A Multidimensional Approach to Measuring Rural Poverty in Kewet District, North Shoa, Ethiopia

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Abstract

This article analyses the multidimensional aspect of rural poverty in Kewet district, Ethiopia using the Alkire Foster method of multidimensional poverty analysis and Logit model. We collected primary data from 245 households selected through stratified and proportional random sampling procedures. Findings reveal that the poverty headcount is 0.812, whereas the intensity and multidimensional poverty index stand at 0.50 and 0.41, respectively. Findings further indicate that the greatest contribution to multidimensional poverty comes from deprivation in years of schooling (21.8%) followed by deprivation in child enrollment (11.3%) and child mortality (10.5%). Thus, policies aimed at targeting poverty should consider its multidimensionality.

Key words: *Multidimensional poverty, deprivation, MPI, Ethiopia*

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Introduction

Poverty manifests itself in several dimensions including lack of adequate food and shelter, poor access to education and health services, lack of assets, being exposed to violence, unemployment, powerlessness, and vulnerability to risk. In order to better explain the livelihood of the poor, poverty measurements should incorporate the non-income dimensions into their assessment (Asmamaw, 2004). This is because the economic status of a person (i.e., being poor or non-poor) goes beyond the availability of commodities (Sen, 1987).

Higher average incomes per capita may not certainly reduce poverty unless they are accompanied by measures to empower the poor, or insure them against risks, or to address specific problems associated with access to social services and their governance (such as inadequacy of schools or a corrupt health service) and protect human rights (World Bank, 2005)

In Ethiopia, studies show that poverty is more prevalent in rural (30.4%) than urban areas (25.7%) (MOFED, 2012). Other studies also confirm that poverty disproportionately affects the people in rural areas (Ayalneh *et al*., 2005; IFAD, 2001, 2010; World Bank, 2008). With a multidimensional headcount ratio of 0.9 and average intensity of deprivation and multidimensional poverty index of 0.65 and 0.58 respectively, poverty is deep rooted in Ethiopia (UNDP, 2010). Despite the fact that commendable progress has been made in terms of poverty reduction (MoFED (2010, and 2012), Ethiopia is still grappling with the goals of ending hunger and extreme poverty (UNDP, 2010).

In order to reduce poverty on a sustainable basis, policies should be supported by rigorous research and well informed decisions through evidence-based analysis. Towards this end, several studies examined poverty in Ethiopia using different methods (Dercon and Krishnan, (2000), Esubalew, 2006; Tesfaye, 2006; Getachew, 2011; MoFED, 2012; Alemi and Derje, 2014). Nevertheless, significant gaps still remain in knowledge and methods. Previous studies mainly used per capita expenditure as a proxy for poverty, without taking into account the non-monetary dimensions of poverty (Mekonen, 2002; Dercon and Tadesse, 1999; Ayalneh et.al, 2005; Islam and Abebe, 2005; Getachew, 2011; Alemi and Derje, 2014).

Since poverty is determined by a number of economic and non-economic factors rather than consumption and/or income alone, applying a multidimensional approach is essential. It is also regarded as a reasonable technique of poverty assessment due to the fact that it indicates long term poverty (Hulme and Shepherd, 2003).

As a matter of fact, few studies have been made in measurement of poverty applying the multidimensional approach (Bruck and Sindu, 2013; Alemayehu *et.al*, 2015). Besides, as poverty is affected by contextual factors, findings of these two studies might not apply to the specific situations of the study area.

Against this backdrop, we used the Multidimensional Poverty Index developed by the Oxford Poverty and Human Development Initiative (OPHI) to analyse poverty in Kewet district, North Shewa, Ethiopia.

Conceptual and Empirical Literature

Concepts and Measures of Poverty

The capability approach, proposed by Sen, indicates that the economic status of a person goes beyond the availability of commodities (Sen, 1987). Sen's analysis of poverty focuses on the "capability" of the individual to function in society. In view of this, as the World Bank (2005) also argues, the poor lack key capabilities, and may have inadequate income or education, or be in poor health, or feel powerless or insecure, or lack political freedoms like freedom of speech (World Bank, 2005). Poverty is not, therefore, just a mere absence or scarcity of income or low consumption.

Being guided by the various conceptualizations of poverty, different measurements have been used for quite some time now. The Foster Greer Thorbeck (1984) method is one of the most widely used poverty measures with important desirable properties. It is unidimensional poverty measurement where the identification of poor household is accomplished only by comparing individual achievements with the inability to attain an income or consumption level considered to be minimal to lead a normal life.

The measurement of poverty via a multidimensional approach is more likely to indicate long term poverty, whereby variables like literacy and asset ownership are much more reasonable ways of poverty assessment (Hulme and Shepherd, 2003).

Bourguignon and Chakravarty (2003) define poverty as a situation when an individual's achievements fall short of specific dimensional cut-offs. Therefore, by looking at achievements across dimensions, it is possible to arrive at complete specification of an identification method. There are two identification criteria;

namely, the union and the intersection approach. According to the union approach, a person is deemed to be multi-dimensionally poor if there is at least one dimension in which the person is deprived of. Conversely, under the intersection approach, an individual or household is said to be poor if there is deprivation in all dimensions. However, these approaches have been criticized in the following grounds. In the former case, when the number of dimensions is large, most of the population will be considered as being poor. The weakness of the latter approach lies on the fact that it misses people who are experiencing extensive, but not universal deprivations (Alkire and Foster, 2011).

A more practical and plausible approach is provided by OPHI (2010). Developed by Alkire and Foster, it defines poverty as a multidimensional phenomenon using Multidimensional Poverty Index (MPI). Based on this definition, the poor are those people who are deprived of access to education, health and asset ownership. The three dimensions of deprivation, namely; education, health and standard of living are measured using ten indicators (Alkire and Santos, 2010; Alkire and Foster, 2011).

The Multidimensional Poverty Index (MPI) is perhaps the most recent method of poverty measurement, which is a composite measure that aggregates several deprivations of a household or an individual into a single index. The practical procedure is that, first; deprivation of a household or an individual in any particular dimension is determined by comparing the achievement in that dimension against the respective dimension specific poverty line. Then, the number of deprivations will be compared against a multidimensional deprivation cut-off point (Yalonetzky, 2011; Alkire and Foster, 2011).

