poverty due to ill health resulting from unsanitary environments' (Wagstaff, 2001). No significant difference was found regarding the poor and non poor households modes of disposing refuse. The tenure of the dwelling was also found not to be statistically significant among the groups.

The study found that the type of cooking fuel used by Ghanaian households is also important in determining their poverty status. While 60

percent of households that use charcoal were less likely to be poor, 10 percent of those using gas were likely to be poor compared with those using firewood as their main source of cooking fuel.

Consistent with other studies elsewhere, this study found that geographical location of a household, community level characteristics, household level characteristics and demographic characteristics of the household head are important if the poor are to be identified. It is only when the poverty profile of the poor is adequately examined that pro- poor policies and programmes will be well targeted.

Conclusions

The results of this study give credence to the fact that the poor have many characteristics that differentiate them from the non-poor. The region a household resides in is by far the most important characteristic that differentiate it from others. This is especially true for the three Northern regions. Tied with the region is the place of residence, households in urban areas were found to be 70.2 percent less likely to be poor compared with those in rural communities. Another important determinant of the poverty status of households is the number of persons in that household. Both the preliminary analysis and the model suggest that the number of persons in a household is directly proportional to the risk of poverty. Poverty was found to be more pervasive in households with 10 or more persons.

Findings of the study also suggest that households that do not have access to improved sources of water and sanitation were between 60 and 70 percent more likely to be poor. Other risk factors include the time a household spends to access their main source of drinking water, a primary school or a health facility among others. It was however realized that not much safety nets are available to Ghanaian households. And a household's access to any available social support system did not contribute to its being either poor or non-poor.

On account of the findings presented above, it is easy to ignore the poor if they are statistically invisible. These findings are thus necessary if the poor are to remain on the political and economic agenda of Ghana with well targeted policies and programmes. Clearly, one cannot help the poor without at least knowing who they are.

Recommendations

In line with the development agenda of the country and the objectives of all poverty alleviation programmes, findings of this study suggest a comprehensive poverty profile of the poor if poverty interventions are to achieve their goal. It is also recommended that well targeted poverty alleviation programmes should be considered for the three Northern regions, especially Upper West Region. The citing of social amenities should also be well targeted to make them more accessible to the rural households who are more prone to extreme poverty conditions.

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APPENDIX I

VARIBLES USED IN THE ANALYSIS

No.	Variable	Reference Category	Description
1	region	Western	region of residence
2	timehosp	0-14 min	time to nearest health clinic or hospital
3	timesec 1	0-14 min	time to nearest secondary school
4	water1	piped into dwelling	main source of drinking water
5	toilet1	none (bush)	type of toilet facility
6	hsetype	separate hse	Housing unit type
7	cookfuel	Firewood	main fuel used for cooking
8	refuse1	public dump	main disposal of refuse
9	suportneed1	family and friends	main source of support in times of need
10	hmstat 1	never married	marital status of head of households
11	hseg 1	public	socio-economic group(employment status)
12	timeprim1	0-14 min	time to nearest primary school
13	dwelown	own dwelling	dwelling ownership
14	wallmat1	mud or mud bricks	material of the walls of the house
15	roofmat1	Thatch	material of the roof of the house
16	floormat1	cement or concrete	material of the floor of the house
17	litefuel	Kerosene	main fuel used for lighting
18	transfout1	yes, regular	does household receive regular transfers
19	transfin1	yes, regular	does household give out regular transfers
20	timarket1	0-14 min	time to nearest food market
21	urbur	Rural	place of residence
22	hgender	Male	gender of head of household
23	hhsize		Number of persons in the household
24	hage		age of household head
25	nschool		number of household members currently in school
26	numroom		Number of rooms in the dwelling

APPENDIX II

LOGISTIC REGRESSION OUTPUT

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	28295	57.7
	Missing Cases	20708	42.3
	Total	49003	100.0
Unselected Cases		0	.0
Total		49003	100.0

