The Effects of Public Welfare Policies on Rural Poverty in Sri Lanka: A Logistic Regression Analysis[1]

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Abstract

Poverty alleviation is one of the greatest phenomenon that acquired a foremost priority within the development effort of Sri Lanka, mainly during the past few decades. Public sector has been playing a vital role in this endeavor. In the first phase of independence, social welfare was given highest priority. Free education, health services, food rationing, land reforms, subsidies for agriculture, control of the prices of essential food items etc. were among the major welfare and poverty alleviation measures in this phase. In addition to these measures, targeted poverty alleviation strategies were implemented in 1980s. As a result of these efforts, the nation has been able to reach to a reasonable level of social development and to reduce income poverty significantly.

The purpose of the present study is to assess the effects of public welfare policies on the reduction of rural poverty in Sri Lanka. The study is based mainly on the Hambantota district of southern Sri Lanka. Logistic Regression Analysis was employed to assess the effects. State of multidimensional poverty (Y) was the dependent variable. Six basic

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1. *This paper has been developed based on the PhD thesis 'Public Welfare policies and rural poverty in Sri Lanka :with reference to Hambantota District'*

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capabilities namely, Avoid hunger and food insecurity (Food capability-FOD), Free from illiteracy and having knowledge (Education capability-EDU), having a healthy life (Health capability – HEL), Access adequately to clean drinking water (Drinking water capability - DRW), Sheltered safely and adequately (Housing capability - HOU) and Access to improved sanitation (Sanitation capability - SAN) were used as independent variables.

The analysis concluded that food related public policies have played a significant role in reducing rural poverty. Though, public policies on health, housing, education, drinking water and sanitation have played a vital role, they have not still been able to provide adequate opportunities for the rural poor. Hence, public expenditure on those spheres can play a significant role in reducing rural poverty. Among the considered areas, public health policy is the comparatively most effective in reducing rural poverty, followed by housing and drinking water policies. Thus, expenditure on health can reduce rural poverty at a comparatively high rate. Education policy is less effective than other services.

Keywords : Basic Capabilities – Logistic Regression Analysis – Multidimensional Poverty – Poverty – Public Welfare Policy

Introduction

Poverty alleviation is the phenomena that acquired foremost priority within the development agenda of Sri Lanka, especially during the past two or three decades with the emergence of poverty as a severe socioeconomic issue. In fact, public sector intervention on poverty alleviation and social welfare goes far back to the pre-independence era. "*The roots of Sri Lanka's welfare policies can be traced back to the colonial period ..*" (Wickramasinghe, 2005: 251). As Anand et al., (1995: 299) says, '*Sri Lanka has a long record of government intervention in the field of social welfare*'.This commitment strengthened with the political independence in 1948. In the first phase of independence, equity has been given priority rather than economic growth. Free education, health services, food rationing, land reforms, subsidies for agriculture, control of the prices of essential food items etc. were among the major welfare and poverty alleviation measures. After independence, it was widely accepted that provision of welfare services for all and safeguarding the basic needs of low-income groups as a responsibility of the

government. Indeed, Sri Lanka is one of the first developing countries that understood the multidimensional nature of poverty, and has strongly emphasized on policies of free health and education as early as the 1930s (Lakshman, 1997; World Bank, 2000; Kelegama, 2001). However, irrationally, benefits of these public provisions were received by all, even the taxpayers, in this phase without considering income or other social status of the beneficiaries. Under the economic reforms made at the end of 1970s, an attempt was made to rationalize some of the welfare provisions while continuing free education and health services, universally. Instead of equity, economic growth is given priority in this phase. As a result, growth rate increased modestly but experiencing high income inequality.

With the growing of social unrest and escalation of poverty incidence, *Janasaviya* (strengthening of people) program was launched in 1989, as the public sector major poverty alleviation program. This was the first need based targeted poverty alleviation program. In 1995, it was superseded by the *Samurdhi* program. Government intervention in the field of housing, especially for low and middle income classes, through a number of housing programs increased since 1980s. Provision of school textbooks for primary and junior secondary students (1980), restoration of free mid-day meal program (1989) and provision of free uniform for students (1993) strengthened the government's commitment on free education. In addition to these island-wide programs, area specific programs such as Integrated Rural Development Program (IRDP), establishment of Regional Development Banks, and the establishment of the Southern Development Authority contributed largely to the social and economic development of the general masses of the country.

These public sector welfare and poverty alleviation programs attempted to address a number of essential dimensions of well-being such as knowledge, healthy life, nutrition, housing and drinking water, of the people. As an outcome of the long- term public intervention, the country has achieved an impressive progress in the realm of social development (Sen, 1981; Gunatilleke, *et al.*, 1992; Anand *et al.*, 1995; Alailima, 1997) and has been able to avoid the hunger and starvation, successfully (Semasinghe, 2008a; 2009).

Anand *et al.* (1995:298) say, "*Assuming that one of the major objectives of development is to enhance the quality of life along the dimensions of health, education and other basic needs, Sri Lanka appears to have been remarkably successful*". Poverty incidence of the country, in terms of income, has also declined modestly during the recent years. This success has widely discussed in the development literature. Sen has often referred to Sri Lanka's achievements in social development in his discussions of poverty, living standards and well-being.