For instance, years of schooling and child enrolment constitute the education dimension. A household is, therefore, said to be deprived of education if no household member has completed five years of schooling or if any school-aged child is not attending school in years one to eight. Each indicator is weighted equally at 1/6 (Alkire and Santos, 2010).Similarly, a household is said to be deprived of health if any child has died in the family or if any adult or child is malnourished[1]. Each indicator is weighted equally at 1/6. In the same vein, living standard deprivation consists of electricity, drinking water, sanitation, flooring, cooking fuel and asset. If a household has no electricity, if it does not have access to clean drinking water or if clean water is more than 30 minutes walk from home, then the household is said to be deprived in these indicators. Further, a household is deprived if it does not have an improved toilet or if their toilet is shared, if the floor is made of dirt, sand or dung. Also, a household is deprived if it uses wood, charcoal or dung for cooking purposes. Furthermore, a household is considered to be deprived if it does not own more than one of: radio, TV, telephone, bike, or motorbike, and do not own a car or tractor (Alkire and Santos, 2010).

Following the theoretical work of Alkire and Santos (2010), we denote $y = \lfloor y_{ij} \rfloor$ to represent the n x d matrix of achievements for individual i across j dimensions. The achievement matrix $y_{ij} \geq 0$ denote person i's achievement in dimension j. The row vector $y_i=(y_{i1}, y_{i2}, \ldots\ldots y_{id})$ gives individual i's achievements in different dimensions, whereas the column vector $y_j=(y_{1j}, y_{2j}, \ldots\ldots y_{nj})$ denotes the distribution of achievements in dimension j across individuals. Based on the weight specified in Alkire and Santos (2010) for each dimensions, the dimensional weight sum is calculated. That is: $\sum_{j=1}^{d} w_j = d$ Then a two-step poverty cutoff points is used.

Let z_j>0 and $g^o = \lfloor g^o{}_{ij} \rfloor$ be the vector of deprivation cutoffs for each of the dimension and matrix of deprivation, respectively. g^o is defined by $g^o = w_j$ when

1 *We calculated the daily per adult equivalent caloric intake for each household to determine the nutrition status of each household. Accordingly, household whose daily caloric intake falls short of 2,200Kcal is considered as malnourished/deprived of nutrition indicator.*

$y_{ij}<z_j$ and $g^o=0$ when $y_{ij}>z_j$. This is equivalent to say that, the ij th entry of the matrix is equal to the dimensional weight w_j when individual i is deprived in dimension j, and is zero when the individual is not deprived. Then, a column vector c of deprivation count is constructed from the matrix of g^o. That is: $C_i = \sum g^o{}_{ij}$ which represent the sum of weighted deprivation suffered by person i. An individual is deemed to be poor if its weighted deprivation count C_i is greater than or equal to the poverty cutoff k>0. Finally, the vector of poverty status of a household is determined. It takes the value of 1 when $C_i>k$, and 0 when $C_i<k$.

In unidimensional analysis, identification of poor household is accomplished by the use of a poverty line or threshold. However, in the multidimensional measurement setting, where there are multiple variables, identification is a substantially more challenging exercise (Alkire and Foster, 2011).

OPHI (2010) stated that a household is identified as multidimensionally poor if and only if it is deprived in some combination of indicators whose weighted sum exceeds 30 percent of all deprivations.

There are three types of multidimensional poverty measurement indices. These are incidence of poverty (H), Average intensity of deprivation (A) and Multidimensional poverty index (MPI) (See Alkire and Santos, 2010 for details). The first poverty aggregation is head count index (H).

$$H = q/n \tag{1}$$

Where, H= Multidimensional headcount index, q= total number of multidimensional poor household, and n=total number of household.

Multidimensional headcount index (H) measures the percentage of the population that is multidimensionally poor. However, multidimensional headcount index violates the crucial poverty measurement properties of dimensional monotonocity and sub group consistency condition[2].

Average Intensity of Deprivation (A) is calculated as follows:

$$A = \sum_{i=1}^{n} \frac{C_i(_k)}{dq} \tag{2}$$

Where, A= intensity of multidimensional poverty, C_i(k)=number of deprivation for person i, and

d= total number of dimensions.

It indicates the average deprivation share experienced by poor individuals. We calculated the deprivation share for each poor person dividing the deprivation count by d, and then average the value across all poor persons.

The third poverty aggregation is Multidimensional Poverty Index (MPI). It is computed as:

$$MPI = H.A \tag{3}$$

MPI summarizes information on the incidence of poverty and its intensity and hence it is alternatively called the Adjusted Headcount Ratio. This measure of poverty satisfies both dimensional monotonicity and sub group decomposability. This property is a very important advantage over the multidimensional headcount index (Alkire and Santos, 2010).

2 Dimensional monotonicity is a condition that indicates if a poor person is deprived in additional dimension, then the overall poverty should increase and sub-group consistency states that the measure must be dis-aggregated to show how much each dimension contributes to poverty.

In spite of the recent popularity of the MPI measurement, it is subject to different criticism. Ravallion (2010) as cited in Lustig (2011) presents his main criticisms to aggregating multiple deprivations into a composite index. These are:

- The aggregate index will be insufficient to guide policy action if the policy interest is on specific deprivation. For instance, if a policymaker wants to address income or services deprivation and different geographic areas reveal different degrees of deprivation, then MPI could be problematic or misleading.

- The MPI's six "living standard" indicators are likely to be correlated with consumption or income, but they are unlikely to be very responsive to economic fluctuation. Thus, it may not describe the true status of the household during economic fluctuations (such as the global financial crisis or during rapid upswings in macro-economic performance) as opposed to the conventional poverty measurement.

- The index essentially adds up different dimensions of poverty without knowing their relative prices. The consumption based poverty analysis on the other hand measures the weights of the deprivation based on the market prices.

- Poor people are extremely concerned about vulnerability to shocks, violence, discrimination and isolation. However, none of which are revealed in the MPI measurement.

- Given such limitations, however, MPI is the most appropriate method in helping figure out the multidimensional nature of poverty.

Empirical Literature

A number of researches were conducted using different methodologies, scope (urban/rural, national/regional analysis) and objectives. For instance, Omonona (2010) analysed the recent poverty situation in Nigeria using fixed effects regression model. The study found that the national poverty headcount, depth and severity index are 0.55, 0.22 and 0.12, respectively. Poverty was more rampant in rural areas than urban centres. This finding corroborates with that of several other research works (Tesfaye and Debebe, 2001; Bigsten *et al.*, 2002; MoFED, 2002; Assefa and Frehiwot, 2003; Asmamaw, 2004; Ayalneh et.al, 2005).