Dependent Variable Encoding

Original Value	Internal Value
Non poor	0
poor	1

Categorical Variables Codings

			Parameter coding								
		Frequency	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Region	Western	3068	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Central	2797	1.0	.0	.0	.0	.0	.0	.0	.0	.0
	Greater Accra	2343	.0	1.0	.0	.0	.0	.0	.0	.0	.0
	Volta	2871	.0	.0	1.0	.0	.0	.0	.0	.0	.0
	Eastern	3629	.0	.0	.0	1.0	.0	.0	.0	.0	.0
	Ashanti	5158	.0	.0	.0	.0	1.0	.0	.0	.0	.0
	Brong Ahafo	3064	.0	.0	.0	.0	.0	1.0	.0	.0	.0
	Northern	2872	.0	.0	.0	.0	.0	.0	1.0	.0	.0
	Upper East	1390	.0	.0	.0	.0	.0	.0	.0	1.0	.0
	Upper West	1103	.0	.0	.0	.0	.0	.0	.0	.0	1.0
Time to nearest health clinic or hospital	0-14 Minutes	8813	.0	.0	.0	.0					
	15-29 Minutes	7047	1.0	.0	.0	.0					
	30-44 Minutes	4940	.0	1.0	.0	.0					
	45-59 Minutes	2578	.0	.0	1.0	.0					
	60+ Minutes	4917	.0	.0	.0	1.0					
Time to nearest secondary school	0-14 Minutes	4999	.0	.0	.0	.0					
	15-29 Minutes	6531	1.0	.0	.0	.0					
	30-44 Minutes	6145	.0	1.0	.0	.0					
	45-59 Minutes	3268	.0	.0	1.0	.0					
	60+ Minutes	7352	.0	.0	.0	1.0					
Main source of drinking water	piped into dwelling or compound	3686	.0	.0	.0	.0					
	public outdoor tap or borehole	6006	1.0	.0	.0	.0					
	Borehole	8956	.0	1.0	.0	.0					

	River, Lake, Pond	5198	.0	.0	1.0	.0						
	Others	4449	.0	.0	.0	1.0						
Type of toilet facility	None (Bush)	7694	.0	.0	.0	.0						
	Covered pit laterine	3721	1.0	.0	.0	.0						
	uncovered pit laterine	6191	.0	1.0	.0	.0						
	ventilation improved pit laterine/KVIP	7892	.0	.0	1.0	.0						
	Others	2797	.0	.0	.0	1.0						
Housing unit type	Separate House	6333	.0	.0	.0							
	Compound House	16551	1.0	.0	.0							
	Huts/buildings (same compound)	3056	.0	1.0	.0							
	Others	2355	.0	.0	1.0							
Main fuel used for cooking	firewood	18976	.0	.0	.0							
	Charcoal	6955	1.0	.0	.0							
	Gas	1613	.0	1.0	.0							
	Others	751	.0	.0	1.0							
Main disposal of refuse	public dump	15936	.0	.0	.0							
	dump elsewhere	8017	1.0	.0	.0							
	burned by house	2188	.0	1.0	.0							
	others	2154	.0	.0	1.0							
Main source of support in times of need	friends/ family	16940	.0	.0	.0							
	groups/govt	1231	1.0	.0	.0							
	bank/insurance/money lenders	2791	.0	1.0	.0							
	None	7333	.0	.0	1.0							
Marital status of head of household	never married/ informal	2832	.0	.0	.0							
	married(monogamous)	16355	1.0	.0	.0							
	married(polygamous)	3671	.0	1.0	.0							
	divorced/separated/widowed	5437	.0	.0	1.0							
Socio-economic group (employment status of head)	public	2579	.0	.0	.0							
	private formal	1458	1.0	.0	.0							
	private informal	19707	.0	1.0	.0							
	others	4551	.0	.0	1.0							
Time to nearest primary school	0 - 14	19781	.0	.0								
	15 - 29	5021	1.0	.0								
	30+	3493	.0	1.0								
Dwelling ownership	Owns the dwelling	14161	.0	.0								
	Rents the dwelling	5666	1.0	.0								
	Uses without paying rent	8468	.0	1.0								
Material of the walls of the house	Mud or mud bricks	17181	.0	.0								
	Cement or Sandcrete	10145	1.0	.0								
	Others	969	.0	1.0								
Material of the roof of	Thatch	766	.0	.0								
	Metal Sheets	4975	1.0	.0								