Even within the remarkable progress in social development and modest decline of income poverty at the national level, a number of issues, which affect the human well-being, are emerging at the micro level. Persistence of relatively high level of income poverty, even though recent estimates show a declining trend, worsening of some dimensions critical to the human well-being and inadequate opportunities to access to economic and social services and widening the gap between urban, rural and estate sectors in terms of economic and social welfare achievements are among them. Rural sector of the country, which is the home for over 70 percent of the population, faces three major challenges in the broad area of equity. The first is related to material deprivation; i.e. rural society suffers from high level of income poverty, and poverty reduction has been rather slow. The second issue pertains to the social development which relates to human poverty. Although, human development seems to be improved, there are notable failures in some critical dimensions of human well-being such as malnutrition, accessibility to education, maternal health, sanitation, housing and drinking water etc. Malnutrition, especially among young children and serious calorie deficiencies in the lower income groups are the evidences, which mark the deterioration of human development in certain regions in the country. As recent estimates shows 3.5 percent, 2.8 percent and 3.5 percents are severely undernourished respectively in terms of height-for-age and weight-for-height (DCS, 2008). The third, the gap between aspiration of the inhabitants and existing opportunities for them to access to education, health, housing, drinking water, employment etc., are widening endangering their living standard and social stability.

Meanwhile, the pursuit of a more efficient allocation of relatively scarce resource has led public decision makers in developing countries to a global reconsideration of public expenditure priorities. In this context, decision makers in Sri Lanka, which allocates much of its scarce resources on welfare services, must establish the priority areas, which are more efficient in improving the quality of life of her people.

Thus, the issues arisen in this context are: Why long-standing public welfare policies have failed to provide adequate opportunities in some areas such as education, nutrition, health, housing, sanitation etc. for the people in the country? Which public welfare policies are more effective in improving the living standards of the rural poor? Which public welfare services have failed to provide adequate opportunities to the rural poor?

Based on this broader set of questions, the present analysis intends to examine the effects of major public welfare policies on the well-being of the rural poor and to identify the most effective public welfare policies or programs in uplifting the living standard of rural dwellers.

Nature of Poverty and Capability Approach

As a very complicated, dynamic and multidimensional entity, poverty is defined in multitude of ways using different criteria. Hence, it could mean different things to different people. The definition of poverty has been broadened over the time encompassing wider range of elements. However, there is no consensus among scholars, researchers, policy makers etc., on a precise and comprehensive definition and measure of poverty.

In the development literature, there are two main approaches to poverty, i.e. 'welfarist approach' and 'non-welfarist approach'. The first approach mainly concentrates on *economic welfare* or *standard of living* of individuals or households and defines poverty in monetary terms (Ravallion and Chen, 1997; Ravallion, 1994; World Bank, 1990; 1997) while the other focuses on the multidimensional nature and encompasses not solely the financial but also non-financial

deprivations. Though defining and measuring poverty in monetary terms is technically elegant and straightforward, it generates a number of difficulties and also it is incapable to describe the reality of human life, adequatly. As some argue, the focus should go beyond the money-matrix measures and should take into account the measures of other aspects, too. According to one such argument, the quality of income/expenditure data is often poor, particularly in developing countries. Thus, mostly, money-matrix measures exaggerate poverty incidence. In fact, there is increasing recognition that the well-being of human being is determined not only by material things as measured by traditional indicators but also by non-material aspects. As Lindenberg (2002) pointed out, the well-being of a person living in the developing world can be determined by assessing whether the person has sufficient food, a place to live, access to clean drinking water, feels safe and secure within his or her home and community etc. Without assessing the achievements on these spheres, one cannot assess the living standard or poverty incidence of any society.

On the contrary, *non-welfarist* approach, which has drawn attention to the multidimensional nature of well-being and poverty, concentrated on identifying specific forms of commodity deprivation. In fact, due to the seminal works of Sen (1981; 1985; 1992; 1997; 2000), well-being and poverty are now seen as multidimensional phenomena. Accordingly, the well-being and poverty of individuals depend not only on income or expenditure or, in other words, on material things but also on several other dimensions or capabilities such as health, education, empowerment, self-respect and dignity. There are two major schools of non-welfarist approach in the poverty literature, i.e. Basic Needs Approach (BNA), and, Capability Approach (CA). The BNA focuses not only on the lack of material things but also on non-tangible services such as education and health, which are identified and perceived as basic needs by the individuals or the households (Streeten *et al.*, 1981). In practice BNA measure poverty by constructing poverty lines based on income or expenditure. Although, this is most popular among researchers as well as international organizations like World Bank, it has also been affected by intrinsic limitations, especially, in deciding and measuring basic needs and taking diversity of poverty into account.

Capability Approach, pioneered by Sen, is mainly developed as an alternative to poverty and inequality analysis in money metric terms. According to Sen, income or expenditure is only one aspect of human life and it is influenced by and, linked with a number of various non-material aspects. Sen and his co-workers argue that the poverty and human well-being do not depend on possessing commodities but on what persons can *do* and *be*. Sen (1987: 25) pointed out that, '*what valued intrinsically are people's capabilities to function, and poverty is interpreted as lack of basic capabilities*'. Thus, poverty can be seen as "*the failure of basic capabilities to reach certain minimally acceptable levels*" (Sen, 1992: 109). He has emphasized in much of his writings that the focus should not be on what people consume or on their income but on what people are able to do and be. The crucial for standard of living is not a basket of goods such as greater income or access to resources, but the possibility of exercising one's capabilities – the basic abilities of a person to achieve states of well-being such as having nourishment, being well sheltered, being adequately clothed, being able to interact with others, and maintain one's self-esteem. However, Sen does not deny the important role of income in human well-being. He considers it as an important *mean* in deciding human capabilities and functionings rather than an end. The core concepts of Sen's approach are functionings and capabilities. Functionings comprise an individual's activities and state of being. On the contrary, capability is a derived notion, and contains the various functionings he or she can potentially achieve. As Sen describes, living may be seen as consisting of a set of interrelated functionings, consisting of one's being and doings. According to Sen (1999), development is best seen as an expansion of people's capabilities, as a process of emancipation from necessities that constrain fuller realization of human freedom. Accordingly, a person's well-being can be evaluated through his capability (Sen, 1985; 1988; 1992; 1997; 1999). Though, Capability Approach suffers from several shortcomings, it bypasses many of the difficulties encountered with financial resources based approaches to welfare and poverty. Hence, the core idea of the approach has become increasingly popular among researchers, development activists, policymakers, international agencies etc., and is employed as a basis to analyze the multidimensional poverty, particularly in developing countries. Indeed, it helps governments

and policy makers to identify the important aspects of human life and also to design their anti-poverty strategies more efficiently.