A number of research works have also been done on poverty in Ethiopia employing income/consumption based analysis. For instance, Dercon and Krishinan, (1996), Bigsten *et al.*, 2002 Esubalew, (2006), Getachew, (2011), Ayalneh et.al, (2005) and Tesfayie, (2006) undertook a study in different parts of Ethiopia. They pointed out that education, sex, income, and family size are the most responsible factors for poverty disparity in the society. Most of their works are indeed similar except for the study areas and differences in data. They used similar methodology and arrived at similar results.

Alemi and Dereje, (2014) examined the vulnerability to poverty of female headed households using the Ethiopian Rural Household Survey. They found out that Female Headed Households are more vulnerable to poverty than Male Headed Households.

Zewdu *et.al* (2014) analyzed the dynamics of growth in agricultural productivity on the dynamics of household poverty using panel data across rural Ethiopia covering 15 villages. Their finding suggests that increasing the technical efficiency of farmers is very helpful in reducing poverty of the sample households.

Alemayehu *et.al* (2015) examined multidimensional poverty in Ethiopia focusing on selected dimensions of education, health, culture and living standards using the 2000, 2005 and 2011 Household Consumption and Expenditure and Welfare Monitoring surveys. They found out that the multiple deprivations experienced by many poor Ethiopians are getting lower over the past decades.

Bruck and Sindu, (2013) analysed poverty dynamics and its determinants in rural Ethiopia using consumption expenditure and multidimensional poverty indices. They found that both measures of poverty give similar result and confirm poverty is mainly transient in rural Ethiopia. Finally, the paper concludes that understanding the nature of poverty and/or deprivations using both consumption and MPI is important to targeting specific deprivations via policy interventions.

Previous research works on poverty in Ethiopia relied largely on income/consumption based analysis where they predominantly utilized the Food Energy Intake method (FEI) and the Cost of Basic needs (CBN) approach. The poverty status of an individual under such analysis is determined based on his/her income/consumption achievement only (Mekonen, 2002; Dercon and Tadesse, 1999; Islam and Abebe, 2005; Tesfayie, (2006); Getachew, 2011). However, such analysis may potentially ignore the multiple dimensions of poverty.

To this end, this study will employ the multidimensional approach which is totally different from the conventional income/consumption based analysis. The utilization of MPI measurement has got the following basic merits (Alkire and Santos, 2010).

- The new innovative index goes beyond a traditional focus on income to reflect the multiple deprivations that a poor person faces with respect to education, health and living standard. The MPI looks at poverty through a 'high-resolution' lens. Thus, it is a pragmatic approach in the sense that the index is very close to the real ground. For example, according to UNDP (2010), 90% of the Ethiopian populations are MPI poor while only 39% of the populations are classified as living in extreme poverty under income terms alone.

- MPI provides information that can help to inform better policies to reduce acute poverty.
- It is a composite measure of poverty where it employs eight of the ten indicators that are directly linked to MDGs and several of the SDGs. Thus, progress towards achieving the SDGs by Ethiopians (particularly by rural population) can be easily estimated to better inform policy uptake in the country.
- It is possible to obtain internationally comparable result without any manipulation.

Data and Methods

We undertook the study in Kewet district, North Shewa. We employed both stratified and systematic random sampling techniques. Samples were drawn from three agro-ecological zones: lowland *(Kola),* mid-altitude *(Woina Dega)* and highland *(Dega)* that account for 44, 33 and 23 percent of the district, respectively.

A primary data was collected from a total of 245 households and surveyed trough questionnaire. To analyze the data we used both descriptive statistics and econometric techniques.

In this paper, we calculated poverty following the conceptual framework of Alkire and Santos, (2010) discussed in section 2.1 and used similar dimensions and indicators fitted to the peculiarities of the study area. Moreover, the household was chosen as the unit of analysis for our poverty assessment.

The logit model

This model is appropriate when we assume the random components of response variables follow binomial distribution and when variables have categorical responses. The endogenous variable is a dichotomous or dummy variable with (1) representing poor household and (0) non poor household. It is assumed that the probability of being in a particular poverty category is determined by an underlying response variable that captures the true economic status of a household (Madala, 1983).

So, the dependent variable is a dichotomous variable with (1) representing MPI poor households and (0) MPI non-poor households.

Let p_i denote the probability that the i-th household is above the deprivation cut-off. We assume that p_i is a Bernouli variable and its distribution depends on the vector of predictors X, so that:

$$p_i(X) = \frac{e^{\alpha+\beta x}}{1+e^{\alpha+\beta x}} \tag{5}$$

Where, β is a row vector and α a scalar. The logit function to be estimated is then written as:

$$\ln\frac{p_i}{1+p_i} = \alpha + \sum_{i}^{j} \beta_i X_{ij} \tag{6}$$

The logit variable $\ln\frac{p_i}{1+p_i}$ is the natural log of the odds of the households falling into multidimensional poverty. Equation (6) is estimated by maximum likelihood method.

The explanatory variables included in this model are described in Table 1:

Table 1: List of explanatory and dependent variables

Variables	Assumption
Dependent variable	
Multidimensional rural poverty(MPI)	1 if poor, 0 otherwise
Explanatory variables	
Sex of the head of the household (sex)	1 for female, 0 otherwise
Age of the head of the household (age)	Age in years
Household size (hhs)	Continuous variable
Marital status (marital2)	1 if married, 0 otherwise
Dependency ratio (depratio)	Continuous variable
Size of land (land)	Continuous variable
Oxen ownership of the household (oxen)	Continuous variable
Education level of the head of the household (edu)	Continuous variable
Number of working days (workdy)	Continuous variable
Land productivity (lanprod)	Continuous variable
Habit of saving (saving)	1 if the household has no saving habit 0 otherwise
Access to market (market)	Continuous variable (measured in time)
Agricultural extension service (agrexten)	1 if not adopt agricultural extension service 0 otherwise
Utilization of agricultural irrigation scheme (irrig)	1 if without irrigation scheme, 0 otherwise
Health status of the head of the household (health)	1 if frequently sick, 0 otherwise
Per adult equivalent income (pinc)	Continuous variable
Type of resident house (house)	1 if corrugated iron, 0 otherwise
Agro-ecological zone difference (agro)	1 if Dega 3 if kolla 2 if Woinadega

Results and Discussion

Identifying the multidimensional poor

Table 2 indicates the total deprivation rate for the study area. Overall deprivation rates are the highest for cooking fuel, where all sample households make use of wood, charcoal or dung for cooking purposes. Albeit 39.18 percent of the sample households have access to electricity, none of them use electric power for cocking purposes. In the study area, 54 and 51 percent of the sample households have not completed at least five years of schooling and have no access to clean water, respectively. The figure is relatively better for health and child enrolment. Less than 30 percent of sample households are deprived in child mortality and nutrition, while 27.76 percent of school aged children have not attended school in years one to eight.