the house	Asbestos	22554	.0	1.0							
Material of the floor the house	mud/mud bricks	4411	.0	.0							
	cement/concrete	23561	1.0	.0							
	others	323	.0	1.0							
Main fuel used for lighting	Kerosene/Paraffin	15792	.0	.0							
	Main electricity	12263	1.0	.0							
	others	240	.0	1.0							
Does household receive regular transfers from others	yes, very and somewhat regular	3326	.0	.0							
	yes, occasionally	9053	1.0	.0							
	hardly ever and never	15916	.0	1.0							
Does household give out regular transfers to others living elsewhere	yes, very and somewhat regular	6088	.0	.0							
	yes, occasionary	12007	1.0	.0							
	hardly ever and never	10200	.0	1.0							
Time to nearest food market	0 - 14	13825	.0	.0							
	15 - 29	5528	1.0	.0							
	30+	8942	.0	1.0							
Place of residence	Rural	17716	.0								
	Urban	10579	1.0								
Gender of head of household	Male	19815	.0								
	Female	8480	1.0								

Block 1: Method = Backward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11029.345	67	.000
	Block	11029.345	67	.000
	Model	11029.345	67	.000
Step 2[a]	Step	-2.181	4	.703
	Block	11027.165	63	.000
	Model	11027.165	66	.000
Step 3[a]	Step	-5.195	3	.158
	Block	11021.970	60	.000
	Model	11021.970	62	.000

a. A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	18331.488[a]	.323	.500
2	18333.669[a]	.323	.500
3	18338.864[a]	.323	.500

a. Estimation terminated at iteration number 9 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	13.923	8	.084
2	13.368	8	.100
3	13.015	8	.111

Variables in the Equation

Step 1[a]	region		638.686	.000			
	region(1)	.579	31.590	.000	1.784	1.458	2.183
	region(2)	1.165	69.315	.000	3.207	2.437	4.219
	region(3)	1.118	135.998	.000	3.058	2.534	3.690
	region(4)	.384	14.885	.000	1.468	1.208	1.784
	region(5)	.683	54.402	.000	1.979	1.651	2.372
	region(6)	1.253	178.556	.000	3.500	2.913	4.206
	region(7)	1.974	360.454	.000	7.202	5.874	8.831
	region(8)	2.003	218.023	.000	7.412	5.681	9.669
	region(9)	2.323	352.275	.000	10.204	8.006	13.006
	dwelown		6.263	.044			
	dwelown(1)	-.199	6.046	.014	.819	.699	.960
	dwelown(2)	-.012	.067	.795	.988	.899	1.085
	numroom	-.193	172.974	.000	.825	.801	.849
	hhsize	.379	959.098	.000	1.461	1.426	1.497
	hage	.007	18.934	.000	1.007	1.004	1.010
	nschool	-.066	15.205	.000	.936	.906	.968
	Wallmat1		56.483	.000			
	Wallmat1(1)	-.439	47.761	.000	.645	.569	.730
	Wallmat1(2)	-.441	12.866	.000	.644	.506	.819
	roofmat1		77.142	.000			
	roofmat1(1)	-.424	15.752	.000	.654	.530	.807
	roofmat1(2)	-.762	51.099	.000	.467	.379	.575
	floormat1		5.479	.065			
	floormat1(1)	.018	.128	.720	1.018	.923	1.124