The United Nations Organization (UNO) has implicitly employed the Sen's framework in poverty analysis (UNDP, 1997; 2002). The Human Development Reports of United Nations Development Program (UNDP) have emphasized that the multidimensionality of poverty and social deprivation can only be addressed, if non-income measures, such as access to basic services, capacities, voice and power of the poor, and other dimensions of living are taken into account. It has derived Human Development Index (HDI), Human Poverty Index (HPI) etc., as multidimensional deprivation indicators of well-being. Similarly, the World Bank (2000) also adopted the capability framework and comprehensively described that poverty is hunger; poverty is lack of shelter; poverty is being sick and not been able to see a doctor; poverty is not being able to go to school and not knowing how to read; poverty is not having a job; poverty is fear for the future; poverty is losing a child or illness brought by unclean water; poverty is powerlessness; lack of representation and freedom.

The present analysis which intends to assess the effect of public welfare policies on multidimensional rural poverty is based basically on Sen's Capability framework. Accordingly, it considered poverty as a state of basic capability failure.

Multidimensional Poverty and Public Welfare Policy

As a multidimensional phenomenon, poverty is not simply a question of lack of material wealth and resources. It is fundamentally about the lack of choices in meeting basic needs as well as dealing with the forces that shape people's quality of life. According to the capability perspective, the choice of life which people value depends on the ability to command over the goods and services i.e. on the capability to 'doings' and 'beings'. Hence, a person who lacks basic capabilities to reach certain minimally acceptable levels is classified as poor. Indeed, the poor often do not have much choice over many things that affect them, ranging from food, shelter, education, health, water and safety etc., to the more complex needs that they require

to participate in the economic system and in the civil society actively. Provision of basic needs for the poor and empowering them is essential for the well-being of them. In fact, markets do not provide sufficient opportunities for the poor due to their inability to pay.

Even though there is a spirited debate on the effects of public welfare policies on poverty levels, many favour the 'pro-poor' public welfare expenditure. According to Kenworthy (1998), a central objective of social welfare policies is to reduce poverty. The welfare system facilitates the development of human capacity and self-reliance leading to improve the capability of people. According to Midgley (1995), social welfare is an approach for promoting human welfare that seeks to integrate economic development with social development. The supporters of this view believe in it for a number of reasons. Firstly, people are unaware of their health and nutrition and therefore do not spend incremental income wisely. Secondly, there is a serious skewed distribution of incomes within a household, which could be overcome only through the direct provision of goods and services. Thirdly, some basic needs can only be met through public provisions such as sanitation facilities and to some extent safe drinking water. Fourthly, the public provision of these facilities are expected to help all people equally, while focusing on the growth-oriented policies such as increasing labour skill and their productivity or employment opportunities which benefit only a certain group of people (Sachs. 2004; UNDP. 1996; 1999; Siddiqui. 2008).

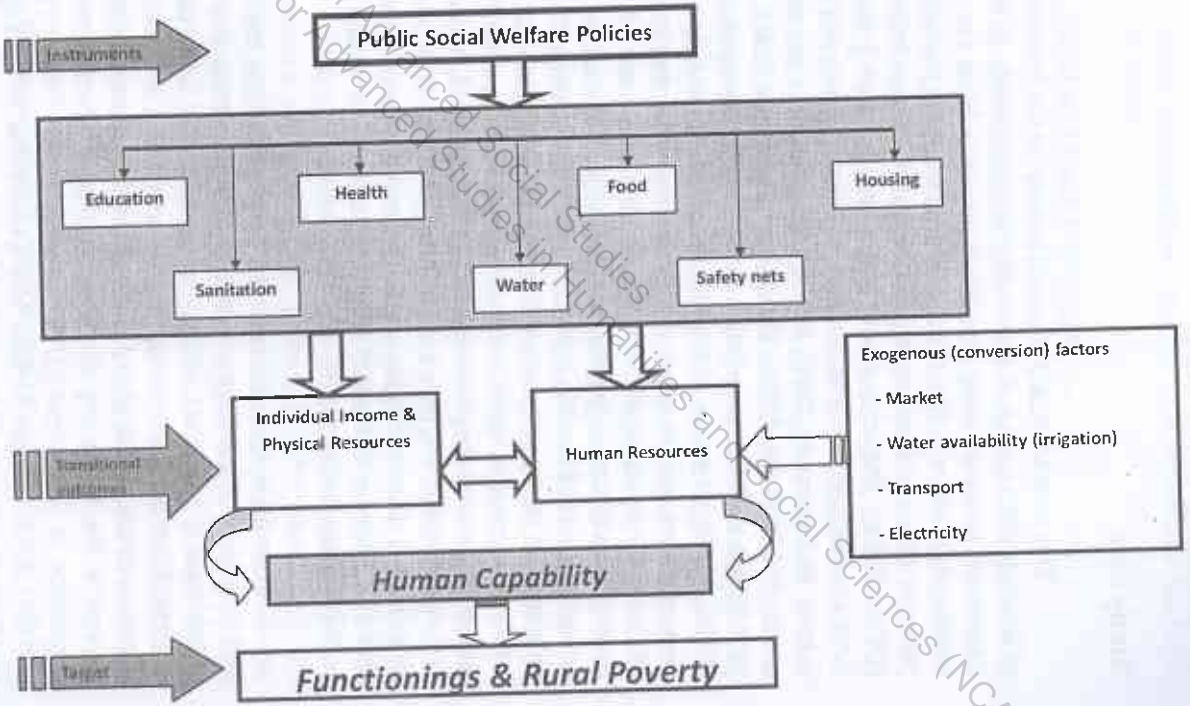
The capabilities produced as outcomes of welfare policies are interrelated and reinforce one another. For example, education policy increases the accessibility to education and in turn increases the ability to acquire knowledge; knowledge increases utilization of health services whereby increasing health condition; good health condition in turn contributes to increase the ability to get knowledge; and knowledge enhances the income earning ability and so on. Deprivation of health of individuals adversely affects the economy because peoples' productivity depends on their nutritional and health conditions. Poor health conditions lead to low earning for individuals. On the contrary, good health condition acts as an instrument in enhancing individual's capacity to work and earn a living which leads to a favourable impact on the economy as a whole. Likewise, different