Table 2: Incidence of deprivation in the study area[3]

Dimensions	Indicators	Deprived		Not deprived	
		Frequency	Percentage	Frequency	Percentage
Education	Years of schooling	133	54.29%	112	45.71%
	Child enrolment	68	27.76%	177	7.24%
Health	Child mortality	64	26.12%	181	73.88%
	Nutrition	61	24.90%	184	75.10%
Standard of living	Electricity	149	60.82%	96	39.18%
	Drinking water	126	51.43%	119	48.57%
	Sanitation	95	38.78%	150	61.22%
	Flooring	222	90.61%	23	9.39%
	Cooking fuel	245	100%	0	0%
	Assets	183	74.69%	62	25.1%

Source: Computed from household survey, 2012.

3 *The standard for households to be considered deprived in each indicator is given in Alkire and Santos, 2010.*

As evident in Table 3, 99.59 percent of households are deprived of more than one indicator. Results indicate that 4.90 percent households suffer from three deprivations; nearly 27 percent are deprived in six dimensions, 3.27 percent from nine deprivations, and 0.41 percent from all deprivations. This suggests that a one-dimensional approach does not help much in assessing poverty.

Table 3: Joint distribution of deprivations

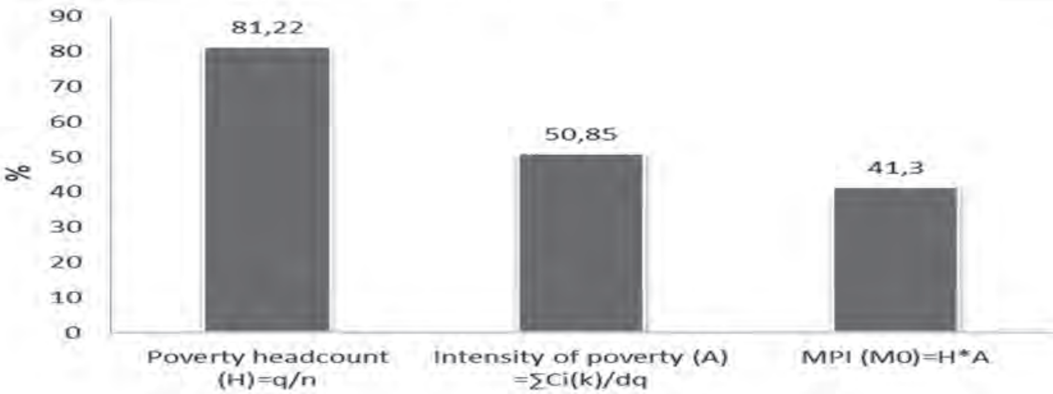
Total deprivation index	Frequency	Percent	Cum. percentage
2	4	1.63%	1.63%
3	12	4.90%	6.53%
4	45	18.37%	24.90%
5	65	26.53%	51.43%
6	66	26.94%	78.37%
7	33	13.47%	91.84%
8	11	4.49%	96.33%
9	8	3.27%	99.59%
10	1	0.41%	100%

Source: Computed from household survey, 2012

Multidimensional poverty measures

Figure 1 portrays that 81.22 percent of the sample households are MPI poor. On average, the MPI poor suffer from deprivation in 50.85 percent of the indicators. Similarly, the adjusted headcount ratio (M_0) for the study area is 0.41. The above mentioned two values are lower than the national average of 64.7 percent and 0.58 respectively (UNDP, 2010).

Figure 1: Multidimensional poverty measures



Source: Computed from own survey, 2012.

Table 4 shows that schooling/educational deprivation contributes the highest share to MPI poverty (21.8%) followed by deprivation in child enrolment (11.3%), cocking fuel (10.9%), and child mortality (10.5%). Sanitation deprivation makes up the lowest contribution to MPI in the study area. In sum, deprivation in education, health and living standard contribute to 33.1 percent, 20.5 percent and 46.4 percent to total MPI poverty in the study area, respectively.

Table 4: Dimensional decomposition of MPI

Deprivation values	Living standard						Education		Health		Over all
	Ass[a]	Ele[b]	San[c]	Fl[d]	Wa[f]	cok[g]	Yea[h]	Chil[i]	Nut[j]	Cmo[k]	
Censored head count	0.63	0.49	0.34	0.74	0.43	0.81	0.54	0.27	0.25	0.261	0.413
Contribution	8.5%	6.6%	4.6%	10%	5.8%	10.9%	21.8%	11.3%	10%	10.5%	100%

Where, [a] represent Asset, [b] Electricity, [c] Sanitation, [d] floor, [f] water, [g] cocking fuel, [h] years of education, [i] child enrolment,[j] nutrition and [k] child mortality.

Source: Computed from household survey, 2012.

A comparison of regional and national estimates is described in Table 5. The result reveals that most households are highly deprived in cooking fuel (81% for the study area and 89.6% for the national). Conversely, the lowest deprivation rate comes from nutrition (25% for the study area and 20% for the national). It is also found that the regional deprivation values for MPI poor households are considerably lower than that of the national estimates. This further explains the fact that the study area is doing well in terms of the indicators mentioned earlier.

Table 5: Comparison of regional and national deprivation percentage of MPI households

Indicators	Regional deprivation	National deprivation
Years of schooling	54%	61%
Child enrollment	27%	64.9%
Child mortality	26%	38%
Nutrition	25%	20.9%
Electricity	49%	85.7%
Drinking water	43%	54%
Sanitation	34%	87.6%
Floor	74%	87.5%
Cooking fuel	81%	89.6%
Assets	63%	88.7%
Mean deprivation percentage	47.6%	67.8%

Source: OPHI, 2010 and household survey, 2012.

Table 6 compares the dimensional decomposition of MPI poverty for national and regional estimates. Accordingly, the highest contributors to total MPI poverty are years of schooling and child enrolment deprivation in both the study area and the country as a whole. Drinking water deprivation makes up the lowest contribution to MPI poverty in the country. The message here is that achieving universal education for all should be the prime agenda of any stakeholder both in the country and the study area to minimize the proportion of MPI poverty.