	floormat1(2)	-.808	5.147	.023	.446	.222	.896
	hsetype1		5.207	.157			
	hsetype1(1)	.020	.168	.682	1.020	.926	1.124
	hsetype1(2)	.131	4.100	.043	1.140	1.004	1.295
	hsetype1(3)	-.051	.286	.593	.950	.788	1.146
	water1		16.990	.002			
	water1(1)	.492	10.782	.001	1.635	1.219	2.193
	water1(2)	.570	14.539	.000	1.768	1.319	2.369
	water1(3)	.473	9.690	.002	1.605	1.191	2.161
	water1(4)	.540	12.628	.000	1.717	1.274	2.313
	toilet1		88.694	.000			
	toilet1(1)	-.423	32.633	.000	.655	.566	.757
	toilet1(2)	-.462	62.981	.000	.630	.562	.706
	toilet1(3)	-.513	61.672	.000	.599	.527	.681
	toilet1(4)	-.320	5.773	.016	.726	.560	.943
	cookfuel1		128.454	.000			
	cookfuel1(1)	-.923	98.511	.000	.397	.331	.477
	cookfuel1(2)	-2.285	19.679	.000	.102	.037	.279
	cookfuel1(3)	-.575	21.072	.000	.563	.440	.719
	litefuel1		82.935	.000			
	litefuel1(1)	-.498	81.679	.000	.608	.546	.677
	litefuel1(2)	.161	.614	.433	1.175	.785	1.757
	refuse1		7.134	.068			
	refuse1(1)	.117	5.098	.024	1.125	1.016	1.245
	refuse1(2)	-.016	.043	.835	.984	.847	1.143
	refuse1(3)	.005	.003	.959	1.005	.841	1.200
	timarket1		4.635	.099			
	timarket1(1)	.011	.030	.862	1.011	.897	1.138
	timarket1(2)	.110	4.145	.042	1.117	1.004	1.242
	timeprim1		8.968	.011			
	timeprim1(1)	-.075	1.951	.163	.928	.835	1.031
	timeprim1(2)	-.169	8.645	.003	.845	.755	.945
	supotneed1		7.983	.046			
	supotneed1(1)	-.104	1.174	.279	.901	.746	1.088
	supotneed1(2)	-.200	7.178	.007	.819	.707	.948
	supotneed1(3)	-.012	.071	.790	.988	.901	1.082
	hmstat1		15.534	.001			
	hmstat1(1)	-.096	1.812	.178	.909	.790	1.045
	hmstat1(2)	-.293	11.437	.001	.746	.630	.884
	hmstat1(3)	-.079	.741	.389	.924	.773	1.106
	hseg1		26.530	.000			
	hseg1(1)	.065	.184	.668	1.067	.793	1.435
	hseg1(2)	.231	5.677	.017	1.259	1.042	1.523
	hseg1(3)	.452	18.189	.000	1.571	1.276	1.933
	transfout1		39.531	.000			
	transfout1(1)	.178	10.099	.001	1.195	1.071	1.334
	transfout1(2)	.350	37.204	.000	1.419	1.268	1.588

	transfin1		4.357	.113			
	transfin1(1)	.061	.760	.383	1.063	.927	1.219
	transfin1(2)	-.031	.209	.647	.969	.847	1.108
	timesec		2.181	.703			
	timesec(1)	-.030	.135	.713	.971	.828	1.138
	timesec(2)	.041	.264	.607	1.042	.890	1.220
	timesec(3)	-.050	.303	.582	.951	.797	1.136
	timesec(4)	.013	.022	.882	1.013	.858	1.195
	timehosp		7.415	.116			
	timehosp(1)	-.123	3.758	.053	.884	.781	1.001
	timehosp(2)	-.026	.153	.696	.974	.853	1.112
	timehosp(3)	.080	.977	.323	1.083	.925	1.268
	timehosp(4)	.024	.102	.750	1.024	.885	1.185
	urbrur(1)	-1.208	310.408	.000	.299	.261	.342
	hgender(1)	-.160	6.915	.009	.852	.756	.960
	Constant	-3.560	186.624	.000	.028		

Variables not in the Equation

			Score	df	Sig.
Step 2[a]	Variables	timesec	2.181	4	.703
		timesec(1)	.492	1	.483
		timesec(2)	1.242	1	.265
		timesec(3)	1.074	1	.300
		timesec(4)	.144	1	.705
	Overall Statistics		2.181	4	.703
Step 3[b]	Variables	hsetype1	5.214	3	.157
		hsetype1(1)	.126	1	.723
		hsetype1(2)	4.567	1	.033
		hsetype1(3)	.720	1	.396
		timesec	2.186	4	.702
		timesec(1)	.504	1	.478
		timesec(2)	1.381	1	.240
		timesec(3)	.987	1	.321
		timesec(4)	.083	1	.774
	Overall Statistics		7.396	7	.389

a. Variable(s) removed on step 2: timesec.
b. Variable(s) removed on step 2: hsetype1.