deprivations – of food, health care, and education – typically go together, and these different deprivations feed one another (Sen, 1990; UNO, 2002).

Further, it is possible to have different achievement levels at a given capability level due to the influence of exogenous elements such as social, cultural, environmental and so on. For example, as explained by Krishnakumar (2004), the 'capability' in this field is given by say, the choice to go to a good school. However, one may utilize this freedom by actually going to school and being educated whereas another may use the same choice not going to school due to various external factors. For example, choice of acquiring knowledge of a rural child in a developing country depends not only on accessibility to school but several other 'socio-cultural' factors such as perceptions on education in the particular society, gender discrimination within the society, non-monetary benefits of education such as self-confidence produced by knowledge acquired through education, value added to one's personality etc., (Krishnakumar, 2005). There are large numbers of such examples to ascertain the interdependence and intra-dependence of capabilities and to disclose the exogenous factors that influence the achievements.

Figure 1 describes the relationships between public welfare policies, individual capabilities and rural poverty. This diagram is based on the Sri Lankan context and it includes only the major public welfare policies which cover the whole or larger part of the entire population of the country over several decades. These welfare policies are the *instruments*. The *target* of the instruments is reducing rural poverty through the development of individual capabilities. The instruments link with the targets through several channels, mainly individual incomes, physical resources, income distribution, and human resources. In fact, these are the outcomes of the instruments, which are generated individually and collectively. These outcomes reinforce each other and are influenced and reinforced by exogenous factors such as market, transport, customs, belief etc., which appear in the right-middle box of the diagram. Lastly these outcomes lead to improvements of capabilities thereby reducing poverty.

Figure 1 : The Linkage Between Public Policies, Individual Capabilities and Rural Poverty



Methodology of the Study

Study Area

The present study is based mainly on the Hambantota district of Southern Sri Lanka. It was selected purposively as it is one of the backward and relatively marginalized districts in the country. The urban population in the district is only about 4 percent. About 5.4 percent of the schooling aged population never attend to school (DCS, 2008). The majority of them are females (10.3%). Labour force participation rate among the male is 70.2 percent while female is only 36.5 percent (DCS, 2010). Mean monthly per capita income in the district is Rs. 5789. The national average is Rs 6463. About 12.7 percent of the population is poor in terms of income poverty (DCS, 2008). In some of the DS divisions especially in the interior divisions such as Katuwana and Sooriyawewa, more than 70 percent of the total number of families are beneficiaries of government poverty alleviation programs. Its rank in terms of the countries human poverty index is 11, while in terms of combined score of consumption poverty and human poverty is 8 out of 17 districts. Adult literacy rate is 91.6, access to safe water and sanitation is only 92.2 percent and 89.7 percent respectively (DCS, 2008). Adult illiteracy is higher among females (9.1%) than males (7.6%). The percentage of households use electricity as the principle type of lightning is only about 74. Number of female headed households is about 20.4 percent in the district (DCS, 2008).

Hambantota district covers 4 percent of the total land extent and 3 percent of the total population of the country. The percentage of the rural population of the district is about 96. There are 576 Grama Niladhari (GN) divisions, the lowest unit in the administrative structure of the country and 12 Divisional Secretariat (DS) divisions, the next in the hierarchy of administration. Ethnically majority of the population is Sinhalese (97%) followed by Sri Lankan Moors (1%) and Sri Lankan Tamils (0.4%). Major economic activity is agriculture and forestry. About 40 percent of the labour force employed in this sector and majority of them are smallholders. Fishing is another important economic activity in the district. It accounts for about 5.5

percent of the nation's fishing fleet and for 12.9 percent of the total marine fish production.[2]

Sampling Method and Data Collection

In this analysis, basically, the Multi-stage sampling process was adopted in picking the sample and sample units. In fact, it involved three stages. In the first stage, Sooriyawewa Divisional Secretariats (DS) was selected as the primary location for the field survey, adopting the purposive sampling technique, by taking into account the consistency of the locations with the objectives of the study, heterogeneity of the locations in terms of economic, social, cultural and also physical. The division comprises 21GN divisions and there are about 56 villages in the division. They differ significantly from each other in terms of the land extent, size of the population, accessibility to essential services, availability of infrastructure, and accessibility to the main centre of the division etc., but not differ much in terms of the nature of social and economic activities. Considering the distance to the main city, availability of physical infrastructure facilities such as road, transport, electricity; accessibility to key welfare services such as education, health, drinking water; and the size of the population, the five villages namely Viharagala, Hathporuwa, Andarawewa, Weliwewa, and Meegahajandura were selected purposively. From the five villages there is a total of 260 households; 60 from Hathporuwa, 60 from Viharagala, 45 from Weliwewa, 50 from Andarawewa and 45 from Meegahajandura were selected based on the details of the households lists maintained by the Grama Niladharis for each village. In fact the total number of sample units were allocated among four GN divisions by taking into account the total number of households in each GN division. Since the sampling frame is obvious and living standards and accessibility to essential services are not much

2. *Anputhas, Markandu. Ranjith Ariyaratne et al. 2005. "A Post-Tsunami Livelihoods · Needs Assessment of Hambantota District in Southern Sri Lanka." International Water Management Institute: Colombo (March) Available at the www.iwmi.cgiar.org /TSUNAMI/ pdf/Formatted -Final -Tsunami - report 30-03-05.pdf*

different within the village, simple random sampling procedure is adopted to select the sample units.