Table 6: Dimensional decomposition of MPI poverty for national and regional estimates

Indicators	Regional contribution	National contribution
Years of schooling	21.8%	17.6%
Child enrollment	11.3%	18.6%
Child mortality	10.5%	10.8%
Nutrition	10%	6%
Electricity	6.6%	8%
Drinking water	5.8%	5.2%
Sanitation	4.6%	8.4%
Floor	10%	8.4%
Cooking fuel	10.9	8.5%
Assets	8.5%	8.5%

Source: OPHI, 2010 and household survey, 2012.

Econometric specifications and results

Before we ran regression analysis, we tested for the validity of the assumptions imposed on the models. We then checked for the existence of multicollinearity among the variables using correlation matrix[3] and Variance Inflation Factor (VIF). VIF for market, distance from a health center, working day, age and age square is greater than 10. As a result, we dropped market, distance from a health center, working day[4] (see annex 2, 3 and 4 for details). More importantly, we used

3 The result showed that there is a problem of multicollinearity between two variables (distance from a health center and market distance with a coefficient of 0.9235) and (age and age squared with a correlation coefficient of 0.98).

4 Moreover, before the variables were dropped the mean value of VIF was 15.72 while after dropping them it becomes 4.29.

the Stata command robust option to deal with the problem of heteroskedasticity. We also tested for the existence of omitted variables/specification errors using the linktest option and found no specification problem (see annex 5). The constructed classification table shows that the model correctly predicted 91.87 percent of poor households as poor and 80.56 percent of non-poor households as non-poor. Overall, the model predicted 90.2 percent of the 245 valid cases[5]. Hence, the model fits the data well. Furthermore, the chi square statistic of the Likelihood Ratio shows that the overall model is a good fit at 1 percent level of significance.

Table 7: Logistic estimates for MPI model

Log pseudolikelihood=-55.98		Number of obs=245 Wald chi2(18)=54.07 Prob>ch2=0000 Pseudo R2=0.526		
Explanatory variables	Coefficient	St.error	Z	P>|Z|
Sex-I	4.208	0.929	4.53	0.000
Age of the head	0.33	0.123	2.71	0.007
Age2	-0.003	0.001	-2.77	0.006
Household size	-0.146	0.216	-0.68	0.5
Marital status-0	-1.65	0.758	-2.18	0.029
Dependency ratio	3.01	1.361	2.22	0.027
Per capita income	0.005	0.002	2.38	0.017
Land size	-0.742	0.998	-0.74	0.457
No of oxen	-1.102	0.255	-4.32	0.000
Education level of the head	-0.260	0.086	-3.01	0.003
Land productivity	-0.00005	0.00025	-2.11	0.035
Saving status of the household	0.190	0.581	0.33	0.743
Agricultural extension service	0.958	0.749	1.28	0.201
Type of house-I	-2.12	0.750	-2.84	0.005
Irrigation scheme	-0.310	0.628	-0.49	0.622

5 See annex 6.

Health status of the head-I	1.084	0.558	1.94	0.052
(Mid-altitude) Woina dega	-1..968	0.960	-2.05	0.040
Low land (Kolla)	2.006	0.859	-2.34	0.020
Constant	-4.405	3.392	-1.30	0.194

Source: Computed from household survey, 2012.

Results in Table 7 show that the coefficients for sex and age of the household head, marital status of household head, dependency ratio, income per adult equivalent, oxen ownership, education level of household head, productivity of land, type of resident house and health status of the head of the household are statistically significant at 1, 5 or 10 per cent level.

The interpretation of the results is based on the odds and odds ratio[6] of the explanatory variables. The estimate of the odds ratio is given in Table 8. The coefficient for sex of the household head is positive and significantly different from zero at 1 percent level of significance. The odds ratio for *Sex1*[7] is ($Exp^{(B)}$ = 67.25). This attests that female headed households in the study area are found to be 67.25 times more likely to be multi-dimensionally poor than male-headed households.

Age of the household head also shows statistically significant result (at 1%), implying that the probability of falling into multidimensional poverty increases with the age of the household head but decreases at a very low and high levels (as it is indicated by the negative coefficient for its square).[8] Hence, as the age

[6] The ratio of the response probability (being poor) to the non-response probability (being-non poor) is called the odds ratio. It indicates the probability of households being poor. Odds ratio= $\frac{pi}{1-pi} = e^{Xi\beta}$

[7] sex-I indicate female household head

[8] age2 is significant at 1% level of significance

of the household head increases by a unit, the odds and odds ratio increase by a factor of 0.33 and 1.39 respectively, keeping other variables constant. This result is inconsistent with *apriori* expectation.

Results further show that single household heads (*marital status-0*)[9] have lower probability of falling into multidimensional poverty as compared to married households. The odds and odds ratio of being poor for single households decrease by a factor of 1.654 and 0.1922 respectively, ceteris paribus. In other words, married households are 5.23 times more likely to fall into multidimensional poverty trap as compared to single households. This result is consistent with *apriori* expectation.

Tables 7 and 8 indicate that as dependency ratio[10] increases by a unit, the odds and odds ratio increase by a factor of 3.02 and 20.46, respectively, ceteris paribus. It is significant at 5 percent level signifying the existence of positive relationship between dependency ratio and multidimensional poverty.

Table 8: Estimates of odds ratio for MPI model

Log pseudolikelihood=-55.98		Number of obs=245 Wald chi2(18)=54.07 Prob>ch2=0000 Pseudo R2=0.526		
Explanatory variables	Coefficient	St.error	Z	P>|Z|
Sex-I	67.25	62.545	4.53	0.000
Age of the head	1.396	0.172	2.71	0.007

[9] Single household head includes widowed, separated and divorced households.

[10] It is defined as the ratio of children under 15 and aged (>60) to the total household size

Age2	0.996	0.001	-2.77	0.006
Household size	0.864	0.186	-0.68	0.5
Marital status-0	0.191	0.145	-2.18	0.029
Dependency ratio	20.461	27.868	2.22	0.027
Per capita income	1.005	0.002	2.38	0.017
Land size	0.476	0.475	-0.74	0.457
No of oxen	0.331	0.084	-4.32	0.000
Education level of the head	0.770	0.066	-3.01	0.003
Land productivity	0.999	0.00002	-2.11	0.035
Saving status of the household	1.209	0.703	0.33	0.743
Agricultural extension service	2.608	1.954	1.28	0.201
Type of house-I	0.118	0.089	-2.84	0.005
Irrigation scheme	0.733	0.461	-0.49	0.622
Health status of the head-I	2.956	1.652	1.94	0.052
(Mid-altitude) Woina dega	0.139	0.134	-2.05	0.040
Low land (Kolla)	0.134	0.115	-2.34	0.020

Source: Computed from household survey, 2012.