Household level data were collected from the selected households using a pre-tested questionnaire. The survey was carried out in March/April, 2008. The facts and information obtained from the pilot survey conducted in November 2007 have provided the basis for developing the final version of the survey schedule. The questionnaire includes mainly the structured questions but several open-ended questions are also included, appropriately.

Semi-structured interviews with the selected public officials, namely Divisional Secretary, Grama Niladharies, Public Health Inspectors, Midwives, and Samurdhi Niyamakas yielded understanding on the economic and social infrastructure, prevailing circumstances on poverty incidence, and experience and issues on social development in the area.

Formulation of the Model

As literature reveals, different econometric techniques have been used extensively to identify the determinants of poverty. Among these the single equation approach is one of the widely applied techniques. This may be the simplicity of the technique when compared with the simultaneous equation technique in terms of structure of the model, data requirements, estimation procedure, interpretation and forecasting procedures.

Because of the multidimensional nature of poverty, the determination of the effects of public welfare policies on rural poverty is undoubtedly a multivariate analysis, which encompasses one response (independent) variable and a number of independent variables. When rural poverty (response variable) is denoted by y and the explanatory variables by x, the general form of the model is,

$$y_i = \beta x_i + \varepsilon_{ij} \qquad (1)$$

Where,

y_i is the vector of response variable,
β is the parameter vector,
x_i is the matrix of explanatory variables and
ε_{ij} is the random error.

In this particular case, the response variable (y) is unobservable in practice. It denotes whether the given household is poor or not. Hence, it is a binary qualitative (categorical) variable which takes the value 1, if the household is poor and 0 otherwise. Accordingly,

$$y_{ij} = \begin{cases} 1 \text{ if the household i is poor} \\ 0, \text{ otherwise.} \end{cases}$$

While the objective of the models with the qualitative response variable y is to estimate the expected value of y given the values of explanatory variables, the objective of the models with qualitative response variables is to find the probability of something (success) happening. When the response variable is a binary choice variable, the application of linear regression technique is inappropriate. If an ordinary regression model is used in such cases, there is no assurance that the predicted value lie between 0 and 1. In fact, the linear regression model allows the independent variable to take values greater than 1 or less than 0.

The regression models, which the response variable is binary, are often known as *probability models*. There are three types of approaches to developing probability models, i.e. Linear probability model (LPM), Probit model (PM) and Binary logistic model (LM), for a qualitative response variables (see Gujarati 2004: 582), which hold identical attributes[3]. This study employs the binary logistic regression

3. *When the dependent variable is dichotomous, one can use it as a dummy variable and can run a classical regression model as an alternative to the probability model. But in such functions, the disturbance term will be heteroscedastic, making adverse effects on parameter estimates and their standard errors. See, Koutsoyiannis, K. 1973. Theory of Econometrics: An Introductory Exposition of Econometric Methods, PALGRAVE, New York.*

approach to determine the effects of public welfare policies on rural poverty. The estimated coefficients can be used to estimate odds ratios for each of the independent variables in the model.

The logistic (logit) regression can be used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the percent of variance in the dependent variable explained by the independents; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariate control variables. The logit model is based on the cumulative logistic distribution function, the form of which is,

$$P_i = \frac{1}{1 + e^{-zi}} = \frac{1}{1 + e^{-(\beta_0 - \beta_1 X_i)}} \qquad (2)$$

where z_i is the value of the unobserved continuous variable for the i^{th} case defined as $z_i = \beta_0 + \beta_1 x_i$ and e is the base of natural logarithms. P_i represents the probability that an individual will make a certain choice (i.e. Y = 1), given the value of x_i. In this function, as z_i ranges from - ∞ to + ∞, P_i ranges between 0 and 1 and P_i is nonlinearly related to z_i. Since P_i is nonlinear both in variables (X_i's) and parameters (β_i's), OLS cannot be used to estimate the parameters of the model. Equation 2 can be linearized re-writing the equation as:

$$e^{-zi} = \frac{1 - P_i}{P_i}$$

then

$$e^{zi} = \frac{P_i}{1 - P_i} \qquad (3)$$

While $(1 - P_i)$ of the equation refer to the probability of not making the given choice, $[P_i/(1 - P_i)]$ of the equation gives the *odds ratio* in favour of the response (choice). Taking natural log of both sides,

$$L_i = \ln\left[\frac{P_i}{1 - P_i}\right] = Z_i$$

$$= \beta_0 + \beta_1 x_i \qquad (4)$$

Where, L_i represents the log of the odds ratio or logits. Hence, the dependent variable in this regression equation is simply the logarithm of the odds of a particular choice. It is linear not only in variables but also parameters. The dependent variable in this model is the natural log of the odds that a particular choice will be made. Although, there is only one independent variable in Equation 4, one can add as many independent variables as may be dictated by the underlining theory (Gujarati 2004; Pindyck et al. 1976, 1998). Thus, for estimation purpose, the model can be expanded for k number of explanatory variables as;

$$L_i = \ln\left[\frac{P_i}{1 - P_i}\right] = \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k + U_i \qquad (5)$$

The constant term, β_0 is the value of the log-odds when all the regressors (x_i s) are zero. Other parameters, (β_i s) measure the change in L (log odds) for a unit change in x_is. In fact, unlike OLS, logistic regression does not assume linearity of relationship between independent variables and dependent variables, does not require normally distributed variables, does not assume homoscedasticity, and in less stringent requirements. However, it is required that observation be independent and that the independent variables be linearly related to the logit of the dependent. Solving equation 5 for P_i or simple odds of a 'success' by first exponentiating both sides we get,

$$P_i = \frac{e^{\beta_0 - \beta_1 X_1 - \cdots - \beta_k X_k - U_i}}{1 + e^{\beta_0 - \beta_1 X_1 - \cdots - \beta_k X_k - U_i}}$$

When the data are on individuals/households, the traditional OLS is inappropriate to estimate the equation 5 because if P_i happens to equal 1 or 0, then the odds $[P_i / (1 - P_i)]$ will equal to 0 or infinity and the logarithm of the odds will be undefined. Thus, Maximum-likelihood (ML) is the appropriate method to estimate the parameters of a binary logistic model. Maximum-likelihood estimation technique yields consistent parameter estimates, and the calculation of the appropriate large sample statistic is not difficult (Pindyck et al., 1998). While OLS seeks to minimize the sum of squared distances of the data points to the regression line, ML method seeks to maximize the log likelihood, which reflects how likely it is (the odds) that the observed values of the dependent variable may be predicted from the observed values of the independent variables.

Specification of the Empirical Model

Since the aim of estimating the empirical model is to identify the effects of specific public welfare policies on multidimensional poverty, those public welfare policies should be the independent variables of the model, while the state of poverty (Y) should be the dependent variable. In fact, in the present study, public welfare policies are represented indirectly through the identified basic capabilities. Six basic capabilities namely, Avoid hunger and food insecurity (Food capability-FOD), Free from illiteracy and having knowledge (Education capability-EDU), Having a healthy life (Health capability – HEL), Access adequately to clean drinking water (Drinking water capability - DRW), Sheltered safely and adequately (Housing capability - HOU) and Access to improved sanitation (Sanitation capability - SAN). Those were identified based on the framework developed by Qizilbash (2002; 2003), and Clark and Qizilbash (2005). Indeed, Qizilbash was inspired from Kit Fine's (1975) 'supervaluationist' account of vagueness and the writings of Max Black (1937). On the supervaluationist account, a specification of poverty is 'admissible' if (roughly speaking) it makes sense as a

way of articulating the notion of poverty. Furthermore, according to this framework, a vague statement is 'super-true' if and only if it is true on all admissible ways of making it more precise. In this sense, if anyone is poor on all admissible ways of making 'poor' he becomes 'core poor', precisely. The important characteristic of this approach is that if someone is doing sufficiently badly in terms of any one dimension, he/she (it) is 'core poor' as long as that dimension is core. Making this judgment, it is not necessary to concern how she/he or it is doing on all dimensions[4].

Since public sector major welfare programs focus mainly on improving these capabilities of rural poor, and private sector involvement in these fields is very little, the analysis may give a reasonable image on the effects of public welfare policies on multidimensional poverty of rural households. Logically, those selected basic capabilities are the independent variables of the empirical model. Accordingly, the mathematical form of the model is:

$$\ln\left[\frac{Pi}{1 - P_i}\right] = \beta_0 \pm \beta_1 FOD + \beta_2 EDU + \beta_3 HEL + \beta_4 HOU + \beta_5 DRW + \beta_6 SAN + U_{ij}$$

Where,

- P_i is the probability that the i^{th} household will be a poor (i.e. Y = 1),

- $[P_i/1-P_i]$ is the odds ratio – the ratio of the probability that a household will be a poor to the probability that it will not be a poor. Hence, $\ln[P_i/1-P_i]$ is the log of the odds ratio.

4. For more detail about the framework see, Qizilbash (2002; 2003), Clark and Qizilbash (2005) and how the framework applied to select the relevant basic capabilities Semasinghe (2008b) and Semasinghe (2009).

- β_is are parameters, which measure the change of the log odds for a one unit change of a particular predictor.

- β_0 is constant term and it may have a plus or minus sign.

- FOD, EDU, HEL, HOU, DRW and SAN represent the food capability, education capability, health capability, housing capability, drinking water capability and sanitation capability, respectively.

- U_{ij} is the error term.

Data for the Variables

All the variables were measured at the household level rather than individual in computing the measures for each capability. However, the effects of public policies on improving basic capabilities cannot be directly measured. Hence, individuals' or households' achievements in these spheres can be used as proxy measures to capture the effects of public welfare policies on living standards of the poor.[5] Each capability was characterized by the indicators given in table below [6]:

5. Similar approach has been used by several researchers including Anderson et al. 2006; Klasen, 2000; Krishnakumar, 2005; Kuklys, 2004.
6. The indicators were determined based on the five criteria i.e. (a). Simplicity, (b). relevance, (c). senesitivity to the context, (d). practicability, and (e). coverage. See for more detail Semasinghe (2009).

Table 1 : Indicators for Basic Capabilities

Capability set	Indicator
Food: - avoid hunger and food insecurity	- Number of meals served to the household members during the last three days. - Size of the stock of main foodstuff (number of days the food stock is sufficient for) in the household.
Education: - free from illiteracy and having knowledge	- Education level of the adults of the household (Level of education reached by each individual of the household)
Health: - having a healthy life	- Number of times, members of the household visited a doctor during past three months
Clean drinking water: - access adequately to clean drinking water	- Source of drinking water - Sufficiency of obtaining drinking water (average status throughout the year)
Housing: - sheltered safely and adequately	- Ownership of house - Space per person (Room/member ratio)
Sanitation: - access to improved sanitation	- Type of latrine

It is assumed that these indicators sufficiently measure the achievement level of relevant capabilities. The values for each indicator were assigned by ranking the achievement level of each household. According to the achievement levels, the rank order values were assigned for each household within the range of 0 and 1. The achievement level of each household in terms of a particular household was measured by these rank order values.