Contrary to *apriori* expectation, we found per adult equivalent income/per capita income of households to be positively correlated with multidimensional poverty (Sig. level at 5%). Hence, when per adult equivalent income of the household increases by a unit, the odds and odds ratio increases by a factor of 0.01 and 1.01 respectively, keeping other factors constant. This implies that it is not a matter of having more income that determines multidimensional poverty but whether households spend it for health, education and other important services, which is a matter of availability, access and awareness. Besides, if people have no access to health, education, clean water e.t.c, it would mean that income has no substantial role in reducing multidimensional poverty. Most high income households reside in areas where basic goods and services (like clean water and electricity) are missing. Thus, deprivation across this subgroup of the study area might be higher in terms of education, health and living standard than the low and middle income households.

Findings also reveal that as ownership of oxen increases by a unit, the odds and odds ratio decreases by a factor of 1.10 and 0.33 respectively, ceteris paribus. In other words, households who own oxen were 3.01 times more likely to escape multidimensional poverty.

As expected, our results indicate that educational attainment of the head of a household has a paramount importance in reducing multidimensional poverty in the study area (sig. level 1%). Educated households are 1.29 times more likely to escape multidimensional poverty. Moreover, an additional year of education decreases the odds and odds ratio by a factor of 0.26 and 0.77 respectively, other things being equal. Education is expected to lead to increased earning potential thereby improve the living standard of households by raising their consciousness.

The coefficient for land productivity[11] was found to be negative and statistically significant at 5 percent. Ceteris paribus, an additional increase of productivity of land by one unit (one birr per hectare) decreases the odds and odds ratio by a factor of 0.0005 and 0.99, respectively.

Consistent with *apriori* expectation, households that reside in thatched roof houses[12] have a higher probability of falling into multidimensional poverty than those who live in corrugated iron roof houses. The magnitude is such that

[11] It was defined as the ratio of the total monetary values of agricultural crop production to the total land size in hectare.

[12] The reference category is thatched roof house.

households in the former category were 8.41 times more likely to be multi-dimensionally poor as compared to the latter category.

The coefficient for health status of the head of the household was positive and significant at 10 percent level. We found that household heads who experience frequent illness (*health status of the head-I*) were 2.96 times more likely to be multidimensionally poor as compared to healthy heads. This is mainly due to the fact that health problem retards people's physical and mental productivity as well as siphons resources away from production for medication purposes.

The probability of falling into poverty is higher for highland (*Dega)* residents than mid altitude (*Woina Dega)* and low land (*kola)* residents. Households who reside in highland (*Dega)* agro-ecological zone are about 7.16 times and 7.43 times more likely to fall into multidimensional poverty trap than households residing in mid altitude and low altitudes, respectively.

A more appealing interpretation of parameter estimates in the logit model can be explained through marginal effect of each exogenous variable.[13] The result suggests that an increase in the age of the head of the household by a unit, all other variables held at their mean values, increases the probability of a household to be multi-dimensionally poor by about 0.71 percent. On the other hand, promoting the household head by one level of education reduces the risk of multidimensional poverty by nearly 0.56 percent. Similarly, additional ownership of ox reduces the probabilities of multidimensional poverty by 2.3 percent. Furthermore, as the dependency ratio increases by a unit, the probability

13 The marginal effect of each independent variable is given in annex 7.

Conclusions and implications for policy

In this article, an attempt has been made to analyse poverty based on the Alkire Foster method of multidimensional poverty measure. Findings of this study show that overall deprivation rates are the highest for cooking fuel followed by deprivation of floor, asset and electricity. This signifies that interventions that help raise the living standard of the community have a great deal in reducing multiple deprivations and the proportion of MPI poor households.

The multidimensional poverty incidence of the study area is found to be very high though it is less than the national average. The Alkire Foster MPI measurement indicates that educational deprivation has deep-rooted and substantial impact on MPI poverty in the study area more than any of the ten indicators. Educational attainment of the head of the household is also found to be negatively correlated to multidimensional poverty. This implies that intervention to expand the coverage of education service for both children and adults has a paramount importance in alleviating multidimensional poverty at household level.

Equally importantly, health care policies should give due emphasis to maternal and children health to reduce child mortality. Besides, the fact that income has a positive sign would mean that it is not a matter of having more income that determines multidimensional poverty but whether households spend it for health, education and other important services. Female headed households in the study area are found to be 67.25 times more likely to be multidimensionally poor as compared to male household heads. This result indicates that female headed households are suffering a lot more in terms of education, health and living standard deprivation than male headed households. Therefore, promoting female education and family planning should be important elements of multidimensional poverty reduction policies. This is because female education and fertility are negatively correlated; such a policy could also have an impact on married households in improving their life style and empower them. Based on the logistic estimates, oxen ownership, land productivity and health status are among the most important household characteristics that determine multidimensional poverty. Thus, in addition to helping households enhance their assets ownership, ways should be devised to boost up land productivity through the use of and better targeted modern agricultural inputs like fertilizer and high yielding varieties.

References

Alkire, S. and Foster, J. (2011). *Understandings and Misunderstandings of Multidimensional Poverty Measurement*. Oxford Poverty and Human Development Initiative (OPHI) working paper series No.43.

Alkire, S. And J.Foster (2011). Counting and multidimensional poverty measurement. *Journal of public economics,* 95(7-8): 476-487

Alkire, S. and Santos, M. (2010). *Acute Multidimensional Poverty: A New Index for Developing Countries*. Oxford Poverty and Human Development Initiative (OPHI) working paper series No.38.

(2010). *Multidimensional Poverty Index*. Oxford Poverty and Human Development Initiative (OPHI). Research brief, Uk.

Alemayehu A., Mehta B. and Biratu Y. (2015). Multidimensional Poverty in Ethiopia: Changes in Overlapping Deprivations. Policy Research Working Paper 7417, Poverty Global Practice, World Bank Group.

Alemi N. and Dereje F. (2014). Determinants of Vulnerability to Poverty in Female Headed Households in Rural Ethiopia. Global Journal of HUMAN-SOCIAL SCIENCE: Volume 14 Issue 5 Version 1.0

Asmamaw E. (2004). *Understanding Poverty: The Ethiopian Context*. A Paper presented at The Gambia AAPAM Roundtable Conference, Banjul, the Gambia, April 19 - 23, 2004. Addis Ababa.

Assefa B. and Frehiwot Y. (2003). *Ageing and Poverty*, Regional Workshop, Dareselam, Tanzania.

Ayalneh B., Hagedorn K. and Korf B. (2005). Determinants of poverty in rural Ethiopia. *Quarterly Journal of International Agriculture*, Vol. 44, No. 2: 101-120.

Begna, B and Paul, I. (2010). An Assessment of Rural Poverty: The Case of Selected Kebeles of Shashemane Woreda, Ethiopia. *Journal of Sustainable Development in Africa*, Volume 12, No.4.

Bigsten, A., Bereket K., Abebe S. and Mekonnen T. (2002). *Growth and Poverty Reduction in Ethiopia: Evidence from Household Panel Surveys*. Working Papers in Economics, No. 65, 2002.

Bigsten, A. and Abebe, S. (2003). *The Dynamics of Poverty in Ethiopia*. A Paper Prepared for a WIDER Conference on Inequality, Poverty and Human Well-being. May 30-31, 2003, Gothenburg, Sweden.

Bourguignon, F. and S.R Chakravarty (2003). The measurement of Multidimesional poverty. *Journal of Economic Inequality,* 1, 25-49.

Bruck ,T. and Sindu W. (2013). Dynamics and Diverse of Consumption and Multidimensional Poverty: Evidenc from Ethiopia. Discussion paper, German Institute for Economic Research.

Dercon, S. and Krishnan, P. (1996). *A Consumption-Based Measure of Poverty for Rural Ethiopia in 1989 and 1994*. In Bereket K. and Mokonen T. (Eds.). The Ethiopian Economy: Poverty and Poverty Alleviation. Proceedings of the Fifth Annual Conference on the Ethiopian Economy. Addis Ababa.

Dercon S. and Krishnan P. (2000). Vulnerability, seasonality and poverty in Ethiopia. The Journal of Development Studies, 36:6, 25-53.

Esubalew, A. (2006). *Determinants of urban poverty in Debre Markos, Ethiopia: a household level analysis*. Msc thesis, Addis Ababa University, Ethiopia.

Foster, J., Greer E. and Thorbecke. (1984). *A class of decomposable poverty measures: Measurement, Robustness tests and decomposition*: working paper, center for the study of Africa economies, universitity of oxford.

Getachew, J. (2011). *Determinants of household poverty: the case of Gondar city in Ethiopia*. Proceedings of the 8th international conference on the Ethiopian economy, EEA.

Hulme, D. And A. Shepherd (2003). Conceptualizing chronic poverty. *World Development*, 31(3), 403-423

IFAD. (2001). Rural poverty report: The challenge of ending rural poverty. International Fund for Agricultural Development (IFAD). Oxford University Press, New York, USA.

IFAD (2010). Rural poverty report: New realities, new challenges: New opportunities for tomorrow's generation. Rome, Italy: International Fund for Agricultural Development (IFAD).

Maddala, G.S. (1983). *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge: Cambridge University Press.

Mekonen, (2002). *Determinants and Dynamics of Urban poverty in Ethiopia*. EEA Journal of Econmocs, V.8, No.1: 61-82.

MoFED, (2002). *Poverty profile of Ethiopia: Analysis based on the 1999/00 HICE & WM Survey Results*, Addis Ababa.

(2010). *Growth and Transformation Plan of Ethiopia, 2010/11-2014/15*, Addis Ababa.

(2012). *Ethiopia's Progress towards eradicating poverty: An Interim Report on Poverty Analysis Study (2010/11)*, Addis Ababa.

Omonona, B. (2010). *Quantitative Analysis of Rural poverty in Nigeria*. Nigerian Strategy Support programme. International food policy research institute, Brief No 17.

OPHI, (2010). *Multidimesional Poverty Index*. Research Brief, University of Oxford.

________(2010). *Multidimensional Poverty Index (MPI) At a Glance*. Country Briefing: Ethiopia

Ray, D. (1998). *Development Economics*. New York, oxford university press.

Sen, Amartya K. (1987). *The Standard of Living: The Tanner Lectures*, Cambridge: Cambridge University Press.

Tesfaye, A. (2006). *The Analysis of Urban Poverty in Ethiopia*. The University of Sydney, Australia.

Tesfaye, A. and Debebe (2001). *Eradicating Poverty and Food Insecurity in Ethiopia: the quest for sustainable Institution and technologies*. Ethiopian social Rehabilitation and Development fund, Addis Ababa.

UNDP (2010). *The Real Wealth of Nation*. Human development report. New York, U.S.A

World Bank Institute (2005). *Introduction to poverty analysis*. The World Bank, Washington D.C.

World Bank (2008). World development report: Agriculture for development. Washington, DC: The World Bank.

Yalonetzky, G. (2011). *Conditions for the Most Robust Poverty Comparisons Using the Alkire-Foster Family of Measures*. Oxford Poverty and Human Development Initiative (OPHI) Working paper series No. 44.

Zewdu A., Bamlaku A. and Munir A. Hanjra (2014). Policies for Agricultural Productivity Growth and Poverty Reduction in Rural Ethiopia. *World Development Vol. 59, pp. 461–474, 2014*

Annexes

Annex 1: Sample size by agro-ecological zone and rural Kebeles:

Name of the Kebele	Agro-ecological zone	Sample size
Abayieatir	Kolla	1130/9536*245= 29
Sefiberet		2026/9536*245= 52
Medina		473/9536*245= 12
Debirina Jegoal		573/9536*245= 15
Total		=108
Yelen	Woina Dega	1507/9536*245= 39
Terrie		1672/9536*245=43
Total		=82
Birbirana Geligelo	Dega	904/9536*245=23
Mengist		655/9536*245=17
Ayaber		596/9536*245=15
Total		=55
Total sample size		245