As described above, the dependent variable of the model measures the level of poverty, i.e. whether the rural household is poor or non-poor. If a given household is poor, it takes the value 1,

while 0 otherwise. Hence, it is a binary variable. Identification of the poor depends on the 'cut-off' or poverty line. The present study used the 'counting approach' suggested by Alkire and Foster (2007; 2008), who followed the Foster, Greer, and Thorbecke (1984) measures, to measure the multidimensional poverty with appropriate adjustment (Semasinghe, 2009). According to this approach, 'dimension specific cut-off' is used to identify the poor household in a particular capability.

Based on the rank order scores of each capability, the achievement levels of each household were categorized[7]. A score of 0.5 was defined as 'dimension specific poverty line'. Accordingly, the households which earned rank order score for the given capability less than 0.5 were defined as poor in terms of that capability. On the contrary, if the score is equal or greater than 0.5, the household is defined as non-poor in terms of that capability.

Estimation of the Model

The logistic regression model was estimated using the maximum-likelihood nonlinear estimation routing in the SPSS computer software. Forward Stepwise/Forward LR (Likelihood Ratio) method was used in estimating the model. This method automatically selects and includes the 'best' predictors into the model. The methods start with a model that doesn't include any of the predictors. At each step, the predictor with the largest score statistic whose significance value is less than a specified value (mostly 0.05) is added to the model. The variables left out of the analysis at the last step all have significance values larger than 0.05, so no more are added. At the present analysis, 5th step has given the best model.

Beginning block of the model estimation includes only the constant term. As classification table shows, given the base rate of

7. If the rank order score of a given capability less than 0.2, the achievement level in that capability of the given household is extremely unsatisfactory. If the score is in between 0.2 and 0.4 the achievement level is unsatisfactory. If it is 0.5 the achievement level was considered as average. If the score is 0.6 - 0.9 the achievement level is satisfactory and if it is I the achievement level is fully satisfactory.

two decisions i.e. whether the given household is poor or not is respectively 67.7% and 32.3%.

Table 1 : Classification Table (a,b)

Observed			Predicted		
			POVT		Percentage Correct
			.00	1.00	
Step 0	POVT	.00	0	84	.0
		1.00	0	176	100.0
	Overall Percentage				67.7

a Constant is included in the model.
b The cut value is .500
Source: Field Survey Data Base (2008).

Table 2 indicates the variables not in the beginning block with their score statistics and significance levels. It reveals that the variable HEL has the highest score statistics. Except FOD all other predictor variables are statistically significant. Thus, the variables whose significance value is less than 0.05 (assigned significance level) will be included into the model step by step but not FOD since its significance value is greater than 0.05 (0.453>0.05) so no more is added. Accordingly, step 5 gives the best model. It includes 5 explanatory variables out of 6 and excludes variable FOD (food capability). Inclusion of FOD does not make significant contribution to the model fit. Practically, it means that FOD does not significantly affect on the dependent variable i.e. whether the given household is poor or not.

Table 2 : Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	FOD	.562	1	.453
		EDU	5.083	1	.024
		HEL	60.299	1	.000
		HOU	11.923	1	.001
		DRW	4.891	1	.027
		SAN	16.163	1	.000
	Overall Statistics		93.400	6	.000

Source: Field Survey Data Base (2008)

According to the Table 3, the -2Log Likelihood statistic, which measures how poorly the model predicts the dependent variable, has dropped from 253.246 at the step 1 to 203.891 by the final step, implying the goodness of the model fitting. Also, the value of the Cox and Snell R Square at the 1st step is 0.247 indicating that approximately 25 percent of the total variation of the outcome variable (probability of being a poor household) is explained by the model. By the 5th step the percentage has increased to 38 indicating the improvement of the goodness of fit. Similarly, according to the Nagelkerke R Square, 35 percent of the total variation of the outcome variable explained by the model and has improved to 53 percent by the 5th step. These measures indicate that the model given in the 5th is reasonably fit for the empirical data.

Table 3 : Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	253.246	.247	.346
2	236.153	.295	.413
3	221.920	.333	.465
4	209.368	.364	.509
5	203.891	.378	.527

Source: Field Survey Data Base (2008)

Hosmer-Lemeshow provides a formal test to find whether the predicted probabilities match the observed probabilities. The Hosmer-Lemeshow statistic indicates a poor fit if the significance value is less than 0.05. The larger the significance value claims the better the fit the model. As shown in Table 4 below, the significance value is 0.118 at the step 5. It is greater than 0.05 (5% significant level) indicating the model adequately fits for the data.

Table 4 : Hosmer and Lemeshow Test

Step	Chi-square	df	Sig
1	18.543	4	0.001
2	41.091	8	0.000
3	31.223	8	0.000
4	25.900	8	0.001
5	12.828	8	0.118

Source: Field Survey Data Base (2008).

The classification table appearing in the appendix 1, show the practical results of using the logistic regression model. It illustrates the predictive accuracy of the logistic regression models each from step 1 to 5. Accordingly, the model at the 5th step is able to predict 'being a non-poor household' 56 percent, while 'being a poor household' 89.8 percent correctly. The overall success rate in predicting a household being a poor is 78.8 percent. Thus, it is reasonable to conclude that the model with predictors EDU, HEL, HOU, DRW and SAN explains adequately the variation of response variable, i.e. being individual household poor or not.