Annex 2: Zero order correlation matrix

	sex	age	marital	educat~n	hhs	land	oxen	extens	workdy	irrig	saving	market	health
sex	1.0000												
age	0.0187	1.0000											
marital	0.6023	0.0290	1.0000										
education	-0.1812	-0.1973	-0.1791	1.0000									
hhs	-0.3269	0.1042	-0.3916	0.1491	1.0000								
land	-0.2054	0.1570	-0.1786	0.0603	0.3408	1.0000							
oxen	-0.3358	-0.0108	-0.3375	0.1587	0.3770	0.2110	1.0000						
extens	0.3280	-0.0939	0.3629	-0.0776	-0.4040	-0.2681	-0.2670	1.0000					
workdy	-0.0422	-0.0250	-0.0580	0.1292	0.0453	0.0169	-0.0390	-0.0354	1.0000				
irrig	0.1459	0.0294	0.1742	-0.1536	-0.1592	0.0007	-0.1419	0.1288	0.0232	1.0000			
saving	0.1246	0.0395	0.0695	-0.2043	-0.1707	-0.0605	-0.1163	0.0364	0.0152	0.1602	1.0000		
market	0.0245	0.2269	-0.1332	-0.0802	0.0500	-0.0639	0.0273	-0.0162	0.0287	0.0247	0.0935	1.0000	
health	0.1084	0.2809	0.0636	-0.1745	-0.0075	0.0215	-0.0802	0.1417	-0.0996	0.0599	-0.0681	0.3123	1.0000
heldist	0.0162	0.2193	-0.1190	-0.0535	0.0484	-0.0896	-0.0032	0.0156	0.0167	-0.0726	0.0939	0.9235	0.2892
agro	-0.1414	-0.0013	-0.0699	-0.0110	0.0788	0.2512	0.0897	-0.1138	-0.0754	0.2940	-0.0542	-0.3697	-0.0635
depratio	0.0195	0.0183	-0.0137	-0.0078	0.0961	-0.0813	0.0168	0.0168	0.0277	-0.0989	-0.0937	0.1771	0.0957
lanpro	-0.2474	-0.1033	-0.2432	0.0428	0.1038	0.1015	0.3957	-0.2135	-0.0740	-0.3281	-0.0611	-0.0958	-0.1045
pinc	-0.2193	-0.0301	-0.2092	0.0607	-0.0054	0.2589	0.3132	-0.2449	0.0670	-0.1041	-0.1565	-0.1465	0.0146
age2	0.0147	0.9810	0.0227	-0.1970	0.0490	0.1314	-0.0172	-0.0691	-0.0393	0.0451	0.0538	0.2395	0.2881

	heldist	agro	depratio	lanpro	pinc	age2
heldist	1.0000					
agro	-0.4870	1.0000				
depratio	0.1763	-0.1948	1.0000			
lanpro	-0.0954	0.0524	-0.0803	1.0000		
pinc	-0.1588	0.1816	-0.1158	0.3392	1.0000	
age2	0.2422	-0.0041	0.0018	-0.0913	-0.0127	1.0000

Annex 3: VIF before dropping the variables

Varaible	VIF	1/VIF
ge	147.24	0.006
age2	51.13	0.019
workdy	19.51	0.051
heldist	15.76	0.063
agro	13.22	0.075
market	11.51	0.086
hhs	11.21	0.089
saving	6.96	0.143
marital2	6.17	0.162
irrig	4.63	0.215
pinc	4.62	0.216
lanpro2	3.40	0.294
oxen	3	0.332
land	2.72	0.367
extens	2.72	0.367
depratio	2.44	0.410
sex	2.42	0.414
health	2.18	0.459
house	2.00	0.499
eucation	1.59	0.627
Mean VIF	15.72	

Annex 4: VIF after dropping the variables

Varaible	VIF	1/VIF
agro	10.04	0.099
age	8.92	0.112
hhs	8.69	0.115
saving	6.03	0.165
marital2	5.59	0.17
irrig	4.42	0.22
pinc	4.23	0.236
landpro2	3.35	0.29
oxen	2.91	0.34
land	2.67	0.375
extens	2.37	0.42
depratio	2.35	0.42
sex	2.19	0.45
health	1.96	0.50
education	1.50	0.66
house	1.48	0.67
Mean VIF	4.29	

Annex 5: Link model specification test for MPI

MPI	Coef.	Std.err.	Z	P>|z|
hat	1.053	0.205	5.13	0.65
hatsq	-0.025	0.053	-0.48	0.632
cons	0.033	0.279	0.12	0.905

• Insignificant _hatsq (p=0.632) the link function is correctly specified (no specification error)

Annex 6: Classification table and Hosmer-Lemeshow goodness of fit statistic

```
Logistic model for MPI

              -------- True --------
Classified |         D            ~D  |      Total
-----------+--------------------------+-----------
     +     |       192            17  |        209
     -     |         7            29  |         36
-----------+--------------------------+-----------
   Total   |       199            46  |        245

Classified + if predicted Pr(D) >= .5
True D defined as MPI != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   96.48%
Specificity                     Pr( -|~D)   63.04%
Positive predictive value       Pr( D| +)   91.87%
Negative predictive value       Pr(~D| -)   80.56%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)   36.96%
False - rate for true D         Pr( -| D)    3.52%
False + rate for classified +   Pr(~D| +)    8.13%
False - rate for classified -   Pr( D| -)   19.44%
--------------------------------------------------
Correctly classified                        90.20%
--------------------------------------------------
```

```
Logistic model for MPI, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       245
             number of groups =        10
      Hosmer-Lemeshow chi2(8) =         7.33
                  Prob > chi2 =         0.5011
```

Insignificant p-value (0.5011) suggests that the model fits the data reasonably well.

Annex 7: Marginal effects for MPI model

Log pseudolikelihood=-55.98		Number of obs=245 Wald chi2(18)=54.07 Prob>ch2=0000 Pseudo R2=0.526		
Explanatory variables	Coefficient	St.error	Z	P>|Z|
SexI	0.069	0.0336	2.05	0.040
Age of the head	0.0071	0.0029	2.46	0.014
Age2	-0.00006	0.00003	-2.44	0.015
Household size	-0.0031	0.0048	-0.64	0.522
Marital status-0	-0.054	0.041	-1.31	0.191
Dependency ratio	0.064	0.024	2.58	0.010
Per capita income	0.0001	0.00006	2.04	0.041
Land size	-0.015	0.0189	-0.84	0.402
No of oxen	-0.023	0.010	-2.29	0.022
Education level of the head	-0.0055	0.0029	-1.89	0.059
Land productivity	-0.0000001	0.0000	-1.58	0.114
Saving status of the household	0.0043	0.013	0.31	0.753
Agricultural extension service	0.020	0.017	1.21	0.227
Type of houseI	-0.094	0.054	-1.73	0.083
Irrigation scheme	-0.0062	0.012	-0.51	0.609
Health status of the head-I	0.021	0.015	1.44	0.149
(Mid-altitude) Woina dega	-0.0649	0.054	-1.20	0.230
Low land (Kolla)	-0.055	0.045	-1.21	0.228