Results of the Logistic Regression Analysis

Table 5 illustrates the results of logistic regression analysis which explain the effects of identified capabilities on rural poverty. In fact, the table gives only the results of the best model (step 5)

including estimated parameters, respective standard errors, Wald statistics, degrees of freedom, significant levels and Exp (B)[8].

Wald statistics, which test the unique contribution of each predictor, with corresponding probability value indicates that all predictor variables are statistically significant at five percent probability level. All predictors meet the conventional 0.05 standard for statistical significance.

Table 5 : Variables in the Equation

		B	S. E.	Wald	df	Sig.	Exp (B)
Step 5(e)	EDU	-3.010	1.318	5.215	1	.022	.049
	HEL	-6.966	1.062	43.040	1	.000	.001
	HOU	-3.901	1.100	12.569	1	.000	.020
	DRW	-3.868	1.176	10.822	1	.001	.021
	SAN	-3.857	1.032	13.959	1	.000	.021
	Constant	13.121	1.956	44.989	1	.000	499566.25

The estimated slope coefficients of the regression model given in column B of the table 5, predict the log odds of the dependent variable but not directly the dependent variable as in OLS regression analysis. In other words, each slope coefficient gives the linear effect of a one-unit change in predictor variable on the log odds. By taking the antilog of both sides of the estimated model we get the plain odds as:

$$\frac{1}{1-P} = e^{13.121 - 3.010EDU - 6.966HEL - 3.901HOU - 3.868DRW - 3.857SAN}$$

The estimated βs of this model measure the changes of the plain odds of a one-unit change in predictor variables. The computed odds of each predictor variable are given in the column of Exp(B) in

8. All five steps are given in Appendix 2.

the 'Variables in the Equation' table above. For example, the odds of variable EDU is $e^{-3.010} = 0.0492$. It means that the odds of a household being in poverty are decreased by 0.0492 for each one unit increase in education achievement of the rural households. Similarly, odds of variable SAN is 0.021, suggesting that the odds a household being in poverty are decreased by 0.021 for each one percent increase in accessibility to improved sanitation of the rural households. The interpretations of the odds of other variables are same. But these interpretations are less helpful in identifying the most important variables for the response variable. It is more useful to interpret the probabilities (P_i) that Y = 1 as follows:

$$P_i = \frac{e^{13.121 - 3.010EDU - 6.966HEL - 3.901HOU - 3.868DRW - 3.857SAN}}{1 + e^{13.121 - 3.010EDU - 6.966HEL - 3.901HOU - 3.968DRW - 3.858SAN}}$$

This formula measures the probability that the i^{th} household being in poverty as a result of the different achievement levels of the given predictor variables. On the contrary, definitionally, $(1 - P_i)$ gives the probability that the i^{th} household leaves out of poverty or being above the defined poverty line. The computed odds and corresponding probabilities of each predictor variable (capability) are given in Table 6 below.

The probabilities that Y = 1of all the predictor variables (capabilities) are very small indicating less likely to a household being in poverty. On the contrary, the probabilities that Y = 0 of all the predictor variables are very large suggesting a higher chance that a household leaving out of poverty as a result of one-unit increase of the given predictor variable (basic capability). That is the effectiveness of the predictor variables on reducing poverty is significantly high. However, the probabilities of capabilities differ suggesting the varying levels of effectiveness of different capabilities on poverty.

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Appendix 1 : Classification Table

Observed			Predicted		
			POVT		Percentage Correct
			.00	1.00	
Step 1	POVT	.00	26	56	31.0
		1.00	13	163	92.6
	Overall Percentage				72.7
Step 2	POVT	.00	33	51	39.3
		1.00	18	158	89.8
	Overall Percentage				73.5
Step 3	POVT	.00	49	35	58.3
		1.00	21	155	88.1
	Overall Percentage				78.5
Step 4	POVT	.00	46	38	54.8
		1.00	21	155	88.1
	Overall Percentage				77.3
Step 5	POVT	.00	47	37	56.0
		1.00	18	158	89.8
	Overall Percentage				78.8

Appendix 2 : Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	HEL	-5.722	.919	38.726	1	.000	.003	.001	.020
	Constant	3.615	.530	46.589	1	.000	37.150		
Step 2(b)	HEL	-5.999	.960	39.041	1	.000	.002	.000	.016
	SAN	-3.714	.966	14.772	1	.000	.024	.004	.162
	Constant	5.598	.814	47.261	1	.000	269.997		
Step 3(c)	HEL	-6.222	.987	39.701	1	.000	.002	.000	.014
	HOU	-3.686	1.038	12.605	1	.000	.025	.003	.192
	SAN	-3.623	.965	14.100	1	.000	.027	.004	.177
	Constant	8.343	1.198	48.476	1	.000	4200.766		
Step 4(d)	HEL	-6.675	1.030	42.000	1	.000	.001	.000	.010
	HOU	-3.988	1.084	13.533	1	.000	.019	.002	.155
	DRW	-3.665	1.122	10.661	1	.001	.026	.003	.231
	SAN	-3.932	1.009	15.193	1	.000	.020	.003	.142
	Constant	11.036	1.587	48.384	1	.000	62082.075		
Step 5(e)	EDU	-3.010	1.318	5.215	1	.022	.049	.004	.653
	HEL	-6.966	1.062	43.040	1	.000	.001	.000	.008
	HOU	-3.901	1.100	12.569	1	.000	.020	.002	.175
	DRW	-3.868	1.176	10.822	1	.001	.021	.002	.209
	SAN	-3.857	1.032	13.959	1	.000	.021	.003	.160
	Constant	13.121	1.956	44.989	1	.000	499566.252		

a Variable(s) entered on step 1: HEL.
b Variable(s) entered on step 2: SAN.
c Variable(s) entered on step 3: HOU.
d Variable(s) entered on step 4: DRW.
e Variable(s) entered on step 5: EDU.